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LAW AND SCIENCE: MARRIAGE, DIVORCE OR MERETRICIOUS RELATIONSHIP?

Leo A. Huard*

I. INTRODUCTION

We live in the age of science—not simply an age of science, nor a scientific age, but the age of science. Science, its products and its gadgets, plays a controlling part in our daily lives. Our comfort, at home and at work, is assured by air conditioning. Our food is augmented and supplemented by vitamins and other complex chemical agents. Health is sustained by miracle drugs and a variety of biochemical marvels. We travel behind jet engines in aircraft produced by highly advanced aerodynamic engineering. Our cars are pulled along by compact and fantastically powerful engines and are brought to smooth stops by marvelously efficient brakes. We pollute the air with the gases exhausted by all these machines and then we set up air pollution control agencies to devise ways and means to purify it again. The examples of “science-in-daily-life” could continue for many pages.

The pervasive influence of science extends also to war and annihilation. A great deal of our military planning depends upon computer science. Nuclear bombs have made infinite our capacity for destruction. Our military scientists are refining nerve gases capable of incapacitating whole populations swiftly, silently, without warning. Bacteriological warfare, capable of making water supplies lethal and foodstuffs poisonous, can now be waged.

Today’s man in the street is expected to achieve some understanding of the meaning of “orbiting” the earth and of rockets with multi-million pounds of “thrust”—even though he had trouble comprehending the law of gravity when he was in school. Our newspapers and magazines, radio and television (two important scientific products in themselves) constantly assail the eye and the ear with stories of the race to the moon, Telstar, development of food for use on years long-rocket trips, nuclear electric power versus conventional electric power, the benefits and the ills of radiation and sundry other technological advances.

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He must know enough about these phenomena to choose intelligently the men who will represent him in the state and federal government. Those selected must, in turn, be able to assess the relative importance of many scientific programs since they must approve or disapprove of these programs and provide for their budgetary needs.

It is not strange that in an atmosphere saturated with the things of science, the opinions and the judgments of men of science have acquired a very great importance. It is somewhat unsettling that these opinions and judgments are often uncritically accepted in fields far beyond the area of their competence.

The law has not been immune from this incursion by science. Some measure of the penetration of scientific methodology into law is the fact that an entire recent issue of a highly respected law review is devoted to a symposium on Jurimetrics—defined as "the scientific investigation of legal problems." One article therein is entitled: "Simultaneous Equations and Boolean Algebra in the Analysis of Judicial Decisions." I wonder how many lawyers are really prepared to meet the challenge expressed by this title. I am not! Of the authors in the symposium, five have the LL.B. degree, six have not, and another is best identified as a Soviet law professor.

In this paper, I propose to examine the impact of science and technology upon our legal institutions. That is to say, I would like to discuss the application of the investigative procedure called the scientific method to law and explore the utility of scientific theory in law. The other branch of my inquiry will be directed to the use of the machines of science in the practice of law, i.e., computers and mechanical search devices. My emphasis throughout will be on the physical sciences and coverage of the social sciences will be incidental.

This formidable task could only be completed in a very long article. The reader is asked to attribute all deficiencies to limitations of time and space.

II. SCIENTIFIC METHOD, THEORY AND CONCEPTS

My daughter's high school biology textbook describes the scientific method as involving the following steps: 1. defining a problem; 2. formulating a hypothesis to explain the problem; 3.

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1 28 LAW & CONTEMP. PROB. 1-270 (1963).
2 Id. at 1, Foreword.
planning and carrying out experiments to prove or disprove the hypothesis; 4. recording and evaluating the facts observed; and, 5. drawing conclusions from these observed facts and explaining the problem in their light. This seems clear and reasonably easy for the lay mind to grasp. It should provide a sufficiently basic starting point for a consideration of science by lawyers. The description also seems to be accurate since it is repeated in substance in a recent, much more sophisticated publication advocating the application of the method to a study of the judicial process.

The goal of the scientific method is the accumulation of knowledge and it is admirably suited to this purpose. However, the goal of the lawyer and the judge, of the legal process and the judicial process is not always knowledge. Sometimes it is truth, or justice or law—and these are not always, perhaps not often, identical to knowledge. They usually contain something more than mere knowledge, something beyond and above knowledge! Truth, law and justice are not even always identical to one another. The law cannot always be equated with justice and truth. Justice may be tempered with mercy and thus become more perfect; truth, if it could be so tempered would cease to be truth. These concepts are foreign to the scientific method. The lawyer and the court are often engaged in a search for something beyond factual data or information. Scientists seem not to understand this search and they tend to deride its importance.

If these distinctions are kept in mind, the scientific method can be very useful to the lawyer and the judge. Wherever their goal is the ascertaining of information, the scientific method is a very efficient tool, perhaps the best. It should not be cast aside simply because it comes to us from another discipline. Beyond specific use in fact gathering, the scientific method encourages the orderly organization of data and logical progression from one bit of factual evidence to another. These qualities are valuable in any discipline and are obviously valuable to the lawyer in many areas of law practice.

The scientific method has often been given a more generalized meaning, when applied to law, than the narrow "natural science" meaning we have attached to it here. Patterson has said that it sometimes means "any legal theory that bases at least its instrumental evaluations on some observable facts," and he includes in

this category, the "scientific ethical relativism" of Arnold Brecht—a curious mélange of natural law and science-oriented thought.\(^7\) Professor Patterson combines strict scientific inquiry and the looser techniques described in the quotation above under the term "legal empiricism."\(^8\)

Does this mean that there is already a scientific jurisprudence? Certainly Patterson's slim volume and Brecht's bulkier work can hardly make such an ambitious claim. In a recent article, Walter Berns describes Beutel's *Some Potentialities of Experimental Jurisprudence as a New Branch of Social Science* (1957) as "the principal work of scientific jurisprudence in our day"\(^9\) and then tears it apart unmercifully. Time and space do not permit defending Beutel's thesis even if one were so inclined, and sympathetic to it! Sufficient to say that the existence of this work is in itself an indication of the impact of science on law—as is Berns' article and the symposium in which it appears.\(^10\) Beutel espouses a science-oriented jurisprudence and Berns cautions against it saying:

... a grasp of the fundamental problems might reveal that there is an irresolvable tension between science ... and politics, and that any attempt to resolve the tension is likely to have terrible consequences in the political world; that the political world must be ruled not by science but by prudence.\(^11\)

Lawyers and judges, the legal process and the judicial process, are all a part and parcel of the political world.

Under any definition or description, the scientific method and scientific thought should be given a place in the lawyer's bag of skills. Great care must be exercised, however, not to accept science unreservedly nor apply it broadside to legal and political problems. The concepts of science cannot always be applied profitably to legal questions. It has been said that the "unanswerable questions of life belong to the realm of philosophy, and jurisprudence is the philosophy of law."\(^12\) Scientific questions can be answered, at least partially, by doing something and observing the result. Scientific answers can be found in the laboratory. The answers of jurisprudence are often only speculation, preference or faith.\(^13\) Legal thinking and

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\(^8\) See note 6, supra, at 48.


\(^11\) See note 9, supra, at 212.


\(^13\) See note 10. Law is tied to philosophy and history, rather than to natural
the scientific approach to problem solving differ in many important respects. Six such differences have been isolated by a recent investigator.

1. Scientific approaches tend to emphasize the general. Law tends to stress the unique, particular aspects of a case.
2. The hard core of legal thinking is not in terms of means and ends. Science deals in causal and functional relationships.
3. Legal thinking takes a normative view of truth—certain kinds of probable truth demand stronger proof than others. This view of truth is alien to science.
4. Legal thinking is oriented to the past rather than the future—to what has happened rather than to what will happen. Science relies much less on the past.
5. Law is a comparison process and science is not.
6. Legal thinking demands that rights and duties be present or absent. Thus the courts are frequently prevented from reaching compromise solutions.  

We began, some time ago, with a basic, almost elemental, definition of the scientific method. We explored its utility in law and found it useful. We moved to the possibility of a scientific jurisprudence and found this unlikely—at least if jurisprudence implies a comprehensive system of legal philosophy. We move on again.

Does science qua science deserve a more important role in forming the legal and political thought of this nation? Should policy making in law and government depend in considerable measure on scientific method, scientific theory and scientific concepts? Perhaps not. A very distinguished scientist has publicly doubted the value of scientific education for a public affairs career.

To claim that the study of science is the best education for young men who aspire to become impartial analysts of human affairs is to put forward a very dubious educational hypothesis at best. Indeed, those who contend that the habits of thought and the point of view of the scientist as a scientist can be transferred with advantage to other human activities have hard work documenting their proposition. Only an occasional brave man will be found nowadays to claim that the so-called scientific method is applicable to the solution of almost all the problems of daily life in the modern world.  


14 Aubert, Researches in the Sociology of Law, 7 AM. BEHAVIORAL SCIENTIST 16, 17 (1963). Professor Aubert is not a "common-law" lawyer.

15 CONANT, ON UNDERSTANDING SCIENCE 10 (1947). The book is based on the Terry Lectures delivered at Yale University by Dr. Conant in 1946.
These words were spoken some 18 years ago and they may sound strange to those who have become accustomed to the cult of science which has developed since that time. Today, in the era of Moonshot and Mohole, it is heresy to doubt the man of science. He is infallible even in fields outside of his specialty. We have swallowed whole the notion that men of science have been divinely touched with a special sort of wisdom. The President, the Congress, masses of bureaucrats and millions of John and Jane Does listen respectfully while scientists explain the theory and technology of sending a rocket to the moon or of digging a hole into the bowels of the earth. This is at it should be! They continue to listen with respect and belief while the scientist goes on to pontificate about the desirability of maintaining an all-out nuclear striking force and whether this nation should wage war against Cuba or not. This is nonsense! As Dr. Conant points out, scientific education is not particularly good training upon which to base value judgments on matters of public policy. The businessman, the accountant, the lawyer and the dentist are every bit as competent, and sometimes much more competent than the scientist to formulate such judgments. Yet, they kow-tow slavishly to these panjandrum of science.

Our policy-making machinery is in danger of being taken over by scientists and science has become the principal Establishment in our national political system. A special breed of scientist, the scientist-manager, continues to extend his influence in government and industry and he now poses a grave threat to our political community. Scientists are gradually merging into technicians and the two are becoming indistinguishable. Formerly the scientist pursued truth for its own sake and the technician was concerned with the usefulness or fitness of his work. It may be that this distinction is blurring and that, in many fields, the scientist has lost his neutrality.

Even the vaunted detachment of scientific inquiry and the emotional stability of the scientist have been challenged—and by one of the breed, not an outsider. Dr. Conant, once a distinguished chemist, asks:

18 Id. at 5. See also, Stover, The Government of Science 17, 24 (1962). A Report to the Center for the Study of Democratic Institutions; See also, Waterman, Science in the Service of Man, 19 Bull. Atomic Scientists 3 (May 1963).
19 CONANT, note 15 supra, at 5-7.
Would it be too much to say that in the natural sciences today the given social environment has made it very easy for even an emotionally unstable person to be exact and impartial in his laboratory? The traditions he inherits, his instruments, the high degree of specialization, the crowd of witnesses that surrounds him...these all exert pressures that make impartiality on matters of his science almost automatic. Let him deviate from the rigorous role of impartial experimenter or observer at his peril; he knows all too well what a fool So-and-so made of himself by blindly sticking to a set of observations or a theory now clearly recognized to be in error. But once he closes the laboratory door behind him, he can indulge his fancy all he pleases and perhaps with all the less restraint because he is now free from the imposed discipline of his calling. One would not be surprised, therefore, if as regards matters beyond their professional competence laboratory workers were a little less impartial and self-restrained than other men, though my own observations lead me to conclude that as human beings scientific investigators are statistically distributed over the whole spectrum of human folly and wisdom much as other men.20

It might be wise to force the chairman of every legislative committee, before whom a scientist is to testify, to read the above quotation before the testimony is heard. At worst, it plants the seed of a very important doubt; at best, it reduces the scientist from omnipotence to humanity. Dr. Conant was speaking of the natural scientist but Professor Patterson has accused the social scientist of a similar lack of neutrality.21

It has remained, however, for a non-scientific academician-cum-foundation director and scholar to mount the most vigorous attack against science and scientists in the political world. Robert M. Hutchins, President, Fund for the Republic, has said:

I wish at the outset to repudiate C. P. Snow, who intimates in one of his books that scientists should be entrusted with the world because they are a little bit better than other people. My view, based on long and painful observation, is that professors are somewhat worse than other people, and that scientists are somewhat worse than other professors. Let me demonstrate that these propositions are self-evidently true.

The foundation of morality in our society is a desire to protect one's reputation. A professor's reputation depends entirely upon his books and his articles in learned journals. The narrower the field in which a man must tell the truth, the wider is the area in which he is free to lie. This is one of the advantages of specialization. C. P. Snow was right about the morality of the man of science within his profession. There have been very few scientific frauds. This is because a scientist would be a fool to commit a scientific fraud when he can commit frauds

20 Id. at 7-8. See also Patterson, supra note 6, at 36-37, the superiority of judicial impartiality over that of natural scientists in political pronouncements.
21 Patterson, supra note 6, at 44-46.
every day on his wife, his associates, the president of his university, and the grocer. Administrators, politicians (not campaigning), and butchers are all likely to be more virtuous than professors, not because they want to be, but because they have to.22

The next time the reader is tempted to accept blindly the philosophical, political, sociological or legal ukases of a Nobel laureate in biology, chemistry or physics, he should read the above. The reader is then free to believe the scientist’s pronunciamento or to accept it as one item of evidence in the totality of testimony on the subject, and, hopefully, to make up his mind by bringing his own learning and experience to bear upon all the evidence.

There seems to be opinion of substance that the thinking of scientists and the concepts of science are not particularly useful outside of science itself. Scientific infallibility, scientific detachment and emotional stability take on the aspect of myths. The “political”23 scientist is omnipresent and heard on every subject.

When scientists enter politics, whether as officials or advisors, they inevitably carry with them the authority of the scientific community. Often this is simply granted; sometimes the impression is deliberately sought. In either case, if the authority is not to be a sham, destroying the integrity of both politics and science, the scientist and his professional community must take responsibility for its wide use. The individual scientist must make his own position clear and identify the voice with which he speaks. The scientific community must establish its own identity, clarify its role and responsibilities, and develop sound policy positions. On scientific questions, its voice should be heard through its most learned members. On questions of public policy affecting the welfare of science and the general society, the voice should be carried by responsible scientific leaders empowered to represent the conclusions of the scientific community arrived at through representative and deliberative councils.

Some efforts in this direction have already been made through the specialized associations of scientists. . . . Groups explicitly committed to participation in the political process . . . have been valuable on many occasions. Yet it is doubtful that any of these efforts has gone far enough in fulfilling the responsibilities of the scientific community to maintain the integrity of science and guarantee that its contributions to public policy are sound. Men of science must give more thoughtful


23 The adjective “political” is used in this sarcastic sense by Michael, Science, Scientists and Politics 6, 7 (1963). For political expressions by prominent scientists see, Szilard, Are We on the Road to War, 18 BULL. ATOMIC SCIENTISTS 23 (April 1962); Glass, Scientists in Politics, 18 BULL. ATOMIC SCIENTISTS 2 (May 1962); Sponsler, Needed: Scientists on Top, 18 BULL. ATOMIC SCIENTISTS 17 (June 1962); Rabinowitch, After Cuba: Two Lessons, 19 BULL. ATOMIC SCIENTISTS 2 (Feb. 1963).
attention to their professional responsibilities if they are to help make a good world.24

Men of law have a duty to test the soundness of scientific thinking and concepts before accepting them into legal thought and theory. All men must bring a healthy skepticism to bear on scientific opinion in order to prevent an unhealthy bias from being imposed on our political institutions.

III. THE MACHINES OF SCIENCE IN LAW PRACTICE

We turn now to the effect that the gadgetry of science is having, and will have, on the practice of law. Every lawyer must do some research, no matter how humble and pedestrian his practice may be. Reference must be made to decided judicial cases, ordinances, statutes, administrative rules and regulations and the decisions of administrative agencies at the municipal, state and federal levels. In practice we are completely dependent on stored information; we are the slaves of the printed word.

In the years since his graduation from law school, the average lawyer has watched with awe as law libraries grew all about him. He has reacted with helpless perplexity to the demands of his own practice for ever more printed materials. It is doubtful, however, whether the members of the profession have fully realized the proportions of the informational dilemma which confronts them.

From 1658 to 1879, a period of 221 years, the reported American cases numbered about 407,000. From 1879 to 1932, a period of fifty-three years, they numbered about 1,121,000. Approximately to equal this latter figure, it has taken only the twenty-nine years since 1932. In quantity alone, therefore, the volume of reported case law has increased at a strongly accelerating rate. Although this is hardly surprising in view of the increases in population, it shows how greatly the aggregate fund of case law available for legal research has increased.25

These figures enumerate the case law only. The Federal Register alone publishes about 15,000 pages of rules, regulations and orders annually. Think for a moment of the avalanche of judicial and administrative material also produced in the states, particularly populous states such as California and New York.

25 Dickerson, Electronic Computers and the Practical Lawyer, 14 J. LEGAL ED. 485, 486 (1962). See also, Eldridge and Dennis, The Computer as a Tool for Legal Research, 28 LAW & CONTEMP. PROB. 78 (1963). Ibid. All literature may soon be legal. The authors also coin a term I cannot resist—"cosmoprudence."
In defense against this unmanageable bulk of information, the lawyer has tended to specialize. This is, of course, an incomplete answer—for one thing, not all lawyers can specialize. A better answer would be to devise ways and means of making the stored information easily accessible. If the lawyer can devote less time to research, and other routine tasks, he will have more time to make the professional judgments for which his clients hire him. By eliminating the physical work of searching the indexes and digests, he will gain more “thinking” time. This is highly desirable both from the lawyer’s viewpoint and that of his clients.

Science and technology have come to the help of the lawyer in this quandary. Mechanical and electronic means have been devised to store and retrieve all manner of data. At the annual meeting of the American Bar Association in San Francisco, August 4-9, 1962, many of these storage and retrieval systems were demonstrated. The program prepared by the association’s Special Committee on Electronic Data Retrieval lists: (a) Computer Indexing, Storage and Retrieval (for statutory law, case law and public law); (b) Specialized Computer Applications (case prediction, estate planning, Keyword in context index); and, (c) Manual Indexing Aids (Project Lawsearch and Port-a-Punch Cards). All this indicates a fairly advanced state of the art.

In the area of computer indexing, storage and retrieval, the demonstrations included the work of John F. Horty and his associates at the Health Law Center, University of Pittsburgh. Mr. Horty has stored on tape in a computer the entire text of the Pennsylvania statutes, some 31,000 sections with over 6,000,000 words. This stored information can be retrieved on command, in the form of a verbatim “print-out” of statutory sections. Professor Robert Wilson, Research Director of the Southwestern Legal Foundation has applied the Horty system (called Key-Word-in-Combination) to case law—specifically to the arbitration cases of five states. Professor John Lyons of the Graduate School of Public Law, George Washington University, is similarly engaged in determining the feasibility of using computers as legal research tools in the field of public law.

26 Electronic and Mechanical Aids to Legal Research and Problem Solving, Special Committee on Electronic Data Retrieval, Annual Meeting American Bar Association, August 4-9, 1962.

27 Horty’s work has been described in many places. For a good recent discussion, see, Loevinger, Jurimetrics: The Methodology of Legal Inquiry, 28 Law & Contemp. Prob. 5, 10-13 (1963); see also, Eldridge and Dennis, The Computer as a Tool for Legal Research, id. at 78, 87-89.

28 Eldridge and Dennis, supra note 27, at 89-90; Maas, Research Help is Coming, 38 J. State Bar of Calif. 405, 409-410 (1963).
The manual indexing aids are much less dramatic than the computers. These systems are specifically designed for law office or law library use by individual researchers. They consist basically of indexing relevant legal materials on cards which can then be sorted out quickly because they are notched or punched for that purpose.29

By far the most interesting and most controversial of the scientific aids to the lawyer is the use of computers in predicting the outcome of cases. The idea that a machine can predict how a court will decide a particular case strikes the average lawyer as almost sacrilegious. Nevertheless, this is precisely the thesis advanced by two learned and courageous men—Fred Kort and Reed C. Lawlor. Professor Kort is a political scientist and Mr. Lawlor is a patent attorney.30 Both have done a great deal of work in an effort to prove that judicial decisions are susceptible to mathematical prediction. Mr. Lawlor has given many demonstrations of this art (skill?) at bar association meetings and other professional gatherings. As a witness and participant in one of these demonstrations,31 I can testify that Mr. Lawlor's results produce a distinct feeling of unease. As an unbeliever, however, I am constrained to admit that his results are impressive! It is the law's great loss that we cannot now have the benefit of Mr. Justice Holmes' opinion of the work of Professor Kort and Mr. Lawlor in view of Holmes' expressed confidence in the importance of science in law.32 How would that great champion of the common law react to science in such ample measure?

The theory proposed by Professor Kort and Mr. Lawlor is much more detailed and complex than we have been able to indicate here. We hope that we have not done them an injustice by giving the impression that they have advanced a sketchy, ill-considered theory.

29 Maas, supra note 28, at 406-408; see also, Dickerson, supra note 25, at 491-493.
31 The occasion was a “Seminar on Use of Electronic Computers for Legal Research” in San Jose, California, May 24 and 25, 1963. The seminar was sponsored by the Santa Clara County Bar Association. Among the participating organizations: San Jose State College, University of Santa Clara Law School, Stanford University Law School, University of California Law School (Berkeley).
32 HOLMES, Law in Science and Science in Law, in COLLECTED LEGAL PAPERS 210, 242 (1920).
Far from it, they have brought learning and serious consideration to the problem of prediction of judicial decisions by mathematical and electronic means. We would be remiss, however, if we did not draw attention to the vigor of the opposition to the Kort-Lawlor prediction theory.

The most forceful and indignant critic of the theory that judicial decisions are electronically predictable is Frederick Bernays Wiener. In fact, Mr. Wiener is distinctly dubious of the utility of the computer even as a research tool. Frederick Bernays Wiener is a scholarly, extremely competent lawyer who has for many years specialized in appellate practice. It seems fair to say that the following quotation expresses his views concerning electronics and the law.

In the opinion of the present writer, for reasons about to be set forth, the notion that a computer can predict the course of judicial decision rests on assumptions that are demonstrably untenable, does violence to the very nature of law, and is moreover certain to blunt the professional techniques of any lawyer who relies on machines rather than on his own powers of reasoning and advocacy. All this will no doubt be obvious to most American Bar Association members. But the intensity, indeed fervor, with which the computer proponents put their case suggests that, here also, "we need education in the obvious more than investigation of the obscure."

Mr. Wiener's criticisms may seem intemperate to some but they are grounded in firm conviction and based upon broad professional experience. Others have expressed somewhat more moderate views. All in all, it seems clear that Messrs. Kort and Lawlor are suffering the vicissitudes common to pioneers: lack of appreciation (at best); and, opprobrium (at worst).

Even at this early day in the application of computer science

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83 Mr. Wiener is the author of a highly regarded work on appellate law practice. WIENER, EFFECTIVE APPELLATE ADVOCACY (1950). He is also a frequent contributor to legal periodicals.


85 Mr. Lawlor seems to feel that the ascendancy of science-machines has frightened some lawyers. Lawlor, What Computers Can Do: Analysis and Prediction of Judicial Decisions, 49 A.B.A.J. 337 (1963). For this proposition, he cites Dickerson, Some Jurisprudential Implications of Electronic Data Processing, 28 LAW & CONTEMP. PROB. 53 (1963). Professor Dickerson is critical but it seems an exaggeration to say that he is frightened by the incursions of science into law. However, he does spell out the fears and the worries of many lawyers at the increasing use of computers in law and law practice. See also, Spengler, Machine-Made Justice: Some Implications, 28 LAW & CONTEMP. PROB. 36 (1963). It should be noted that Professor Spengler is in agreement with some of Wiener's arguments, 28 LAW & CONTEMP. PROB. 36, 52 note 37.
to law there have been some eminently practical legal questions raised concerning their use. For instance, computers store records and the introduction of records into court is a vital and necessary part of litigation. Without records available for use at trial, the trial lawyer often would be helpless. The records of the computer are stored on punched cards, tapes and wires. Are these susceptible to the subpoena power? How would the best evidence rule, the hearsay rule and the shopbook rule apply to “records” of this kind? Is computer evidence expert testimony?

The lawyer must also ask himself: Who is custodian of these records—the programmer, the machine operator, the system designer? It does not require extra-sensory perception to foresee great difficulty for the lawyer attempting to explain the basis for the admissibility of the “print-out” from a computer.

Of more than passing interest in the computer field are the problems which may develop in the law of torts. In the field of latent defects, it is likely that the basic law as set forth in McPherson v. Buick [sic] will be unchanged. However, the assessment of liability against the responsible party will be made doubly difficult. One example will serve to illustrate this point. Not long ago a new type aircraft crashed, resulting in considerable loss of life. The cause of the crash was determined to be a defective wing strut, which had been designed by the use of a computer. The question has now arisen as to what extent liability may be assessed against an aircraft manufacturer as the users of the computer, against both the computer manufacturer and the aircraft manufacturer because the program analyst and the console operator acted as agents for both, and against the computer manufacturer for a failure of the computer due to faulty manufacture.

What would Cardozo’s luminous intellect do with these questions? Obviously, the issues raised in the above quotation will be multiplied a hundredfold, a thousandfold as the use of computers increases. What should we do to meet this challenge of computer science? Are we really discharging our professional responsibilities in this area? If not, what does professional duty require?

IV. SCIENCE AND THE GOVERNMENT CONTRACT

At the beginning of this paper, we proposed to discuss science and technology as they touched upon law and legal institutions.

86 At common-law only documents could be subpoenaed; under the federal rules, however, “tangible objects” may be subpoenaed. FED. R. CIV. P. 45(b).
88 Ibid.
89 Douglass note 37, supra, at 141-142.
40 For other practical applications of computers having legal significance, see,
The subject now at hand is perhaps not strictly true to this dichotomy. Herein I would speak of the long-time influence of the federal government on science and the more recent phenomenon of the government contract, in some respects a means by which science influences the federal government.

The federal government has a long history of assistance and encouragement to science and scientists. The Patent Office was created in 1790, the United States Coast Survey was established in 1807, Franklin Institute received the first grant for experimental research in 1832 and the passage of the Morrill Act and establishment of the Department of Agriculture in 1862 initiated a substantial and durable program of federal aid to science and technology.

The National Academy of Science was chartered in 1863. The National Bureau of Standards began its distinguished career in, and for, science in 1901. During World War II, a tremendous mobilization of scientific effort was effected and the Office of Scientific Research and Development emerged. After the war, the Atomic Energy Commission was created in 1946. The National Science Foundation appeared in 1950 with the responsibility for the development of a national policy to promote research and education in the sciences. Most recently, Congress put the National Aeronautics and Space Administration into operation.

President Eisenhower thought it necessary to appoint a science adviser and a Science Advisory Committee. Presidents Kennedy and Johnson have continued the practice. In recent years, proposals have frequently been advanced for a cabinet Department of Science and Technology. The march of science continues!

In 1960-1961, federal funds allocated to basic research accounted for 60% of national basic research expenditures from all sources—$1.1 billion. When such vast sums are involved, it can


45 Stover, supra note 41, at 41-44.

46 Id. at 15 (text) and 47 (note 5). Without specifying allocations to basic research, the 1965 budget message seems to continue federal generosity to science and technology generally. Atomic Energy is to receive $2.735 billions and Space Research and Technology $4.990 billions in 1965. 22 CONG. QUART. WEEKLY REPT. 138, 140 (Jan. 24, 1964).
be supposed that science loses some of its freedom of action and becomes government directed to an uncertain extent. On the other hand, when so many scientists are involved in these vast expenditures for projects important to the national security, it can scarcely be doubted that scientists have a vital impact on governmental policies.

This is "Big Science" and it is largely supported and made possible by the government contract and its handmaiden—the non-profit corporation. Within the memory of most lawyers who read this paper, the government contract was a relatively simple legal instrument used to procure supplies for the federal government. It was ignored in law schools and few lawyers ever saw one, much less negotiated one.

Now, a comparatively large group of attorneys specialize in government contract law and draw all or most of their livelihood from a law practice limited to such contracts. Many, perhaps most law schools, now have one or more courses dealing with the law of government contracts. The government contract has been used to control research and development in "basic research, systems analysis, systems engineering . . . technical direction, testing, and manufacturing."47 The government also contracts "for policy planning, management of government facilities, technical assistance activities, educational programs, and management surveys."48 This is a far cry from our earlier understanding of government procurement.

The government contract enables the federal government to accomplish many useful, desirable and expedient things which could not be performed within the normal structure of the federal government. It circumvents embarrassing problems in governmental administration, for instance, it makes it possible to pay higher salaries for government work than the civil service pay scale permits.

In essence, the government contract effects a delegation of governmental power to a private institution, which, of course, need not account to the public as an agency of government would be required to do. It has led to the development of the non-profit corporation as a vehicle for achieving governmental objectives. This phenomenon is a direct product of the era of science unknown to prior ages. The world has never seen anything like the Rand Corporation, the Institute for Defense Analyses, the Aerospace Corpora-

47 Stover, supra note 41, at 27.
48 Ibid.
tion and the Communications Satellite Corporation. These corporate entities are, in fact, camouflaged government agencies.\textsuperscript{49}

\dots in the hands of Vannevar Bush, James B. Conant, and Karl T. Compton, the government contract became a new type of federalism.

\ldots

In dollar volume, the biggest contracts are between the military services and industrial corporations; while most of this money goes for procurement, much of it goes for research and development, and for the kind of systems analysis and the direction and supervision of subcontractors that in a simpler age would have been done by the technical services of the Army and Navy. And even in the business of procurement, the contractual relation is not the traditional market affair: the contract is not let on competitive bids, the product cannot be specified, the price is not fixed, the government supplies much of the plant and capital, and the government may determine or approve the letting of subcontracts, the salaries of key executives, and a host of other managerial matters. A sizeable proportion of the government's (and nation's) business is done this way \ldots \textsuperscript{50}

This contractual system has broken down the political opposition to federal assistance more effectively than did any program of grants to the states. It has now become respectable for a state to base a substantial part of its economy on government contracts.

A great deal of private enterprise is now secreted in the interstices of government contracts. In short, what the grant-in-aid programs did to the arguments for states' rights, the new contractual systems are doing to those for pure private enterprise.\textsuperscript{51}

\textbf{V. CONCLUSION}

The scientific method is very useful in fact finding. It does not have the same success, however, when one seeks to use it as the basis for a system of jurisprudence. Science and its method are producers of knowledge not particularly well suited to making value judgments. Scientific education is not geared to turning out minds which easily grasp and correctly resolve the issues found in the legal and political world. The detachment which the scientist brings to the problems of his specialty is not often transferred to questions outside of that field.

Science can help the law and the lawyer but it must not be permitted to supplant or exclude other methods of investigation and reasoning. The lawyer must treat science as one of the many tools in his kit, a single weapon in his large arsenal. By the same token,\textsuperscript{49} \textsuperscript{Id. at 29-32.} \textsuperscript{50} Price, \textit{The Scientific Establishment}, 106 \textit{PROC. AMER. PHIL. SOC.} 235, 241-242 (1962). \textsuperscript{51} \textsuperscript{Id. at 243.}
men of law and men of politics must keep firmly in mind that in the legal-political arena, the scientist enjoys no special position of eminence. His views are worthy of belief only to the extent that he is knowledgeable on the particular legal or political issue at hand. The arrogance of the scientist speaking on non-scientific subjects should not be permitted to weaken this stand.\footnote{52}

The great technological advances of science—the ingenious machines for mechanical research and the marvelous electronic computers—have an immediate and positive value to the lawyer. They can make the task of research infinitely easier and faster. All the time-consuming physical effort of library research is eliminated. One question arises, however. If library research technique is no longer necessary to the lawyer, will the law schools teach it? If they do, will it be a required course? An elective? It seems to me that a very valuable part of the lawyer's training will vanish if "Legal Bib" is dropped from the curriculum. As a law teacher, I am almost always suspicious of devices which eliminate "routine" and save the "lawyer's time." Often the net effect is to reduce a segment of law practice to the level of a trade, to something that can be done by a clerk or secretary, without supervision or under the most casual supervision. When this happens the profession does not gain.

Prediction of judicial decisions by means of computers may be possible. It does not seem to me, however, that this adds anything to the administration of justice or to the practice of law. In the hands of the unscrupulous, it may even be dangerous. I would be surprised if this aspect of computer science ever went beyond the stage of a scientific game.

The government contract will continue to afford a substantial field of law practice. It provides a deceptively easy way for the government to carry on its business and it is likely to increase rather than to decrease. It is sometimes unhealthy in the sense that it permits the government to do something indirectly that it could not do through its usual, normal and direct procedures. The same criticism can be leveled at the governmental non-profit corporation. The government contract and the non-profit corporation also often have the effect of delegating some of the power of government to private parties who cannot be held accountable to the people or

\footnote{52} Wohlstetter, Scientists, Seers and Strategy, 41 FOREIGN AFFAIRS 466, 470-472, 475-476 (1963); Physical Scientist Thinks He's a Seer, San Jose Mercury, May 16, 1963, p. 61, col. 1; Royce Brier, Dr. Teller's Credentials, San Francisco Chronicle, Aug. 23, 1963, p. 38, col. 5.
their elected representatives. These situations bear watching by the legal profession.

It seems clear that science impinges on the law at enough points that the United States lawyer now has a duty to make a very real, very serious effort to understand science. Few lawyers have even a rudimentary education in science and this situation can no longer be permitted to endure. Law schools must begin to look for science courses in the college transcripts of applicants and to turn away those who have no science training. There must be more communication between science and technology and the practicing bar. Bar associations must sponsor "law and science" programs and "computer research" panels.

The law is not married to science, yet the two are not divorced!