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Evidence and inference: some food for thought

A. Introduction

The field of evidence is no other than the field of knowledge. (Bentham, *An Introductory View*, Chapter 1)

Evidence is the basis of justice: exclude evidence, you exclude justice. (Bentham, *Rationale of Judicial Evidence*, Part III, Chapter 1)

In this chapter we present some concrete examples and exercises that introduce the main questions and the basic concepts that are involved in analyzing evidence. The purpose of presenting them at this stage is partly to stimulate interest and puzzlement and partly to encourage you to start to think actively about some basic issues. We use many of the examples and exercises presented here to illustrate points developed later in the book.

The examples in part B raise questions about the similarities and differences involved in confronting problems of evidence and inference in different non-legal contexts, including bible stories, intelligence analysis, famous “analysts,” and commonplace events. Each develops variations around the central theme that the kind of reasoning involved in all these different kinds of factual enquiries is based on the same underlying principles that apply differently as the contexts and standpoints vary.

The examples in part C illustrate the same central theme using examples from legal contexts. The first four examples introduce the process of imaginative reasoning and the roles that generalizations and stories play in arguments about disputed questions of fact. The remaining examples involve cases of increasing complexity that focus upon the kinds of analysis required at different stages of criminal and civil cases and raise issues about the relationship between law and fact, standards of proof, and inferential reasoning in both kinds of cases.

This book is concerned with techniques of analysis, but a central theme is that the logic of proof and the law of evidence are closely related and interdependent. *Sargent v Southern Accident Co.* and *United States v Able* were originally devised as examination questions in traditional evidence courses that had analysis of facts as a significant objective. Each item raises a number of interconnected issues dealing

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with the law of evidence and problems of proof within the context of a case as a whole. The final exercise, “An investigation,” is intended as a vehicle for reviewing the basic concepts and for introducing a vocabulary for discourse about analysis and evaluation of evidence.

In our experience, all of these examples are good vehicles for use in teaching and reflection, but it is not necessary to introduce all of them at the start of a course. Several of the examples are used to illustrate important points in the text (principally, the cases involving Bywaters and Thompson, Sacco and Vanzetti, O. J. Simpson, the United States and Richard Able, Sargent and the Southern Accident Co., and An investigation). Readers and teachers may wish to postpone the detailed study of these until they come to the relevant topics.

B. Evidence and inference in non-legal contexts

1. Whose baby!? The judgment of Solomon

Then came there two women, that were harlots, unto the king, and stood before him. And the one woman said, O my lord, I and this woman dwell in one house; and I was delivered of a child with her in the house. And it came to pass the third day after that I was delivered, that this woman was delivered also: and we were together; there was no stranger with us in the house, save we two in the house. And this woman's child died in the night; because she overlaid it. And she arose at midnight, and took my son from beside me, while thine handmaid slept, and laid it in her bosom, and laid her dead child in my bosom. And when I rose in the morning to give my child suck, behold, it was dead: but when I had considered it in the morning, behold, it was not my son, which I did bear. And the other woman said, Nay; but the living is my son, and the dead is thy son. And this said, No; but the dead is thy son, and the living is my son. Thus they spake before the king.

Then said the king, The one saith, This is my son that liveth, and thy son is the dead: and the other saith, Nay; but thy son is the dead, and my son is the living. And the king said, Bring me a sword. And they brought a sword before the king. And the king said, Divide the living child in two, and give half to the one, and half to the other. Then spake the woman whose the living child was unto the king, for her bowels yearned upon her son, and she said, O my lord, give her the living child, and in no wise slay it. But the other said, Let it be neither mine nor thine, but divide it. Then the king answered and said, Give her the living child, and in no wise slay it: she is the mother thereof. And all Israel heard of the judgment which the king had judged; and they feared the king: for they saw that the wisdom of God was in him, to do judgment. (I Kings iii, 16–28)

Questions

- 1 Was this case concerned with
 - a the interpretation of a rule,
 - b a straightforward dispute about past facts,

- c solving a problem for the future, or
 - d a combination of some or all of these?
- 2 Which of the following questions were pure questions of fact, and which were directly in issue in this case?
 - a Who was the natural mother?
 - b Who would look after the child better?
 - c Who had a right to the child?
 - d What disposition would be in the best interests of the child?
 - 3 What general assumptions about the relations between mothers and children are implicit in this passage? Do you believe them to be universally or generally true today? What is the basis for your belief?
 - 4 Do you think that (a) both women genuinely believed that the child was theirs?
(b) both women believed that Solomon would carry out his threat?
 - 5 Does this story suggest that Solomon's "wisdom" was founded on the notion that he was a clever investigator; a just judge; an enlightened problem-solver; or a potentially good poker-player?
 - 6 There are different versions of the Bible. In the Revised Standard Edition of the Bible, the last sentence reads: "And all Israel heard the judgment which the king had rendered; and they stood in awe of the king, because they perceived that the wisdom of God was in him, to render justice." What evidence should a biblical scholar examine to determine which version is the most accurate? What standards should she apply? What evidence should a Justice of the United States Supreme Court examine to determine the meaning of a clause of the Constitution of the United States? What standards should the Justice apply?

2. The intelligence analyst: an intelligence scenario "from the top-down"

Investigations and inferences in intelligence analysis share many elements of such tasks that are performed in other areas such as law, medicine, history, and science. There are three disciplines in which persons performing analytic tasks must be prepared to encounter and evaluate every imaginable substantive kind of evidence; these disciplines are law, intelligence analysis, and history. Establishing the relevance, credibility, and inferential [probative] force of evidence is just as important in intelligence analysis as it is in law.

During fact investigation in law, as well as in intelligence investigations, hypotheses are generated as explanations for what is being observed. The generation of hypotheses requires imaginative reasoning mixed with critical reasoning. New hypotheses are put to use in generating new lines of inquiry and potential evidence. One criterion for assessing the merit of a new hypothesis concerns how well it assists the analyst in generating new and productive lines of inquiry that would not have been generated from other existing hypotheses. On occasion, the role of hypothesis generation is either downplayed or overlooked entirely. In some cases, new hypotheses come in the form of guesses about what has happened or what will happen. According to an old saying, hypotheses are like nets; only he who casts

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will catch. In every episode of fact investigation in law, intelligence analysis, or elsewhere, analysts have evidence in search of hypotheses at the same time as they have hypotheses in search of evidence. The following is an example from intelligence analysis in which a hypothesis is put to use in generating new observable evidence.

The generation of a new hypothesis from observations we make is frequently said to involve “bottom-up” reasoning; generation of new potential evidence from a hypothesis is said to involve “top-down” reasoning. In intelligence analysis, as in law, both forms of reasoning are necessary.

An important area of intelligence analysis is called “Indications and Warnings” (I & W). The purpose of I & W efforts is to alert decision-makers in our government and military organizations to the existence of possible immediate or near-term threats that are posed by hostile or potentially hostile forces or organizations. An obvious objective of I & W efforts today is to predict and prevent terrorist actions such as the destruction of the World Trade Center and parts of the Pentagon that we witnessed on September 11, 2001, during which more than 3,000 lives were lost. Those tragedies involved the hijacked domestic airliners used essentially as flying bombs. There is concern that such a method of destruction might be used again in the future. Unfortunately, there are other methods that terrorist organizations might employ in their efforts to cause loss of life, destruction, and widespread terror in our homeland.

You are a member of an I & W team. Based upon recent intelligence reports, your agency believes that there is a significant possibility that one or more terrorist groups are planning to commit a major terrorist action involving a “dirty bomb.” Dirty bombs involve radioactive, but not fissionable, materials such as strontium, cobalt-60, and cesium 137. Such devices can be set off using conventional explosives such as TNT, Semtex, or C-4 plastic explosives. They are much less expensive to construct and require much less technical expertise.

A dirty bomb will simply have radioactive materials packed around a core of conventional explosives. Such devices can be triggered electronically from remote locations. When triggered, a dirty bomb can disperse radioactive material over a wide area. Though dirty bombs cause far less destruction and loss of life, they do produce serious consequences in any area where they are set off. Persons in the immediate vicinity will be subject to serious radiation and the surrounding area will be contaminated for long periods of time. A dirty bomb would certainly cause panic throughout any country in which it is set off.

Cesium 137 has already been employed in suspected terrorist activities. In March 1996 it was reported that certain Chechen leaders had threatened to expose the city of Moscow to radioactive devastation. Anonymous calls directed police officers to a park in Moscow where they would find a container of powdered cesium 137. Just a few ounces of this material could contaminate an entire city for decades. It is estimated that just one ounce of powdered cesium 137 released by a dirty bomb could spread radioactive fallout over 60 city blocks. Radioactive materials such as strontium, cobalt-60, and cesium 137 have been widely used for various

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medical and industrial purposes. For example, cesium 137 was used by the Soviets to bombard wheat and other seeds to see if radiated seeds would produce more abundant crops. It is also used in processing dental X-rays. Unfortunately, large numbers of canisters of cesium 137, and other radioactive wastes are known to be stored in facilities having little or no security. The Soviets appear to have left considerable stores of powdered cesium 137 in various places in Georgia. No one knows how much of this stored material has already been stolen or, possibly, sold.

Your I & W team has been assigned to the task evaluating the capabilities and intentions of a certain known terrorist organization codenamed X. Based on recent intelligence reports, your team has been asked to evaluate the hypothesis that group X may be planning one or more actions using dirty bombs. According to one report, a leader in group X was heard to boast that his group will have a very unpleasant surprise for an unnamed American city. According to another report, a person known to be a member of group X, codenamed “Ned,” was dismissed in 2002 from a doctoral program in nuclear physics at a university in Germany.

The I & W team must identify and carefully state the hypothesis regarding terrorist group X, taking into account the information it has. In any intelligence analysis regarding the actions of some actual or potential adversary, the analysts need to make inferences about an adversary’s *capabilities* and *intentions*. Capability and intention must be distinguished: having capability does not entail intention, nor does having intention entail capability. At the moment, however, the I & W team is concerned with the capability of terrorist group X to develop a dirty bomb. Based upon information about group X, the agency considers it almost certain that group X has every intention of using any kind of weapon against the United States, given the appropriate opportunity. Group X, like other current terrorist organizations, seems to have an implacable hatred of American society and its values. Group X has already participated in terrorist activities in which the lives of innocent persons, including women and children, have been taken.

The team has identified the hypothesis as follows:

H: Group X now has the capability to assemble a dirty bomb containing cesium 137.

There is always an alternative hypothesis which, in this case, can be stated as:

not-H: Group X does not now have the capability to assemble a dirty bomb containing cesium 137.

The team’s task is now to put hypothesis **H** to work in generating new evidence. The team deems it very unlikely that it could obtain any direct evidence on **H**. Group X maintains very strict control over the security of its operations and is known to have employed the most medieval means of punishing any member whom it suspects of divulging information about its activities. If they did have such direct evidence of **H**, this evidence would be termed a “nugget.” Lacking any such nugget, they must be prepared to mine lots of lower-grade evidential ore.

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If hypothesis **H** is true, one proposition can easily be deduced: that group X must have obtained, or will obtain, some powdered cesium 137. It is known that such materials seem to be available throughout Eastern Europe including Georgia and Poland. But we have no direct evidence that group X has in fact obtained any powdered cesium 137. But, if group X has obtained, or will obtain, some powdered cesium 137, we can deduce that some member of group X has had, or will have, contacts with potential suppliers of powdered cesium 137 in Eastern Europe. Finally, we deduce that the member of Group X who has had, or will have, contact with potential suppliers of cesium 137 has at least some knowledge of radioactive substances such as cesium 137. Figure 1.1 summarizes our top-down reasoning. At each stage of this top-down reasoning we have a proposition that may be true or false.

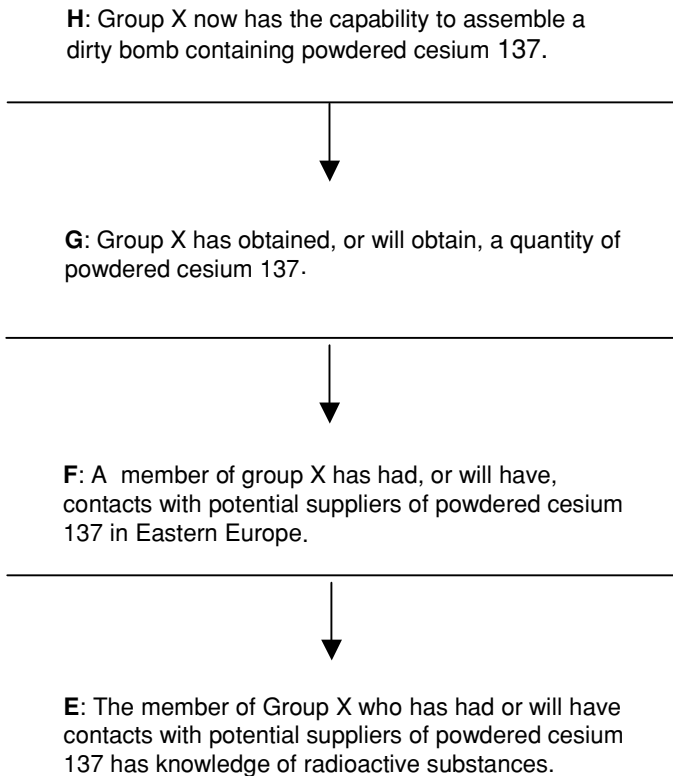


Figure 1.1 Reasoning stages in the “top-down” intelligence example

This chain of reasoning finally leads us to ask a question that can potentially be answered: Is there any evidence that any member of Group X has expertise regarding radioactive substances? According to the report the team has received, Ned, a known member of group X, failed to complete his PhD dissertation requirements in nuclear

physics at a university in Germany. Though Ned may have failed to complete his PhD in nuclear physics, we can easily suppose that he knows enough about radioactive materials to be highly useful in obtaining such materials as powdered cesium 137 and in handling such materials during the construction of a dirty bomb. Here is a summary of what this top-down reasoning has enabled us to do.

From hypothesis **H** the team has generated a new line of inquiry involving the activities of group X. It is known that many members of known terrorist organizations have studied various areas of the sciences in Western universities. It is also known that not all of these persons have completed their degree requirements. So, just finding out that Ned left a university without finishing his degree is, by itself, quite uninformative. But the argument we have constructed links Ned with group X's efforts to develop one or more dirty weapons that could easily be used against us.

The top-down reasoning we have developed seems entirely plausible. If **H** is true, this suggests that **G** is true: Group X must have or will acquire some of this radioactive material to develop a dirty bomb using cesium 137. If **G** is true, this suggests that **F** is true: A member of group X has had or will have contact with potential suppliers of cesium 137. Finally, if **F** is true, this suggests that **E** may be true: Someone in group X is qualified to inspect the cesium 137, to see what kind of container it is in, and how it might best be made available for use by group X in constructing a dirty bomb.

Finally, we note that propositions or events at each stage of reasoning may or may not be true; in other words, each proposition represents a source of doubt. For a start, **H** might not be true; perhaps group X has other plans for our discomfort. Proposition **G** might not be true either. Perhaps the cost of obtaining a sufficient quantity of cesium 137 exceeds the present resources of group X (another hypothesis, **D**, to be explored). Or, perhaps the security of stores of radioactive materials in Eastern Europe has tightened in light of public knowledge about how weak such security has been in the past (another hypothesis, **C**, to be explored). Proposition **F** might not be true since obtaining materials like cesium 137 might not have to involve any member of group X itself (another hypothesis, **B**, to be explored). It is possible that group X might have obtained some of this material without exposing any of its members to the scrutiny of various intelligence agencies. Finally, it might not require an unusual degree of expertise in nuclear physics to negotiate for and obtain substances like cesium 137 (another hypothesis, **A**, to be explored).

Questions and a problem

- 1 Your I & W team has received evidence from an airline that Ned traveled to Warsaw last month and has booked another flight to Warsaw next week. The argument the team has constructed establishes the relevance of Ned's travel activities to hypothesis **H**. Ned is a member of group X who is qualified to inspect the cesium 137,

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to see what kind of container it is in, and to work out how it might best be made available for use by group X in constructing a dirty bomb. In light of those facts, you have been asked to recommend steps that should be taken to confirm or negate a new hypothesis: Ned is traveling to Warsaw to arrange for or confirm the arrangements for the shipping and delivery of cesium 137 to group X. Will this require top-down or bottom-up reasoning or both? Identify plausible innocent explanations inconsistent with this new hypothesis. (There is a natural tendency to focus on finding evidence that will support a hypothesis, but a good analyst knows that it is equally important to seek evidence that would negate the hypothesis.)

- 2 How should the I & W team proceed to investigate hypotheses A, B, and C? Does your response with respect to each hypothesis involve top-down or bottom-up reasoning or both?
- 3 Top-down reasoning, as illustrated in the above fictitious example, is very common in fact investigation in law. Suppose your firm represents a client who claims that her arm was broken when she slipped and fell down the stairs in the building where her doctor has his office. You have determined that the firm must show that the owner or manager of the building breached a duty of care to warn persons who might use the stairs of any unusual conditions that might cause an injury. The senior partner has asked you to advise what steps the firm should take. Use the top-down method illustrated above in formulating your response.

3. The doctor and the detective: Joseph Bell and Sherlock Holmes

Sir Arthur Conan Doyle frequently mentioned that a major source of inspiration for his development of the character of Sherlock Holmes was a professor he encountered when he was a student at the University of Edinburgh Medical School. Dr. Joseph Bell was then a noted professor of surgery who, in 1887, was president of the Royal College of Surgeons in Edinburgh. Dr. Bell was also personal surgeon to Queen Victoria whenever she was in Scotland. For a time when he was in medical school, Conan Doyle served as an assistant to Dr. Bell. As skilled as Dr. Bell was, it was his astonishingly acute inferential or diagnostic skills for which he is now best remembered, thanks, perhaps, to Sherlock Holmes. Over the years his students kept an account of examples of Dr. Bell's diagnostic feats, some of which are recorded in Britain's leading medical journals, such as the *Lancet*. Following is an example of his diagnostic skill that today we would say involves the same *abductive* reasoning illustrated in so many of the exploits of Sherlock Holmes and also illustrated in Kemelman's "The Nine Mile Walk."

a. The doctor

The City of Edinburgh and its port city Leith lie on the Firth of Forth. Directly north across the Firth lies a town in Fife called Burntisland [pronounced "burnt island"]. In Bell's day, there was no Forth Road Bridge; travelers used any one of a number of ferries to cross from Fife to Edinburgh; the closest and most direct ferry left Fife from Burntisland. From Leith, a street called Inverleith Row leads in the

direction of the University of Edinburgh. To the right of Inverleith Row, just past Leith, lie Edinburgh's Botanical Gardens. Dr. Bell frequently interviewed patients in an amphitheater and allowed his students to observe these interviews. Here is what his students observed on one occasion.

A woman, accompanied by a child, was shown into the amphitheater. Dr. Bell had never met nor seen this woman before. After greeting her, Dr. Bell first asked her if she had a good crossing from Burntisland; the woman replied "aye" [yes]. Bell then asked her if she had a good walk up Inverleith Row; the woman replied "aye." Then Bell asked her what she did with the other child; the woman replied that she had left the child with her sister in Leith. Finally, Dr. Bell asked the woman if she was still working at a linoleum factory; the woman replied "aye."

Dr. Bell's students were of course astonished by this encounter between Dr. Bell and the woman whom he had never seen before. In explanation, Dr. Bell first told his students that they must have noticed her Fife accent and that the closest ferry would have left from Burntisland. He then asked the students if they noticed the red clay on her shoes, which he explained was peculiar to areas around the Botanical Gardens. Then Bell asked his students if they noticed that a coat the woman was carrying over her shoulder was too large for the child who accompanied her; she very likely had another child with her when she crossed from Fife. Finally, Dr. Bell asked his students to observe the dermatitis on her hands, which he explained was peculiar to persons who worked in linoleum factories.

b. The detective

"Dr. Watson, Mr. Sherlock Holmes," said Stamford, introducing us.

"How are you?" he said cordially, gripping my hand with a strength for which I should hardly have given him credit. "You have been in Afghanistan, I perceive."

* * *

"Observation with me is second nature. You appeared to be surprised when I told you, on our first meeting, that you had come from Afghanistan."

"You were told, no doubt."

"Nothing of the sort. I knew you came from Afghanistan. From long habit the train of thoughts ran so swiftly through my mind that I arrived at the conclusion without being conscious of intermediate steps. There were such steps, however. The train of reasoning ran, 'Here is a gentleman of a medical type, but with the air of a military man. Clearly an army doctor, then. He has just come from the tropics, for his face is dark, and that is not the natural tint of his skin, for his wrists are fair. He has undergone hardship and sickness, as his haggard face says clearly. His left arm has been injured. He holds it in a stiff and unnatural manner. Where in the tropics could an English army doctor have seen much hardship and got his arm wounded? Clearly in Afghanistan.' The whole train of thought did not occupy a second. I then remarked that you came from Afghanistan, and you were astonished." (Conan Doyle, *A Study in Scarlet* (1887)).

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Notes and a question

- 1 Sir Arthur Conan Doyle frequently mentioned that Dr. Joseph Bell was a major source of inspiration for his development of the character of Sherlock Holmes. For a time when he was in medical school Conan Doyle served as an assistant to Dr. Bell. If you have read any of the Sherlock Holmes stories, you will note the similarity between what happened in Dr. Bell's interview just described and so many instances in which Holmes amazed Dr. Watson with his acute observational and inferential abilities. Both were highly skilled in the use of what would today be called abductive logic. But abductive logic can only identify hypotheses to be tested.
- 2 In these anecdotes Bell's and Holmes's hypotheses were confirmed by the woman and Watson respectively. Suppose that they had not. Absent confirmation, would you accept Dr. Bell's or Holmes's conclusions? Can you construct a different scenario in each instance that would also be consistent with all of the observed details?
4. Generalizations and stories: Sam's party
 Once upon a time, John went to Sam's party. Sam blew out the candles.¹

Questions

- 1 Is this a story?
- 2 Can you infer from this passage:
 - a That there was a cake?
 - b What kind of party this was?
 - c Sam's age?
- 3 How would you justify such inferences?

C. Evidence and inference in legal contexts

1. Two murders

a. The murder of Y

Y was murdered in his home at approximately 4:30 p.m. on January 1. W states that she saw X enter Y's house at 4:15 p.m. on that day. Show how W's statement tends to support the conclusion that it was X who murdered Y.

b. Bywaters and Thompson

Edith Thompson was charged with the murder of her husband Percy in that she either conspired with or incited her lover, Frederick Bywaters, to murder Percy.

- i In the trial it was assumed that the fact that Edith was 28 and Freddie was 20 was relevant to the charge. Is this a reasonable assumption? If so, why?

¹ Adapted with grateful acknowledgment from Nancy Pennington, who uses it with great effect to illustrate the idea of confabulation.