THE USE OF SCIENTIFIC AND TECHNOLOGICAL EVIDENCE IN LITIGATION

FINAL REPORT

THE USE OF SCIENTIFIC AND TECHNOLOGICAL EVIDENCE IN LITIGATION

FINAL REPORT

Michael J. Saks and Richard Van Duizend

National Center for State Courts

This report was prepared under Grant No. 80-IJ-CX-00[illegible]27 from the National Institute of Justice, Office of Justice Assistance, Research and Statistics, United States Department of Justice. The opinions, recommendations and conclusions contained in this report are those of the authors and do not necessarily represent the official policy or position of the National Center for State Courts, the National Institute of Justice, the Office of Justice Assistance, Research and Statistics, or the United States Department of Justice.

TABLE OF CONTENTS

ACKNOWLEDGMENT

Listing individually all the people who assisted us in conducting the research and preparing the report and bibliography would require several papes printed in the style of a telephone directory. Thus, we are caught in the eddies between the Scylla (the mythological antecedent of the "rock") of a voluminous acknowledgment section which few will have the fortitude to read, and the Charybdis (the predecessor of the "hard place") of appearing to be blind to and ungrateful for the substantial help we have received. The following is our attempt to emerge from these cross currents with both our readers and reputations.

First, thank you to the many individuals around the country who gave generously of their time and thoughts during our interviews (a list of interviewees appear in Appendix C).

Second, thank you to our reviewers, The Honorable Robert Hallisey, Professor Edward J. Imwinkelreid, Professor Joseph L. Peterson, and The Honorable William Young, for your good words, exhaustive comments and suggestions, and helpful criticism.

Third, thank you to Jeffrey Jacobs, Linda Marshall, Esther Naylor, and Brain Stegman for your tireless exploratory forays into the library stacks and card catalogs, to Hugh L. Bernard, Law Librarian, George Washington National Law Center for allowing access to the Law Center's fine collection, and to Linda Sweeney for your valient and valuable help in completing the coding for the bibliography.

Fourth, thank you to Venessa Allison, Jane Daly, Martha Luther, Brenda Synder and Deborah Washington, for putting up with all our drafts and changes over the past year and a half.

Finally, a special thanks to our grant monitor, Linda James McKay, for your help, guidance and understanding throughout the project.

Michael J. Saks
Richard Van Duizend

ABSTRACT

In litigation, as elswhere in contemporary American society, we have come to rely on scientific and technological information with increasing frequency. Plaintiffs in personal injury suits must usually present expert medical testimony in order to avoid a directed verdict for the defendant. In many jurisdictions, testimony from an economist or statistician regarding the amount of income the plaintiff could have earned is also presented as a matter of course. In criminal cases, experts ranging from chemists to document examiners to psychiatrists routinely testify. In addition, judges and juries are called upon to assess lengthy presentations and voluminous technical material concerning such matters as pricing structures in a particular industry, employment practices, and industrial waste disposal procedures.

Scientific evidence is valued because it helps bring about the authoritative resolution of disputes. Yet when the management of such infusions of unfamiliar, complex, even alien information into the litigation process is itself the issue, almost no scientific evidence is available to provide guidance. Accordingly, the Scientific and Technological Evidence in Litigation Project was undertaken to summarize what is known about the process, to identify the issues and problems that arise in the use of such evidence, to note the solutions often proposed for coping with the identified problems, and to suggest priorities and directions for future research. It was intended to lay the groundwork for the development of knowledge about how attorneys and courts use or try to use scientific and technical evidence.

During the course of the project, Richard Van Duizend, Senior Staff Attorney at the National Center for State Courts, and Michael J. Saks, Professor of Psychology at Boston College, reviewed the written materials pertaining to the use of scientific evidence. This literature came not only from legal practitioners and scholars, but from practitioners and scholars in fields whose members sometimes serve as experts in litigation: medicine, psychiatry, clinical psychology, economics, engineering, statistics, and the specifically litigation support field of criminalistics and forensic science, among others. In addition, relevant published legal opinions, federal and state statutes controlling the discovery of scientific evidence and its admissibility as evidence, certain trial transcripts, codes of ethics from various scientific and professional fields, and miscellaneous other documents were examined. Saks and Van Duizend also conducted nine "case studies" as well as over twenty non-case study interviews. The case studies consisted of typical cases which varied along several dimensions in an effort to capture the range of possible difference in procedure and practice: civil and criminal cases, different geographic locations, urban and rural settings, various scientific and technological fields. While it is common to find articles in which a judge or lawyer or expert from one or another locality reflects on his or her experiences, no other sources exist in which all the major perspectives--judge, lawyer, expert--are invited to talk about a single case common to all.

Among the many problems which were identified through the literature review, case studies, and interviews are: the difficulty which lawyers have in locating qualified experts willing to testify, particularly when all available experts in a certain field are employed by one of the parties to the litigation (e.g., a police forensic science laboratory); the reluctance or inability (due to time and financial pressures) of many attorneys to prepare themselves and the experts before the trial so as to be able to present the scientific evidence as cogently as possible and to illustrate the shortcomings of the technical materials presented by the opposing party; the conflict experts experience over their role in the proceedings--i.e., are they neutral purveyors of scientific fact or part of a litigation team; and finally, the inability of courts in general and appellate courts in particular to obtain the information, advice and perspective needed to decide cases that are based on conflicting scientific or technological evidence and interpretations.

The report is organized into five chapters. The first introduces the subject and the nature, design, and limitations of the study. Chapter 2 presents the nine case studies which constitute the original information collected by this study. Chapter 3 contains the findings concerning the rulings, rules, statutes, informal practices and factors external to the justice system which appear to affect (facilitate or distort) the delivery of state-of-the-art scientific or technological knowledge to the fact-finder. It also presents the ways in which the scientific and technological knowledge affect case processing--for example, possible effects upon settlements or upon the nature and balance of trials. Chapter 4 highlights the problems experienced by participants in the system and discussed by knowledgable observers. Chapter 5 presents recommendations for future work both to better understand the mutual impact of the litigation system and expert knowledge, and to facilitate the implementation and evaluation of improvements.

Accompanying the report is an indexed bibliography of books and articles concerning the use of scientific evidence in litigation. The bibliography contains approximately 800 entries. These entries are numerically coded to assist readers in identifying the issues, types of expertise, and the type and stage of litigation addressed.

For further information regarding the project, contact Richard Van Duizend, National Center for State Courts, 6723 Whittier Avenue, Suite 302, McLean, VA 22101 [(703) 893-4111], or Michael J. Saks, Boston College, Department of Psychology, Chestnut Hill, MA 02167 [(617) 969-0100, ext. 4100].

Chapter 1. Introduction

In litigation, as elsewhere in contemporary society, we have come to advert to scientific and technological information with increasing frequency and even dependence. While this trend has been well established for generations (e.g., see Foster, 1897; Friedman, 1910), practitioners and policy makers have had to cope with the problems engendered by it in largely unsystematic ways. Virtually all that has been written and said on the subject reflects the anecdotal experiences of those authors, or at best the accumulated wisdom of those who have had to deal with such evidence by the seats of their pants, skirts, or robes. The statutes and rules written to govern the development and presentation of scientific evidence in court has, similarly, been informed largely by non-empirical or non-systematic understanding of what actually takes place. Controversies in this area have been resolved not so much by an examination of data on the subject but instead by a "heated exchange of quotations."

This is an ironic state of affairs. Scientific evidence is valued by the law because it helps bring about the authoritative resolution of disputes. Yet when the management of such infusions of unfamiliar, complex, even alien information into the litigation process is itself the issue, almost no scientific evidence is available to provide guidance.

What is needed, then, is systematic empirically derived information about scientific and other technical evidence. In recent years, such work has been undertaken to study the use of scientific knowledge in decision-making in other forums, such as executive branch agencies, legislatures, and even appelate courts (see Weiss, Social Science Research in Public Policy Making (Lexington Books, 1977)). But trial courts have been overlooked. The present study lays the groundwork for the development of knowledge about how litigation at the trial level uses or tries to use scientific and technical evidence. The purpose of this study is to summarize what is known about the process, to identify the issues and problems that arise in the use of such evidence in this context, to note the solutions often proposed to cope with the identified problems, and to suggest priorities and directions for the future research that will produce a body of systematic knowledge about scientific and technical evidence in litigation. Thus, the present study is a frankly primitive effort which begins by broadly exploring the territory, rather than plunging in to do more refined work on narrower ranges. An unexplored continent should first be mapped, perhaps including some topological information, before a detailed ecological and geological analysis is made of one or a few tracts.

The report is organized into five chapters. The first introduces the subject and the nature, design, and limitations of the present study. Chapter 2 presents the nine case studies which constitute the original information collected by this study. Chapter 3 is the heart of the report. Based upon our literature review and interviews, it contains our findings concerning the rulings, rules, statutes, informal practices and

factors external to the justice system which appear to affect (facilitate or distort) the delivery of state-of-the-art scientific or technological knowledge to the fact-finder. Also presented are the ways in which the scientific and technological knowledge affect case processing, for example, possible effects upon settlements, or upon the nature and balance of trials when cases do reach that stage. In essence, the chapter describes what appears to take place in terms of the range of variations in the system's processing of cases involving scientific and technical issues. Within Chapter 3, subsections proceed ad seriatum through the stages of litigation: prefiling, pretrial, trial, post-trial. Within each of those subsections, we describe germane rulings, rules, and statutes; informal processes; and extra-systematic influences found through our broadly defined literature review and interviews. Figure 1 portrays the litigation sequence graphically, including the salient influences on its functioning with regard to the flow of scientific and technological information.

Chapter 4 highlights the problems experienced by participants in the system and discussed by knowledgeable observers. These problems flow from the examination of the litigation process presented in Chapter 3. Some were explicitly identified by our information sources; others appeared implicit in the process or emerged from study of it. While Chapter 3 would be of major interest to persons wanting to better understand the use of scientific and technological information in litigation, or the process of litigation generally, Chapter 4 would be of major interest to persons concerned with practical improvement of the system.

Chapter 5 presents recommendations for future work both to better understand the mutual impact of the litigation system and expert knowledge, and to facilitate the implementation and evaluation of improvements. Included in this section are solutions which have been "experimented" with, contemplated, or suggested, and strategies for determining which proposed solutions have real promise and for empirically evaluating those solutions that may actually be implemented.

Since most of the references in the text are included in the Indexed Bibliography of books and articles concerning the use of scientific evidence in litigation which accompanies this report, only the author's name and publication date are given. The full citation may be found in the alphabetical listing in Section II of the bibliography. For references which are germane to the report but are not within the scope of the bibliography (e.g., cases, rules, legal treatises and articles on research findings), a full citation is included in the text. Citations to particular case studies refer to the summaries included in Chapter 2.

The Function of Scientific and Technological Evidence

The courts are a forum for making decisions under conditions of uncertainty. These decisions, to be sure, are made within a context of values, both procedural (e.g., what process is due?) and substantive

(under what circumstances ought a defendant to be required to compensate someone for injuries?). But these decisions also require the resolution of disputed issues of fact. Indeed, where there is no disagreement as to facts, there is no real trial, only arguments as to the applicable law.

Even the ancient forms of trial by compurgation, battle, ordeal, and torture were attempts to resolve disputed facts by reducing uncertainty as to where the truth lay. Even the most barbaric of these practices was not invented to inflict suffering or to be laughed at centuries later, but instead to turn the decision over to a higher, more omniscient power. God knew the truth, would be on the side of truth, and the truthful party would thus prevail (Lea, Superstion and Force, 1978). By the end of the 17th Century, this theory of finding the truth had been replaced in Western European nations by the principle that a verdict should be reached only on the basis of evidence (Wigmore, Evidence (Little, Brown 3d ed., 1940)). The manner of reducing uncertainty in decision-making evolved in the courts, as it did in the larger society, into a more rational system based upon evidence and rules of logic by which to draw conclusions from the evidence (Holmes, The Common Law (Little, Brown, 1881)). It is not surprising that an increasingly rational society would find increasing comfort legal decision-making that grew increasingly rational and decreasingly mystical. "In the early 19th Century the primitive modes of trial or truth-seeking were formally abolished, and the two basic evidentiary principles of modern legal procedure were established: First, none but facts having rational probative value are admissible; and second, all facts having rational probative value are admissible unless some specific rule excludes them." (Loevinger, 1977, citing Thayer, 1940.)

The advantage of any system for making decisions by reducing uncertainty is that, to the extent possible, it removes the outcome from the realm of chance or the caprice of decision-makers. The more evidence that is available and the more dispositive it is, the less freedom a decision-maker has to decide arbitrarily. Scientific evidence has the potential for contributing importantly to contemporary methods for reducing uncertainty in legal decision-making. At a minimum, it does so simply by providing additional evidence either in support of a conviction or finding for the plaintiff, or to raise doubts as to the correctness of such a finding. Its advantage over the testimony of lay witnesses is that scientific evidence at its best is not subject to the limitations of human perception, memory, bias, or interest (see Levine & Tapp, 1973). In the same way that properly acting courts defer to evidence to dictate decisions on the facts, properly acting scientists defer to principles and evidence outside of themselves, the evidence, methods, and conclusions and bases for them are articulable and (unlike lay testimony on the "historical" events in dispute) are usually replicable. That is, chemicals can be re-calculated, handwriting can be re-compared, victims can be re-examined, data can be re-analyzed. All this makes scientific and technological evidence eminently subject to cross-examination. Moreover, this means that the fact-finder need never take a scientific expert witness's "word for it." In contrast to a lay witness, whose credibility largely determines the truth-value of his or her testimony, a

scientific witness often can share with the fact-finder the entire process from raw evidence to conclusion (opinion), and the fact-finder, with help from counsel, is in a position to detect errors or be persuaded. This is not to say that scientific and technical evidence have no subjective or interpretive components; rather it argues that such components are narrower and more amenable to scrutiny than is the situation with lay witnesses. Seventy-five percent of respondents to a 1974 survey of 1363 (original sample size 5550) judges and lawyers throughout the United States stated that they believed judges accord scientific evidence more credibility than other evidence and 70 percent of respondents believed that juries find scientific evidence more credible (Schroeder, undated). Whether judges and juries do in fact believe scientific evidence more than other kinds, such as eyewitness testimony, is an important empirical question (Loftus, 1980; also see New York Times 17 March 1981 report on Loftus' research).

We have suggested that the major purpose of the form of trial known in Anglo-American society has been the resolution of disputes through structured truth-seeking, that the contemporary method for such truth-seeking employs the rational consideration of evidence, and that scientific and technological evidence has the potential for assisting such fact-finding. While truth-seeking is a central purpose of trials (Wigmore, Evidence (Little, Brown, 3d. ed., 1940); FRE 102), it must be kept in mind that the over-arching objective of the justice system is the authoritative resolution of disputes. Litigation is a device which serves the social purpose of dispute resolution, not of truth-seeking for its own sake. Because law and science serve different social functions, their respective methodologies for truth-seeking differ (Loevinger, 1977). Science is a continuing quest for improved understanding in its own right. Litigation is a last ditch effort to end a dispute as justly and authoritatively as practicable, and allow the parties and other members of society affected by the dispute to get on with their normal activities. Thus, truth-seeking in court is instrumental to the primary function of dispute resolution (see Cowan, 1963; Thibaut and Walker, 1978). In other times and cultures the parties and the public might have been satisfied with the examination of goat bowels, consultation with an oracle, or trial by combat; this time and place puts its confidence in a fair and rational search for accurate conclusions. To do otherwise would reduce the legitimacy and power of the courts (Aronson, 1978; Yellin, 1981). Only those disputed facts germane to resolving the conflict need be or will be addressed; all evidence must be relevant to the issues defined by the dispute and the law. This instrumental role of truth-seeking, this limitation on what scientific or technological knowledge is of interest to the court, apparently is difficult for some or most experts to adapt to; for them, the knowledge of their particular discipline is of central interest. The instrumental nature of truth in adjudication also means that in deciding whether, what kind, and how much scientific and technological evidence a court will hear, more than truth seeking alone is considered. A judge must make such trade-off decisions as probative value versus prejudicial impact and probative value versus time consumed.

Thus, the benefits of greater reduction in uncertainty and improved fact-finding stand against an assortment of shortcomings, increased burdens, and institutional dilemmas that interfere with achievement of these potential benefits.

Some Examples

To assist readers unfamiliar with the potential benefits of scientific evidence to fact-finding in litigation, we present several concrete illustrations at this early point.

Often cited as the earliest example is the one that led Archimedes to leap from his tub and run through the streets shouting "Eureka." Hieron, king of Syracuse in about 215 B.C., became suspicious that his new purportedly solid gold crown was actually made partly of silver. Hieron asked Archimedes, a mathematician and physicist, to figure out whether the crown was or was not solid gold without harming it in any way. Archimedes was perplexed by the problem for quite some time until he discovered an answer one day while bathing. Noticing that immersing his body into a full tub displaced a volume of water equal to that volume his body occupied, Archimedes realized that the density of objects could be found by comparing their weights (in air) to the weight of the water displaced. This ratio of the object's weight to the weight of an equal volume of water is what we now call specific gravity. Gold is denser than silver; a given volume of gold weighs about twice as much as the same volume of silver. Thus, by calculating the density of the crown and comparing it to that of gold and silver, Archimedes could state not only whether the crown was made of pure gold (it was not), but the exact proportions of its gold and silver content. (This discovery also explained why some objects float, or have buoyancy. Objects which displaced an amount of water equal to the object's weight, but without equaling the displaced water in volume, would float. That is, the objects were less dense than water, and would have a specific gravity of less than 1.0 because the objects' weight in air was less than the weight of an equal volume of water.)

Kramer (1967) reports another example from civil litigation. A rural Maryland family called in exterminators to rid their property of termites. The exterminators used an nondegradable insecticide of chlorinated hydrocarbon. Members of the family subsequently were afflicted by stomach cramps, malaise, diarrhea, and binding up of their muscles. Their physician attributed the illness to well water thought to have been contaminated by the insecticide. Once the well was closed and other water was used, the family quickly recovered. They brought suit against the exterminators. The plaintiff's attorney had a laboratory test performed on the well water. It reported a (dangerous) level of 0.01 parts per million of the chlorinated hydrocarbon, confirming the physician's diagnosis. In the face of this evidence, it appeared that the defendants would have to settle the claim in a substantial amount. The defendant's insurer's lawyer, however, obtained the assistance of an expert. The scientist read the laboratory report and doubted its conclusions. Accurate detection of 0.01 parts per million would have

required the extraction of large volumes of water on large chromatographic columns. The plaintiff's laboratory's simple spot analysis was refined enough only to know that the measurement was somewhere between 0.00 and 0.01 parts per million. Further, a check of state health department files found that ground water in the area had an insecticide contamination level of 0.001 parts per million, attributed to seepage from widespread cropdusting. An inspection of the property by the defendant's scientist revealed unsanitary sewage disposal conditions, so he had the well water tested again, this time for bacterial measures. High levels of pathogenic contamination were found. These findings cast doubt on the cause of the family's illness and based on this information a more modest settlement was agreed to.

The final example comes from the criminal side. Organic chemist Robert Shapiro in an interview published by Levitt and Guralnick (1977) reports that in cases alleging illegal possession of controlled substances, prosecution chemists sometimes use tests which are suitable only for screening, not for specific identification of a substance. That is, the test is able to reduce the possibilities from three million compounds to only a half million or 100,000. On the basis of a test which shows only that the compound in question is a member of a sizeable class, some forensic chemists are prepared to take the stand and state their opinion that the substance is methamphetamine (or THC, or cocaine, or whatever). Often, such testimony goes unchallenged by the defense. Through proper preparation with a defense chemist, however, defense counsel is often able to cross-examine effectively, and to have the defense expert explain why the tests performed were not sufficient to specifically identify the compound in question. Shapiro gives several examples of cases where the drugs in fact turned out not to be what the prosecution alleged and the prosecution's forensic chemist testified they were. (Also see State v. Vail 274 N.W. 2d 127 (Minn. 1978) for a dramatic example of the point.) That this problem is common is evidenced by the fact that Peterson, Fabricant and Field's (1978) study of laboratory proficiency found that over 18% failed to accurately identify the sample drug.

Still other examples are provided by our description of the nine cases examined as part of our research (see Chapter 2).

In What Context Is Scientific Evidence Used

The range of scientific and technological subjects that now enters the courts almost certainly approaches the range of scientific and professional disciplines: the many fields of engineering, the many branches of medicine, chemistry, physics, toxicology, physical and cultural anthropology, statistics, economics, accounting, biology, document examination, sociology, psychology, law, linguistics, ballistics and weapons identification, and so on. The kinds of cases which employ scientific and technological experts similarly is almost without limit. Various commentators note that the use of experts is steadily rising (e.g., Cooney, 1971), perhaps due to the continual development of new uses for science and technology in answering old questions, perhaps due

to the discovery by lawyers of techniques that have long been available, perhaps due to new questions arising with the increasing complexity of society (Younger, 1977; Yellin, 1981; Bazelon, 1979). Schroeder's survey (undated) indicated that 23 percent of judges and lawyers encountered scientific evidence in at least half of their criminal cases; 24 percent believed that in at least half the cases where it was not used it could have been; and 86 percent felt that they would like to see more used than has been. Apparently, scientific evidence is used less than it could be. Parker (1963) concluded that fewer than two percent of local criminal cases benefitted from laboratory analysis of any kind. Parker and Peterson (1972) found that only four of 3303 felony cases they examined involved the submission of evidence to a laboratory. Lassers (1967) found that only 25% of capital trials in Illinois included scientific testimony.

Some cases virtually cannot be tried without the assistance of experts. On the criminal side, these include homicide (in which cause of death is testified to by pathologists) (see e.g., Homicide Case - Case Study 1), arson (fire marshals) (see e.g. Arson Case - Case Study 7) (forensic chemists) (see e.g. Ballistics Case - Case Study 8), forgery (document examiners)(see e.g. Questionned Documents Case - Case Study 5), and possession or sale of controlled substances (toxicologists, chemists) (see e.g. Drug Case - Case Study 9). On the civil side these include antitrust (economists), environmental litigation (engineers, chemists), products liability (engineers), professional negligence (physicians and lawyers), personal injury and wrongful death (physicians, economists) (see e.g., Personal Injury Case - Case Study 2). Unfortunately, no reliable current data exist which provides useful estimates of the frequency with which particular kinds of experts are used in which kinds of cases. Schroeder (undated) and Kalven and Zeisel (1966) are the only studies known to us containing such data, and these pertain only to criminal cases. Such data would permit the more cost-effective targeting of many kinds of efforts to improve the use of science in courts.

Scientific and technological knowledge can enter the judicial process through a number of doors. At the trial level, the most usual is through the presentation of testimony by expert witnesses called by parties (FRE 702, 703, 704, and 705) or through reports stipulated to by counsel. However, trial judges may also receive briefs which contain such evidence, may call their own witnesses, may appoint court advisers, may refer parts of a case to a special master, or, under certain circumstances, may appoint an advisory jury composed of experts (Fed. R. Civ. P. 39(c)), or may take judicial notice of scientific and technological facts not in evidence. At the appellate level, where it is appropriate to the case to introduce scientific or technological facts (in contrast to legal arguments), typically they are received through the trial record and briefs submitted by the parties and by an amicus curiae. Appellate judges and their clerks are also free to read anything that can be found on library shelves or to judicially notice facts about which there is no dispute. Other, less formal avenues of information receipt are occasionally travelled (Marvell, 1978).

Problems Areas

The primary assumption of the present study is that the potential exemplified by the above illustrations is achieved only infrequently. In order for the courts to benefit properly from scientific and technological evidence, every step in the process from a lawyer's first identifying a question as susceptible to scientific study, through final comprehension and consideration by the fact-finder must be navigated successfully. Various commentators and a few systematic studies suggest that various opportunities exist for something to go wrong and something often does. At a relatively sophisticated level of consideration, the use of experts creates additional burdens on the courts to decide whether and what to admit as evidence, on the attorney to develop and present lucid scientific or technical evidence, and on the fact-finder to comprehend the evidence, the opinions, the underlying reasoning. In short, the benefits come at the price of straining the information processing capacities of the institution.

At a cruder level are more fundamental problems: the additional cost creates inequities that place the less well-financed party at a disadvantage; some experts may be incompetent, incomprehensible, or dishonest; qualified experts may simply not be available (or will not make themselves available).

In brief, the purpose of the present study is to identify problems in the use of scientific and technological evidence in litigation, to identify suggested solutions to those problems, and to propose ways of implementing and evaluating those solutions, or, where appropriate, suggesting avenues of further study.

Research Questions

This project sought to begin filling a vacuum in the effort to improve the use of science and technology as evidence in litigation. Little systematic data exist about any aspect of the problem. Indeed, there are no systematic data to confirm that certain problems do in fact exist. While our preference would have been to select one or several promising reforms, to arrange for their implementation on an experimental basis, and then to evaluate empirically the effects of those reforms; we have little or no basis on which to choose a solution or even the problems to which to turn our attention. To choose a problem area arbitrarily might leave us studying a non-problem and neglecting real or larger or more important issues.

Reason exists, however, to think that some problems are present. Books and articles by lawyers, judges, and experts talking about various aspects of science and technology in litigation, or casual conversations with lawyers, judges, or experts, reveals that their encounters with each other are characterized by dissatisfaction, tension, or even hostility (e.g.,Bazelon, 1979; Belli, 1968; Gots, 1977). What limited data already exist suggests the presence of unaddressed problems and, conversely, much vaunted "problems" that may not really be problems. Schroeder's survey,

for example, suggests the existence of such problems as underutilization of science where it could have been helpful, lack of expertise on the part of experts (41 percent of respondents say there is), lack of understanding by experts of the court process (49 percent), insufficient preparation for court appearance (49 percent). Kalven and Zeisel (1966) in surveying judges as part of their famous study of juries found that in criminal cases a "battle of experts" developed in no more than 3 percent of cases. Peterson, Fabricant and Field (1978) studied the accuracy of results of testing by forensic science laboratories by sending samples of known materials to them for identification. Error rates ran as high as 70 percent. There is little reason to think that many of these kinds of errors were detected by counsel for the defense (Levitt & Guralnick, 1977; also see, Parker, 1963; Parker and Peterson, 1972; Peterson, 1974; and Schroeder, 1977). Given the low pay and slight emphasis on education and professional qualifications in many forensic science laboratories, this result ought not to be as surprising as it is (Lappas, 1978). These important beginnings are all in the criminal justice area. Virtually no relevant studies exist of trial courts hearing civil cases. A reasonable surmise would be that experts are used more in civil cases, though less is known about that use.

The present study sought to examine broadly the entire range of possible problems--from the initial stages of an action through verdict plus some consideration of post-trial activity; in civil as well as criminal cases; at various levels of influence on the process, including rules of evidence and procedure, the informal relations among attorneys and experts, and the influence of the world outside of law offices and courts: the state-of-the-art of different fields, the training of experts, codes of ethics and informal norms which exist in professional associations, the structure of organizations which provide experts for litigation; and the alternative perspectives of attorneys, experts, and fact-finders, especially judges, in various geographic locations.

Method Used

A thorough, systematic, quantitative study of such a large range of questions would be prohibitively expensive and time-consuming. The present study seeks instead to identify key problem areas by an essentially qualitative examination of diverse kinds of "data."

One class of source information consisted of a review of written materials relevant to the subject. Most of this material consisted of books and articles published in professional journals. This literature came not only from legal practitioners and scholars, but from practitioners and scholars in fields whose members sometimes serve as experts in litigation: medicine, psychiatry and clinical psychology, economics, engineering, statistics, the specifically litigation support field of criminalistics and forensic science, and assorted others. Much of the literature unearthed by this search has been assembled into a bibliography coded along a number of dimensions, and published as a document separate from the present report. Appendix A of this report contains the content coding scheme of that bibliography (in a sense, its

table of contents). In addition, we examined relevant published legal opinions, federal and state statutes controlling the discovery of scientific evidence and its admissibility as evidence, certain trial transcripts, codes of ethics from various scientific and professional fields, and miscellaneous other documents. These documents are cited, as appropriate, in the body of this report.

The second class of source information consisted of "case studies," and miscellaneous other interviews not part of the case studies. The case studies consisted of nine cases which varied along several dimensions in an effort to capture the range of possible differences in procedure and practice: civil and criminal cases, different geographic locations, urban and rural, employing different scientific and technological fields. While it is common to find articles in which a judge or lawyer or expert from one or another locality reflects on his or her experiences, no other sources exist in which all the major perspectives--judge, lawyer, expert--are invited to talk about a single case common to all of them. We found, also, that what gets published and what gets discussed privately are not altogether the same. Table 1 summarizes the mix of cases, localities, and so on included in our case studies. The cases were found by conducting preliminary interviews with a variety of judges, lawyers, and experts known to us personally or known by reputation or to whom we were referred by others. These people alerted us to cases known to them or to referrals whom they thought would know of suitable cases. People had considerable difficulty remembering "run-of-the-mill" cases, which is what we asked for; the cases they recalled tended to stand out in their memory owing to some unusual feature. Our list of nominations included thirty-five cases, which we pared back to nine. Table 1 also shows the distribution of attributes of the original set of nominated cases.

We contacted the judge, lawyers, and experts involved in each case, obtained their consent to be interviewed, and had various documents related to the cases--transcript, pleadings, briefs, reports by the experts, exhibits, and so on--made available to us. We informed ourselves of the cases by examining as many of the documents as possible, and then met with the case principals to interview them. The interviews were moderately structured, following different protocols prepared for judges, lawyers, and experts. The questions included in each protocol are contained in Appendix B. Each interview lasted approximately one hour. The level of cooperation we received from the respondents was a extremely gratifying. They gave us their time, shared with us their documents, on some occasions placed portions of their offices at our disposal, and were willing to explore a variety of sometimes delicate areas with us in our interviews, sometimes even making statements against interest. Our interviews also inquired about the respondent's experience with cases other than the focal case. In one instance, the attorney declined to discuss the focal case due to the possibility of appeal so that interview was limited to other cases. Each of the nine case studies is summarized in Chapter 2 and discussed in greater detail in Appendix C.

In addition to persons involved with the nine cases, we interviewed (without protocol) over 20 persons involved in various aspects of litigation which makes use of scientific and technological evidence, such as a former director of a state police laboratory, a judge of the federal court of appeals, researchers concerned with forensic science, educators, and numerous others. Appendix C contains the names and organizations of all persons interviewed in the course of the study. We also attended a class in scientific evidence and trial practice taught by a medical school and a law school, and attended a continuing education workshop for expert witnesss given under the auspices of a professional association. These case studies, interviews, and meetings provided the second major class of "data" for the study.

Limitations of the Methodology

Because the "data" of the present study are not random, and because we have no way of knowing if they are representative of the universe of problems experienced, they can make no claim to portraying the distribution of problems in a way that can give a reliable estimate of which are the most frequent. Because of the study's qualitative nature, no claim can be made to weighting some areas as more problematic than others, or some solutions more promising than others. The purpose has been to identify the range of solutions, not their central tendencies. And, obviously, no empirical analysis of causal connections is possible because neither experimental nor correlational data were developed. What the study does offer is a catalogue of identifiable problems. Through logical analyses some may be seen to be more central to the business of delivering state-of-the-art scientific and technological knowledge to fact-finders, or some problems to be more soluble than others. Some tenuous inferences might be drawn from the frequency with which some issues appear in the literature or were mentioned in interviews as to their frequency or seriousness, or at least their perceived frequency or seriousness. Knowledge about those features must await futher research. The present study seeks to identify the issues and possible solutions, and thereby lay the groundwork for that further study.

Products of the Study

The goal of this study is not to find answers, but to focus in on what may prove to be the most worthwhile questions. The products of this study consist of the Bibliography of books and periodical articles and this report, most notably the findings and recommendations contained in the following chapters. We have attempted to capture, organize, and present the range of problems experienced in the use of science and technology in litigation and the solutions variously proposed. Further, the report suggests, with specificity, lines along which we believe fruitful further research and reform might proceed in light of the problems found by the study.

Chapter 2. Original Case Studies

One of the novel aspects of the present study is that we conducted a series of case studies in which we interviewed sets of attorneys, judges, and experts who, within each case study, had all played a role in the same case. Since they all were reacting to a common central experience, we had the possibility of detecting differences in perception due to their differing roles. At the same time that we interviewed regarding the primary case that brought us to them, we went beyond these cases by asking them about their experiences with other cases and asked how they felt that the case at hand was similar to or different from what they regarded as typical of their experiences (see Interview Protocols, Appendix B).

The issues raised in these interviews were used, along with the literature reviewed, as a source of information for the analyses and discussions that appear in the subsequent chapters. What follows now are case by case summaries of what we learned from the interviews.

HOMICIDE CASE: CASE STUDY 1

In this case, an 18 year old defendant in a large northeastern city was charged with homicide and convicted of murder in the first degree by a jury. The expertise called upon in this case was medical. The major factual issues were the proximate cause of death and the definition of death.

The facts of the case can be summarized as follows. On a Sunday afternoon the victim was on his way to visit the home of a friend and co-worker. While walking along the sidewalk someone came up behind him and swung a baseball bat at his head, striking the right side. The incident was observed by a number of people who had known the assailant for many years. The victim was ministered to by a bystander who was a nurse, and soon was taken by police to a hospital. There he was diagnosed as suffering a subdural hematoma (bleeding within the brain, which creates pressure that destroys brain cells and requires urgent treatment to try to release the pressure and prevent damage). Extensive skull and brain surgery was performed, including removal of a large portion of the skull. The victim, in a coma and unable to breathe for himself, was placed on a respirator. After a few days and through consultation with the victims family, it was decided to remove the respirator.

Pre-filing Issues

Primary Case. The first contact with one of the physicians occurred when he was called into the district attorney's office to help read and interpret the medical chart, apparently because his signature was the most legible of those present. Contact was mostly with the assistants to the prosecutor who was actually managing and would try the case. In

going through the medical records with one of the physicians, the prosecutor was disturbed to find that the respirator had been removed. He thought that might create a barrier to the successful prosecution of the case. As it turned out, the defense attorney said that on his perusal of the hospital records, that struck him as the best chance for a successful defense. One of the physicians commented that when they contacted the hospital's lawyer for advice while managing the victim, the hospital lawyer showed little comprehension of the issue of little interest (or, we speculate, might have understood but failed to explain the reasoning to the physicians, because the hospital lawyer did advise them to continue life support). They might have chosen differently if their legal advice had been more informed and informative. The prosecutor did explain the "big picture" to the medical witnesses--what the legal issues were, what was needed of them, what defense they anticipated--and their help was sought in assisting to substantiate what the prosecution needed to prove. On the other hand, communication was probably hampered by the use of intermediaries to interview physicians, a threat made once to one of the physicians that they had better be helpful or they themselves might be charged with manslaughter for removal of the respirator, and the unkept promise made by the prosecutor to rehearse the testimony with one or more of the physicians. One of the physicians commented that as the trial drew close and he needed more guidance for preparation, he felt abandoned by the prosecutor.

In General. The search for experts is almost always conducted, according to our attorney interviewees, by resort to an informal social network, rather than by use of ads or brokering agencies. The attorneys trust the recommendations of their friends, and some intelligence about a track record, more than a referral by strangers.

Pre-trial Issues

Primary Case. The preparation for this case was rated as generally excellent by all involved (witnesses, attorneys, and judge commenting on each other). However, there were some chinks in this picture as well as some suspicious motives attributed for the unusally good preparation. A reading of the transcript suggests that the prosecution was not as conversant with the medical facts as the defense. The judge, however, praised the prosecutor's preparation and was unimpressed by the defense. One of the medical witnesses said that the defense lawyer was so well-prepared, he had the doctor terrified. Well-prepared in this context means both highly conversant with the general medical facts and highly knowledgable about the contents of the medical record, procedures, and facts of this specific case. One witness believed that the defense attorney worked especially hard on this case because he saw it as a chance to advance his reputation through an important medical controversy. The judge and lawyers believed that the witnesses prepared themselves to get the brain death criteria accepted as law. But, the medical witnesses said no such meetings or discussions took place. It was agreed by the witnesses and lawyers alike that preparation for civil cases is usually better than for criminal.

The defense attorney was appointed as assigned counsel at the arraignment, literally being pulled off the corridor when the defendant's hired attorney did not appear. The defense attorney's firm lost a good deal of money on the case, because the resources put into it far exceeded the state's compensation. When asked why this uneconomical strategy was employed, the answer was that the firm only operates one way, and "if you're in for a penny, you're in for a pound."

The defense attorney was unable to obtain emminent out-of-state witnesses to counter the prosecution's brain-death opinions because, he speculated, the out-of-state medical witnesses did not want to testify against their brethen in a context in which to prevail would likely expose some of the prosecution's medical witnesses to civil liability for wrongful death. The medical witnesses had reason to want a conviction: the prosecutor's office said it might go after them for manslaughter if a conviction were not obtained in this case, and malpractice action was also salient.

In General. It was generally agreed that scientific and technological evidence usually facilitates settlement, by reducing a case's factual ambiguity, even though this did not happen in the instant case. The defense attorney favored very liberal discovery and essentially open files on the scientific fact issues.

Trial Issues

Primary Case. The major defense put forward at trial was that death was caused not by the assault with the baseball bat, but either by errors made during emergency surgery or by the premature removal of the respirator, with the latter emphasized. The issue became the common law definition of death (cessation of circulation and respiration) versus a new definition of death as also including "brain-death" (defined as no response to external stimuli, no effort to breathe, no reflexes, flat EEG). The prosecution's position was that death is best defined by the physicians. The defense argued that it is a legal question, and includes more than biological considerations. The judge said that it was a factual question to be left to the jury. The judge fashioned a set of instructions which gave this question to the jury and guided them by instructing that brain-death could constitute legally valid death. The instructions and definitions were upheld on appeal to the state's supreme court.

Normally the qualifications of experts in this area is simply a matter of establishing the witness's credentials as a licensed physician. Sometimes the question of specialization arises. In the present case, because of the nature of the defense, challenges were raised and in a few instances limitations placed on the testimony. These had to do with the ability of any physician to define death, and certain physicians to diagnose neurological injury or read EEG's. The judge's basis for deciding when a medical expert has the necessary training or experience to speak on a certain issue (how many hours of instruction on X is enough hours?) is largely decided by the seat of the pants. In

addition, the judge said at the trial that he would allow ethicists to testify on the issues if they were called, but they were not. The judge has the dual problem of deciding if such expertise is relevant and whether this expert is qualified. On the subject of brain-death as a definition of death, the fact finder wants to know the consensus of the field, but can only know what the individual witness' view is or what the witness says a consensus is.

Post-trial Issues

The prosecution witnesses remained informed about the case largely because they called the prosecutor to find out what happened. Interestingly, one interviewee asked the Project Interviewer if he could find out the defendant's earliest parole date and convey that to the interviewee. The appeal itself focused on the definition of death employed, the judge's rulings allowing physicians to so testify, and the judge's instructions. The highest appellate court of the state upheld the decisions made at trial, allowing a change in the common law definition of death, and permitting that definition to be shaped by experts.

PERSONAL INJURY CASE: CASE STUDY 2

This case was a personal-injury tort action in a large eastern city. The plaintiff fell down a trash strewn stairway in a city facility injuring his back. He alleged further that poor treatment by city employees aggravated the injury. The case was tried before a jury. The primary issues were the extent of the plaintiff's injuries resulting from the fall and the nature of his current disabilities. Three experts witnesses testified in the case. A neurosurgeon and an economist testified on behalf of the plaintiff. An orthopedist testified for the defense. Voluminous medical records were introduced. The jury found for the plaintiff and awarded approximately $45,000 in damages.

Pre-filing Issues

Primary Case. Since medical records were available regarding the plaintiff's injuries and treatment, and since the basic issues in this case were relatively clear, there was no effort to seek expert advice in filing and preparing the case. The plaintiff's attorney felt competent to review the medical records and talk with the treating physicians for purposes of defining the issues and proposing a damage figure.

In General. There is a greater need for pre-filing expertise in more unclear or technical cases. For example, plaintiff's counsel indicated that unless there has been medical investigation prior to the filing of a medical malpractice suit, the defendant physician is likely to sue the plaintiff's attorney for malicious prosecution if the malpractice suit is unsuccessful. Product liability is another area in which there is a need for expert advice prior to filing. One mechanism which has been developed

to address this problem is an unsigned preliminary opinion letter provided for a fee by one of the expert referral services. Another technique is for the prospective plaintiff to hire an expert as a consultant.

Pre-trial Issues

Primary Case. The major pre-trial issues were the decision to use scientific evidence and the selection of an appropriate expert. Plaintiff's attorney concluded that having medical and economic experts was necessary "to get the case to the jury." Defendant's attorney indicated that his office retains a medical expert and has the plaintiff examined only where a 100 percent disability or "big bucks" are involved, and rarely employs an economist to rebut the lost future income projections presented by the plaintiff. Both attorneys located their experts through "the grapevine"--i.e., through referrals from other attorneys and physicians--rather than through an expert referral service. It was noted that expert locator services, particularly those charging a 5 to 10 percent contingent fee, substantially raise the cost of litigation. Plaintiff's medical expert indicated that informal referral is the usual way in which he becomes involved in a case, since he does not advertise or otherwise promote his availability as an expert witness. Plaintiff's economic expert, on the other hand, has placed advertisements in local legal papers and periodicals. He commented, with evident frustration, that such ads have borne little fruit, and that he too is retained primarily on the basis of referrals. Fee negotiations were carried out during the initial telephone conversation. Plaintiff's medical expert indicated that he had asked the attorney to send him a brief outline of the case so that he could estimate how much time would be involved and the consequent fee. The plaintiff's economic expert had worked with plaintiff's attorney previously and simply reminded him of the hourly rate. The defendant's medical expert advised counsel of his rate and that rate was agreed to in the initital call.

There was little discovery in the case although the plaintiff underwent tests and examinations at the defendant's request. The absence of depositions and a written report from defendant's expert were attributed to the retaining of the expert close to the date of trial, rather than to a tactical ploy to surprise the opposing party. In fact, defendant's counsel commented that he found written reports critical for preparing his own case. Both experts stated that in their experience, depositions were rare. Plaintiff's attorney stated that he sent prospective expert witnesses a copy of the complaint followed by an explanatory phone call rather than a detailed letter explaining the facts and theory of the case, because such a letter would be subject to discovery and might suggest that the witness was being coached. In addition, he sometimes employed experts for consultation purposes to obtain non-discoverable information.

Both attorneys met with their experts to prepare for trial. Plaintiff's attorney met with his medical expert three or four times prior to trial at the physician's office. Two of these meetings were

specifically for going over the proposed testimony and preparing the witness for cross-examination. The attorney and expert engaged in a mock examination and cross-examination during these meetings. In prior meetings and during several telephone calls, they discussed the facts of the case and the results of the doctor's examination, although the doctor noted that a number of questions had been asked on direct exaination at trial which they had not gone over. The same practice was followed with regard to the economist. The attorney stated that he always asks experts whom he has retained to brief him on the scientific and technical areas which are involved to explain to him the tests and terms used. Both experts observed that they had to brief counsel on only very few of the technical aspects of the case because of his experience in the field. They too required little explanation of the legal aspects.

In General. Plaintiff's attorney discussed the dilemma of selecting an expert before knowing what he or she is going to say. He indicated that there were three techniques used to handle this problem. The first is to retain someone with a known orientation towards the particular matter at issue. It was the attorney's view that the value of such witnesses is minimal at trial, because the jury will not find them as credible as an expert who appears as an objective, neutral scientist. He indicated, however, that others felt that an expert who testifies for both sides is seen as wishy-washy by the jury and that someone with strong direct views is a preferrable witness. The second method of selection is to retain an expert for consultation purposes. In most jurisdictions some one retained for consultation is not subject to discovery unless he or she will testify at trial. In this way an attorney is able to shop around at relatively low expense to find an expert who will best aid the case. The third method is to have a telephone discussion with an expert in which the general facts are laid out and a general sense of the expert's inclinations are obtained. If the attorney is comfortable with the expert and the expert is comfortable with the case, then the expert can be hired for consultation purposes. It was indicated that there appeared to be an unwritten rule among the expert community to be available for this type of informal exploration. Both attorneys indicated the ability of an expert being able to present information clearly and effectively is as important as his or her substantive knowledge.

Both of the plaintiff's experts described their methods of preparation. The medical expert stated that he preferred to receive only a brief outline of a case initially so that he can form an independent opinion to the greatest extent possible form an examination of the litigant and a study of the records. The economic expert stated that he has developed a checklist of questions to ask attorneys to obtain the information needed for his projections. He commented that most attorneys have much of this information readily available or are quite willing to obtain it. There is then considerable back and forth discussion to clarify facts and assumptions. He then prepares a number of alternatives based on differing assumptions to discuss with the attorney and to prepare himself for hypothetical questions and cross-examination. He noted that the explanation desired by attorneys varies considerably.

Both experts commented that it is common to be called very close to the date of trial. Both also noted that their decision to participate in a case is largely dependent upon the attitude of the lawyer who called them. If the lawyer suggests that he or she has a predetermined idea of what the testimony should be, neither expert will accept the retainment offer. The medical expert also stated that he is reluctant to work for a criminal defendant whom he feels is clearly guilty.

Both plaintiff's and the defendant's medical experts commented that they are sometimes more anxious than the attorney to prepare for both their own cross-examination and that of the opposing expert. They stated that such preparation is particularly crucial in malpractice cases, noting that preparation of references to articles in professional journals is far more important in such litigation. With regard to discovery, the defense medical expert commented that the degree to which an attorney prepares for a deposition is often related to the attorney's experience. He indicated that more experienced attorneys prepare for a deposition to almost the same extent as trial. He has sometimes been retained to help an attorney hone deposition questions, particularly on technical issues. From the perspective of the expert, he felt that a deposition requires less preparation than trial, since some matters can be left open pending further investigation of the record. Defendant's attorney stated that his office's policy permits depositions in major cases, but that he only deposes a witness if the deposition is required to gain a better understanding of the plaintiff's claim or when he feels confident that he can poke holes in the report or theory of the opposing witness.

Trial Issues

Primary Case. There was little skirmishing over the admissibility of the medical records or the qualification of the experts at trial. The former was attributable to a pretrial stipulation. The latter resulted from the overlapping expertise of neurosurgeons and orthopedists concerning the type of back injury suffered by the plaintiff. While the differences in focus were pointed out to the jury, there was a consensus that those difference did not affect the credibility of the witnesses. Both attorneys and all three witnesses were perceived as being well-prepared, and there was agreement that both the medical and economic evidence was well-presented. One attorney stated that it was the lawyers' job to clarify the expert's testimony for the jury by requesting definitions in lay terms of any technical terms and descriptions of the tests used. The conflicting medical testimony was viewed as different interpretations of the same set of facts regarding a type of injury that is, by nature unclear. Cross-examination was characterized by several interviews as "a chess game," with the attorney and expert parrying each other's moves. The defense expert observed that a well-prepared expert can turn almost any cross-examination question to his side's advantage so long as a yes or no answer is not required.

As noted earlier, expert testimony on behalf of the plaintiff regarding the injury and damages as necessary to avoid directed verdict. All three testifying experts believed that they had been able to present

their information effectively. However, the judge and attorneys felt the net effect of the medical testimony was indecisive. The economic presentation appeared to have some impact, since the verdict matched the bottomline figure specified by the witness. However, the judge and attorneys questioned the degree to which the jury understood that testimony since the figure represented the estimated future income of the plaintiff rather than that for pain and suffering, and based on the plaintiff's work history, the probability of future income was rather low. The economic expert attributed his effectiveness to the conservative approach he takes in making projections. He stated that although this somewhat limits the possible award, it limits the vulnerability of his testimony and makes him appear more credible, neutral and objective. He noted with some pride the number of cases like this one in which the jury has returned a verdict matching his projection.

In General. There was disagreement among the interviewees regarding the most credible posture for an expert to take. The judge felt that expert witnesses who acknowledge that there can be differing interpretations of particular evidence are more credible than those who maintain an unequivocal stance. On the other hand, the defense medical expert felt that an expert is forced by the nature of the legal system to give the answer most helpful to his or her side in the litigation within the bounds of conscience and truth. There was also a split of opinion over the credibility of experts who derive a large proportion of their income from litigation support. Some felt that a cadre of professional experts is needed because of the general unfamiliarity of many physicians with the legal system and their unwillingness to undergo the inconvenience and tribulations of trial. Others were suspicious of professionals who have "forgotten how to practice" their specialities outside the litigation process.

Plaintiff's medical expert mentioned that many physicians unfamiliar with the trial process appear to be terrified about appearing in court. He attributed this in part to the fact that they were unused to both the procedures and to having their opinions questioned by laymen. He mentioned that to overcome at least the portion of the problem attributable to unfamiliarity, he is helping to prepare a medical legal manual for the local area. Another problem cited by this physician was the willingness of some doctors to attest to theories with little support (e.g., that a brain tumor could be attributable to a blow on the head during an automobile accident) or to claim that one method is the only way to conduct a particular procedure when in reality, there were two or three accepted techniques.

There was greater unanimity regarding the use of court-appointed witnesses. All agreed that for a number of reasons including the absense of funds, judges in the jurisdiction rarely appointed an "impartial court witness" in civil cases. It was noted that in criminal cases, such appointments were more frequent because of the availability of a court psychiatric clinic. Both of the plaintiff's experts indicated that their testimony would not have been different had they been appointed by the court. The economist added a court retained panel of experts would

likely include economists with excellent paper credentials but little practical experience and that the selection criteria were likely to be arbitrary. He suggested that individuals who appear frequently in court should be asked to donate a certain amount of time pro bono to assure all classes of litigants equal access to experts.

There was agreement by the attorneys that it would be beneficial if the court could appoint a single expert agreed to by the parties rather than having each party call his or her own expert. It was anticipated that this would reduce the amount of time and money spent on expert testimony as well as reducing the confusion to jurors. It was pointed out that the agreement to call a court appointed witness must be reached prior to trial to avoid delay, and that the current reluctance of judges at the pretrial conference to encourage agreement on a single witness or stipulation to non-disputed facts should be overcome.

Post-trial Issues

As a general practice, though not in this case, it appeared that the attorneys in the case informed experts whom they had retained of the verdict. All the experts stated that if an attorney does not call them following the verdict, they will call the attorney.

CIVIL RIGHTS CASE: CASE STUDY 3

This taxpayer's suit originated in a major west-coast city, but was immediately recognized by all parties as the first step in a chain of appeal designed to result in state-wide reform of the bail system. The plaintiffs were several taxpayers interested in reform; the defendants were the county's Sheriff and city's Chief of Police. The goal was broad-gauged modifications of the laws and rules governing bail, including the elimination of the money bail system. The case reached the state's Supreme Court, which upheld the money bail system, but reversed the burden of proof, by requiring that prosecutors show why defendants should not be ROR'd. The major factual issues were the workings of the money bail system, the nature and effects of pretrial confinement, and the availability and efficacy of alternative systems and programs for assuring the appearance of defendants for trial. The experts called upon were persons who administered the city's pretrial detainment facilities, a judge, a bail bondsman, attorneys, and persons who administer ROR Projects in other cities around the country.

Pre-filing Issues

Primary Case. The original strategy of this case was to prepare a statistical case, presenting economic and demographic data to describe the function of the bail system under attack, failure to appear rates (FTA), and make comparisons with alternative programs in other cities. Plaintiffs' attorneys say they "fumbled along" trying to find the evidence and witnesses. The plaintiffs found that the data either did not exist or were inaccessible. They resorted to using persons who were

personally and directly involved in bail and pretrial detention systems and could report their observations, make quantitative (or quasi-quantitative) estimates, and speculated on effects and effectiveness. When the case was filed, a controversy barely existed. One of the defendants essentially sided with the plaintiffs, saying that jail conditions were indeed deplorable, because his department was underbudgeted. The "real" adverse parties were the bail bondsmen. They were the only party that really stood to lose if money bail was abolished. The City Attorney at that time decided to do battle with minimal vigor--perhaps due to political considerations, perhaps due to considerations of the wisest allocation of the Office's resources.

Pre-trial Issues

Primary Case. The case involved extensive filings and briefings. The plaintiffs cited published studies relevant to bail. The defense primarily argued legal points in trying to have the case dismissed or more defendants joined (in particular, the judges who imposed bail).

The plaintiff's attorneys stated that the facts meant virtually nothing in this case. That is, the truth of the facts were obvious to all, and the key was to persuade the court that less restrictive alternatives existed to assure appearance at trial, and the if the courts need not be so restrictive, the Constitution required that they must not be so restrictive. The major purpose of the fact presentation was to demonstrate the availability of effective alternatives to money bail. The plaintiffs deposed potentially hostile witnesses and sent legal assistants to interview the prospective experts. The remaining preparation was done by phone or letter. It appears to have been quite thorough. Plaintiff's counsel also said that studies by bail programs themselves or academics were of little interest because they thought statistics would not hold up and they would be less persuasive than people who administer pretrial services programs. Witnesses received no payment; expenses were reimbursed.

Plaintiff's attorneys delivered to the defense all their anticipated evidence--depositions and so on. Although they had tactics to avoid discovery (e.g., to not designate experts and to treat reports as work products), the attorneys interviewed in this case felt that reasonably full disclosure would not hurt their case.

Defense counsel felt that in this case the facts were "everything." They, however, used no experts other than the defendant's themselves.

In General. Regarding cases in general, the attorneys interviewed believed that it was valuable to ask experts for help in understanding the fact issues and in preparing for cross-examination through the other side's experts, that it was often necessary to prompt experts or question them carefully to get them to explain clearly and in detail, and that negotiaions often did rely heavily on the facts. The search for experts was carried out in a fairly haphazard manner, asking colleagues or similarly situated people whom they used. One of the defense attorneys

used the example of the advent of Title VII litigation. They did not understand the field (statistics, economics, sociology, psychology) or who the practitioners would be, and did considerable fumbling around before identifying satisfactory expertise.

Trial Issues

Primary Case. At the trial, the defense offered little opposition to the qualification of various lawywers and administrators as experts and little objection to their testimony. That testimony includes a description of their (non-quantitative) observations of the workings of the court, jails, and pretrial services programs, as well as quantitative guesstimates and occasionally some specific quantification, with documentation, of the numbers of persons ROR'd and the FTA rate. In addition, various causal assertions were made without benefit of data (e.g., effects of programs on appearance rates; effects of incarceration and probability of conviction). The appellate attorney observed that many opinions went in as evidence that ought to have been excluded. Also questionable was the relevance or probativeness of data from outside the jurisdiction, and the accuracy of older data from within the jurisdiction. All this went unchallenged. At one point the trial judge, in an effort to accelerate the trial (so that it could be concluded and the appeals begun) suggested that some witnesses could be skipped and they could "get right down to the statistical facts and put these on the record." Clearly, both sides valued anecdotal testimony over more genuinely expert data presentation. The defense strategy was essentially to let the testimony go, then cross-examine to obtain some assenting answers from the witnesses ("You're not suggesting we abolish the money bail system entirely, are you?"), to establish limits on disagreements and some common ground. This trial was an example of plaintiffs being allowed to present whatever they wanted and to go largely unchallenged. They did succeed in making the points they aimed to make, but did so almost entirely anecdotally. The more rigorous studies were relegated to the briefs. The trial court's ruling was narrower than that sought by the plaintiffs.

Post-trial Issues

By the time the plaintiffs filed their appeal, the City Attorney's Office had changed hands and a more vigorous effort was made to respond to the appeal. The "data" presented by the witnesses at trial were attached fairly incisively on methodological grounds. The attorney on the appeal said, however, that he saw no need to consult an expert (such as a statistician or research methodologist), that his common sense was sufficient. It is possible that the City Attorney's Office did not even realize that experts on scientific method exist and that with their help the evidence offered at trial might have been quite thoroughly taken apart. The City's Attorney on appeal also believed he could not present any studies in his briefs that had not been part of the trial record, so no published critiques or countervailing empirical studies were presented. One of the major arguments against the evidence was that it did not cite a single instance of a criminal defendant being insufficiently

anecdotal. (It could have been made more concrete by going to case examples or to more rigorous data.) The State's Supreme Court opinion in this case did cite scholarly and agency studies, more so than the transcript did, along with the anecdotal testimony at trial.

INSANITY DEFENSE CASE: CASE STUDY 4

This criminal case took place in a medium-sized western city. The defendant was charged with aggravated assault. The charge arose from an incident at a local donut shop in which the defendant began insulting a deputy sheriff, took away the deputy's gun, and pulled the trigger. The gun misfired and the defendant was quickly subdued and arrested. Prior to the incident, the defendant had told people at the donut shop that he heard voices and that he could do anything he wanted to do. He had stated that he would prove to them that he could get himself arrested and then get out of it. The defendant was taken from the jail to the county mental health facility where he stayed until after the conclusion of the trial. The defendant was represented by the local public defender office. He was examined by three psychiatrists: a staff psychiatrist at the hospital who treated the defendant during his stay there, a psychiatrist initially retained by the defense attorney and subsequently appointed by the court to conduct a competency and sanity examination, and by a third psychiatrist appointed by the court at the prosecutor's request for determining competence and sanity. All three of these psychiatrists plus a resident physician at the hospital testified in the case. All agreed that at the time of trial, the defendant was competent but that he was unable to differentiate between right and wrong because of a mental illness at the time the offense was committed. The jury found the defendant to be not guilty by reason of insanity.

Pre-filing Issues

Primary Case. Because of the nature of the case, the selection of experts occurred after a complaint had been filed. Both the prosecutor and defense attorney stated that they selected psychiatrists on the basis of the psychiatrists work in past cases involving their respective offices. Both had seen their selectees testify before and were impressed particularly with their ability to communicate. Both of the psychiatrists selected to perform the competency and sanity examinations conduct such examinations on a regular basis. The psychiatrist selected by the prosecution indicated that although under the state's procedure he is not informed of the side which submitted his name, it is his understanding that he is generally chosen by the prosecution. The psychiatrist selected by the defense indicated that he had been considered a prosecution psychiatrist, but, of late, he is being called more often by the defense. Payment for the competency and sanity examination and subsequent testimony is from the court budget at a standard rate. Payment for the initial examination at the request of the defense attorney came from the public defender office's budget. The psychiatrist who appeared for the defense stated that both the promptness of the call and the fact that it came directly from an attorney was

somewhat unusual since in most cases he is only appointed by the court to determine competency. The call in the particular case came three days after the defendant's arrest. It apparently was prompted by information provided to the defense attorney by the defendant's girlfriend aout his behavior prior to the incident.

In General. It was indicated by all of the attorneys who were interviewed that the grapevine and friendship referral system is the usual method for identifying possible expert witnesses when the individual attorney does not have personal knowledge of the available experts. In some cases, the local public defender office has called public defender offices in other larger cities for advice and suggestions on experts in particular fields. None of the attorneys indicated that they had ever used a professional referral service. The defense attorneys stated that a number of times, they have been impressed by and retained experts who appeared against them in prior cases. They have also used the services of a private California laboratory which provides various types of testing and expert services at fixed fees. In the past, there has been adequate funds available in the public defender budget to employ out-of-town experts on occasion. However, these funds are becoming tighter and there is growing concern about the possibility of hiring such experts in the future when they are needed. Obtaining certain types of forensic expertise was cited as a problem by the defense attorneys in that the experts are either employees or former employees of law enforcement agencies. This inhibits the ability of the defense to present independent evidence on ballistics and fingerprint evidence in particular. In addition, because of regulations concerning transfer of narcotics and other controlled drugs, it was not possible for defense attorneys to have tests run on a controlled substance except in the police crime lab.

Pre-trial Issues

Primary Case. There was considerable contact between the attorneys for both sides and all three psychiatric experts. The prosecutor conducted formal interviews which were tape recorded with each of the psychiatrists as well as having a number of less formal telephone conversations. The defense attorney talked with each psychiatrist both in person and on the phone but did not conduct a formal interview. The prosecutor stated that such interviews are standard procedure for him, but only one of the three psychiatrists saw nothing unusual in the interview. One of the other two attributed the interview to the fact that he would be out of the country at the time of trial and the prosecutor was simply preparing for the scheduled deposition. The other found the prosecutor to be unusually thorough and felt that the prosecutor was attempting to intimidate him by setting traps throughout the interview. All agreed that there was little need to educate the attorneys concerning the basic psychiatric concepts involved. Both attorneys provided the psychiatrist whom he had nominated to perform the competency examination with information about the case prior to the examination. In his initial phone call requesting the psychiatrist to examine the defendant, the defense attorney outlined the facts of the

case and indicated that a not guilty by reason of insanity plea might be entered. He also made available to both the examining psychiatrist and the treating psychiatrist the contents of the defense case file. The prosecutor sent to his nominee, a copy of the indictment, police reports and the grand jury transcript. There was a split among the psychiatrists about the value and importance of this type of information. One felt that although it was helpful to have information about an individual, it was not his responsibility to seek it out. If the attorney sent it that was fine; but if they did not he would not ask for it. Another of the psychiatrists finds such information critical and periodically sends a letter to the prosecutor and public defender office reminding them of his desire to have background information on a case prior to the time of examination. He feels that it is the expert's duty to obtain such information. The prosecutor noted that while he sends police reports and the indictment routinely to experts, not all psychiatrists read it either before examining the defendant or even prior to trial. Pretrial conferences were held by the defense attorney with the psychiatrist which he nominated and the treating psychiatrist in order to go over the questions to be asked at trial and the possible lines of cross-examination.

In General. All the interviewees appeared fairly satisfied with the current pretrial procedures. The process was considered familiar and routine and efforts have been made to simplify matters. For example, when there is agreement regarding the defendant's competency or incompetency among the examiners, the determination is made on the basis of their written reports. Where the two examining psychiatrists disagree, the court will often appoint a third and will follow his or her opinion. One of the psychiatrists noted that it would be helpful if the request for examination came earlier during the pretrial process since competency exams are usually linked to determinations of sanity at the time of trial as well. The request for a competency examination came three weeks after the defendant's arrest in the case that was studied. As a result, all the opinions regarding the defendant's sanity at the time of the offense were based on the initial examination by the psychiatrist retained by the defense. No average time was suggested by any of the persons interviewed. Expert reports are automatically sent to the prosecuting and defense attorneys in the jurisdiction. Psychiatrists are instructed that statements by the defendant regarding the offense are not be included in the report or sent to the prosecutor. Both attorneys indicated that psychiatrist reports are often used in plea bargaining.

Trial Issues

Primary Case. Neither the qualifications of the experts nor the admissibility of the expert testimony were seriously challenged in the case. However, a pretrial motion had been filed to prevent lay witnesses from testifying regarding their conclusions about the defendant's behavior prior to the offense. This motion was not ruled on prior to the trial and the issue was not raised during the trial. However, the defense attorney indicated that he felt that the psychiatric evidence without the support of the lay witness descriptions of the defendant's

conduct prior to the offense would not have been enough to yield a verdict of not guilty by reason of insanity. All the experts indicated that they believed that they were able to present their information effectively at the trial and that they were not bothered by the cross-examination. One indicated that the prosecuting attorney tried to "outquote the experts" by citing specific textual references but that this tactic was unsuccessful. The judge indicated that he felt that all the testifying experts were lucid and comprehensible. There was a split among the experts regarding their role in the proceedings. One indicated that he was officially a neutral court witness according to the rules of procedure, but he acknowledged that it was clear from his testimony which side he was on. The others saw themselves as very much a part of the adversary process once they had formed their conclusions about the case. Both attorneys suggested that there was little illusion about neutrality once an expert appeared on the stand. One of the psychiatrists also noted that he is suspicious of witnesses who purport to be neutral.

In General. The three psychiatrists indicated that although they examine a great number of criminal defendants, they testify only rarely, perhaps in 10% to 20% of the cases that survive the early dismissal and diversion process. They all felt comfortable with the courtroom process and indicated that most attorneys who are experienced triers of criminal cases enter the courtroom fairly well prepared. The problems come with those attorneys who are appointed only rarely or who are handling a criminal case as a favor to a civil client. They are often very unfamiliar with the psychiatric aspects of the criminal law, the procedures involved, and with psychiatrists themselves. The judge concurred that attorney preparation is the key to how well expert evidence is presented and its effect upon a jury. The attorneys felt that expert testimony was usually handled well by juries except where there were direct conflicts in which case the jurors, like anyone else, become confused. Such conflicts occur in two areas according to the judge: mental health evaluations in criminal cases and land value appraisals in condemnation cases. Although most experts were seen as honest and forthright, questions were raised by a number of the interviewees regarding expert shopping practices and the integrity of some types of experts. Conversely, the experts considered most attorneys earnest and competent, but one of the psychiatrists observed that some attorneys fail to extend normal professional courtesies to experts. Examples included failures to notify an expert when a case has been postponed or when the expert should be present to testify.

Post-trial Issues

In this case and in cases in general, the psychiatrists indicated that they are not informed by the attorneys of the outcome of the case unless they make it a point to call and ask. This was annoying to them both personally and professionally, since they would appreciate being informed of what effect their testimony may have had. The prosecutor suggested that appellate courts sometimes put too much weight on scientific evidence, particularly regarding whether a defendant was legally insane at the time of an offense. He felt that lay testimony could serve as a sufficient rebuttal to psychiatric opinion in many cases.

QUESTIONNED DOCUMENTS CASE: CASE STUDY 5

This criminal case took place in a large midwestern city. The defendant, an employee of a bookkeeping firm, was alleged to have forged the signature on a number of checks of the account. She was charged in three separate cases with forgery and theft. The cases were handled by the financial crimes unit of the prosecutor's office and the documents were forwarded to the city's police forensic laboratory for examination. In one of the cases the defendant pleaded guilty. In a second, she was acquitted. In the third, she was convicted on two counts. The chief document examiner of the city police forensic laboratory testified in the third case that the signature on the check had been copied by someone. The examiner was unable to state that the defendant had been the one who forged the signature.

Pre-filing Issue

Primary Case. Expert examination of questioned documents is a routine part of most investigations conducted by the financial crimes unit of the prosecutor's office. There are three sources for such expertise to which the prosecutor can turn: the city police forensic laboratory, the state forensic laboratory, and private experts. The prosecutor stated that the city laboratory was selected in this case, even though the alleged offense occurred in a suburban jurisdiction, because the city lab has more experienced personnel and is able to provide a faster turnaround than the state laboratory. The state has a system of regional labs plus a central laboratory. The volume of cases for these laboratories, however, is so great that there is often a significant delay in getting the examination performed and the material returned. The prosecutor said that they have used private questioned document examiners on occasion, but problems have occurred when they have done so. In particular, he indicated that many private examiners raise speculative issues in their reports which provide a basis for a defense even tough the speculation may be unfounded. In addition, their analysis is often not as careful as that performed by the city police laboratory. Examples included a report in which the questioned document examiner stated that the handwriting of the suspect's family should be examined before the case is filed, since handwriting of family members often includes common characteristics, and an instance in which the analysis was performed on photocopies rather than on the originals. The examiner stated that the increasing number of cases generated from within the city was making it impossible for the city police lab to handle suburban and other non-city cases. Accordingly, a program has been established to train suburban officers in at least the basic analysis techniques.

In General. Both the prosecutors and the experts cited a need for better training to facilitate initial investigation. The attorneys focused on the need for training officers in how to gather scientific evidence in general and handwriting and other documentary evidence in particular in a manner which meets both the technical and legal requirements. Problems which had occurred include obtaining handwriting examplars under coercion from a grand jury subpoena and obtaining

examplars on lined paper when the questioned document was on unlined paper thus making analysis far more difficult. The expert added, in this regard, that when problems are discovered in the initial examplars, some judges are reluctant to order defendants to prepare and submit other examples of their handwriting in the appropriate form or on the comparable type of paper. This was attributed to a lack of understanding of why such examplars are necessary and how they may benefit the defendant as well as the prosecution. The expert also noted that many attorneys do not understand the difference between a questioned document examiner and graphologist. It was stated that all too often, the two are considered to be identical despite the differences in training and sophistication of the techniques used. The expert was hopeful that the training materials being prepared by the Forensic Science Foundation and its certification program would help to remedy this particular problem.

Pre-trial Issues

Primary Case. The normal procedure and the procedure used in this case is for the prosecutor to call the examiner to discuss the case in general and to determine what the expert will need in order to examine the documents. Both the questioned documents and the known samples will then be sent by mail or hand-delivered to the examiner. If additional materials are needed, the examiner will call and normally the prosecutor will obtain the added samples. Several telephone conversations were held between the examiner and the prosecutors in this case and there were two pre-trial conferences. The examiner insists on such conferences and stated that normally the prosecutors readily agree. At the conference, the examiner and attorneys went over and labelled each of the questioned and known documents in order to avoid confusion. (More than 30 were introduced into evidence at the trial.) They also went over the questions to be asked and the exact phrasing of the questions regarding the examiner's qualifications as well as those intended to elicit the substantive results of the examination. While the attorneys did give the expert a general picture of the case both at the initial phone call and at the conference, there was no need to provide detailed explanation of the legal theories because of the expert's considerable experience.

In General. The expert stated that it is not not uncommon for defense attorneys to call the lab, and that the standard practice is to talk with defense attorneys after first notifying the prosecutor of the call. The expert also stated that the lab is willing to and has done work for defendants when such work has been ordered by the court. It appears that such orders can be obtained on a routine basis. The expert has also testified for the defense following a court appointment. It was noted that most of the experienced defense attorneys are familiar with the capabilities and limitations of document examination. The same is true with the experienced prosecutors. The examiner takes the initiative in briefing new assistant prosecutors assigned to the financial crimes unit, explaining to them what can be done and how it can be used. More general briefings are provided in the course of training city police officers. It is emphasized in such training that document examination may become relevant in almost any kind of case, not just white-collar

crime. An example was used of an auto theft in which the signature on the title had been changed. Prosecutors noted that the results of an analysis of handwriting on a questioned document and other scientific evidence is used extensively in plea bargaining and often has major impact on the agreement reached.

Trial Issues

Primary Case. The defense stipulated to the examiner's qualifications. This was viewed as unusual by all the participants. The judge and the prosecutors attributed this defense action to the examiner's reputation and the desire of the defense attorney to try the case quickly. The examiner attributed it to the reputation of the questioned document section in particular and the lab's personnel in general for "calling cases as they see them." Because of the equivocal nature of the expert testimony--i.e., the inability to determine that the defendant had altered the checks--the cross-examination was brief and limited only to re-emphasizing the points favorable to the defense. This appeared to be somewhat unusual since more extensive cross-examination is usually made of both crime lab experts and expert witnesses in general. The prosecutors pointed out that an attorney must be careful in cross-examining an expert. In particular, they must try to treat the expert with respect. Nitpicking or trying to out-quote an expert from a standard text is often unsuccessful.

In General. The prosecutors stated that they had used or had planned to use several types of experts in various white-collar crime cases. These included voice print analyzers, fingerprint experts, and computer technicians who had analyzed complex telephone records. They estimated that in approximately 50% of the white collar crimes cases which go to trial, the defense presents an expert witness as well as the prosecution. The judge observed that juries are able to analyze and weigh the expert testimony quite effectively except where there is a direct conflict between equally authoritative experts. In such cases, according to the judge's post-trial conversations with jurors, there is considerable confusion. The judge felt that such conflicts occurred most often between mental health experts and was uncertain whether those conflicts were the result of an honest difference of opinion or not. The judge commented that conflicts can occur in any case in which a defendant has sufficient funds to afford a search for an expert whose views are in accord with the defense theory. He recalled only one case in which there was any conflicting evidence between document examiners. The judge saw the presentation of conflicting views as the major problem regarding scientific evidence. He felt that the certification program as a step in the right direction, but that abuses will be difficult to prove.

The judge also commented that he appoints court experts in two different types of situations. The first is when the experts presented by the parties do not satisfy him. The second is when the competence of the defendant in a criminal case may be in question. The chief judge of the court maintains a list of experts in various fields from which a judge can select a person for appointment as a court witness. The judge

can also check with one of the individuals on the list for a referral to someone whose expertise is more on point. It is unclear how these experts are paid once they are appointed. In each case in which an expert is appointed by the court, a special instruction is given to the jury that they are to give no added weight to the witness' testimony simply because he or she was called by the judge.

Post-trial Issues

Even though the questioned documents examiner's section is within the city police department, it is rare for them to learn the outcome of a case in which they have provided an examination. Notification occurs more frequently when court testimony is required, but it is still not the general rule. As in other cases this is an irritant.

TITLE VII CASE: CASE STUDY 6

Two cases were tried together, one alleging race discrimination and the other sex discrimination in the employment practices of the defendant, a major financial corporation in a large southwestern city. The case was precipitated by an incident which occurred in 1969; suit was filed in 1973 when less extreme recourse failed; the 24 days of trial began in October, 1979; and the opinion was issued in October, 1980. Unlike our other case studies, this one asserted claims under federal law and was filed in a federal court. It throws light on state court cases by providing a contrast to them. It is widely thought that the quality of practice, the judges, and the amount of resources supporting cases brought before federal trial courts is generally greater than that in the state courts. Each side employed a contingent of experts presenting complex statistical analyses of the defendant's personnel data compared with relevant labor market data. These included five labor economists, three statisticians, one sociologist, and one computer specialist. The judge's findings were highly specific (favoring the plaintiffs on certain points and the defendants on others) and were tied closely to the statistical evidence. Appeal is anticipated.

Pre-filing Issues

Primary Case. Perhaps the most noteworthy aspect of this case prior to filing is that the plaintiffs had no idea at the outset what the case potentially consisted of. They thought they had an individual case supported by anecdotal, case-specific facts. Once the subtlety of the pattern of alleged discrimination became evident and the case became a class action, the nature of the evidence needed changed dramatically. Plaintiffs' attorneys--two modest-sized firms--had no idea of the intellectual and financial demands the case would eventually place upon them.

In General. Plaintiffs' attorneys observed that the cost of litigating a case such as this, due to the fees of the experts and data analysis, which falls on a law firm, will unavoidably influence the type and number of such cases that will be filed.

Pre-trial Issues

Primary Case. When asked how he supposed the particular experts used in this case were located, the trial judge said that he supposed the attorneys did what he used to do: head for (the social science) indexes and see who publishes the leading work in the area. In fact, the experts were found in the way we have seen to be the most usual: word of mouth. In this case, the EEOC recommended an expert they had been pleased with and that expert referred plaintiffs' lawyers to other competent experts. If the experts in this case were of especially high competence--and the consensus is that they were--that was because an especially well informed grapevine had been tapped. One attorney said that more experts were interviewed than hired and that the ability of the expert to communicate was the deciding factor. One attorney said that you are "safer" without using a referral service.

Communication among attorneys and experts seems to have been plentiful but "there is never enough." The frequency of contact increased as the case progressed toward trial. One problem in communication was geography; several of the most central experts were located in other parts of the country. Written and phone communication was relied upon heavily. Another problem was time. As the data analysis proceeded, what case the attorneys actually had and what their adversaries had became progressively better known. The bulk of the evidence in this case was data analysis and inferences of the experts. Lawyers did not really know what to look for beyond anecdotal evidence. It was only in 1977 that the Supreme Court made experts a desirable if not necessary source of evidence in such cases. The raw data have little meaning by themselves, so the attorneys were highly dependent upon the findings of the experts. Some of the experts (the labor economists) were said by the judge to have been the most useful and by the lawyers to have the best grasp of the legal issues and how the data meshed with the legal issues.

Some tension between the lawyers and their experts was evident. Three of the experts interviewed expressed a great deal of uneasiness about their role. They did not know if they were supposed to be objective witnesses or interested advocates. For example, one witness said that the lawyer was angry that the witness had spoken with the other side, when approached by the other side. The witness said there had been no advice not to, and simply did not know it was taboo. (In fact, no formal prohibitions against such contact exist and to try to prevent it or not or be present when it occurs or not (by deposition) is a tactical decision by an attorney. In any event, the expert witness is not bound to obey the lawyer.) Their training and profession implied to them that they should be loyal to the evidence and standards of their field. The

lawyers, however, pressured them (more or less subtlely) to be loyal to the claims of the side employing them. One expert described this as a "constant negotiating process" over what data to analyze, what analyses to perform, and what interpretations to place on the results. Another expert said that "we were always telling them (the lawyers) things they didn't want to hear." "The lawyers didn't understand anything I did (by way of data analysis)." For two of the experts, this was the first case on which they worked. The third was not only experienced, but had learned to assert independence and control, pointing out that the expert has increasing leverage as time progresses. Once the expert is employed by the lawyers, the closer they are to trial, the more dependent the lawyer becomes on the expert's cooperation, so the more cooperation the expert can extract from the lawyer. For example, due to time pressure, the lawyer wanted to have an abbreviated meeting with the expert the day the expert was to testify. The expert said that without an acceptably long meeting, there would be no testimony. Consequently, complicated arrangements were made to accommodate the lawyer's schedule to the expert's demand for adequate preparation. This expert also insisted on hands-on control over the analyses.

One of the lawyers described the case preparation as "trying to catch a moving train," and was relieved when the trial finally began, because then things would stand reasonably still. This kind of discrimination case was far different from "the old days" when discrimination was glaring and case-specific anecdotal testimony would suffice. The exposure of more subtle patterns of discrimination by use of statistical microscopes placed burdensome demands on the lawyers and they did not know how to anticipate the nature of case preparation.

The judge helped make the case use the experts' analyses more effectively and substantively by pressing the sides early to agree on and use a common data base (cf., Judge Wright's opinion in Hobson) ordering production of that data base, and requiring statistical briefs to be filed pre-trial, so that everyone would know what was coming.

In General. The tension between experts and lawyers evident in the preparation of this case is common according to the interviewees. The two experts interviewed for whom this was their first case nevertheless have gone on to work much more as experts.

One expert reported great variation in lawyers' ability and knowledge of the substance of the expertise, as well as the degree to which they try to push the expert to draw favorable conclusions. Mention was made of the "clean" vs. "dirty" expert (one for preparation to whom all is revealed; one for trial whose knowledge of the case is kept limited). One expert suggested that the larger the firm, the better prepared and less "pushy" the lawyers. All lawyers, another expert thought, were "short-run" thinkers--interested in establishing a point, but not concerned with how that would affect the case later when they may have to shift ground on that point. Also complained of was that lawyers maintained too tight a hold on the case. The lawyers have the complementary concern that they lose control over pieces of cases as they become dependent upon experts.

The most experienced of the expert witnesses said that being called into a case late was endemic, and that lawyer unfamiliarity with the evidence development in Title VII cases created severe problems. In "life and limb" cases, where the value of lost future earnings is estimated, and lawyers and economists are familiar with the issues and each other, interactions proceed more smoothly. This expert said that when confronted at the outset with the requirement that the expert be allowed to develop the full facts whether they support one's own side or the other, few if any lawyers had declined to engage her. The expert's report, usually to be filed with a court, presented both the favorable and unfavorable findings. The other, less experienced, experts interviewed in this case said they submitted to the attorneys' limitations on what could be analyzed and reported on. One noted that if both sides had competent experts and competent lawyers, then the competing findings would emerge and the full picture would be presented to the court. But otherwise, pieces would be missing. These experts were distressed at this one-sidedness, but felt they had no choice. Some of this was overcome by court orders to disclose all essential findings. But, of course, what was not found in the first place could not be disclosed.

One expert, who did life and limb cases also, felt that the expert's data may do as much to impede settlement, especially in those cases, as to facilitate it. That would occur when the expert's findings showed the plaintiffs that they had a more valuable case than they themselves had thought. Thus, it would provide more divergent views of the case's value and make settlement less likely. Still, this expert estimated that 95% of such cases settled. Even in these cases, the expert insisted on presenting a range of models or assumptions which led to a range of damage values. She felt it was then the factfinder's province to decide which assumptions were to be adopted and therefore which value was correct. One issue on which there was little disagreement was that if the same data were available to both sides, and if the same analytical principles were used, the same conclusions should be reached. Any differences in conclusions were understandable as resulting from different assumptions, different choices of variables or models, and those choices could be explicitly addressed so that the factfinder could make a judgment about which made the most sense.

Trial Issues

Primary Case. Because of the judge's management of certain pretrial aspects of the case, and perhaps because of the assertiveness of some of the experts, the trial was essentially a presentation and critique of the evidence. Surprises were few, substance was great. The judge's plan was to get the lawyers and experts "to fight with each other," and accomplished that by requiring early agreement on data bases to be used, full disclosure of data analyses, filing of statistical briefs. In other cases of this type, because the two sides manage to address different empirical issues with different data bases, it is often impossible to base the decision on evidence; evidentiary issues are never joined. The trial was characterized as lucid, yet hard to follow because it was

complex and dull. At the end of each day of trial the judge dictated notes and impressions of what had been learned during the day's testimony. The judge felt the lawyers were well prepared. The lawyers and experts commented that the best questions were those put to the experts by the judge. The lawyers' questions were more likely to search for weaknesses or inconsistencies, while the judge's were more likely to go to the substantive heart of the evidence. That is not to say, however, that the lawyers did not also deal with substantive evidence. The judge employed flexible procedures in managing the trial. On several occasions the judge allowed experts to conduct what in essence was an in-court seminar through which they were invited to explain in more detail their underlying conceptualizations or mathematical procedures. Although the attorneys objected to this departure from the traditional procedures for eliciting testimony, they were overruled.

The experts generally felt constrained by the trial process, even with this judge's flexible procedures. They felt unable to present an overall, balanced picture. "Each side is selecting skewed information from you." The piecemeal elicitation of testimony made them feel they could not present an overview of the arguments. The experts also felt the lawyers on both sides were inadequately prepared. Discussions among experts and lawyers were, as noted earlier, hurried. It was only at one expert's insistence that a more detailed pre-trial conference was held in preparation for that expert's testimony. Discussions to prepare the expert for his or her own cross-examination were felt to be inadequate. But even more inadequate, the experts felt, were discussions wherein the experts prepared the lawyers to cross-examine the opposing side's expert.

The judge reported that he and his clerks took a full month off from their other duties to devote themselves to understanding and assessing and arguing about the findings in this case. In this otherwise apparently typical Title VII case, the resulting opinion is unusual for its serious, explicit and lucid grappling with the statistical evidence. The judge explained that because the lawyers and experts made such data-based case presentations, he had little choice but to base his findings on that evidence. Flaws in the data were not considered a reason for discounting it, but required more thoughtful weighing of what sense to make of it. The judge also wanted to facilitate consideration by the Appeals Court of his decision and the basis for it, should the case be appealed.

In General. This case illustrates some of the possibilities for management of a case by the trial judge. By statute, Title VII cases are not tried to juries. The judge explained that he also has some techniques for managing jury trials that he believes facilitate competent decision making by juries in complex cases. For example, he will allow only juries of twelve people, encourages note taking, gives a preliminary charge before trial and a written charge at the end of trial. The judge noted that semantic problems in cases requiring unfamiliar fields of expertise are considerable, but that lawyers who adopted a strategy of obfuscation were choosing a high risk strategy.

One of the experts felt that the capacity of judges and juries to understand the area of technical expertise was so limited, that they simply could not make a knowledgeable finding. This expert felt that in cases requiring such expertise that the technical portions of the decision be made by experts, perhaps through a seriated trial. The experts felt that it was typical for lawyers to be well prepared on direct but not on cross-examination. On cross-examination they sometimes began with good questions (apparently supplied to them by their own experts) but then to get lost quickly once the colloquy resulting from the initial question began.

Post-trial Issues

Primary Case. The experts wanted feedback, mostly to satisfy their curiosity, but felt that in part the feedback would help them understand how to be more effective in future cases.

In General. The judge and lawyers felt the appellate courts must have an exceedingly difficult time with such cases because the tools for "education" available to trial judges, namely live experts to talk with, are not available to appellate courts. The judge tried through his unusually careful, lengthy, and statistical opinion, to assist an appellate court hearing this case to overcome that gap.

ARSON CASE: CASE STUDY 7

This was a criminal case in a rural southwestern town. A fire occurred in a mobile home occupied by a husband and wife. The wife died in the fire. The day after the fire the body was transferred for autopsy to the county forensic sciences laboratory which serves a nearby large city. A few days to a week after that, the fire marshal of a nearby medium-sized city examined the scene, took photographs, and sent samples of material from the scene to the same forensic sciences laboratory for analysis. The medical examiner concluded on the basis of the autopsy that the manner of death was accidental. The four cans of material sampled included one can of charcoal lighter fluid still containing 200 ml of fluid, and the rest were found to contain no accelerants of any type.

Because the couple owned life insurance policies naming each other as beneficiaries, the husband contacted a lawyer in a larger nearby city to help him collect on his deceased wife's life insurance policy. The attorney became interested in the possibility of a cause of action against the mobile home manufacturer and retained an investigator from a private laboratory to examine the fire scene. The same laboratory is often used by the fire marshal of the nearby medium-sized city to conduct chemical analyses for its arson investigations. The investigator reached the unsecured site nearly two weeks after the fire, inspected the scene, and gathered samples of soil and debris. Upon analyzing the samples, he concluded that accelerants were present and that arson had been involved. He reported his findings and opinions to the husband's lawyer

who promptly closed the case. Shortly thereafter, the husband was indicted for causing the death of his wife by arson. Jurisdiction, of course, lay with the rural town where the fire occurred. That county's court assigned a local attorney, whose practice consisted of general business and civil matters, to represent the defendant.

At the trial, the prosecution sought to introduce into evidence the consulting laboratory report, the laboratory's expert, the fire marshal's photographs, and the fire marshal as an expert witness. The defendant was able to have the consulting laboratory report excluded because the samples had been taken from a site unsecured for several weeks, and the fire marshal was not qualified as an expert. The defense did not introduce the earlier reports from the neighboring county's forensic science laboratory which concluded there were no accelerants. The defendant was found guilty and sentenced to 10 years probation.

Pre-filing Issues

Primary Case. A major problem in this case, but typical of rural communities, is the unavailability of personnel to secure the (alleged) crime scene site and the limited availability of scientific help. The police and prosecutor in this town had to rely on help from the fire marshal of a nearby medium-sized city who in turn had laboratory analyses done by the forensic sciences laboratory of a large nearby city. Violent crimes are so few and far between in this community that it makes no economic sense to have forensic sciences personnel in the town or city. But the neighboring jurisdictions on whom they rely for help cannot give them high priority. Thus, in this case, the evidentiary problems of an unsecured scene were exacerbated by the delay in the fire marshal's arrival to investigate. Such delay, the fire marshal's office told us, is common "out in the counties."

Important to note is that the laboratory analysis of the investigating fire marshal's samples revealed no evidence of arson. It was a subsequent private investigation in support of possible civil action by the decedent's husband that resulted in the first chemical evidence of arson. This raises an ethical issue on which firm and opposed positions were taken. Is the private engineering laboratory's investigator an employee of the client and is the client entitled to the evidence and the data as well as the loyalty of the investigator; or does the investigator have an ethical obligation as a citizen to turn over any evidence that a crime has been committed which may come in to his possession? In this instance the consulting laboratory had a continuing relationship with the fire marshal on other cases.

In General. The general issues concerning pre-filing were all raised by the fire marshal's office and had to do with investigation of fires for possible arson and the ability of prosecutors to understand the findings and make the decision to prosecute or not. The deputy fire marshal felt that fewer cases were filed than could be supported by the evidence. He attributed this to the prosecutor's lack of understanding of the evidence and the problems of tying circumstantial evidence to a specific suspect.

Pre-trial Issues

Primary Case. The attorney for the defense was court-appointed. He and his young associate to whom he delegated much of the preparation for the case had had little experience in criminal defense work. The defense lawyers used no experts of their own and made no contact with the prosecution's experts. They explained that they did have access to the reports by both laboratories and the fire marshal. Such lack of contact is common. The deputy fire marshal stated that not once in his experience had defense counsel interviewed a witness from the fire marshal's office in preparation for trial. He added that the prosecution did so only rarely. In this case, the prosecution met with the fire marshal and his deputy the morning of the trial. Thus, preparation of the scientific aspects of the case were limited to examining the reports provided by the experts pursuant to their investigations.

In General. Although the experts we spoke with said they were willing and available to meet with defense counsel and explain the strengths and weaknesses of the scientific evidence, it rarely happened. Further, the prosecutors were typically inadequately prepared, did a poor job of preparing their own experts, especially in terms of possible cross examination points. The deputy fire marshal said in response to probing that some day he might take the initiative and try to arrange a meeting for mutual preparation with the prosecutor on a case that is going to trial.

The prosecutor pointed out that in his rural county there is little use of experts. Most of the serious crimes, which did occur, were assaults or murders among and in front of people who knew each other well, and so that there were usually eyewitnesses to the crime.

Defense counsel bemoaned his state's use of assigned counsel, pointing out that it paid lawyers only for court appearances. He favored a public defender system which would provide lawyers experienced in criminal defense and perhaps the resources to allow the lawyers to do the job properly. In his civil work, the defense attorney said that he evaluates experts largely on the basis of their educational background. Some experts dislike testifying (e.g., physicians) and others either do not mind (e.g., psychiatrists) or like to do it (e.g., real estate people and engineers). He felt that these preferences were easily explained by how the fees for serving as witnesses compared to what the expert could earn otherwise in his or her practice.

Trial Issues

Primary Case. The prosecutor introduced the fire marshal's photographs of the fire scene into evidence, but on motion of the defense attorney the fire marshal was not permitted to testify as an expert in interpreting the burn patterns or to state an opinion as to whether the fire had been set deliberately or was accidental (e.g., by looking for multiple points of origin). The prosecution's next witness was the private consultant investigator. Although he was qualified as an expert,

his laboratory analyses of debris (in which he found chemical evidence of accelerants) were excluded due to the inability to prove a chain of custody because of the failure to secure the fire site. The prosecution then used the fire marshal's photographs which had previously been admitted and had the expert testify as to what they showed. The deputy fire marshal said that this case showed an unusually good use of fire scene photographs, but that like all such evidence, there were weaknesses. He felt that had the defense attorney asked him to specify those weaknesses during a pretrial conference, so that he would have understood what the photographs were and were not able to show, the defense attorney would then have been able to ask pointed and effective questions on cross examination, to reveal those weaknesses. ("[He could have] tore up our butt.") The deputy fire marshal said that such weaknesses went almost always unexposed.

The defense attorney felt that the expert testimony that was introduced was circumstantial and not inconsistent with innocence. The defense did not introduce the original exculpatory report or witnesses from the forensic sciences laboratory. The person interviewed from that laboratory said they would have testified for the defense in such an out-of-county case, and would have done so at no charge. One of the interviewees pointed out that state law now requires a search warrant in order to enter upon private property for such an investigation, so that today even the photographs might have been inadmissible.

In General. The interviewees yielded a potpourri of observations, insights, and opinions about trials in general.

The deputy fire marshal noted that their work infrequently resulted in trial testimony. When they did testify, they felt the format and the questions put by the lawyers did not permit effective presentation of what they had to offer. The lawyers, especially defense counsel, do not know what questions to ask.

The prosecutor felt that scientific evidence is very believable and would be used more if it were more readily available to him. But he also thought that its impact was largely attributable to the jury's being impressed by big words, and that they did not really understand the evidence. He observed that the forensic science laboratory of the neighboring county (which is organized and funded as an independent agency and which produced the initial exculpatory report) was highly respected throughout the state "compared to the police department boys" in other places. He felt that experts are not immune to making mistakes, and that juries were becoming more skeptical of all experts in society. He prefers eyewitnesses to scientific experts when they are available in a case. He thought that the numerically few but well publicized battles of experts hurts the credibility of all experts, that if you looked hard enough you could find an expert who would say anything, and that in the end it comes down to the fact that "each side hires their liars."

Post-trial Issues

Primary Case. Because the sentence upon conviction included no incarceration, no further action was taken on the case.

In General. Win or lose, lawyers generally did not follow-up a case by contacting the experts. The deputy fire marshal felt that it would be extremely helpful for both the expert witnesses and the attorneys if after a trial, especially a loss, they sat down to discuss what they think went wrong. From the attorney's viewpoint of course, this is a luxury their time did not permit, whatever the future payoff might be.

BALLISTICS CASE: CASE STUDY 8

This criminal case took place in a medium sized southern city. The defendant was charged with the murder of two police officers. The facts of the case were as follows. A police officer spotted the defendant and another person speeding in a car along a country road. The officer turned on his lights and siren and a high speed chase ensued. During the chase, several shotgun blasts were fired at the officer's car from the pursued vehicle. The defendant's car turned off on to a dirt road which ended in a dense swamp. The pursuing officer called for reinforcements. When five other officers arrived, they entered the swamp and found the defendant's vehicle. Three officers stayed behind to examine the weapons and apparent narcotics left in the vehicle while three others entered the swamp. A gun battle ensued in the swamp. When the three officers who stayed behind rushed to help, they heard the sound of someone running and found two of the other officers dead and the third one wounded in the arm from shotgun blasts. A massive manhunt was initiated including the use of dogs and helicoptors. The testimony at trial indicated that the body of the defendant's companion was found approximately sixty feet from where the officers had been killed. He was dead from a pistol shot in the head. A pistol was found adjacent to his body together with a 20 gauge shotgun. At about the same time that this body was found, the defendant was arrested on a road on the far side of the swamp about one and a half to two miles away. He was unarmed at the time of arrest but subsequently showed officers where he had left a 12 gauge shotgun and other weapons, between the site where the body of the defendant's companion was found and the entrance to the swamp.

Several types of forensic tests were run following the defendant's arrest. Autopsies were performed on the three bodies and ballistics tests were run on the slugs and pellets removed from the bodies to determine which of the weapons found at the scene had fired the fatal shots. Swabs were taken from the hands of the defendant's companion and tested through the atomic absorption test process to determine whether he had fired a weapon. Personnel from the local regional office of the state forensic laboratory attended the autopsies and performed the ballistics tests. The atomic absorption test was performed by a forensic scientist at another forensic laboratory regional office. In addition, the defendant took a polygraph test from a private polygraph examiner. Arrangements for the test were made by one of the defense attorneys.

At trial, the forensic scientist who had attended the autopsy and the individual who had conducted the atomic absorption test testified for the prosecution. The latter was called as a surprise witness on the second day of trial. At an early stage in the trial, the defense attempted to introduce the results of polygraph tests. This was denied by the court. In response to prosecution questions, the forensic scientist who had conducted the atomic absorption test testified that there was no residue on the defendant's companion's hand and that this was indicative that he had not fired a gun. Under cross-examination, this individual testified that residue is found through this test in 75 to 80% of the cases. At this point, the defense objected to the admission of the test on the grounds that it was not reliable. Apparently, this was the first time that the atomic absorption test had been introduced in the state's courts. The defense also called a member of the forensic laboratory's staff who had test-fired the gun and had had swabs taken from his hand tested for residue. He testified that the test had also been inconclusive for him. A motion to exclude the evidence regarding the test was denied and the defendant was found guilty by the jury and sentenced to life imprisonment. The conviction was appealed to the state's intermediate appellate court on several grounds including the admission of the testimony concerning the atomic absorption test. The appellate court reversed the conviction on the grounds that an insufficient foundation had been laid regarding the qualifications of the expert to perform the test, the procedures used in conducting the test and how they related to the procedures which should be used, and the overall reliability of the test. The opinion included a series of questions which the court believed the prosecutor should have asked in laying the foundation for this evidence. The case was then reviewed by the state supreme court which reversed the intermediate court's decision on the grounds that no objection had been made to the witness' qualifications or the test prior to its introduction. The state supreme court in its five to four opinion specifically declined to hold that the test was inadmissible as a matter of law, indicating that the matter was within the discretion of the trial judge. A case from another state was cited which had held that the atomic absorption test did not meet the standards of Frye vs. U.S. and, therefore, was inadmissible.

Pre-filing Issues

Primary Case. The decision to use scientific evidence was made by the prosecutor at the crime scene soon after the bodies were discovered. The head of the local forensic laboratory office was called by the sheriff's office and briefed on the basic facts in the case by a deputy. He was asked to attend the autopsies and sent swabs from the body of the defendant's companion together with swabs taken from cartridges and the gun itself to a crime lab office across the state by certified mail. A decision was made at the crime scene not to look for fingerprints because of the wet conditions at the scene. The forensic laboratory, which is a separate state agency, responds to requests for assistance from any police agency in the state as well as prosecutor's offices and local coronors. The basic procedures of being contacted and briefed by a police officer, and of then being asked to attend the autopsy of the

crime victim are fairly standard procedures, although the massive manhunt and intense publicity surrounding this particular case gave it a special aura. One of the defense attorneys noted that the swabs from the body and the gun were put into the same bag and were not separately identified. He suggested that these unusually sloppy procedures were the result of the frantic activity which surrounded the case.

In General. It was generally agreed that the forensic laboratories were called on often and responded well to requests for assistance. The availability of a pathologist to conduct or attend autopsies appeared to be a significant factor in determining the laboratory workload. The experts indicated that they got along well with most of the police departments, sheriff's offices, and prosecutor's offices in their regions of the state. The one problem that was cited was the difficulty in obtaining blood and seminal samples from defendants in rape cases. The experts felt frustrated that their knowledge and facilities were not being called upon in an area in which they felt strongly they could provide assistance. The prosecutor explained that Alabama law does not permit the prosecutor to seek a court order to require defendants in rape case to provide such samples and that, in most instances, defense attorneys object when a motion is made. However, the experts noted that in many of the surrounding counties, there is no problem obtaining such samples and that the test results have been used both to convict and to exonerate defendants.

The experts stated that they were authorized and very willing to assist defense counsel but are seldom called upon to do so. Although they perceive themselves as neutral scientists, they are seen by defense attorneys as working for the prosecution. As one of the defense attorneys stated, "you work for who pays you." Both defense attorneys were unaware that the crime lab was available to defendants. The experts acknowledged that some defense attorneys saw them as hostile rather than neutral witnesses and suggested that some other defense attorneys were unaware of how to use forensic science for their own benefit. The failure of defense attorneys to use the services of the state forensic laboratory is not the result of the easy availability of forensic experts for indigent defendants. There is no formal provision in the state law for appointment of experts to assist the defense and no funds available to the court for such appointments. Both the forensic science laboratory personnel and the defense attorneys believe that better forensic science services should be available to defendants including a separate set of state laboratories if the current ones were considered to be too closely linked with the police and prosecution. Both the prosecutor and the judge felt that most defendants who really wanted and needed experts were able to find them either at the local university or at the state forensic science laboratories in neighboring states. It appears to be a relatively common practice for the forensic scientists from one state lab to testify for the defense in criminal cases in a neighboring state or for either party in civil cases. The judge and prosecutor suggested that many defendants just do not wish to spend the money to obtain an expert or do not wish to admit that they have sufficient funds to hire an expert.

One of the defense attorneys stated that, where money is available in a criminal case or in civil cases, a favorable expert can usually be found. The judge in the case made a similar statement. The defense attorney said when local sources are not available, such as local universities, he often calls the American Trial Lawyers Association headquarters. ATLA maintains files of experts in various fields. The attorney noted that often several sources much be tapped before an individual with the knowledge in the particular area needed is found who is willing to work on the case.

The training of attorneys and police on forensic science varies from locale to locale. Forensic laboratory personnel are encouraged to work with police and prosecution offices on training and many do provide a lecture during initial police training and at state district attorney meetings. One of the experts mentioned a seminar given on forensic science for the local bar at which only one or two defense attorneys attended. The prosecutor stated that, in addition to the local seminars, he sent his assistants to the courses given for prosecutors at Northwestern University which include training on the use of forensic science. He stated that he found these courses to be excellent. He also collected tape cassettes and other training materials from various programs to use as training materials for himself and his staff. The forensic science lab personnel also mentioned that they attempted to promote and improve the use of the forensic sciences through periodic articles in the state law enforcement bulletin which goes to each police department in the state and to many of the attorneys practicing criminal law.

Pre-trial Issues

Primary Case. Both the experts and the prosecutor stated that it is routine in major cases for the prosecutor and experts to meet prior to trial to discuss the experts' findings, identify problem areas, and determine the questions to ask to qualify the expert and to bring out the results of the testing. Possible lines of cross-examination are also discussed. Although it occurs sometimes, particularly in important cases such as this one, telephone conversations or meetings between the experts and the prosecutor are rare until the trial is imminent. In non-major cases, the prosecutor seldom prepares prior to the day of trial and meets with the expert only for a few minutes before he or she is about to testify. In the particular case studied, the prosecutor met with the expert who attended the autopsy for a typical, major case, pre-trial discussion. However, the expert who conducted the atomic absorption test was not subpoenaed until trial was under way and met with the prosecutor for the first time ten minutes before he was to testify. He commented that this was all too usual a procedure. He also noted that the prosecutor was quite upset to learn that the atomic absorption test results were inconclusive. It was mentioned by one of the other experts that, rather than phrasing his or her own qualifying questions, prosecutors often hand an expert a standardized list of qualification questions and ask the expert to check off those which are appropriate. The prosecutor noted that the staff of the forensic science laboratories

are often very helpful in suggesting the best way of phrasing a particular qualifying or direct examination question and are helpful in explaining the implications of the test run to the prosecuting attorney. The prosecutor stated that he had done some research on atomic absorption testing in preparation for this particular case, although it was the perception of other interviewees that introducing this evidence was a last minute decision to bolster the state's case. There was no contact between the defense attorneys and crime lab personnel in the primary case. However, defense counsel did have copies of the laboratory reports on the autopsy and ballistics test, though not on the atomic absorption test. The prosecutor, defense attorneys, and experts, all had different views about the availability of reports from the forensic science laboratory. The prosecutor indicated that expert reports provided to the state were discoverable under the state rules of criminal procedure but that defense expert reports were not. Defense attorneys felt that expert reports provided to the state were not formally discoverable but were usually available on an informal basis from the prosecutor. The experts stated that their reports, including reports prepared for defendants in criminal cases, were public documents available to anyone at a slight fee.

The one expert used prior to trial by the defense in the primary case was a polygraph operator. The defense attorney stated that he often has his clients take lie detector tests and uses the results in pre-trial negotiation with the prosecutor or makes mention of them at trial. He has also used voice stress and voice print analysis. (The attorney represents the local polygraph operators association.) The prosecutor expressed considerable interest in polygraph testing but acknowledged that there were too many uncertainties currently to permit such evidence to be introduced in court. He expressed the hope that the technology could be improved since it could have a significant impact on courtroom practices. The judge, on the other hand, commented that he felt lie detectors were unreliable and that anyone could fool the machine. He observed that they should never be introducted unless both parties stipulate that they will be bound by the results. He has yet to have a defendant take that risk.

In General. The defense attorney stated that, while he did not do so in this case, he often does talk with the forensic science laboratory staff informally about a case and that they are quite willing to tell him about the test results and the implications thereof. He stated that such information is useful not only in preparing for trial but in pre-trial negotiations since a favorable or inconclusive result from the state lab carries much weight with the prosecutor's office. While the prosecutor did not address this point directly, he did comment that, if a report from the state hospital indicates that the defendant was insane at the time of the offense, the prosecutor will almost always dismiss the case and seek a civil commitment or stipulate to a not guilty by reason of insanity plea by the defendant. The forensic science lab personnel indicated that, on occasion, experts hired by the defense have requested permission to use the laboratory's facilities to test drugs or firearms in the possession of the laboratory. This permission is granted as a

matter of routine and lab personnel cooperate with the outside expert to the extent possible. The defense attorney noted that face to face meetings between an attorney and an expert are critical to refine the testimony and avoid surprises. He noted, however, that he attempts to limit the time taken by these meetings to the greatest extent possible in order to limit expert fees and his own charges in the case. The prosecutor stated that he has, on occasion, interviewed defense experts pre-trial. He added that the expert almost always seeks the permission of the defense attorney before agreeing to meet with the prosecutor. No rule requires this but it is a matter of standard practice in the jurisdiction.

Trial Issues

Primary Case. As indicated by the appellate court, the qualifications of the experts who testified in the case were not rigorously challenged. The forensic scientists stated that this is the usual practice when they are testifying close to home. However, when they travel to another region in the state where they are not known to the local bar and courts, their qualifications are examined with greater scrutiny. The admissibility of scientific evidence was challenged in the primary case. The prosecutor successfully challenged the attempt by the defense to introduce the results of polygraph tests performed on the defendant, and the defense challenged unsuccessfully the admissibility of the atomic absorption test. The defense cross-examination of the expert who testified regarding the atomic absorption test brought out that the test was not conclusive in 20 to 25% of the cases. Although this was not stated at trial, the expert explained that 20 to 25% of handguns do not emit sufficient amounts of the trace elements measured in the test to obtain a result. He had conducted test firings of the weapon in question and it was one of those which did not release the residue measured in the atomic absorption test. He was also unclear how long after the shootings the swabs were taken from the body of the defendant's companion, to what extent his hands had been wet as he lay in the swamp and whether they had been extensively handled between the time of the shooting and the autopsy. This is important since the residue is easily removed. The forensic scientists observed that, although it is not true in this case, cross-examination often is irrelevant to what they consider to be the main issues. This is often true in direct examination as well when there has been insufficient time to prepare with the prosecutor.

In General. There were varying views regarding the effect of expert testimony at trial. One of the defense attorneys stated that he felt juries are impressed by experts who present themselves as objective seekers of the truth and that the personnel from the forensic science laboratory are able to present their materials effectively to the jury. The other defense attorney felt that judges and juries tend to treat experts like any other witness and do not give them extraordinary weight. He noted that many experts, particularly physicians, have difficulty talking in laymen's terms. The prosecutor commented that forensic evidence is often very effective and that the staff of the forensic science laboratory was extremely good in not volunteering extra

or confusing information, looking at the jury, and keeping answers simple. He mentioned that he did not know whether this was due to specific training or experience. The judge stated that juries have high regard for scientific evidence except for psychiatric and accident reconstruction testimony. He mentioned that there has never been a not guilty by reason of insanity verdict in his courtroom. He also observed that when there is conflict between the experts, the more articulate expert often wins. He stated that juries give less credence to professional expert witnesses than they do to local practitioners. He stated that local physicians are held in particularly high regard, indicating that he has presided over only one case in which malpractice was found. In that instance, the plaintiff's expert witness, who was from another city in the state, stated directly and explicitly that the defendant doctor had been negligent and that his negligence resulted in the harm to the plaintiff. It is felt that local juries have the attitude that, if a doctor has been negligent, the local doctors will say so, and they tend to disbelieve the outside physician brought in by the plaintiff.

The experts felt that the effectiveness of their presentation was largely dependent on the preparation and skill of the prosecutor. They estimated that in perhaps 50% of the cases they are satisfied with their presentation. They appeared to be greatly troubled by selective questioning which only provides the factfinder with part of the results and implications of their test. (They acknowledge that judges will often allow them to explain an answer.) They also question, despite their attempts to gear their answer to a lay audience, whether juries really understand the materials which they present since much of the answer, of necessity, is quite technical. One of the experts noted that one factor which may contribute to the jury's inattention in many of the cases in which he has testified is that the expert is often called after a long and grueling cross-examination of the investigating police officer. The prosecutor added that the skill of the expert at making technical matters appear simple is often the key factor in the effectiveness of the scientific evidence. He stated that the former head of the regional laboratory had been exceptionally good at explaining matters to juries. The prosecutor also felt that judges tend to weigh scientific evidence more evenly than juries do.

Varying views were expressed regarding cross-examination of experts as well. As noted above, the experts felt the cross-examination was often irrelevant to the real issues. The judge felt that, unless the lawyer is also an expert in a particular field, smart lawyers will leave an expert alone. They also felt that if more defense experts were presented it would be beneficial to the whole process. It would cause crime lab personnel to sharpen their practices and would develop greater confidence in the use of forensic science. They felt that at present, with defense experts testifying in only a small number of cases--usually drug cases--there is no way of detecting mistakes when they do occur. Certification was seen as costly and not particularly effective. The regional association of forensic scientists recently rejected a proposal to institute a certification program.

Two of the forensic scientists and one of the defense attorneys suggested that the presentation of scientific evidence can be greatly improved if the rules regarding what is needed to qualify an expert and to lay a foundation for tests were clarified so that the experts would know what information to present and how to present it initially. It was suggested that if this occurred, more cases would be handled simply by stipulating to the report or the judge accepting certain facts by judicial notice. Overall they felt it would promote greater efficiency though they did acknowledge such practices would not be applicable in those areas where subjective judgments are made. The prosecutor did not feel that such rules require tightening.

It was generally agreed that it is very rare for judges in the jurisdiction to appoint a court expert or to request experts to perform additional tests. When it does occur, it is usually with regard to psychiatric experts and the state hospital is relied on heavily.

Post-trial Issues

Although the appellate decisions both focused on the use of the scientific evidence in the case, the concern was with the legal issues. Little attention appeared to be given by the court to the accuracy of the atomic absorption test and the implications of a negative reading. It was indicated by the defense attorney that his brief did cover some of the scientific issues regarding the test and that these were gleaned from legally oriented sources such as entries in American Jurisprudence and case notes from The Criminal Law Reporter.

DRUG CASE: CASE STUDY 9

This case occurred in a small town in southern New England. After receiving complaints from neighbors, police conducted 20 days of surveillance on an apartment, culminating in the purchase by an informant of what was alleged to be marijuana. A few days later the police obtained a search and seizure warrant and one day after that executed the warrant seizing quantities of "plant-like material" and paraphernalia and arresting the defendant. The case proceeded in routine fashion. Samples of the seized substance were sent to the state toxicology laboratory for identification. The laboratory concluded the substance was marijuana. Several defense motions to dismiss or suppress the evidence were denied. Shortly before the trial was to begin the toxicologist was notified of the need for his testimony. A jury trial ensued, resulting in the conviction of the defendant for both charges: possession of a controlled substance for sale and simple possession. During trial, the defendant objected to the toxicologist's testimony as hearsay since he had not conducted the test on which the conclusions were based (the testing had been done by one of the laboratory's chemists, who reported the results to the toxicologist). In a series of decisions which debated whether such testimony was or was not hearsay and whether the defendant's right of cross-examination was or was not unconstitutionally curtailed, the state's Supreme Court ruled that such testimony was not hearsay; the U.S.

District Court reversed, finding that the right of cross-examination had been precluded; and the U.S. Court of Appeals reversed again, holding that when "subjective" judgments are involved the declarant must testify; but when objective or mechanical judgments are involved, the supervisor may testify for the person performing the test.

Pre-filing Issues

Primary Case. As with most such cases, the charges were filed before the laboratory had confirmed the suspicions or field analyses of the police that the seized substances were in fact illegal. The police felt they knew what they had and that the laboratory's role would be pro forma. If it were later discovered that the material was not a controlled substance, the charges could be dropped.

In General. The prosecutor felt the police were uninformed and lazy about collecting and protecting evidence. The expert witness said that most police were unaware of the basic principles of labelling and preservation and sometimes expected the laboratory to magically correct damage done to evidence by poor police handling.

Pre-trial Issues

Primary Case. The defense sought to have the Information dismissed or, in the alternative, to have the seized evidence suppressed on the grounds that the search and seizure warrant was based on an affidavit which relied on an informant's warrantless search and seizure. The judge, it was argued, had no probable cause for issuing the warrant, and anything seized pursuant to the warrant was inadmissible. Both motions were denied by the trial judge.

In General. In preparation for the trial, little or no contact occurred between the prosecutor and the experts. The expert stated that the usual procedure in the few cases that go to trial is that he gets a call to testify, he pulls the file, and he is on his way to court. Such cases are so routine that little preparation is needed between prosecutor and the expert; both know the scenario to be followed. Problems do arise with younger and less experienced prosecutors. They sometimes do not know the routine. One of the prosecutors stated that he was sure the laboratory staff were available for briefings and preparations, but that the lawyers did not avail themselves of this assistance. The younger lawyers would ask a more experienced prosecutor for help if they felt they needed guidance. The toxicologist, noted that in his experience the public defenders exercised more care in preparation than the prosecutors, and certainly more than private counsel. Public defenders would contact him by phone or visit to learn more about the evidence in pending cases. All told, the expert spent no more than one-half hour per week answering inquiries by lawyers about upcoming cases. The prosecutor said no real continuing legal education exists on scientific evidence because funds are no longer available for it. He regretted the situation, because he found that such seminars in the past were highly informative. Complementarily, the expert said that he felt that such continuing educational

seminars could lead to better use of the laboratory's services. They were prepared to provide them, but were not called upon to do so. He also felt that more interchange between the laboratory and utilizing agencies was needed, such as through newsletters, as part of police training, or through other vehicles, but the resources and demand did not exist. On the question of discovery of scientific evidence, the prosecutor felt that as discovery opens up, the defense would have more opportunity to raise red herrings.

Trial Issues

Primary Case. This trial was routine, except for the objections to the toxicologist's testimony as being hearsay. That issue led to the toxicologist being cross-examined more closely on his laboratory's procedures.

In General. The prosecutor noted that outside of cases where forensic scientists on the state payroll are involved, getting expert witnesses is often difficult because the state pays too little and in many areas an inadequate pool of experts exists. The prosecutor felt that expert witnesses were effective and honest, except for psychiatrists. He thought the toxicology laboratory, though working for the prosecution, "called them as they saw them." The expert witness said the prosecutor seemed indifferent to whether the laboratory worked with the defense or declined to; and the defense usually approached the laboratory only after checking with the prosecution. The prosecutor suggested that better personnel and better continuing education "all along the line" is the way to improve use of scientific evidence. The expert said that the prosecution was sometimes incorrect on the law, and the expert testimony sometimes, therefore, did not not mesh well with the elements to be proved. The defense lawyers, he said, sometimes wandered around during cross-examination asking nonsense questions. The favorite area of attack seemed to be the chain of custody of the evidence. The prosecution's greatest interest in the scientific evidence, the expert said, occurred when cases were already in the trial phase and the prosecutor discovered he/she had forgotten to submit samples to laboratories. The expert said that judges typically acted properly as mediators, making sure the evidence was brought out. He tries to be understandable to juries, but finds them so docile and passive an audience that he cannot tell if he is getting through or not.

Post-trial Issues

Primary Case. As noted earlier, this case followed a see-saw appeal route. The central issue was whether someone who had not actually performed a test but only supervised, spoke with the technician, and looked at notes and certain test results (e.g., chromatographic plates), could testify to the findings, or whether such testimony constituted hearsay and denied the defendant the full opportunity for cross-examination. The issue seems a critical one, representing the clash between economic and administrative needs and evidentiary ideals. In this case, the laboratory in question had three doctorate level toxicologists and 22 or 24 less credentialed chemists.

The volume of tests performed (about 20,000 annually) left the toxicologist an average of only a few minutes per day to attend to any given test. Is this adequate involvement to be testifying to the findings? If the holding were that only the person performing the test could testify as to the procedures employed and the results obtained, this would require drastic changes in the laboratory's own procedures and apply great financial pressure. The briefs and the opinions focused on the laboratory procedures, both technical and administrative, without real evidence of the workloads and methods, and reached various different conclusions about the directness of the supervising toxicologist's observations under the given circumstances. The post-trial decisions appeared to turn on the judges' sense of the degree of closeness of the supervision, a sense which was informed by the briefs and the record only impressionistically.

In General. The expert witness said that one of his major unaddressed problems was the disposal of evidence. Lack of facilities made the growing stock of samples from old cases a burden, and the law made inadequate provisions for disposal. The expert stated that he was virtually never notified of the outcome of a case and did not care to be notified. He said that his job was to report the test results and get back to the lab; it did not matter to him what the court did with the scientific evidence once he had communicated it to them.

Chapter 3. Case Processing Practices, Contexts, and Variations

Pre-filing

Several of the issues to be discussed in this report can reside as easily in the pre-filing as the pre-trial stages of a case. For some of these issues the decision as to the heading under which they might best be discussed is arbitrary.

Rulings, Rules, Statutes, Canons. For obvious reasons formal rulings, rules, or statutes play a far more limited role in regulating the conduct of parties prior to the filing of a suit than after a dispute has been referred to the jurisdiction of the courts. Although the ABA Code of Professional Responsibility governs certain aspects of attorney's conduct before a case is intiated (see e.g., Canon 2) and some states provide for prefiling discovery (see e.g., Wolfe v. Massachusetts Port Authority, 366 Mass. 417, 419, 319 N.E. 2d 423 (1974)), there is generally, much more latitude for informal action.

Informal Processes. Some cases handled by some lawyers require no consultation with any experts prior to filing. This may be because no issues in the case call for scientific and technological evidence or because they do but the attorney is sufficiently familiar with the area of knowledge that he or she is confident that a supportable claim exists and that appropriate experts can be found after filing. Even in cases where the attorney might otherwise forego consultation with an expert, such consultation is sometimes sought not for enlightenment but as a matter of the practice of "defensive law." For example, some attorneys will not file a medical malpractice action without first having a physician review the case to reduce the possibility of a defendant physician filing a successful suit for malicious prosecution should the plaintiff's original malpractice claim fail (Personal Injury Case - Case Study 2).

The rule of thumb suggested in the literature is that attorneys should contact experts at the earliest possible point in a case where they might be needed, and no later than the first sighting of a technical matter that the attorney does not understand (e.g., Foreman, 1976). This rule of thumb appears to be infrequently observed in practice. One ubiquitous complaint of experts is that they are called too late in the2process; with weekend before, night before, or mid-trial calls familiar to many experts (see e.g., Ballistics Case - Case Study 8; Drug Case - Case Study 9). The more complicated a case, the more pre-filing consultation takes place.

Attorneys decide intuitively whether and which issues in a case require the aid of an expert, and none of our interviews or the literature reviewed revealed a single instance of the articulation of how that decision is to be made. Attorneys simply "know" when an expert is called for. Where the attorney errs by calling in an expert when an issue calls for none or by calling the wrong one, that error is capable

of correction once the attorney and expert discuss the matter. Where the attorney errs by failing to consult an expert when the case would benefit from such expertise, that is an error from which the case may never recover. How can attorneys be conversant with the expertise and subject matter of the enormous numbers of fields potentially at their disposal? This seems an insurmountable problem. Even expertise that is commonly used by lawyers is sometimes not well understood by them. They do not distinguish ballisticians from experts in firearms identification, psychiatrists from psychologists, graphologists from questioned document examiners (Questioned Documents Case - Case Study 5; Joling and Stern, 1981). As is discussed in greater detail later, lawyers report that appropriate or willing experts are sometimes unavailable or cannot be located (Schroeder, undated; Civil Rights Case - Case Study 3), and that they often fumble around unsuccessfully looking for experts they feel they need, but without finding any. At the same time, our interviewees report that they do not trust referral services or advertisements. Moreover, the cost of such services is sometimes prohibitive. They prefer referrals through the grapevine of other lawyers.

The filing of a lawsuit is, of course, not a beginning of a conflict but rather a sign that the parties have found themselves unable otherwise to resolve a dispute. At the pre-filing stage, attorneys and parties often communicate informally in an effort to bring about a settlement, or at least to posture or threaten. Those endeavors, like efforts to negotiate the settlement of a case once filed, can benefit from the availability of information. Indeed, to the extent that scientific and technological information reduces uncertainty as to the probable outcome of a case, it can prevent filing of a lawsuit in the first place. That is what happens in the extreme when an attorney advises a client after initial investigation that a colorable claim does not exist. After actual filing, positions harden, if only temporarily. The informational dilemma, however, is that less information is available before filing because no or only a limited right to discovery exists at that point. (Cf. Wolfe v. Massachusetts Port Authority, 366 Mass. 417, 319 N.E. 2d 423 (1974)). Sometimes cases are filed so that discovery may proceed--revealing facts which might have precluded filing.

Extra-Systemic Organizations and Processes: Impediments to Selection and Use. The ability to retain and make use of scientific and technological experts depends in part upon matters external to the dispute, the attorneys, and the courts. Experts individually or as organizations may elect to make themselves available or not for litigation, or may exert pressure on each other not to assist in cases against other members of their particular profession, or may choose not to be available for limited consultations or for service under a variety of circumstances. In a brief conversation with counsel for the American Medical Association, we were told that it is "no longer" the case that lawyers cannot get physicians to testify against other physicians. Plaintiff's physician witnesses may have to be brought in from another county or state, because local medical societies may adhere to informal norms prohibiting them from testifying against each other. This practice, where it exists, occurs in spite of a formal ethical principle

urging physicians to "strive to expose those physicians deficient in character or competence, or who engage in fraud or deception" (AMA, Current Opinions of the Judicial Council of the American Medical Association Including the Principles of Medical Ethics, Sec. 2 (1981)) and an interprofessional code urging, among other things, cooperation in lawsuits (Helwig, 1968; also see Gots, 1977). In one city we were told of an "unwritten rule" among physicians to be available for consultations of an abbreviated nature in the very early stages of the case. (Personal Injury Case - Case Study 2).

The accessibility of experts is also affected by the way experts are organized in their working lives. Some are independent, single-person practitioners such as physicians, consulting engineers, university professors, or independent document examiners. This group receives a particular kind of praise and criticism, which appears to be tied to its independence. Independent practitioners are said to be the most likely to come up with what we might call balanced reports, sometimes to the chagrin of the party hiring them, and the most interested in subjecting themselves to cross-examination (e.g., Klein, 1972). For example, prosecutors in the questioned documents case we studied (Case Study 5) disliked referring work to private document examiners because unlike those in the employ of the police department, they tended to come up with "speculative" and "unfounded" results which formed a basis for a defense.

Other experts have formed or joined consulting firms and referral services specifically designed to provide litigation support. One interviewee commented that a "small industry" had grown up around Title VII cases (Civil Rights Case - Case Study 3), although the lawyers interviewed tended to shy away from these.

The most highly organized experts (in terms of work setting, not professional associations) are those who provide litigation support for criminal investigation and prosecution, namely, forensic science laboratories typically--but not always--attached to local or state police departments and the FBI (Drug Case - Case Study 9). Prosecutors are largely dependent upon their work and courts are familiar with their testimony. Experts in these settings face the greatest dilemma as to their role. On the one hand, they wish to be objective scientists and technicians, "calling them as they see them," yielding only to the dictates of evidence and the scientific principles which guide their tests and conclusions. Yet if they are in the employ of the state, their role is seen as "working for" the prosecution. While in some jurisdictions, the experts in the forensic science laboratories and medical examiner offices are available and willing to talk with and to conduct tests and analyses for criminal defense attorneys, often at little or no cost (Arson Case - Case Study 7 and Ballistics Case - Case Study 8; Feegel, 1978), they are perceived by defense attorneys as employees of the other side, and prosecutors expect them to be cooperative and supportive. Given what is known about reference group phenomena (Siegel and Siegel, Reference Groups, Membership Groups, and Attitude Change, 55 Journal of Abnormal and Social Psychology, 360-364 (1957)), the need that people have for social support of attitudes and

conduct (Kiesler and Kiesler, Conformity (Addison-Wesley (1969)), and the process of socialization in occupational settings (Lieberman, The Effects of Changes in Roles on the Attitudes of Role Occupants, 9 Human Relations 385-402 (1956)), it strains credulity to believe that these experts do not identify with prosecutors. Even structurally independent experts (e.g., physicians, statisticians) who work on civil matters tend to fall into advocacy roles (as will be discussed in more detail later). What of the structurally dependent, whose promotions, raises, vacation schedules, and assignments depend upon satisfying the "boss" and the "boss" is the police chief or superintendent? Moreover, these experts have ongoing relations with police and prosecutors, and are regularly brought to court as part of the prosecution "team" (See e.g., State v. Rhone 555 S.W. 2d 839, 857 (Mo. 1977) (Bardgett, J. dissenting)). A few labs are organized as independent agencies, receiving separate state or county funding, able to administer their own policies and control their own internal workings, not subject to administrative control by the police or prosecutor's office. We visited one such agency, which is highly respected nationally. In part due to its structural independence (and in part due to strong professional scientific leadership), it appears better able to assert its role as disinterested examiner and analyzer of evidence. Its staff are encouraged and protected in making independent, data-based judgments by the laboratory's management and perhaps by co-workers who create a norm for such behavior. This is illustrated by the fact that once a case is filed, the laboratory makes its reports and staff available to counsel for the defense. Reportedly, prosecutors objected to but were unable to stop this practice, and have grown increasingly accepting of it. The objection indicates that prosecutors hold expectations that the forensic science laboratory will be "on their side."

On the civil side, a corporate client may have in-house expertise, such as engineers, who are already intimately familiar with the subject matter. Their availability makes pre-filing consultation expeditious, easy, and inexpensive. These advantages are offset by problems which occur when in-house experts are used in subsequent litigation. The credibility of such experts may be marred by the fact that they will be testifying for their employer (and perhaps even regarding their co-workers' or their own prior work). In addition, they are often subject to discovery as ordinary witnesses rather than as experts engaged in anticipation of litigation. (Fed. R. Civ. P. 25(b)(4)).

External to the experts themselves are those people responsible for gathering and preserving the initial evidence. Evidence such individuals damage, fail to maintain through a chain of custody, or never collect in the first place, cannot be studied by an expert no matter where the expert is located or how competent he or she may be (Drug Case - Case Study 9). We encountered what appeared to be not uncommon complaints about the problems of crime scene investigation: obtaining handwriting exemplars (Questioned Documents Case - Case Study 5), or recognizing fires of suspicious origin so that the fire marshal can mount an effective investigation (Arson Case - Case Study 7) (see also Peterson

1974). Shortcomings on the part of those on whom the experts must depend increases the difficulty of the expert's job and decreases their value to the process of reducing the fact-finder's uncertainty.

All of these external factors play a part in facilitating or inhibiting the effective use of scientific and technological expertise by attorneys and ultimately by fact-finders.

Pre-trial

Rulings, Rules, Statutes, Canons. The issue with which this sub-section is concerned can be stated in a word: discovery. The rationale for discovery is that a trial is not a place for high drama and surprises. It is a place for educating the fact-finder concerning two competing points of view so that an intelligent decision can be made. If facts are to come out that will overwhelm one side, let them be overwhelmed in advance of trial so that trial can be obviated. If a settlement is not to be, then the case to be presented at trial should be as narrow in disputed issues and as informative as possible. The validity of each party's case should be put fully to the test. Effective cross-examination is facilitated by adverse parties knowing what is to be presented so they can expose its weaknesses or rebut it. The adversary method may have many of the signs of a game, but it is in the interest of the courts and the society at large to keep the game-playing to a minimum.

> "Mutual knowledge of all relevant facts gathered by both parties is essential to proper litigation. To that end, either party may compel the other to disgorge whatever facts he has in his possession. The deposition-discovery procedure simply advances the stage at which the disclosure can be compelled ...." Hickman v. Taylor, 329 U.S. 495, 507 (1947).

The other side of the balance is that parties need sufficient confidentiality to develop their respective cases in as favorable a light as the facts permit, that excessive discovery might cause parties to shut down investigation and analysis (thereby depriving the process and the fact-finder of facts), and that one side should not be effectively compelled to conduct the investigatory and fact research for the other. Rules of discovery have been developed to govern the manner and amount of discovery presumably to maximize the exposure of facts while minimizing potential abuse. We examined the statutes of the 50 states and the District of Columbia and found some consensus to exist (see Table 2).

Provisions were found in all but 10 states governing discovery of scientific evidence and expert reports in civil cases. Of these, 37 states and the District of Columbia follow the federal rule which permits a party to discover the facts known and opinions held by an expert whom the opposing party expects to call at trial. The facts and opinions of experts "employed ... in anticipation of litigation or preparation for trial" are discoverable only:

> [U]pon a showing of exceptional circumstances under which it is impractical for the party seeking discovery to obtain facts and opinions on the same subject by other means or upon a showing of other exceptional circumstances indicating that denial of discovery would cause manifest injustice [Fed. R. Civ. P. 26(b)(4)(A)].

New York imposes a stricter rule in civil cases allowing discovery of experts' opinions rendered in preparation for litigation reparation only if the court finds that the material can no longer be duplicated and withholding would result in injustice or undue hardship. South Carolina requires disclosure of only the names of experts who may testify at trial but has provisions permitting depositions.

Thirty-six states and the District of Columbia permit or require discovery of the names of expert witnesses and the results of scientific tests in criminal cases. All but two permit or require disclosure of such information by both sides. Georgia and Kansas provide only for disclosure by the prosecutor. Generally, the prosecution must turn over the names and addresses of experts who examined the defendant, the results of all tests, and all reports. The defense is to disclose the names and addresses of experts who will be called at trial together with the results of tests and reports made by those experts (see e.g., Ariz. R. Crim. P., Rules 15.1(a)(3) and 15.2(c)(2).

Section 26(b)(4) was added to the Federal Rules of Civil Procedure for the explicit purpose of opening to discovery that expert testimony which was to be presented at trial and which could be effectively cross-examined only with careful advance preparation (Advisory Committee's Notes, 1970). Thus, as the complexity of scientific and technological evidence increased, the rules of the game changed to try to make the information most useful to the fact-finder as well as fair to the parties. The balancing is accomplished by permitting discovery of the opinions and basis for them of those experts to be called at trial but not of those used only as consultants, and by authorizing discovery through interrogatories but not by deposition (except upon motion showing special circumstances) (see Note, University of Richmond Law Review, 1976).

The importance of discovery to effective preparation for cross-examination and rebuttal is patent. The balancing of discovery versus shielding from discovery is presumed to have a powerful effect upon the picture that eventually reaches the judge or jury.

Informal Processes. Rules are one thing. The behavior that actually takes place may be constrained by the rules, may circumvent the rules, or may obviate them. Our admittedly small sample of interviewees generally felt that a high degree of information sharing, an "open file" policy with regard to the scientific evidence, was usually the best policy. Although this was the most typical view expressed when we inquired about how the lawyers shield expert witnesses from discovery, we also were told of the use of "clean" experts (Fed. R. Civ. P. 26(b)(4)(A))

and "dirty" experts (Fed. R. Civ. P. 26(b)(4)(B)). "Dirty" experts are not employed to testify at trial. Therefore, they are not normally subject to discovery and can safely become more intimately familiar with the case. "Clean" experts are more fastidiously prepared for trial--and discovery--by being exposed only to safer information. Other lawyers sometimes attempt to avoid incurring harmful reports or nonsupportive experts available for discovery by obtaining only unsigned letters from an expert consulting firm or oral reports, or by advising the client to directly hire an appropriate expert for the pretrial investigation.

Some attorneys fail to take advantage of the opportunity for discovery that is available (Greenwald, 1979). In theory, the rules of discovery lend clarity and predictability to what parties' obligations and privileges are. In the ballistics case we examined (Case Study 8), it became apparent that confusion reigned regarding the availability of reports from the forensic science laboratory: the prosecutor thought that reports prepared for the prosecution were discoverable but reports prepared for the defense were not; the defense attorneys thought that reports prepared for the prosecution were not discoverable but were made available as a matter of courtesy; the experts thought their reports were public documents available to anyone who wanted them.

In any event, unless deposed, the expert is bound only by informal agreements and professional courtesies. Whether lawyers wish to discourage their experts from talking with the "other" side is really a tactical issue (Keeton, 1973), yet some attorneys and experts believe the expert may not do so or may do so only with the permission of the lawyer. Other experts regard themselves innocently as witnesses who will speak with whomever wishes to talk with them (e.g., Title VII Case - Case Study 6). And still others maintain an explicit policy of being available to the non-calling party (Arson Case - Case Study 7). At a minimum, this is a point of tension and misunderstanding between some attorneys and experts. (Also see Questioned Documents Case - Case Study 5). The relationship between a lawyer and expert witness, how candid and intimate it becomes, is conditioned in part by the prevailing rules for discovery, and in part by their respective understanding of the expert's role (see Becker, 1977).

Many commentators advise that one's own expert should be used as a consultant to assist in planning discovery of the other side's expert (Keeton, 1973; Foreman, 1976). Because the expert understands the work of the opposing expert, he or she is in an ideal position to plan interrogatory questions and to evaluate answers; and, if appropriate, to help plan deposition questions and lists of documents and data to be obtained. Such use of experts obviously seems likely to increase the productivity of discovery. However, it seems that this use of experts is not made as often or as well as it might be (Title VII Case - Case Study 6). While the reasons for this are not entirely clear, attempts to limit the cost of expert services may be a significant factor. (Ballistics Case - Case Study 8).

An issue that will be developed more fully below, is whether the expert's role is properly regarded as that of an advocate or simply a witness. The fact that expert witnesses retained to testify are not protected from discovery under Rule 26(b)(3) as an "attorney or other representative of a party" (emphasis added) (but see People v. Aiken 519 Cal. App. 3d 685, 97 Cal. Rptr. 251 (1971)), and that their analyses are not shielded under the "work product" doctrine implies that they are not advocates. Informally, however, they are encouraged to be part of the "team," especially if they help educate the lawyer, help prepare for discovery and trial, and help think through the issues and how the scientific and technological evidence can support the calling party's contentions, what the holes are, and so on--matters to which we now turn.

Discovery is by no means the largest part of the informal relations between attorneys and the experts that they engage. Lawyers are advised to make extensive use of their experts in developing the factual aspects of their cases (Becker, 1977; Foreman, 1976; Jeans, 1975; Keeton, 1973). A study of the components of attorneys' work indicates that they find fact development to be the most difficult part of their job (Carlson, 1976). That is a skill not usually taught in law schools and a task which can be accomplished more successfully if expert witnesses are used effectively. The effective development of the scientific and technological factual component of a case requires effective communication between the lawyer and the expert. The lawyer's understanding of the case's strengths and weaknesses, of the questions to ask in interrogatories, depositions, and trial, and of the answers received, and of the arguments which can be based on the evidence, is, in large part, a function of the lawyer's comprehension of the technical issues. The most eminent expert can not give intelligent answers unless the lawyer poses intelligent questions.

It became apparent through our literature review and interviews that this communication often does not occur, at least to the extent required. There appear to be a number of impediments to effective communication between lawyers and experts. Some commentators suggest that inherent differences exist in the styles and thinking of lawyers and scientists (e.g., Loevinger, 1977) such that they have difficulty meshing their approach to problems. Danner and Sagall (1977), for example, suggest that the meaning of the concept of "causation" is so different between law and medicine that lawyers and their experts must always encounter some difficulty in fitting the evidence of one to the needed proof of the other. The conceptual conflicts between law and psychiatry are legendary (e.g., Bazelon, 1974). At another level, communication is difficult due to the lawyer's substantive unfamiliarity with the field of knowledge being drawn upon, and the expert's lack of understanding of the legal issues which the scientific or technological information must address. Experts are openly delighted with lawyers who understand the scientific or technological field well enough to discuss it intelligently (e.g., Personal Injury Case - Case Study 2; Levitt & Guralnick, 1977) and experts who understand the legal issues are better able to apply the data to the case (Personal Injury Case - Case Study 2; Title VII Case - Case Study 6).

A third cause of communication problems appears to be a failure of attorneys to prepare themselves for meetings with their experts. Complaints about attorney ill-preparedness were raised frequently during our interviews and were often coupled with comments regarding the failure by attorneys to engage experts early enough (e.g., Browne, Bramer, & Caswell, 1979), to spend the necessary time studying reports provided by their experts (e.g., Charfoos & Peters, 1976), to help the expert prepare for direct and especially cross examination (e.g., Homicide Case - Case Study 1), to use the expert to review the other side's reports and answers to interrogatories (e.g., Title VII Case - Case Study 6), and to use the expert to plan cross-examination of the other side's experts (e.g., Title VII Case - Case Study 6). Concrete illustrations arose in our interviews. Although the lawyers had promised to spend time preparing the experts for their testimony, they simply did not do so. One expert described himself as having felt abandoned by the lawyer who was to call him to testify (Homicide Case - Case Study 1). Another expert threatened not to appear for the trial unless the lawyer first met to go over the testimony (Title VII Case - Case Study 6). In another instance, an expert prepared a flowchart of questions to use during cross-examination of the other side's experts. Although the lawyer used the questions, it was apparent according to the expert, that the lawyer was reading the questions for the first time at the trial (Title VII Case - Case Study 6). Other experts reported that they often see the lawyer for the first time on the morning of the trial (Ballistics Case - Case Study 8, Arson Case - Case Study 7; Drug Case - Case Study 9, but see Insanity Defense Case - Case Study 4).

Lawyers are not lazy; they are typically busy, even frenetic. But that is probably at the heart of the problem. There is so much to do, they can barely keep up with doing whatever must be done today. Planning ahead and preparing thoroughly, however important that may be to the quality of negotiations and trial, is simply a luxury many lawyers cannot afford. Working with scientific and technological experts often magnifies the problems (See Feegel, 1978). The need for preparation is more acute; the greater complexity of the cases places ever more demands on the lawyer's time, staff, and intellect. One of our interviewees described a complex case as being like a train that one is forever trying to catch but which will not stand still until the day the trial begins (Title VII Case - Case Study 6). Unfortunately, for experts who are often unfamiliar with the process, who are anxious, and who ought to be thoroughly prepared for depositions (Greenwald, 1979) as well as trial, the mismatch of needs and schedules is a formidable problem. More experienced experts seem either to accept this as a fact of life in litigation or devise ways to "manage" the lawyer, such as by stating their own expectations early and in writing, and applying pressure for the lawyer's time when the expert is in a position to do so--as the trial approaches and the lawyer has become dependent upon the expert's testimony.

The problem of limited time is likely to be correlated with limitations of other resources (Drug Case - Case Study 9). Thus, it appears that with respect to scientific and all other aspects,

preparation for civil cases handled by a large law firm for a major corporation is generally more thorough than that for criminal cases including an indigent defendant represented by assigned counsel (Ballistics Case - Case Study 8; but see Insanity Defense Case - Case Study 4). The amount of resources put into a major antitrust, products liability, and Title VII defense case, the meticulousness of preparation, and the quality of the resulting presentation is often quite impressive. Some large law firms hire attorneys holding advanced degrees in a field related to the firm's litigation activities (e.g., biochemical engineering, economics). The point, then, is that the quality of communication and preparation in general varies widely and probably for obvious economic reasons.

The facts that are developed by the scientific and technological experts can have a profound effect on the way the case proceeds: whether it is filed in the first place, the cost of its preparation, the strategy pursued, and whether it goes to trial. Negotiations can succeed or fail depending upon the nature of the facts developed and whether the attorneys are in command of those facts at the time of negotiation. Sometimes experts take part in the negotiations. The general assumption is that greater clarity of the fact situation leads to greater predictability of the result if the case goes to trial, and less likelihood that it will. Thus, if the experts bring about a convergence of views, settlement ought to be facilitated. In some circumstances, however, the findings of expert consultants result in the attorneys' "digging in their heels" and refusing to settle. This may occur, for example, when an economist projects a lost earnings figure that is far better than the attorneys had guestimated (Title VII Case - Case Study 6) or an expert shows the attorneys that they have a stronger case than they had earlier thought--and the adverse party's lawyers see these facts differently. The question is whether, in fact, experts more frequently facilitate settlement or retard it. More specifically, do some fields of expertise serve to encourage settlement better and others worse? Might a judge promote settlement by appointing court experts or masters to hold factually authoritative pre-trial discussions with the lawyers in appropriate factual contexts? No studies of these questions were found. But, our interviewees who had views on the subject of why some cases did not settle thought that different readings of the facts and of the weight of the evidence played a large part (Civil Rights Case - Case Study 3). If it is true, as at least one observer has suggested, that judges are reluctant to press for stipulations of facts or agreement to rely on a single expert, or to maneuver for clarification of the facts pre-trial (cf., Title VII Case - Case Study 6), then they may be passing up opportunities to promote settlements. Another source suggested that as scientific and technological issues in a case grow more complex, judges press harder for settlements, since complex cases are high on the list of those judges would like to keep out of their courtrooms. Still another source cautioned that by threatening to appoint as a court expert, an individual known to favor one side or the other, a judge can cross the line from encouraging to manipulating settlement process.

Cost is an issue that sometimes drives strategy. Some sources (e.g., Foreman, 1976; Personal Injury Case - Case Study 2) note that experts' costs affect the economic feasibility of litigating a case and discuss strategies for keeping costs down. This often means making selective use of the expert, which bears on our earlier discussion of attorney preparation. The choices are obvious: the full use of experts costs the greatest amount of money; less money can be spent if some corners are cut in preparation. These trade-offs are rational and have to be made by the attorney and the client. The value of a case affects the balancing of these considerations. Wealthy clients worry less about this. In the Title VII Case we studied (Case Study 6), the plaintiff's attorneys endured a serious financial strain and complained to us openly about the cost of experts in this kind of case. The defendants in the same case were able to make the decision not to settle under any circumstances (and to appeal the verdict if it was less than satisfactory) independent of cost considerations. Experts in Title VII and products liability cases say it is often more comfortable working for defendants. On the other hand, resources that are available to counsel at little or no cost are often underused. In both our arson and ballistics case studies (Case Studies 7 and 8), the forensic scientists stated that they would willingly work with the defense in a criminal case but were seldom asked to do so (see also Feegel, 1978). In addition independent experts such as university faculty are available in many cases for consultation to educate a lawyer about scientific or technical field or to prepare a substantive cross-examination. (Levitt & Guralnick, 1977; Klein, 1972).

Fees are sometimes a matter of some friction between attorneys and experts in a scenario that is somewhat Gordian. Experts are hired by attorneys, usually conduct all of their work under the supervision of attorneys, and usually submit their bills to the attorneys. However, the attorney hires the expert acting as agent for the client, so the client and not the attorney is liable for the fees. Indeed, the Code of Professional Responsibility bars attorneys from paying fees for a client (See Disciplinary Rule 5-103). Many experts believe they are employed by the lawyer. Months or years go by and they are not paid. The trial comes and goes and they are not paid. The attorney tells them they must collect from the client. Doctors became so tired of being the last paid that their interprofessional code addresses that issue (Helwig, 1968). Further, experts are almost universally prohibited by law from entering into contingent fee arrangements (See ABA Disciplinary Rule 7-109(c)). Yet when a plaintiff's experts are told that the money to pay them will become available only if the case is won, they are de facto working for a contingent fee. This is not a "mere" matter of the expert's bread and butter, but it affects whether the expert really is being paid for time or for testimony, affects the expert's credibility, and affects the willingness of experts to become involved in litigation when they can make more and more reliable money elsewhere. Attorneys by the magical stroke of entering into a good faith agreement with the client to reimburse the lawyer for such payments, are permitted to pay the expert's fee. (Helwig, 1968; Code of Professional Responsibility, Disciplinary Rules 5-103 B and 9-102. See also, ABA Commission on Evaluation of

Professional Standards, Model Rules of Professional Conduct, Rule 1.8(e) (Proposed Final Draft, May 1981)). However, in doing so the lawyer, like the plaintiff's firm in our Title VII case, must finance the case and, in essence, underwrite the risks of litigation.

Extra-systemic Organizations and Processes. The existence of organizations, processes, and pressures outside of any given piece of litigation can affect the resources available to that litigation. Many of the processes that have been noted in previous sections are again applicable at the pretrial as well as during the prefiling stage of litigation: the way experts are organized in their work (and thus the availability and choice of experts) (Browne, et al., 1979; Danner and Sagall, 1977; Green and Smith, 1976); disparity in client resources and resources made available by the state (e.g., assigned counsel almost of necessity lose money and the mounting of a full-fledged defense including experts can be done only at substantial expense to a firm) (Boston Globe, 30 May 1981); the differential resources in criminal versus civil cases; the training and professionalism of experts in their respective fields and the existence and nature of professional organizations in those fields; and the existence and terms of ethical and interprofessional codes.

Outside organizations determine the availability of experts. Before a lawyer can prepare a case with the assistance of an expert, one must be found. If the police laboratory employs all or nearly all of particular kinds of experts in an area, that monopoly creates problems for defense counsel. Kalven and Zeisel (1966) show that in criminal cases, the prosecution is more than four times as likely to offer expert witnesses in court than the defense. Although no similar data are available for civil litigation, we feel safe in speculating that no such imbalance exists there. Of such monopoly, where it exists, public officials state that if the defense really wants experts they can be obtained from other counties or states (Ballistics Case - Case Study 8). It should be noted that the geographic and cost constraints associated with such a plan still will limit the ability of the defense to work effectively with their experts.

The field of experts from which lawyers may choose is further limited by the fact that many potential experts dislike litigation. They find it too intimidating (e.g., Levitt & Guralnick, 1977, quoting Shapiro), too costly, or too demanding, or they dislike having their opinions and in some instances, reputations questioned by lawyers and evaluated by laymen. For example, the pages of Gots, 1977 almost burn the reader's fingers as he lectures lawyers, perhaps justifiably, on "how not to alienate the medical expert") (also see Charfoos and Peters, 1976). As Belli (1968) and many others suggest, the more the competent and ethical experts remove themselves from the pool of those who will advise or testify, the more the field is left to the less able and less ethical and justice, society, and the reputation of professional fields will inevitably suffer. To make this assertion will neither prove its truth nor remedy the problem. Whether the experts who do participate in

litigation are in fact the less able and trustworthy is an empirical question worthy of study. If it is true, the reasons should be identified and the situation rectified. That will call for structural and material correctives in addition to exhortations.

The relationships experts have with the parties and attorneys, and other loyalties they may have can affect the part they play in a particular case. Experts have attributes, conflicts, and contacts unrelated to law and lawyers which are of potential importance to lawyers and in turn the courts. Attorneys with several experts from whom to choose look for a variety of characteristics and abilities (Jeans, 1975; Browne, et al., 1979; Green and Smith, 1976; Becker, 1977) and seek to avoid others (e.g., Green and Smith, 1976; Kornblum, 1974). One factor is the competence of the expert to conduct the tests or interpret the data. The fields of expertise applicable to common types of litigation range from those requiring extensive training and graduate degrees (e.g., medicine, psychology, economics), to those requiring specific vigorous programs of training and a college degree (e.g., engineering, chemistry) to those with no formal preparation requirements other than wildly varying on-the-job training (e.g., ballistics, questioned document examination, automotive mechanics) (Lappas, 1978; see also Baxter, 1970; Peterson and DeForest, 1977). There is of course no simple litmus paper test for determining whether a particular individual is qualified in the requisite specialty to perform the analysis required by the case. Expert certification programs have been initiated for a number of fields, by the American Academy of Forensic Sciences and others, but they are still quite limited and, on the basis of our interviews, virtually unknown to the bar and the bench.

Another factor is the presence of a personal interest or a loyalty that may make the expert something other than a disinterested witness. In our homicide case study (Case Study 1), the medical experts called as witnesses for the prosecution realized that the defense contention that the proximate cause of death was not the injury inflicted by the defendant but rather the actions of the physicians, was an argument that could lead to civil liability if it succeeded. In addition, the prosecution had threatened to charge at least one of the physicians with manslaughter if he did not help obtain a conviction. These physicians had more than enough motivation to want the prosecution to succeed. In many cases, it seems likely that experts who are also the ordinary fact witnesses are testifying about their own ability or conduct and have an interest in the fact-finder's conclusions. In other instances, experts may have doctrinal positions that they wish to defend and that may color their testimony and conclusions.

The relationships experts have with each other either as individuals or as members of cognizable groups can affect their conduct. We became aware of interprofessional competition, conflict, and jealousy among groups of potential or actual experts. Each group wants the lawyers and the courts to recognize them as the superior authority on a subject. For example, in the Title VII case we examined (Case Study 6), at least two of the fields represented felt that their respective contributions and

expertise were superior. This battle goes on between psychiatrists and clinical psychologists, graphologists and questioned document examiners, orthopedists and neurosurgeons, statisticians and economists and no doubt among other fields (See Personal Injury Case - Case Study 2 and Questioned Documents Case - Case Study 5).

In contrast to inter-expert competition, we found inter-expert cooperation between experts on opposite sides of the case. One interviewee said that it was not unusual for members of the same discipline who happened to know each other or who have mutual friends to communicate about the case. This interviewee said it was mostly "gossip" about the case and without substance, in her experience, but the fact that such lines of communication exist is of interest. It can have some impact on the kind of cases developed, either for settlement or trial. It is easy to see that disciplines with strong professional associations or close local professional communities see each other as colleagues and allies, not intrinsically tied to their respective lawyers or clients, and have the opportunity and network to carry on these informal expert-to-expert communications when and if they wish.

Trial

Rulings, Rules, Statutes, Canons. The rationale for the use of evidence at trial is familiar: the fact finder is to base a verdict on the evidence presented and only on that evidence; only relevant evidence is to be presented; and all relevant evidence is admissible unless a specific reason for its exclusion exists. The primary function of rules of evidence is to assure the trustworthiness of evidence (e.g., Aronson, 1978). The rules of evidence are essentially the catalogue of exclusions. From 1970 to 1974, revision of the Federal Rules of Evidence was undertaken to try to codify the court rulings that had developed around evidentiary questions and to try to take into account the tactics of attorneys that were thought to need some modification (see e.g., the Notes of the Advisory Committee for Fed. R. Evid., Rules 704 and 705). Of interest to the present study are those rules pertaining to the admissibility of expert testimony, some of which represent substantial departures from earlier practice and were adopted explicitly to cope with the increasing role of scientific and technological evidence in trials. They include such dramatic changes as the abolition of the ultimate issue doctrine. They also eliminate the prohibitions against experts offering opinions based on information which has not been offered into evidence (thereby allowing lawyers to do directly what they previously had to resort to hypothetical questions to accomplish), and based on information which may not be admissible as evidence. (For discussion see Bua, 1977; Fisher, 1976; Gibbons, 1976; Aronson, 1978). The central rules of interest are the following.

> FRE 702 Testimony by Experts. If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise.

> FRE 703 Bases of Opinion Testimony by Experts. The facts or data in the particular case upon which an expert bases an opinion or inference may be those perceived by or made known to him at or before the hearing. If of a type reasonably relied upon by experts in the particular field in forming opinions or inferences upon the subject, the facts or data need not be admissible in evidence.
>
> FRE 704 Opinion on Ultimate Issue. Testimony in the form of an opinion or inference otherwise admissible is not objectionable because it embraces an ultimate issue to be decided by the trier of fact.
>
> FRE 705 Disclosure of Facts or Data Underlying Expert Opinion. The expert may testify in terms of opinion or inference and give his reasons therefore without prior disclosure of the underlying facts or data, unless the judge requires otherwise. The expert may in any event be required to disclose the underlying facts or data on cross-examination.
>
> FRE 706 Court Appointed Experts.
>
> (a) Appointment. The court may on its own motion or on the motion of any party enter an order to show cause why expert witnesses should not be appointed, and may request the parties to submit nominations. The court may appoint any expert witnesses agreed upon by the parties, and may appoint expert witnesses of its own selection. An expert witness shall not be appointed by the court unless he consents to act. A witness so appointed shall be informed of his duties by the court in writing, a copy of which shall be filed with the clerk, or at a conference in which the parties shall have opportunity to participate. A witness so appointed shall advise the parties of his findings, if any; his deposition may be taken by any party; and he may be called to testify by the court or any party. He shall be subject to cross-examination by each party, including a party calling him as a witness.
>
> (b) Compensation. Expert witnesses so appointed are entitled to reasonable compensation in whatever sum the court may allow. The compensation thus fixed is payable from funds which may be provided by law in criminal cases and civil actions and proceedings involving just compensation under the fifth amendment. In other civil actions and proceedings the compensation shall be paid by the parties in such proportion and at such time as the court directs, and thereafter charged in like manner as other costs.

(c) Disclosure of appointment. In the exercise of its discretion, the court may authorize disclosure to the jury of the fact that the court appointed the expert witness.

(d) Parties' experts of own selection. Nothing in this rule limits the parties in calling expert witnesses of their own selection.

> FRE 803 (18) Learned treatises as an exception to the hearsay rule. To the extent called to the attention of the expert witness upon cross-examination or relied upon by him in direct examination, statements contained in published treatises, periodicals, or pamphlets on a subject of history, medicine, or other science or art, established as a reliable authority by the testimony or admission of the witness or by other expert testimony or by judicial notice. If admitted, the statements may be read into evidence but may not be received as exhibits.

We conducted a statutory survey of the States' rules. This statutory survey is based on an examination of the statutes, rules of procedure and or rules of evidence of each of the 50 states and the District of Columbia. It is intended to identify common provisions which affect the use of scientific evidence and expert witnesses. Six questions were addressed: when may an expert testify, how is "expert" defined, what are the permissible bases for opinion testimony presented by experts, what evidentiary foundation is required, to what extent are experts and their reports subject to discovery in civil and criminal cases, and is the judge authorized to appoint an expert to serve as the court's witness. Eleven states address all of these questions in their statutes and rules. Two states apparently leave the issues to case law. In the remaining thirty-eight jurisdictions, some questions are covered by statute and others by case law. As is evident in the following summary of the survey and in Table 2, the impact of the promulgation of the Federal Rules of Evidence has been substantial.

When Experts May Testify. Statutes or rules were found in 24 states that define when an expert may testify. These provisions are substantially identical to Federal Rules of Evidence 702, which provides that expert testimony may be received "if scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue."

Definition of Expert or Fields of Expertise. Of the 22 provisions found which address the factors qualifying an individual to be considered an expert witness, 17 follow the language of Federal Rule 702 that a witness may be qualified as an expert by virtue of his or her "knowledge, skill, experience, training or education." Four others adopt the similar phrasing of Uniform Rule of Evidence 56(2)(b). Louisiana provides that designation as an expert should be based solely on the witness's knowledge of the subject matter.

Basis of Opinion Testimony By Experts. Sections were identified in the codes or rules of 23 states that address the source of the case specific facts upon which an expert opinion may be based. Seventeen of these jurisdictions follow the federal rule by permitting an expert to base an opinion or inference upon the case related facts or data "perceived by or made known to [the expert] at or before the hearing." Thus, there are three sources of case specific information on which an expert may form an opinion: first hand observation, presentation of data outside the court, and presentation at trial by other witnesses or hypothetical questions posed by counsel. The Comment to Federal Rule of Evidence 703 points out that the second source broadened the preexisting provisions (limiting out-of-court information from third persons to that admissible under the hearsay doctrine) "to bring judicial practice into line with the practice of experts themselves when not in court." The illustration is given of physicians who often make their decisions on the basis of records, x-rays and statements of other doctors, nurses and technicians. The Comment also indicates that by requiring the information to "be of a type reasonably relied upon by experts in the particular field," the rule protects against the indirect admission of unreliable data. Four states (Kansas, New Jersey, Ohio and Utah) adopt the more narrow position of the Uniform Rules of Evidence by limiting the facts to those perceived or made known to the expert at the hearing. Alabama and Georgia apparently follow an even more restrictive rule which requires that the facts be proven by other witnesses.

Foundation Required Before Scientific Evidence May be Presented. The codes or rules of 22 states were found to address whether and when the facts or data on which an expert's opinion is based must be disclosed at trial. The major issue is whether opinion testimony can be offered only in response to a hypothetical fact situation posed by counsel. The Comment to the Federal Rule of Evidence 705 points out that:

> The hypothetical question has been the target of a great deal of criticism as encouraging partisan bias, affording an opportunity for summing up in the middle of a case, and as complex and time consuming.

The Advisory Committee which proposed the federal rule concluded that prior disclosure of the facts and data at trial is unnecessary because of the broad right to pretrial discovery provided by the Federal Rules of Civil Procedure.

Twenty jurisdictions follow the federal and uniform rules in dispensing with the requirement that the facts and data on which an opinion is based be disclosed before the opinion is offered. The trial judge retains the authority to order prior disclosure, and the underlying facts and data are a proper subject for cross-examination. Two jurisdictions (Louisiana and Ohio) retain the traditional rule requiring prior disclosure. The Hawaii rule provides that if the underlying facts were disclosed during discovery, they need not be stated by the expert at the trial before an opinion is offered.

A potentially important variant on the use of expert witnesses is the calling of experts by the court rather than the parties. FRE 706 provides for "court appointed experts," though it is recognized that the power to appoint its own expert witnesses is inherent in the courts and was exercised at common law (see discussions in Basten, 1977; Kraft 1977; Bua, 1977). In commenting on FRE 706, the Supreme Court's Advisory Committee stated:

> The practice of shopping for experts, the venality of some experts, and the reluctance of many reputable experts to involve themselves in litigation, have been matters of deep concern.... While experience indicates that actual appointment is a relatively infrequent occurence, the assumption may be made that the availability of the procedure in itself decreases the need for resorting to it. The ever present possibility that the judge may appoint an expert in a given case must inevitably exert a sobering effect on the expert witness of a party and upon the person utilizing his services. (Emphasis added.)

In various other legal systems, such as Civil and Marxist, the court's appointment of its own experts is common. In our system it is permissible but rare--in spite of the Advisory Committee's expressed concerns, the ancient existence of the power, and the modern rule. This is an interesting phenomenon: many judges and a surprising number of our lawyer interviewees favored the appointment of court experts, notwithstanding their nearly unanimous confidence in the adversary process, yet they do not make such appointments (Personal Injury Case--Case Study 2; Questioned Documents Case--Case Study 5). Several possible explanations arose: judges are unsure about how to finance their experts or unable to; they do not want to do battle with the subset of lawyers who will protest however small or large that group might be; they are simply strangers to the practice and prefer staying on familiar ground. One of our interviewees, who had been the chief of his state's trial courts, enthusiatically volunteered the suggestion that panels of impartial experts be retained by the court. He acknowledged, however, that he rarely made use of court appointed experts. Favoring the use of court appointed experts in appropriate cases is the concern that experts are "bought" by and biased toward the attorneys who engage them, about which more will be said in section 2.32, and that court appointed experts would be free to serve the fact-finder's interest for full and unbiased information. Opposition to their use rests on the fears that because there are no impartial experts ("everyone has biases"), the choice of an expert (where two or more established schools of thought exist on a subject) will be dispositive of the result; that a judge could use the appointment process to force a settlement by threatening to appoint an expert known to be unfavorable to one side; and that court-appointed experts may carry undue weight with the jury. (See the discussion in Kraft 1977). It is possible that the use of court appointed experts as a supplement to experts called by the parties would assist the fact-finder in the search for truth that the rules of evidence are designed to

advance (FRE 102). If so, the informal barriers to their use might be overcome, at least for the purposes of an experiment to determine whether the hoped for blessings are reaped or the fears are founded.

When advocates offer the testimony of experts, the trial judge has broad discretion to exclude the testimony or to admit it. How the judge is to decide is addressed by a number of appellate opinions.

In Frye v. United States, 293 F. 1013 (D.C. Cir. 1923), the Federal Court of Appeals for the District of Columbia Circuit enunciated a special test for the admissibility of scientific evidence and expert testimony based on such evidence. Although the Frye test is currently under fire, it had been adopted by most federal courts. Frye v. United States, supra, at 1014, stated that "while courts will go a long way in admitting expert testimony deduced from a well-recognized scientific principle or discovery, the thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs." The court admitted, however, that "just when a scientific principle crosses the line between experimental and demonstrable stages is difficult to define." Frye v. United States, supra, at 1014.

Subsequent decisions applying the Frye test have attempted to set guidelines for distinguishing between experimental and demonstrable stages. For instance, the court in United States v. Stifel, 433 F.2d 431, 438 (6th Cir. 1970), applied the Frye test to uphold the admissibility of neutron activation analysis, stating that "neither newness nor lack of absolute certainty in a test suffices to render it inadmissible in court. Every useful new development must have its first day in court." United States v. Stifel, supra, at 438. The court added that the test need not be conclusive, so long as it had "gained general acceptance," citing Frye v. United States, 293 F.1013, 1014 (D.C. Cir. 1923). United States v. Stifel, 433 F.2d 431, 441 (6th Cir. 1970).

Seven years later, however, the Sixth Circuit Court of Appeals was less liberal in its application of the Frye test. In United States v. Brown, 557 F.2d 541, 557 (6th Cir. 1977), the court refused to admit evidence of ion microprobic analysis used to make hair comparisons, despite the fact that the appellant admitted that the technique had attained a "sufficient degree of acceptance in the field of mass spectrometry." The court noted, "(t)he clear trend in federal court is toward the admission of expert testimony whenever it will aid the trier of fact. See FRE 702. However, a strong countervailing restraint on the admission of expert testimony is the defendant's right to a fair trial. See United States v. Green, 548 F.2d at 1268." United States v. Brown, supra at 556. The court continued:

> A courtroom is not a research laboratory. The fate of a defendant in a criminal prosecution should not hang on his ability to successfully rebut scientific evidence which bears an "aura of special reliability and trustworthiness," although, in reality the witness is testifying on the basis

> of an unproved hypothesis in an isolated experiment which has yet to gain general acceptance in its field. United States v. Brown, supra at 556.

The court ruled that ion microprobic analysis of human hair had not yet reached a level of general acceptance in its field; that the experiments conducted had not been shown to be sufficiently reliable and accurate; and that therefore the evidence was not admissible as a basis for expert identification.

Courts, also, appear to be divided on the question of who should determine whether a scientific technique is sufficiently reliable to be admitted in evidence. The Circuit Court of Appeals for the District of Columbia took the position in United States v. Addison, 498 F.2d 741 (D.C. Cir. 1974), affirming 337 F.Supp. 641 (D.D.C. 1972), that the determination should be made by the scientific community. In rejecting evidence of voiceprint identification, the court explained that "the requirement of general acceptance in the scientific community assures that those most qualified to assess the general validity of a scientific method will have the determinative voice" (United States v. Addison, 498 F.2d 741, 744 (D.C. Cir. 1974), affirming 337 F. Supp. 641 (D.D.C. 1972). (See also People v. Kelly, 17 Cal. 3d 24, 549 P. 2d 1240, 130 Cal. Rptr. 144 (1976).

The Second Circuit Court of Appeals took an opposite stand in United States v. Williams, 583 F.2d 1194 (2nd Cir. 1978), holding voiceprints not excludible per se, that is, trial judges may admit the evidence at their discretion. The court, in reaching its decision, noted that "unanimity of opinion in the scientific community, on virtually any scientific question, is extremely rare. Only slightly less rare is a strong majority." United States v. Williams, supra, at 1198. For these reasons the court refused to "surrender to scientists the responsibility for determining the reliability of (scientific) evidence." United States v. Williams, supra, at 1198. Instead the court undertook an independent evaluation of the evidence focusing on "the probativeness, materiality and reliability of the evidence, on one side, and any tendency to mislead, prejudice, or confuse the jury on the other." United States v. Williams, supra, at 1198.

In its discussion of the reliability of scientific evidence, the Williams court reasoned that a "determination of reliability cannot rest solely on a process of 'counting (scientific) noses.'" United States v. Williams, supra at 1198. The court proposed four indicators of reliability: a) potential rate of error, b) existence and maintenance of standards, c) care and concern with which a scientific technique has been performed and whether it appears to lend itself to abuse, and d) whether the technique stands in an analogous relationship to routinely admissible scientific evidence. These factors would be subject to exposition at trial, or in a preliminary hearing.

The court also discussed the tendency of scientific evidence to mislead the jury due to its aura of mystic infallibility. United States v. Williams, supra, at 1199. The court noted that this objection could be raised whenever an expert testified; but "with less force" with regard to voice prints which can be examined and compared by the jury. United States v. Williams, 583 F.2d 1194, 1199 (2nd Cir. 1978). The Williams test, thus, employs a "flexible" standard for the admission of scientific evidence which is not unlike the traditional test for the admissibility of expert testimony generally.

The Fourth Circuit Court of Appeals, also, applies a "flexible" standard of admissibility. In United States v. Baller, 519 F.2d 463 (4th Cir. 1975), cert. denied 423 U.S. 1019 (1975), the court upheld the admissibility of voice prints stating its position on the subject as follows:

> [U]nless an exaggerated popular opinion of the accuracy of a particular technique makes its use prejudicial or likely to mislead the jury, it is better to admit relevant scientific evidence in the same manner as other expert testimony and allow its weight to be attacked by cross-examination and refutation. United States v. Baller, supra, at 466.

The court also agreed that "(a)bsolute certainty of result or unanimity of scientific opinion is not required for admissibility." United States v. Baller, supra, at 466.

A lower federal court refused to apply the Frye test in the context of a probation revocation hearing. The court ruled that "the Frye test, of general acceptance in the scientific community precludes too much relevant evidence for purposes of the fact determining process at a revocation hearing." United States v. Sample, 378 F.Supp. 44 (E.D.Pa. 1974). In place of the Frye test the court applied the standard for admissibility of expert testimony generally: "testimony by a witness as to matters which are beyond the ken of the layman will be admissible if relevant and the witness is qualified to give an opinion as to the specialized area of knowledge." United States v. Sample, supra at 53. (See also Lipton, 1978). Other courts have taken issue with the Frye test on constitutional grounds (see e.g., Jackson v. Garrison, 495 F. Supp. 9 (W.D.N.C. 1979); State v. Dorsey, 87 N.M. 323, 532 P. 2d 912 (Ct. of App.), aff'd, 88 N.M. 184, 539 P.2d 204 (1975)).

Proponents of the Frye test assert that the safeguards inherent in the test are necessary to "assure that a minimal reserve of experts exists who can critically examine the validity of a scientific determination in a particular case" (e.g., United States v. Addison, 498 F.2d 741, 744 (D.C. Cir. 1974), aff'g. 337 F. Supp. 641 (D.D.C. 1972)). In United States v. Addison, supra, at 744, the court suggested that "the ability to produce rebuttal experts, equally conversant with the mechanics and methods of a particular technique [could] prove to be essential."

The trial judge faces certain problems for which the resources and guidelines at his or her disposal offer little help. In deciding whether to admit a field of knowledge or technique new to the courts, the usual methods available to the judge--in-court testimony and an examination of precedents involving the new technique--are at best only modestly informative. How can the court determine when knowledge or a technique is reliable or the consensus of the scientific community? Numerous incongruities have come to exist as a result, where less reliable scientific and technological information is admitted but the admission of demonstrably more reliable techniques is delayed until the requisite consensus has formed. (Giannelli, 1980). Once the first two tiers are accepted--the underlying theoretical principle is held valid and the application to a question before the court is deemed to work--then the judge must decide if this expert is qualified to make the application in this case for the fact-finder (See 7 Wigmore, Evidence §1923 at 21 (1940)). Like lawyers looking for experts, judges cannot know all things about all fields. Even with the material brought out when an expert witness is being qualified, the judge really has to make a largely seat-of-the-pants judgment as to the expert's competence. Erroneous exclusions may occur, such as when a judge excludes all persons with a given occupational label (a practice rejected by Jenkins v. United States, 307 F.2d 637 (D.C. Cir, 1962)). The obverse error is when a judge routinely admits testimony by experts of a certain professional label rather than trying to assess the quality and probativeness of the content of their offerings. Any individual engineer or physician may be incompetent. How can the judge know?

If the adversary method is working properly, the lack of qualification can be shown by opposing counsel, and many would argue that that is where the focus of responsibility lies. Once an expert is qualified and speaks to a topic within his or her competence, the danger arises that he or she will slip beyond the borders of his or her expertise. Again, the responsibility must be said to be that of opposing counsel. Sometimes it is not found out until an answer is given or on cross-examination that a witness is testifying beyond his or her competence. This is difficult to cure once it has happened (Ballistics Case - Case Study 8). In practice, judges are usually faced with a familiar array of experts correlated with a familiar array of cases, and the process is fairly routine. In our Case Studies, rarely was an issue raised as to qualifications or scope of testimony. The problems, where they exist, are more salient at the edges where familiar areas and experts fade into the unfamiliar. The routinization is at once an efficient solution and a narcotic that allows material to be presented by an expert who may not be qualified. One of our attorney interviewees (Civil Rights Case - Case Study 3) was critical of the liberal use of experts, and suggested that they constituted an unwritten "garbage exception" to the hearsay rule: anything that could not properly be testified to could always be gotten in through the mouth of an expert. Thus, we have been alerted to the possibility that qualification of experts is too routine and liberal in some areas, that in unfamilar areas the judge is afforded little substantive help, and the lines on scope are difficult to draw.

A number of less obvious problems were suggested by our literature review and interviews. One is that the adversary method is alien to some experts and interferes with their ability to operate and inform as they are accustomed to. Other experts, particularly those familiar with court procedures, are quite comfortable with the trial format. Part of this problem may be the role confusion the adversary method engenders, but there is also an issue concerning the suitability of the question and the answer format for extracting and informing a judge or jury about complicated technical information (Brownlie, 1978). (Also see Thibaut and Walker, 1978.) In our Title VII Case (Case Study 6) the trial judge exercised an unusual degree of creativity and flexibility in making sure he was able to be properly educated about the complex statistical and econometric data being presented. For example, over objections from both attorneys, he invited an expert to spend an hour at the blackboard lecturing the judge and answering the judge's questions until the judge was satisfied that he understood the expert's points. Also, the judge asked many questions of other expert witnesses, did a good deal of homework to be ready for them, and dictated impressions of the testimony on a daily basis. Pretrial, the judge compelled the parties to focus on the same issues and the same data including supplying statistical briefs--so that trial was an opportunity to confront the real differences in the parties' contentions.

Other interviewees suggested that some topics did not admit of expertise--such as a dispute concerning the nature and functioning of social institutions, like the courts (Civil Rights Case--Case Study 3). Another issue has to do with the role of case specific (or adjudicative) facts versus background (sometimes equivalent to legislative) facts. Trial courts are most accustomed to dealing with specific, concrete, "historical" facts of a case. So, too, are practitioners (technologists) of various fields. In this regard, engineers and physicians should be comfortable with the level of discourse in court. A judge is likely to ask what the expert saw, did, and think about the specific case at issue. But most scientists and others who work with aggregate data or phenomena in general, sometimes have difficulty understanding and being understood by lawyers and judges (see Levitt & Guralnick, 1977; Loevinger, 1967). A scientist might well have trouble citing a specific case instance; but because he or she deals generally and in the aggregate, his or her portrayal of the principles is likely to be the most reliable. The translation problem, the deductive logic required to go from that abstraction down to cases is a source of difficulty (see e.g., Thomas, 1974; Baron, 1980). In our Civil Rights Case (Case Study 3) challenging the operation of the local bail system, for example, the defense complained in their brief on appeal that the plaintiffs never cited a single instance in which a defendant was denied release on recognizance. Finally, when is an expert's testimony hearsay because it offers data obtained by an out of court declarant (see e.g., Drug Case - Case Study 9).

Testimony by experts, whether called by the parties or the court, is not the only way scientific and technological information can reach trial judges. Information regarding scientific or technological facts can also

be presented by way of pre-trial briefs or memoranda, memoranda on proposed findings of fact, and through oral arguments before, in the middle, and at the close of trial. Rules exist which permit the judge to seek his or her own information or help in getting it. Judges may take judicial notice of scientific facts or methods (e.g., FRE 201). Judges may refer unusually complicated matters to a special master who may hold hearings and report findings to the court (e.g., Fed. R. Civ. P. 53). The judge may appoint a court advisor, in essence a consultant, who will educate the judge as the judge directs on difficult subjects before the court (Konopka, 1980). In our Title VII Case (Case Study 6) the judge said that one thing he did not have or use that could have been a help would have been a "tutor," but that judge declined to make such an appointment. Lawyers dislike advisors because their communications with the judge are ex parte. A number of states have, however, modified their canons of judicial ethics to make it clear that prohibitions against ex parte communication were not intended to include consultations with court advisors. Judges may also appoint advisory juries in "actions not triable of right by a jury" (Fed. R. Civ. P 39(c)). The advisory jury may be composed of anyone the judge wishes to appoint, including scientists and technical experts, and they serve as advisors to the judge. These were commonly used in the days when complexity and regulation of litigation were new, during the era of Franklin Roosevelt, but fell into disuse during World War II and never returned to popularity (Konopka, 1980). Finally, specialized courts exist with specially trained personnel--like the Court of Customs and Patent Appeals--to deal with complex scientific and technological subject matter. Judges have also been known to conduct impromptu data collections of their own (Wolf v. Colorado, 388 U.S. 25 (1949); Triangle Publications v. Rohrlich, 167 F.2d 969 (2d Cir. 1948)), to call acquaintances thought to be knowledgeable for briefings (Schick, 1970), or to visit a library. (Generally, see Beuscher, 1941).

Informal Processes. We see three large issues in this subsection: role conflict, strategies and tactics of lawyers and judges, and dependence of the court upon experts and its perceptions of them. The most troubling of these is the question of role.

The "role" a person performs is defined by his or her understanding of what the role entails; by the behavior called for by the role; by the expectations of others as to proper behavior of the role occupant; and by societal or institutional norms regarding the content of a particular role (Katz and Kahn, The Social Psychology of Organizations, Ch. 7 (Wiley 1966)). If societal definitions, one's personal understanding of a role, and the expectations of people with whom one must interact while in the role are all in agreement, a person can perform the role without confusion, conflict, or stress. Sometimes, however, people experience "role conflict." Role conflict comes in various forms. Inter-role conflict occurs because a person can occupy several roles at once (e.g., lawyer and parent) and feel pressure from one role while in the other. Intra-role conflict occurs when a person occupying one role feels competing pressure to behave in mutually inconsistent ways (what is commonly called a conflict of interest). The lawyers and judges we

interviewed seemed to feel comfortable in their roles as advocate and disinterested judge. At least half of the experts we interviewed were decidedly uncomfortable. Their discomfort seemed to center about their role as an expert and ranged from puzzlement to distress (Homicide Case - Case Study 1; Title VII Case - Case Study 7). In a few instances the experts momentarily turned the interview around and wanted to ask us what their role really is. What are they supposed to be doing there? The heart of the problem is a set of shifting demands on the expert to be a decision-maker ("do you have an opinion...."), a witness ("can you tell the court what an EEG is?"), and an advocate helping the lawyer plan interrogatories and depositions, planning the testimony, preparing to be cross- examined. Lawyers and judges have other reasons to be comfortable in their roles: they have had much more practice, they have many colleagues with whom to compare notes on their experiences, they have formal education, canons of ethics, and professional associations which deal explicitly with what is in and what is out of bounds for their respective roles. Infrequent experience with the role and lack of professional guidelines and support for experts is, no doubt, part of the cause of their problems. Experts who testify often appear much less ill at ease with their role (e.g., Personal Injury Case - Case Study 2, Insanity Defense Case - Case Study 4, and Drug Case - Case Study 9). Whether this is because more experience allows them to make some peace with the role or because those who dislike the tension stop serving as expert witnesses, we do not know.

The role of the expert witness is not clear if only because it is disputed. Some point out that an expert witness is a "witness," not an advocate, and takes an oath (Fed. R. Civ. P. 43(d)) to tell the "whole truth" (Loftus and Monahan, 1980). Others tell expert witnesses to forget about the science game; when you work for an attorney you are part of the team trying to win the case (Preconvention Workshop on Clinical Psychologists as Expert Witnesses, Massachusetts Psychological Association Convention (Boston, 1981)). Others observe that the expert is somewhere in between a witness and an advocate and will never be able to extricate him or herself from that never-never land (Peters, 1980). Much less dispute occurs with regard to the proper role of any other participant in a trial. Historically, the role of the expert has gone through some of the same kinds of shifting. Originally experts were cast as jurors. Just as lay witnesses were once used as jurors because they had direct knowledge of the incidents in dispute and of the parties, experts were once used as jurors because they had knowledge of farming or accounting or shipping. Experts were not moved out of the jury box until the 16th Century, but it remained unclear whether the expert witnesses were called by a party or the court. (Basten, 1977). The first clear reference to a partisan expert being called by one side of a controversy is Folkes v. Chadd (3 Dougl. 157; 99 E.R. 589 (1782)). The role confusion persists. Based on their writings and our interviews it appears to us that most experts value their expertise, their loyalty to their discipline, their deference to what the data and the scientific and technological principles show. They would be more comfortable being called by the judge and are uneasy being viewed or treated as partisans. The structure of the usual procedures, however, challenges these preferences, and nudges, tugs, or pulls them toward the calling party.

Let us simply review some of the elements of the process that create the role conflict. The court wants an impartial witness and most experts prefer to try to serve in that capacity. That much seems fairly clear. (But see Personal Injury Case - Case Study 2 and Ballistics Case - Case Study 8). The lawyer who approaches the expert defines the issues. That is not a minor point. The definition of an issue immediately orients the expert's thinking (Civil Rights Case - Case Study 3). If the expert is not to the lawyer's liking by virtue of style, substantive leaning, or ability (both technical and communicative), the lawyer will go find another expert (Personal Injury Case - Case Study 2; Insanity Defense Case - Case Study 4). The lawyer and the expert work together over time; the more complex the issues and the more conscientiously they prepare, the more contact they have. The lawyer (or at least the lawyer's client) pays for the expert's time. The expert, more than other witnesses, is taken into the lawyer's confidence to help develop the case. The expert is not insensitive to the needs and goals of the lawyer. Even experts who apparently are highly conscientious and independent (stylistically as well as structurally) reveal their sensitivities at the same time they display their objectivity: "We were always telling them [the lawyers] things they didn't want to hear" (Title VII Case - Case Study 6).

The writings on the subject are either silent on the question of influence or advise lawyers to allow objectivity and independence (e.g., Belli, 1968; Getman, 1979). But our interviewees indicate the lawyers vary considerably along a spectrum from allowing the witness to report and testify as the witness sees fit through trying to nudge a witness ("Gee, if only you were able to say X, that would lock up our case"), over to urging a witness to testify in a particular way. Some expert witnesses told us that dealing with the lawyers was a "constant negotiating process." Some lawyers told us they found experts easy to "move around." Kogan (1978) goes so far as to argue that experts have an affirmative obligation to reveal to the court or the other side what the calling party may not bring out on direct examination. Even experts who keep in view their role as disinterested witnesses and who are willing to talk with the other side's lawyer about their anticipated testimony, its basis, and its weaknesses, usually feel uncomfortable doing so without first checking with "their" lawyer (Questioned Documents Case - Case Study 5; Ballistics Case - Case Study 8). Two expert witnesses who seemed especially independent and resistant to the manipulation of lawyers were asked by us how they would respond if at the completion of their examination the judge asked them: "Is there anything else you know about this case that you think I might want to hear about?" One said that he had once been asked that question and said he replied that he had nothing to add. The other appeared disarmed by such an unorthodox question, but said that if it ever did happen she would refer the judge to her written report. Thus, it appears that even the most independent expert has a sense that there is a line which separates the "whole" truth from the realm of the traitor, a line which one crosses at some social, if not financial, peril.

Arriving at the courthouse, if people are milling about in the corridor, whom does the expert see as familiar and friendly, that is, whom does the expert know? The structure of taking testimony, the manner of questioning on direct in contrast to cross-examination, the shift that occurs in the mood of the courtroom when it is time for cross-examination, all imply that the expert witness called by a lawyer is an agent of that lawyer (Broder, 1971). Even the expert witnesses who are committed to objectivity and fairness in viewing and reporting the data, almost have to end up identifying with the lawyer who calls them, and hope that the motions or claims on whose behalf they are testifying prevail. And yet, the expert witnesses are uneasy about this. The frequency with which expert witnesses were called "prostitutes" or "whores" by our interviewees --including the same lawyers who may have seduced or browbeat the experts into compliance--indicates that experts are perceived as partisans by the time the case is ready for trial. We should note, however, that many trial lawyers are skeptical enough to believe that just about everyone is a prostitute or a liar. The interesting question, really, is whether they believe expert witnesses are more, less, or just as untrustworthy as other witnesses. One defense lawyer said of the forensic scientists who saw themselves as unbiased, "you work for who pays you" (Ballistics Case - Case Study 8). This perception is manifested further in the Advisory Committee note quoted previously. The reality of the lawyer's "success" in finding or manipulating experts may be seen in the wild discrepancies in expert testimony sometimes seen (Hallisey, 1980; Basten, 1977; Personal Injury Case - Case Study 2), in glaring lies by experts (Personal Injury Csse - Case Study 2), and perhaps in the "battle of experts."

It is probably less correct to say the experts can be bought, but more correct to say they can be sold--by the same professional advocates who are going to have to "sell" the case to judges and juries. That lawyers are relatively good at this should surprise no one. To the degree that expert witnesses have knowledge that is useful to a fact-finder, useful in accurately and authoritatively filling in some of their uncertainty with knowledge, the expert witness can be a valuable resource. The expert witness is put into what may be characterized as an ironic plight. Their very value and credibility makes them a target of influence by lawyers. That influence--incidental as well as deliberate--makes them seriously doubted by many judges and, depending upon the testimony, perhaps by many lawyers. The present arrangement and the consequences it has for some or much of the expert testimony received by the court is what has led some commentators to urge the increased use of court appointed experts in appropriate cases and the rules of evidence to govern the practice (e.g., Botter, 1977; Basten, 1977; and Advisory Committe Note to F.R.E. 706).

An expert's role is affected in part by the perceptions and expectations people have of the expert. As suggested above, if experts are or are perceived to be willing to say anything the calling party asks of them, that will affect their value to the fact-finder in reducing uncertainty. The extent to which hard facts and scientific principles place desired constraints on experts' testimony has not been studied. It

may be that experts are movable within the gray zone of a factual environment, but that the gray areas are relatively small. The "battle of experts" is often held up as an example of the untrustworthiness of experts and hopelessness of a fact-finder's sorting out the truth when a "battle" occurs. Kalven and Zeisel (1966) found that in fewer than 3 percent of criminal cases did the celebrated battle erupt. Whether this low number represents the result of unambiguous scientific data, or the imbalance of prosecution and defense resources is not clear. Much would be learned from comparable data on civil cases, where the imbalance often does not exist, and from studies dealing with the content of the "battle," and the extent and nature of the opposing testimony.

Our interviews suggest that different disciplines familiar to lawyers and courts are differently perceived and trusted. While all experts were frequently castigated, most interviewees singled out (voluntarily, without prompting) psychiatry and clinical psychology for special contempt, with appraisers and accidentologists close behind. This may be a consequence of the distinction between expertise that focuses on relatively more objective vs. relatively more subjective or interpretive techniques. One result has been an effort to refine interpretive standards to make them more rigorous, specific and reliable (see e.g., Spitzer, Endicott and Robins, Clinical Criteria for Psychiatric Diagnosis and DSM III, 132 AMERICAN JOURNAL OF PSYCHIATRY 1187 (1975); Feighner et. al., Diagnostic Criteria for Use in Psychiatric Research, 26 ARCHIVES OF GENERAL PSYCHIATRY 57 (1972)).

Let us now turn to some issues that may be classified as dependence upon the expert's knowledge and the nature of that knowledge. Suppose an expert witness presents false testimony (either because the knowledge is in error or the expert deliberately lies). A scientific or professional field has a powerful defense against unsubstantiated or exaggerated conclusions: replication. Professional/technical fields which apply such knowledge have a "defense": erroneous principles will be found out because patients will not get well, planes will not fly, or chemicals will not be synthesized. How can the courts assure the integrity of knowledge offered to them? One means is to ensure that individuals who testify as experts have the requisite training and experience and that forensic laboratories maintain rigorous quality control practices (a more extensive discussion of these issues follows in the section on Extra-Systemic Organizations and Processes). Once an individual is qualified as an expert, the operational elements of the adversary system--cross-examination and rebuttal experts--are the only potent defense. If the lawyers on the other side let false testimony go ineffectively challenged, the court is likely to believe it. Many reasons exist to suspect that the knowledge reaching fact-finders is not being tested well. If lawyers are incompetent or overburdened, inadequately prepared, with imbalanced resources, the court does not get the potential benefit of the adversary process (Arson Case - Case Study 7; Ballistics Case - Case Study 8). Peterson, Fabricant, and Field (1978) have offered data showing that forensic laboratories make many mistakes. Combined with the unavailibility of experts to defense attorneys, erroneous scientific evidence can be taken as correct. (Also

see Arson Case - Case Study 7.) This places much of the burden on the lawyers themselves (Brownlie, 1978). And that is one, perhaps the, major place to focus. Even good experts with accurate data cannot get it in if the lawyer who asks the questions does not understand what he or she is doing (Levitt and Guralnick, 1977; Ballistics Case - Case Study 8). Equally unskilled lawyers is no answer. Lawyers not substantively prepared are known to turn to second rate cross-examinations and "derogatory tactics" (Drug Case - Case Study 9). These are poor substitutes for incisive, informed questioning. Even at its best, the adversary method cannot deal as well with experts as it can with lay witnesses. Lay witnesses come in finite numbers. Experts are potentially a large pool. The court will hear only one or two experts per side on a given issue. Suppose the population of experts consists of 1,000 persons, 999 of whom hold view A and one holds view not-A. The fact-finder will hear a "balanced" presentation and may not know how distorted is its picture of the state of knowledge (Peters, 1980).

Some commentators question the ability of the fact-finding process and its supporting resources to digest and apply technical knowledge (Title VII Case - Case Study 6; Bazelon, 1979; Horowitz, 1977; MacGowan, 1979). The more technical and complex a case, the more the court's capacity to process information intelligently is tested (see MacGowan, 1979). Most of these commentators point to its limits, and feel that examples are easy to find showing the courts as they now exist cannot deal with all the issues about which they are asked to decide. Obviously such examples occur primarily in the extreme cases in the distribution of complexity. But, the problem can be expected to worsen with the increasing reliance of our society on technology. Will courts have to change in order to process these cases? Will they have to change in order to more effectively process the more common technical cases they have now? Perhaps they will have only to make more use of tools already at their disposal.

The trial is in an important sense an educational forum. The lawyers and witnesses are there to educate the fact-finder about the case. A central part of this process is communication, and a common concern about expert witnesses is how effectively they express their ideas, translate their jargon, and share their knowledge with the fact-finder (See Brownlie, 1979). We encountered cases containing the full range, from lucid to nearly opaque. As discussed earlier, judges have at their disposal flexible procedures to facilitate this learning process, including allowing jurors to ask questions, take notes, and to have exhibits and documents in hand while they deliberate. The mode of communicating information can have an effect on comprehension of the message. Jacoubovitch, et al. (1977) presented the same information to mock jurors either by a video tape of lawyers reading the transcript of an expert's deposition or a video tape of the expert being deposed, and found the latter to be a more effective manner of communicating the content to the jury.

Does the information that may be available get presented fully? In what ways might incomplete information reach the fact-finder? Experts in our Title VII case (Case Study 6) suggested the following scenario. An

expert on one side of a case does a thoroughgoing and two-sided analysis of the available data, finding the strengths and weaknesses of both sides. The same happens on the other side of the case. The correct factual conclusion is plain to the experts on both sides. Lawyer A who engaged expert A elicits at trial only that information that is favorable to side A. Lawyer B elicits the complementary information. The fact-finder then has a full and complete picture and can reach the correct factual conclusion. If one party is unable to fill in the side of the picture favorable to them, the fact-finder will never learn of it and may reach an incorrect conclusion--not in terms of what is presented at trial but in terms of what was available and known by at least one of the parties. This, of course, is an overly neat scenario, but the fundamental points it makes are important. In principle, the same methods applied to the same facts should lead to the same conclusions. When this fails to happen, the reasons are worth inquiring of. Is there disagreement in the field as to accepted techniques? Were errors committed? Were the analyses incomplete? Was counsel on one side unable to present complementary parts of the picture?

Suppose a complete and clear picture of the adjudicative facts does reach the fact-finder. Does a substantial possibility exist that such a picture is not enough to properly interpret the meaning of the facts? An illustration from the literature will clarify the point. A suspect is arrested for a serious crime. The culprit, whoever he or she is, broke into a home by breaking a window. The police laboratory examines the clothing of the suspect and finds glass fragments. The fragments "match" the type of glass the window had been made of. Does this evidence inculpate the suspect? How probative are these facts? Numerous commentators have discussed the importance of quantifying, where possible, and giving "base rate" data to provide a context for interpreting the probability that the defendant committed the crime, given the evidence (Finkelstein and Fairley, 1970; Saks and Kidd, 1981). In this example, it makes quite a difference if a person selected at random from the population has a probability of one in 1,000 of wearing glass fragments that have the same composition and refraction as the glass at the crime scene or a probability of 600 in 1000. Some forensic scientists have attempted to develop base rate data for glass fragments by examining clothing at a dry cleaner and found that over 60 percent of the garments had glass fragments in them--far more than a fact-finder probably would have assumed (Pearson, 1971). Thus, the availability of these background data inform the fact-finder's decision. Indeed, without such data the fact-finder has no choice but to guess at the probativeness of the data and the guess may be wide of the mark (Saferstein, 1979).

In order to determine the significance of tests results, factfinders should be presented with information regarding the base rates for common phenomena analyzed by forensic scientists (Coleman and Walls, 1974); the accuracy limits of the tests and analytic techniques used (such limits have been determined for virtually all bio-medical laboratory tests (Saks and Kidd, 1981), and the accuracy of the tests <u>in practice</u>, as determined by quality control studies run on the laboratories. (Some forensic laboratories are much more accurate than others (Peterson, Fabricant, and

Field, 1978), apart from the state-of-the-art capability (the theoretical potential) of the test used.) Judges and lawyers will then have to become sufficiently conversant with the statistical principles involved to employ this background data in assessing the testimony presented.

Although it is given the least attention here of the areas we are covering in this subsection, we must note that much of the literature on trials is devoted to a discussion of tactics and strategy (e.g., Broder, 1971; Keeton, 1973; Moenssens and Inbau, 1978; Jeans in 1975; Charfoos and Peters, 1976). These deal with an almost mind-boggling web of permutations of how to present and counter experts and how to present oneself to a witness. Expose your own expert witness' credentials with great specificity. If the other side's expert witness is quite good, try to stipulate to the qualification so the jury does not hear them (see e.g., Questioned Documents Case - Case Study 5). On cross-examination, do not ask other than yes/no questions unless you are highly conversant with the subject you are examining, since a well prepared expert witness can turn careless open-ended questions to his or her side's advantage. Do not let an attorney limit you to a yes or no answer; ask the judge to let you explain (see e.g., Personal Injury Case--Case Study 2). Expert witnesses who are too familiar with the courtroom (professional witnesses) lack credibility. Expert witnesses who testify for only one side lack credibility. Expert witnesses who testify too readily for either side lack credibility (e.g., Personal Injury Case--Case Study 2). It is unfortunate that other issues relating to the use of expert witnesses in litigation are not as well considered and as intricately worked out as the strategy and tactics of the courtroom aspects of trial practice.

<u>Extra-Systemic Organizations and Processes</u> Organizations outside of the courts influence the material presented to the courts by regulating or informally influencing the behavior of scientific and technological experts. (see Gibbons, 1973). We contacted several professional associations whose members sometimes serve as expert witnesses and asked their counsel or ethics committees whether the organization had codes or complaint procedures that bear on the conduct of members in judicial proceedings. Two of the organizations we contacted had special provisions for ethical responsibility during participation in litigation.

American Academy of Forensic Sciences

The forensic scientist should render technically correct statements in all written or oral reports, testimony, public addresses, or publications, and should avoid any misleading or inaccurate claims.

The forensic scientist should act in an impartial manner and do nothing which would imply partisanship or any interest in a case except the proof of the facts and their correct interpretation.

National Society of Professional Engineers

Engineers shall issue public statements only in an objective and truthful manner. Engineers shall be objective and truthful in professional reports, statements, or testimony. They shall include all relevant and pertinent information in such reports, statements or testimony.

Others had no specific provisions but said that when inquiries or complaints were received, it was possible to subsume members' conduct as expert witnesses under more general provisions. For example:

American Medical Association

A physician shall deal honestly with patients and colleagues, and strive to expose those physicians deficient in character or competence, or who engage in fraud or deception. A physician shall ... make relevant information available to patients, colleagues, and the public....

American Psychological Association

Psychologists have the responsibility to attempt to prevent distortion, misuse, or suppression of psychological findings.... Psychologists present the science of psychology and offer their services ... fairly and accurately....

All of these organizations said that complaints against members for litigation-related ethical questions were rare. The one group that did receive and was accustomed to dealing with such complaints was, understandably, the American Academy of Forensic Sciences. The chairman of its Ethics Committee told us that two types of complaints were brought against members acting in their role as expert witnesses. One type had to do with misrepresenting qualifications: saying one had certain credentials when one did not. To his memory, this arose twice. It was concluded in one case that a misunderstanding had occurred, where a Ph.D candidate was thought by the calling party to hold the degree already. The second case was found to be a deliberate misrepresentation. Regarding substantive misrepresentations, the chairman said these were as likely to be brought by the calling party as by the adverse party. In such cases the ethics committee procedure was to assemble an ad hoc committee of substantive experts who would look into the case and make recommendations to the ethics committee. Essentially, these complaints are resolvable into one of two conclusions. Either an expert witness did assert opinions unwarranted by the available data and accepted scientific principles, or a difference of opinion between experts was within reasonable bounds of differing opinion given the state-of-the-art. In his several years of experience on the ethics committee, the chairman told us, the former conclusion was never reached.

The attorney with whom we spoke at the American Medical Association's General Counsel's Office suggested that since the disagreement between experts is a difference of opinions, no one could ever conclude that an

"opinion" was incorrect or deceptive. He further explained that the great majority of inquiries his office receives concerning litigation are by physicians who have been asked to testify or have been subpoenaed and in either case are strangers to courts, do not know what the "rules of the game" and want guidance. Medical witnesses face special problems in the world of expert witnesses. They often are the treating physician, by virtue of being on duty in an emergency room or are the personal physician of a crime victim or a victim of a personal injury. They have little choice as to whether or not they wish to become involved if litigation ensues. And if the case does result in a trial they are likely to have to testify as both a lay and an expert witness.

In a brief interview with an official of the American Psychological Association, much the same types of problems were reported. That is, members may call up before becoming involved in litigation as expert witnesses to seek advice and guidance on the ethical and legal principles involved. The national APA staff, like that of the AMA, typically give little more than general guidelines, point out some issues to be sensitive to (usually those embodied in the ethical code) and suggest that advice be sought from a local attorney concerning relevant rules and practices of the jurisdiction. It was noted that clinical psychologists [psychiatrists also] face certain unique problems as expert witnesses. The subject matter about which they are asked to testify is often the parties to litigation themselves; their knowledge is likely to have been obtained earlier as part of a confidential or privileged therapeutic relationship; and participation in the litigation could impair the therapeutic relationship. Perhaps the most complicated ethical problems arise when a psychologist is asked by one side of a child custody battle to provide a report or testimony assessing the family, the children, or the other spouse. The psychologists may have obtained information concerning the adverse spouse during an earlier therapeutic relationship or as a result of the client spouse bringing the children to the psychologist without the other spouse's knowledge. In such situations the psychologist is supposed to be aware that human service providers are not advocates, and that their ethical obligation is to inform all parties as to the role and function of the psychologist in meeting with or interviewing any members of the family. (APA, 1981 Principle 6(b) also Principles 1(f) and 5) Such disclosures may conflict with the lawyers' strategy.

Organizations outside the justice system can take certain actions that may tend to enhance the competence of their members as expert witnesses and in turn improve the evidence provided to the court. Or such organizations can take actions that interfere with the courts' ability to obtain sound and useful information (see discussion of extra-systemic factors in the section of this chapter on the pre-filing stage). On the positive side may be the development of high standards of scientific and professional competence and the provision of continuing education in general. Professional organizations may conduct courses, provide reading matter, or maintain sub-organizations especially concerned with the role of their members as experts in litigation. They may organize certification programs or promote licensure in the states.

Certification and licensing are controversial because of the double-edged potential to help or hurt professionals' guild interests. It has also been suggested that certification may tend to over emphasize academic credentials and undervalue on-the-job experience thus misleading rather than assisting courts to determine expert qualifications. We have been told of an organization of appraisers which trains, tests, and certifies its members, and investigates any discrepancies in excess of 10 percent in estimates of the value of property. The assumption, clearly, is that the same property appraised by two competent appraisers using state-of-the-art methods ought not to differ much in their results. That is an assumption shared by the court (e.g., Hallisey, 1980), but not always achieved when testimony is given (Insanity Defense Case--Case Study 4). Appraising is patently quantitative and lends itself to easy monitoring. How feasible might this be in other fields? A dramatic change in courtroom expert testimony might occur if all professional organizations decided to look over the shoulders of their members whose testimony diverged more than some reasonable amount. On the negative side, professional associations may promote non-cooperation with lawyers and courts, resulting in the "conspiracy of silence" (Cooney, 1971) discussed earlier.

To the extent that professional associations encourage, support, and demand integrity and competence among their members, experts may serve to place limits on the excesses of some lawyers in some cases. The admission of scientific and technological evidence would then have the intended effect of evidence: to reduce the fact-finder's uncertainty and tie conclusions to reliable, stable, and predictable knowledge. Where experts are tied to organizations that specify the limits of expertise and set boundaries on permissible speculation, limits are in turn placed on what lawyers can get into evidence. For example, one county prosecutor we interviewed said that forensic scientists on loan from the Federal Bureau of Investigation insist on not going very far beyond the data provided by the laboratory tests, and refuse to offer opinions in some areas. These boundaries were set by the superiors of the agent scientist. The prosecutor said that this limit made his job more difficult and for that reason he preferred using local police laboratory experts when circumstances permitted (Homicide Case - Case Study 1). Others suggest that this reluctance to overstep the bounds set by the data make FBI agent scientists far more credible and effective witnesses. Although this is an employer and a federal law enforcement agency at that, not a scientific or professional association, it illustrates the point about the influence of "external" organizations.

Professional associations, employers, and the courts or bar associations could develop inter-professional codes that offer guidance to experts in particular fields (see e.g., Helwig, 1968). Experts do not know, for example, how pro-active they should become where they have knowledge of a case. Should they be passive, and merely appear in court when called and answer the questions asked; or, should they take on the role of "good citizen," bringing forward all knowledge that may have come into their possession? We have encountered urgings at both extremes. In our arson case (Case Study 7), an expert was retained to do a preliminary

investigation as part of a possible civil action. The expert believed he had uncovered evidence of arson and apparently took his evidence to the fire marshall for whom the expert often did laboratory work. Some of the lawyers we talked with maintained that this conduct was a serious breach of trust with a client who paid for and owned the findings as well as disloyalty from one retained in anticipation of litigation. Others suggest that bringing forward facts to get at the truth is the obligation of any expert regardless of whom he or she is working for (Kogan, 1978). At trial, this would lead to a situation where if an expert knows something harmful to the calling party and the adverse party's lawyer is not smart enough to elicit it on cross-examination, the expert witness would turn to the judge and reveal the not yet uncovered information.

Clearly, the courts often wish to defer to the judgment of outside scientific and professional groups. In this sense, the scientific and technological work of the larger society massively affects the findings, and even the rules, of courts. For example, the Frye test leaves to the "scientific community" the determination of whether a technique is valid enough for use at trial. The courts, under Frye, are not to look to the substance of the science or technology so much as they are to look at what the community of experts thinks of it. Another example is Federal Rule of Evidence 703, which states that an expert need not base an opinion on facts or data that would be admissible in court so long as those facts and data "of a type reasonably relied upon by experts in the particular field ...." Still another illustration occurred in our homicide case study (Case Study 1), in which the legal definition of death became a disputed issue in the case. The prosecutor wished to replace the common law definition which was "the law" up to this point with a new definition of "brain death." Because this definition had come to be accepted by some (most? all?) physicians in the jurisdiction, the judge ruled that on the basis of the medical community's redefinition of death, the time had come for the common law definition to go. The state's highest appellate court upheld the trial court and the resulting conviction. In each of these instances, the scientific and technological community wields great influence over the court's decisions.

Finally, as the larger society educates its members, it will affect the role citizens play when they serve briefly as jurors. To the extent citizens become more literate (or illiterate) in matters of science and technology, they will be more (or less) able to comprehend technical evidence and use it intelligently in deliberating over a case. In this way, all educational systems and communication mediums in the society eventually affect the capability of the judicial institution to decide cases with scientific or technological content.

Post-trial

Although this study is concerned with the trial level, obvious interplay exists between trial and post-trial events. We will mention only a few issues that were made salient in our literature review and interviews that extend into the post-trial period.

Rulings, Rules, Statutes, Canons. Decisions from lower courts sometimes are appealed on the basis of some scientific of technological issue. Perhaps expert testimony was excluded that the losing party believes ought to have been admitted. Perhaps the party thinks the scientific or technological evidence that was admitted was misunderstood by the judge or jury and that the verdict rendered is not supported by the evidence. Perhaps the matter being litigated is centrally a matter of science or technology: appeals from regulatory agencies or rate-setting commissions, trials involving the safety of toxic waste sites, etc. In any of these situations, the appellate court may be faced with having to make decisions based not only upon legal doctrine but on a comprehension of the scientific or technological subject matter (Bazelon, 1977; Leventhal, 1974; MacGowan, 1979; Ballistics Case - Case Study 8; Drug Case - Case Study 9). The question of the institutional capacity of appellate courts is an issue.

The appellate court has at its disposal fewer informational resources than trial courts. It does not take testimony, it cannot question experts. It must rely on briefs and appendices supplied by the parties and possible amici curia, and it can examine published material. Other sources of information are informal and subject to controversy. The record provided to the court is sometimes of inadequate help, especially in appeals from regulatory agencies (MacGowan, 1979). How can an appellate judge decide that a new technology ought to have been admitted at trial? From whence does the necessary knowledge come to the appellate judge that was not available to the trial judge? When appeals decisions must turn on scientific or technological subject matter, and not legal doctrine subject to briefing, the traditional method of learning about and deciding cases may be an ineffective anachronism. (Many of the problems are discussed in Saks and Baron, 1980). In our Title VII case study (Case Study 6), the trial judge was aware that whatever his decision, the case was likely to be appealed. Knowing the evidence was exceedingly complex and knowing the appeals court would have a terrible time with it, he endeavored to write his opinion in as detailed and explicit a way as possible so that the maximum amount of information and reasoning could be transmitted to the appeals court. Some appeals court judges have been quite candid about the limitations they feel in their court's capacity to decide these issues intelligently (MacGowan, 1979; Bazelon, 1977). Solutions will have to be found. One state supreme court is now experimenting with procedures for directly providing scientific and technical expertise during appellate proceedings. The results of this effort are expected in late 1982 (National Science Foundation, Catalog of Research on the Use of Scientific Evidence in Legal Settings 1981).

Informal Processes. Once an expert witness has testified, his or her connection with the case is over--unless there is a dispute about fees or unless the case is to be appealed and the expert's assistance is needed in preparing the brief and arguments for the appeal. One rather minor and common issue arose, however. Almost without exception, the experts we interviewed had great curiosity about the outcome of the cases in which they were involved; and almost without exception, they never

received a follow-up call from the attorney. Some experts thought that knowing the outcome of a negotiated settlement or trial would help them understand how they might be more useful or effective in the future. Most experts were simply curious. In both instances, the interest shown is good for the lawyers they serve and for the courts which benefit from their testimony. But, it also reveals that the experts have become infected, if only mildly, by advocacy. If the expert merely delivered facts and was indifferent to the competing causes being advocated, they would stand down, having completed their work, and get back to their usual business (e.g., Drug Case - Case Study 9). But, they want their testimony to have been influential. They want to know if they "won." It is a crude index of their effectiveness, but it is all there is. We would speculate that experts called by judges would take on the viewpoint of the judge or jury.

Extra-Systemic Organizations and Processes. The point we wish to make here is simply that appellate courts, like trial courts, are dependent upon the definitions, the findings, and the resources made available by professionals and their associations outside of the justice system. An example is given by our homicide case study (Case Study 1) in which the state's supreme court upheld the medical profession's revised definition of death, dispensing, as did the trial court, with the common law definition.

4. Problems Identified

The purpose of this chapter is to try to narrow our concerns to a collection of problems identified through our literature review and interviews.

Although we have tried to err on the side of inclusiveness, the problems identified here for concern are not an exhaustive collection. They are the problems which were mentioned often or in many contexts, which our sources emphasized as critical, or which in our judgment ought to be addressed because of their centrality to the whole range of issues reviewed in Chapter 3, or because of their high potential for cure. Some problems were excluded because in a cost-benefit sense, they just are not worth the trouble or expense it would take to cure them, or because they are already being addressed in other contexts. (e.g., attorney dilatoriness). Some problems are insoluble. Some problems exist at a relatively macro level (such as imbalance of resources or institutional competence), others exist at a more micro level (such as attorney-expert relations or clear communication at trial). One problem may have many solutions. One solution may cure several problems at once. Some solutions may stand in conflict with other solutions. Some problems are amenable to relatively short-term solutions. Others can be solved only in the long term if at all.

We also have tried to focus on problems (and solutions) that will allow our successors to do more than plead with the various professions to be more honest, more conscientious, more substantive, better prepared, or to have more inter-disciplinary meetings to get to know each other. While these all are worthy changes to encourage, we wanted to provide a basis for more than exhortations.

Pre-filing

Finding Experts. The major problem that arises in the earliest stages of litigation is finding qualified experts. This appears to be less a problem for prosecutors (unless they are in rural communities) and counsel in civil cases. The problem is said to be exacerbated where a monopoly exists such as where all available experts in a certain field are employed by the police laboratory or where a particular profession conspires to withhold its services.

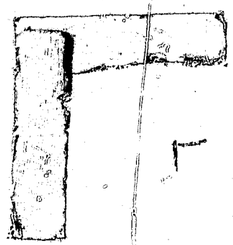
Finding Evidence. A corollary problem is where police or others in an official position to find and protect evidence fail to do so, thereby limiting the ability of experts subsequently to be useful. This initial encounter with a crime scene is, in view of many forensic scientists, as crucial as it is neglected. The first officials on the scene are not the "lab" people; they are police officers or fire-fighters. They are often poorly trained to see, perceive the significance of, and collect or protect vital evidence. Too frequently they ignore it, miss it, or contaminate it. What is not found or preserved, cannot be used as evidence at trials (see Arson Case - Case Study 7).

Time of Entry. As indicated in the preceding chapter, a frequent complaint by experts is that they are called in too close to the date of trial. Delicate tradeoffs are at issue, not the least of which is economic: the sooner an expert is brought in, the greater the cost of litigation (though possibly not in the long run). Another important tradeoff has to do with the expert's role in establishing the historical case facts. If the expert enters too soon (s)he may misdirect the attorney's efforts to focus factual-historical issues, and generate data which may ultimately be inadmissible. If the expert enters too late, the expert's help in identifying issues and developing theories may have been foreclosed. In short, qualified experts may be too few in number, too hard to find, or initially contacted at the wrong time.

Pre-trial

The problem of attorney untimeliness, and inadequacy of preparation arose so often and is so important that we mention it. But this is not a problem that we will deal with except in a narrow way, relevant to experts. This is a problem endemic to large segments of the legal profession and is being worried about more broadly elsewhere (see Kaufman, A Response to Objections to the Second Circuit's Proposed District Court Admission Rules, 61 American Bar Association Journal 1514-1517 (December 1975); Roady and Anderson (eds.) Professional Negligence (Vanderbilt Univ. Press 1960); Rosenthal, Evaluating the Competence of Lawyers, 11 Law and Society Review 257-285 (1976); or the annual reports of bar association disciplinary committees).

Discovery. Where scientific evidence is concerned, it appears that the more that is revealed the better. It also appears that the federal rules provide a satisfactory guide. A survey conducted by the Columbia Law School under the sponsorship of the Supreme Court's Advisory Committee on Civil Procedure found widespread satisfaction with discovery guidelines (Fed. R. Civ. P., 1980, at 261). Some lawyers, however, feel that expanded use of depositions to discover the opinions held by opposing experts would be desirable. (See ABA Litigation Journal issue on experts; also, Masterman and Hanson, 1980). The problem, at a minimum, is for those states which still limit discovery in such a way that cases cannot be knowledgeably prepared for trial. The result is that the court is not adequately informed because the parties are not engaged in direct enough debate. Included under this heading is the willingness or lack of willingness of experts to share their knowledge about a case with attorneys on the other side, especially when the experts are employees of police laboratories and working on criminal cases, and there is confusion about the accessibility of reports and individual scientists (see e.g., Ballistics Case - Case Study 2). In addition to discovery of extant facts, an issue exists regarding advance notice of any scientific experiments or analyses to be done in preparation for trial. In its more stringent form, such notice would be a precondition of admissibility. Most courts have refused to impose this requirement, but strong arguments have been adduced in its favor (see also In re Dumas, 22 Am. Trial Lawyers Ass'n Law Rept'r 64 (C.D. Cal. Oct. 19, 1978).



CONTINUED

1 OF 2

Lawyer-expert relations. Problems involving the direct interaction of experts and lawyers include inadequacy of mutual preparation, conflicts over fees and who is to pay them, the clarity of communication, and the cooption of experts.

Imbalance of resources. It must be recognized that in a system of private representation for hire, attorneys of unequal skill will be hired by clients of unequal means. Those attorneys are, in turn, able to hire experts of unequal talents who can be rewarded unequally. Some litigants and their counsel are unable to afford experts at all. Such differential resources and talent at the input end of the process seen almost certainly to be reflected in the factfinding and decision-making output from the system. The unequal resources of the parties is not limited to the use of scientific and technological experts, but it appears to be especially acute where experts are used in criminal prosecutions. This is illustrated by our Arson Case (Case Study 5) and Ballistics Case (Case Study 8) but cf. Insanity Defense Case - Case Study 4). The lack of resources on the part of the defendant compounds the problem of monopolizing of experts noted earlier.

Missed opportunities for settlements, stipulations, single experts. The use of experts pre-trial ought to enhance the possibility of reducing the issues to be disputed at the trial, either by acceding to requests for admissions, agreeing to stipulations, or settling the case in the face of a finding by scientific or technological consultants. Another simplifying possibility is that of agreeing to the use of a single expert at trial. Where scientific evidence is relatively clear and dispositive, and yet a case continues, somewhere there has been a failure to advert to the evidence or to expose it.

Trial

Informativeness of Trial Presentations. Several more discreet problems contribute to limitations or distortions of information at trial. The first is the capability of the expert to express him or herself in terms that have meaning for the fact-finder. Second is the ability of counsel to organize the presentation, and elicit direct testimony and cross-examine in a fashion that is the most informative for the fact-finder. Third is the court's ability to decide correctly which principles and techniques are sufficiently reliable to be admitted and which witnesses offered as experts on the scientific principles or techniques are in fact qualified.

Role Conflict. The conflict experts experience over their proper role is discussed at some length earlier in this report. This conflict is not merely a source of confusion and discomfort for experts. To the degree that experts come to behave as advocates or become biased, they become a less reliable source of information for the fact-finder.

Institutional Capacity. The capability of the fact-finding ability of the courts arose frequently as an issue, especially among judges and experts. Here we are concerned not only with the individual intellectual

abilities of judges and jurors, but with the tools the institution makes available to itself to allow its fact-finders to become informed. Notably, there is the question of whether and how the courts will make gate-keeping decisions about receiving unfamiliar scientific information. The most salient and controversial issue under this heading is focused on the Frye test. In essence, Frye requires courts to defer to the opinions held by the relevant scientific community: principles are valid when the scientists believe them (U.S. v. Addison). An alternative that is more consistent with the norms of science (though not with the sociology of science) would be for a court to examine the evidence germane to the validity of a novel technique or principle: they are valid when the court is persuaded by the data that they are valid (U.S. v. Williams). This is an issue of current dispute and of profound jurisprudential and practical importance As we shall see in the next chapter, institutional solutions have been proposed to these institutional problems, such as the creation of a special "science court".

Post-trial

The major problem raised with respect to the workings of appellate courts has been the institutional capacity to understand and intelligently decide matters with difficult scientific or technological content.

5. Finding and Implementing Solutions

The final chapter discusses the areas and kinds of research and reform that would be fruitful sequels to this project. The present study sought to identify the problems thought to exist in the use of scientific and technological evidence by lawyers and courts. This exploratory search for problems is only a bare beginning in the pursuit of working solutions. Only with tentativeness have we offered the list of problems we have gleaned from our literature review and case based interviews. It is with even greater tentativeness that we share the solutions mentioned in that literature or by our interviewees. Because we regard these only as thinking points, we have deliberately submerged the putative solutions in this chapter, which is largely addressed to a strategy for finding solutions and testing them for efficacy. We emphatically do not wish our mention of these putative solutions to be considered an endorsement or a result of legal, logical, or empirical analysis. We mention them only because others mentioned them and because they seemed at least plausible. The problems and solutions presented provide a large set of possibilities for better understanding and improving the law's use of scientific and technical expertise. But, to be sure, these are only possibilities. Knowing of them does not lead directly to remedies. Rather, it guides the way to more refined study to determine which of the identified problems truly exist and the extent of their impact on the litigation process. It also can lead to more informed efforts to implement solutions to these problems and to evaluate the success of these attempted solutions.

Ideal Scenario of Applied Research and Development

In an ideal world, a logical sequence of research to measure and understand problems and their impact would be conducted and proposed solutions would be assessed, implemented on a trial basis, and empirically evaluated for effectiveness. This logical sequence would be untroubled by urgencies in one or another area, by the exigencies of cost and funding, or by the attractiveness of certain solutions to certain interests or opposition by others. This section describes the remaining steps in such an ideal program to improve the use of science and technology in litigation.

Parametric Studies of the Identified Problems

We now have a catalogue of problems. We do not have an inventory. We do not know how often any given problem occurs, or how serious any given problem is owing either to its nature or frequency. For example, the inability to locate experts would seem to be a serious barrier to effective use of expertise in litigation, when it occurs. But how often does a lawyer find him or herself without desired experts at court? The celebrated "battle of experts" may be a less fatal problem, but could be more common and, therefore, more troublesome. How often does it occur? To the extent possible, some measure of the seriousness of a given

problem would be helpful in deciding which ought to be given priority in subsequent attacks. This could be a measure of the problems' "cost" to proper fact-finding, and the mischief each creates.

Research to answer the frequency question might consist of a large-sample structured survey of lawyers, judges, and experts asking them to indicate whether in the most recent case on which they worked they encountered the listed problems. Each structured questionnaire or interview would, of course, include only those problems relevant to the class of respondents (i.e., judges, lawyers, and experts would be asked about different problems). Respondents could, in addition, be asked to rate the seriousness of each problem to the specific most-recent case they were replying about, and seriousness generally in their experience. Such self-report surveys have well understood shortcomings (Babbie, 1973), but are often resorted to because of their extraordinary cost savings and relative ease of administration. To the extent that some problems could be measured by examination of archives (court files, transcripts, attorneys' files, etc.) or by direct observation (e.g., placing trained observers in courtrooms) these would be desirable though costly backups to a survey. Such archival or direct observation would be a check on systematic misreporting tendencies by survey respondents. Some problems, however, are accessible only through self-reports, for example, judgments of the effectiveness of communication between lawyers and experts in case preparation. Many important interactions around a case are non-public; only the lawyer and the experts are present to observe them. Once the most important of the problems are identified, it makes sense to shift attention to solutions.

Putative Solutions

Following is a summary of the putative solutions to the problems outlined in the previous chapter. As noted above, these proposed solutions have been suggested by the authors whose entries we have reviewed, have been mentioned by our interviewees, have occurred to us in the course of thinking about these problems, or, in few instances, have even been "experimented" with in some jurisdictions in a rudimentary way. As will be seen, these solutions fall into several categories of change. One option is to preserve the status quo. A second category or degree of change involves moderate tinkering, such as with resource lists, certification, education programs, and making more resources available to the less well supported party. The final category consists of the solutions which, for varying reasons, might be termed radical. These includes: liberalizing the standard for admissibility by eliminating Frye; developing science courts either to create presumptions of validity or to bind trial courts; replacing lay juries in appropriate cases with more technically knowledgable jurors; or radically modifying procedures or trial structure..

Pre-filing

Some of the solutions proposed have always been in the hands of attorneys. Their excessive reliance on the "grapevine" is limiting. When word-of-mouth works it is an excellent system. But when it turns up

no experts in a given area, the attorney has not reached a dead end. Some lawyers need to learn where and how experts may be found. Some articles (e.g., Klein, 1972) discuss alternative sources: universities, the literature of a given field, the "grapevine" of a professional field rather than the lawyer's grapevine, and so on. Referral services may need to do for lawyers what the grapevine does: offer candid evaluations of the experts' abilities. Bar associations could maintain lists of names, perhaps nominated by member attorneys (the American Trial Lawyers Association currently maintains a file for use by its members, see Ballistics Case - Case Study 8). Independent organizations can develop such lists. An important example of this is the Forensic Services Directory (West Publishing), compiled by the National Forensic Center (Fair Lawn, NJ), which contains over 3700 listings. Professional association certification programs would create source lists that would make it easier for attorneys to find and have some confidence in the quality of those professionals certified (Questioned Documents Case - Case Study 5). Some certification programs have been in existence for some time (e.g., American Board of Forensic Pathology, Medical Licensing Boards) and several other have come into being in recent years (e.g., American Boards of Toxicology, Odontology, Anthropology, Psychiatry, and Document Examination). Because certification is not only an availability list but an endorsement of competence, such programs carry the risk of dictating who is competent and who is not, taking from lawyers and courts the determination of who is a useful source of scientific and technological information, perhaps certifying in some who are not competent and certifying out some who are.

The strategies noted above are largely brokering strategies. Other possibilities include organizational strategies. These might consist of organizing panels of independent experts funded by the state and perhaps also by the bar. This panel might be especially useful if used in conjunction with court appointments of experts, discussed further below. Such panels could be an additional resource, not a sole source. Particularly for early consultation and investigation, other experts might be useful to attorneys. These panels could replace police laboratories, with experts working for defendants as well as prosecutors and in civil litigation as well. In the latter case the panel or laboratory could be paid on a fee-for-services basis. Perhaps the laboratory or panel could be structured into two teams, one available to each side of a dispute. If these laboratories or panels work as regularly for one side of a dispute as another, their objectives will be promoted by well-divided loyalties: all parties are their clients. These approaches are not problem-free of course. Court-appointed panels could take on imprimatur more exclusive than that of certification. The selection criteria and process would have to be carefully developed and closely monitored. "Independent" laboratories may still find themselves in more frequent and continuing contact with police than with defendants. More definitive solutions would have to be developed over time.

The problem of police being inadequately skilled at crime scene investigation seems a problem obviously to be solved at a beginning by including more attention to such work in police training. Of course,

more advanced and continuing training, in collaboration with universities or conducted by Forensic Science laboratory staff are possible. Some law enforcement agencies have developed detailed forensic handbooks for use in the field. Lists of what physical evidence to look for are listed by type of crime being investigated. This is a relatively easy and inexpensive solution.

Pre-trial

Educating Experts. Since many experts are unfamiliar with the legal process, it would be useful for them to be prepared other than by the sink-or-swim reality of being asked one day to become involved in litigation. For some experts, who are going to become full time professional forensic scientists, it makes sense to provide an academic base that would educate them not only about the scientific or technological subject matter, but about rules of evidence and procedure, what to expect of lawyers and judges, how to communicate effectively, and so on. Forensic science laboratories are too willing to hire under-prepared staff. Or, perhaps they have little choice but to hire undereducated staff: people with forensic experience but inadequate basic science training; others with strong science backgrounds but no understanding of the special problems, both communictive and ethical, of doing science in an adversary context. What is needed is people specifically trained to have both competencies (e.g., the programs at George Washington University). Relatively few university programs and courses in forensic science exist in the United States today (Ward, in U.S Dept. of Justice, 1978). Such formal programs might be well worth developing. An easier step short of that and far more easily accomplished might be for professional schools and academic science departments to interact more, perhaps grant credit for taking courses outside of one's field (already commonly permitted) or having joint or cross-listed courses, or at least an occasional guest lecturer.

For the great many experts who work on cases occasionally, but for whom it is a sideline, continuing education courses and workshops could be promoted. It would be important that these be organized and run by other experts or by judges. Done that way, they prepare the experts to serve the interests of the field of knowledge and the interests of the fact-finder. If run by lawyers or bar associations (or if organized by expert groups and then turned over to lawyers to do the teaching), the class might become an indoctrination session for advocates. The advantage of using experts and preparing them for work in the adversary system is that they can serve as a stabilizing force whose inertia would reduce the seductive advocacy of counsel. Stepping into a new role, experts are highly susceptible to such seduction. Preparation to be witnesses not advocates, and knowing that they will be under subtle or blatant pressure to be advocates, will help them later to resist the lawyers' advances and resolve role conflicts. Experts could also be taught where lawyers are vulnerable (e.g., two days before trial) and dependent and where the pressure points are for compelling lawyers to prepare properly. Some experts know how to do this; most do not.

Finally, educational materials (covering topics such as "surviving in the adversary system"), lists of do's and don'ts, and so on, by the courts or by professional associations, might be made available so that a person asked to serve as an expert has some ready advice and guidance. A number of such works already exist (see e.g., Kraft, 1977; Houts, 1974; Brodsky, 1977; and other publications cited in our Bibliography).

Educating Attorneys. It appears that attorneys need to know more about the substance of a scientific field and the uses to which they can put the field's knowledge. Some become highly expert themselves in areas they employ often. New prosecutors are often briefed by police laboratory scientists. But the knowledge comes too slowly or not at all and many of the field's capabilities are underutilized or inadequately exploited. More law school courses in such work, admission of more people with undergraduate science backgrounds to law schools, and continuing education courses in the content of various expert areas are among the suggestions that arise under this heading. (For example, see the integrated science and law curriculum provided by the Franklin Pierce Law Center (Concord, New Hampshire).)

Balancing Resources. One solution was discussed above: make experts equally available to the parties through state or court sponsored laboratories or panels of experts (see e.g., Insanity Defense Case - Case Study 4). Short of that, police laboratories could be required to share all information on a case with defense counsel, to do blind testing not revealing whether their analysis was for prosecution or defense, or the expenses associated with hiring an expert could be made a recoverable cost in civil litigation. Wisconsin, for example, mandates by statute the evenhanded treatment by police laboratories of both defense and prosecution evidence. Another possibility would be the creation of defense forensic laboratories at the state level. A further option for increasing fairness and balance in criminal cases would be to grant to assigned counsel an amount of money equal to the value of the prosecution's scientific expertise. The only shortcomings that are apparent in such changes are their cost and the feasibility of implementing them; it seems difficult to fault the goal of equalizing the resources available to adversaries, on grounds of both fairness and facilitating the courts factfinding.

Discovery and Issue Reduction. Some recommend that discovery be enhanced in those jurisdictions which now employ less liberal discovery than the federal rules. It is also suggested that by enforcing requests for admissions or by conducting or referring pre-trial conferences on the scientific and technological issues, judges reduce the number of disputed technical issues before a case comes to trial. In many instances this may promote a settlement, keeping the case from coming to trial at all. Also, by requiring statistical briefs in one of our cases, the judge helped to ensure that each party knew what the other was asserting and would be more likely to confront the scientific and technological issues that eventually had to be resolved by the court. Discovery may, however, become so liberal that the cost of litigation in dollars and time offsets

the benefits. It may also create the unfair situation of one party doing the other's research, thus, encouraging parties to delay or slow their preparation. Clearly this is an area where a balance must be struck.

Judicial Implementation. A suggestion on how many of the above suggestions and some of those below, could be pressed into service relatively quickly has been proposed by Professor Oliver Schroeder and seconded by Professor Joseph Peterson. They point out that because the judge controls what gets into the trial, (s)he can powerfully influence the quality of that evidence and its preparation. If judges, for example, require that all experts be certified, that laboratories engage in quality control programs, that police agencies have well-trained crime scene investigators, and so on, parties coming before them would see to it that necessary changes were made. Even if the certification, quality control and training programs were not implemented, evidence with a substantial probability of defect would thus be excluded.

Trial

Under this heading were proposed some of the most inventive if not radical solutions, and also several philosophical arguments for not drawing the boundaries of permissible change too far from current procedures and practices. Some sources proposed that the problem of institutional capacity is solved by changing courts so that decision-makers with the proper expertise are hearing and weighing testimony on scientific and technological matters. Others argue that this is the next step in the creation of a technocracy, that the courts are one of the last strongholds of generalist and citizen control over a galloping complexity that threatens to--if it has not already--become society's master instead of its servant. This line of thinking concludes that if the scientific and technological material cannot be made comprehensible by those presenting it, if judges and juries cannot understand it, then it simply will not be understood. The solutions on which we focus are those which preserve the basic integrity of the judicial process and the adversary system, but propose changes in its supporting resources and procedures.

Science Courts To Establish Presumptive Validity. The problem of determining which techniques are valid for establishing certain factual claims in court is compounded by an assortment of barriers discussed earlier: the expert witnesses available to any court are limited and may not represent fully the scientific "community's" views; the court is in a weak position to make the decision; although the state-of-the-art is fairly unitary different courts come to different conclusions as to the scientific validity; etc. One solution is that a "science court" could be assembled under the aegis of the National Academy of Sciences, American Association for the Advancement of Science, Federal Judicial Center, National Center for State Courts, or other organizations concerned with science, the courts, or both. The science court would follow essentially the procedure proposed by the Presidential Advisory Group on Anticipated Advances in Science and Technology (Task Force 1976; Kantrowitz, 1975, 1977). A panel of judges (who could be jurists or

scientists or both) would be provided and case managers would present the best possible case for and against the principle or technique at issue, including witnessses who were the leading substantive proponents and opponents in the nation or world, armed with studies, data and so on. The decisions of this "science court" would produce a collection of presumptions for trial courts to rely on when scientific technique is offered as evidence. Any party wishing to include or exclude scientific evidence contrary to the presumption created by the science court would be free to present evidence to overcome the presumption and the judge would be free to rule accordingly. Such factual presumptions would serve the same purpose as presumptions elsewhere in the law. They would promote efficiency, consistency, establish the burdens of proof and production, and in this situation even more than usual promote correct decisions. A more potent version of this solution is that the science court's ruling on the validity of a given technique be binding on all other courts. Individual courts would lose some of their autonomy. What they gain is a greater likelihood that the proferred evidence is valid, based not on the consensus of the scientific community but on the weight of the scientific data, and increased efficiency, certain peripheral decision-making burdens are lifted. This proposed solution carries the distinct disadvantages of feasibility and cost. Organizing and conducting science court proceedings for the large number of scientific techniques used in litigation, or even just the "gray area" techniques, would be a formidable undertaking. In addition, some will be concerned that even mere presumptions will tend to be definitive in a sphere where lawyers already are not conversant.

Certification of Experts. The decision as to the competence of any given person to testify as an expert witness would be aided by the development of certification programs. Again, the suggestion is not that these ought to dictate who a judge may or may not hear, but would create a presumption. The value of certification, those who favor it argue, is that members of the field are better able to test who among them has achieved a certain level of expertise and who has not, both because they know the subject matter and can take the necessary time to examine putative experts. (Some such programs have extensive training and testing requirements in contrast to the 10 or 15 minutes of voir dire a court can devote to it.) On the other hand, such programs of certification may tend to usurp the court's prerogatives and become a guild instrument more than an aid to the courts.

Impartial Panels and Court Appointed Experts. The creation of panels of "impartial" experts by a court may begin to overcome an assortment of problems. It identifies available experts, thus making them more susceptible to briefing if not indoctrination from the fact-finder's viewpoint. It also begins to solve the role conflict problem: merely being organized into such a panel by the court may alter the expectations of lawyers and the sense that experts have of to whom their first loyalty is owed. If the courts go further, and begin to use court-appointed experts drawn from such panels, in appropriate cases, they may go even further in solving the problem of the proper role of experts and facilitating the delivery of reliable information (see, e.g., People v.

Meikrantz, 76 Misc. 2d 915, 351 N.Y.S. 2d. 549 (1974)). A detailed example of how to conduct court appointments while preserving the benefits of the adversary representation of parties is provided by the New York experiment (N.Y. Medical Expert Testing Project, 1956). This solution must be handled carefully, however, since it may have a potential of undermining the adversary process. Lawyers worry that all experts have biases, that the court's expert will be too influential, that if two or more schools of thought exist, the outcome may be a lottery, and that the court may use its appointment authority to force a settlement.

Increased Use of Existing Tools. Judges already have at their disposal tools that might aid the fact-finder in better understanding the contribution that scientific and technological evidence have to make in reaching a correct result in a given case. The use of court appointed expert witnesses, discussed above, is one example. Others include the use of court advisors, special masters, advisory juries, increased use of judicial notice, greater encouragement of stipulations, admissions, and other issue-reducing steps. In cases above some threshhold of complexity, judges can (and have) denied motions for trial by jury and could resort to other (probably better) solutions. (See a series of reports by the Federal Judicial Center on the problem of complex civil litigation, which cite the leading cases and law review articles and research on this controversial subject over which federal circuits are split.) On a less formal note, judges could employ more flexible strategies for the trial of cases where these strategies would help the fact-finder in digesting the scientific evidence. Our Title VII case (Case Study 6) illustrates these latter possibilities. In all these instances, the only change that needs to take place is for judges to elect to use more of these tools as appropriate. It may be that further research needs to be done to discover why judges do not use these tools, or demonstration and evaluation projects need to be implemented whereby judges experiment with them on a limited basis and the helpfulness of the tools--or problems caused by them--are carefully assessed.

Change in Trial Structure. A modest, yet novel, change in the structure of case presentation has been suggested that seems likely to make it easier for a fact-finder to understand and evaluate the competing views offered by experts on opposite sides of an issue. This suggestion essentially involves juxtaposing competing testimony so that jurors do not have to wait days or months to hear what the rebuttal expert witnesses have to say about the same point. The "seriated trial" approach (Lowrance, 1976, p. 117) would tackle issues and obtain decisions on them ad seriatum, enabling the fact-finder to concentrate on one set of contentions and evidence at a time. If the issues in a trial did not sort themselves out in a neat way so that one expert might have to testify on a range of issues, then the factfinder's clarity is purchased at the cost of increased inconvenience to the witnesses and expense to the parties.

Quality Control by External Organizations. Substantial potential for improving the quality and integrity that reaches the courts rests with organizations of professionals. Perhaps as part of certification

programs or in conjunction with ethics panels, organizations of professionals could investigate charges that members' testimony was not limited by the facts and scientific principles. (For example, testimony that diverged more than some threshold amount could trigger a review by the organization to discover the sources of disagreement.) Another level of oversight might be the certification and quality control of laboratories, where such work as that of Peterson, Fabricant, and Field (1978) becomes routine, where tested samples regularly are submitted to laboratories, and where their accuracy rates are made known and the laboratories keep or lose their accreditation on the basis of adherance to certain standards of accuracy. At present such a program would apparently mean a good number of laboratories would be shut down. In the future, it would mean the work that is offered as evidence in trials will be more accurate.

Post-trial

A variety of possibilities have been suggested of which we will take only brief note here. These suggestions have included the advent of advisory panels, science courts, the appointment of justices with scientific or technological backgrounds in addition to or instead of legal backgrounds (noting that U.S. Supreme Court justices are not Constitutionally required to be legally educated), or appointing clerks who are trained in appropriate scientific or technological fields ("science clerks") as well as law clerks. We have been told that some appeals court judges select law clerks whose educational backgrounds are relevant to cases they anticipate deciding during that clerk's term--a biologist this time, an engineer next, and so on. Research is now underway on a procedure for providing scientific and technical expertise to the Alabama Supreme Court (a NSF grant to F. E. McGovern and J. D. Nyhart). Another suggestion has been the release of preliminary opinions, inviting comment and additional briefing for those cases a judge feels warrant such an extended opportunity. If the opinion has gone off the track on technical issues (e.g., Zeisel, ...And Then There Were None: The Diminution of the Federal Jury, 38 University of Chicago Law Review 710-724 (1971); Saks, 1977) the court will find out in a hurry and have an opportunity to revise the opinion. By analogy such a procedure is conducted by California Law and Motion Judges. They issue tentative rulings which the parties learn about before oral arguments on the motion. The parties can then accept or argue against the points in the tentative ruling. (We are told that they usually accept the rulings.)

A Priori Assessment of Contemplated Solutions

The listed solutions are too numerous for all to be implemented; some are redundant; some are antagonistic. Various considerations need to be taken into account: cost-effectiveness (the greater the curative impact per unit cost, the more desirable a solution), feasibility of implementation, a solution's substantive quality (its inherent ability to cure the problem it is intended to cure), the ability of a solution to treat several problems at once, the tendency of a solution to cause unintended troublesome side effects, and so on. Some systematic manner

of selecting the "best" solutions needs to be employed. To the extent it is possible to do one, a systems analysis would help to anticipate the effects of any intervention or combination of interventions. All components of a litigation system, all its problems and all contemplated modifications would be taken into account simultaneously. Techniques for trying to systematically link so many variables have been developed to address areas having analogous concerns (e.g., health, environment, military). These include decision trees, transition probabilities, and meta-evaluation. But, none of these has yet achieved a high level of predictive success. One of the greatest difficulties in making such a priori assessment is the fact that they are a priori--they do not have the benefit of complete data.

A workable method, which combines available data with professional judgments on those variables and relationships on which no data are available, is multi-attribute utility analysis (Edwards, Guttentag, and Snapper, A Decision - Theoretic Approach to Evalution Research, in Streuning and Guttentag, Handbook of Evaluation Research (Sage, 1975). This is a relatively simple linear decision-making model first described by Benjamin Franklin (see Dawes and Corrigan, Linear Models in Decision-Making, 81 Psychological Bulletin 95 (1974)). It enables alternative solutions (or groupings of solutions) to be compared against each other with respect to a set of "attributes" (curative potential, feasibility of implementation, public or professional resistance, etc.). Each attribute is weighted for its importance. Each solution is rated (given a scale value) on each attribute. The weighted sum of these ratings is the solution's "utility." The ratio of a solution's cost to its utility is its cost-benefit ratio. Where do these scale values come from? Where reliable empirical data have been developed, these can be plugged in as appropriate. Where data gaps exist, the estimates or judgments of well-placed observers (lawyers, judges, experts) can be obtained through surveys and the consensuses used in place of data. Ample scaling techniques exist for measuring these judgments and translating them into indices for use in the multi-attribute utility analysis. The choice of attributes to be concerned about and the weight accorded these attributes reflect value preferences and can come from various sources: surveys of the public, professional groups, influential subgroups, or from the researchers themselves (though least preferably the latter). The output from such an analysis is the identification of the most promising solutions. (Also worth considering would be the techniques of operations research or deductive modelling (Nagel and Neef, Legal Policy Analysis (Lexington Books, 1977)).

Implementation and Evaluation

The most promising solutions ought then to be tested in selected jurisdictions. The same surveys that assessed judges', lawyers' and experts' ratings of various attributes of the contemplated solutions might serve to identify persons who would be interested in facilitating adoption of the change. Some solutions, such as the use of court-appointed experts are, at least in principle, capable of implementation in a short span of time. Others, such as improved public education in

science, can take a generation or more. Still others, such as increasing the availability of forensic scientists and other experts to indigent criminal defendants, lie somewhere in between. In any event, the "solutions" must be recognized as only proposed or hypothesized solutions. Despite all the work leading up to their selection and adoption, whether or not they work is an empirical question. Thus, any solutions adopted should be adopted in a fashion that permits the most rigorous empirical evaluation of their effects. The design of the implementation would, ideally, go hand in hand with the design of an empirical evaluation, preferably a true experiment. The precise design would depend upon the particular solutions contemplated, the variables indicative of its anticipated effects and side effects, and the local circumstances in which implementation takes places. The benefits (indeed, the necessity) of rigorous empirical evaluation to informed policy-making are well known (Struening and Guttentag, Handbook of Evaluation Research (Sage, 1975); Riecken and Boruch, Social Experimentation (Academic Press, 1974) as well as the practical difficulties encountered in carrying out well designed evaluation research (Cook and Campbell, Quasi-Experimentation (Rand McNally, 1979); Weiss, Social Science Research in Public Policy Making (Lexington Books, 1977)).

Short-Cuts to Applied Research

The approach described above places a good deal of time between the present and the implementation of putative solutions. It might be possible, on the basis of only the present study, to identify certain solutions that appear so feasible and promising that they might be implemented and evaluated without further delay. For example, there seems to be no reason why one or many of the procedural options already available to judges under existing law but rarely exercised, might not be promoted and the effects of their use rigorously evaluated. Judges willing to use court-appointed experts (or advisory juries, special masters, etc.) might agree to do so randomly in half of the cases suitable for such treatment and allow the other half to proceed as they might otherwise. The two groups of cases could be compared on such dimensions as subsequent clarity of technical issues from the factfinder's viewpoint, reduction in complexity, settlement rates, length of trial, etc. These kinds of steps are already available at the discretion of judges. Thus, they could be taken almost immediately and need only be organized and carried out by interested judges in a manner that permits informative evaluation.

Certain other solutions are implemented from time to time as a consequence of interests and forces unrelated to the central concern of the present study. An example is the certification of experts. Interested agencies and researchers might be alert to these developments and take advantage of their occurrence to study their impact on lawyers and litigation.

Still other solutions seem so fundamental and unavoidable that their development and implementation could begin without delay--and in some instances already have. An example of this class of solutions is

educational strategies. Lawyers need more structured opportunities to learn about the applications of scientific and technological knowledge to areas in which they litigate. Experts will inevitably function better in the legal system if they are helped to understand it and their role in it. Various efforts of undoubtedly varying quality already exist along these lines. The contribution of research to such "unavoidable" solutions would be formative evaluations: i.e., how can educational strategies be made increasingly better?

Thus, some evaluation research could be undertaken almost immediately in support of various solutions that could be or already have been set into motion. These can go on simultaneously with the more orderly scenario discussed at the beginning of this chapter.

Basic Research

Scholars whose primary commitment is to pure research can find in the present study issues of social perception, social structure, communication, conflict resolution, knowledge utilization, and other topics in psychology, sociology, economics, political science, and legal studies. Research undertaken on those basic issues in the setting of the present study is likely to be useful to the development of workable solutions to the problems of lawyers, courts, and experts. Such work could be encouraged. Below are several examples of studies that would probably be characterized as basic research, yet would be informative for efforts to improve the law's use of science and technology.

Role Conflict. A recurring issue in our interviews with experts and in some of the literature reviewed is the conflicting pressures exerted upon individuals serving in the role of expert witnesses. At least some of the experts find the role conflicts sufficiently intolerable that they refuse to become expert witnesses. Researchers interested in role taking, role conflict, perception of persons in the roles and those outside looking in, might find the issues encountered to be worthy topics of basic research. What is the nature and source of the conflict? Why do some experts experience it and not others? What means do individuals use to resolve the conflicts? Where the experience of role conflict (e.g., "neutral scientist" vs. "advocate") and perception of experts by others (e.g., "neutral scientist" vs. "testifier for hire") varies across fields, what are the determinants of those variations?

Knowledge Utilization. A goal of introducing scientific and technological evidence into trials is to enlighten the factfinder and permit a decision to be based on less uncertainty. The effectiveness of this knowledge in guiding correct decisions is a function of the state-of-the-art of the knowledge and faithfulness with which it is delivered to the factfinder. Studies might be conducted which ask whether the picture presented to a factfinder by experts at trial is recognizable to a representative sample of members of the appropriate discipline as the state-of-the-art knowledge of that field. If it is not, at what points in the process does the distortion occur? Measures and procedures developed in such research would be useful to researchers

evaluating the efficacy of various reforms. And the substantive findings would be useful guides to a more refined understanding of the problems the legal process has in making effective use of science.

Dispute Settlement. What role does information play in disputes and their settlement? That is a fundamental question addressed by students of conflict. To the extent that scientific and technological evidence are stable, trustworthy, and dispositive, settlements ought to be increased. Does dispositive scientific information, in fact, produce any such effect? If not (or not always), what other factors account for the failure of these disputes to settle? Under what conditions is dispositive information determinative of a settlement? Such studies would inform us about the role information plays in the maintenance and resolution of disputes, and would provide insights into how scientific and technological information might best be used to facilitate settlement and when circumstances are likely to be favorable to such use.

Communication. The difficulty of communicating across cultures has been the subject of concern for many years. The difficulty of communicating across professional cultures is a problem that is growing as the depth of human knowledge and extent of specialization grow. Litigation provides an unusual opportunity to study the comprehension--or lack of it--by neutral, generalist laypersons of specialized knowledge rendered by an expert. What characteristics of the communication facilitate and what characteristics inhibit, the successful sharing of knowledge? Studies on this topic would be analogous to that of Sales, Elwork, and Alfini (1981), studying how technical legal knowledge given in judges' instructions can be made more comprehensible to juries.

Conclusion

The studies suggested above as basic research may be regarded as containing major elements of pure research interest, but having important spin off possibilities for improving the use lawyers and courts make of scientific and technological knowledge. The basic research and the "short-cut" applied research can go on simultaneously to the more systematic applied research scenario described at the beginning of this section, with each stimulating the other. To be sure, more risk attaches to any piecemeal strategy of research as opposed to more systematic programmatic efforts. But it is unlikely that any compulsive regimen would be adhered to by all students of the subject, nor should one be.

Perhaps no other area of legal studies is as proper a subject for research that is applied, interdisciplinary, and used to guide decision-making, than is the employment by litigants and the courts of various bodies of scientific and technological knowledge to inform their decisions.

Table 1. Survey of Statutes and Rules on the Use of Expert Testimony

TABLE 1. Survey of Statutes and Rules on the Use of Expert Testimony

STATE	WHEN EXPERTS MAY TESTIFY[1]	DEFINING EXPERT OR FIELDS OF EXPERTISE[1]	BASIS OF OPINION TESTIMONY BY EXPERTS[1]	FOUNDATION REQUIRED BEFORE SCIENTIFIC EVIDENCE MAY BE PRESENTED[1]	DISCOVERY OF EXPERTS AND TEST RESULTS Civil[2] / Criminal	COURT APPOINTED EXPERTS[1]
ALABAMA Code (Michie 1975 & Supp. 1979)	§12-21-160	--	§12-21-160[3]		Ala.R.Civ.P.26(b) No Criminal Rule	--
ALASKA Stat. (1980)	--	--	--	--	--	--
ARIZONA Rules of Court (West 1980)	Ariz. R. Evid. 702	Ariz. R. Evid. 702	Ariz. R. Evid. 703	Ariz. R. Evid. 705	Ariz. R. Civ. P.26(b)(4) Ariz. R. Crim. P. 15.1[4] 15.2[5]	Ariz. R. Evid. 706
ARKANSAS Stat. Ann. (Michie Supp. 1979	U.R.E. 702	U.R.E. 702	U.R.E. 703	U.R.E. 705	Ark. R. Civ. P. 26(b)(4) Ark. R. Crim.P.17.1[4] Ark. R. Crim. P.18.2[5]	U.R.E. 706
CALIFORNIA (West 1970 & Supp. 1979)	Cal. Evid. Code § 801(a)	--	Cal. Evid. Code § 801(b)	Cal. Evid. Code § 802	Cal.Civ.Proc.Code §2016(b) No Criminal Rule	Cal.Evid. Code §460 Cal.Evid. Code §730

STATE	WHEN EXPERTS MAY TESTIFY[1]	DEFINING EXPERT OR FIELDS OF EXPERTISE [1]	BASIS OF OPINION TESTIMONY BY EXPERTS [1]	FOUNDATION REQUIRED BEFORE SCIENTIFIC EVIDENCE MAY BE PRESENTED[1]	DISCOVERY OF EXPERTS AND TEST RESULTS Civil[2] Criminal	COURT APPOINTED EXPERTS[1]
COLORADO Rev.Stat.(1973 & 1978 Supp)	--	--	--	--	Colo.R.Civ.P.26(b)(4) Colo.R.Crim.P.16I [4] 16II[5]	--
CONNECTICUT Gen.Stat.Ann. (West 1972 & Supp. 1978)	--	--	--	--	No Civil Rule ch.26§§743 & 741(6)[4] §§764 & 769(2)[5]	--
DELAWARE Code Ann.(1974 and Cum. Supp. 1980)	U.R.E. 702	U.R.E. 702	U.R.E. 703	--	Super Ct. Civ.R.26(b)(4) Super Ct.Crim.R.16(a)[4] 16(b)[5]	Super Ct. Crim.R.28[6]
DISTRICT OF COLUMBIA Code Ann.(1974)	--	--	--	--	D.C. R.Civ.P.26(b)(4) D.C. R.Crim.P.16(a)[4] 16(b)[5]	D.C. Super. Ct.Crim.R.28[6]
FLORIDA Stat.Ann. (West 1979)	§90.702	§90.702	§90.704	§90.705	Fla.R.Civ.P.1.280(b)(3) Fla.R.Crim.P. 3.220(a)(1)(x)[4] 3.220(b)(4)[5]	--

STATE	WHEN EXPERTS MAY TESTIFY[1]	DEFINING EXPERT OR FIELDS OF EXPERTISE[1]	BASIS OF OPINION TESTIMONY BY EXPERTS[1]	FOUNDATION REQUIRED BEFORE SCIENTIFIC EVIDENCE MAY BE PRESENTED[1]	DISCOVERY OF EXPERTS AND TEST RESULTS Civil[2] Criminal	COURT APPOINTED EXPERTS[1]
GEORGIA Code Ann. (1977, 1980 Cum.Supp)	tit.38 §1710	--	tit.38 §1710[3]	--	tit. 81A §126(b)(5) tit. 27§1303[4]	--
HAWAII Rev.Stat.(1976 and Spl.Pamph. 1980)	Haw.R.Evid. 702	Haw.R.Evid.702	Haw.R.Evid. 703	Haw.R.Evid. 705[7]	No Civil Rule Haw.R.Crim.P.16[4/5]	Haw.R.Crim.P.28(a)[6]
IDAHO Code (1979)	--	--	--	--	Id.R.Civ.P.26(b)(4) Id.R.Crim.P.16(b)[4/5]	--
ILLINOIS Ann.Stat. (Smith-Hurd 1979)	--	--	--	--	ch.110A §201[9] ch.110A §412[4] ch.110A §413(c)[5]	--
INDIANA Code Ann. (Burns 1980)	--	--	--	--	Trial Pro.Rule 26(b)(4) No Criminal Rule	--
IOWA Rules of Ct. (West 1980)	--	--	--	--	Iowa R.Civ.P.122 Iowa Crim.P.13(2)(b)(1)[4] Iowa Crim.P.13(3)(b)[5]	--

STATE	WHEN EXPERTS MAY TESTIFY[1]	DEFINING EXPERT OR FIELDS OF EXPERTISE[1]	BASIS OF OPINION TESTIMONY BY EXPERTS[1]	FOUNDATION REQUIRED BEFORE SCIENTIFIC EVIDENCE MAY BE PRESENTED[1]	DISCOVERY OF EXPERTS AND TEST RESULTS Civil[2] Criminal	COURT APPOINTED EXPERTS[1]
KANSAS Stat.Ann. (1976)	§60-456(b)	§60-456	§60-456(b)[10]	§§60-457 60-458	§60-226(b)(4) §12-4410[4]	
KENTUCKY Rev.Stat (1980)	--	--	--	--	Ky.R.Civ.P.26.02(4) Ky.R.Crim.P.7,24[4/5]	
LOUISIANA Rev.Stat.Ann. (West 1967 & Supp. 1980)	§15:464	§15:466[11]	--	§15:465[12]	La.Code Civ.Pro.Ann. art. 26.02(4) No Criminal Rule	La.Code Civ.Pro.Ann. art. 192[8]
MAINE Rules of Court (West 1980)	Me. R. Evid. 702	Me. R. Evid. 702	Me. R. Evid. 703	Me. R. Evid. 705	No Civil Rule Me.R.Crim.P. 16(b)(2)(B)[4] 16A(C)[5]	Me. R. Evid. 706
MARYLAND Ann.Code (1980)	--	--	--	--	Md.R.Pro.400(d)&(f)[13] Md.R.Prb.741(b)(4)&(d)(2)[4/5]	
MASSACHUSETTS Gen.Laws Ann. (West 1974)	--	--	--	--	Mass.R.Civ.P.26(b)(4) Mass.R.Crim.P.14(a)(2)[4] Mass.R.Crim.P.14(a)(3)[5]	

STATE	WHEN EXPERTS MAY TESTIFY[1]	DEFINING EXPERT OR FIELDS OF EXPERTISE[1]	BASIS OF OPINION TESTIMONY BY EXPERTS[1]	FOUNDATION REQUIRED BEFORE SCIENTIFIC EVIDENCE MAY BE PRESENTED[1]	DISCOVERY OF EXPERTS AND TEST RESULTS Civil[2] Criminal	COURT APPOINTED EXPERTS[1]
MICHIGAN Stat.Ann.(1978)	Mich. R. Evid. 702	Mich.R.Evid. 702	Mich.R. Evid. 703	Mich. R. Evid. 705	--	Mich.R.Evid. 706
MINNESOTA Rules of Court (West 1980)	Minn. R. Evid. 702	Minn.R.Evid. 702	Minn.R. Evid. 703	Minn. R. Evid. 705	Minn.R.Civ.P.26.02(4) Minn.R.Crim. 9.01(4)[4] 9.02(2)[5]	Minn.R.Evid. 706
MISSISSIPPI Code Ann.(1972)	--	--	--	--	§13-1-226(b)(4) No Criminal Rule	--
MISSOURI Ann.Stat. (Vernon 1953 & Supp. 1980)	--	--	--	--	Mo.R.Civ.P.56.01(b)(4) Mo.R.Crim.P.25.03(A)(5)[4] 25.03(A)(1)[5]	--
MONTANA Rev.Codes Ann. (1947 & 1978 Supp)	Mont.R.Evid. 702	Mont.R.Evid. 702	Mont.R.Evid. 703	Mont.R.Evid. 705	Mont.R.Civ.P. 26 tit.95, §§1803(2)&(9)[4/5]	--
NEBRASKA Rev.Stat.(1978)	Neb. R. Evid. 702	Neb. R. Evid. 702	Neb. R. Evid 703	Neb. R. Evid. 705	§25-1267.02 §29-1912[4] §29-1916[5]	Neb.R.Evid. 706

STATE	WHEN EXPERTS MAY TESTIFY[1]	DEFINING EXPERT OR FIELDS OF EXPERTISE[1]	BASIS OF OPINION TESTIMONY BY EXPERTS[1]	FOUNDATION REQUIRED BEFORE SCIENTIFIC EVIDENCE MAY BE PRESENTED[1]	DISCOVERY OF EXPERTS AND TEST RESULTS Civil[2] Criminal	COURT APPOINTED EXPERTS[1]
NEVADA Rev.Stat. (1980)	--	--	--	--	N.R.C.P. 26(b)(4)(A) §174.235(2)[4] §174.255[5]	§178.271[6]
NEW HAMPSHIRE	--	--	--	--	--	
NEW JERSEY Stat.Ann. (West & Supp. 1980)	--	R.E. 56(2)(b)	R.E. 56(2)(a)[10]	R.E. 57 R.E. 58	N.J.R.Civ.P.4:10-2(d) No Criminal Rule	
NEW MEXICO Stat.Ann. (1980)	N.M. R. Evid. 702	N.M. R. Evid. 702	N.M. R. Evid. 703	N.M. R. Evid. 705	N.M. R.Civ.P. 26(b) No Criminal Rule	N.M. R. Evid. 706
NEW YORK (McKinney 1970 & Supp. 1980)	--	--	--	N.Y.Civ.Prac.Law §4515	N.Y.Civ.Prac.Law §§3101[9] §240.20(2)[4] [5]	
NORTH CAROLINA Gen.Stat. (1978)	--	--	--	--	N.C. R.Civ.P.26(b)(4) §15A-903(e)[4] §15A-905(b)[5]	

STATE	WHEN EXPERTS MAY TESTIFY[1]	DEFINING EXPERT OR FIELDS OF EXPERTISE[1]	BASIS OF OPINION TESTIMONY BY EXPERTS[1]	FOUNDATION REQUIRED BEFORE SCIENTIFIC EVIDENCE MAY BE PRESENTED[1]	DISCOVERY OF EXPERTS AND TEST RESULTS Civil[2] / Criminal	COURT APPOINTED EXPERTS[1]
NORTH DAKOTA Cent.Code(1974)	N.D. R. Evid. 702	N.D. R. Evid. 702	N.D. R. Evid. 703	N.D. R. Evid. 705	N.D. R.Civ.P. 26(b)(4) / N.D. R.Crim.P. 16(a)(2)[4] 16(c)[5]	N.D. R. Evid. 706 / N.D.R.Crim.P.28
OHIO Rev.Code Ann. (Page 1971 & Supp. 1980)	Ohio R.Evid. 702	Ohio R. Evid. 702	Ohio R.Evid.703[10]	Ohio R.Evid.705[12]	Ohio R.Civ.P.26(b)(4) / Ohio R.Crim.P.16(B)(1)(c)[4] 16(C)(1)(b)[5]	--
OKLAHOMA Stat.Ann.(West 1958 & Supp.1980)	Okla. R.Evid. 702	Okla. R.Evid. 702	Okla. R.Evid. 703	Okla.R. Evid. 705	--	
OREGON Rev.Stat.(1979)	41.900	--	--	--	No Civil Rule / 135.815[4] 135.825[5]	
PENNSYLVANIA Rules of Court (West 19[illegible]	--	--	--	--	Pa.R.Civ.P.4011 / Pa.R.Crim.P.305(B)(1)(e)[4] 305(C)(2)[5]	
RHODE ISLAND Gen.Laws (Michie 1970 & Supp.1980)	--	--	--	--	No Civil Rule / R.I. R.Crim.P.16(a)(5)[4] 16(b)(2)[5]	9-17-19 / R.I.R.Crim.P.28

STATE	WHEN EXPERTS MAY TESTIFY[1]	DEFINING EXPERT OR FIELDS OF EXPERTISE[1]	BASIS OF OPINION TESTIMONY BY EXPERTS[1]	FOUNDATION REQUIRED BEFORE SCIENTIFIC EVIDENCE MAY BE PRESENTED[1]	DISCOVERY OF EXPERTS AND TEST RESULTS Civil[2] Criminal	COURT APPOINTED EXPERTS[1]
SOUTH CAROLINA Code (1976)	--	--	--	--	S.C.Cir.Ct.Prac.R.90(e)(6) No Criminal Rule	
SOUTH DAKOTA Codified Laws (1977)	S.D. R. Evid. 702	S.D. R. Evid. 702	S.D. R. Evid. 703	S.D.R.Evid. 704	§15-6-26(b)(4) §23A-13-4[4] §23A-13-13[5]	S.D. R. Evid. 706
TENNESSEE Code Ann. (1980)		--	--	--	Tenn.R.Civ.P. 26 Tenn.R.Crim.P. 16 [4][5]	
TEXAS Code Ann. (Vernon 1979)	--	--	--	--	Tex. R.Civ. P. 186(a) No Criminal Rule	
UTAH Code Ann. (1978 and Supp. 1980)	--	Utah R. Evid. 56(2)(b)	Utah, R. Evid. 56(2)(a)[10] ..	Utah. R. Evid, 57 Utah R, Evid. 58	Utah R.Civ. P.26(b)(4) §77-35-16[4][5]	tit.77-35-15[6]
VERMONT Stat.Ann.(1974)	--	--	--	--	Vt.R.Civ.P.26(b)(4) Vt.R.Crim.P.16[4] 16.1[5]	

STATE	WHEN EXPERTS MAY TESTIFY[1]	DEFINING EXPERT OR FIELDS OF EXPERTISE [1]	BASIS OF OPINION TESTIMONY BY EXPERTS [1]	FOUNDATION REQUIRED BEFORE SCIENTIFIC EVIDENCE MAY BE PRESENTED[1]	DISCOVERY OF EXPERTS AND TEST RESULTS Civil[2] / Criminal	COURT APPOINTED EXPERTS[1]
VIRGINIA Code (1975)	--	--	--	--	Va.Ct.R.4.1(b)(4) / Va.R.Crim.P.3A:14(b)(1)(ii)[4] 3A:14(c)[5]	
WASHINGTON Rev. Code Ann. (West 1961 & Supp.1980)	--	--	--	--	Wa.Super.Ct.Crim.R.4.7[4/5]	
WEST VIRGINIA Code (1977)	--	--	--	--	W.Va. R.Civ.P.26(b)(4) / §62-1B-2[4]	
WISCONSIN Stat.Ann.(West 1958 & Supp.1980)	Wis.R.Evid.907.02	Wis.R.Evid.907.02	Wis.R.Evid.907.03	Wis.R.Evid.907.05	Wis.R.Civ.P.804.01(2)(d) / Wis.R.Crim.P.971.23(5)[4/5]	Wis.R.Evid.907.06
WYOMING Stat. (1980)	Wyo.R.Evid. 702	Wyo.R.Evid. 702	Wyo.R.Evid. 703	Wyo.R.Evid. 705	Wyo.R.Civ.P.26(b)(4) / Wyo.R.Crim.P.18(a)(2)[4] 18(d)[5]	Wyo.R.Evid. 706

Notes -

1 - Unless otherwise noted, the rules of evidence listed below are essentially the same as the applicable Federal Rule of Evidence.

2 - Unless otherwise noted, the civil rule on discovery conforms to Federal Rule of Civil Procedure 26(b)(4).

3 - Facts must be proven by other witnesses.

4 - Prosecution disclosure of names and addresses of experts and test results.

5 - Defense disclosure of names and addresses of experts and test results.

6 - Criminal cases only.

7 - If the underlying facts were disclosed during discovery they need not be stated by the expert before offering an opinion.

8 - Civil cases only

9 - This rule provides for much more limited discovery than the federal rule. "An opinion of an expert is not discoverable unless the court finds that the material can no longer be duplicated...and that withholding it will result in injustice or undue hardship."

10- Expert may base his opinion upon those facts perceived by him or made known to him at the hearing.

11- Test of competency is knowledge of the subject matter established to the satisfaction of the court.

12- Every expert must state the facts upon which his opinion is based before testifying.

13- Only information from experts to be called must be disclosed.

Table 2. Summary of Problems Identified and Solutions Proposed

TABLE 2. SUMMARY OF PROBLEMS IDENTIFIED AND SOLUTIONS PROPOSED

Problems Identified

Pre-filing

1. Locating qualified experts

2. Failure of investigators (police, fire) to protect and preserve possible evidence

Pre-trial

3. Inadequate discovery for disclosure of scientific and technical evidence, inadequate joining of the issues at trial

4. Availability of experts to meet with adverse party's lawyers (other than by desposition)

5. Inadequate attorney-expert interaction (insufficient familiarity with subject matter, inadequate preparation; conflicts over fees)

6. Imbalance of resources

7. Missed opportunities for settlement

Trial

8. Unclarity of expression by experts

9. Lack of skill by counsel in organizing and eliciting scientific testimony

10. Role conflict (on part of experts)

11. Difficulty on court's part in deciding what scientific evidence to admit or exclude, and which experts to find qualified or not

12. Institutional capacity of trial courts (including juries) to make correct decisions on scientific and technological issues

Post-trial

13. Institutional capacity of appellate courts

Solutions Proposed	Problems Addressed
Educational solutions	
o Teaching lawyers about science - Law school courses - Continuing legal education - Preparation of suitable materials - More interaction between law schools and university science departments	1, 5, 9, 11. 12, 13
o Teaching scientists about the legal process - Academic base for full-time forensic scientists - Continuing education for occasional experts - Preparation of suitable materials - More interaction between law schools and university science departments	4, 5, 8, 10
o Training police on evidence collection procedures which will facilitate scientific analysis	2
Expert Source Lists prepared by o Bar associations o Professional organizations of scientists o Independent organizations	1
Court-appointed impartial panels	1, 4, 10
Certification programs	1, 10, 11
Creation of independent forensic laboratories	4, 6
Creation of forensic laboratories for the defense in criminal cases	4, 6
Increase admissions of law students with science backgrounds	5, 9, 11, 12, 13
Procedural solutions for trial courts	
o Enhance discovery of scientific evidence	3
o Enforce requests for admissions	7, 12
o Pre-trial conferences on scientic issues	7, 12
o Court-appointed experts	10, 12
o Court advisers	10, 12
o Special masters	7, 12
o Advisory juries	10, 12
o Increased use of judicial notice	12
o Increased use of stipulations	11
o Seriated trials	12
o Flexible, creative trial procedures by judges in appropriate cases	12
Science courts to establish presumptive validity	11

Solutions Proposed	Problems Addressed
Quality control by professional and scientific organizations	12
o of forensic science laboratories (certification)	12
o of expert testimony by members (peer review)	12
Solutions for appellate courts	
o Advisory panels	13
o Science courts	13
o Appointment of judges with science backgrounds	13
o Appointment of clerks with science backgrounds	13
o Preliminary opinions	

Figure 1. Information Flow Through the Litigation Sequence

Figure 1. Information flow through the Litigation Sequence

Effects Of Scientific Evidence

A B C D E F G

Effects On Scientific Evidence

A' C' E' F'

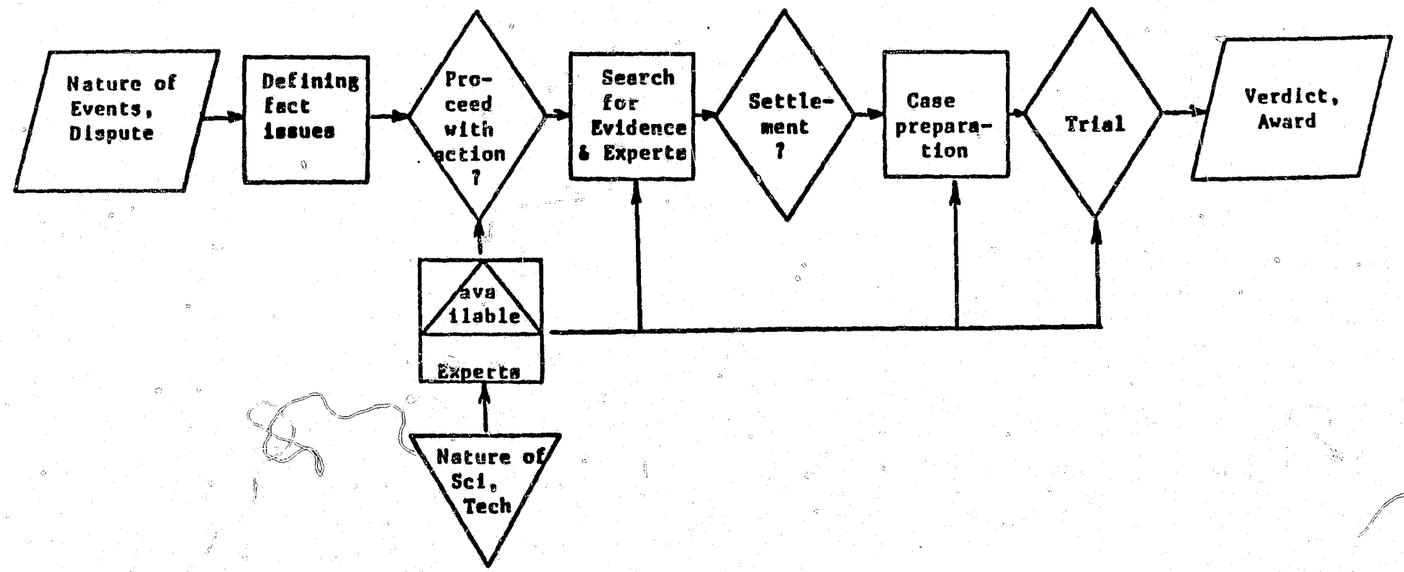


Figure 1 (cont'd)

Illustrative Issues

Effects Of Scientific Evidence	Effects on Scientific Evidence
A. Tactical and strategic judgments One party's evidence "awes" the other side	Recognition of questions susceptible to empirical analysis Tactical and strategic judgments $ judgments Kinds of scientific disciplines sought Attorney competence
B. Exculpation Judgment of probability of success General role of findings Tradeoff judgments	
C. Cost of evidence gathering Control (of lack) by lawyers $ barriers to success	Police crime laboratories How documented, operationalized, controlled by expert Paralegals, investigators gathering evidence Guidance by experts Rules for discovery "Snipers" Manner of search for experts, their representativeness of field (selection bias) Appointment by courts Conflict between defense counsel and experts Differential availaiblity of experts
D. Information as bargaining chips As exchange for cooperation As basis for resolution Rates of settlement, of guilty pleas	
E. Burden, cost of preparation	Adversariness Impartiality of experts Called by court, by counsel Location of laboratories Relationship between experts and counsel

Figure 1 (cont'd)

Effects Of Scientific Evidence	Effects on Scientific Evidence
F. Time, complexity of trial Clarity of trial Persuasive influence	Role of experts Rules of evidence Rules of procedure Instructions to jury Background of judge Backgound of jurors Evidence presented, how much Admissibility Stipulation Judicial notice Counsel's ability to qualify experts, elicit testimony, cross-examine
G. Direction of verdict, amount of award	

APPENDIX A

CATEGORICAL INDEX

CATEGORICAL INDEX

Scientific-Technical Field 400

Issues 500

APPENDIX B

INTERVIEW PROTOCOLS

INTERVIEW PROTOCOL -- EXPERTS

Questions to pose throughout interview

Probe for "critical incidents": When was the first time you had some trouble in this area? Describe it. Before that? Before that?

What changes, improvements might be made?

Compare your experience in this case with other similar cases you have worked on. What similarities? Differences?

Initial contact and background

How did you become involved in the case? Who contacted you? Work together previously? Referral? At what point in the development of the case?

Do you serve as an expert often?

Was your expertise a good/bad match with the information needs of the case?

Was payment involved? If so, how were these arrangements negotiated? Were any special terms negotiated?

Communication with own side

Did the attorney give clear, complete picture at outset?

Was any critical information added later?

Were you presented with the information, data, and other material you needed?

How was it obtained.

Was it in appropriate condition or form?

Did you have to obtain additional materials?

To what extent did the attorney discuss the legal theories of the case with you?

To what extent did you explain the background of the scientific area to the attorney?

The problems with the evidence?

Was the scientific field's knowledge a good/bad fit with the information needs of the case?

How often did you and the attorney communicate?

For what purposes?

Verbal briefings?

Written reports?

In terms of the substance of the case, to what uses was you work put?

Could the attorney have made better use of you?

Did your work change the attorney's view of the case, strategy, etc.?

Was the communication effective, or were there problems understanding or being understood?

Any conflicts? Over what? How resolved?

Did attorney try to get you to stretch your conclusions beyond what you felt the data and principles allowed?

Communication with other side before trial

What kinds of communication occurred?

Deposition?

Subpoenaed reports, records, etc.?

Interrogatories?

Any other contact? Informal? With whom?

If deposed or if interrogatories submitted, was the other side's attorney prepared?

What appeared to be the attorney's objective?

Trial and preparation for it

To what extent did your side's attorney prepare you for your testimony?

To what extent did you prepare the attorney for your testimony?

To what extent did you prepare the attorney for cross-examination of other side's experts?

Did you testify?

How often does your work as an expert culminate in trial testimony?

Describe you impressions of the trial experience.

Direct

Cross

Re-direct

Do you feel you were able to present your information effectively? What problems? Covered by what?

Would there have been a better way for you to inform the factfinder accurately?
(Court's witness; non-adversarial forum, etc.)

What impact do you feel your testimony had?

Is there any difference when you are involved in an _____ case?

Regarding the other side's experts,
Did your assessments, views, etc., conflict or agree with theirs?

General evaluation of the other side's experts?

Follow-up

Did the attorney provide you with follow-up information? If so, what? When?

If not, what would you like to have known?

Of what value might that have been?

INTERVIEW PROTOCOL -- JUDGES

Usual cross-cutting questions

Critical Incidents: Problems

Similarity/Difference of other cases

Recommended changes for improvement

Background issues

Any issues raised about qualifying an expert?

Any issues raised about the admissibility of the scientific evidence? What were they?

How did you resolve them? On what basis?

Testimony

Any problems in the presentation of the scientific evidence?

Was the testimony lucid, comprehensible, germane? If not, in what ways not?

What, if anything, was done to enhance the effectiveness of presentation?

How might it have been improved?

Were the attorneys well prepared?

Did they make good/bad use of the scientific evidence?

Were the experts well prepared?

Did they adapt their testimony to the factual needs of the case?

Was cross-examination effective? Why or why not?

Did the attorneys focus on substance on cross or did they resort to "tricks"?

Court-appointed experts

Did you contemplate calling a court-appointed expert, advisory jury, or other resource?

What do you see as the advantages/disadvantages of court-appointed witnesses?

If yes, did you call one?

If not, why not?

If a court-appointed expert was used,
How did you determine one would be helpful?

How did you locate the expert(s)?

How were financial arrangements concluded?

How was necessary information provided to the experts?

Did you meet with the expert prior to trial?
What kinds of matters were discussed?

What use did you put your expert to?

Jury

If this was a jury trial, do you think the jury understood the scientific evidence?

Did the scientific issues or evidence become a factor in developing jury instructions?

General Information

Of what value were the experts to the factfinder?

Did they tend to clarify or complicate issues in the case?

If complicated, could they have clarified?

If clarified, were they virtually indispensible?

Was the presentation of scientific evidence useful (necessary)? or could it have been dispensed with?

Was the scientific evidence used in arguments by counsel?

Did the lawyers use the experts and the scientific evidence to bolster the substance of the case or to obfuscate?

Were the experts (particularly those called by the parties) biased (for sale, advocates not witnesses, etc.)?

What is your general assessment of the experts in this case?

What is the single most important change that you think could be made to improve the use of scientific evidence in litigation?

Do you think there is a difference in the use of scientific evidence in _____ cases?

INTERVIEW PROTOCOL -- ATTORNEYS

How did you determine that you would use an expert?

How did you go about locating _____?

Did you talk to others?

Use a service?

How were payment negotiations carried out?

How often did you meet with the expert pretrial?

How did you tell the expert about the legal theories of the case?

The facts?

What you were looking for?

When?

To what extent did the expert brief you on the general scientific areas?

About the limits of his/her knowledge?

About the limits of the type of information which his/her discipline could provide?

When?

In what ways did you use the expert and evidence pretrial?

Negotiations?

Discovery?

Witness preparation?

Refining theories of the case?

How did you prepare the expert for discovery?

How did you protect yourself and the expert for discovery?

How did you prepare for use of the evidence at the trial?

What, if any, problems occurred at trial with the expert and evidence?

How were they overcome?

Assess the probable impact of the testimony.

How did you prepare the other party's expert?

How would you compare this case to others you have participated in involving experts?

If you were able to change one thing, in the way scientific evidence is used, what would it be?

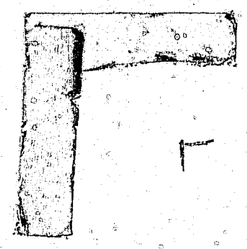
Is there a difference in _____ cases?

APPENDIX C

LIST OF INTERVIEWEES

PERSONS INTERVIEWED

Michael Addis
Reynold T. Alonzo
J. Lawrence Angell
Matthew T. Barnhill
Walter E. Barton
Bruce Beaudin
Allan Beigel
Billy Bell
William Bennett
E. J. Boren
Sally Brown
James Carruth
Maureen A. Casey
Linda Coffee
Robert Collins
David R. Curfman
John Dawson
James E. Delaney
Kurt Dubowski
George Economos
Paula England
Kenneth Field
Gary S. Freeman
Dewaine L. Gedney
Charles Graddick
Brenda Grantland
Patrick Higgenbotham
Richard F. Jacobson
Joseph O. Kulakowski
John LaWall
Barbara Linden
Betty Lipscher
William Lowry
Milton F. Lunch
Carl MacGowan
Janice Madden
John McDuffie
Walter McLaughlin
Ferrill D. McRae
Cornelius McWright
Stephan Michelson
David Mills
Thomas Mundy
Robert Norgren
Patrick O'Dell
Charles O'Rear
Richard Oseran
Girvan Peck
Joseph L. Peterson
Charles Reading
Michael Rebell
Roark M. Reed
John M. Roll
Jose M. Santiago
Elaine Scott
Ira T. Silvergleit
James L. Small
Manual Smith
William B. Smith
Roger C. Spaeder
Thomas Stair
William Stewart
Don Stodghill
Irving Stone
John O. Sullivan
Irving Sunshine
Tony Tanke
Albert H. Teich
Ralph J. Temple
William A. Thomas
Ellen Weiss
James T. Weston
John P. White
Sherman Winters



END