ARTICLES

A Theory of Preliminary Fact Investigation*

*Peter Tillers** and David Schum***

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INTRODUCTION

Anon., "Just imagine!" (date unknown)

How do human beings *know*? And how can human beings make sure that they know the truth? These are old questions.[1] How-

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[1] *See, e.g.,* PLATO, *Thaetetus,* in THE COLLECTED DIALOGUES OF PLATO (E. Hamilton & H. Cairns eds. 1961).

ever, their shape has changed, or so many people think. Until very recently — roughly until the middle of the twentieth century — many observers believed that the question of the foundations of human knowledge is an unanswerable philosophical riddle.[2] Today, however, there are signs of a shift in the attitude toward epistemological issues. A diverse group of theorists views the riddle of human knowledge as a practical problem that admits of answers.[3] These epistemological optimists would reject the wry suggestion that "cognitive science" is an oxymoron; they believe that a science of the mind is possible.[4] Indeed, some of these optimists are hyperoptimists. In recent years "neural networks" have become one of the hottest topics in the field of computer

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[2] *See, e.g.,* L. WITTGENSTEIN, ON CERTAINTY (G. Anscombe & G. von Wright eds. 1969) (notes made by Wittgenstein in 1950-51). A more recent example of epistemological skepticism is N. GOODMAN, FACT, FICTION, AND FORECAST (2d ed. 1965). Another contemporary example may be Thomas Kuhn's theory of the evolution of scientific theory, which seems to have relativizing and possibly skeptical implications. *See* T. KUHN, THE STRUCTURE OF SCIENTIFIC REVOLUTIONS (1962). Epistemological skepticism, of course, has a long history. *See, e.g.,* D. HUME, ENQUIRY INTO THE HUMAN UNDERSTANDING (1748). *See generally* Popkin, *Skepticism,* in 7 THE ENCYCLOPEDIA OF PHILOSOPHY (1967) (providing historical overview).

Of course, even though some philosophers may have despaired at explaining how and why people know, people went on knowing anyway. They unravelled some of the mysteries of the atom, they developed the periodic table of the elements, they predicted weather, and the like.

[3] *See, e.g.,* A. GOLDMAN, EPISTEMOLOGY AND COGNITION (1986); *see also infra* notes 4-5.

[4] *See, e.g.,* Z. PYLYSHYN, COMPUTATION AND COGNITION xi (1984) (stating: "there is another, much more exciting possibility: the prospect that cognitive science is a genuine scientific domain like the domains of chemistry, biology, economics, or geology").

Only some of the theorists alluded to in this Article are professionally employed solely as "cognitive scientists." One of them is Paul Thagard, mentioned at *infra* note 5. The others have various kinds of professional titles. For example, Alvin Goldman, *supra* note 3, holds a professorship in philosophy. Zenon Pylyshyn, *supra,* holds a professorship in psychology and computer science and is the director of a center for cognitive science. Paul Churchland, *infra* note 5, is a professor of philosophy and a faculty member of a cognitive science department. Whatever their nominal fields, however, these theorists are students of cognitive science. *See* Z. PYLYSHYN, *supra;* A. GOLDMAN, *supra* note 3; and P. THAGARD and P. CHURCHLAND, *infra* note 5. The diverse professional backgrounds of these epistemological optimists is not surprising. Their work blends elements of psychology (cognitive science), philosophy (epistemology), mathematics (logic), and computer science (artificial intelligence and computer logic).

logic and artificial intelligence. Some students of cognitive science believe that "neurocomputational" logic may allow them to model and mimic the operations of the brain, and not just understand them.[5]

We share the view that real progress in understanding human knowledge is now possible. In one respect, however, we part ways with the more enthusiastic advocates of artificial intelligence, neural networks, computational models of the mind, and the like. We believe that imagination plays an essential role in all human knowledge, and we believe that no model of the mind, no matter how esoteric or subtle, can duplicate, much less replace, the imaginative activities of the human mind. Despite our skepticism about machine-minds, however, we think it is important to use logic to map the operations of the mind. Logic portrays human thought in an orderly way. Logical pictures of possible ways of thinking can facilitate orderly and imaginative reasoning about facts.

Fact investigation in litigation is hard to do well.[6] One of the causes of investigative failure is conceptual failure; effective investigation requires good thinking. This Article describes a device for ordering thought during preliminary fact investigation: a network of twelve systems for marshalling evidence. Although this network is not a machine that somehow churns out good investigative decisions all by itself, it is a useful tool for the analysis of investigative problems. The network of evidence marshalling strategies described in this Article facilitates good thinking about problems of evidence in the early stages of fact investigation in litigation.

In Part I of the Article we provide a bird's-eye view of our theory. We identify twelve separate systems or strategies for mar-

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[5] *See, e.g.*, P. Churchland, A Neurocomputational Perspective: The Nature of Mind and the Structure of Science (1989); P. Thagard, Computational Philosophy of Science (1988).

[6] There is a substantial body of literature on fact investigation. The quality of this literature is uneven, but some of it is quite good. *See, e.g.*, T. Anderson & W. Twining, Analysis of Evidence (rev. ed. 1987) (forthcoming Little, Brown & Co. 1991); M. Berger, J. Mitchell & R. Clark, Pretrial Advocacy: Planning, Analysis and Strategy (1988); D. Binder & P. Bergman, Fact Investigation: From Hypothesis to Proof (1984); E. Imwinkelried & T. Blumoff, Pretrial Discovery: Strategy & Tactics (1986-1988 & Supp. 1990); *see also* Brazil, *The Adversary Character of Civil Discovery: A Critique and Proposals for Change*, 31 Vand. L. Rev. 1295 (1978).

shalling evidence. We provide in Part I a brief description of each of these methods of marshalling evidence, and we suggest how these various marshalling strategies can influence each other. A diagram depicts the entire theory as a network of linked marshalling operations.[7]

In Part II we describe several of the marshalling strategies in more detail. In particular, we discuss how factual hypotheses are constructed, refined, and also "coarsened."[8] We pay close attention to the impact of evidentiary trifles, or details, on the formation of factual hypotheses and conjectures.[9] Evidentiary details support and suggest various possibilities, and a detail combined with one or more other details may suggest and support yet further possibilities. Since different combinations of details suggest and support different possibilities, arranging and combing evidentiary trifles in various ways may be a useful heuristic exercise. However, even a small number of details can be combined in many different ways. Shuffling details in a random fashion to see what they suggest is inefficient. Therefore, we describe several systematic procedures for combining details and for flushing out the possibilities that different combinations of details might suggest or support.[10]

In Part II we also discuss strategies for eliminating hypotheses and possibilities, but strategies for generating factual hypotheses and conjectures remain our primary concern. Although shuffling combinations of details is a useful strategy for generating hypotheses, it is not always sufficient. Imagination and conjecture play an essential role in effective fact investigation.[11] While most of our methods for flushing possibilities out of details and combinations of details require the use of imagination, not all of the strategies involve fancy or conjecture. For example, we describe a strategy of marshalling evidence by "possibilities." This strategy involves imaginative reasoning but not conjecture because marshalling by possibilities supposes that every possibility must be directly supported by the evidence.[12] It is often useful — and it may be essential — however, to entertain possibilities that go past or "outrun" the available evidence. Hence, some of the "abduc-

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7 *See infra* Figure 2 and accompanying text.
8 *See infra* text accompanying notes 123-38.
9 *See infra* text accompanying notes 123-34.
10 *See infra* text accompanying Figures 5-9.
11 *See infra* text accompanying notes 141-49.
12 *See infra* Section I(C)(8).

tive" marshalling strategies we describe generate hypotheses that are not directly supported by evidence.[13] For example, we discuss the role of stories in hypothesis formation.[14] Stories, or "scenarios," combine elements of fact and fancy.

The Article concludes with some general observations about the nature of our theory. We argue that our network of evidence marshalling systems, though complex, is "user-friendly" at least in principle.[15] The intellectual processes and operations we describe do not have a "transcendental" character or origin, but are "natural" to ordinary thinking human beings. It is true that the workings of our network of marshalling systems can be very intricate: the twelve marshalling systems can interact in complex ways, and users of our network may be forced to pay attention to several marshalling operations simultaneously. The obstacles to the use of our marshalling systems are no greater than those presently faced by real-world investigators, however, who must already walk and chew gum at the same time. The purpose of our theory is to facilitate the management of already complex tasks.

Our final observations concern the computer-generated diagrams and devices that we use to depict the network of evidence marshalling operations. We argue that our computer-generated visual representations serve a theoretical purpose as well as a practical one. These representations are metaphors. The fact that they are user-friendly — the fact that they make complex strategies for organizing evidence more understandable and intelligible — is some evidence of the validity of our theory. Our theory is a map of the mind. If it is a good map, it will enable us to think more clearly.

I. OUTLINE OF THEORY

A. *The Place of Preliminary Fact Investigation in the Life Cycle of Litigation*

The traditional centerpiece of American legal scholarship in evidence is the trial. Wigmore's mammoth treatise on the law of

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[13] *See infra* Section II (B)(1).

[14] *See infra* text accompanying notes 154-62.

[15] Although we have not yet developed a user-friendly technology for implementing the network in real-time, real-world situations, we believe the development of such user-friendly systems is possible. We have developed computer based prototypes of our evidence marshalling systems. *See infra* text accompanying notes 51-53, 171.

evidence[16] devotes little attention to the pretrial process. As its title suggests, its focus is on the legal rules governing the admissibility and presentation of evidence at trial.[17] The focus of Wigmore's contemporaries and successors was much the same; scholars such as Edmund Morgan, Charles McCormick, and John Maguire talked about the trial, and little if at all about evidentiary processes before trial.[18]

Things are not much different today.[19] Contemporary casebooks, legal treatises, and "hornbooks" on evidence typically pay little attention to evidentiary processes before trial.[20] The new evidence scholarship has not significantly diminished the traditional emphasis on the trial. Although the new evidence scholarship focuses more on proof and less on the admissibility of evidence at trial,[21] the work of the new evidence scholars focuses on the process of proof at trial,[22] and only little is said about evi-

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[16] J. WIGMORE, A TREATISE ON THE ANGLO-AMERICAN SYSTEM OF EVIDENCE IN TRIALS AT COMMON LAW (3d ed. 1940).

[17] Wigmore's treatise on the logic of proof, however, devotes substantial attention to fact investigation. See J. WIGMORE, THE PRINCIPLES OF JUDICIAL PROOF §§ 156-58 (1913) [hereafter J. WIGMORE, JUDICIAL PROOF]. Until recently, however, Wigmore's work on the logic of proof had little effect on the work of other evidence scholars. See W. TWINING, THEORIES OF EVIDENCE: BENTHAM AND WIGMORE 112-13 (1985).

[18] See, e.g., J. MAGUIRE, EVIDENCE: COMMON SENSE AND COMMON LAW (1947); C. McCORMICK, HANDBOOK OF THE LAW OF EVIDENCE (1954); E. MORGAN, BASIC PROBLEMS OF STATE AND FEDERAL EVIDENCE (5th ed. 1976).

[19] There is, however, one important exception. Clinical education has emerged as an important force in American legal education. Although clinical courses in litigation tend to emphasize trial practice, a substantial number of clinical offerings deal with pretrial practice and preparation. Even in these courses, however, systematic study of the logic of evidentiary processes is often absent. The emphasis instead is on the "touchie-feelie" aspects of fact investigation and case preparation (e.g., the personal and social dynamics of witness interviews). In recent years, however, clinicians have generated literature in a rather different, more analytic vein. See, e.g., D. BINDER & P. BERGMAN and E. IMWINKELRIED & T. BLUMOFF, supra note 6.

[20] See, e.g., L. LETWIN, EVIDENCE LAW: COMMENTARY, PROBLEMS AND CASES (1986); G. LILLY, AN INTRODUCTION TO THE LAW OF EVIDENCE (2d ed. 1987); J. WEINSTEIN & M. BERGER, WEINSTEIN'S EVIDENCE MANUAL (1987); G. WEISSENBERGER, FEDERAL EVIDENCE (Student Edition) (1987).

[21] Lempert, The New Evidence Scholarship: Analyzing the Process of Proof, 66 B.U.L. REV. 439, 439-40 (1986).

[22] For example, the extensive debate about Dr. Cohen's "conjunction paradox" has always addressed that supposed paradox in the context of a trial. See Allen, A Reconceptualization of Civil Trials, 66 B.U.L. REV. 401, 405-07 (1986).

dentiary processes before trial.[23]

There are good practical reasons to bemoan this emphasis on the trial,[24] but there are also theoretical disadvantages. When a case goes to trial — particularly when a case is submitted to the trier of fact — the factual issues in the case have been determined with a relative degree of specificity, and the evidence to be considered by the decision maker is known. If theorists view the trial as the paradigmatic setting for problems of evidence, inference, and proof, they are likely to focus on a type of inferential analysis that we call "relational analysis."[25] This is because in the sort of trial setting we have described, the most obvious responsibility of the trier of fact is to determine how strongly known evidence supports the factual contentions that the parties and the court have identified and formulated.[26] As this Article demonstrates, however, the process of proof in litigation involves forms of analysis

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[23] There are some exceptions. *See, e.g.,* Jackson, *Theories of Truth Finding in Criminal Procedure: An Evolutionary Approach,* 10 CARDOZO L. REV. 475 (1988); Schum, *Probability and the Processes of Discovery, Proof, and Choice,* 66 B.U.L. REV. 825 (1986). *Cf. supra* note 6 (listing some scholarly works on fact investigation).

[24] For example, litigators spend far more time preparing cases than trying them. Pretrial preparation undoubtedly has a major impact on the outcomes of the relatively few cases that are tried. Pretrial fact investigation in criminal cases raises a wide variety of constitutional issues and careful analysis of the evidentiary dimensions of those problems would be helpful. *See infra* text accompanying notes 35-43.

The preoccupation with the trial cannot be justified by the important insight that proof and admissibility requirements at trial influence and shape pretrial activity. Although the trial does cast a backward shadow, pretrial processes and activities also cast a shadow into the future. While some features of trials may be invariant, many are not, and actors such as lawyers and police detectives know that the character of their pretrial investigation and preparation will influence the structure of any subsequent trial, including the character of the evidence presented at any such trial. Hence, the requirements for effective pretrial investigation and preparation cannot be "read off" directly or simply from the general rules and principles regulating admissibility and proof at trial. The expected structure and characteristics of a trial naturally influence pretrial activity. Yet, decision makers in litigation expect that the structure and characteristics of a trial in any particular case will be affected by pretrial proceedings and events, including the decisions that participants such as lawyers make before trial.

[25] Tillers & Schum, *Charting New Territory in Judicial Proof: Beyond Wigmore,* 9 CARDOZO L. REV. 907 (1988).

[26] Jury instructions, of course, tell the jury that this is one of its primary responsibilities. *See, e.g.,* 1 CALIFORNIA JURY INSTRUCTIONS: CRIMINAL (CALJIC) 2.20 (5th ed. 1988).

other than relational analysis. For example, the process of proof involves the formation and differentiation of factual hypotheses[27] and the acquisition of new evidence. Cognitive processes of this sort can and do take place during a trial,[28] but many of them are far more palpable in the pretrial process than at the trial itself.[29] Hence, fact investigation is a field of study that offers important insights into the nature of inference and proof in litigation.[30]

When we began our research, we hoped to examine marshalling processes throughout the life cycle of inferential problems in litigation.[31] Figure 1 is a representation of what we imagined a full-scale life cycle might include.

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[27] *See infra* Section II(A).

[28] For example, although the factual issues in a case may have been determined by the court by the start of trial (*e.g.*, in a pretrial conference), the issues as defined may still be relatively diffuse, and the lawyers at the trial may attempt to formulate them more precisely. Similarly, lawyers at a trial will frequently be faced with the decision whether to acquire additional evidence (*e.g.*, by cross-examining a witness about matters on which the witness has not been questioned before).

[29] This is partly, but not entirely, because: (1) in the early stages of litigation factual issues are typically less stable (*i.e.*, more dynamic, more likely to change) than they are at the trial; (2) the factual issues "in the case" are ordinarily less precisely defined in early phases of litigation than in later phases; and (3) at the outset of a lawsuit the quantity of the pertinent evidence and information is typically far more meager than it is by the time of trial.

[30] Some law teachers may think that fact investigation is the wrong horse to ride in the pursuit of theoretical objectives. To judge by the their choice of subject matter in the typical course in civil procedure, many civil procedure teachers seem to think of fact investigation as a nuts-and-bolts topic that is bereft of any theoretical significance. However, the view that fact investigation lacks theoretical charm is mistaken. While it is true that fact investigation involves tedious and pedestrian work — very often a great deal of it — it is not true that fact investigation in litigation is a simple intellectual activity; it is an immensely complex activity that implicates the highest reaches of human thought. In particular, imagination plays a crucial role in the initial stages of the process of judicial proof. This fact alone makes fact investigation a worthy object of study. *See infra* Sections II(B) and II(C)(2).

[31] We sketched our research objectives in Tillers & Schum, *supra* note 25. For an unduly defensive comment on our sketch, see W. TWINING, RETHINKING EVIDENCE: EXPLORATORY ESSAYS 319 (1990). In defending Wigmore's evidence marshalling strategy against a nonexistent attack, however, Twining glosses over the difference between a marshalling strategy that is compatible with other evidence marshalling strategies and methods of organizing evidence and devices that portray other evidence marshalling strategies. *Id.* For example, while it is true that Wigmore's

FIGURE 1

FACT INVESTIGATION AND
OTHER PRETRIAL ACTIVITIES
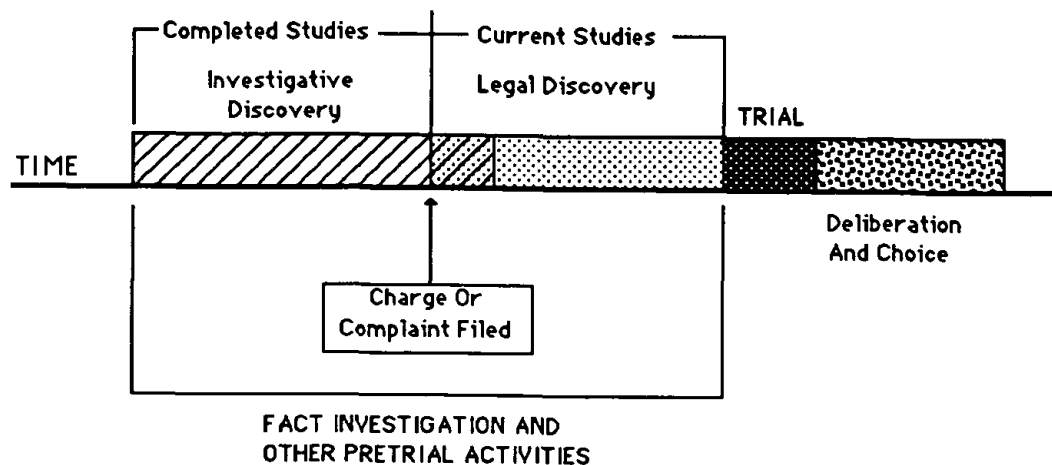
This life cycle includes investigation, legal discovery and other pretrial preparation, the trial, and deliberation and choice by the trier of fact.[32] Very soon after we began our work, however, we realized that the full life cycle of the process of judicial proof involves a far larger number of types of marshalling and inferential activity than Figure 1 shows.[33] We therefore chose to limit the scope of our project and decided that a good place to begin a study of the process of judicial proof was at the beginning. Hence, instead of trying to tackle the entire process of proof, we use this Article to examine only the initial pretrial evidentiary processes.[34] We refer to these initial phases of the process of

"chart method" is compatible with the use of scenarios, the chart method does not portray the structure, formation, and evaluation of stories.

[32] *See* Schum, *supra* note 23, at 830-46.

[33] We did not foresee that preliminary fact investigation alone involves at least the twelve marshalling systems described in this Article. Figure 1, *supra*, offers, at best, only a hint of this complexity.

[34] It follows that our theory is not a complete theory of evidentiary processes in litigation, let alone a complete theory of empirical knowledge. For example, this Article does not examine the impact of resource limitations on the acquisition of human knowledge. Moreover, we do not consider how human beings might try to calculate the relative utility of divergent lines of real-world investigative activity. Furthermore, our Article does not examine how social, legal, or similar stipulations about initial assumptions affect the enterprise of finding out the "truth" about matters of fact. Nonetheless, our theory adds to an understanding of proof. Any comprehensive theory of judicial proof must take the history of any stage of proof into account. Moreover, the evidence marshalling strategies used in investigation also play a role in proceedings such as trials.

proof as "preliminary fact investigation."

A theory describing strategies for marshalling evidence in preliminary investigation may be valuable for a variety of reasons. First, if our theory holds any water, it ought to interest actors such as trial lawyers, who must marshal and analyze evidence. Moreover, a good theory of evidence marshalling during investigation may be beneficial for the society at large. A central function of litigation is the adjudication of factual disputes.[35] The reliability of factual adjudication is a matter of considerable importance from the standpoint of almost any perspective on litigation, whether from a moral,[36] social,[37] ideological,[38] or economic[39] perspective, or from the point of view of fields of law

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[35] *Cf.* Rose v. Clark, 478 U.S. 570, 577 (1986)("the central purpose of a criminal trial is to decide the factual question of the defendant's guilt or innocence," quoting Delaware v. Van Arsdall, 475 U.S. 673, 681 (1986)).

[36] *See, e.g.*, Frankel, *The Search for the Truth: An Umpireal View*, 123 U. PA. L. REV. 1031 (1975) (criticizing existing adversary system for placing too low a premium on truth); Zuckerman, *Law, Fact or Justice?*, 66 B.U.L. REV. 487, 498-508 (1986) (emphasizing importance of accurate fact finding in each case). Even Professor Laurence Tribe, who stresses the moral, symbolic, and expressive functions of litigation and modes of proof in litigation, does not deny that factual truth is important. *See* Tribe, *Trial by Mathematics: Precision and Ritual in the Legal Process*, 84 HARV. L. REV. 1329, 1376 (1971) (stating: "It would be a terrible mistake to forget that a typical lawsuit is only *in part an objective search for the historical truth*") (emphasis added).

[37] Professor Charles Nesson emphasizes the importance of the "social acceptability" of verdicts but, like Tribe, *supra* note 36, he does not deny that truth is important. *See* Nesson, *The Evidence or the Event? On Judicial Proof and the Acceptability of Verdicts*, 98 HARV. L. REV. 1357, 1359 (1985)("Through trials, society *seeks* not only *to discover the truth* about a past event, but also to forge a link between crime and punishment") (emphasis added). Nesson suggests that there must be compromises between the value of truth and other values, but his argument assumes that truth is an important value. *Id.* at 1390-92.

[38] The ideal of the rule of law puts a premium on accurate fact finding. *See* Tillers, *Introduction, Symposium on Probability and Inference in the Law of Evidence*, 66 B.U.L. REV. 381, 381-82 (1986) [hereafter Tillers, *Introduction*]. Professor Kenneth Graham apparently does not share this view. *See* Graham, *Book Review, "There'll Always be an England": The Instrumental Ideology of Evidence*, 85 MICH. L. REV. 1204, 1232-34 (1987) (viewing ideal of law as an ideology and demanding "fairness" rather than accuracy in litigation). But see the rejoinders to Graham in Tillers, *Prejudice, Politics, and Proof*, 86 MICH. L. REV. 768, 773-74 (1988) and Twining, *Book Review, Hot Air in the Redwoods, a Sequel to the Wind in the Willows*, 86 MICH. L. REV. 1523, 1544-45 (1988).

[39] Tillers, *Introduction, supra* note 38, at 381.

such as the law of evidence[40] and constitutional law.[41] (There are dissenters, but they are few).[42] A theory about the logical and cognitive dimensions of fact investigation is germane to a concern about the reliability of adjudication because the manner in which actors in litigation marshal and analyze evidence affects litigation outcomes.[43]

While the practical significance of a valid theory of fact investigation may be substantial, the theoretical significance of the topic of fact investigation is no less important. Although we have said that our Article is about preliminary fact investigation, we might as easily have said that it is about "investigative discovery."[44] The

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[40] The law of evidence has always put special emphasis on the reliability of fact finding. *See, e.g.,* FED. R. EVID. 102 ("to the end that the truth may be ascertained").

[41] *See, e.g.,* Perry v. Leeke, 109 S. Ct. 594, 601 (1989) (holding that in interest of trial's truth-seeking function, defendant-witness had no right to consult with attorney between direct and cross-examinations); Rose v. Clark, 478 U.S. 570, 579 (1986) (stating: "The thrust of many constitutional rules governing the conduct of criminal trials is to ensure that those trials lead to fair and correct judgments") *In re* Winship, 397 U.S. 358, 364 (1970) (reasonable doubt standard necessary in criminal cases because "[i]t is critical that the moral force of the criminal law not be diluted by a standard of proof that leaves people in doubt whether innocent men are being condemned"); Tehar v. Shott, 382 U.S. 406, 416 (1965).

[42] *See, e.g.,* Graham, *supra* note 38, at 1232-34 (1987); Weyrauch, *Law as Mask—Legal Ritual and Relevance,* 66 CALIF. L. REV. 699, 710 (1978) ("The rules of relevancy, in short, have little to do with logic, reason, daily experience, common knowledge, and proper courtroom atmosphere. They are, rather, the product of deep-seated and largely unconscious value choices.").

Professor John Langbein has argued that rules of evidence were introduced into English criminal trials only to serve the interests of lawyers, not to advance the search for the truth. *See* Langbein, *The Criminal Trial before the Lawyers,* 45 U. CHI. L. REV. 263 (1978). *Cf.* Brilmayer, *Wobble, or the Death of Error,* 59 S. CAL. L. REV. 363 (1986) (apparently arguing that idea of legal error is an incoherent if not illusory concept).

[43] Although many factors affect the accuracy of fact finding in litigation, the analytical and marshalling techniques used by decision makers do so as well.

[44] Preliminary fact investigation and investigative discovery overlap because investigative discovery tends to play an important role in the early stages of the life cycle of the process of proof in litigation. We use the phrase "investigative discovery" to distinguish it from the type of "discovery" authorized by Federal Rules of Civil Procedure 26-37. We refer to the latter type of discovery as "legal discovery." Investigative discovery may take place during legal discovery. Although investigative discovery is ordinarily most prominent during the earliest stages of litigation, it can and

function of proof is to provide an answer. Any answer, however, requires a question. Figuring out how to ask a good question is as important as figuring out how to answer a question.[45] In studying preliminary fact investigation, we are essentially studying a process of questioning.

Asking appropriate questions is partly an art; it requires imagination. Yet, just as imagination alone cannot produce a great work of art, imagination alone cannot generate useful questions. Mental discipline is required to produce either a great overture in a symphony or a productive question during fact investigation. The network of evidence marshalling strategies described in this Article constitutes a theory of the economics of questioning. Our theory speaks to the efficiency of the questioning process; it speaks to the effective and disciplined deployment of cognitive resources during the process of inquiry.[46]

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does occur during other stages as well. Legal discovery, however, is not always investigative discovery; legal discovery can serve other purposes.

[45] A good answer to a bad question is worthless.

[46] Some observers believe that theories of mental processes (such as those involved in inference) are either descriptive or prescriptive. However, our theory of discovery and questioning neither describes how investigators actually think nor how investigators should think. Indeed, our theory does not even purvey conditional imperatives such as "If you wish to ask useful and productive questions, think this way or that way." Nonetheless, our theory is not an illegitimate hybrid. The range of possible types of theories of mental processes is not exhausted by the dichotomy between descriptive theories and prescriptive theories (or by the somewhat less common trichotomy between descriptive, prescriptive, and normative theories). This is because mental processes have two peculiar qualities. First, some mental processes are in the nature of standards. These standards, which "really exist," cannot be trapped either by a purely descriptive theory or by a purely prescriptive theory. *See* Tillers, *Mapping Inferential Domains*, 66 B.U.L. REV. 883, 932-33 (1986). *Cf.* 1 D. SCHUM, EVIDENCE AND INFERENCE FOR THE INTELLIGENCE ANALYST 376 (1987) (accepting distinction between cognitive performance and cognitive competence). Second, since it is not possible to demonstrate that natural standards of cognitive performance are defective, Cohen, *Can Human Irrationality Be Experimentally Demonstrated?*, 4 BEHAV. & BRAIN SCI. 317 (1981); Tillers, *supra*, at 933, there is no objective basis for claiming that any general way of thinking is better than another general way of thinking.

Although we do not see our theory as a purely normative theory of fact investigation, we do think that our theory describes strategies that can improve cognitive performance. However, given our conviction that the practical value of our theory to any individual must stand or fall at the bar of that individual's subjective judgment, it follows that our theory is nothing more than a tool, to be used by an individual as she sees fit. Hence, we

The question of the nature of discovery processes, of course, arises in contexts other than forensic proof and investigation; the issue has engaged the attention of philosophers and other people for generations.[47] It is therefore possible that a better under-standing of the nature of investigative discovery in litigation has general implications. While it may be true that lawyers and judges use an "artificiall reason"[48] to interpret legal rules and principles, it probably is not true that lawyers, judges, and other participants in the process of litigation do use or should use entirely idiosyncratic mental and logical operations when addressing factual issues. Differences in methods of assessing evidence in legal contexts and in nonlegal contexts such as medicine and science may stem from contextual and situational factors and from the characteristics of specialized bodies of knowledge about particular types of phenomena. They do not necessarily stem from any fundamental differences in methods of analyzing problems of evidence and inference.

B. General Structure of Theory

Our theory consists of twelve linked systems for marshalling evidence. This entire network of systems is represented in Figure 2.

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characterize our theory not as a descriptive theory, nor as a prescriptive theory, but as a theory of the possible. We describe a set of procedures that a rational person could use and might choose to use.

[47] *See, e.g.*, F. BACON, *The New Organon*, in THE NEW ORGANON AND RELATED WRITINGS 3 (F. Anderson ed. 1960); N. HANSON, PATTERNS OF DISCOVERY (1965); A. KOESTLER, THE ACT OF CREATION (1964); T. KUHN, *supra* note 2; P. LANGLEY, H. SIMON, G. BRADSHAW & J.M. ZYTKOW, SCIENTIFIC DISCOVERY: COMPUTATIONAL EXPLORATIONS OF THE CREATIVE PROCESS (1987); K. POPPER, THE LOGIC OF SCIENTIFIC DISCOVERY (1959); B. RUSSELL, HUMAN KNOWLEDGE: ITS SCOPE AND LIMITS (1948); I. SCHEFFLER, THE ANATOMY OF INQUIRY (1963); Hempel, *Fundamentals of Concept Formation in Empirical Science*, 2:7, INT'L ENCYLOPEDIA UNIFIED SCI. 1 (1952).

[48] COKE, COKE ON LITTLETON *62a ("Not . . . understood of eurie unlearned mans reason, but of artificiall and legall reason").
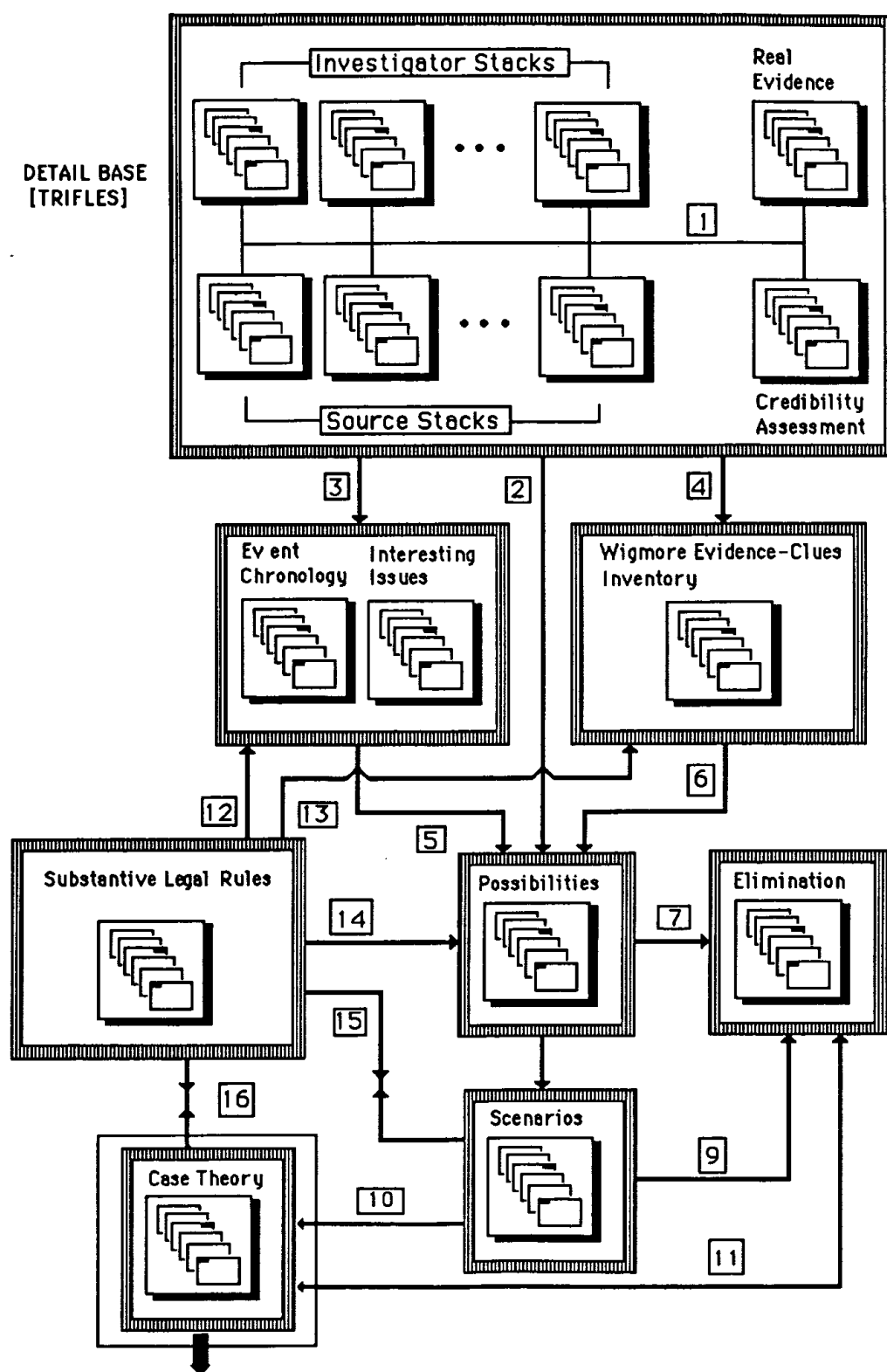
FIGURE 2

Figure 2 resembles an influence diagram. This resemblance is entirely deliberate. The concept of an influence diagram, first introduced by Howard,[49] is a useful method of describing the operations of complex networks. The nodes in an influence diagram, which typically appear either as boxes, circles, or ovals, refer to operations or functions. The arcs, or lines, represent linkages between nodes. Hence, arcs that connect nodes show the relations of different types of operations. In Figure 2 the nodes refer to evidence marshalling operations and the arcs indicate avenues of influence between separate evidence marshalling systems.[50]

In addition to showing operations and linkages between operations, our network diagram has two important characteristics. First, the operations shown there can be performed in any order (providing that the movement from one set of operations to another set of operations does not take a path for which there is no arc). The spatial arrangement of nodes or arcs conveys no suggestion of which marshalling operation must be the initial operation. More generally, the spatial relationships among the nodes in the network say nothing about the necessary or appropriate temporal order of the evidence marshalling operations symbolized by the nodes.

Second, our network diagram, unlike some influence diagrams, does not represent causal relationships. The arcs between the nodes, or evidence marshalling operations, only indicate avenues of influence; they indicate that marshalling schemes may influence other marshalling schemes. These avenues of influence express the possibility of subjective conceptual links, rather than of causal links, between different marshalling strategies.

These characteristics of our network diagram reflect several basic propositions about the characteristics of rational preliminary fact investigation. Our first proposition is that an investigation relating to matters of fact can rationally begin with any of the

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[49] Howard & Matheson, *Influence Diagrams*, in 2 READINGS ON THE PRINCIPLES AND APPLICATIONS OF DECISION ANALYSIS (R. Howard & J. Matheson eds. 1983); Howard, *Knowledge Maps*, 35 MGMT. SCI. 903 (1989). There is now a great deal of interest in influence diagrams. *See, e.g.*, Shachter, *Evaluating Influence Diagrams*, 34 OPERATIONS RESEARCH 871 (1986).

[50] An influence diagram is an acyclical graph. In our diagram acyclical movement is possible. Hence, we will refer to the diagram in Figure 2 as the "network diagram."

marshalling systems symbolized by the nodes. The choice of where analysis starts depends on the nature of the problem and the judgment of the investigator. Second, we propose that the sequence of marshalling strategies is not objectively or causally determined, and we therefore believe that analysis can move from any given marshalling strategy along any of the arcs leading to other marshalling strategies. Thus, the order in which marshalling strategies should be used depends on the investigator's view of the nature of the problem she faces. Finally, since the arcs in the network diagram represent only possible avenues of influence, the design and contents of the network diagram do not imply that an investigator must use all of the marshalling schemes represented in the diagram. We believe that a rational investigator may make little or no use of a variety of the marshalling operations that we have identified. These three judgments taken together reflect our more global judgment that our theory is a device for mapping the mind rather than the world. Unlike the world, the mind is not determined by law-like principles.

The network diagram in Figure 2 also suggests how research on evidence marshalling strategies can combine theoretical analysis and technological considerations. While Figure 2 represents our analysis of marshalling strategies and the manner in which they may affect each other, it also reflects our attempt to use computer technology to facilitate the use of our theory in real-world settings. We have developed computer-implemented prototypes of each of the twelve evidence marshalling strategies in our theory, and we have developed a computer-based method of exhibiting the linkages among these prototypes of evidence marshalling strategies. The resulting network of linked evidence marshalling systems emulates a complex system of evidence marshalling operations.

Our attempt to construct computer prototypes of evidence marshalling systems is more than a gimmick; there is an intimate relationship between our work on theoretical issues and our work on technological issues. We will explain more of how and why this is so after we describe our theory in more detail.[51] We will make two general claims now. The first is that our theoretical analysis determines which prototypes need to be constructed. In addition, however, we claim that our computer-based prototypes are metaphors that illuminate and illustrate elements of our the-

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[51] *See infra* CONCLUSION.

ory of evidence marshalling.[52] In particular, our computer prototypes of evidence marshalling strategies use the metaphor of a stack of cards.[53] In our discussion of the marshalling of details,[54] we illustrate how evidence marshalling strategies can be captured with this metaphor.

C. Basic Characteristics of Individual Marshalling Systems

Our network of twelve marshalling systems can be broken down into subgroups. The first subgroup is comprised of four of these separate marshalling systems which together form a basic detail or information base. Two of the systems in this subgroup allow the marshalling of evidence from and about investigators and other sources such as witnesses. A third system concerns real or tangible evidence and structuring an analysis of the authenticity of such evidence. The fourth system concerns marshalling evidence about the competence and credibility of witnesses.

The second major subgroup is comprised of three systems concerned with the marshalling of combinations of details. One of these systems facilitates the formation of event chronologies; another marshals thought and evidence about issues of interest that arise during investigation; and a third marshals evidence on the basis of the order in which events occur and evidence of those events appears.

The third major subgroup also contains three systems. These systems are concerned primarily with the marshalling of possibilities and scenarios. One allows for the marshalling of evidence on the basis of hypotheses, or possibilities, at various levels of refinement as they emerge during investigation. Another allows marshalling of evidence to eliminate possibilities in a systematic way. The last system in the subgroup facilitates the construction of stories and scenarios, which serve to suggest new evidence and possibilities.

The eleventh and twelfth systems can be classified under a fourth subgroup centered around marshalling evidence on the basis of legal doctrine. The eleventh system consists of a base of

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[52] *See id.*

[53] This metaphor is taken from the software system we used in the construction of our prototypes of evidence marshalling strategies. That system is the "Hypercard" system developed by Apple Computer Corporation.

[54] *See infra* Section I(C)(5).

legal rules and principles. The twelfth, and final, system allows for marshalling of evidence on the basis of the elements, or points, of these legal theories.

1. Marshalling Details

The first four marshalling systems concern details. Details, or small parcels of data, ordinarily accumulate very rapidly during an investigation. Since few investigators can match the ability of Sherlock Holmes to remember "trifles,"[55] the recording of details for later use is important.

There are practical and logistical difficulties in recording large quantities of information. The computer-based system we have constructed allows large numbers of trifles to be recorded and stored in a compact form. The storing of details, however, also involves theoretical difficulties. The first difficulty is caused by the fact that the world is full of trifles. Even if we had the most powerful computer in the world, we could not record all the trifles that come to our attention. Moreover, even if we could record every trifle, we would not want to do so. (For one thing, we would not want to expend the resources necessary to do so.) Hence, in any investigation it is necessary to decide which details are worth recording and preserving and which are not.

Determining the relevance of details during an investigation is difficult. Investigators face a dynamic environment and they lack clairvoyance. Consequently, a detail that seems irrelevant at Time "x" may become highly relevant at Time "x + 1."[56] Unfortunately, we know of no method of recording that will preserve all significant details and discard the rest. There are methods of marshalling, however, that may improve the chances that important details will be preserved. Moreover, there are methods of storing details on the basis of important differences in their evidential character. We examine some of these methods next.

2. Marshalling by Actors

The first two systems in our detail base organize evidence in

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[55] A. DOYLE, *The Boscombe Valley Mystery*, in THE COMPLETE SHERLOCK HOLMES 202, 214 (1981) (Holmes remarking that his method "is founded upon the observation of trifles").

[56] This is why we call the set of recorded details the "detail base." We avoid the more conventional label "knowledge base" because the details in an investigator's base may or may not supply knowledge.

relationship to "actors." In our usage, actors are people who are sources of information. The domain of actor-based marshalling is wide because all details acquired during an investigation originate with or pass through people.

The first actor-based evidence marshalling system makes it possible for investigators to identify the actors who are the sources of specific items of information and to identify the details that originated or passed through particular actors. The second actor-based marshalling system makes it possible to identify the details that contain information about actors. In other words, one marshalling system records details from actors and the other records details about actors.[57]

These two actor-based marshalling systems have a variety of advantages and uses. It may be of some theoretical, as well as practical, significance that trial lawyers routinely marshal evidence on the basis of people, frequently recording the identities of people having information and the type of information that such individuals have.[58] Lawyers are particularly likely to make this type of record when a trial is near. This is because they need to know which people should be called as witnesses. However, lawyers also make such records earlier in the life of a lawsuit. They do so, for example, because they need to know which people might have to be questioned again for further information about particular matters.

In making records about potential witnesses and about people who are potential sources of evidence, lawyers also routinely record details about these sources of information. Thus, matters such as age, occupation, employment history, and other matters will be recorded. Among the reasons for this sort of record-keeping, of course, is the lawyer's concern with the credibility of his potential witnesses. There are other reasons for this sort of record-keeping, some of which are mundane and some of which are not. Among the mundane, for example, is the lawyer's need to be able to locate people when she wishes to speak with them or subpoena them. Yet some of the reasons why lawyers preserve

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[57] Our computer prototype of these two marshalling systems allows the user to obtain either kind of actor-based details with ease. One "button" produces on-screen the details provided by an actor, another produces the details about an actor.

[58] *See, e.g.*, Brosnahan, *Are You Going Through Life without a Trial Notebook?*, CASE & COMMENT, Nov.-Dec. 1990, at 9, 11 (recommending that lawyers follow this common practice).

details about actors are less mundane. For example, as already noted, lawyers may think that information about actors is important because they may think that the credibility of actors is an important consideration even during investigation.

There may be another reason why the preservation of details about actors is an important method of marshalling evidence. The importance of stories during the trial process is well-documented.[59] As we shall later show, stories, or scenarios, are also important during investigation.[60] In almost every lawsuit the matter, or matters, in controversy involve actions by human beings. Consequently, the scenarios that investigators construct must also involve actions by human beings. As we shall later show, the construction of useful stories for investigative purposes is not an automatic act. Story telling involves imagination and, in a legal context where the truth of a story is a matter of considerable concern, effective story telling, or scenario construction, may involve a considerable amount of intellectual labor. Consequently, a system that marshals evidence about "actors" may facilitate the process of scenario construction.

Actor-based marshalling can facilitate the construction of scenarios in several different ways. Most obviously, an efficient method for preserving and recalling information about actors involved in a scenario makes it easier to flesh out the scenario, and the ability to retrieve details about people can speed and improve the initial decision of whether a person should be made an actor in a particular story. In addition, an actor-based detail base can aid in the construction of complex scenarios where actors interact. For example, actor-based marshalling may facilitate the process of telling the story of each individual actor which, in turn, may lead to the combination of those stories into a larger story.[61]

3. Marshalling Real Evidence

Another method of marshalling evidence seems so natural that it may not seem to require comment: the process of segregating evidence that has a tangible form. Lawyers and other investiga-

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[59] *See infra* notes 83, 85-86.

[60] *See infra* Section II(C)(2).

[61] In short, it will sometimes happen that the best way to construct a useful story is to move from parts to wholes rather than from a global story to its pieces.

tors routinely separate evidence on this basis. Here again, the reasons for doing so are both conceptual and logistical. Conceptually, real and testimonial evidence impart information in different ways and thus require different analytical treatment. This assumption, which plays an important role in the law of evidence,[62] is well-founded. Although the assessment of real evidence does involve inference — it is not true that real evidence speaks entirely by or for itself — it is also true that human sources and nonhuman sources of information are fundamentally different and the special characteristics of human sources require a different and special mode of inferential reasoning.

In the case of real evidence, the structure of the inferential process required is simpler than in the case of testimonial evidence.[63] The use of real evidence generally involves the question of its authenticity: it must be determined whether the thing in question is what it appears to be or what its proponent says it is. Attention will not focus, however, on the question of whether the tangible thing in question is "sincere" or whether it is "biased." Consequently, it is logistically useful to segregate evidence that does not involve these sorts of issues.[64]

4. Marshalling for Credibility

In our discussion of actor-based marshalling we have noted the importance of marshalling details about the credibility of human sources of information.[65] Although one of the actor-based marshalling systems is a technique for gathering details about human

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[62] The law of evidence draws a distinction between "real" and testimonial evidence. *See* 1A J. WIGMORE, WIGMORE ON EVIDENCE § 24 (P. Tillers rev. 1983). Wigmore coined the neologism "autopic proference" to refer to evidence that presents itself directly to the senses. *Id.*

[63] This is not to say that assessing the properties of tangible things is easy. If it were, we would not need sciences such as physics and chemistry.

[64] It is, of course, true that testimonial evidence will often be necessary to lend meaning to the tangible evidence in the case. Often it is also true that the decision maker's attention will focus not on the information that can be obtained from a tangible thing if it is what its proponent claims but, rather, on the question of whether a witness is believable when she claims that a tangible thing is such-and-such. All of this, however, does not denigrate the conclusion that if certain testimony about the authenticity of a tangible thing is believed, the assessment of the tangible thing lacks forms of inferential reasoning that are involved when the believability of a human source is drawn into question.

[65] *See supra* text accompanying notes 57-61.

sources of information, however, the resulting collection of evidence is just a list of details. Such a list does not organize details in a way that fully displays their significance for credibility issues. One of the authors of this Article, David Schum, has described a method for organizing evidence and thought about questions of credibility.[66] Although that analysis will not be restated here, we do note that Schum's analysis of credibility has many affinities with the way the law of evidence views problems of credibility. For example, in both Schum's schema and the law's, veracity, objectivity, and observational accuracy of a human source are important factors bearing on the probative value of testimonial evidence.[67] It is clearly useful to organize details on the basis of their potential bearing on matters such as sincerity, bias, and memory.

5. Marshalling by Arranging and Combining Details

A major purpose of marshalling strategies in investigation — at least in the preliminary phases of investigation — is the stimulation of useful questions or hypotheses. Marshalling schemes interest us to the extent that they perform this heuristic function. On some occasions a single detail provokes or stimulates a question or hypothesis. For example, X has died of a gunshot wound and one detail at the scene of the crime is a small quantity of a narcotic substance. This single datum will likely provoke the formation of the relatively diffuse hypothesis that X was killed by someone who was somehow involved with narcotics. In addition, details can also provoke the formation of relatively discrete hypotheses. For example, the information that X's body has a firearm wound and that Y's recently-fired revolver was found at the scene of the crime is likely to provoke the hypothesis that Y killed X with his revolver.

While single details can provoke the formation of hypotheses, so too can combinations of details. When details accumulate,

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[66] Schum's theory of credibility assessment, which is part of his more general theory of multistage or "cascaded" inference, appears in a variety of journals and books. A recent formulation of his theory of credibility is found in Schum, *Knowledge, Credibility, and Probability*, 2 J. BEHAV. DECISION MAKING 39 (1989).

[67] *See, e.g.*, 3A J. WIGMORE, WIGMORE ON EVIDENCE § 922 (J. Chadbourn rev. 1970) (impeachment for lack of veracity); *id.* §§ 948-53, 966-69 (impeachment for bias and interest); *id.* §§ 931-38 (impeachment for organic incapacity).

however, there are both practical and conceptual difficulties. A practical difficulty is keeping track of the vast number of details that typically accumulate even during a brief investigation. For example, in the simulation on which this Article rests we accumulated thousands of details. In addition to the practical difficulty of preserving large numbers of details, there is the conceptual or analytical problem of combining details in an order that will stimulate the formation of useful questions and hypotheses.

A method based on the procedure used in our computer prototype may substantially alleviate many of the practical problems of recording details for later use. As noted earlier, the computer prototype uses a method of storage that resembles a stack of cards.[68] The prototype permits a user to enter details on each card within each of the stacks for each of the four detail marshalling methods that we have just described. Questions and ideas can also be recorded on each of these cards. The underlying Hypercard system[69] on which these stacks are built makes it easy for a user to navigate through and between these various stacks with relative ease. If there is merit to the theories of evidence marshalling on which these four types of stacks rest, a method of recording data based on the prototype computer-based marshalling system we have designed should enhance the ability of users to ask productive questions on the basis of the available details.

The ability to navigate among the four stacks, however, does not resolve the issue of how details should be combined in order to enhance the efficiency of the process of questioning. Even with the assistance of a computer, it is neither practicable nor enlightening to consider every possible combination of details. Even when the number of details is relatively small, it would take aeons to consider every possible combination.[70] Moreover, long before anyone could finish considering all possible combinations of details, there would almost certainly be new details to consider. Hence, we need a more efficient method for arranging and combining details. We need a strategy for combining details that omits a variety of combinations, but does so without obliterating an excessive number of potentially useful combinations and arrangements. As shown immediately below, the arcs numbered

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[68] *See supra* text accompanying note 53; *supra* note 57.

[69] *See supra* note 53 (explaining Hypercard system).

[70] If there are just 50 details, there are $2^{50}-1$ combinations. This is roughly 1,000,000,000,000,000 combinations.

3 and 4 in Figure 2 lead us to methods of combining details that may be productive.

6. Marshalling Details for Interesting Issues and Temporal Inventorying of Evidence

Details may provoke the formulation of hypotheses and questions that we call "interesting issues." These issues are relatively granular hypotheses that are derivative of more general hypotheses. For example, the general hypothesis that a murder was committed in some fashion may, and often does, provoke a variety of more discrete hypotheses or questions that bear on the general question of the *modus operandi*. One such general hypothesis might be that a murder was committed in one way or another. This hypothesis may provoke the "interesting issues" of why an attempt was made to remove blood stains from the scene of the crime and who attempted to do so. It is plainly useful to record these sorts of subsidiary queries.

It is also useful to "time-stamp" evidence. To gauge the significance of evidence, it is often necessary to know if it postdates, accompanies, or predates the hypothesized event.[71] Time-stamping evidence — organizing and arranging it on the basis of the order of its appearance in time in relation to possible events in the world — is important because evidence is not just evidence. It is also an event in time. The temporal locus of evidence in time is a matter of some importance because, as an event in time, evidence stands in a causal relationship with other events in the

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[71] Wigmore distinguished among evidence that predates, accompanies, and postdates a fact in issue. He called these three classes: prospectant, concomitant, and restrospectant. J. WIGMORE, JUDICIAL PROOF, *supra* note 17, at §§ 55, 83, 138; *see also* 1A J. WIGMORE, WIGMORE ON EVIDENCE, *supra* note 62, § 43, at 1140-42. Some observers may think that Wigmore's tripartite temporal classification of evidence is merely quaint. This sort of reaction to Wigmore's tripartite temporal classification of evidence, however, may be another example of the tendency of some of Wigmore's most important theoretical work to suffer the fate of a lead balloon. W. TWINING, *supra* note 17, at 164-66. Indeed, the words Wigmore used to discuss the temporal sorting of evidence, *e.g.*, "progress chart of indications," are not elegant. Yet, buried in Wigmore's ungainly language is the important insight that dating the appearance of evidence can serve an important heuristic function. *See* J. WIGMORE, THE SCIENCE OF JUDICIAL PROOF § 4, app. 5, at 998-1003 (3d ed. 1937) (discussing value of temporal classification of evidence in investigation) [hereafter J. WIGMORE, SCIENCE OF JUDICIAL PROOF].

world. Consequently, identification of the temporal locus of evidence — dating its appearance in the world — facilitates investigation of the causal relationships between evidence, on the one hand, and hypotheses about events of legal significance, on the other. In some cases, time-stamping evidence promotes a kind of reasoning known as retroduction.[72] An investigator using this kind of reasoning will suppose, for example, that the murder in issue in the case did in fact take place and then attempt to predict the evidence that would likely appear after such a murder. On this basis, he might predict in a particular case that the defendant would have referred to the murder in later conversations with his close friends.[73] The major difference between the retroductive reasoning used in scenario analysis and the reasoning in this connection is that scenario analysis focuses on causal relations among events,[74] whereas time-stamping evidence promotes retroductive reasoning about the causal relations between (possible) events and evidence.

One might argue that temporal marshalling of evidence does not merit a separate node in the influence diagram. The node representing evidence marshalling with scenarios already describes a procedure for thinking about temporal and causal relationships among events. Wigmore's method of temporal marshalling differs from marshalling by scenarios, however, because Wigmore's method of time-stamping evidence has an "eliminative" element.[75] Wigmore argued that a complete temporal audit of evidence — which he called a "progress chart of indications" — can indicate when a case is "completely" prepared.[76] In his view a case is completely prepared when all alternative possibilities are eliminated and only one remains.[77] The basis for this process of elimination appears to be a form of causal reasoning about the relationship between evidence-events and issue-events. Hence, in Wigmore's view it is possible, at least on some occasions, to use this type of reasoning to establish conclusively that only one hypothesis is possible. Wigmore undoubtedly overstated

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[72] We discuss retroductive reasoning *infra* in Section II(B)(2).

[73] This type of reasoning is structurally similar to the retroductive process in scenario analysis discussed *infra* in Section II(B)(2).

[74] *See infra* Section I(C)(7).

[75] *See generally* J. WIGMORE, SCIENCE OF JUDICIAL PROOF, *supra* note 71, § 4, app. 5, at 998-1003 (explaining "progress chart").

[76] *Id.*

[77] *Id.*

his case when he said that it is possible to reach the conclusion that a case has been "completely prepared." Causal reasoning can never conclusively exclude alternative causal explanations.[78]

7. Event Chronologies and Scenarios

One way of arranging details is by the temporal order of the events they seem to indicate. This method of arranging and marshalling details is familiar to many lawyers. The practice of constructing "time lines" is a common method of pretrial preparation.[79] This method of marshalling evidence is useful because it often stimulates fruitful questions. For example, event chronologies may disclose "gaps." By constructing time lines an investigator may discover the existence of time intervals about which there are no details and it may be apparent to the investigator that some events in that interval may be important. Similarly, an event chronology may reveal that there is some information about an interval of time, but it is not enough or it is not the right kind.[80]

While event chronologies, or time lines, are heuristically valuable in their catalyzing questions about a case, they also have limitations. A symptom of these limitations is "clutter." When numerous events are packed into an event chronology, the usual effect is that the event chronology appears cluttered.[81] The primary reason for the cluttered appearance of event chronologies is that many of the events entered on a temporal axis have no appar-

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[78] Wigmore appears to have good company, however. For example, Dr. L. Jonathan Cohen has argued that the weight of evidence is a function of the number of evidential tests that a possibility or hypothesis has surmounted. In Cohen's opinion, conclusive proof of a hypothesis is possible and it is achieved when a hypothesis has surmounted every imaginable evidential test. *See* L. COHEN, AN INTRODUCTION TO THE PHILOSOPHY OF INDUCTION AND PROBABILITY 37-38 (1989). Cohen's thesis is much like Wigmore's. It is possible, however, to reach the conclusion that the preparation for a case is effectively and practically complete. For example, it may be hard to imagine additional evidential tests.

[79] *See* D. BINDER & P. BERGMAN, *supra* note 6, chs. 4, 14.

[80] In Part II we examine in more detail some of the possible uses and forms of event chronologies.

[81] The clutter effect is not solely or even largely attributable to the density of the events in a time line. As we explain *infra* in Part II(C)(1), there are devices that can reduce the apparent density of events in an event chronology.

ent relationship with each other. In this situation, an event chronology may muddle as well as clarify the process of inquiry.

Our reason for the limitations of event chronologies also suggests the cure. If simple temporal sequences are often unilluminating or confusing because of the lack of any apparent connections between the events recorded in an event chronology, one remedy is the construction of scenarios,[82] or "stories."[83] Unlike a simple event chronology, a scenario describes a sequence of events that are causally related. This type of temporal marshalling gives scenarios a measure of intelligibility that time lines do not have.

Powerful theoretical considerations speak in favor of story telling as an evidence marshalling technique. For example, Kant made the ontological argument that states of the world are necessarily part of a spatio-temporal order.[84] This view implies that all of the issues in every lawsuit concern causally related events. Moreover, there is strong empirical evidence that stories are both a common natural information processing technique and an effective technique for storing and recalling large amounts of information.[85] It is also noteworthy that trial lawyers often consciously tell stories in trials.[86] Some lawyers may view stories only as rhetorical devices, yet others realize that story telling makes evidence

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[82] There is an extensive body of literature on scenario analysis. A good introduction is D. VON WINTERFELDT & W. EDWARDS, DECISION ANALYSIS AND BEHAVIORAL RESEARCH 163-72 (1986).

[83] In recent years there has been growing interest in the role of stories in trials. *See, e.g.*, Bennett, *Storytelling in Criminal Trials: A Model of Social Judgment*, 64 SPEECH 1 (1978); Bennett, *Rhetorical Transformation of Evidence in Criminal Trials: Creating Grounds for Legal Judgment.* 65 SPEECH 311 (1979). An overview is provided in W. TWINING, *Lawyers' Stories*, in RETHINKING EVIDENCE: EXPLORATORY ESSAYS 219-61 (1990); *see also* Tillers, *supra* note 46, at 916-27; *cf.* Allen, *supra* note 22, at 426-28 (conceptualizing trials as presenting and evaluating plaintiff's story and defendant's story, rather than merely plaintiff's allegations and defendant's denials).

[84] I. KANT, KRITIK DER REINEN VERNUNFT (2d ed. 1787).

[85] *See, e.g.*, W. BENNETT & M. FELDMAN, RECONSTRUCTING REALITY IN THE COURTROOM 3-18 (1981); R. HASTIE, S. PENROD & N. PENNINGTON, INSIDE THE JURY 22-23, 163-65, 234 (1983); Pennington & Hastie, *Explanation-Based Decision Making*, in PROGRAM OF THE NINTH ANNUAL COGNITIVE SCIENCE SOCIETY 682, 682 (1987).

[86] *See, e.g.*, W. TWINING, *supra* note 83, at 224 (classic example of forensic story telling); *cf.* Snadaker, *Storytelling in Opening Statements: Framing the Argumentation of the Trial*, 10 AM. J. TRIAL ADVOCACY 15 (1986) (role of stories in lawyer's opening statement).

more intelligible to the trier of fact. Hence, the importance of stories in inferential contexts has been recognized in many different quarters. If we have something to add to the argument that story telling is important, it is the claim that stories are important in investigative processes as well as in deliberative processes.

There are many different kinds of stories. The kinds of stories we have in mind — scenarios[87] — contain a mixture of evidence and conjecture. In a forensic context stories ordinarily must incorporate evidentiary elements as well as a dose of fancy. In a forensic context stories are constructed because of an interest in actual states of the world; their purpose is to facilitate the accurate assessment of matters of fact. If a story has no evidentiary foundations, there is ordinarily little reason to think that the story is a plausible one. Scenarios are very complex hypotheses about a temporal sequence of events in the "real world." These hypotheses are useful only if they have a basis in evidence. In the absence of evidentiary indicators and constraints, an infinite number of possible scenarios of equal dignity can be constructed. Yet, in the absence of all evidence, no scenario that describes a possible sequence of events can be deemed more or less plausible than any other scenario describing another possible sequence of events.

While useful scenarios rest on evidence, they are not limited to the possibilities directly disclosed by the evidence. Any scenario must have an element of fancy. A scenario is a hypothesis about connections between events; it contains a theory or explanation of how things are connected in time. When a scenario is constructed for forensic purposes, it serves as a gap-filler. Scenarios fill gaps precisely because they incorporate, or are, theories that specify relationships between events in time. Hence, story telling is more than just another method of organizing details. Story telling is a method of marshalling that explicitly mixes evidence with the construction of theories about the behavior of sectors of the cosmos over time.

The conjectural dimension of a story serves a number of important purposes. The conjectural or hypothesized parts of a story serve as indicators of potentially relevant evidence. A story having conjectural components suggests the importance of evidence bearing on the conjectural portions of the story. For example, if an investigator conjectures that a suspect purchased a gun at a

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[87] For present purposes we equate "stories" with "scenarios."

store before he shot the victim, an investigator would also have to guess that evidence showing such a purchase might be useful. In addition, a clearly told story practically forces an investigator or decision maker to focus on the relative merits of competing visions and theories of the workings of natural processes and human beings. The construction of an intelligible scenario makes a story teller's causal theories explicit. Hence, a story, if clearly articulated, invites and facilitates rumination about the adequacy of the causal theory that underlies the story. For example, if an investigator conjectures that a suspect killed the victim to get revenge for the mistreatment of the suspect's dog, questions are likely to be raised about whether this is the way the mind of the suspect could have worked.[88]

Although we believe that event chronologies may spur and facilitate the formation of stories, we believe that the link between event chronologies and stories is indirect rather than direct.[89] We believe that the interaction of time lines and stories is mediated by other marshalling strategies, including marshalling according to "possibilities." The term "possibilities" refers to hypotheses that are directly[90] indicated or suggested by evidence. We believe that stories can emerge out of "possibilities" but not out of time lines.[91] We discuss the marshalling of possibilities next.

8. Possibilities Marshalling

When taken at face value, evidence often seems to indicate a variety of possibilities. A trace of cocaine is found at the scene of an apparent murder. This evidence indicates the possibility that the perpetrator of the murder (if there was a murder) was a user or peddler of cocaine. A gun is also found near the dead body.

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[88] *See infra* text accompanying Figures 17 & 18 in Section II(C)(2) (discussing devices and procedures that facilitate formation, assessment, and comparison of stories).

[89] The absence of an arc linking the story node and the event chronology node in Figure 2 signifies that there is no direct interaction between the operation of marshalling evidence by forming time lines and marshalling evidence by telling stories.

[90] To be sure, a possibility requires an inference from evidence. Our point is that a possibility never outruns evidence.

[91] One may have the "experience" of seeing a scenario emerge out of an event chronology. However, we believe that when an event chronology inspires a scenario it does so because an event chronology suggests possibilities, which then become the basis of a scenario.

This evidence may indicate the possibility that the murderer (if there was a murderer) used a gun to kill the victim, and it may indicate the alternative possibility that the dead person committed suicide by shooting herself. As noted earlier,[92] however, evidentiary details can be combined in various ways. Examination of various combinations of evidentiary details is a useful technique for stimulating the formation of further possibilities and hypotheses. For example, the evidence of the cocaine and the gun taken together may suggest the possibility that the killer shot the victim to get the victim's cocaine. The examination of such a possibility may suggest a scenario. For example, the possibility that the killer shot the victim to get the victim's cocaine may induce an investigator to conjecture that the killer and the victim had dealings with each other in the past.

It is also important to assess the possibilities that the available evidence seems to suggest. A useful way of doing so is to imagine further possibilities that are compatible with the possibilities already recognized. When this is done, the extent to which existing evidence supports different sets of possibilities at various levels of refinement can be considered. Moreover, identification of hypotheses lacking extensive evidentiary support can serve as a guide for additional investigation or inquiry. We describe this sort of possibilities analysis at some length in Part II of this Article. There we describe a "possibilities tree" and some other graphic representations that may facilitate both the formation and assessment of possibilities.[93]

While orderly thinking about the relationship between possibilities and evidentiary details can clearly be useful and productive, the strategy of marshalling details on the basis of possibilities also has its limitations. As we suggested before,[94] when details multiply the number of possibilities increases rapidly. This fact alone places limits on a strategy that aims to "exhaust the possibilities." In addition, there is a further complication: a single possibilities tree, supported by a relatively small collection of evidence can contain a vast number of possibilities.[95] Ordinarily it is neither feasible nor desirable to examine all the possibilities that a collection of details suggests. Hence, it is essential to prune

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[92] *See supra* Section I(C)(5).

[93] *See infra* Sections II(B)(1)-(2).

[94] *See supra* note 70 and accompanying text.

[95] *See infra* Figures 8 & 9 together with accompanying text in Section II(A).

some of the possibilities from the possibilities tree that we describe in Section II(B).

There are at least two methods for pruning a possibilities tree of some of its branches. First, since combinations of possibilities tend to suggest possible scenarios, one way of pruning a possibilities tree (as well as making it grow new branches) is to construct scenarios that incorporate some of the possibilities suggested by the evidence. Once such scenarios are constructed and their plausibility assessed, they may be used to reconsider the possibilities that evidence suggests. In some situations, this reassessment will cause an investigator to jettison a variety of possibilities.

Another method of reducing possibilities is to engage in a process we call "elimination." This approach subjects possibilities to evidential tests. The use of evidential tests involves an analytic process known as retroductive reasoning.[96] When an investigator uses eliminative reasoning to extinguish possibilities, he thinks retroductively because he makes predictions or guesses about the evidence that would exist if a particular possibility is, in fact, true. After making this prediction, or guess, he then attempts to determine whether these items of evidence actually exist. The nature of this process of evidential testing is described in detail by Dr. Cohen.[97] He argues that the strength of a hypothesis, (in our usage here, a "possibility") is a function of the number of evidential tests that it is able to pass. The greater the number of evidential tests that a hypothesis passes, the greater is our confidence in that hypothesis.[98]

Of course, neither of these two methods for eliminating possibilities, scenario analysis and eliminative reasoning, guarantees that an investigator will be able to cope with a number of possibilities so large as to cause mental stupefaction. If an investigator entertains so many possibilities that they cause only bewilderment, the investigator will not be able to use marshalling methods such as story telling and eliminative reasoning to reduce a cognitively unmanageable number of possibilities to manageable proportions. Nonetheless, methods such as scenario analysis

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[96] *See infra* Section II(B)(2).

[97] L. COHEN, THE PROBABLE AND THE PROVABLE, pt. III (1977).

[98] *Id.* at ch. 13. Some critics have argued that Dr. Cohen's theories of inference and probability are incoherent. *See, e.g.*, Williams, *The Mathematics of Proof*, pts. I & II, 1979 CRIM. L. REV. 297, 340. However, these critics have made a category mistake: they fail to appreciate the difference between enumerative and eliminative inference.

and eliminative reasoning do have the capacity to make a relatively (but not wholly) unmanageable number of possibilities relatively more manageable. The fact that an investigator can make no headway if he entertains a stupefying number of possibilities only demonstrates that the network of marshalling strategies described does not capture all of the processes involved in investigation.[99]

The importance of cognitive manageability is obvious. Yet, although it is advantageous to have fewer possibilities rather than more, this kind of simplicity is not the only important cognitive value. For example, marshalling by scenarios may expand as well as reduce the number of recognizable possibilities, but an investigator may rationally embrace story telling as a marshalling strategy even when it multiplies possibilities. Similarly, when an investigator suspects that possibilities having no present relevance may become significant later, he should hesitate to abandon them completely and irrevocably. Thus, intricacy and complexity in matters such as possibilities are only one factor in a theory of the economics of questioning. The benefits of entertaining, considering, and recording possibilities and details must be weighed against the costs of doing so. Thus, while cognitive parsimony is important, it does not follow that an efficient strategy for marshalling evidence is one that reduces possibilities and details to a small number.[100]

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[99] At this point we have no recourse except to refer to these undescribed processes as "intuitive" or "tacit" methods of dissecting, organizing, and assembling evidence.

[100] We can make the point found in the text by drawing an analogy between a parsimonious strategy for understanding natural processes and a parsimonious strategy for assessing evidence. A parsimonious theory of nature (*e.g.*, special relativity theory) does not achieve parsimony by obliterating the complexity of natural processes. Rather, it is a parsimonious strategy for explaining complex natural processes. To be sure, the analogy is imperfect because a theory of evidence marshalling is a map of the mind rather than the world, and the subject matter of our theory — including matters such as "possibilities" and "details" — exists only in our heads. It does not follow, however, that investigators should capitalize on this kind of subjectivity of the subject matter of our theory by randomly eliminating — thinking away, as it were — including matters such as possibilities and details. If that were a rational strategy, every investigator would eliminate details and possibilities until only one was left. This *reductio ad absurdum* demonstrates that whatever the subjectivity of inferential processes and strategies may mean, it does not mean that they impose no constraints or limitations on cognitive processes concerning the existence of

9. Legal Marshalling

We claim that substantive legal rules are important heuristic devices. Our claim may sound odd; if asked to explain the importance of substantive law, people are more likely to refer to the impact of substantive law on conduct than to its impact on the process of inquiry and discovery. Nonetheless, substantive legal rules really are important heuristic devices. Yet, the reason for the heuristic importance of substantive law for investigative and evidentiary processes is special. The other evidence marshalling strategies considered in this Article have innate heuristic charm and power. The same cannot be said of the strategy of marshalling evidence on the basis of substantive law. Substantive legal rules have heuristic significance because they are *authoritative*. If substantive legal rules were not authoritative, participants in litigation would not necessarily want to use them to organize evidence.[101] However, judges and jurors are required to follow the

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matters of fact. This Article devotes considerable attention to processes and strategies that can multiply details and hypotheses.

[101] The distinctive character of legal marshalling raises several interesting questions. One of them is whether there are comparable marshalling strategies in nonlegal contexts. For example, do some marshalling strategies in medical investigation owe their existence to social conventions rather than to the inherent "fertility" of the marshalling strategy in question? Questions of this sort raise the further question of the universality of the marshalling strategies described in the Article. *See supra* text accompanying notes 62-63; *infra* note 103.

Another interesting question is whether legal marshalling is entirely different from other evidence marshalling strategies described in this Article. Although the "nonlegal" marshalling strategies described in this Article have innate heuristic charm, the structure of the legal process sometimes encourages or requires the use of specific marshalling strategies. For example, there are legal rules that prescribe certain methods of impeachment and proscribe others. Legal rules of this sort might result in the use of marshalling strategies that would not otherwise have been employed. As our study of investigation brings us closer to the trial, the question of the extent to which marshalling strategies have their roots in social and legal conventions will become more acute. As the trial draws nigh, pretrial activities of lawyers focus more on the preparation for the tasks they must perform in the trial. For example, a lawyer facing a jury trial knows that the trial judge will instruct the jurors to determine whether the evidence in the case shows that the parties having the burden of proof on specified claims and defenses have met their burden of proof. The trial lawyer's expectation that these instructions will be given may influence the way that the lawyer marshals evidence when preparing for trial. For example, she may want to focus more than she otherwise would on matters

applicable substantive rules when making decisions in a lawsuit. The substantive legal rules function as "decision rules" that specify the conditions under which the decision maker ought to grant or deny redress.[102] The obligatory character of these rules lends them heuristic significance. For example, any person trying a lawsuit must take substantive legal rules into account when marshalling and presenting evidence; it is possible that the judge and jurors will abide by the rules that the substantive law tells them to use when reaching a decision in the case.

Although it is apparent that substantive legal rules about matters such as "battery," "nuisance," "larceny," and "manslaughter" have important implications for marshalling evidence in pretrial investigation as well as at trial,[103] the question of precisely how substantive law influences fact investigation remains to be answered. Unfortunately, we cannot give the full answer to this question here. We are reasonably sure that the substantive legal framework of legal disputes dictates the use of a wide variety of evidence marshalling strategies,[104] and we have neither the

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such as the range and force of her evidence and less than she otherwise would on matters such as "story telling."

[102] The jurisprudentially-minded reader may regard this perspective on substantive legal rules as both unduly crabbed and unduly expansive — unduly crabbed because it ignores the possibility of substantive legal rules that do not themselves specify the conditions of liability or nonliability; and unduly expansive because it ignores the possibility of procedural preconditions for judicial recognition of a claim or defense. Neither slight is intended here. It is enough for our purposes that *some* substantive rules specify at least *some* conditions (under some circumstances) for the award or denial of judicial relief.

[103] Although most trial lawyers do not need to be told that marshalling evidence on the basis of legal theories is important, there are several reasons why some discussion of this method of marshalling evidence is warranted. First, of course, many people who are not schooled in the arts of litigation and pretrial preparation have not even thought about legal marshalling, and it may be necessary to convince them that legal marshalling is important. Second, our discussion of legal marshalling may reveal specific methods of legal marshalling that even meticulous trial lawyers may not yet appreciate. Third, systematic analysis of legal marshalling raises important questions about the relationship between reasoning about evidence and reasoning about law. Finally, since legal doctrines are not implicated in many inferential processes (*e.g.*, those in astrophysics), analysis of legal marshalling makes it possible to examine the question of the extent to which the network of evidence marshalling systems described in this Article is context-specific rather than general.

[104] There is more than a little reason to believe that legal reasoning and

time nor the resources to examine all of these law-related mar-
shalling strategies. We have given some thought to a strategy
that involves the decomposition of legal concepts, however. This
strategy requires that concepts such as "murder" and "battery"
be broken down into their constituents, or "elements." For
example, "negligence" might be broken down into the elements
of "duty of care," "breach," "proximate cause," and "dam-
ages."[105] In our network diagram the decomposition of legal
rules and concepts into elements is symbolized by the node called
"substantive legal rules."[106]

The enumeration of the elements of a legal claim or defense
may suggest various methods of organizing evidence. For exam-
ple, the procedure of explicitly articulating the elements of a legal
claim such as "conspiracy" may inspire the formation of possible
scenarios which, if shown to be true, would support that claim.
Similarly, an investigator, again proceeding in a retroductive
mode, may ponder the elements of legal rules in the abstract and
then speculate about the possible combinations of facts and
events that would instantiate those generic, abstract elements. In
that case, she might then examine the detail base to see whether
the evidence already available supports the elements of the claims
or defenses she is considering, or she may engage in further

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argument take a variety of forms. *See infra* note 116. If there are various
types of legal reasoning and argument, there is likely to be a corresponding
diversity in law-related, evidence marshalling strategies. Each distinctive
method of legal reasoning may assign a distinctive role to facts and evidence
and may therefore require distinctive forms of evidence marshalling. We do
not attempt to provide a comprehensive account of the varieties of legal
reasoning and the evidence marshalling schemes that various species of
legal reasoning might entail. However, we do allude to the distinctive
evidentiary heuristics that two specific types of legal argument might
generate. *See infra* notes 113-16 and accompanying text; *cf.* Tillers, *The Value
of Evidence in Law*, 39 No. IRE. LEG. Q. 167 (1988).

105 This list of elements highlights the fact that the appropriate
breakdown of a legal concept may be uncertain. This is not an insignificant
fact. Uncertainty about the definition of a legal claim or defense
complicates the task of marshalling evidence.

106 *See supra* Figure 2. Not all legal doctrines and rules fall into the
category of "substantive" rules; there are also "procedural" rules. We are
certain that marshalling evidence on the basis of procedural rules is as
important as marshalling evidence on the basis of substantive rules. We
have not yet examined how the process of relating evidence to procedural
rules works, however. We propose to do so in the next phase of our
research.

investigation to see if evidence supporting those claims or defenses can be found.

These examples of the retroductive use of the elements of legal concepts have special pertinence to the initial stages of litigation and investigation. In pretrial phases of litigation it is often very uncertain whether a possible legal basis for relief or for denial of relief will survive to the time of any trial or whether it will die an early death for lack of evidence. In the face of such uncertainty, an investigator might find it useful to imagine scenarios and possibilities that might substantiate the legal grounds for relief or defense that he can imagine asserting at some eventual trial. In some situations, however, it might make sense for the investigator to work the other way around — to emphasize not fine evidentiary details, but gross legal categories. For example, if an investigator has few details and the meager evidence available to him does not point specifically to particular elements of substantive legal rules, he may wish to rely on his "gut sense" of what legal rules are likely to be important "down the road" to guide his investigation of the case. In some circumstances, this approach may be an efficient strategy for hypothesizing interesting possibilities and for ruling out others.

The law-related marshalling strategies just mentioned center largely on problems that involve uncertainty about the future. However, there is another type of uncertainty associated with substantive legal rules and doctrines: to some extent, legal principles, rules, and doctrines are always vague and fuzzy. The vagueness and imprecision of legal rules might be thought to pose only a problem of theories and strategies of legal argument and legal reasoning. In fact, however, the imprecision of legal rules has important implications for evidence marshalling strategies as well. In addition, the fuzziness of substantive legal doctrine has important implications for the way that investigators and lawyers must grapple with the uncertainties associated with the dynamic character of investigation and litigation: an investigator's or lawyer's appreciation of the fuzziness of substantive legal rules can have a profound impact on the nature and extent of her uncertainty about future developments in the case.

In assessing the impact of "doctrinal fuzziness" on investigation, it is important to understand the ways in which legal rules may be "fuzzy." In an earlier article we suggested that the concept of an "equivalence class" may be a useful device for describing the relationship between legal doctrines and factual

hypotheses.[107] Our use of this concept rests on a distinction between the elements of a legal rule,[108] on the one hand, and factual hypotheses on the other. Although it is sometimes said that a party having the burden of proving a claim or defense has the burden of proving the elements of "negligence," "waiver," and similar matters, this is a loose way of talking. Like a number of legal experts,[109] we prefer to say that a party having the burden of proving the elements of a claim or defense has the burden of proving legally material facts.

There is a difference between the elements of a legal rule and the facts that establish those elements in a particular case. The elements of a legal rule — *e.g.*, "causation" or "failure to warn" — have a generic character. The elements of legal concepts such as "negligence" do not require proof of a unique set of factual circumstances; they can be satisfied by proof of a great variety of acts and events. Hence, particular acts and events instantiate rather than constitute the elements of legal claims and defenses. When the relationship between the elements of a legal theory and facts is understood this way, it is possible to use the concept of an equivalence class to describe the relationship between legal doctrines and hypotheses about states of the world.

The concept of an equivalence class originates in mathemat-

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[107] Tillers & Schum, *supra* note 25, at 956-59.

[108] There are at least two ways in which substantive legal rules may be fuzzy. First, the definition of a legal doctrine such as "conspiracy" may be in doubt. It may not be clear, for example, whether or not an "overt act" is one of the elements of "conspiracy." Although the implications of this type of fuzziness for evidence marshalling strategies during investigation are fairly apparent — *e.g.*, an investigator faces the choice of gathering or not gathering evidence pertaining to an "overt act" — the other type of fuzziness is more interesting. The meaning of a legal concept or category may be elastic. This type of fuzziness more clearly and directly implicates the question of the relationship between concepts and facts as well as the question of the implications of fuzzy decision rules for preparatory investigative activity.

[109] For example, Wigmore's analysis of the notion of "materiality" presupposes a distinction between the elements of a legal theory and the "historical" or factual events that satisfy those elements. 1 J. WIGMORE, *supra* note 62, § 2, at 15-19; *see also* H.L.A. HART, THE CONCEPT OF LAW 123 (1963) ("Particular fact-situations do not await us already marked off from each other, and labelled as instances of the general rule, the application of which is in question; nor can the rule itself step forward to claim its own instances."); A. ZUCKERMAN, THE PRINCIPLES OF CRIMINAL EVIDENCE ch. 2 (1989).

ics.[110] Formally stated, an equivalence class is the class of all outcomes that have the property that they correspond with the occurrence of some "event." The word "event" in this definition is a term of art referring not to a unique event but to a set of general conditions or circumstances embodied in a "reference class." Hence, informally stated, an equivalence class is the collection of all particular instances that satisfy the requirements of a general rule.[111] In the case of legal concepts, the number of instances in an equivalence class is practically infinite. For example, the number of factual circumstances ("outcomes") that satisfy the requirements of a general concept ("reference class") such as "manslaughter" or "waiver" is enormous. The concept of an equivalence class is a useful device for describing the impact of uncertainty in legal doctrine on other evidence marshalling strategies, and the concept of an equivalence class also brings into relief different possible strategies for reducing or coping with the uncertainty of legal rules.

One of the difficulties any investigator or lawyer faces before trial is the problem of marshalling evidence when legal doctrines are vague and uncertain. In the parlance of mathematics, such an investigator confronts fuzzy (legal) reference classes. When the definition of a reference class is fuzzy[112] or vague, there is a measure of uncertainty about the membership of any particular entity in the reference class. Moreover, if the definition of a reference class is completely vague, it is impossible to determine whether any particular event falls within or without the reference class; *i.e.*,

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[110] MILLINGTON & MILLINGTON, DICTIONARY OF MATHEMATICS 84 (1966).

[111] For example, in a game of cards there are a number of different outcomes of a card deal that satisfy, or fit within, the reference class "full house." Similarly, a legal concept such as "manslaughter" may be instantiated by a variety of factual circumstances. In the parlance of statisticians, the event "murder" can be made to occur by numerous particular states of the world. (The intersection between the language of probabilists and the language of lawyers can be confusing. In the eyes of a lawyer an "event" such as "murder" is a particular, specific state of the world whereas for a probabilist an "event" such as "murder" is more akin to a general concept. The probabilist would refer to a particular as an "outcome." A lawyer might speak of a particular murder as an instance of the general idea of murder).

[112] There is a well-known theory of fuzzy probability. *See* Zadeh, *Fuzzy Sets*, 8 INFO. & CONTROL 338 (1965). In using the word "fuzzy" in this Article we are not suggesting that fuzzy probability theory is useful in the analysis of fuzzy legal reasoning. At this time we take no position on this question.

if the definition of an "event," taken in its probabilistic sense, is completely fuzzy, it is impossible to determine whether any particular state of the world makes that "event" occur.[113]

Legal concepts such as "murder" are often vague.[114] When a legal concept is vague, there must also be uncertainty about whether a particular act or situation is an example or instance of the concept. This proposition may be rephrased in terms of the equivalence class concept: if a legal reference class such as "murder" is fuzzy, there must be uncertainty about which "outcomes" make an "event" such as "murder" occur. Stated otherwise, if the event "murder" has an ambiguous definition, there will always be uncertainty about whether any particular state of affairs does or does not constitute, or instantiate, murder.

If we visualize the relationship between legal reasoning and factual issues in litigation against this conceptual background, it seems natural to think that when the ambiguity of a legal concept (*e.g.*, "undue influence") impedes or hinders an attempt to use a legal concept to marshall evidence, the proper remedy is to clarify the legal reference class. This way of grappling with the unsettling effects of uncertainty in the law on the marshalling of evidence is a top-down process — the uncertainty in the law is addressed before the law is used to marshal evidence. Yet, once the relationship between fuzzy legal concepts and particular instances is formulated in these terms — as a top-down process — almost any lawyer trained in the common law tradition will recognize that this is not the only possible way that generic legal concepts and specific instances are related. She will see that legal reasoning involving fuzzy legal doctrines may work in reverse. That is, instead of trying to clarify a legal concept before applying it to particular situations, a judge or lawyer may examine particular situations (*e.g.*, in prior cases) that admittedly or apparently constitute instances of a particular legal concept, such as "murder," and try to use those instances to formulate or reformulate the definition of the concept.[115]

In noting the differences between top-down and bottom-up

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[113] For example, if the reference class "justice" means anything and everything, there is no way to decide whether any particular state of affairs in the world is or is not an example of "justice."

[114] Indeed, all legal concepts are vague to some degree.

[115] Perhaps a bottom-up process, rather than a top-down process, is the one that legal theorists such as Edward Levi favored. *See* E. LEVI, AN INTRODUCTION TO LEGAL REASONING (1949).

responses to legal uncertainty, we do not answer the question of which of these two general approaches is the appropriate one or which of them is more often used. Moreover, our distinction between two types of responses to legal uncertainty is not intended to be an exhaustive taxonomy of modes of reasoning that address uncertainty in the law.[116] Our objective is to describe an heuristic strategy that people such as investigators and lawyers can use to organize their thinking about a case. We have accomplished something important if we have shown that the concept of an equivalence class facilitates analysis of the evidentiary and investigative implications of top-down and bottom-up approaches to legal uncertainty. Moreover, our analysis of the implications of two types of responses to legal uncertainty ought to suggest that careful study of the relationship between facts and other types of legal responses is warranted. The question of the evidentiary implications of different modes of legal reasoning is an important topic.

II. Granular Analysis of Marshalling Systems

In the previous Part of the Article, we surveyed some of the heuristic functions of legal marshalling. We have not yet expressly considered a form of legal marshalling that involves a "case theory." A case theory is an unusually complex method of marshalling evidence, because a case theory incorporates several distinct marshalling techniques. Before examining the notion of a case theory,[117] we will first consider in more detail several marshalling strategies that are embedded in, and intrinsic to, case theories.

Our study concerns factual proof in litigation. Many general discussions of evidentiary processes in litigation focus on analysis of the impact available and known evidence has on an identifiable

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[116] Theories of legal reasoning abound. *See, e.g.*, S. Burton, An Introduction to Law and Legal Reasoning (1985) (legal argument has a definable logical structure but specific conclusions are not logically determined); N. MacCormick, Legal Reasoning and Legal Theory (1978) (arguing for possibility of deductive legal argument); Ross, *Tû-Tû*, 70 Harv. L. Rev. 812, 818 (1957) (arguing that legal concepts are "nothing at all . . . merely . . . empty word[s] . . . semantic reference[s]" for particular states of affairs); Simpson, *The Analysis of Legal Concepts*, 80 L.Q. Rev. 535 (1964) (criticizing Ross); *see also* Tillers, *supra* note 104 (arguing that there can be "evidence" for interpretation of law).

[117] *See infra* Section II(C)(3).

and identified factual hypotheses. This type of analysis, which we call "relational analysis,"[118] is not the primary focus here.[119] In preliminary fact investigation the investigator knows that she does not yet have all of the relevant evidence that she may later acquire. Ordinarily she has not yet identified the factual issues to her satisfaction. Moreover, the task of assessing the force of evidence is relatively less prominent during investigation than at trial.[120] Our detailed analysis of marshalling strategies begins with a discussion of the formation and specification of issues and hypotheses. The framing of hypotheses is particularly important in exploratory investigation.

A. Determining Possibilities and Framing Issues

When a lawyer or other actor in litigation first encounters information suggestive of a possible lawsuit, he may anticipate having problems of proof if litigation ensues. If the lawyer does think ahead about such possible problems, however, he is likely to have only a fairly vague sense of what those problems may turn out to be. The potential proof problems he sees ahead are likely to be ill-defined.[121]

The poor definition of the problems that an investigator faces at the outset of an investigation raises a variety of interesting and important issues. For example, how do and how should actors in litigation cope with fuzzy problems during investigation? Why is it important to make factual issues specific? And if it is important to frame problems of evidence, inference, and proof in a discrete and specific way by the time a trial eventuates, is it important to be specific long before trial, in the early stages of investigation? If so, how is that to be done in an efficient manner?

Imagine yourself a detective in a metropolitan police force in

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[118] *See* Tillers & Schum, *supra* note 25, at 943.

[119] Indeed, in this Article we have no discussion of methods for gauging the degree of the probative force of evidence on material facts in issue.

[120] It cannot be said, however, that assessments of the force of evidence are immaterial during investigation. Decisions about the direction of an investigation are, and should be, affected by assessments of the strength of available and expected evidence.

[121] This consequence is partly, but not entirely, a function of the limited amount of information available to the lawyer at the outset. There is not yet enough information, either factual or legal, to give the problem a more precise structure or definition.

the United States.[122] On December 8, 1987, you learn that the body of a white male has been found in a garage attached to a home in Falls Church, Virginia. You learn that the body was found lying on a floor between two cars and that the hood of one car was open. You have been told that there were deep lacerations in the head of the deceased.

How might you think about this information?

You might entertain the hypothesis that the deceased — whom we shall call Mark Vincent — died as a result of someone's criminal act. Given the limited and ambiguous nature of the information available to you, however, you might also entertain other hypotheses. You might, for example, entertain the hypotheses that Mark Vincent's death was accidental, that Mark Vincent died as a result of natural causes, or that he committed suicide.

These hypotheses are relatively diffuse, vague, coarse, or undifferentiated. The evidence does not seem to suggest any hypotheses about the precise sort of criminal act that might have caused Mark Vincent's death. Alternatively, if you are willing to speculate that a homicide took place, the evidence does not seem to support any guesses about the grade of any homicide that might have been committed. Similarly, if the evidence suggests the possibility of a suicide, the evidence does not seem to suggest how Mark Vincent might have done himself in.

Glenn Shafer has suggested a way of thinking about conjectures and hypotheses that are suggested by evidence.[123] He refers to different sets of possible hypotheses, or outcomes, as "frames of discernment."[124] In Shafer's terminology, the set of conjectures we have ascribed to you — our hypothetical police detective — is a frame of discernment. Your frame — the frame of our hypothetical police investigator — consists of all the hypotheses about Mark Vincent's death that you happen to entertain.[125]

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[122] This example and other examples in this Article are drawn from an extended simulation conducted by the authors. The full details of the simulation are given in D. SCHUM & P. TILLERS, MARSHALLING EVIDENCE THROUGHOUT THE PROCESS OF FACT-INVESTIGATION: A SIMULATION (pts. 1-4) (1989) (copy on file with U.C. Davis Law Review).

[123] G. SHAFER, A MATHEMATICAL THEORY OF EVIDENCE (1976).

[124] *Id.* at 114-40, 172-95, 274-86.

[125] Glenn Shafer emphasizes the importance of the "construction" of probability arguments and he has emphasized how, from a formal point of view, it makes quite a difference how one formulates the possibilities or, in fancier parlance, how one partitions the "sample space" or, to say the same

We shall refer to your first frame as F_1 and we stipulate that it consists of the possible outcomes (1) death by natural causes, (2) death by accident, (3) death by suicide, and (4) death by criminal act. This frame may be represented thus:

$$F_1 = \{\text{natural causes, accident, suicide, criminal act}\}$$

Now suppose that you, the detective, acquire some additional morsels of information. You have some evidence that Mark Vincent's sister, Marsha Vincent, was in the residence adjacent to the garage on the day of Mark Vincent's death. Under these circumstances you might entertain a slightly different set of tentative hypotheses, conjectures, or possibilities. (Expressed in terms of probability theory, you might now partition the sample space in a different way.) Your new list of possibilities, which constitute another frame of discernment F_2, might now look like this:

$$F_2 = \{\text{natural causes, accident, suicide,}$$
$$\text{Marsha did it, someone else did it}\}$$

This frame is somewhat more specific and somewhat more differentiated because the hypothesis of death by criminal act has been divided into two hypotheses, one of which focuses on a particular person, Marsha Vincent.

It is of course possible that the police detective has a different set of conjectures. He might rule out death by natural causes. If so, his collection of hypotheses might look like this:

$$F_3 = \{\text{accident, suicide, criminal act}\}$$

The possibilities in this frame are as coarse as in the first frame. However, the frame now contains fewer possibilities.

Shafer speaks of these sets of possible outcomes as frames of discernment because he maintains that differences in the possibilities or hypotheses a person entertains generate differences in the way that information and data are partitioned. As different questions or hypotheses are asked or put, the available evidence sorts itself out, or is sorted out, in different ways.

Shafer's insight that there is a relationship between the structure of hypotheses and evidence is very important. The notion of a frame of discernment implies that the relevance of evidence depends on the nature of the hypotheses or conjectures "in the case." It illustrates the familiar and common sense point that the

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thing, how one specifies the possible outcomes to which probabilities are to be assigned. *See, e.g.*, Shafer, *The Construction of Probability Arguments*, 66 B.U.L. Rev. 799 (1986).

pertinence and relevance of information is in part a function of the question or questions that one asks or wishes to answer. This basic insight is crucial. Unlike most probabilistic perspectives on evidence and inference, Shafer's theory speaks to the process of inquiry.[126] This is because Shafer examines the formation of factual hypotheses, not just the question of how existing factual issues are to be resolved.[127]

Shafer makes a variety of useful observations about the influence of evidence on the formation of factual hypotheses. Shafer observes that hypotheses, conjectures, and "possibilities" vary in their degree of differentiation. Some hypotheses are relatively coarse or diffuse while other hypotheses are relatively differentiated and specific.[128] The fact that the specificity of hypotheses can vary has two important implications. First, since the relevance of evidence is a function of the nature of the hypotheses or conjectures posited, the relevance of evidence varies as the specificity of the hypotheses varies.[129] Second, the relative specificity of a frame of possibilities is a function of the available evidence. Shafer maintains that as evidence accumulates, a frame and the possibilities within it tend to become more specific.[130] Shafer illustrates this point with "The Case of the Missing Cookie."[131]

Sally and Billy are two children. One morning their mother notices that there is only one cookie left in the cookie jar. Later that morning she notices that the cookie is no longer there. She

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[126] However, Shafer's theory perhaps does not speak to "investigation," which connotes the process of gathering evidence as well as the process of deciding what evidence to gather.

[127] Both traditional and modern evidence scholarship focuses on the relevance and probative force of evidence on already-specified issues. At a theoretical level, this produces an emphasis on "relational analysis." *See supra* notes 25, 26 and accompanying text.

[128] *See, e.g.*, G. SHAFER, *supra* note 123, ch. 6; *cf.* Shafer, *supra* note 125, at 809-15 (illustrating how more inclusive likelihood ratios are generated as more evidentiary details are taken into account).

[129] This thesis pervades the entire argument made by Shafer in G. SHAFER, *supra* note 123. The thesis that the relevance of evidence is a function of the possibilities discerned is perhaps stated most directly in *id.* ch. 6.

[130] *See, e.g., id.* at 36 ("It should not be thought that the 'possibilities' that comprise . . . [a set of possibilities] will be determined and meaningful independently of our knowledge. Quite to the contrary: [the set] . . . will acquire its meaning from what we know or think we know . . . .").

[131] G. SHAFER, THE PROBLEM OF DEPENDENT EVIDENCE 5 (Sch. of Business, Univ. of Kansas, Working Paper No. 164, 1984).

shouts, "Who took the last cookie?" Billy answers, "I saw Sally take it." The mother rushes to Sally's room and finds cookie crumbs there. This evidence suggests that Sally was the miscreant, but it does not convince the mother of Sally's guilt. Hence, Sally's mother entertains two possibilities, "Sally Did It" and "Sally Didn't Do It." In Shafer's terminology these two possibilities make out a "frame" and they may be represented in the following way:

$$F_A = \{\text{Sally Did It, Sally Didn't Do It}\}$$

As the mother ponders these alternative possibilities, it seems to her that two separate pieces of evidence support the possibility "Sally Did It;" Billy's accusation does so, but so does the cookie crumb evidence. Hence, even if Billy is being untruthful and did not see Sally take the cookie, the cookie crumb evidence still supports the hypothesis that Sally took the cookie. As the mother ponders further, however, it occurs to her that it is possible that Billy ate the cookie and planted the cookie crumbs in Sally's room.

Shafer argues that the way the mother originally framed the possibilities is no longer satisfactory. The mother originally believed that two pieces of evidence point to Sally as the miscreant. However, if it is possible that Billy planted the cookie crumbs, the possibility that Billy was being untruthful affects the probative value of the cookie crumb evidence as well as the probative value of Billy's accusation.[132] Given this relationship between the two pieces of evidence, it is necessary for the mother to reformulate or restructure the problem of the missing cookie. Shafer argues that if she wants to think about the problem clearly, she must construct a new and more refined frame that takes into account the possibility that Billy planted the cookie crumbs.[133] Figure 3 describes the possibilities she now sees.

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[132] Stated in the parlance of probability theory, the difficulty is that the two pieces of evidence are not independent with respect to the possibilities in Frame F_A.

[133] G. Shafer, *supra* note 131.

FIGURE 3

Frame F_A	{ Sally Did It		Sally Didn't Do It}	
Frame F_B	Sally did and Billy saw her	Sally did and Billy didn't see her	Sally didn't and Billy dropped the crumbs deliberately	Sally didn't and Billy didn't drop the crumbs deliberately
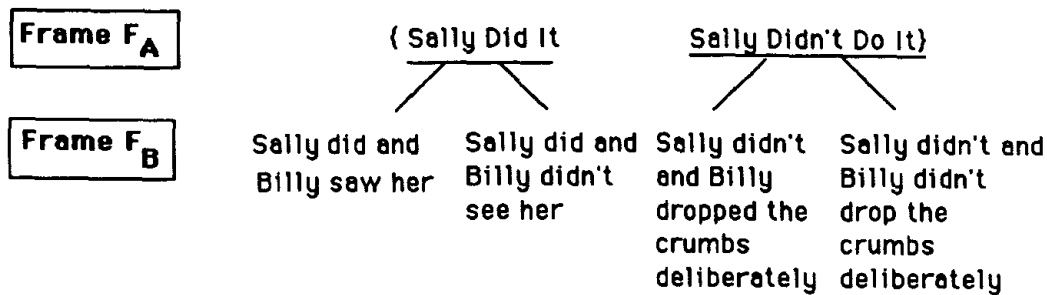
The new frame F_B is more refined, less coarse, and more differentiated than frame F_A. Yet, Frame F_A can be differentiated in various ways. Moreover, it may be differentiated to a greater degree. For example, if Sally's and Billy's mother notices that there are other children in the house — friends of Billy and Sally who have come over to play — she may wish to consider a variety of new hypotheses about the reason for the missing cookie. For example, she may decide that it is possible that neither Sally nor Billy took the missing cookie. It is possible that Sally joined with one, or more, of the visiting children in taking the missing cookie, and that Billy and a visitor, or visitors, acted in concert. It may now also occur to the mother that Billy and Sally might have acted in concert. She might entertain this possibility, together with the possibility that Sally acted alone and the possibility that Billy acted alone. This new set of possibilities, greater in number and more differentiated than those in F_B, is represented in Figure 4.

FIGURE 4

Frame F_A	{ Sally Did It			Sally Didn't Do It}		
Frame F_{B^*}	S did it alone	S & B did it together	S and someone else did it	B did it alone	B and someone else [not Sally] did it	Neither S nor B did it
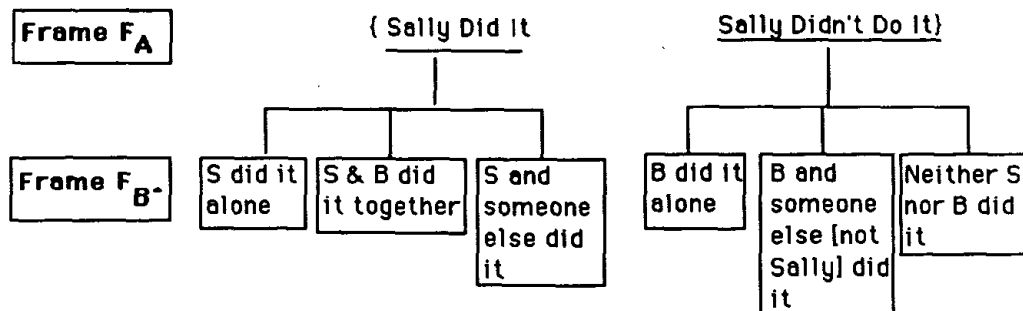
Notice that F_{B^*}, like F_B, is consistent with F_A. Moreover, F_{B^*} and F_B, we have supposed, were formed after F_A was formed. However, the process can also work in reverse; a relatively richer frame such as F_B can be abandoned (because, for example, it is discovered that Billy was not in a position to plant cookies in

Sally's room), thus restoring the primacy of a more general frame, such as F_A.

There are multiple messages in "The Case of the Missing Cookie." First, the specificity of frames can vary. Second, the specificity of a frame is related to the nature of the available evidence. Third, frames can be refined and made more specific. Fourth, the frames can be made more specific in different ways. Another possible lesson is that the frames can be coarsened as well as refined. These propositions shed a great deal of light on investigative strategy.

Shafer's argument about how the mother in the cookie case refines her possibilities suggests that extremely coarse hypotheses are generally of little value to an investigator. For example, suppose that the frame concerning Mark Vincent's death consists of the possibilities: (1) Mark Vincent died unfairly, and (2) Mark Vincent did not die unfairly. The possibilities in this frame are not sharp; they are relatively undifferentiated. They are also of little value to an investigator because they do not serve to sort out potentially interesting items of evidence in any very specific or discrete way. Indeed, the possibilities in the frame are so coarse that they give little if any indication of what sort of evidence might serve to confirm or repudiate them. We might say that this frame does not serve to partition any evidence we might happen to acquire.[134] Hence, this frame of coarse possibilities gives almost no guidance or instruction to an investigator.

Specific hypotheses, by contrast, are excellent indicators of important evidence. Specific hypotheses focus attention on particular types and items of evidence. Their specificity is suggestive of the specific items of evidence that are relevant to the assessment of the hypotheses under consideration. For example, suppose that you — the police detective — seriously entertain the hypothesis that Marsha Vincent deliberately stabbed Mark Vincent in the head with a screwdriver at 3:01 a.m. in the garage

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[134] Shafer's general thesis about the importance of frames of discernment in the construction of probability arguments is related to the debate about the alleged theory-dependence of evidence. Shafer's point of view, however, is not the same as those who argue that evidence is a function of theory. While Shafer agrees that the significance of evidence is related to the hypotheses under consideration, Shafer also believes that evidence shapes hypotheses. *See supra* note 130. Shafer's unique contribution consists of his detailed and precise account of how evidence may influence the formation of hypotheses.

because she became angry about his animosity toward Harriet Jones. This hypothesis or possibility is highly differentiated or particularized. It is also suggestive of the types of evidence that might be of interest to you. For example, it suggests that (1) an interview with Harriet Jones might produce highly significant evidence, (2) you might wish to ask Marsha about her feelings toward Harriet, (3) you should attempt to establish that Marsha was home before 3:01 a.m., and so on.

The highly specific hypothesis also imparts a very different lesson. It demonstrates that specificity in conjectures and hypotheses is not always a virtue. Even if highly differentiated and specific hypotheses indicate more precisely how they may be verified or disconfirmed, it does not follow that investigators should always formulate highly differentiated hypotheses. As the Mark Vincent problem suggests, highly differentiated hypotheses may be of little value if they "outrun" the available evidence.[135] For example, there is little if anything in the evidence recited earlier that supports the conjecture that the homicide (if one took place) was committed at 3:01 a.m. rather than at 3:02 a.m. The precision of this conjecture outruns the evidence.[136] A rational investigator

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[135] However, in our view — if perhaps not in Shafer's — hypotheses that outrun the evidence, that is that contain conjectures not directly supported by the evidence, sometimes do have heuristic value. *See infra* notes 141, 148-49.

[136] The problem of excessive specificity is not overcome if the detective decides to construct, not one or two differentiated homicide hypotheses, but a mass of differentiated homicide hypotheses that exhaust (pretty much, at least) every possible way that a homicide might have occurred (assuming that a homicide occurred). Suppose the detective uses only two variables — the time of the killing and the identity of the killer — to construct a (relatively) exhaustive set of differentiated homicide hypotheses. It is easy to see that the detective would have to formulate an enormous number of distinct homicide hypotheses. For example, if the detective limited herself to one 24-hour period and distinguished homicide hypotheses on the basis of the minute when the death occurred, she would generate 1440 distinct homicide possibilities. Moreover, if the detective assumed that anyone in the Washington, D.C., metropolitan area might have been the killer, the number of distinct homicide hypotheses would be vastly greater. If the adult population in the D.C. area were 3,000,000, the number of distinct homicide hypotheses would have to equal 1440 x 3,000,000, or more than four billion hypotheses. Hence, it seems clear that differentiated sets of hypotheses and conjectures are not always better than coarser and more diffuse hypotheses.

will sometimes decide not to refine her hypotheses, but to make them more coarse and diffuse.

The difficulty with constructing differentiated hypotheses that outstrip the evidence is partly economic. It would be much, much too expensive and time-consuming to give equal dignity to all of the discrete hypotheses that could be imagined by an investigator who feels free to invent possibilities without any reference to the available evidence. The costs associated with simply inventing and recording such possibilities — not to speak of the costs associated with actually gathering evidence about all of them — would very quickly exceed the gross world product.[137]

The difficulty posed by rampant multiplication of distinct homicide hypotheses, however, is not entirely economic; it also violates the virtue of cognitive parsimony. One objective of formulating conjectures and hypotheses is to facilitate analysis of possible courses of investigation (and, ultimately, possible courses of proof activity at trial). In the investigative situation we have just hypothesized, one can imagine little reason for the particular method used to generate specific hypotheses. For example, there is no apparent reason to distinguish homicide conjectures on the basis of the exact minute they might have been committed. For all that appears, distinctions on the basis of hours or days would have served equally well. Hence, there is no particular reason to think that differentiating homicide hypotheses on the basis of the minute of the killing or on the basis of the identity of the killer will produce any cognitive benefits; ruder distinctions, it appears, would do as well. Indeed, given the available evidence, the variable of the identity of the killer might well be omitted altogether.[138] In short, the precision of the possibilities is excessive and spurious and the frame it generates is cognitively unparsimonious.

If it is true that one cause of waste of cognitive resources is the absence of evidential support for possibilities, what is an investi-

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[137] Our theory of investigative discovery does not address the relationship of real-world resources and investigation. Our focus is on cognitive parsimony and productivity. We may address more traditional forms of economic analysis in the next phase of our research.
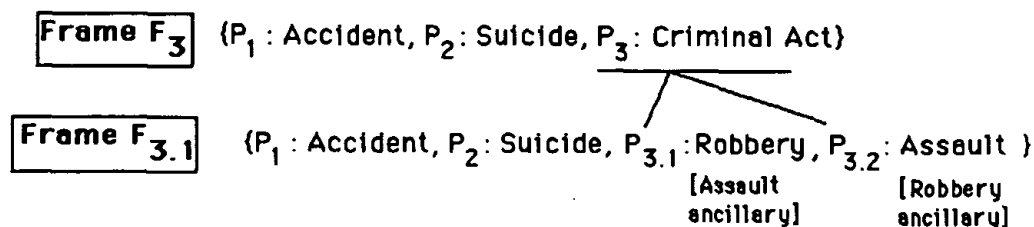
[138] Adverse resource implications result from this analytical failure but one of the causes of the resource difficulties is of a cognitive, analytical sort. That is, not only is the amount of investigation required enormous, but the mental structuring of the problem, which gives rise to the demands on resources, is itself not efficient or parsimonious.

gator to do when the evidence available to him fails to suggest any possibilities except hopelessly coarse ones? It is safe to say that the concept of frames of discernment offers little if any help to an investigator in this situation. This does not mean that the refinement of possibilities is of no value during exploratory investigation. Even small collections of details may suggest relatively differentiated possibilities, and Shafer's procedure has considerable heuristic value when some possibilities begin to emerge from the evidence at hand.

The Case of the Missing Cookie illustrates Shafer's thesis that evidence serves to refine hypotheses. By this he means that evidence itself suggests various possibilities and evidence gets incorporated in hypotheses. This is why we say that Shafer refuses to permit possibilities to outrun the evidence. Shafer describes a procedure for incorporating evidence into hypotheses.[139] To illustrate how Shafer's technique works we will now add a few details to the detective's information base.

Suppose, first, that the detective searched Mark's body, the garage, and the adjacent house, and she did not find Mark Vincent's wallet. Suppose, further, that evidence suggests that Mark Vincent and Marsha Vincent stopped to cash a check for $200 shortly before Mark and Marsha went home the night before Mark's death. This new information suggests a new possibility: Mark's death occurred in the course of a robbery. If we take F_3 as the basic frame, this new possibility of robbery generates a new frame, which we shall call $F_{3.1}$. Figure 5 shows the relationship of this new frame to the basic frame F_3.

FIGURE 5

$\boxed{\text{Frame } F_3}$ {P_1 : Accident, P_2 : Suicide, P_3 : Criminal Act}

$\boxed{\text{Frame } F_{3.1}}$ {P_1 : Accident, P_2 : Suicide, $P_{3.1}$: Robbery, $P_{3.2}$: Assault }
                               [Assault   [Robbery
                                ancillary]   ancillary]

Now add some more information to the pot. Specifically, after a further search Mark's wallet is found in a bush directly adjacent to the garage in which Mark's body was found. There is no money in it, however, and even though it is known that Mark usu-

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[139] G. SHAFER, *supra* note 123, ch. 6.

ally carried credit cards, there are also no credit cards in the wallet. Moreover, the search uncovers an Anacin box in the vicinity of Mark's body. The Anacin box may contain traces of cocaine. Furthermore, the investigator discovers that Mark Vincent had been seeing a woman called Monica Carlson, the wife of Richard Carlson, and that Richard Carlson's van had been seen in the vicinity of Mark's house the night of Mark's death. Finally, the investigator discovers that Mark and Marsha, who were brother and sister, were joint owners of a computer company.

This new information again suggests the possibility of a robbery, but this time it may also suggest the possibility that the robbery was ancillary to an assault, motivated either by Carlson's possible jealousy, by a sour narcotics deal, or by the desire of Marsha to harm Mark to get his share of the computer company for herself. If we add these possibilities to the pot, we get this sort of picture:

FIGURE 6

Frame 3.2

$\{P_1 : \text{Accident}, P_2 : \text{Suicide}, P_{3.1} : \text{Robbery}, P_{3.2} : \text{Assault}\}$

[Assault ancillary]   [Robbery ancillary]

$P_{3.2.1}$ Carlson Jealousy $P_{3.2.2}$ Narcotics $P_{3.2.3}$ Marsha
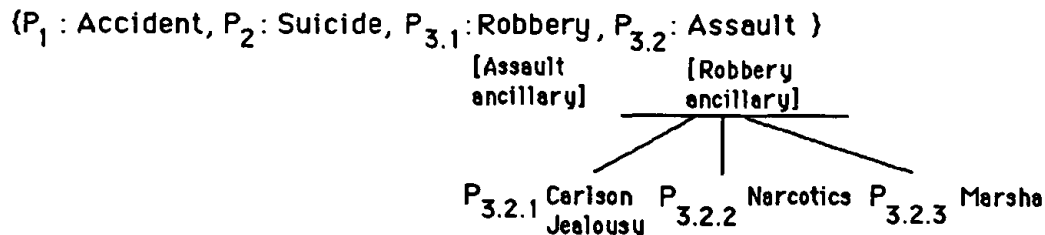
In addition, the facts recited suggest another possible variation on frame F_3. It is possible that there was an assault on Mark Vincent, but no robbery. If so, the new frame now may look like this:

FIGURE 7

Frame 3.3

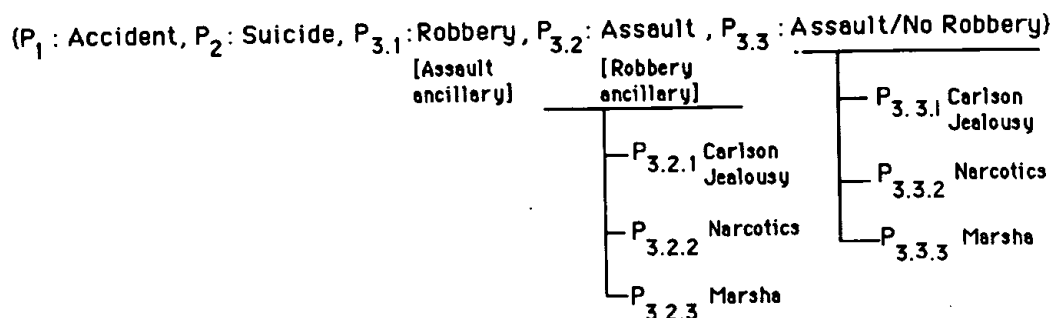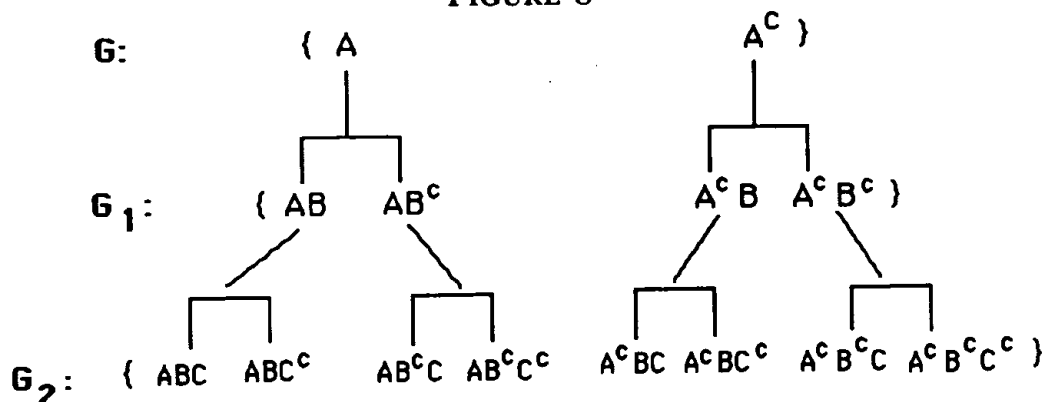$(P_1$: Accident, P_2: Suicide, $P_{3.1}$:Robbery, $P_{3.2}$: Assault , $P_{3.3}$: Assault/No Robbery)

[Assault   [Robbery
ancillary]   ancillary]

$P_{3.2.1}$ Carlson Jealousy $P_{3.3.1}$ Carlson Jealousy

$P_{3.2.2}$ Narcotics $P_{3.3.2}$ Narcotics

$P_{3.2.3}$ Marsha $P_{3.3.3}$ Marsha

It is now becoming apparent, we trust, that the process of refining frames of possibilities may generate disadvantages as well as advantages. We have already described why disadvantages may accrue if an investigator allows her hypotheses to outstrip the available evidence. The tactic of refining possibilities, however, can cause difficulty even if all of the possibilities are suggested by the available evidence. The illustrations we have given of the process of refinement show that possibilities are extracted by a branching, tree-like procedure. Figure 8 shows one abstraction of the refinement process.

FIGURE 8

G: { A A^c }

G_1:   { AB AB^c $A^c B$ $A^c B^c$ }

G_2:   { ABC ABC^c $AB^c C$ $AB^c C^c$ $A^c BC$ $A^c BC^c$ $A^c B^c C$ $A^c B^c C^c$ }

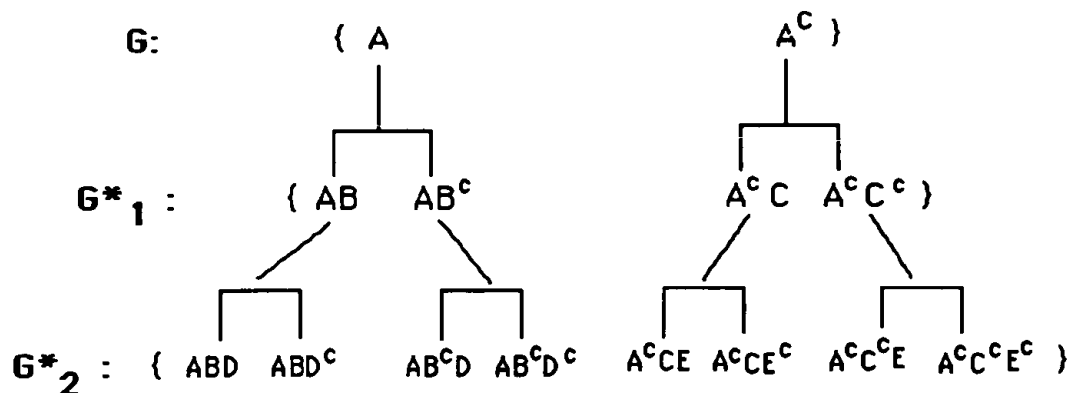The initial frame G shows two possibilities, $\{A, A^c\}$. (Read A^c as "not A.") These possibilities are embellished in frame G_1 because the occurrence or nonoccurrence of B is now considered. Thus, one possibility now is AB^c, A happened and B did not happen. In Frame G_2 the possibilities are further embellished by consideration of the occurrence C.

There is an entailment relationship among these three levels of

refinement. For example, ABC → AB → A. (Read "→" as "implies.") That is to say, if A and B and C happened, then A and B necessarily happened, and if A and B happened, then A necessarily happened. This logical point is quite important for present purposes because it means that all of the possibilities in the lower frames are compatible with the possibilities in the higher frames; there is no contradiction between the possibilities in the different frames.

The compatibility of lower frames with frames higher up means that possibilities can easily be expanded without limit and without fear of producing any contradiction with the initial frame. The refinement process shown in Figure 8 is just a special case of the process of producing compatible refinements. If S is the universe of all possibilities, frame G is simply a partition of all of these possibilities in terms of $\{A, A^c\}$; frame G_1 is just another partition of S when $\{B, B^c\}$ are considered; and frame G_2 results when $\{C, C^c\}$ are considered. In addition, new frames can be generated at will, and to any level, simply by increasing the number of single events in joint events (*i.e.*, A & B & C & D & . . . N), together with the complements of those single events. Moreover, different sets of compatible refinements can be generated by selecting joint events consisting of different single events. For example, Figure 9 shows another set of refinements, different from those in Figure 8, but also compatible with frame G.

FIGURE 9

G: { A A^c }

G^*_1 :   { AB AB^c A^c C $A^c C^c$ }

G^*_2 :   { ABD ABD^c $AB^c D$ $AB^c D^c$ $A^c CE$ $A^c CE^c$ $A^c C^c E$ $A^c C^c E^c$ }

We need not describe this tree-like refinement process any further. It is evident that the refinement strategy can generate a vast number of possibilities and that it can do so even without the possibilities outstripping the evidence. While it is possible that a real-world investigator who is attempting to make sense of the information available to her might make conscious use of only a

possibilities strategy, it is very unlikely that the possibilities marshalling strategy can fully explain how any real-world investigator conducts a real-world investigation. Since the possibilities strategy is a tree-like hierarchical process, the number of possibilities directly indicated by evidence can multiply rapidly. Indeed, if the possibilities branch out symmetrically, the number of possibilities increases exponentially at each additional level of branches. Consequently, if the tree metaphor correctly describes the manner in which evidence generates possibilities, the strategy of refining possibilities can generate millions or billions of possibilities even if there has been only little investigation and the number of details collected is small.

Ordinarily it is not useful to formulate millions or billions of possibilities. There are, of course, considerable logistical problems and resource allocation problems associated with any investigative process that generates this many possibilities for serious consideration and investigation. Another kind of cost may be associated with numerous possibilities: even if an investigator has all the time and resources in the world at her command, she will not wish to scan all refined possibilities that the evidence suggests. It is not cognitively fruitful to consider all the possibilities suggested by the evidence.

It is fair to infer that any real-world investigator — particularly a mortal investigator having limited resources — must and will prune the possibilities tree of many of its limbs and branches. If an investigator prunes branches from a possibility tree, however, while leaving others intact, it is clear that some sort of cognitive process apart from possibilities analysis is at work in her brain, telling her that some possibilities should be eliminated and others retained. Something is telling the investigator that some possibilities are interesting while others are not. If this process of selective pruning of possibilities is effable rather than ineffable, it follows that the investigator who prunes possibilities trees is using one or more marshalling strategies that, although making an imprint on Shaferean marshalling, are not captured, or portrayed, by Shaferean formalizations.

The remainder of this Part of the Article will examine in detail several of the other marshalling strategies that may interact with the Shaferean possibilities marshalling strategy that we have just described. Yet, instead of emphasizing how various marshalling strategies can reduce the number of possibilities, we will generally emphasize how marshalling strategies can expand the number

of possibilities to be considered.[140]

B. *Possibilities and Imaginative Reasoning*

1. Possibilities and Abduction

A marshalling system based on Shaferean possibilities tends to emphasize the importance of framing hypotheses that incorporate the possibilities disclosed and supported by available evidence. In this Part of the Article we view the relationship between hypotheses and evidence in a rather different way: we stress the importance of having hypotheses, conjectures, and possibilities that outstrip and outrun the available evidence. The Shaferean perspective is rooted in common sense; there are clearly risks in forming hypotheses that outstrip the available evidence. However, there are also grave dangers if possibilities analysis is the only strategy used to marshall evidence.[141] The Shaferean perspective on hypothesis formation, by stressing the isomorphism between evidence and hypothesis, understates the importance of invention in hypothesis formation.

Among the most important contributions made by the cantankerous American theorist Charles Saunders Peirce were his discus-

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[140] It is true that it is unfruitful to form and consider an excessive number of possibilities, but it is also true that multiplication of possibilities is sometimes a cognitively productive strategy. Much depends on the nature of the possibilities that are "in the picture" because not all possibilities are equally valuable in generating further evidence.

[141] By suggesting that other marshalling strategies (e.g., scenario analysis) influence possibilities structuring, we are not making an imperialistic claim that other methods of structuring are superior to possibilities analysis. The marshalling strategies we are about to discuss complement rather than displace possibilities analysis. Hence, while it is true that scenario analysis and other formalizations capture features of investigation that elude Shaferean analysis, it is also true that Shaferean analysis captures features of investigation that elude other forms of analysis and structuring. Moreover, we are not just trying to be charitable to Glenn Shafer. A central theoretical underpinning for our entire research project is the thesis that a variety of logics is necessary to portray the process of judicial proof. *See* D. SCHUM, *Research on the Marshalling of Evidence and Structuring of Argument*, in OPERATIONS RESEARCH AND ARTIFICIAL INTELLIGENCE: THE INTEGRATION OF PROBLEM SOLVING STRATEGIES (D. Brown ed.) (forthcoming); *see also* Tillers, *supra* note 46, at 887-91. Hence, the discussion below of matters such as scenario analysis is as much designed to vindicate the general thesis of the importance of using a variety of logics as to vindicate the value of any specific marshalling strategy such as scenario analysis.

sions of the nature of imaginative and creative processes.[142] In Peirce's day it was fashionable to say that scientific investigation involves two types of reasoning processes, deduction and induction.[143] Peirce's contemporaries — many of whom were steeped in Mill's theory of scientific method — generally portrayed both deductive and inductive reasoning as rule-based processes.[144] While Peirce did not deny that rule-based inductive reasoning is important in scientific investigation, he did insist that imaginative reasoning — a type of reasoning that produces outcomes that are not determined by pre-existing rules — also plays a crucial role. According to Peirce, imaginative reasoning cannot be subsumed under deduction or induction, but rather is a third category of reasoning, distinct from both deduction and induction. He called this third form of reasoning abduction.[145]

The concept of abduction is a useful device for thinking about the relationship between possibilities and scenarios, and it also helps to explain why possibilities analysis cannot always stand alone. Return to the Mark Vincent hypothetical. Recall that one collection of the evidence in the case supports the possibilities, captured in Frame 3.3, which look like this:

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142 *See, e.g.*, PEIRCE, COLLECTED PAPERS OF CHARLES SAUNDERS PEIRCE (C. Hartshorne, P. Weiss & A. Burke eds. 1931-58).

143 *See, e.g.*, A. SIDGWICK, FALLACIES: A VIEW OF LOGIC FROM THE PRACTICAL SIDE 212 (1883).

144 *See* J. MILL, A SYSTEM OF LOGIC—RATIOCINATIVE AND INDUCTIVE (8th ed. reprint Longmans Green & Co. 1952). See discussions of Mill's theory in A. BURKS, CHANCE, CAUSE, REASON: AN INQUIRY INTO THE NATURE OF SCIENTIFIC EVIDENCE 102 (1977); J. CARNEY & R. SCHEER, FUNDAMENTALS OF LOGIC 355-56 (2d ed. 1974); L. COHEN, A PREFACE TO LOGIC 20-21 (1944); M. POLANYI, PERSONAL KNOWLEDGE 167, 270-71 (1958); I. SCHEFFLER, *supra* note 62, at 22-24, 76, 79, 295-97, 304-05.

145 *See* N. RESCHER, PEIRCE'S PHILOSOPHY OF SCIENCE 41-51 (1978); THE SIGN OF THREE: DUPIN, HOLMES, PEIRCE (U. Eco & T. Sebrok eds. 1983).

FIGURE 7

Frame 3.3

(P$_1$: Accident, P$_2$: Suicide, P$_{3.1}$:Robbery, P$_{3.2}$: Assault , P$_{3.3}$: Assault/No Robbery)

[Assault   [Robbery
ancillary]   ancillary]

─ P$_{3.3.1}$ Carlson
               Jealousy

─P$_{3.2.1}$ Carlson
            Jealousy

─ P$_{3.3.2}$ Narcotics

─P$_{3.2.2}$ Narcotics

─P$_{3.3.3}$ Marsha

─P$_{3.2.3}$ Marsha
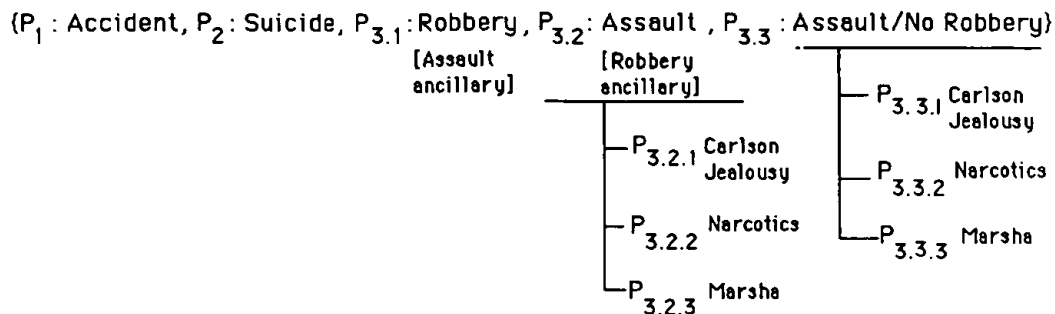
In verbal terms, the possibilities portrayed in the above diagram are the following:
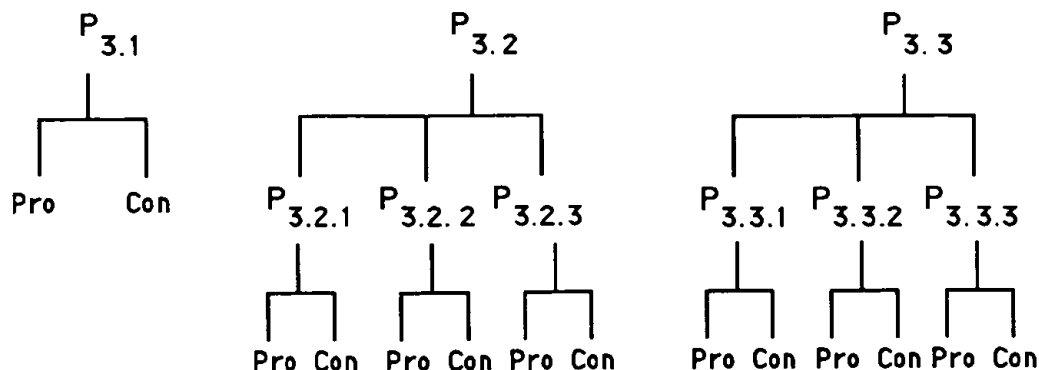
1. Mark Vincent was killed as a result of an assault that was incidental to a robbery. The evidence of Vincent's empty wallet supports this possibility.

2. Mark Vincent was killed incidental to an assault that was made to look like a robbery. The evidence that a person was at the scene of the crime after the ambulance removed the body and that the wallet was not found before the ambulance removed the body supports this possibility.

3. Mark Vincent was killed during an assault. Mark Vincent lost the empty wallet at some other time or was robbed at another time by another person.

Now consider Figure 10.

FIGURE 10

P$_{3.1}$ P$_{3.2}$ P$_{3.3}$

Pro   Con   P$_{3.2.1}$ P$_{3.2.2}$ P$_{3.2.3}$ P$_{3.3.1}$ P$_{3.3.2}$ P$_{3.3.3}$

Pro Con Pro Con Pro Con   Pro Con Pro Con Pro Con
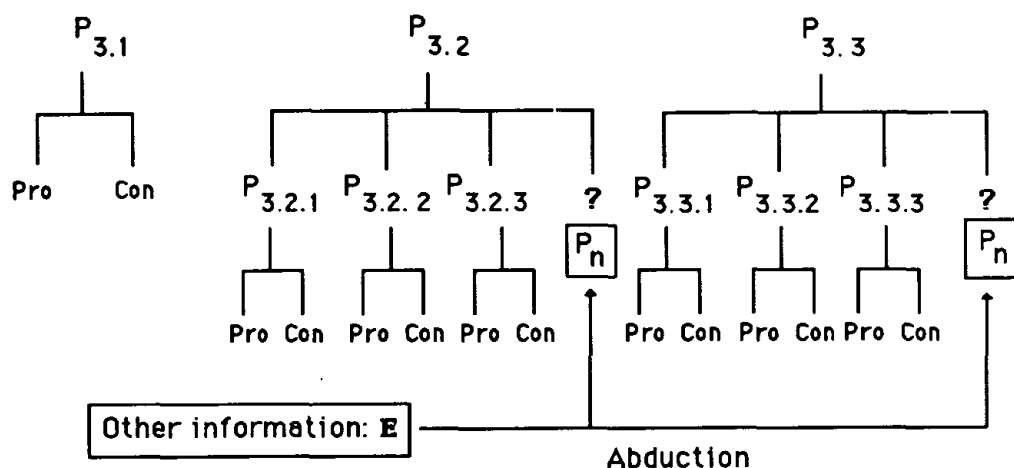
The diagram in Figure 10 captures one crucial ingredient of Shaferean possibilities analysis. The terms "pro" and "con" rep-

resent evidence that bears on each possibility suggested by the evidence. For each possibility, however, there is always "pro" evidence. This is because, in Shafer's scheme, a possibility is always embedded in the evidence; the only possibilities he recognizes are those that the evidence discloses. In reality, however, people attempting to assess the significance of evidence frequently construct or invent possibilities that the evidence itself does not suggest or manifest. The possibility P_n in the square below the question mark in Figure 11 represents such a possibility.

FIGURE 11

$P_{3.1}$ $P_{3.2}$ $P_{3.3}$

Pro   Con $P_{3.2.1}$ $P_{3.2.2}$ $P_{3.2.3}$? $P_{3.3.1}$ $P_{3.3.2}$ $P_{3.3.3}$?

$\boxed{P_n}$ $\boxed{P_n}$

Pro Con Pro Con Pro Con   Pro Con Pro Con Pro Con

$\boxed{\text{Other information: } \mathbf{E}}$

Abduction

The extraction of the new possibility P_n is an example of abduction. Figure 11 arrays all the evidence that favors and disfavors the possibilities in frames of discernment such as frame 3.3. Yet, as Figure 11 illustrates, after the evidence is arrayed pro and con on identified possibilities, it often happens that there remains a body of evidence or details that neither favors or disfavors any of the possibilities that have been previously identified. In Figure 11 this "unconnected" body of evidence is represented by the symbol E. In the face of E an investigator may well invent a new possibility, P_n. E is evidence in search of an hypothesis. The invention of a hypothesis P_n to explain E is a form of abduction. Since possibility P_n is not directly shown by the evidence E, we can say that the investigator manufactures hypothesis P_n.

2. Possibilities and Retroduction

We have just seen that abductive reasoning may be applied to possibilities. In addition, possibilities may figure in another type

of reasoning that Peirce called "retroduction."[146] There is a close relationship between abductive and retroductive reasoning. When an investigator thinks abductively, he invents possibilities. When an investigator thinks about possibilities retroductively, he reverses the process. Instead of hypothesizing possibilities to explain otherwise mystifying evidence, he imagines the evidence that a possibility might generate; instead of asking what possibilities are suggested by the evidence, he asks what evidence is suggested by the possibilities. When thinking retroductively the investigator would ask the following type of question: "If a given possibility (hypothesis) is true, what sort of evidence should I expect to find?"[147]

Retroductive thinking about the relationship between evidence and possibilities is hypothesis-driven. Abductive reasoning, by contrast, is evidence-driven. Figure 12 represents the basic nature of abduction.

FIGURE 12

$$\frac{H}{\uparrow}$$

E
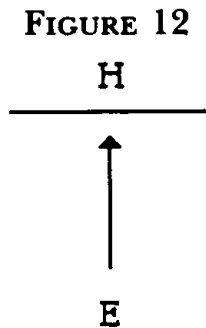
The arrow in Figure 12 indicates the direction in which reasoning moves. It moves from evidence E to hypothesis H; that is, H is inferred from E. However, the direction of the reasoning process can be reversed. In abduction a body of evidence supports an inference about a hypothesis, but when the direction of the reasoning process is reversed, H, a hypothesis, is the basis for an inference about E, evidence. Figure 13 represents this reverse reasoning.

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[146] N. RESCHER, *supra* note 145, at 65-72.

[147] For example, he might ask, "Suppose it is true that Jimmy Hoffa was killed at Fidel Castro's order. If this is what led to Hoffa's death, what sort of evidence should I expect to see?"

FIGURE 13

H
_____

↓

E·
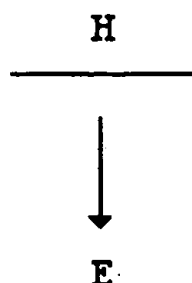
While abduction is bottom-up reasoning, retroduction is top-down reasoning. In abduction we have evidence in search of a hypot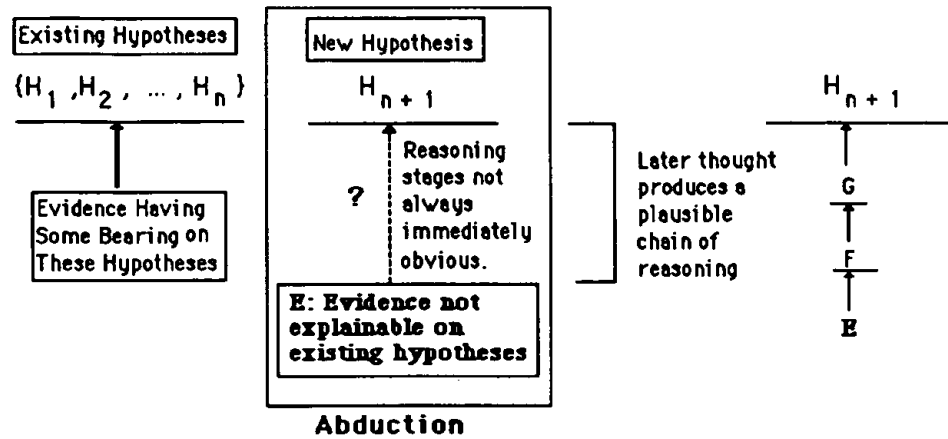hesis, and in retroduction we have a hypothesis searching for evidence. Retroduction, properly so-called, results when top-down reasoning follows on bottom-up reasoning. We have pictured this reasoning process as one that involves the steps shown in Figure 14.

In this schema, we suppose that an investigator (1) begins with a given set of hypotheses H_1 through H_n, (2) discovers that there is an body of evidence E that cannot be arrayed against these existing hypotheses, (3) infers a new hypothesis from E that may explain H_{n+1}, and (4) infers new evidence (in addition to E) from H_{n+1}.

When retroductive reasoning is applied to evidence and possibilities, one or more hypotheses — "possibilities," in Shafer's terminology — are taken as true. Additional hypotheses, or possibilities, are then extracted, or "deduced," from the possibilities that are assumed to be true. The derivative hypotheses or possibilities become indicators of potentially relevant evidence. They indicate, or point to, the potential significance of evidence that either favors or disfavors the deduced possibilities. For example, consider possibility $P_{3.2.1}$ (see Figure 7), the possibility that Mark Vincent was assaulted by Richard Carlson, the jealous husband of Monica Carlson. If retroductive reasoning is employed, the investigator might ask, "If $P_{3.2.1}$ is true, what other possibilities and evidence would we expect to have?" If she asks this question, the investigator might conclude that there may be witnesses who will say that they saw Mark and Monica together in circumstances consistent with the possibility of a romantic interest between Mark and Monica.

The concepts of abduction and retroduction serve to clarify our thesis that possibilities analysis does not stand alone and that it is

FIGURE 14

A. Abduction: Generating A New Possibility

Existing Hypotheses

$\{H_1, H_2, \ldots, H_n\}$

Evidence Having Some Bearing on These Hypotheses

New Hypothesis

H_{n+1}

? | Reasoning stages not always immediately obvious.

E: Evidence not explainable on existing hypotheses

Abduction

Later thought produces a plausible chain of reasoning

H_{n+1}

G

F

E

S₁:

Premise 1: The surprising fact E is observed

Premise 2: If H_{n+1} were true, E would be a matter of course

Conclusion: There is reason to suspect that H_{n+1} is true

S₂:

Premise 1: The surprising fact E is observed

Premise 2: Hypothesis H_{n+1} is capable of explaining E

Conclusion: There are prima facie grounds for pursuing H_{n+1}

B. Retroduction And Hypothesis Testing

H_{n+1}

G

F

E

A_1 A_2 A_3

B   Ⓓ

Ⓒ

Observable

Deduction Of Relevant Evidential Tests

FIGURE 14
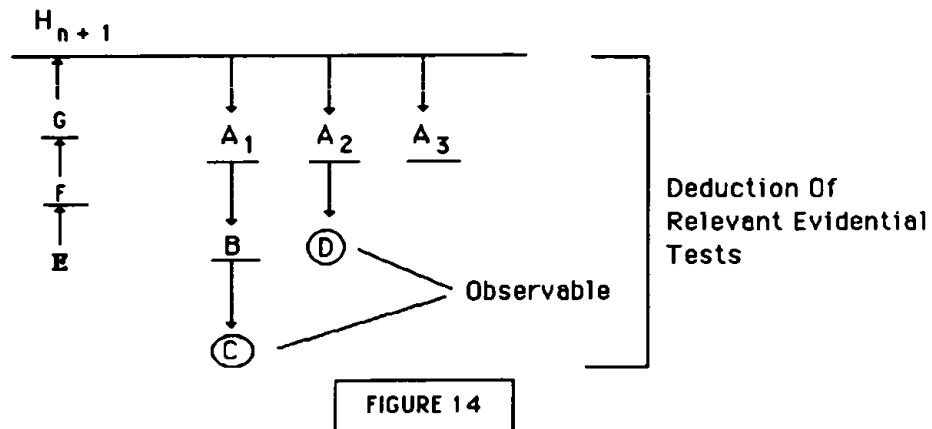
subject to the influence of other evidence marshalling techniques. Indeed, the illustrations we have given of the potential impact of abduction and retroduction on possibilities analysis understate the potential impact of abductive and retroductive reasoning. For example, in our discussion of abduction we assumed that abduction only enters the picture when a portion of the available evidence cannot be arrayed (pro and con) against existing possibilities.[148] Hence, we assumed that existing possibilities are simply present or given. However, it is of course possible that the existing possibilities were themselves obtained by abduction. Indeed, it might be said that no possibility exists in the absence of abduction. For example, the formation of the hypothesis that Mark Vincent was killed as a result of a robbery is a possibility manufactured by the investigator. Although this possibility is supported by the evidence, it is nevertheless a hypothesis that the investigator formulates and invents.[149]

Our earlier illustrations also understated the potential impact of retroductive reasoning on possibilities analysis. Any assessment of the force of evidence on known possibilities inescapably involves retroduction. Even if a body of evidence can be arrayed pro and con against existing possibilities, it is always possible to invent a new possibility having evidential implications and consequences. Hence, whether or not existing possibilities are satisfactory cannot be determined without a determination of whether there are yet other plausible possibilities that can also explain the available evidence. For example, if all the available evidence could be arrayed pro and con against the hypothesis that Mark Vincent was killed as a result of a robbery, it might still be necessary to consider the additional possibility that Mark Vincent was killed as a result of a drug deal gone sour. It might turn out that the sour drug deal hypothesis is superior to the robbery hypothesis even though all of the available evidence is pertinent to the robbery hypothesis.

These considerations are a partial vindication of our general thesis that it cannot be assumed that any single evidence marshalling system operates without being influenced by any other

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[148] *See supra* text accompanying Figures 10 & 11.

[149] *Cf.* G. SHAFER, *supra* note 123, at 285 (although the assessment of evidence within a frame is a disciplined activity, "[t]he construction of a frame of discernment is a creative act, and we choose among frames of discernment, in the first instance at least, by asking not which is truer but which is more beautiful and more useful").

scheme of evidence marshalling. If this general point is granted, however, the exact nature of the connection between possibilities analysis and other evidence marshalling strategies remains to be determined and described. Hence, we now focus on the possible relationships between possibilities analysis and several other forms of evidence marshalling.

C. *Event Chronologies, Scenarios, Possibilities*
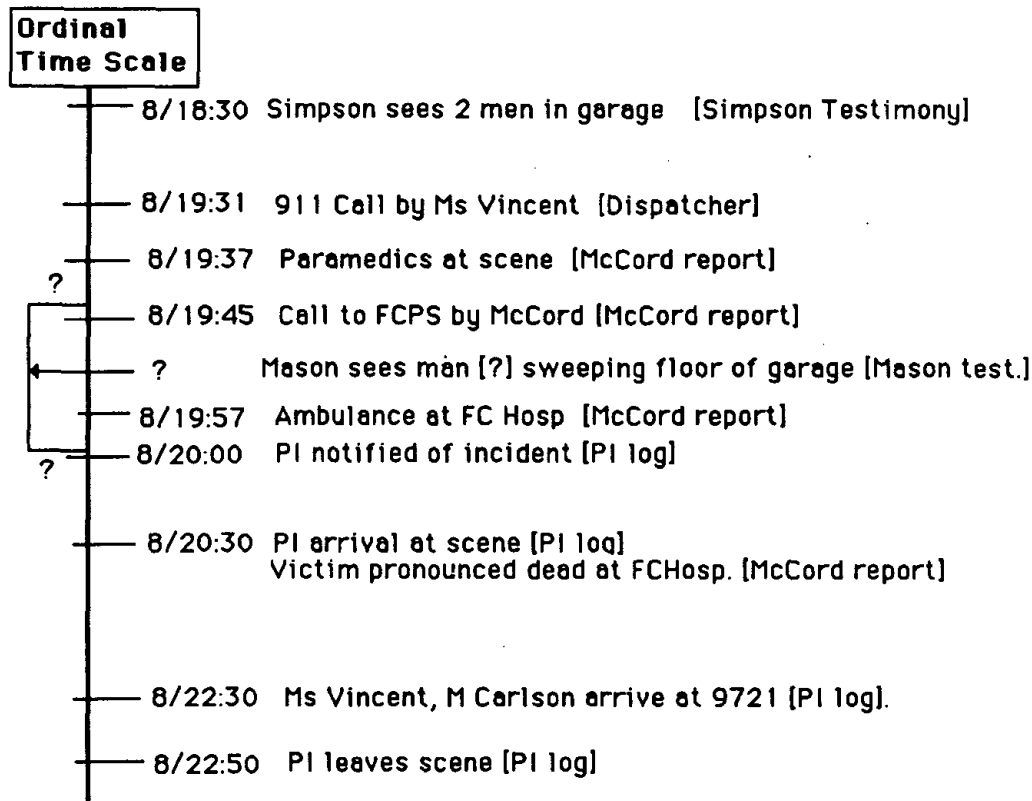
1. Marshalling by Time: Event Chronologies

The construction of a hierarchy of possibilities takes into account the order in which evidence was discovered. Yet, the order in which events are believed to have occurred is also a matter of considerable importance. An investigator who acquires details may feel a need not only to record the time at which the evidence was received (which is not the same as time-stamping the order in which possibilities were imagined), but also to time-stamp the events that the evidence may show. One reason for the importance of the effort to temporally order the events possibly shown by the evidence is plain: one of the investigator's ultimate objectives may be to demonstrate that certain events or acts-in-time took place or that a certain sequence of events or acts took place.[150] Consequently, as we mentioned in Part I, one step an investigator may take is to construct a "time line." We refer to a time line as an "event chronology." Figure 15 is an example of a simple event chronology.

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[150] Many, perhaps most, legal rules specifying grounds for liability and defense imply a need for a certain sequence of events. For example, killing is first degree murder only if the killing was premeditated, and killing is murder only if death occurred as a result of the act designed to cause death.

FIGURE 15

Event Chronology: Reported Times

Ordinal
Time Scale

8/18:30 Simpson sees 2 men in garage   [Simpson Testimony]

8/19:31 911 Call by Ms Vincent [Dispatcher]

8/19:37 Paramedics at scene [McCord report]

?

8/19:45 Call to FCPS by McCord [McCord report]

?   Mason sees man [?] sweeping floor of garage [Mason test.]

8/19:57 Ambulance at FC Hosp [McCord report]

8/20:00 PI notified of incident [PI log]

?

8/20:30 PI arrival at scene [PI log]
         Victim pronounced dead at FCHosp. [McCord report]

8/22:30 Ms Vincent, M Carlson arrive at 9721 [PI log].

8/22:50 PI leaves scene [PI log]

An event chronology can serve various useful functions. One of its functions hinges on the inconclusive character of evidence. Since evidence is always inconclusive, it is never certain that the reported order of events conforms to the actual order of events. An event chronology is a useful device for marshalling various items of evidence that bear on the question of the temporal locus of a particular event. The evidence suggesting a particular temporal locus of an event can be arrayed against a point or an interval on a time line.

Assuming that an investigator has some confidence that the reported order of events conforms with the actual order of events, an event chronology also serves the obvious function of arranging significant events in a temporal order. As noted earlier,[151] one obvious reason for arranging events temporally is the expectation that at any trial someone — judge or jury — must

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[151] *See supra* note 150 and accompanying text.

make decisions about events and acts that took place in time. Moreover, the order in which events and acts occur may be of enormous significance. In a murder case, for example, it may make all the difference whether the accused purchased a gun before or after the victim was shot, and in a conspiracy case it may make a difference whether the alleged conspirators became acquainted with each other before or after the alleged conspiracy.

Although a time line of events can be useful, it is not always simple to assemble a useful one. In the course of an investigation an investigator may receive reports of a great many events. The multitude of such reports can generate two kinds of difficulties. The first difficulty is that the number or distribution of reported events may make it difficult to display them clearly. For example, a great many events and acts may have taken place in one relatively short interval of time (*e.g.*, twenty seconds). The result may be great "event density" in one interval of time, while relatively few events and acts are reported as having occurred in other comparable intervals in the event chronology. It is not easy to display events clearly when they are distributed unevenly over time.[152]

Event density is not the only cause of clutter in an event chro-

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[152] Suppose that an attempt is made to depict a sequence of events graphically. If some time intervals are filled with many events, several unfortunate things can happen. First, the time line may be unintelligible because too many events are packed too closely together in some intervals of the time line. Alternatively, if the size of the time line is expanded to create more space between densely packed events, the expanded diagram may be physically unwieldy and it may not be possible to "take in" the entire time line in one glance. There appears to be a third remedy, however: keep the physical dimensions of lightly peppered intervals small and expand the size only of densely-packed intervals. Yet, this remedy also exacts a cost. For example, since the graphic dimensions of time intervals do not correspond to their true dimensions, the diagram may impede an observer's ability to grasp temporal relationships accurately. (For example, it may matter whether a price of a commodity was raised shortly after or long after an alleged price-fixing agreement was made.) Moreover, as new reports of events are gathered, events may have to be recorded on time segments that were not expanded.

While no remedy for the practical difficulties generated by differentials in event density is without cost, computer-based technology can alleviate such difficulties. For example, it would not be difficult for an artful software programmer to design a program that allows a user to expand a densely packed segment of a graphic event chronology at the push of a button. This would allow a user both to scan the events already recorded in a densely-packed interval more easily and record additional events in that interval. *See* D. SCHUM & P. TILLERS, *supra* note 122, pt. 3, at 65-68.

nology. The intrinsic nature of an event chronology creates a second source of clutter. If an investigator receives reports of numerous events and attempts to record every such event, the resulting event chronology will appear cluttered even in the absence of event density because many of the events recorded by the investigator will have no apparent connection with each other and many of the recorded acts and events will have no apparent significance. The consequence is that such an event chronology may impede rather than improve comprehension.[153]

The existence of this second type of clutter reflects the fact that an event chronology is not a scenario. An event chronology merely lists the order of events and acts but establishes no links or connections between the acts and events shown in the chronology. The absence of links between events may produce clutter and impede comprehension even if all the events recorded are significant ones. For example, Event A, a significant event, may be connected with Events F and J, but not with Events B, C, D, and E, which fall between A and F, or with Events G, H, and I, which fall between F and J.[154] The importance of being able to see connections between events suggests that one of the purposes of an event chronology is the development of a scenario. A scenario, unlike an event chronology, purveys a theory about events and acts in time; a theory that explains events establishes connections among them. Hence, a scenario lends a measure of intelligibility and coherence to temporally-ordered events and, by doing that, it also makes it easier for an observer to grasp, store, and recall the events in question.

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[153] One seemingly obvious remedy for this type of clutter is a prohibition against the recording of insignificant events and acts; only salient, important, or significant events should be recorded. Although easily stated, however, this mandate is less easily implemented. The unanswered question, of course, is when an act or event is important enough to be recorded.

[154] For example, the following events take place in the following order (A) Peter Plaintiff hits David Defendant, (B) Shopkeeper closes his drug store for the day, (C) David Defendant goes to Shopkeeper's drug store, (D) David Defendant's wife Martha Marks takes a sleeping pill, (E) Peter Plaintiff hits Martha Marks, (F) Shopkeeper unlocks his closed drugstore, (G) David Defendant screams in anguish, (H) David Defendant takes a pain killer, and (I) Peter Plaintiff suffers an attack of strychnine poisoning. All of these events may be significant but their arrangement is unilluminating. They can be arranged in a more meaningful way. For example, (A), (B), (C), (E) and (C), (D), (E), (G), (I) are some possible arrangements that are more illuminating.

If it is granted that an event chronology facilitates the development of scenarios and that scenarios make an event chronology more intelligible to an observer, it remains to be established how an event chronology should be constructed in order to facilitate the construction of scenarios. This, like every similar question about the relationship between marshalling strategies, presents something of a chicken and egg problem: without knowing what the probable scenario is, we cannot be sure how to construct an event chronology, and without some type of an event chronology, we may find it hard to construct a scenario.

Part of the answer to this dilemma must be simply that the investigator must rely on her intuitions in deciding which events are likely to be significant.[155] However, we have more substantial and useful advice to give about the design of event chronologies. One piece of advice is that investigators consider constructing event chronologies around actors. Figure 16 shows how such an event chronology might look.

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[155] The first step is always the hardest; any initial effort to marshal evidence is practically by definition unstructured. However, beginnings are made and some beginnings are well made. This suggests that nature, accident, intuition, biology, and matters of that sort can work to give the investigator some confidence (for reasons he cannot explain) that one type of marshalling strategy is the right one to use at the outset and that it is appropriate to use it in this or that particular way. In a report on the research described here, we invoke chaos theory in an effort to describe the meandering character of investigative activity and to explain how meandering sometimes becomes productive. *See* D. SCHUM & P. TILLERS, *supra* note 122, pt. 3, at 158-61. Our recourse to chaos theory, however, is a recourse to a simile. Although chaos theory may provide comfort and reassurance, it yields no specific prescriptions for marshalling evidence in the face of intellectual and cognitive confusion.

FIGURE 16
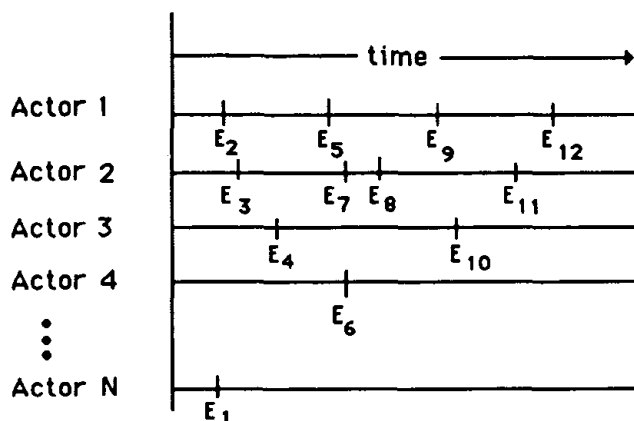
While our advice to construct event chronologies around actors partially begs the question of how an investigator is to decide whether an actor is or is not a significant player, our advice does not beg the somewhat different question of the appropriate design of an event chronology when an investigator's ignorance is great but not complete. An investigator may always surmise that the issues in any eventual trial will implicate hypotheses about human actions; lawsuits always involve hypotheses about the conduct of human beings. Consequently, an investigator may reasonably surmise that regardless of the nature of the central issues in a case, a party involved in a trial will have to construct and present a coherent and plausible story about the activities of one or more people. Hence, lacking any particular reason to use any particular marshalling strategy or to use a particular marshalling strategy in a particular way, an investigator may be well-advised to begin the project of constructing an overall scenario by assembling mini-scenarios about particular individuals, with the expectation that she may later be able to piece together those mini-scenarios to make out the larger story that she, or someone else, will eventually want to tell at trial. One additional reason to take this course is that most investigators already have a reservoir of background information about the behavior of human beings. This reservoir of information allows them to make plausible guesses, even when little specific information is available, about how actors might have acted and interacted.[156]

In the discussion of scenarios found immediately below we offer more advice about the design and uses of event chronologies. The reason we can do so — the reason why the chicken-and-

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[156] Tillers, *supra* note 46, at 927-32.

egg problem does not stop us — is that it is not sensible to assume that an investigator cannot have a sense of the possible uses and purposes of an event chronology before she has used another marshalling strategy. Not all knowledge is explicit; some is tacit.[157] The marshalling systems that we describe are heuristic devices. Any users of these systems must and will capitalize on the knowledge they already have, including their tacit knowledge. Indeed, it may be permissible to think of the network described here as a device that has the capacity to bring to consciousness and make explicit the methods and procedures that people already tacitly and naturally use when they engage in fact investigation.[158]

2. Marshalling by Time: Scenarios

We have already explained that a scenario constitutes an explanation of a sequence of events in time.[159] We also noted that a scenario also serves as a "gap filler."[160] A scenario performs this service precisely because a scenario is an explanation or a theory. That is, there is more to a scenario than the events it explains; there is also the explanation or theory that it contains. This theory is a theory of how things and events are related in time and a theory of this sort — a scenario — allows the person constructing it to posit events and acts for which there is no evidence. It is this conjectural or fanciful ingredient that legitimates use of the loose phrase "story telling" to refer to the process of scenario construction. As we explained in Part I,[161] however, a story used for forensic purposes cannot be entirely fanciful. We are ultimately concerned about the truth of a matter or matters of fact. Hence, if a scenario has elements of fancy, it must be a mixture of fact and fancy — we are interested only in plausible stories. Figure 17 represents a scenario containing a mixture of fact and fancy.

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[157] *See, e.g.*, I. ROCK, THE LOGIC OF PERCEPTION 11 (1983) (noting that "child who erroneously refers to 'sheeps' evidences [implicit] knowledge of the rule that plural nouns add an 's' " though child has never seen or heard the word). In a more philosophical vein, see M. POLANYI, THE TACIT DIMENSION (1958).

[158] Making tacit cognitive processes explicit is not necessarily a useless exercise. The explicit formulation of tacit standards can change the "outputs" of cognitive processes. *See* Tillers, *supra* note 46, at 933.

[159] *See supra* text accompanying notes 82-83, 154.

[160] *See supra* text accompanying notes 79-80, 87-88.

[161] *See supra* text accompanying note 87.

FIGURE 17

TIME ———●—☑—☑—☑———☑———☑—●☑—☑—●┤——▶

16:30   03:00

● Benchmarks
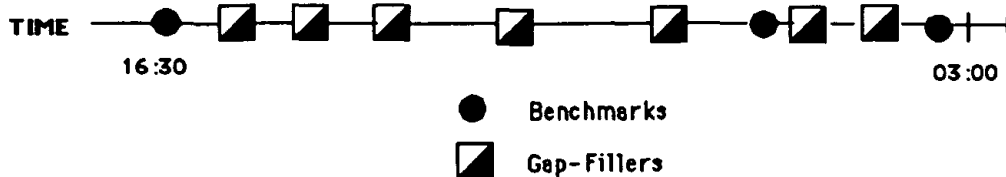
☑ Gap-Fillers

The partially shaded squares in Figure 17 represent "gap fillers." For example, if an investigator has good evidence that Abel intended to go to Stop & Shop (a supermarket) but there is no other evidence whether he actually did so, we may "fill the gap" in our story by guessing that he did go to the supermarket. Hence, gap fillers are hypothesized events representing the fanciful or conjectural components of a scenario.[162] By contrast, the black circles in Figure 17 represent "benchmark events." Benchmark events are the stable components of the scenario; they are the scaffolding on which the conjectural parts of the scenario can be hung.

Although some events may be treated as benchmarks, the question of whether an event is or is not a benchmark does not always, if ever, have a secure answer. If benchmark events are ever "stable," they are only relatively so. An event that was taken to be a benchmark may later seem less (or more) "solid," and the initial judgment that an event is a benchmark may be questioned and revised later. Hence, the question of whether an event is a benchmark may be the subject of conscious, and continuing deliberation. An investigator may wonder which events should serve as the basis for additional conjectures.

The strength of the evidence pointing to the existence of an event is one factor that influences the decision whether or not to treat an event as a benchmark. The reason for this is plain: since our ultimate interest is in the truth of some matter of fact, we do not want to build the fanciful parts of our stories on rungs that

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[162] Of course, it is true that the evidence of Abel's intent may be taken as evidence of Abel's action as well as of his intent. While true, this point is immaterial. A scenario shows that the reasoning that takes us from evidence of intent to the conclusion of the act involves causal and temporal reasoning, *i.e.*, hypotheses about workings of space-time sectors, including, of course, the workings of persons in space and time. That is to say, an important component of the argument that leads from evidence of intent to action is a theory of how things, events, persons, and actions are related in a spatio-temporal framework.

may fall out from under our feet. We want to choose rungs that we think will hold up. The importance of identifying benchmarks for possible scenarios suggests that one of the functions of an event chronology is to facilitate assessments of the strength of the evidence supporting an event recorded on the event chronology. We have already noted that an event chronology permits an investigator to juxtapose events and the evidence that points to the occurrence of those events. This juxtaposition improves an investigator's ability to determine how strongly evidence supports the hypothesis that an event occurred, and it aids the investigator in making the decision whether to accord a hypothesized event benchmark status. In short, an event chronology stimulates the formation of scenarios not only by the manner in which it displays the temporal order of possible events, but also by the way it displays the probability that the events recorded conform to actual events. It follows that a well-supported event in an event chronology may become a benchmark event in a scenario. The manner in which this transposition might take place is illustrated by the diagrams in Figure 18.

FIGURE 18
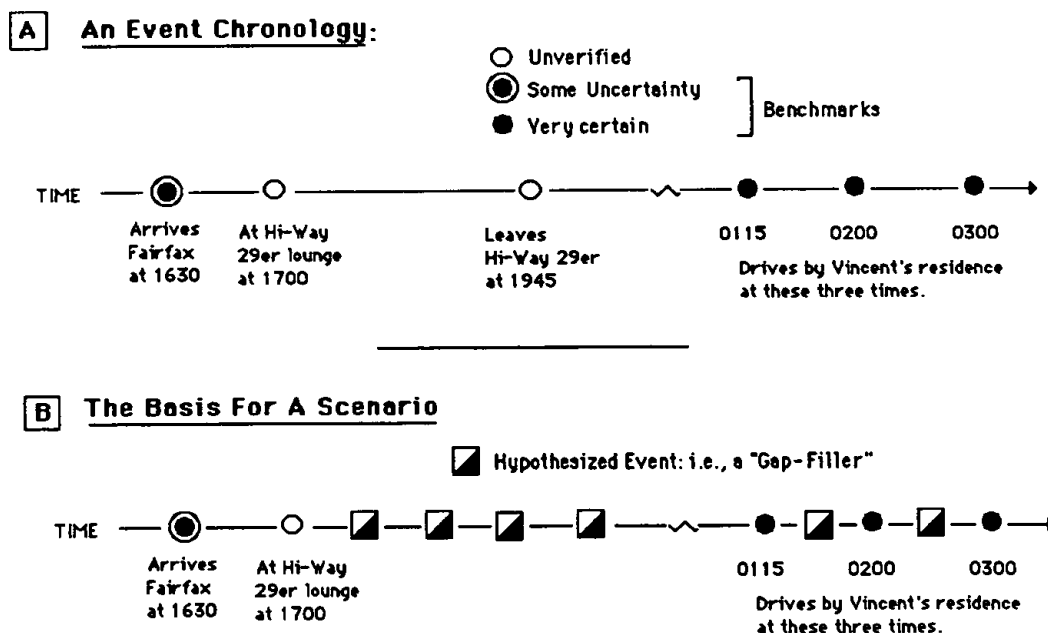
3. Legal Marshalling & Case Theories

The use of a case theory as an evidence marshalling strategy is closely related to the use of elements of substantive legal rules to

marshal evidence.[163] Like marshalling by legal rules, a case theory implicates substantive[164] legal doctrines. However, a case theory is more than a method for marshalling thought about legal doctrines. A case theory is a method of relating legal doctrines to evidence and hypotheses about facts.

A lawyer might say that a theory of the case relates factual issues to the elements of the legal claims and defenses that are (thought to be) "in" the case. Indeed, our imaginary lawyer might go one step further by saying that a case theory describes the relationship between the material factual issues in the case and the evidence that is relevant to each material factual issue.[165] When viewed in these terms, a case theory collapses several distinct marshalling strategies into one. In formulating his case theory the lawyer will consider the elements of legal rules, material factual hypotheses, and, in our terms, "details," "possibilities," or other matters of this sort. While we use rather different language to explain what a case theory is, our account of a case theory is very much like our imaginary lawyer's. Moreover, our formulation of a case theory also suggests that a case theory combines, or integrates, several distinct methods of marshalling. It is as if several different methods of marshalling are drawn up into a case theory.

In our terms (*i.e.*, in terms of the equivalence class concept) a case theory incorporates those substantive legal rules whose joint satisfaction through a scenario constitutes instantiation of a case theory. In other words, a case theory prescribes a theoretical

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[163] We have already discussed the use of substantive legal rules to marshall evidence. *See supra* Section I(C)(9). As already explained, legal marshalling may involve the decomposition of legal rules into their elements. Marshalling by case theories, which we discuss here, is closely related to marshalling by "substantive legal rules." However, there are also some important differences. *See* discussion at text accompanying *infra* notes 165-67.

[164] We have not yet considered the implications of procedural and evidentiary rules for evidence marshalling. We plan to do so in the next stage of our research.

[165] This way of formulating a case theory conflates analysis of the elements of legal rules with analysis of the legal materiality of factual hypotheses. It is interesting to note that the blurring of this real distinction can enhance the efficiency of a decision maker's ability to array available evidence against pertinent factual issues. This gain in cognitive efficiency will sometimes occur precisely because it is sometimes cognitively fruitful and efficient to suppress explicit analysis of the validity of a definition of a legal claim or legal defense.

equivalence class consisting of scenarios in which all of the substantive legal rules in the theory are instantiated by the evidential foundations of those scenarios. This interpretation of the notion of a "case theory" involves several methods of marshalling evidence. First, since a case theory is a theory about the relationship between legal doctrines and evidence, a case theory involves the decomposition of legal doctrines into elements. Second, since a case theory is a theory of how facts establish or satisfy the elements of legal doctrines, a case theory incorporates a hypothesis that specifies the particular states of the world (factual situations) that instantiate the elements of legal rules. (We might think of this as reasoning that addresses the relationship between abstract legal principles and concrete factual situations.) Third, since a case theory posits instantiation of elements of legal rules by particular facts whose existence is uncertain, a case theory necessarily incorporates factual hypotheses, and since a factual hypothesis is always embedded in a scenario,[166] a case theory inevitably incorporates a scenario. Finally, since a case theory has value only if there is evidential support for the theory, a case theory incorporates or reflects methods of marshalling such as the marshalling of details, marshalling by possibilities, marshalling for credibility, and the marshalling of real evidence.[167]

CONCLUSION

A. Integration and Coordination of Marshalling Strategies

We have shown that marshalling strategies taken individually have the capacity to generate very complex webs of arguments and extremely intricate arrangements of details.[168] In view of this, one may question whether any natural person has the capacity to use a single marshalling strategy effectively. The use of a

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[166] This is because "facts" always occur in a temporal order and hypothetical facts are part of a hypothetical temporal order, which is nothing other than a scenario.

[167] In summary, a case theory contains (at least): (1) a theory of the elements of a legal rule; (2) a theory of how these elements may be instantiated in facts (*i.e.*, which facts are instances of an element); (3) a scenario containing hypotheses (events) that constitutes such instantiations; and (4) a theory or theories about how evidence supports such hypotheses.

[168] Only a few details are necessary to produce enormously complex argument structures and arrangements of details. Recall that there are $2^{100}-1$ combinations of 100 details. Now note that each combination of details can be used to form one or more arguments that have various steps.

case theory to organize investigation makes this question more acute because at least several different methods of marshalling are embedded in any case theory.[169] Hence, if it is true that the use of a case theory to marshal and organize evidence "works," this fact has important implications for the feasibility of coordinating marshalling strategies.

We have devoted a substantial amount of discussion to several marshalling strategies. In some of those discussions, we have alluded to the problem of coordinating marshalling strategies. For example, our discussion of the relationship between scenarios and event chronologies suggests that an intelligent investigator may want to skip back and forth between different marshalling strategies. Thus, when an investigator attempts to construct a scenario, he may also want to think — at the same time — of an event chronology. Moreover, to make good use of the event chronology, he may also want to think, again roughly at the same time, about the evidence that is arrayed against the events shown in the event chronology.[170] The job of coordinating and integrating marshalling strategies forces an investigator to do more than merely walk and chew gum at the same time. Indeed, the mental operations required for such coordination are extraordinarily complex. Their complexity raises the question whether it is possible to use a network of marshalling strategies such as ours to any practical advantage.

Our answer to this question is by way of confession and avoidance. The confession is that it is true that the mental processes described by our network of marshalling strategies are extraordinarily complex, and it is true that it may be impossible for any human being to keep all of these systems and all of their details and refinements in her head at the same time. The plea by way of avoidance is twofold. First, it is likely that human beings, unaided by our theory, are also required to keep different kinds of mental processes in their heads at the same time. The question, therefore, is not whether anyone can keep everything in one's head at the same time. Rather, the question is how one can better keep in

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[169] Indeed, we might say that the very purpose of a case theory is to integrate distinct marshalling strategies.

[170] This need for thinking in different modes need not stop there. For example, while constructing a scenario and also thinking about an event chronology and also ruminating about the evidence supporting the events in the event chronology, an investigator may also want to be thinking — at the same time! — about the elements of legal claims and defenses.

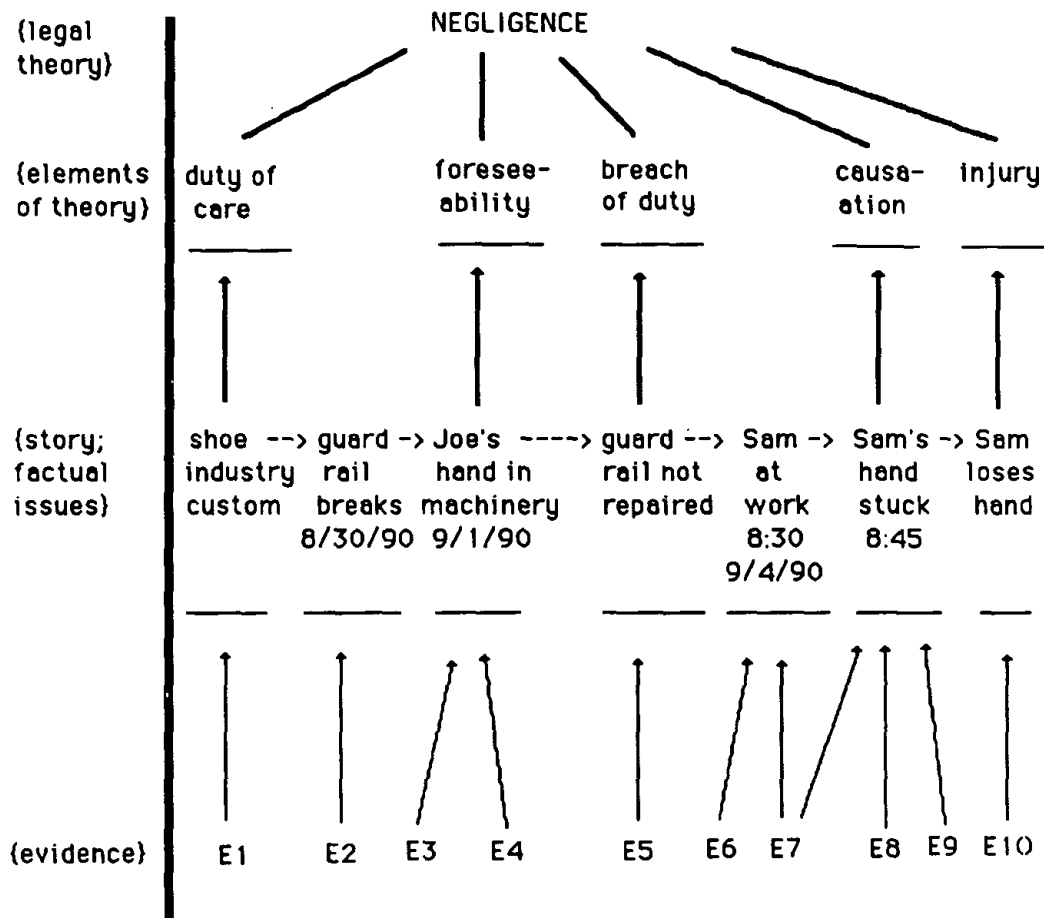one's head the various things that one would like to keep in her head.

Second, one of the purposes of our computer system is precisely to improve the ability of people to keep many things in their heads. It is a fact that people's ability to recall all pertinent details and to think of everything pertinent is limited. We cannot, and do not, promise that our scheme for marshalling evidence will enable people to recall everything and to conjure up every argument and consideration simultaneously. To the extent that our work addresses the marshalling of evidence in real-world contexts, our aim is only to improve people's ability to remember and think about various things at the same time.

The problem of coordinating and integrating marshalling strategies is nothing more than a problem of juxtaposing ideas in an orderly and meaningful way. There are several reasons for believing that natural persons have the capacity to coordinate and integrate contrived marshalling strategies. First, people already have an enormous capacity to juxtapose ideas. It is noteworthy that many of the marshalling strategies we describe are ones that some lawyers already use. Second, our theory is itself a system or procedure designed for juxtaposing ideas; that is, our theory is a tool or device that can be used, and is meant to be used, to juxtapose diverse ideas.[171] Third, there is good reason to think that the orderly and meaningful juxtaposition of ideas greatly increases the capacity of human beings to remember details while keeping them in order. Hence, if our method of sorting evidence and organizing thought about evidence is orderly and meaningful, there is reason to think it can improve the ability of people to keep their thinking about details straight.

Consider the schematic representation in Figure 19 of how a lawyer might visualize a particular case theory.

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[171] The theoretical significance of our work on computer prototypes of evidence marshalling systems may now be more apparent. Our prototypes allow users to shift back and forth between different marshalling strategies and they allow users to view, almost simultaneously, linked portions of different marshalling strategies. These prototypes thus illustrate the importance of the juxtaposition of ideas. However, they also do more. They illustrate the particular types of juxtaposition that are helpful and in this way they suggest some basic properties of human thinking about facts and evidence. In particular, our effort to portray the nature of a case theory suggests, first, the epistemological importance of juxtaposing local and global perspectives, *see infra* Section B, and, second, the epistemological importance and implications of metaphors, *see infra* Section C.

FIGURE 19

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(legal                          NEGLIGENCE
theory)


(elements    duty of      foresee-    breach           causa-    injury
of theory)   care         ability     of duty          ation


(story;      shoe --> guard -> Joe's ----> guard --> Sam -> Sam's -> Sam
factual      industry rail     hand in     rail not   at      hand     loses
issues)      custom   breaks   machinery   repaired   work    stuck    hand
                      8/30/90  9/1/90                 8:30    8:45
                                                      9/4/90


(evidence)    E1      E2   E3   E4       E5     E6  E7      E8  E9  E10
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It seems to us that a case theory such as the one depicted in Figure 19 "works;" that is, we think that this way of structuring thought about a case may be an effective and intelligible way of keeping in mind a variety of matters and details at the same time. Moreover, it seems to us that when a case theory such as the one schematized in Figure 19 does work, it does so because a case theory is an orderly and meaningful way of arranging evidence. Both the overall structure and the lattices within the structure make sense.

Intuition suggests that meaningful arrangements of information, as opposed to random arrangements, improve memory and retrieval. For example, people can apparently better remember sequences of letters or numbers when those letters or numbers are meaningfully arranged than when they are randomly arranged. Moreover, empirical research by Pennington, Hastie, and Penrod strongly suggests that a "story model" allows people

to retrieve details with great efficiency.[172]

B. Parts and Wholes in Inference

One of the lessons we relearned from our work on computer prototypes is that people need to be able both to recall details and to "see the whole picture;" effective marshalling of evidence requires both a local and a global juxtaposition of ideas. The importance of both these perspectives, however, raises a basic logical problem. We can refer to this problem as the problem of the relationship between parts and wholes.

The problem of parts and wholes — the problem of the relationship between synthetic and granular perspectives on evidence — assumes various guises. One example of this problem also illustrates why a synthetic perspective on problems of investigation and proof is essential. As we noted earlier,[173] the task of coordinating marshalling strategies closely parallels the project of making effective use of a single marshalling strategy. When a marshalling strategy is actually applied, it can produce an intricate network of arguments. In graphic form a complex of arguments based on a marshalling system takes the form of a network of arcs and nodes. This network can resemble a spider web. A person attempting to assess the significance of a collection of evidence may sense the importance of the details but she may have a hard time keeping all of those details in mind when she is trying to assess the overall impact of her fine-grained analyses.

We have discussed various strategies that may enhance the ability of people to remember and retrieve details. While those strategies seem sensible and effective, the premise that any one of them can work is not free of difficulty. A chicken-and-egg problem inheres in the use of any particular strategy that we recommend. We have said that uninhibited use of any marshalling strategy can produce excessive complexity, and we have suggested that an investigator should refer to other marshalling strategies to prune away such excessive noise and complexity. The chicken-and-egg difficulty is that those other marshalling strategies are themselves intricate and an investigator's ability to use them as shearing devices depends on her ability to remember their details. But how is she supposed to do that without resort-

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[172] *See* R. Hastie, S. Penrod & N. Pennington, *supra* note 85, at 22-23, 163-65, 234; Pennington & Hastie, *supra* note 85.

[173] *See supra* text accompanying note 168.

ing to yet some other marshalling strategy, which then again presents her with the same problem?

We believe that a global perspective is necessary to make this otherwise inexplicable process work. The workings of any network of marshalling systems are inexplicable without the supposition that people have the capacity to regulate the detailed workings of individual marshalling strategies by some sort of global, synthetic perspective. In an earlier work one of the authors of this Article wrote:

> It is tempting to think that what happens (and should happen) [in fact finding] is that a trier of fact — any trier of fact — engages in a sequential process in which there is a repeated reciprocal interaction between a general vision of the evidence as a whole and a general vision of its parts, a process in which each vision is progressively revised and checked by the other but in which neither can be supposed, in principle, to be entirely independent of the other.[174]

We still think that the general sentiment expressed here is correct. From a logical point of view, however, the ability of people to shift back and forth between local and global perspectives does not solve the chicken-and-egg problem. While local perspectives may have to rest on global ones, global perspectives must rest on granular details. We end where we began.

The logical intractability of the question of the temporal relationship between local and global perspectives leaves us no alternative except the supposition that the logical problem is answered by psychology. On another occasion one of the authors wrote: "While, as a logical matter, it seems, at least to us, that the interaction of parts and wholes, and their interdependence, are inescapable, it is not true, physically considered, that this logical interdependence continues indefinitely . . . ."[175] The same kind of answer must be given to the question of the temporal relationship between wholes and parts during the beginnings of the process of inference and proof. Logically speaking, neither global analysis nor granular analysis can start first, but "physically considered" — psychologically speaking — one or the other must have some sort of priority at any given moment in time. By the same token, despite the fact that it is hard to keep a granular and a global perspective in mind at the same time, and despite the fact that one or another must have some kind of priority at any partic-

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[174] 1A J. WIGMORE, *supra* note 62, § 37.7, at 1084.
[175] *Id.*

ular time, it must also be true that both perspectives are somehow at work at the same time, no matter how mysterious this proposition may seem. This proposition, however, is not really all that mysterious. We only need to posit that marshalling processes, even artificial ones such as ours, are partly psychological. When any marshalling process is explicitly at work, tacit marshalling processes are also work. Those tacit processes remain in the background, but they are working nonetheless.

C. *Personal Meaning, Metaphorical Translation, and Theoretical Validity*

We have often been asked whether our theory of evidence marshalling is a descriptive or a prescriptive theory. Our answer is that it is neither. Our theory is of a third kind: it is an heuristic theory. We reject the thesis that a theory about evidence and inference must be either descriptive or prescriptive.[176] This has been and this remains our answer to questions about the character and purpose of our theory of evidence marshalling. We also recognize that this answer is incomplete, however. There must be a link between any heuristic theory and natural mental processes. Without such a link, an heuristic theory cannot serve as a device that illuminates natural thought.

Our work on computer prototypes of evidence marshalling systems suggests the nature of the link between our theory and natural mental processes. We have said that our computer prototypes and our diagrams serve as metaphors.[177] If we are right in thinking that our prototypes and diagrams are effective metaphors, our diagrammatic devices appeal to the natural imagination. By doing so they translate our theoretical constructs into natural and familiar ways of thinking. Hence, our computer prototypes and diagrams are far more than gimmicks or mere rhetorical devices. The link between our heuristic theory and natural thought is by way of metaphor.[178] Metaphors serve to translate our theory into

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[176] *See supra* note 46; *infra* notes 180-81.

[177] *See* Tillers, *supra* note 46; text accompanying *supra* notes 46-47.

[178] Lon Fuller made a similar claim in L. FULLER, LEGAL FICTIONS 113-21 (1967). There Fuller discussed Hans Vaihinger's theory of fictions and why "New Experiences Are Converted into the Terms of Those Already Familiar." *Id.* at 113. Fuller shared Vaihinger's view that "human thought must always proceed by analogy, and . . . analogies must always be taken

natural language and thought.[179] If we are unable to find metaphors that translate our theory into received ways of thinking and imagining, our theory must suffer the fate of being either a descriptive theory or a prescriptive theory. This fate would not be a happy one since neither one of these types of theories can guide people in the investigation of real-world factual problems.[180]

If it is true that metaphor is the link between heuristic theory and natural imagination and thought, we have obviated certain objections to our theory, but new questions about the validity of our theory emerge. For example, suppose our metaphors are not popular. Must we admit the invalidity of our theory if the intended consumers of our theory do not find our theory "user-friendly?" Are we required to take the inability or unwillingness of our audience to make any sense or use of our theory as evidence that our theory is defective?

Although we have not yet attempted to formulate comprehensive responses to these questions, we see a good possibility that the answers to them might be "no." This possibility occurred to the authors as they reflected on the way that they initially tackled

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from an existing stock of experience." *Id.* Fuller says, "*A metaphorical element taints all our concepts.*" *Id.* at 115. (emphasis in original)

While Fuller believed that fictions and metaphors are essential, he also believed that they do harm as well as good. He asserted that analogies, metaphors, and fictions must "*drop out of the final reckoning,*" *id.* at 117 (emphasis in original), after they have done their job of making new concepts familiar. The "hypostatization" of concepts — the use of fiction after it has done its job of making a new concept familiar — is the "original sin of human reasoning." *Id.* at 118.

While we do not doubt that metaphors can be harmful as well as beneficial, it is probable that a theory having an heuristic character cannot wholly abandon metaphors and analogies. A novel mathematical concept was Fuller's paradigmatic example of an unfamiliar concept. *See id.* An heuristic theory, however, is a special kind of beast. Its purpose is to shed light on natural and familiar mental processes rather than to replace them with novel conceptual operations. Since an heuristic theory cannot replace existing, familiar thinking, metaphor would seem to be always necessary.

[179] We are indebted to Richard Weisberg for this thought. *Cf.* J. WHITE, JUSTICE AS TRANSLATION 36 (1990) (one learns language by learning from it the meaning of what we already know how to say).

[180] A purely descriptive theory — one that merely describes existing mental processes — cannot improve inferential performance. A purely prescriptive theory of inference — one that mandates the replacement of natural inference with ideal inference — cannot be used by real-world human beings. *See* Tillers, *supra* note 46, at 932-36.

the project of investigating investigation. One of the authors is something of an expert on probability theory. He is also adept at figuring the probabilities of various outcomes in card games. By contrast, the other author is singularly inept both in card games and at calculating probabilities. It is probably not a matter of chance that the author who is familiar with card games was drawn to computer prototypes that are based on the metaphor of a stack of cards. This author saw a card game metaphor as the appropriate metaphor for describing both the underlying structure of all evidence marshalling systems and the nature of the relationships between evidence marshalling systems. It is probably also not fortuitous that this same author has devoted a great deal of attention to combinations of "possibilities," shuffling them in various ways, like a pack of cards. The other author, by contrast, entertained no hypotheses or images that even remotely resembled the structure of a card game when he first tackled the topic of investigation. He thought about matters such as stories and the fuzziness of legal language, but in no event about card games.

This difference in the way that we as co-authors initially tackled the problem of investigation shows that different metaphors have different appeal for different people. Does this suggest that the epistemological validity of different techniques of marshalling evidence varies with the person? Perhaps. Yet, our own experience learning and understanding each other's metaphors demonstrates that metaphors that are initially unfamiliar and unappealing may, in time, become appealing and powerful. Hence, it is possible that our metaphors and images will have general appeal. If they do, this may be some evidence that our heuristic theory of evidence marshalling has interpersonal force and theoretical validity.[181]

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[181] The criteria of the validity of any heuristic theory are perforce rather different from the criteria of the validity of a mathematical theory or of a theory in the sciences. The reason lies in the subject matter of an heuristic theory. An heuristic theory is a map of the mind. It is a logical map of the mind. But it is not just a picture of logic. The picture must also appeal to the mind; the mind must say, "That's the way it is!"