Spring 1974

Product Liability: A Study of the Interaction of Law and Technology

Aaron Twerski
Brooklyn Law School, aaron.twerski@brooklaw.edu

Alvin S. Weinstein

Henry R. Piehler

William A. Donaher

Recommended Citation
12 Duq. L. Rev. 425 (1974)

Duquesne Law Review

Volume 12, Number 3, Spring, 1974

Product Liability: An Interaction of Law and Technology†

*Alvin S. Weinstein**

*Aaron D. Twerski***

*Henry R. Piehler****

*William A. Donaher*****

INTRODUCTION

In 1970 the President's Commission on Product Safety chronicled a set of shocking statistics. Some 20 million Americans are injured each year as a result of incidents connected with consumer products.[1] Incidents connected with industrial products account for an additional 7 million injuries each year.[2] Personal injuries are the primary source of the burgeoning number of product liability cases entering our courts.

† This article has resulted from a study sponsored by the National Science Foundation under a grant (NSF Grant No. GI-34857) to Carnegie-Mellon University. The Law School of Duquesne University participated through the efforts of the two members of that faculty (Twerski and Donaher) who were members of the study team. The research underlying these results was conducted by the authors, the co-principal investigators for the study.

* B.S., University of Michigan, 1951; M.S., Carnegie Institute of Technology, 1953; Ph.D., Carnegie Institute of Technology, 1955; Professor of Mechanical Engineering and Public Affairs, Carnegie-Mellon University.

** A.B., Beth Medrash Elyon Research Institute, 1962; B.S., University of Wisconsin, 1970; J.D., Marquette Law School, 1965; Professor of Law, Hofstra University School of Law.

*** S.B., Massachusetts Institute of Technology, 1960; S.M., Massachusetts Institute of Technology, 1962; Sc.D., Massachusetts Institute of Technology, 1967; Associate Professor of Metallurgy, Materials Science and Public Affairs, Carnegie-Mellon University.

**** A.B., Catholic University of America, 1949; LL.B., Harvard University, 1952; Professor of Law, Duquesne University School of Law.

1. FINAL REPORT OF THE NATIONAL COMMISSION ON PRODUCT SAFETY (June, 1970), LIB. CONG. No. 76-600753.
2. THE PRESIDENT'S REPORT ON OCCUPATIONAL SAFETY AND HEALTH (May, 1972).

In 1969 approximately 300,000 such cases were filed, a threefold increase over 1968. The number of product liability litigations will inevitably continue to escalate, spurred primarily by the public's increased awareness of the potential defects in consumer products and industrial machinery.

The explosion of product liability litigation has thrust the technologist into a position of preeminence in the judicial decision-making process. His role in product liability litigation is pivotal. The technical expert is uniquely qualified to extract from the complex facts, conclusions and opinions which pose the crucial questions for jury determination. Yet, strangely enough, the role of the technologist and the interaction of law and technology in product liability litigation have essentially been unexamined.[3]

Plaintiff and defense groups have written trial technique materials which develop the "how to do it" approach in some depth.[4] However, the most serious shortcoming of these works is that they assume the basic validity of the system within which they work. Thus, the numerous monographs available on how best to elicit the testimony of an expert witness serve only to sharpen the skills of the lawyer who must utilize the technical expert. They do not confront the question of the proper role of the expert: to what extent do his biases and predispositions affect the outcome of the lawsuit? Do fundamental semantic barriers exist between the technologist's language and that of a court of law? To what extent is the expert hampered by the quality and quantity of the technical data made available to him? Is the entire litigation process indeed designed to bring forth a clear and cogent technological view of the problem which must be resolved?[5] These questions prompted the

3. *Cf.* De Parcq, *Law, Science and the Expert*, 24 TENN. L. REV. 166 (1956); Louisell & Diamond, *The Psychiatrist as Expert Witness: Some Ruminations and Speculations*, 63 MICH. L. REV. 1330 (1964). While there is extensive literature dealing with various aspects of the law-technology interface, the focuses have not been on the critical nature of the establishment of the defect-causation link in strict-liability litigations. *See* Korn, *Law, Fact and Science in the Courts*, 66 COLUM. L. REV. 1080 (1966) [hereinafter cited as Korn], for an interesting exploration of the roles of the expert and his interactions with the legal system.

4. Many articles have been written, detailing for the trial attorney various practical techniques for optimal utilization of expert testimony within a products liability trial. *See generally* Hammon, *The Lawyer and the Expert*, 54 A.B.A.J. 583 (1968); Johnson, *How to Try Products Liability Cases*, 17 WYO. L.J. 111 (1963); Meyer, *Some Problems Concerning Expert Witnesses*, 42 ST. JOHNS L. REV. 317 (1967); Panel, *Trial Tactics in Handling Expert Witnesses*, 29 TENN. L. REV. 208 (1961). Also *see generally* DEFENSE LAW JOURNAL, under the topic heading *Products Liability*. Ashe, *So You're Going to Try a Products Liability Case*, 13 HASTINGS L.J. 66 (1961), is an excellent and thorough introduction to the mechanics of products litigation for practicing attorneys.

5. An incisive study by Professor Korn resulting from his work as Research Director of the Armstrong Project raises many of these questions with regard to the generic problems of

authors to undertake this study, "Product Liability: A Study of the Interaction of Law and Technology," under the auspices of the National Science Foundation's Division of Exploratory Research in its program Research Applied to National Needs (RANN).

To undertake this interdisciplinary study at a substantive level, a team of four, consisting of two lawyers and two engineers examined and evaluated each other's problem-solving methodologies. The vehicle for this examination was transcripts[6] of well-litigated products liability trials. The choice of trial transcripts containing complex expert testimony permitted the research team to test the validity of the products trial against established legal criteria.

In order to appreciate the methodology we evolved, it seems in order to first set forth the basic elements of a products liability suit. To establish a prima facie products liability case, the plaintiff must prove that:

(a) the product was defective and unreasonably dangerous;
(b) the defect existed at the time the product left the defendant's hands;
(c) the defect caused the harm; and
(d) this harm is appropriately assignable to the identified defect.[7]

These essential elements, as adduced by the facts brought out in the trial, were distilled according to the following outline:

A. Case Characterization
  1. Product Description
     The product is described and discussed in the context of its function, use, safety and cost.
  2. Accident Description
     The specific accident is narrated.
  3. Defect Description
     The defect, as identified by the plaintiff, is described with respect to the integrity, function, safety and use of the product.
  4. Description of the Unreasonably Dangerous Nature of the Product

expert testimony. We have addressed ourselves to these questions in the specific area of products liability litigation with a primary concern for the role of the technologist in device-oriented situations. *See* Korn, *supra* note 3.

6. Wherever possible, the study included the physical evidence, interrogatories, experts' reports, depositions and exhibits. In some instances we were able to accomplish independent testing.

7. *See generally* W. PROSSER, THE LAW OF TORTS (4th ed. 1971); Wade, *Strict Liability of Manufacturers*, 19 Sw. L.J. 5 (1965) [hereinafter cited as Wade].

a. Alternatives to reduce danger
b. Probability and gravity of the harm
5. Causal Relationship Between the Defect and the Resulting Harm
6. Whether this Harm is Appropriately Assignable to this Defect
B. Critical Analysis of Each of the Above Elements
C. Conclusions

The six elements listed above under the general title of Case Characterization must all be addressed in some way in any product liability litigation. A distillation of the evidence that actually appeared in the trial in support of each area was recorded under these headings in a neutral, narrative fashion.

In the critical analysis, the authors established, with admitted subjectivity, the quality, comprehensiveness and, to some extent, the validity of the evidence, as well as of the experts' opinions. Having accomplished this evaluation, a determination was made as to whether the evidence, including expert testimony, adequately addressed the legal criteria requisite to adjudicating issues on the proper bases.

A unique feature of this critical evaluation is that we sought to examine not only whether the technological evidence met the legal criteria realistically but also whether the technological evaluation was consistent with the problem-solving methodology of technology. The result of these parallel investigations led to the identification of serious litigation problems which appear to require a reexamination of many of the basic premises of litigation in the products liability area.

The detailed documentation of a representative number of cases can be found in the Appendix to this article. An in-depth understanding of the analysis presented here can only be gained from a careful reading of the Appendix.

Strict Liability—What Is It?

In order to prevail under strict liability[8] a plaintiff must prove that the product was defective and unreasonably dangerous, that the defect

8. Restatement (Second) of Torts § 402A (1966):
§ 402A. Special Liability of Seller of Product for Physical Harm to User or Consumer
(1) One who sells any product in a defective condition unreasonably dangerous to the user or consumer or to his property is subject to liability for physical harm thereby caused to the ultimate user or consumer, or to his property, if
(a) the seller is engaged in the business of selling such a product

existed when it left the hands of defendant, and that the defect caused the harm. What is an unreasonably dangerous product? A product is after all an object, a thing. How does it become unreasonably dangerous? Perhaps it is important to stress the obvious at this juncture. In deciding whether or not a product is or is not unreasonably dangerous the focus is on the *product* and not on the conduct of the manufacturer. The shift from negligence to strict liability requires, if nothing else, that the inquiry be focused on the product and the use of the product and away from what the manufacturer should or should not have done or foreseen.[9] In order to develop the issue of unreasonable danger it becomes crucial to understand not only the scope of consumer expectations but also the entire milieu of product use—the total environment in which the product finds itself. Understanding the concept of unreasonable danger is crucial to the trial of both design and production defect cases. While it may be more obvious that the standard of unreasonable danger is crucial to determining the efficacy of a design, it demonstrably merits equal consideration in production defects as well.

The criteria against which the defective and unreasonably dangerous nature of any product is tested are broad and far reaching. In a leading article, Dean Wade[10] has provided a list of seven succinct indicia for this purpose:

1) The usefulness and desirability of the product

(b) It is expected to and does reach the user or consumer without substantial change in the condition in which it is sold

(2) The rule stated in Subsection (1) applies although

(a) the seller has exercised all possible care in the preparation and sale of his product

(b) the user or consumer has not bought the product from or entered into any contractual relationship with the seller.

A parallel guarantee of quality is given the user or consumer by the UNIFORM COMMERCIAL CODE § 2-314:

Section 2-314. Implied Warranty: Merchantability; Usage of Trade

(1) Unless excluded or modified (Section 2-316), a warranty that the goods shall be merchantable is implied in a contract for their sale if the seller is a merchant with respect to goods of that kind . . . .

(2) Goods to be merchantable must be at least such as

(a) are fit for the ordinary purposes for which such goods are used . . . .

9. *See* RESTATEMENT (Second) OF TORTS § 402A (1966); Wade, *supra* note 7.

10. *See* Wade, *supra* note 7. It should be noted that Dean Wade's formulation is an expansion and adaptation of negligence risk-utility concepts to strict products liability. *See* RESTATEMENT (Second) OF TORTS § 283 (1966). This approach to strict liability has not gone unchallenged. *See* Calabresi & Hirschoff, *Toward a Test for Strict Liability in Tort*, 81 YALE L.J. 1055 (1972). It is clear to us that the major thrust of strict liability law has adopted risk-utility concepts. *See, e.g.*, Dorsey v. Yoder, 331 F. Supp. 753 (E.D. Pa. 1971); Metal Window Product Co. v. Magnusen, 485 S.W.2d 355 (Tex. Ct. App. 1972). Also note that the Consumer Product Safety Act, 15 U.S.C. §§ 2051-81 (1970), specifically adopts the standard of unreasonable danger as the standard for products covered under the Act.

2) The availability of other and safer products to meet the same need
3) The likelihood of injury and its probable seriousness
4) The obviousness of the danger
5) Common knowledge and normal public expectation of the danger (particularly for established products)
6) The avoidability of injury by care in use of the product (including the effect of instructions or warnings)
7) The ability to eliminate the danger without seriously impairing the usefulness of the product or making it unduly expensive.

While certain of these indicia may be quantifiable with the remainder requiring subjective evaluation, the final decision as to whether a product is in fact defective and unreasonably dangerous is an amalgam of all seven. The determination of defect and its unreasonable danger is, in one sense, subjective because each product must be viewed in the particular context of its function and use. The use of the same product in two different environments, domestic and industrial, for example, may lead to different conclusions regarding its defectiveness and unreasonable danger. Thus it is critical that the product be described comprehensively because only then can the appropriate focus be established for application of the Wade indicia.

Yet the criteria are no less operative for the problem of production defects, since the concept of defect is not self-defining when a product contains a flaw. Since all products are flawed at some technological level,[11] the decision must still be made as to when a flaw emerges as a

11. To a metallurgist all metallic structures contain flaws or irregularities at some size level. They range from dislocations at the atomic size level to cracks visible to the naked eye. These flaws or deviations from structural perfection can have beneficial effects in certain use environments and deleterious effects in others, completely analogous to the defectiveness or nondefectiveness, perhaps even utility, of the same product in different use environments. Since these flaws can be identified in all products, the critical question to be asked is when can these deviations from structural perfection really lead to a conclusion of defect.

To give a sense of the scope of the problem involved in the attempt to classify structural imperfections as flaws or ultimately as defects, consider examples of flaws (unfortunately sometimes called *defects* by metallurgists) which always occur in metallic load-bearing structures.

1. Dislocations. The yield stress of metals containing atoms arranged in ideal, structurally perfect lattices has been calculated to be about a *factor of one thousand higher* than that measured experimentally (*see* Frenkel, *Zur Theorie der Elastizätsgrenze und der Festigkeit Kristallinischer Köper*, 37 ZEITSCHRIFT FÜR PHYSIK, 572-609 (1926)). In 1934 this discrepancy between theory and experiment was reconciled by the suggestion that all metals contain line imperfections, or dislocations, which can move to cause yielding at stresses much lower than that necessary to cause yielding in a structurally perfect, yet unobtainable, dislocation-free metal (*see* Orwan, *Zur Kristallplastizität. III. Uber den Mechanismus des Gleituorganges*, 89 ZEITSCHRIFT FÜR PHYSIK, 614-59 (1934); Polanyi, *Uber eine Art Gitterotörung, die einen Kristall Plastish Machen Könnte*, 89 ZEITSCHRIFT FÜR PHYSIK 660-64 (1934); Taylor, *The Mechanism of Plastic Deformation of Crystals. Part I—Theoretically*, 145 PROCEEDINGS OF THE ROYAL SOCIETY OF LONDON 362-87 (1934)).

defect. In order to make this decision, some judgmental standard must be utilized. It is clear to us that this standard must be based on the concept of unreasonable danger.[12]

However, it has long been recognized that metals harden due to continued cold working (usually a beneficial effect). Yet this effect requires that the dislocations, or imperfections, originally present in a metal must increase in number during continued permanent deformation of a metal. *See* Frank & Read, *Multiplication Processes for Slow Moving Dislocations*, 79 PHYSICAL REVIEW 722-23 (series 2, 1950). Unfortunately, an undesirable consequence of hardening metals by cold working is the attendant decrease in ductility, the ability to undergo general permanent deformation prior to fracture (*e.g.*, Webster, Christie & Pratt, *Comparative Properties of Oxygen-Free High-Conductivity, Phosphorized and Tough-Pitch Coppers*, 104 TRANSACTIONS OF THE AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS, INSTITUTE OF METALS DIVISION 166-69 (1933)) and to signal that the structure should be taken out of service. These imperfections then make the basic material less strong than perfect material, but do permit the material to harden at the expense of ductility.

2. Foreign Elements and Inclusions. Minute or trace quantities of foreign elements can lead to catastrophic fracture when the metallic structure is subjected to specific heat treatments or use environments. *E.g.*, Jolivet & Vidal, *Valeur de L'essai de Resilience Pour L'etude de la Fragilite de Revenu*, 41 REVEU DE METALLURGIE 378-88 (1944). Many foreign elements present in greater than trace concentrations are actually present in the form of inclusions or second phase particles within the parent metallic structure. Inclusions which can be classified as imperfections or flaws may be formed as a result of chemical processing reactions in the melt (endogenous inclusions) or may come from sources external to the melt such as furnace linings (exogenous inclusions). Inclusions have a negligible effect on the strength of metallic structures, but do decrease ductility, *E.g.*, Chin, Hosford & Backofen, *Ductile Fracture of Aluminum*, 230 TRANSACTIONS OF THE METALLURGICAL SOCIETY OF THE AMERICAN INSTITUTE OF MINING, METALLURGICAL, AND PETROLEUM ENGINEERS 437-49 (1964). Ductility can be increased by lowering inclusion contents but this involves the use of costlier processing procedures. One can conclude, therefore, that inclusions and trace elements may lead to flaws or defects under certain conditions.

3. Solid Solutions and Precipitates. Additional elements are often added intentionally to form alloys which are stronger than the parent metal. These alloying elements can simply assume positions in the lattice sites of the parent metal to produce a substitutional solid solution (brass is a common example of a substitutional solid solution produced by the addition of zinc to copper). Substitutional solid solution strengthening also produces an attendant decrease in ductility. *E.g.*, Saeftel & Sachs, *Festigkeitseigenschaften und Struktur Einiger Begrenzter Mischkristallreiken*, 17 ZEITSCHRIFT FÜR METALLKUNDE 155-61 (1925). Elements whose atomic size is small compared to that of the parent metal may assume positions within the interstices of the parent-metal lattice structure itself (carbon and nitrogen can assume interstitial positions in iron). The inverse effects on yield strength and ductility are also present in interstitially hardened solid solutions. *E.g.*, Smith & Rutherford, *Tensile Properties of Zone Refined Iron in the Temperature Range from 298° to 4.2° K*, 209 TRANSACTIONS OF THE METALLURGICAL SOCIETY OF THE AMERICAN INSTITUTE OF MINING, METALLURGICAL, AND PETROLEUM ENGINEERS 857-64 (1957). Alloying elements which cannot go into solid solution in the parent metal often are intentionally added to form precipitates, particles of a chemical composition and crystal structure different from that of the parent metal (aluminum alloys are commonly precipitation hardened). These precipitates produce a strengthening by obstructing dislocation motion (a possible benefit) but again do lead to a decrease in ductility (possibly a deficiency). *See* Merica, Waltenburg & Scott, *Heat Treatment and Enstitution of Duralumin*, 64 TRANSACTIONS OF THE AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS 41-77 (1920).

4. Grain Boundaries. Metallic structures are not composed of single continuous three-dimensional arrangements of atoms, but rather are composed of grains. The architectural order of atoms within each grain is the same; the crystal axes of neighboring grains are merely rotated with respect to one another. Grain boundaries are thin regions of architectural compromise between neighboring grains. Decreasing the grain size of a metal through thermo-mechanical processing produces an increase in yield strength. *See* Sauveur, *Microstructure of Steel*, 22 TRANSACTIONS OF THE AMERICAN INSTITUTE OF MINING ENGINEERS 546-57 (1893). Grain refinement in steels has the added advantage that it increases the stress

The above discussion has subscribed to the existing distinction between production and design defect cases. While at the polar extremes

---

sustainable before brittle fracture will occur by a process of cleavage along specific atomic planes in the crystal lattice. *See* Petch, *The Cleavage Strength of Polycrystals*, 174 JOURNAL OF THE IRON & STEEL INSTITUTE 25-28 (1953). Brittle fracture by cleavage is dependent upon the specific chemistry and grain size of the steel but also is enhanced by low temperature environments, high rates of loading, as well as sharp notches in the structure.

Grain refinement is not without its deleterious consequences in other use environments. At high temperatures approaching the melting point of the metallic structure, grain boundaries actually impart weakness in that they enhance high temperature permanent deformation under constant load or creep. *See* Hanson, *The Creep of Metals*, 113 TRANSACTIONS OF THE AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS, IRON AND STEEL DIVISION 15-57 (1939).

Materials processing and fabrication are thus based upon flaw or irregularity control to achieve an economically feasible trade-off among all the properties of the material which, together with proper design, serve to achieve a given performance requirement.

It should be abundantly clear that the mere presence of an identifiable irregularity or flaw in a metallic structure is in and of itself an insufficient basis for the establishment of defect.

5. Cracks. Failure by fracture in engineering structures commonly initiates at a crack or discontinuity which existed prior to fracture. For example, cracks or discontinuities can arise from solidification shrinkage. Inclusions, especially those which are strung out over large distances during primary hot working to form "seams," are also a source of cracks. Subsequent secondary forming operations can also lead to cracks or discontinuities, either as a result of physically separating metal or folding metal over onto itself to form "laps." Cracks or conditions which will promote cracks can also form during heat treatments in the solid state, especially those which involve quenching from elevated temperatures. Machining or grinding marks can also be deleterious flaws under certain use conditions. Welding invariably introduces some level of holes or discontinuities and changes the properties of the base metal in the vicinity of the weld as well. Corrosive or high temperature environments may also lead to the formation of cracks or holes in structures which would be unaffected in less hostile use environments.

It has long been recognized that most fractures arising in structures or members which flex develop by progressive crack propagation or fatigue. *See* REPORT OF THE COMMISSIONERS APPOINTED TO INQUIRE INTO THE APPLICATION OF IRON TO RAILWAY STRUCTURES (London, 1849). The earliest fatigue fracture remedies, still very widely used today, involved designing structures to remove both sharp notches and abrupt changes of section or by designing the part to reduce the applied stress level. *See* Wohler, *Bericht über die versuche, welche . . . mit Apparaten zum messen der Biegung und Verdrehung von Eisenbahnwagen—Achsen wahrend der Fahrt, Angestellt Werden*, 8 ZEITSCHRIFT FÜR BAUEISEN 642-52 (1858). Case hardening (*e.g.*, GIAMBATTISTA DELLA PORTA, MAGIA NATURALIS (Naples, 1589) (english translation, London, 1658)) is another widely used technique for fatigue resistance which not only physically hardens the surface but also introduces a favorable residual stress distribution. *E.g.*, Buhler & Buckholtz, *über die wirkung von eigenspannungen auf die schwingungsfestigkeit*, 3 MITTERLUNGER FORSCHUNGS INSTITUT 235-48 (1933) (it should again be noted that residual stresses can be useful in certain applications and deleterious in others).

Hence, resistance to fracture is dependent not only on the nature of the bulk material itself but the size of the cracks which it contains. It must be noted that without exception, all metallic materials contain cracks even though they may be microscopic. This combined role of crack size and material characteristics was first quantitatively investigated in experiments on glass (*see* Griffith, *The Phenomenon of Rupture and Flow in Solids*, 221 PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY OF LONDON 163-98 (series A, 1920)) and later extended to metals fractured under single or monotonic loading (*see* Irwin, *Fracture*, in 79 HANDBUCH DER PHYSIK 551-90 (1958)) as well as cyclic loading (*see* Paris, Gomez & Anderson, *A Rational Analytic Theory of Fatigue*, in THE TREND IN ENGINEERING 9-14 ((Univ. of Wash. ed. 1961)). However, these newer, more sophisticated quantitative crack-propagation concepts cannot at present be applied to the design or failure analysis of most metallic products. It should be obvious, therefore, that the fact that cracks exist in all metallic materials does *not* mean that all materials are defective per se.

Hence, structural irregularities or flaws are inevitable in any metallic structure. Many of the frequency at which flaws occur this distinction has meaning, it must be recognized that there exists a gray area in which the distinction becomes blurred. For example, assume a truck leaf spring is flawed by gouge marks on its surface. If a very small fraction of the leaf springs produced by a given manufacturer contain these gouge marks, the judgment will be made that the litigation will proceed in the context of a production defect question.[13] However, if a significant fraction of these springs, as produced, contain the gouge marks, then the perspective of the litigation may proceed on the premise of design defect. At which point we shift from the former perspective to the latter will be of little consequence, as long as the concept of unreasonable danger[14] is the judgmental standard of *every* case in strict liability.

THE TRIAL PROCESS: AN ANALYTICAL OVERVIEW

A design-defect problem provides a convenient starting point for this analysis. The decision that is made when a product design is declared defective could be the equivalent of capital punishment of an entire model line or at the very least of a certain aspect of that product. This decision has major social and societal significance. It should be made with full understanding of the complex trade-offs which are involved in

---

irregularities are actually introduced or controlled to enhance certain properties, with the certain knowledge that others often will be compromised.

12. It should be clear from the textual discussion that this study finds the standard for strict liability established by the California and New Jersey courts in Cronin v. J.B.E. Olson Corp., 20 Cal. App. 2d 33, 501 P.2d 1153, 104 Cal. Rptr. 433 (1972), and Glass v. Ford Motor Co., No. L-17576-70 (N.J. Super. Ct., May 3, 1973), seriously off the mark. Those courts permitted the establishment of defect without reference to the "unreasonable danger" standard. For a sharp criticism of *Cronin*, *see* Keeton, *Product Liability and the Meaning of Defect*, 5 ST. MARYS L.J. 30 (1973). In a telling footnote, the *Cronin* court recognized that defect could not be established without reference to some given standard while simultaneously discarding "unreasonable danger." It said:

> We recognize, of course, the difficulties inherent in giving content to the defectiveness standard. However, as Justice Traynor notes, "there is now a cluster of useful precedents to supersede the confusing decisions based on indiscriminate invocation of sales and warranty law.

20 Cal. App. 2d at 42, 501 P.2d at 1162, 104 Cal. Rptr. at 442.

13. Whether or not the flaw is an unreasonably dangerous defect must be decided using the standards of the risk-utility theory. *See* note 12 *supra*. It is our purpose here to focus on the production-design defect dichotomy, not on the issue of unreasonable danger.

14. While the test of unreasonable danger is the same for both questions, the result may be different for each case. For example, the burden of precaution in the production defect case may be for the manufacturer to rid himself of the few gouge-marked springs, while the burden of precaution for the design defect may be a substantial alteration in either the design of the spring or the manufacturing process. A problem may arise if the manufacturing standards of a given company give rise to a flaw which still meets the acceptable standards using risk-utility theory. In such an instance, in the absence of an express warranty, it would be improper to hold this manufacturer liable for a flaw based upon a standard higher than that imposed on the industry as a whole.

product design.[15] How in fact are the decisions made? Consider a case which typifies the approach in vogue today. The case was particularly well tried. Yet, the faults which are found in the trial reflect a litigation emphasis and approach which we deem unsound when tested against the express requirements of strict liability.

The product which was the subject of litigation was a printer-slotter machine (see Figure A). The basic functions of the machine are to print advertising and labelling material on corrugated cardboard and to cut and score the cardboard for later assembly as cartons. Printing dies are stapled on large rotating wooden rolls. The ink is transferred from the upper portion of the machine to these rolls by a series of smaller rolls. Because this machine is equipped to print in two colors, there are two sets of ink-transfer and die-mounting rolls. The machine was designed to open to a width of 30 inches in order to change the dies. When the machine opens there is a clear passageway in the center of the machine which permits a worker to enter and make die changes on the rolls.

The back (feed) end of the machine is equipped to feed the cardboard into the first set of rolls for printing purposes. The cardboard then passes through the second set of printing rollers located on the front or exit end of the machine. When the cardboard emerges from the second set of rollers, it passes into the slotter section of the machine which is integrally attached to the front set of printing rolls. Adjustable knives are located in this section to score and cut the cardboard.

The principal driving motor is located at the back end of the machine and transfers power to both sets of printing rolls and the knives and scores, using gears. When the machine is opened only the front end rolls and knives and scores are mechanically disconnected from the driving motor and are inoperative even though the primary motor may be energized. During this operation the back or feed end of the machine can still function from the primary motor even when the machine sections are separated. The passageway created by the opening of the machine is thus bordered by the inoperative front rolls on one side and by the rotating back rolls on the other, if the primary motor is on. An automatic washing attachment was subsequently added to this machine. In order for washing to take place, the rolls to be washed must be rotated by the primary motor. If both rear feed and front exit ends are to be washed,

15. Wade, *supra* note 7.

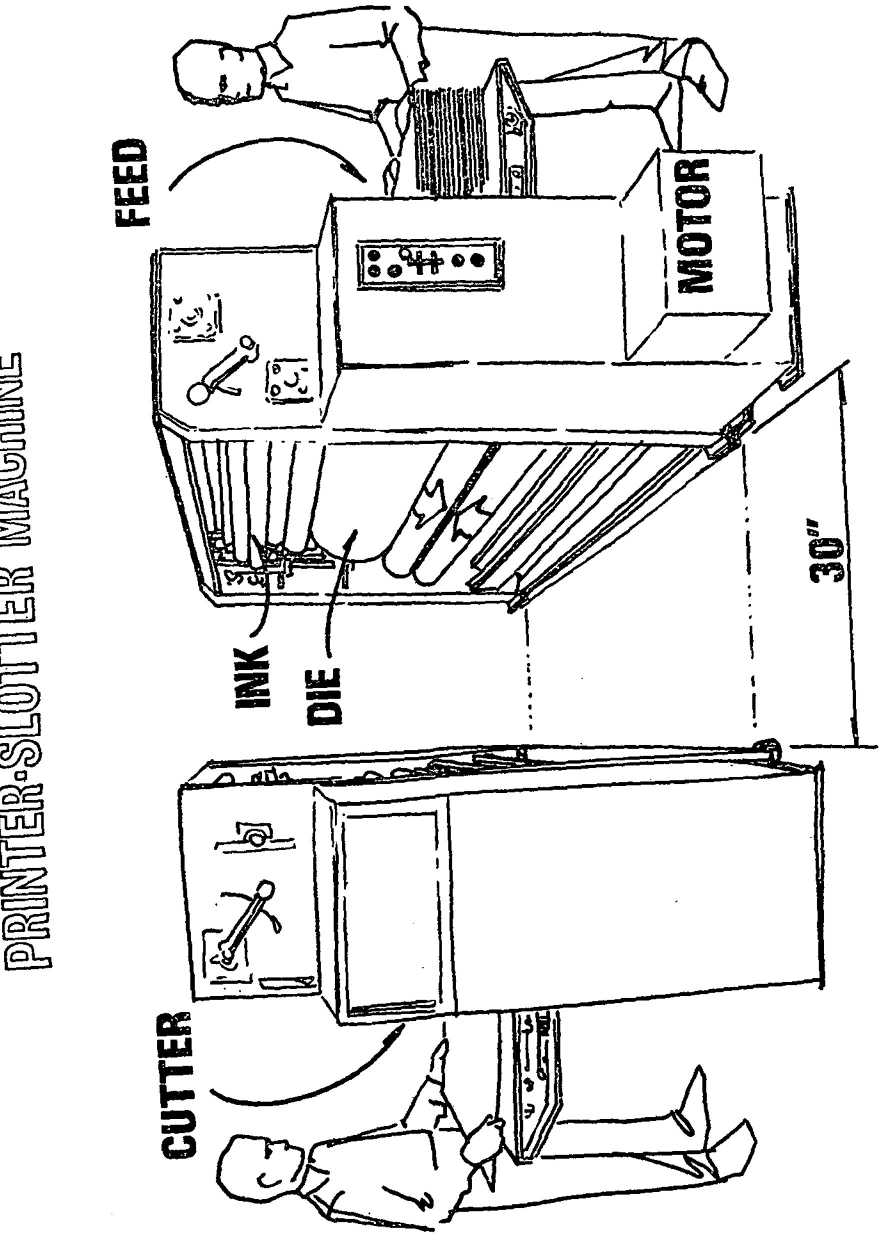

FIGURE A

the machine must be run in the closed position. The back (feed) end can be washed alone when the machine is separated since the back feed-end rolls can still be driven by the primary motor.

The injury to the plaintiff occurred when he entered into the open passsageway of the printer-slotter. Since the machine separation only prevented power transfer to the front end, there was still power available to the rolls on the back (feed) end and they were in fact rotating, presumably washing the rear set of rolls, at the time of injury to the plaintiff.

Plaintiff walked through the open passageway of the machine to get to an auxilliary piece of equipment, a staple gun, which was located at the far end of the passageway. His motive for doing so was not altogether clear but he apparently hoped to save time by getting to the staple gun so that he could begin the next step in the operation and thus reduce the amount of non-working time (or downtime) of the machine and thus increase his earnings. Plaintiff was carrying a rag at the time and somehow the rag was drawn into the moving back rollers. His hand followed the rag and his arm followed his hand into the machine. The end result was a plaintiff with an amputated arm.

The design defect claimed by plaintiff was that the machine was not equipped with a breakaway switch shutting down the primary motor and automatically cutting off power to both front and rear rolls when the machine was opened up. With such a switch, the power to the back rolls would have been shut off and those rolls not permitted to rotate when the passageway was open. Plaintiff's expert testified to the feasibility of a breakaway switch—indeed a switch similar to a refrigerator door switch which makes the light go on and off. Skillfully plaintiff's counsel focused attention on three factors—the breakaway switch, the open passageway and the amputated arm. The trilogy was hammered home effectively and appeared to be the crux of the case as it was presented in court.

On the basis of critical analysis, this approach is believed to be *inconsistent* with the meaning of strict liability. First, the product is brought to the trial setting not in the atmosphere or context of its legitimate use but in the atmosphere of the injury-creating event. This inside-out approach seriously distorts the nature of the proceeding. What is on trial first and foremost is a product design. The printer-slotter was designed and operated with several complex trade-offs in mind. Among these trade-offs[16] must have been an assessment of the cost of having a machine setup where the operator in the passageway could change front roll dies while the back rolls were rotating in a wash cycle versus the increased cost of having a setup where the back rolls could not operate if the operator was changing front roll dies. If a simultaneous setting of dies and washing of back rolls was inadvisable from a safety standpoint, machine downtime would increase substantially. This consideration was directly related to the actual operation of the machine, as this machine's downtime affected the efficiency of the entire production process. Perhaps the machine was unreasonably dangerous and perhaps the trade-offs were sound, but the issue cannot be determined without a comprehensive understanding of the product and its overall environment. It is crucial to recognize that it is the product design that is on trial in an action in strict liability. The injury-producing event reflects on the efficacy of the design, but the question of unreasonably dangerous defect is not solely defined by the injury. Lest it may seem that there is a defense bias to the insistence upon a comprehensive description of the product, it is suggested that in fact the failure to place the product in its overall perspective can compromise plaintiff's as well as defendant's case. Comprehensive product description is, in our opinion, the cornerstone of the product liability trial.

Secondly, the role of the expert came to the fore in this case in a manner which brings to light some of the problems which are indigenous to the use of an expert in a complex products trial. The plaintiff's expert

16. The competing factors which may come into play in the design of the printer-slotter are:

(1) The necessity for the machine to open for the purpose of changing dies on one or both sets of rollers (front and feed ends).
(2) The necessity of having the feed end of the machine operative when machine sections are separated.
(3) The effect of subsequent design modification as a result of the installation of automatic washers for the cleaning of rolls.
(4) The functional advantage of simultaneously setting scores and knives on the inactive front end while permitting operation of the automatic washers and rollers on the feed end.
(5) An understanding of the time sequence in setting up, cleaning, and operating the machine within the pay incentive scheme of the plant.
(6) The operational feasibility, cost, and effectiveness of various kinds of breakaway switches.
(7) The necessity of cleaning both sets of rolls subsequent to single color printing.
(8) A precise description of the location and direction of rotation of all rotating rolls.
(9) The location of all controls and auxiliary power sources with a clear understanding of their functional purposes.
(10) The perception of the open machine as an access route to auxiliary equipment.
(11) The necessity of two auxiliary power sources, one for die changing and color registration and the other for opening the machine.

was subjected to the normal qualification procedure. Plaintiff presented the general engineering qualifications of his expert, alluding to skill in the general principles of design; defendant countered with arguments that the expert's lack of specific experience in the design of printer-slotter machines disqualified him. These disparate approaches to the qualification of the expert, not uncommon in products liability litigation, obfuscated the real issue of what qualifications are appropriate to speak to the design of a product. The trial judge predictably ruled in favor of permitting the expert to testify.

The common belief that cross-examination of an inappropriate expert will cure all ills is not well founded. It may be very hard indeed to dislodge the testimony of an inappropriate expert and it may be difficult to retain the credibility of an appropriate expert who may be discredited under cross-examination because of his lack of specific design experience related to the product under adjudication.

A significant problem which surfaced throughout the analysis of expert testimony was the failure of the expert to describe the reasoning process which led to his conclusion. If the only input the jury has provided for its consideration is two conflicting expert opinions without the supporting reasoning processes which links the foundation testimony to those opinions, the jury is in no position to intelligently choose between them. Further, there exists a lack of clarity as to the role of the expert in the trial setting. Too often the expert comes to the trial for the sole purpose of filling an evidentiary gap in the prima facie case or the defense case. Rather, it is contended that the expert's opinion should be based upon the results of a broad inquiry into the totality of the product in the environment of its use and that this comprehensive inquiry, together with his underlying reasoning process, should be developed during his testimony. All of these points shall be examined in greater depth in a later section.

While many of the problems found in a design defect case are also present in a case characterized as a production defect case, there are other problems which are peculiar to the production defect situation. To illustrate these additional problem areas, consider an accident allegedly resulting from a broken truck spring.

The accident occurred following impact with a car when the truck veered off to the right and overturned after striking an embankment. The plaintiff-driver testified that the right front end of the truck cab dropped down and that he lost control of the truck prior to striking the car. Subsequent to the accident it was discovered that the right front leaf spring had fractured just behind the front eye (see Figure B). Plaintiff contended that the fracture was initiated by flaws in the manufacturing process. The two manufacturing flaws identified by plaintiff were: (1) gouge marks on the main leaf in the vicinity of the front eye, and (2) undesirable microstructure near the surface of the main leaf in the vicinity of the front eye which caused a structural weakness in the metal. Plaintiff alleged that these flaws rose to the level of defect and led to the

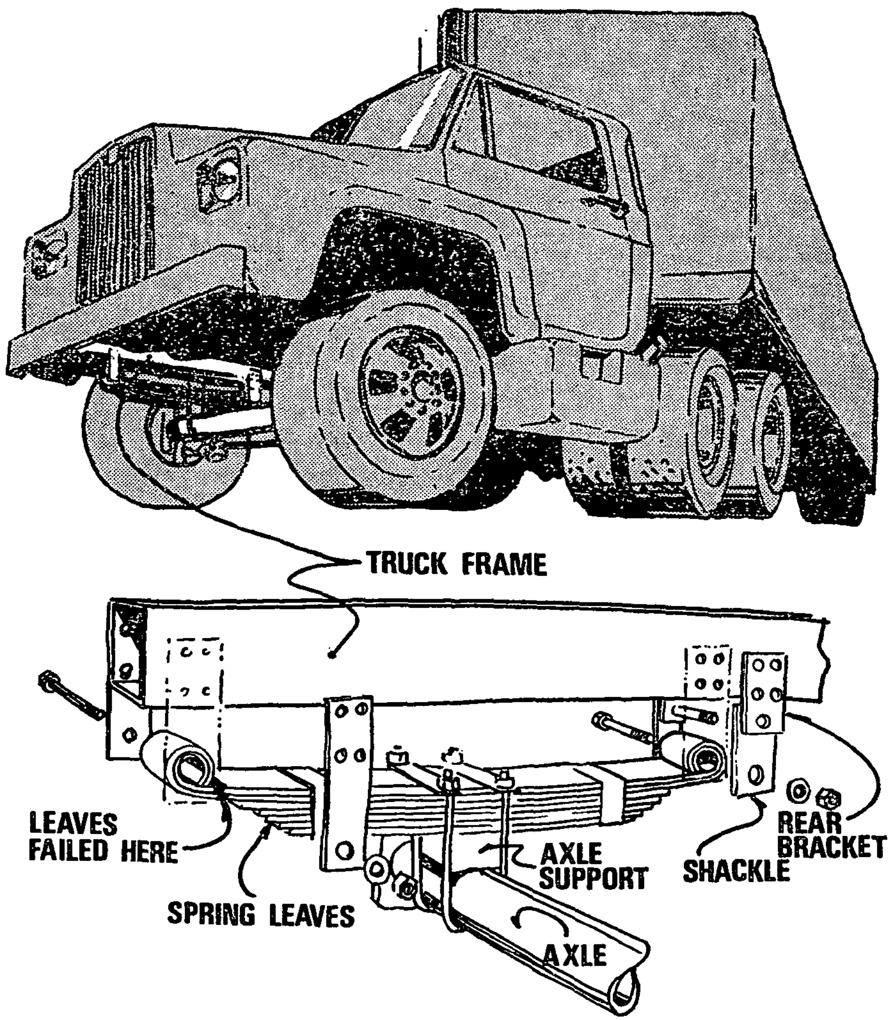

FIGURE B

premature fatigue failure of the leaf spring, causing the truck to go out of control. Defendant denied that the metal had substandard properties and that the gouge marks had any influence on the fracture. He buttressed this conclusion by pointing out that the fracture originated beneath the surface, ruling out any causative relationship between either of the alleged defects and the resulting fracture.

A crucial problem here was the establishment of a conclusion of legal defect arising from production flaws. Strangely enough, the primary focus of both plaintiff and defendant was on the origin of the flawed condition rather than on the effect of these flaws upon the service performance of the spring. It should, however, be obvious that in order to establish the presence of an unreasonably dangerous defect the flaws must be tested against standards of performance of the device and not the manufacturing standards.[17] Processing and physical property standards may be used, however, as guides to determining deviations from normal average quality (*i.e.*, flaws). These flaws must then be tested against the expected performance behavior. Thus, in this case the gouge marks on the spring, although admittedly a flaw, might not be a defect in the legal sense. A similar conclusion might also be reached with regard to the adequacy of the microstructure at the surface of the spring.

The difficulties in establishing whether the flaws were the principal cause of the spring failure, and if so, whether they made the product defective and unreasonably dangerous, were compounded by the fact that the physical evidence was poorly preserved and wantonly dismembered and partially destroyed during its examination in a misguided attempt to provide indicator evidence. Here, even if there had been adequate testing and evaluation of well-preserved evidence, there still would have been, in our opinion, substantial difficulties in definitively establishing whether the spring failed by progressive fatigue or single-load impact. Thus, in order to establish defect, it was imperative that any other indicator evidence relevant to the mode of failure be utilized by the expert in reaching his conclusion. One must be prepared to question the viability of the trial process when the issues are close and there is insufficient attention paid to the preservation and meaningful testing of the physical evidence. At some stage the court must be adequately

17. The term "standards of performance" denotes the behavior of the product within the range of normal consumer uses. The range is essentially defined by actual consumer practice and not manufacturer foreseeability. Essentially, we are describing herein a risk-utility standard based upon a community standard.

equipped to judge the adequacy of the technical evidence necessary to make out a prima facie case.

Against this background of uncertainty, there can be no justification for the predilection of experts to state conclusions of defect or causation in absolutist terms. We suggest that to confront a jury with two opposing experts, each speaking in the jargon of his profession and concluding with a dogmatic assertion which admits of no contrary possibilities, is to place a responsibility for choice upon the jury which it has not been equipped to handle. What the jury may be equipped to do, however, is to evaluate the experts' decision-making process and their inherent credibility.

To recapitulate, our research has identified the following problem areas:

a) Inadequate and disjointed product description;
b) Early, excessive, and dominant position of the product as an injury-producing rather than a productive or useful device, which can obscure or supplant certain basic elements of the cause of action;
c) Inadequate or obscured identification and proof of defect;
d) Obfuscation of the causation question by permitting its improper merger with defect and injury issues;
e) Poor procedures for evidence gathering, control, and preservation, and
f) Role of the expert witness:
   i) utilization of the expert to plug an evidentiary gap;
   ii) insufficient attention to qualification of an expert as the appropriate expert in a given case;
   iii) presentation by the expert of his technical conclusions without addressing and evaluating the totality of the engineering indicia he utilized in arriving at his conclusions; and
   iv) presentation and unrealistic evaluation by the expert of his conclusions without regard to the totality of the event.

Having identified in general some major problem areas, there follows an extended discussion of some proposed solutions. For a comprehensive understanding of our problem identification and characterization, the reader is referred to the Appendix. The thesis upon which all of these proposals are premised is that a products liability trial is first and foremost a trial of a product. Given this basic premise, it becomes possible to define the trial scenario, the role of the expert, the functions of the judge and jury, and to restructure the role of each to meet a common objective. We believe that a restructuring is entirely feasible within the parameters of the existing adversarial system. More to the point, we believe it to be of critical importance.

The Trial of the Product

Throughout this study, products cases have been characterized and analyzed according to the following elements: a description of product, accident, and defect; a description of the unreasonably dangerous nature of the product; the causal relationship between the defect and the resulting harm; and the issue of proximate cause.

The evidentiary flow relating to each of these elements in the two cases previously described is shown schematically on Figures C and D. Note in particular that the product description testimony is interspersed throughout the trial and that a substantial as well as factually important fraction of this testimony appears in the *defendant's* case. While a proper foundation for all the elements of a products case may be contained somewhere in the record and thus may well be available for purposes of appeal, the improper sequencing and intermingling of evidence related to different elements of the cause of action not only militate against effective evidentiary transmission, but corrupt the basic integrity of strict products liability.

Since the manufacturer's conduct is no longer on trial in strict liability, it follows that the central issue in a products trial must be the product in the environment of its use. It is the product itself that must ultimately be judged as defective and unreasonably dangerous. It therefore follows that the product must be viewed in the totality of its environment before the issue of defect can be properly joined. A comprehensive description of the product in the environment of its use should precede any of the other elements in a products trial. If this product is not appreciated in the environment of its use, the consideration of the defect and causation issues can never be properly addressed. The necessity for adequate product description appears to be in the nature of a motherhood statement, but product description has been found to be deficient in a substantial number of cases. Difficulties encountered later in the trial are often directly attributable to the weak foundation of an inadequate product description, which has been found

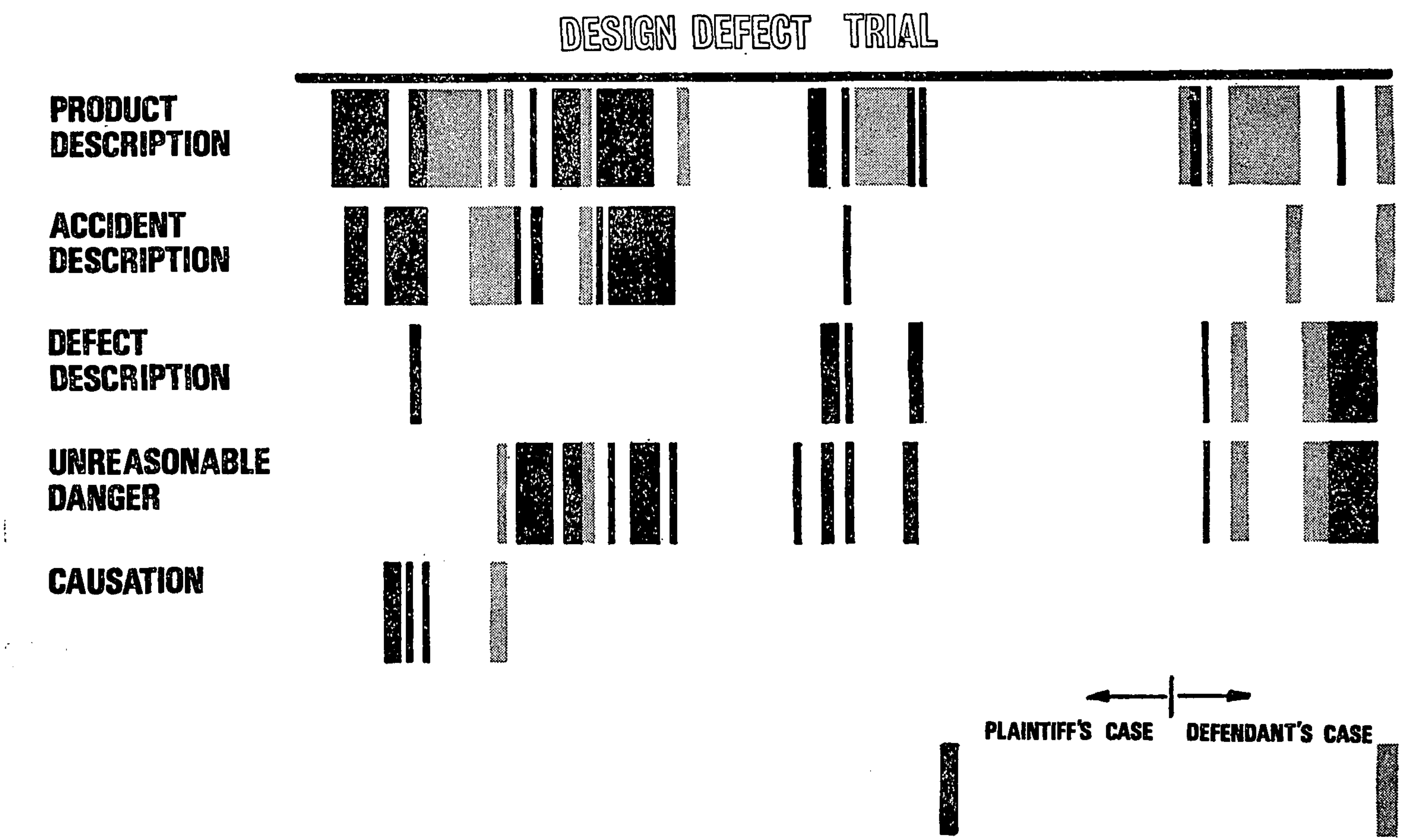
DESIGN DEFECT TRIAL
PRODUCT DESCRIPTION
ACCIDENT DESCRIPTION
DEFECT DESCRIPTION
UNREASONABLE DANGER
CAUSATION
PLAINTIFF'S CASE
DEFENDANT'S CASE

FIGURE C

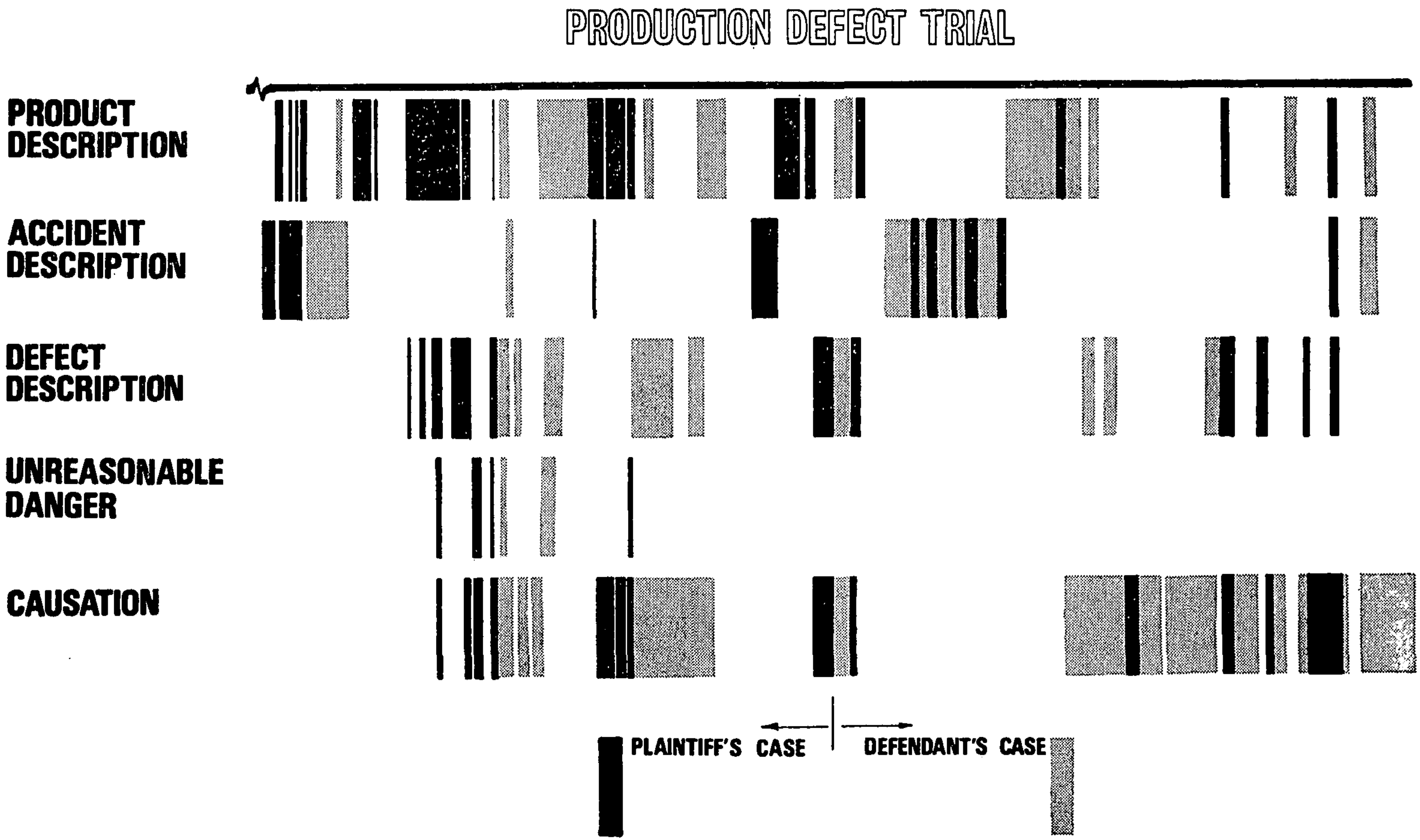
PRODUCTION DEFECT TRIAL
PRODUCT DESCRIPTION
ACCIDENT DESCRIPTION
DEFECT DESCRIPTION
UNREASONABLE DANGER
CAUSATION
PLAINTIFF'S CASE
DEFENDANT'S CASE

FIGURE D

to compromise both plaintiffs' and defendants' cases. The failure to first describe the product in the environment of its use can result in several serious distortions in the comprehension of the product. First, the product is viewed primarily as an injury-producing instrument rather than as a useful, functioning device. Second, the random interspersion of product description among the various elements of the cause of action not only militates against understanding the product but also taints the ultimate comprehension of the product with value judgments derived from other elements of the lawsuit. Third, if the accident and injury are graphically described on the witness stand at the beginning of the trial and reinforced by the continued presence of the maimed plaintiff himself, it is difficult, if not impossible, to overcome in a jury's mind the inference that the product whose use led to this injury must indeed be unreasonably dangerous.

Demonstrative evidence should be provided at the inception of the trial to familiarize the court with the product in question. This product description can be accomplished in several ways. The product itself might well be described by an expert who will later testify as to defect and causation. A user of the product can also provide part or all of this description since his experiences would focus attention on the product in its use environment. This testimony can be offered in conjunction with such visual aids as movies or video tapes of the product in use when it is necessary for adequate comprehension. Mock-ups of salient features of the product can also be used to clarify the function and operation of the product.

In addition to exploring the operation of the product in the environment of its use, the economics of the product must also be addressed as a critical part of the product description. This economic probing should include not only the manufacturer's costs in producing this product or viable alternatives, but also the economic perceptions of the user of the product. For example, in the printer-slotter case described earlier, the plaintiff believed he was minimizing downtime by leaving the feed-end rollers running while walking through the open passageway. The reduction of downtime would augment his income since he was paid a higher hourly rate when the machine was in production. Indeed a large number of other trade-offs should have been considered to enhance the understanding of the product in its environment.[18] Only after an adequate

18. *See* note 16 *supra.*

perception of the product in question has been accomplished can the central issues of defect and causation be addressed.

To implement this product-based reorientation, we propose a seriated trial[19] in which the product is first tried before the jury on the question of whether or not the product itself, apart from any considerations arising from the injury-producing event, is defective and unreasonably dangerous. The product itself would first be extensively described in the manner outlined previously. The alleged defect would then be identified. The design would next be tested against the Wade indicia,[20] allowing viable alternatives to be examined in order to weigh the question of defect. These potential viable alternatives would be described in the same manner used to describe the product itself. At the completion of this evidentiary presentation, with direct and cross-examination by both plaintiff's and defendant's counsel, the jury would be asked to make its initial determination as to whether or not the product is defective and unreasonably dangerous. This format is particularly amenable to design defect cases. The absence of the plaintiff and injury-related evidence during this portion of the trial would reduce the possibility of elements extraneous to the design problem interfering with the proper weighing of the defect issue as intended under strict liability.

We recognize that there may be potential difficulties in implementing a truly seriated trial and securing a jury decision on the defect issue alone. However, as a first step in the implementation of this suggested trial format, a resequencing of the evidentiary presentation to follow the seriated structure is proposed.

A seriated trial appears also to be feasible in many production defect cases, especially those in which the alleged defect can be clearly identified without recourse to inference. The product in these cases would again be thoroughly described, but it then would be tested for defect against performance standards developed during trial, utilizing a risk-utility theory.[21] In many cases this would require a description of performance standards not only at the time the product left the hands of

19. The concept of the bifurcated trial has been presented by several judicial authors; *see* Mayers, *The Severance for Trial of Liability from Damage*, 86 U. PA. L. REV. 389 (1938); Weinstein, *Routine Bifurcation of Jury Negligence Trials: An Example of the Questionable Use of Rule Making Power*, 14 VAND. L. REV. 831 (1961). A case comment on the additional time length required thereby and the validity of bifurcated trials per se may be found at 74 HARV. L. REV. 781 (1961).

20. Wade, *supra* note 7.

21. *Id.*

the manufacturer, but also after a reasonable period of ordinary use as well as foreseeable misuse.

The jury must be educated to the fact that all products contain certain levels of flaws. Only when a particular flaw is outside the limits of acceptable performance standards can a production defect be established. If the flaw lies within the norms of the manufacturer's quality spectrum but outside acceptable performance standards, the case can only go forward on a theory of generic defect or design on the basis of improper quality standards. The climate of a products trial as currently litigated often prevents the defendant from providing a clear base line of normal average quality. To do this requires the admission of his tolerating certain levels of flaws, a position which invites the attack of plaintiff's counsel. Yet it is precisely this determination of normal average quality and permissible levels for flaws based on performance standards that is central to the determination of defect and unreasonable danger in a production defect case.

It should be noted that in litigation a threshold issue of a special aspect of causation often surfaces even before the issue of defect can be resolved. We term this special aspect of causation *technical causation*. Technical causation is intimately tied to the establishment of a production defect. Given the existence of a deviation from the manufacturer's standards, *i.e.*, a flaw, the technical causation question is simply, "Did this flaw cause this failure or malfunction of the product?"

For example, in the litigation centering around the broken truck spring (described in brief earlier and detailed in the Appendix under heading Case E), the technical causation issue is whether the flaws (gouge marks on the spring surface and allegedly imperfect microstructure) caused the spring to fail. Questions such as these are essentially technical in nature and obviously must be addressed before the flaw is examined to establish whether or not it was an unreasonably dangerous defect. If it is shown that the flaw could not cause the failure or malfunction, then the only other product liability alternative would be product design. Too often the technical causation question is bypassed at the initial stages of litigation. It surfaces, if at all, in the overall causation question where the inquiry is whether the defect caused the injury-producing event. The effect of this unfortunate confusion of issues is that a truly technological issue which may be amenable to precise technological resolution is lost in the morass of legal causation evidence which focuses upon the whole panoply of events linking product failure to injury.

If, however, insufficient attention is focused on the relationship of the flaw to the failure or malfunction of the product, then the pervasive effect is simply the creation of an aura of defect without the hard proof necessary to relate the failure to the flaw. This proof can take the form of physical examination, or engineering calculations, or whatever is needed to establish the technical causation link. Sometimes this detailed examination is compromised by the deterioration of evidence or the disciplinary bias of the expert. However, these difficulties are not a rational basis for deflecting attention away from the crucial technical causation issue. An earlier litigation of this issue is essential to avoid the cascading confusion which results from the introduction of evidence relating to subsequent events in the causal chain. In Figure E the position of the technical causation issue in the seriated trial of a production defect case is shown.

The subtleties of the technical issues may force an expansion of the seriated trial of a production defect case to include more than the defect issue. An example of this would be the determination of whether the actual failure occurred as the result of a single load or progressively by fatigue, which would necessitate drawing upon some of the evidentiary elements of causation-in-fact, as well as technical causation. The expert's analysis of a failure which potentially involves fatigue always proceeds by establishing the mode of failure first and then the defect, if any, which promoted this mode of failure. Since in these cases the issues of defect, technical causation, and causation in fact are inextricably intertwined technically, it appears appropriate to combine them in the seriated trial format as well.

Using a seriated format, the trial of the product can be conducted so that a jury will be given a coherent evidentiary basis for the establishment of defect and unreasonable danger. While current litigation practice may lead to a trial record sufficient for the purposes of appeal, the usual evidentiary sequencing does not provide the clarity and direction required for the real task of trying the product itself. The seriated trial format, which isolates and examines the product in the environment of its use, is offered as a viable means for achieving the goals of strict liability, untainted by the irrelevancies of the manufacturer's conduct or unduly influenced by the injury-producing event.

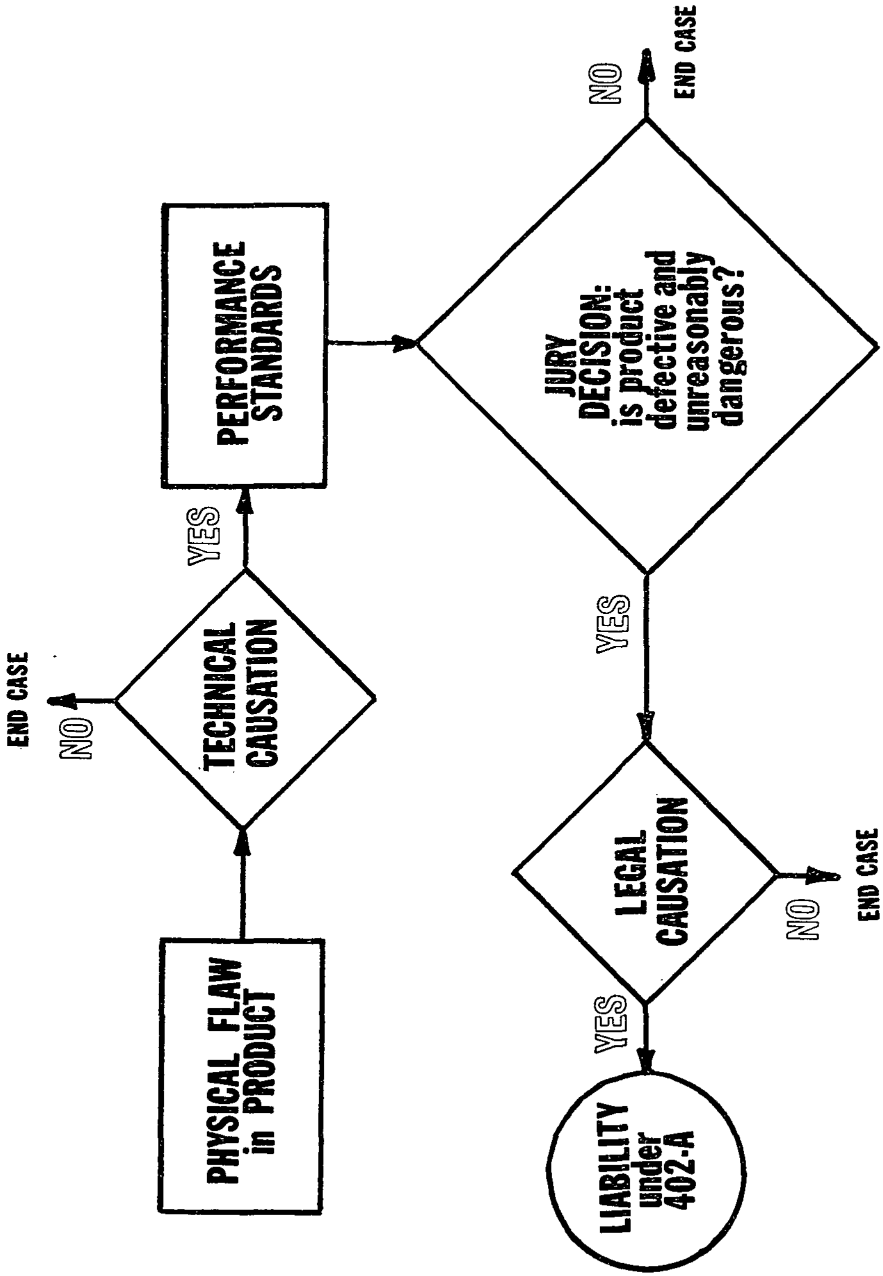
PHYSICAL FLAW in PRODUCT
TECHNICAL CAUSATION
NO
END CASE
YES
PERFORMANCE STANDARDS
JURY DECISION: is product defective and unreasonably dangerous?
NO
END CASE
YES
LEGAL CAUSATION
NO
END CASE
YES
LIABILITY under 402-A

FIGURE E

IDENTITY AND ROLE OF THE EXPERT

To achieve validity in strict liability, the expert's opinion must be a subjective amalgam of physical indicator evidence and must be firmly based upon an understanding of the product. The opinion must reflect the product in the context of its actual use, its relationship to other products meeting the same need, the obviousness of and the ability to eliminate the danger without seriously impairing the product's usefulness or significantly increasing its cost.

If the downtime of the printer-slotter would have been substantially increased by the use of the breakaway switch, the economic utility of this machine might have been seriously impaired. If such a switch could have been easily made inoperative by the machine operator, one could argue that the machine might be safer *without* the switch. Considerations such as these must be addressed by the expert and brought forth by him in trial, if proper scope is to be given to the question of unreasonably dangerous defect. It is the jury's function to decide the existence of defect. But how can their answer be properly framed, if the expert's view of the product is myopic and fails to consider the product as it is actually used within its environment before he concludes defect?

Thus it is neither reasonable nor, in fact, proper to expect an expert to function within the limited domain of viewing the product only from the standpoint of whether a proposed modification would have prevented the plaintiff's injury. The plaintiff's expert in discussing the adequacy of the design of the printer-slotter justified his opinion of defective design by proclaiming the caveat "all machines must be as humanly safe as possible." If this is the only principle upon which we base the concept of unreasonable danger, then are we not insisting on a posture of absolute liability? The test of strict liability is not an absolute one, but is a balance of meaningful trade-offs between risk and utility. It is not meant to be simply an assessment of what alteration a product should have had to have prevented this particular injury.

There are other aspects of the expert's role that must be considered. The initial decision as to whether or not a lawsuit is even warranted can be made intelligently by counsel only after the evidence has been identified and examined by the expert. There are few instances in which the surface appearance of the tangible evidence speaks unambiguously to the attorney. And it is only the expert who can properly suggest that more detailed examination and testing are indicated.

While counsel must guide the expert concerning the feasible economic limits of his investigation, the expert must also guide counsel, especially in the initial stages of investigation, as to the reasonable certainty of what may or may not be anticipated. This requires that the expert be considered as a resource and not a tool to be later used to fill an evidentiary gap during trial. A more appropriate view of the expert in products liability litigation is as a co-equal partner[22] with counsel from the moment they agree to undertake the lawsuit. Once this partnership is entered, the expert's role should expand to encompass the direction which discovery procedures will take. He must synthesize the totality of the evidence, non-technical as well as technical, and he must exercise proper control and care of the physical evidence.

If, for example, the issues of defect and causation hinge on whether a particular part of a product failed by fatigue or by the application of a single load, the physical evidence is crucial. But if the broken parts have reposed in a junk yard for three years, exposed to the elements, and the fracture surfaces have not only corroded but have been knocked about, any probative value the evidence may have had has most certainly been lost. Such evidence leads only to the sort of speculation that serves *no* useful purpose for *either* side in confronting the real issues. It is only the careful expert who can guide counsel and provide the proper considerations for control and preservation of the physical evidence.

In very few instances, however, is the expert's judgment based solely on technical evidence. His conclusions, more often than not, are a composite judgment based upon the physical evidence, the circumstances surrounding the incident, his understanding of the product and its use, and finally upon his technologically-founded intuitive sense. In synthesizing a conclusion, the expert must not only reach the conclusion which is most probable but he must also balance that conclusion against other possibilities[23] which he considers to be less probable.[24] This is the art form of the technologist.

---

22. In products liability litigation, an optimal utilization of the talents of the expert is of critical importance due to the extremely complex nature of the issues to which his expertise is directed. The concept that the attorney and expert must share responsibility for the course of the litigation, with the expert's having full authority for development of the technical aspects of the case, is advocated for general trial practice by Nickerson, *The Expert Technical Witness on Trial*, 50 A.B.A.J. 731 (1964).

23. In a litigation centering around the design of a 30 year-old steel pickling machine,

Popular misconception notwithstanding, the technological expert does not bring an absolute sense of precision to most, if not all, of his opinions. It must be recognized that any product is a compromise between quantifiable aspects of its design and specifications and the uncertainties of actual performance of the product in the environment of use. This gap is usually closed by the safety factor but it focuses precisely on the inherent uncertainties in any design (see Figure F). Thus, when a product is challenged as defective and unreasonably dangerous, the issue lies in this band of uncertainty between the quantifiable engineering parameters and the performance of the product in

---

one of the issues was whether or not it was possible for a link on a partially corroded chain to have engaged a lug projecting from a rack. The rack had overturned during the operation of the machine and had killed an employee. At the time of the accident, the machine had 16 chains. The four chains in the vicinity of the rack which overturned had not been identified, but all 16 were removed and stored in a garage for some years. The rack was never removed from service or identified. One of plaintiff's experts, a safety expert, did not bother to examine the chains, but merely concluded, retrospectively, that the design was faulty because a man had been killed. Plaintiff's second expert examined only one of the 16 chains—not necessarily one of the ones on the rack—and concluded that one link of this chain had corroded to the point where it could have engaged a lug on a rack. Had the experts, at the very least, examined all of the chains to determine how many oversize links there were, they might have been able to give some reasonable probabilities to reinforce the plaintiff's contention that an oversize link had caused the rack to tip. As it was, the limited evidence offered for the theory of faulty design—one link on one chain—could not be advanced as the most probable cause of the accident when balanced against the other possible explanations suggested by the defense. To compound the difficulty, these other possible causes were not considered by the plaintiff's experts in reaching their conclusions. Needless to say, the plaintiff lost. It is our contention that the expert must see himself and must be viewed by both counsel and court as taking a global view of the problems of identification of an unreasonably dangerous defect and the establishment of causation. These problems arise, in our opinion, not necessarily because of the incompetence of the expert, but rather from the traditionally limited role which has been assigned to him.

24. Suggestions that the jury itself goes through a process of balancing probabilities and possibilities in order to arrive at its verdict on the facts, and an accompanying analysis of that process in terms of elementary statistical methods, can be found in Cullison, *Probability Analysis*, 1969 Tol. L. Rev. 538. Many articles are devoted to expositions of the use of statistical techniques to augment and implement the fact-finding process. *See* Ball, *The Moment of Truth: Probability Theory and Standards of Proof*, 14 Vand. L. Rev. 807 (1961); Broun & Kelly, *Playing the Percentages and the Law of Evidence*, 1970 U. Ill. L.F. 23 [hereinafter cited as Broun & Kelly]; Kaplan, *Decision Theory and the Fact-finding Process*, 20 Stan. L. Rev. 1065 (1970) [hereinafter cited as Kaplan]; Tribe, *Trial by Mathematics*, 84 Harv. L. Rev. 1329 (1971) [hereinafter cited as Tribe]; Comment, *Evidence—Rules of Admissibility and the Law of Probability*, 8 Land & Water L. Rev. 285 (1973) [hereinafter cited as *Admissibility*]. One use of the above probability theory hitherto has been to attempt to show that what actually occurred on a particular unknown and unique instance of interest to the jury was more likely than not to have been a certain event "*A*" rather than the less likely event "*B*." This technique was utilized to identify a defendant by circumstantial evidence in People v. Collins, 68 Cal. 2d 319, 438 P.2d 33, 66 Cal. Rptr. 497 (1968). The additional uncertainty introduced should a jury be asked to "pyramid the probabilities" to reach its decision by assuming the certainty of each event in a chain of disputed events is dangerous at best. The problems inherent when probabilities are made interdependent and interrelated, when the viability of a conclusion depends on the correctness of all prior statistical assumptions, have caused authors to relegate probability theory as a trial tool to being an "interesting method of looking at the fact-finding process" (*see* Tribe, *supra* note 24, at 1337) but one ". . . more dangerous than fruitful." *See* Kaplan, *supra* note 24, at 1073.

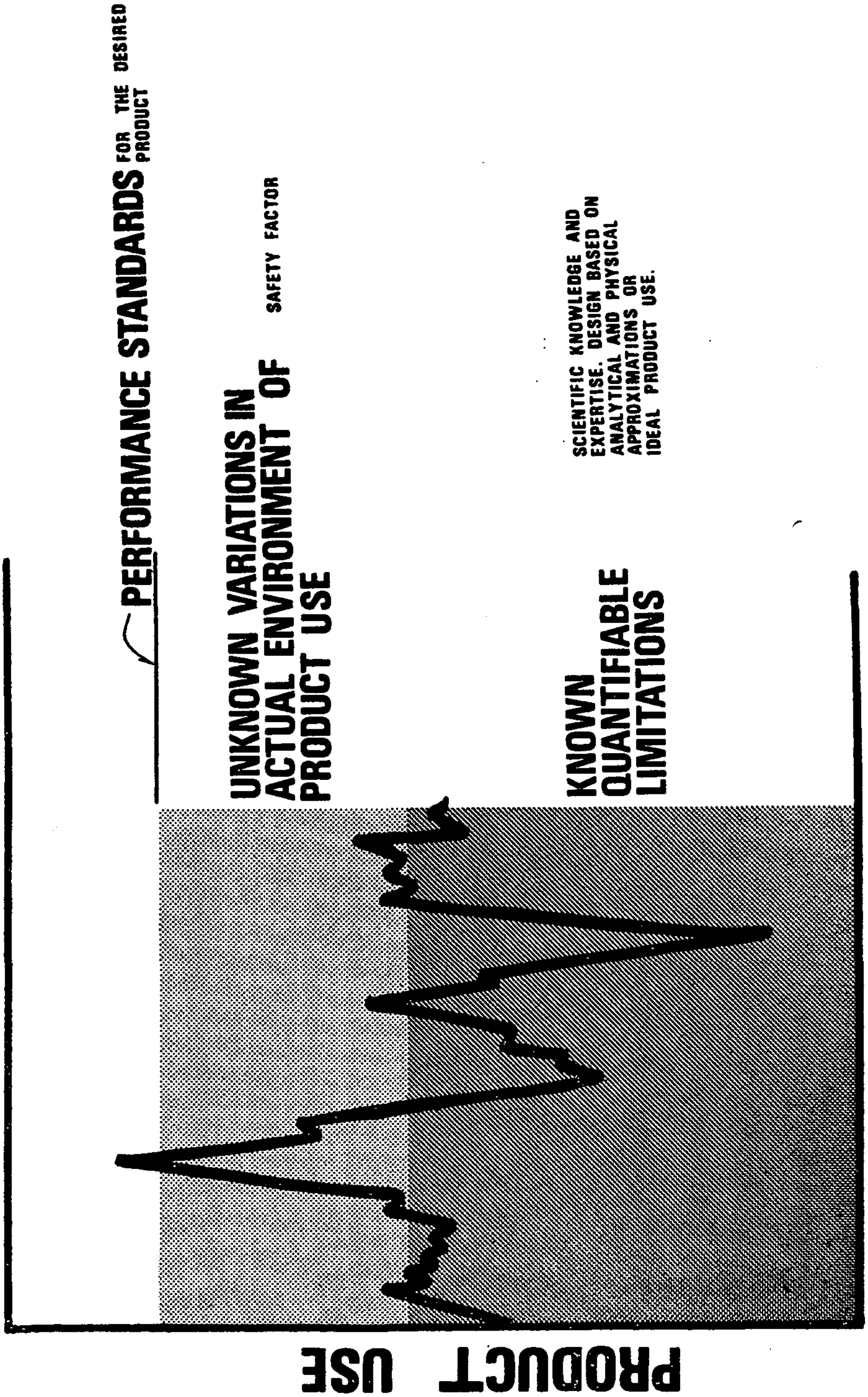
PERFORMANCE STANDARDS FOR THE DESIRED PRODUCT
UNKNOWN VARIATIONS IN ACTUAL ENVIRONMENT OF PRODUCT USE
SAFETY FACTOR
KNOWN QUANTIFIABLE LIMITATIONS
SCIENTIFIC KNOWLEDGE AND EXPERTISE. DESIGN BASED ON ANALYTICAL AND PHYSICAL APPROXIMATIONS OR IDEAL PRODUCT USE.
PRODUCT USE

FIGURE F

the environment of its use. This band of uncertainty is inherent in the establishment of a production defect just as it is in the establishment of a design defect and arises in the litigation of both the defect and causation issues. It is a travesty to expect an expert to bring any more certainty to his conclusions of defect and causation than existed in the original engineering of the product.

To shatter the myth of absolute scientific certainty in the expert's having reached his conclusions, it is essential that the expert be questioned by counsel in a manner which will permit his synthesizing process to be completely revealed to the jury.[25] The function of the expert is to utilize his evaluative sense in assessing difficult fact situations. Thus the traditional practice of basing an opinion upon an entire set of facts taken at 100 per cent probability of truth raises a serious question as to the validity of the expert's opinion. To counter, the opposing side removes one or more of the facts and assigns a 0 per cent probability of truth to those previously assumed facts. This approach, rather than demonstrating the real-world probabilities which result in sensitively balanced intermediate positions inherent in a valid decision-making process, distorts the process by giving an aura of unreality to any opinion. Note that cross-examination under this unrealistic approach

25. Opponents of the proposal to utilize expert testimony at less than the 100 per cent certainty levels will certainly advance the proposition that the expert's credibility before the jury is much reduced by his admitting only a 60 per cent or 80 per cent probability level for a given opinion. *See* Broun & Kelly, *supra* note 24. Difficulties also arise when the "80% certain" expert is subject to cross-examination by an opponent whose own expert professes to have decided the disputed facts at 100 per cent levels. Neither of these criticisms is viable when a careful analysis is made of the overall function of the expert and his relation to the finder of fact. Intrinsic to every decision process, including the jury's, is the assessment of the probabilities of the various subdecisions. It is this very cumulation pattern of the assessment process, coupled with probability evaluations, which we propose to have the expert present to the jury. In the present trial system, the "practice of repeating the assumed facts over and over until the aura of assumption is gone" further leads the jury to "accept as truth assumptions which properly should have probabilities associated with them." *Admissibility, supra* note 24, at 1291. But there is a danger that the court itself will refuse to find a probabilistic analysis of less than 100 per cent certainty to be of sufficient probative value to warrant its being submitted to the jury. This facet of the problem is particularly well-demonstrated by the cases in which a medical doctor's opinion was formulated of necessity in terms of medical probability, yet was inadmissible because the probability did not approach "reasonable medical certainty." See cases noted in Broun & Kelly, *supra* note 24, at 39. Conceivably the same argument might bar admission of the technical expert's probability assessments on the grounds that anything less than "scientific certainty" has no probative value. The problem remains that there have been no judicial determinations to quantify either "medical" or "scientific" certainties. For an interesting solution to this question, *see* Bertram v. Wunning, 385 S.W.2d 803 (Mo. Ct. App. 1965), wherein the expert's testimony in terms of "90%-probable," was held not to be "reasonable medical certainty" when originally presented at trial. Upon remand and new trial, the answer to the hypothetical was admitted when the expert omitted the percentage from his answer.

may result in the opposite conclusion based on equally unrealistic probabilities.

The problem described above is serious enough when one is faced with expert testimony from a single technical discipline. When the litigation necessarily involves the interrelationship between two or more technical disciplines, the failure to reveal the probabilistic aspect of the decision-making process compounds the felony, for now each discipline builds upon the conclusions of the other, using unrealistic probability levels in support of the other discipline's conclusions.[26] Unless the synthesizing process is completely and coherently revealed in the courtroom the jury may indulge in a process of evaluating the expert testimony, probably by half-believing some of the opinion and discarding the rest.[27] The juries are then left to *their own devices* in conjuring up a scientific theory of the case which lies somewhere in between the theory of the plaintiff's expert and the theory of the defendant's expert. The assumption of this process is that the truth rests somewhere between 0 per cent and 100 per cent credibility and the jury exercises the normal evaluative role that it accomplishes when it evaluates key testimony. This assumption must be resisted as inaccurate in cases involving expert testimony. The function of the expert is to evaluate the close case and bring *his evaluative sense* to difficult fact

26. The myraid problems arising from expert testimony which is based on the opinion of other experts has been explored in great depth in the literature. *See* Maguire & Hahesy, *Requisite Proof of Basis for Exprt Opinion*, 5 VAND. L. REV. 432 (1952); Rheingold, *The Basis of Medical Testimony*, 15 VAND. L. REV. 473 (1962). The problem discussed herein presupposes that the second expert opinion will be admissible.

27. Much criticism exists of the current practice of using the medical expert to set forth an opinion without permitting him to substantiate it by also setting forth all information the expert himself feels had had a bearing on his ultimate conclusions. The within plea to allow the technical consultant in products cases to place before the jury not only the opinion but also the evaluative balancings of evidentiary facts against technical expertise through which that opinion had been formulated joins the plea of the medical expert in this regard:

> In all instances, the expert should be allowed to tell the court exactly how he reached his opinion and what were the sources of information . . . to describe in fairly precise terms his own process of evaluating his source material . . . . What information did he reject and which accepted . . . what did he place great weight on, and what did he minimize? . . . and why he evaluated the clinical material in these ways.

Louisell & Diamond, *The Psychiatrist as Expert Witness: Some Ruminations and Speculations*, 63 MICH. L. REV. 1330, 1354 (1964).

The controversy over admitting the bases for medico-psychiatric opinions, however, may be more founded on the fact that some of the medical diagnoses rest upon evidence itself inadmissible as hearsay, rather than a failure by the attorney to recognize its value as measured by increased jury understanding as seems to be the case in products litigation to date. Regardless of the reasons currently in vogue for failing to allow the expert witness to propound the bases and reasoning processes whereby he reached his opinion, it is suggested that serious consideration be given to a full revelation of the expert's reasoning process to the jury.

situations. The jury should then choose between the *competing expert evaluations* rather than formulate its own notion of the case as an amalgam of the testimony of plaintiff's and defendant's expert. If the jury is to function with competing experts it *cannot* create its own theory of the case. Rather it should *evaluate* the competing expert evaluations and make an intelligent choice between them. This makes it all the more crucial that experts address themselves to real probabilities and to a sensitive evaluation of competing possibilities rather than to the formulation of unrealistic positions. It should be carefully noted that what is here suggested is a refinement and an enhancement of the adversary system rather than a weakening of its traditional role.

There is no question that juries are well-equipped, as the triers of fact, to evaluate *human* behavior in judging the validity of testimony. When the questions center around the *technological* behavior of a product, however, they must rely on the experts' interpretation of all of the indicator evidence. This interpretation must be comprehensive enough to reveal how the expert reaches his conclusions as well as his perception of the probable certainties and uncertainties. If not, it becomes inevitable that the jury's evaluation will remain at a superficial level and will not be capable of probing the substantive questions that must be addressed in finding an unreasonably dangerous defect or establishing causation.

Yet it must be noted that regardless of how well an expert addresses himself to real probabilities and to sensitive evaluation of competing possibilities, there remains a major question whether any layman can bring to bear the necessary evaluative sense to the litigation process where complex technological data is involved. This question must ultimately be considered and answered.

The role of the expert has been described as that of a resource, not a tool, as a co-equal partner with counsel, not as a filler of an evidentiary gap. But who is this person or persons? He must have a sufficient understanding of the law to permit his judgment of technical issues to reflect the proper perspective for advancing an opinion of unreasonably dangerous defect.[28] He must be sufficiently expert to perceive the scope of the inquiry necessary during discovery as well as in further testing and evaluating of the evidence. The expert should not only provide guidance for counsel, but where necessary he must undertake self-

28. *See* Wade, *supra* note 7.

education prior to trial in those aspects of the particular technology with which he is unfamiliar.

In pre-trial hearings, the experts should play an active role in aiding court and counsel in defining the appropriate technical issues. During the trial, apart from his direct testimony, he should "second-chair" counsel and thereby provide relevant insight on the development of testimony concerning product description and defect and guide the direction and content of the cross-examination of the opposing expert.

This then is the expert, as defined by his role. Regarding the qualifications the expert must possess in order to be identified as such, this research group is now at work with a committee of the National Society of Professional Engineers to establish more definitive guidelines to aid the technologist as well as the court and counsel in recognizing and qualifying the expert. This problem is a crucial one in the products liability area since the range of expertise is so very broad. It runs the gamut from the garage mechanic to the highly learned academician. While this entire spectrum of experts can contribute effectively to the litigation process, the broad band of potential expertise is so unlike the very narrow range of expert qualifications to which we are accustomed in the medical area that we must be concerned with the appropriateness of the expert to speak the issues.[29] It is clear that guidelines for technical experts must be drawn so as to distinguish their particular skills from those of other types of experts as well as to indicate how these skills are to be characterized. Thus the focus is not only on credentials and experience qualifications, but also on developing a method for determining the appropriate expertise to speak to a particular issue.

In addition we have recognized a serious absence of standards for the gathering, preservation, control, physical examination, and testing of physical evidence as well as standardized formats for experts' reporting of the indicator evidence. It is no exaggeration to say that the deficiencies in these areas have been scandalous. A committee on the technical aspects of product liability has been established under the auspices of the American Society for Testing and Materials for the purpose of developing the consensus standards necessary to alleviate these ills. It is strongly contended, however, that the procedures for legal qualification of experts and the evaluation of technical evidence should occur prior to trial, during the pre-trial hearing, so as to establish the appropriate-

29. Korn, *supra* note 3, at 1094-97.

ness of the experts *and* the appropriateness of their testimony in focusing on the issues to be litigated.

It is *not* a valid premise to assume that the ills engendered by an improper expert witness in the courtroom are eliminated or obviated by skillful cross-examination. The real danger of cross-examination of the improper witness lies in diverting the attention of the jury from the real issues of the case into a morass of technical minutiae that may cause their evaluative sense to focus more naturally on the plaintiff's injury or other areas not directly relevant to the presence or absence of defect in the product.

The cross-examination, however, of the appropriate expert, who has been permitted to describe his observations of the physical evidence and tests, who has related the facts surrounding the incident, and who has bared the process of synthesis which led to his conclusions, will at once be more critical and more effective in revealing the expert's capacity and ability for evaluation. It is precisely this reasoning process that must be exposed to the finder of fact if strict liability litigation is to respond to the proper posture of technology.

Judge and Jury in a Products Case

The central concerns for the proper adjudication of a question in strict liability have been shown to be the comprehensive examination of the behavior of the product within its environment and the role of the expert, which is not only expanded in scope but is made more consistent with the technological decision-making process. The problem of defining a mechanism to implement this shift in orientation must now be confronted. Whatever the degree of acceptance such a suggestion of re-focusing may gain in theory, however, there follows the determinative question of defining an implementation mechanism which will effectuate the change. It cannot be expected that acquiescence to these proposed major shifts will follow upon identification of a newly recognized adjudication question. The element of the subconscious, even instinctive, reaction of the experienced trial lawyer will militate against an easy transition.

Let us make it clear at the outset that we foresee that the strong guidance of the trial judge will be indispensable to execution, on an individual case basis, of our suggested shift in orientation. A higher degree of judicial intervention, at pre-determined stages, respecting established points of controversy would be completely consistent with the role of the judge as a neutral toward the litigating parties. Such higher visibility and responsibility of the bench in products litigation, as opposed to its responsibility in other civil actions, need not and would not be at the expense of any responsibility borne by counsel on either side of the controversy.

The enhanced role of the trial judge may be played largely within the framework of established judicial authority. The pre-trial conference presents the preeminent opportunity to establish the product and its environment as the focal point of litigation. It is then that plaintiff's counsel could be compelled to elect his cause of action. The accepted procedure of drafting the complaint so as to encompass claims sounding in negligence, warranty, and strict liability may be defensible at the preliminary stages of litigation; it is *not* defensible at the stage of evidentiary presentations to the jury. The presentation of various inconsistent and partially contradictory theories of recovery, with corresponding evidence in support of each, must serve to confound even the most conscientious juryman.[30] The confusion of the theories fosters an overall aura of defect which may make it difficult to establish a prima facie case on any of these theories standing alone. If we are to ask the jury to *focus upon product behavior,* the trial judge quite properly adopts and *applies* a procedure which substantially contains the area of admissible evidence to that which is ultimately responsive to the *issue of product behavior.* The jury should neither be expected nor asked to sort out a grab bag of evidence, discarding that which is not germane to product behavior and retaining the remainder for later consideration and evaluation.

The pre-trial conference also affords the trial judge an opportunity to evaluate the expert in the context of his personal background, his anticipated role in this litigation, and the scope of his testimony. Altogether too much emphasis has been placed on the presence or absence of paper credentials as the sole determinant of an expert's qualifications. A judicial pre-trial determination thus serves both to assure a minimum level of evidentiary presentation and avoidance of irrelevant but potentially misleading foundation testimony. Further, to the extent that the necessary qualification of the expert is established in conjunction with a statement of the nature and degree of supporting evidence upon which the experts' opinion will be brought to bear, the court will be afforded

30. *Id.* at 1083-85.

an opportunity to judge the general and specific capacity of the witness to offer probative evidence and to conclusively pass upon this expert's capacity to testify on this particular matter.

As indicated earlier, we are attempting to formulate guidelines for evaluating an expert's ability to speak to the litigated issues. The mechanisms by which this evaluation can be undertaken are diverse. While in many instances the court may have the capacity to make these judgments without outside aid, in other cases the complexity of both the issues and the requisite expertise may suggest the need for a technical arm to the court. Although the utility of technical aides to the court has been the subject of much discussion,[31] this question will be examined from a different perspective. Our particular focus will be threefold:

1) To match the expert with the technical issues in the litigation.
2) To aid the court in defining the precise technical issues to be litigated.
3) To establish minimal levels of evidence, both physical and theoretical, for the technical indicia necessary to prove the cause of action.

Judicial activism also will be called for in making the difficult determination regarding the propriety of admitting evidence which has been ill-preserved or which has been produced through improper testing procedures which have virtually destroyed the sample itself. In many instances the compounding of what is at best a difficult technical issue by requiring its resolution with physical evidence that has been compromised may result in resolving an issue by sheer speculation.

There are flagrant inadequacies in the present system for control of evidence. Steps should be taken by which the judiciary becomes the agency for controlling the integrity of the real evidence. This may require post-accident intervention by the judicial system to secure the evidence. In certain kinds of cases where institutional defendants (*e.g.*, industrial) are involved this might be accomplished with relative ease; and in other kinds of cases the involvement of the law (*e.g.*, police accident investigation) may provide an appropriate agency for interven-

31. Suggested "neutral expert" procedures, whereby the problems inherent in the use of the adversarial expert witness might be obviated, have included the following: specialized juries composed only of experts in the particular technical area to be litigated; use of the expert as an "aide to the court" who advises the judge on technological matters with no duties of testimony at trial; and use of a court-appointed expert who has duties at trial identical to those of the experts called by the adversaries. *Id.* at 1083.

tion. When there has been evidence deterioration, however, it may be necessary for the court to utilize its own staff of experts to inform it as to the meaningfulness of litigation given such deteriorated real evidence. The charade of trying complex cases based on physical evidence in an advanced state of deterioration is a waste of judicial time and contributes little to the advancement of justice.

In those cases where a party has treated evidence in so cavalier a manner as to destroy his opponent's opportunity to conduct his own critical evaluations, an exclusionary ruling by the trial judge would serve to maintain a fair and proper balance between litigants. Such determinations by trial judges, over a period of time, would lead to the acceptance of techniques and standards of evidence preservation which would give promise of a higher quality of litigation.

The trial judge who has been apprised of the nature of the product and the defects alleged will be in a position at each stage of the trial to compel parties to focus upon the central questions of *product description* within its environment and the allegedly deficient *aspects* of that product which would permit a conclusion of "legal" defect. The likelihood that the trial court will be ruling blindly, or nearly so, upon evidentiary questions at a premature stage of the trial's development is therefore substantially reduced.

A highly structured and fully developed pre-trial proceeding which accomplishes the goals set forth above can result only if the parties are forced to sharply define the issues and the method of proof as they see them prior to the pre-trial hearing. Whatever method is utilized by the court to accomplish the goals of qualifying the experts and evaluating the issues and the evidence, they cannot be accomplished in the context of loose and vague commitments by the parties to their theories of the case.

At the inception of the trial, the judge will have been provided with a basis for a preliminary instruction to the jury of the nature and range of the matters to which the jury will bring its evaluative sense. The pretrial activities will have cleared away the irrelevancies of alternative bases of liability and will have sharply defined within the structure of strict liability the particular premise of the instant action. The judge therefore may outline the legal principles of strict liability within the framework of the kind of suit about to be presented.

Finally, we recognize that in establishing standards for experts and minimal levels for testing and evaluation of evidence, we are touching upon a very difficult problem. It is common knowledge that the level of expertise and expert investigation varies according to recovery expectation. It is also clear that many cases in which the anticipated level of recovery is low the technological problems can be as substantial and financially demanding as those with a high recovery expectation. These cases today are often tried in a totally inadequate fashion. There is usually tacit acquiescence between the parties which realistically controls the expenditures of expert time and effort regarding the matter to be litigated. The proposals we have set forth would challenge the litigation of cases below a certain minimum level of competence. Since the quality of experts and testing would be required to meet a given standard, the implications of such a conclusion are rather clear. Where the litigation process is not economically feasible, thought must be given to alternative systems for the resolution of conflicts.

Conclusions

The sociological system that has had the greatest impact on man's interaction with his society is the legal system. And that aspect of the legal system that deals with the interaction of society with technology —products liability—provides a model for viewing the importance of the technologist's role in understanding and providing expert guidance for the further developments of technology as well as for the legal system itself.

It is evident that we are in an era of transition. Our society and our government are both sensitized to the necessity of enhancing the safety of industry's wares. The new federal agencies for both occupational safety and product safety, together with the literally hundreds of independent consumer groups, are ample evidence of society's concern for a safer interaction with technology. Out of this ferment will undoubtedly emerge a plethora of guidelines, standards, and codes designed to establish a framework for the production of safer products.

It might well appear that the emergence of these mechanisms of governmental and private regulation may attenuate the role of the legal system as the determinant forum for legal liability and economic responsibility. In fact, these mechanisms, apart from the legal system, afford an incomplete basis for adjudication of legal and economic responsibility. Their function is to develop new levels of manufacturer awareness and consumer acceptability. However, it is ultimately only the courts of law which will determine whether these new levels, externally established, are the appropriate criteria for the determination of legal and economic liability in the private sector.[32]

To be explicit, federal and state agencies are now in the process of developing standards for both consumer and industrial product safety. The civil lawsuit in products liability stands ready to accomplish an important function in determining the validity of the standards established. When agency standards are brought to the courts in the context of a product liability suit, the courts will be forced to pass on the adequacy of governmental standards in deciding the issue of unreasonable danger. Thus, in passing on the adequacy of product design a court is free, in a civil suit, to establish a standard either more exacting or less onerous than the governmental standard.

This power exercised by the courts in a civil lawsuit can provide to society independent and objective evaluations of the quality of the standards and ultimately the overall direction of government regulation. The product will be exposed in its actual use and environment and be subjected to the evaluation of experts in the context of a real controversy. Consequently, it appears certain that the legal system will be presented with early and insistent opportunities to employ the criteria for product safety as crucial elements in the adjudicating process. The frequent recourse which will be made to these standards as indicators rather than determinants in the judicial forum gives promise of a constant refinement of these mechanisms in response to the stringent testing to which they are to be ultimately subjected in the adjudicatory process.

32. The Consumer Product Safety Act, 15 U.S.C. §§ 2051-81 (1970), has as its purpose the protection of the consuming public against unreasonable risks of injury and the development of uniform safety standards against which a manufacturer's product may be tested. Criminal and civil penalties may be invoked by the government against a manufacturer who fails to comply with the duties and standards promulgated under sections 2069-70 of the Act. The Act also provides that any consumer who sustains injury by reason of a manufacturer's or retailer's knowing violation of a requirement of the Act may bring suit in federal court for damages (section 2072). It is expressly provided that the latter remedy under the Act is *"in addition to"* and not "in lieu of" any other common law remedy or right conferred under state or federal laws. It is also provided that a product's compliance with the requirements of the Act shall not relieve the manufacturer or retailer from liability he may have at common law or under state or federal statute, nor shall the failure of the Product Safety Commission to designate the product as a substantial product hazard or ban it in its entirety be admissible in evidence at any litigation (section 2074). Thus it can be seen that although the Consumer Product Safety Act has taken solid steps to ensure the protection of the consuming public, it is not a panacea for all ills arising from hazardous products. Courts of law must of necessity formulate their decisions in the great majority of cases before them, wherein the alleged defective products are not touched by the standards of the Consumer Product Safety Act, using the 402A standards of defect and unreasonable danger.

However, the additional precision which would seem to be the inevitable consequence of these developments in the technological field pose a challenge of fundamental seriousness to the litigation system. If that system is capable of absorbing this input so as to more accurately gage the point of legal liability, litigation of private claims will remain a central testing area of societal needs.

On the other hand, the failure to understand and employ these mechanisms in a meaningful way in the litigation process will render the private claim lawsuit an anomaly, without relevance to the questions supposedly central to the issue of legal liability.

One cannot expect state and federal agencies to respond to judicial criticism of inadequate or overly harsh standards when the thrust of the civil lawsuit designed to establish standards is erratic and not primarily focused on evaluating the product in its environment in order to establish defect and unreasonable danger. Another result of such a fossilization will necessarily be the conversion of a strict liability test into an absolute liability test, with a showing of injury being the only issue in dispute. Such a liability standard can have only a minimal effect on industry standards. Finally, if this is the direction in which society chooses to move, that choice should be made as between possible alternatives rather than one foisted upon it by the unresponsive nature of a litigation system. We believe that the legal system *is* inherently capable of such adaptation as will demonstrate its viability as a central forum of determination of society's needs.

We believe, however, that there are serious problems extant in the form and substance of products liability litigation. It appears that some of these problems have arisen from the attempt to fit the new theory of strict liability into the old framework of negligence litigation. The problems which we have uncovered would seem to be serious enough, if not solved, to prevent the legal system from being responsive to the new demands being placed upon it by society. We therefore suggest that these problems and their solutions must be addressed in order to permit the legal system to function effectively as society's arbiter.