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THE LAG BETWEEN SCIENTIFIC DISCOVERIES AND LEGAL PROCEDURES

Frederick K. Beutel*

Factors Encouraging the Lag Between Science and Legal Procedure

It is a generally recognized fact that law and legal procedures lag far behind any type of social change. This is true even in matters of change in social custom, religion, and habits of the people. But it seems to be far more marked when one approaches the problem of picking up scientific developments and transposing them to be used as tools in legal and governmental procedures. The reasons for the failure of the legal system immediately to adopt scientific innovations are numerous. Many of them are found in the nature of the legal system itself. Its ancient origins, written statutes and constitutions, judicial reliance upon precedent, the doctrine of stare decisis and the habit of a free legal profession to be largely occupied in the profitable business of defending the status quo, all constitute brakes on any sudden change. The machinery for change which is provided by most governments, the system of legislative law, is also not very well calculated to pick up innovations from the field of science. In America, at least, the legislature is not provided with facilities for acting on change in the law such as ministers of justice or research organizations. It depends for its information on interested pressure groups and donated time of public spirited citizens or do-gooders.

The separation of governmental functions which is supposed to be one of the basic tenets of government in this country also stands in the way of progress. Our separation of powers in the national government plus our division into states, cities, counties and myriads of local units all are likely to retard the bringing of new information into the law. When there is added to all of this the complete reliance on the democratic process which assumes that desired change will arise from an informed public and, when considered in the light of the fact that scientific data is known only to a few people and is so complicated as to be beyond the reach of the masses at large, it might be expected that it is not only difficult, but almost impossible to bring the information from the new and rapidly growing scientific revolution back into our conservative forms of government and law.

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The Ancient Origins of the Legal System. All of our legal and major governmental devices were established before the industrial and scientific revolution to govern a type of society now almost extinct. Our legal forms, customs and methods of procedure are much older than any known science and many of them have existed almost without change through the centuries. Wigmore in his panorama of the world's legal systems sets out a negotiable promissory note which meets the requirements of our modern legal system; a note which was in current use in 2100 B.C.¹ Like many of our commercial forms, the court system goes back beyond history or the discoveries of archeology.² Our own American type of procedure can be traced directly and in continuous line to the thirteenth century British courts.³ The present American system in most of its details was completely crystalized at the founding of the American colonies,⁴ and before great inventions like the steam engine,⁵ the power loom⁶ and the cotton gin⁷ could have had any social effect—to say nothing of the automatic factories, electrical and atomic energy and all the products of modern science which have appeared in the last one hundred years. The English legislative system, often called the mother of parliaments although it is a mere infant among the popular and representative legislatures of the world,⁸ was maturing in most of its details as it now appears in the American constitutions and statutes early in the Seventeenth Century⁹ and during the lifetime of Sir Francis Bacon¹⁰ who is often called the fore-runner of modern science.

Written Statutes and Constitution. The American system of government and law, based on written statutes and constitutions, is also of ancient origin. Mankind from the dawn of history has believed that fundamental legal rules could be written down for all times. The Babylonian code of Hammurabi, 2100 B.C., the Hebrew Ten Commandments, about 1200 B.C., and the Roman Twelve Tables, 400 B.C.,¹¹ are all early examples of the world habit of reducing current legal concepts to writing, endowing them with supernatural sanctions and setting them up as guides for future generations. Our own constitutions and statutes are directly descended from this age-old device of

¹ Wigmore, A Panorama of the World’s Legal Systems 69 (1928).
² Id. at 12, 73, 177, 289, 406 et seq.
³ ¹ Holdsworth, History of English Law 54 et seq. (3d ed. 1922).
⁴ See Harlow, Legislative Methods Before 1828, c.1 (1884); Atkins, Lex Parliamentaria (1748).
⁸ See ¹ Wigmore, op. cit. supra note 1, at 343; Buckland and McNair, Roman Law and Common Law 1 et seq. (1936).
⁹ Atkins, op. cit. supra note 4.
¹⁰ Bacon died in 1621.
¹¹ ¹ Wigmore, op. cit. supra note 1, at 86, 104, 374.
freezing social control to prevent change. True, we no longer rely upon the supernatural and our founding fathers wisely provided machinery for amendment and interpretation to take care of change, but it should be kept in mind that the Federal Constitution crystalized a form of government which grew out of the pre-scientific age and that the Constitution itself was reduced to its present form long before scientific discoveries had created any appreciable change in society. It should also be remembered that in practice the means provided by the fathers for change have not been particularly effective in picking up new ideas.

If there is one thing which science has demonstrated it is that there is no correlation between the age of an idea and its validity for any purpose.

Judicial Interpretation and Stare Decisis. One of the methods for change upon which most reliance has been placed in this history of our country has been the interpretative devices developed in the court system; but it should be noted that the nature of the judicial system is such that change by the process of accretion and interpretation cannot be very great. All over the world courts feel themselves bound to follow the written law, and in the Anglo-American system they suffer under a further brake upon the process of change in the doctrine of stare decisis, the great Anglo-American rule which provides that once a court has decided an issue it becomes a basic rule of law not to be changed except in the most unusual situations. This had its origin in the English system where, by historical accident, the fundamental rules of law had not been reduced to writing so the court decision was the only evidence of the law. But through professional custom it has been applied to interpretation of both legislation and constitutions, and has been one of the greatest stumbling blocks in the way of change of the law even by legislative process.

In many situations where an ancient rule of law has been specifically abolished in plain words by legislative action, the doctrine of stare decisis has again and again prevented the courts from following the clear intention of the legislature. A few examples of this tendency will suffice. In the field of commercial law the Negotiable Instruments Act adopted almost uniformly in England and in all states of the United States, provided in plain terms that credit should be value for the purpose of giving a transferee the special rights of a holder in due course, but to this day the majority of the courts in spite of the clear meaning of the Negotiable Instruments Act, following pre-statutory

\[12\] See Lynd and Lynd, Middletown c. 2 (1929); cf. Seagle, Law, The Science of Inefficiency (1952).
decisions, refuse to treat bank credit as value. In the field of constitutional law in like manner the doctrine of stare decisis has been used to cut down the growth of civil rights under the constitution of the United States. The courts first put a narrow interpretation upon the Bill of Rights holding in spite of much plain language to the contrary that it only limited the Federal Government. Then after the Civil War when the Fourteenth Amendment provided that "no state shall make or enforce any law which shall abridge the privileges and immunities of citizens of the United States," obviously referring to the first ten amendments, the courts, following the older decisions, continued to hold that the many rights set up in the first ten amendments applied only against the Federal Government, and even limited Federal enforcement of civil rights, which was specifically authorized by the Thirteenth, Fourteenth and Fifteenth Amendments. Today they are still quibbling over the question of whether freedom of speech, freedom of press, freedom of religion, the right to trial by jury and the protection against unreasonable search and seizure, among some of the "privileges and immunities of citizens of the United States," are all beyond the power of restriction by the laws of the several states.

These are only two examples of the common tendency of courts to refuse to give effect to legislative change in the rules of law.

The habit of stare decisis is so strong that it can be said almost without danger of contradiction that judicial decisions lag from thirty to one hundred years behind the intention of legislatures in adopting new statutes and rules of law. It took forty years and the affirmative vote of nineteen state legislatures before the Federal courts would recognize that the enactments of maximum hours of labor were reasonable exercises of the state police power. The same process for minimum wages took over twenty-five years more of enactments, and a similar fight. In all, it required over seventy years from the adoption of the

14 See Beutel's Brannan, Negotiable Instruments Law 498 (1948), and authorities there cited.
15 See, e.g., 2 Crosskey, Politics and the Constitution 1058 et seq. (1953); Rottschaeffer, Constitutional Law 781, 782, 785, 800, 812, 817 (1939).
16 Rottschaeffer, op. cit. supra note 15, at 446 et seq. For the true meaning of the Fourteenth Amendment and its history, see 2 Crosskey, op. cit. supra note 15, at 1083 et seq.
19 See Brandeis' brief, Muller v. Oregon, 208 U.S. 412 (1908); cf. Lochner v. New York, 198 U.S. 45 (1905); Frankfurter, Hours of Labor and Realism in Constitutional Law, 29 Harv. L. Rev. 352 (1916).
eight hour day for women statute in Wisconsin in 1867 until the
Supreme Court finally admitted that regulation of hours and pay of
labor was within due process of law. It makes little difference whether
these innovations are in the field of significant social reforms like
minimum wages and hours or, as will be shown later, whether they
are in non-controversial fields; where there has been an attempt to
adopt scientific techniques, the courts in either case usually have stood
as a road block against legislatively adopted progress.

Legislative change itself is not geared to the immediate adoption of
new ideas. Anglo-American legislatures as such have little continuity,
depending almost entirely upon the whim of public election. Con-
stituted as they were in England at the beginning of the Eighteenth
Century, our American legislatures have no independent research
equipment. They depend for their factual material almost entirely
upon public pressure which makes its appearance at the legislative
hearing and invariable forms of lobbying. This pressure is usually
from people who want something, and falls into two main categories:
those who are so pinched by social conditions that they are forced to de-
mand change, mostly for selfish ends; and those who are already ad-
versely affected by current legal regulations. As the old saying goes,
its the wheel that squeaks which gets the grease. Often this results
in anti-social forces such as gamblers, criminal elements, predatory big
business and big labor gaining control of the legislative and administra-
tive machinery which has been set up to regulate them.

There is no ministry of justice such as exists in European govern-
ments, chiefly interested in perfecting the legal system. The con-
gressional investigating committee which is supposed to take its place
is more interested in politics and sensationalism than it is in pursuit
of the truth. Most of the demand for change, even before the in-
vestigating committee, takes some sort of popular pressure which be-
cause of its nature is always far behind those innovations which would
be dictated by the discoveries of science. But even when this change
is slowly accomplished, it must be piece-meal.

22 United States v. Darby Lumber Co., 312 U.S. 100 (1941).
23 The whole doctrine of substantive due process of law is now almost dead
since the case of Nebbia v. New York, 291 U.S. 502 (1934). These cases were
simply a rationalization of the Court's opposition to reading progress into the
Fifth and Fourteen Amendments. See Holmes' dissents in Baldwin v. Missouri,
281 U.S. 586, 595 (1930); and Lochner v. New York, 198 U.S. 45, 75 (1905); 
24 Cf. Harlow, op. cit. supra note 4; Atkins, op. cit. supra note 4.
25 See Beutel, Pressure of Organized Interests on Legislation, 3 So. Calif.
L. Rev. 10 (1929).
26 See Cardozo, A Ministry of Justice, 35 Harv. L. Rev. 113 (1921). Even
to this day little has been done to implement the suggestions of this great
jurist. The so-called legislative research agencies connected with many state
The endless separation of government functions is a further impediment to change. The founding fathers had reason to be afraid of centralized government because it could be used as an instrument of irresponsible class tyranny. So they carefully prevented the centralization of power. The separation of powers within our governments and our multiple governmental system with its more than one hundred and fifty thousand units with law making power\(^2\)\(^7\) are an effective check on the adoption of new ideas. New laws of whatever nature must be put through thousands of legislative bodies before they can become effective. This requires tremendous public sentiment, all of which eventually leads us to consider the effectiveness of the so-called democratic process.

The democratic process which is supposed to control our present form of government, whatever its good features may be, is not adapted to social change involving the adoption and use of scientific ideas. The reasons are legion; only a few need to be discussed here.

The people as a whole who do the voting and form the core of the democratic power are not in direct contact with legal administration and machinery. They are only conscious of its existence at election time or when it interferes with their activities or provides them a means of getting something which they cannot otherwise attain. Therefore, most of the ideas concerning the administration of justice and the operation of the law come to the voters in a secondhand or in a round-about manner from public servants and lawyers who are in direct control of the legal machinery.

Both of these groups have a very important interest in maintaining the status quo. They are in direct control of the legal machinery and in a sense have a monopoly upon its operation. Their stock-in-trade is their knowledge of the current machinery and their ability to manipulate it to serve the purpose of their clients. Changes in methods and rules upset the tranquility of their control and make them learn new techniques, sometimes even result in their displacement by others. Failures in the operation of the legal and governmental machinery reflect directly upon lawyers and public servants, so it is in their interest to see that the status quo appears in the best light to the voters. In the case of the lawyers this has become such an obsession that even a casual visitor to a bar association meeting cannot help being impressed by the amount of oratory devoted to the glory of the legal system, the honesty of the judges, and the up-rightness of the profession.

Legislatures should not be confused with a Ministry of Justice. Most of them are mere drafting bureaus or devices for continuous committee hearings during recess.

The lawyer by the very nature of his training has his ideas deeply rooted in the past. Precedent is his most important weapon, and most of the leading lawyers represent clients who have succeeded under the present system and whose main purpose, therefore, is to preserve the status quo. It is not surprising, then, that most bar associations will be found in the forefront of the leadership of conservatism or reaction. Such information and influence as they may have on public sentiment will scarcely ever be found to move in the direction of the adoption of new ideas, especially those coming from other professions, the scientists.

Public interest at large in the adoption of changes indicated by scientific developments is very hard to develop. This is partly due to the fact that the complicated nature of our society has created many divisions of labor and interests. The average citizen is lucky if he can understand the ramifications of his own business without ever expecting to absorb the new developments of science in other fields. The nature of scientific information is so highly technical that it requires years of study to grasp its implications even in those fields which it directly affects. It is very difficult for anyone, to say nothing of the average voter, to comprehend the social result of scientific change and to foresee the usefulness of adopting scientific methods and inventions to aid in the law enforcement machinery.

Recent intelligence tests and census figures in 1950 show that of the adult population of America, eighty-seven per cent have only a high school education, or less. A further six per cent have completed college, and of the total population only forty per cent are capable of advanced scientific study. Of this latter group only one sixth or six per cent of the entire population have actually received sufficient scientific advanced training to qualify for a bachelor's degree. This last group of potential scholars is the only one that can hope to comprehend the implications of scientific developments or to construct means whereby they can be adapted to the use of the legal and governmental machinery. If, therefore, sufficient public interest is to be developed in adopting new scientific methods, it will be necessary for this small nucleus from which come the able scientists to convince the great majority to agree to types of governmental and legal devices which the overwhelming mass of people cannot even understand. Under the circumstances the development of popular pressure for adoption of scientific discoveries into the legal and governmental field, sufficient to overcome the inertia of those in control of the machinery, is difficult, if not impossible, to achieve.


The number of people granted Ph.D's in science totaled less than 4,000 in 1950, less than 6/1000 of one per cent of the population over that age. Wolfe, Intellectual Resources, 185 Sci. Am. 46 (Sept., 1951).
The newness, speed and complications of scientific developments is the last and most important factor in the lag between science and law. As measured by the age of legal institutions and procedures, the scientific method is a mere infant. With the exception of a very few administrative agencies initiated in the Twentieth Century, all of our legal agencies, procedures, and governmental devices were started and had reached full maturity before science had any impact whatsoever upon social control. This is more graphically illustrated in the introduction to Middletown, an anthropological study of a mid-west American city, published in 1929. There is described an old man living in Middletown who was born in a civilization nearer in its essentials to the year 1 A.D., than to the year 1929. During the life of this one doctor, scientific developments had completely changed the nature of life and the ways of living: ³⁰

Within the lifetime of this one man local transportation has changed from virtually the 'hoof and sail' methods in use in the time of Homer; grain has ceased to be cut in the state by thrusting the sickle into the ripened grain as in the days of Ruth and threshing done by trampling out by horses on the threshing-floor or by flail; getting a living and making a home have ceased to be conducted under one roof by the majority of the American people; education has ceased to be a luxury accessible only to the few; in his own field of medicine the X-ray, anaesthetics, asepsis, and other developments have tended to make the healing art a science; electricity, the telephone, telegraph, and radio have appeared; and the theory of evolution has shaken the theological cosmogony that had reigned for centuries.

Today, scientific advancements are being carried on at an even more accelerated pace. Figures from the patent office show that there have been twice as many inventions registered since 1907 as in the whole history of the patent office from the founding of the republic down to that time. ³¹ These inventions and discoveries are being turned back into the scientific process where each innovation breeds a myriad of other changes in scientific methods and devices. New and magic gadgets, elixirs for the cure of disease and marvelous changes in production, distribution and transportation coupled with corresponding changes in methods of living are appearing at an ever accelerated pace. Vast research organizations both private and public are operating to spend billions of dollars to accentuate this scientific change.

The Lag in the Adoption of Scientific Methods by the Legal System

In contrast to the many institutions and organizations set up to accelerate scientific change in the economic and social life of man

³⁰ Lynd and Lynd, op. cit. supra note 12, at 10.
³¹ One of the railroad block signal patents issued to Bliss in 1907 was No. 861,015. As of June, 1952, the number of issued patents had passed 2,600,000. See Annual Rep. of Comm. of Patents 6 (1951).
there are few if any bodies or organized efforts to place this vast accumulation of scientific data at the disposal of the legal system to be used for the benefit of the body politic. With all of its handicaps, it is to be expected therefore that our legal system would be slow to adapt to its uses the developments of science. Although this should be obvious from the nature of its organization, few people seem to realize the extent to which law has failed to pick up the scientific information which could be used to accomplish its purpose. A complete catalog of all the instances of this lag is impossible because it would require a collection of all scientific developments, a task beyond the grasp of any group of men or institutions. A few examples of this general tendency however will be sufficient to show the grossness of this shocking lag and to indicate its dangerous implications to the public welfare.

The most spectacular developments in government control and in the use of scientific information are in the areas where lawmaking power and sanctions, including authority to experiment, are delegated to agencies with great research potentials supported by large appropriations; but it might be interesting to examine the slowness of science in penetrating even into these fields.

Public Health Laws

One of the foremost of these advances is in the field of public health. Here there are well organized educational and research institutions for the development of scientific data, and numerous governmental bodies for promoting the adoption of scientific data for the use of the legal system. Almost every governmental unit of any general jurisdiction in this country has some kind of public health official whose duty it is to apply medical information to the maintenance of the health of the community. Most medical colleges have courses in the subject and there are even a few schools devoted entirely to the discipline of public health. But in spite of this, the instances of the lag between medical knowledge and its use in legal devices or sanctions to protect the public health are revealing and shocking. A few examples chosen from those areas where science has made great progress toward infiltrating the legal machinery will be enlightening.

Vaccination to Prevent Small-Pox is one of the oldest, most effective and widely adopted means of preserving public health. Prior to the perfection of vaccination, small-pox was one of the most deadly scourges of mankind, killing about sixty per cent of its victims, and few people escaped it.\(^{32}\)

Although the first European scientific discovery and publication on vaccination was nine years after the adoption of the American

\(^{32}\) Rehberger, Lippincott's Reference Book of Medical Science 512 (11th ed. 1940); Stedman, Reference Book of Medical Science 782 (3d ed. 1947).
Constitution, the effect of the disease was so deadly that there was immediate demand for any kind of relief. Statutes authorizing vaccination at public expense appeared in Massachusetts in 1810, only twelve years after Jenner's publication of his paper on the subject in England and ten years after the first experiments in the United States. There followed almost immediately a federal statute encouraging vaccination in cooperation with state governments desiring to use it. Vaccination was made mandatory in Massachusetts in 1855 but was not finally held constitutional by the Supreme Court of the United States until after the turn of the twentieth century at which time many states had adopted regulations similar to those of Massachusetts.

Today, although the efficiency of vaccination is proved beyond a shadow of a doubt, though every state in the Union has some method of providing the public with protection against small-pox, and while the scientific means exist for wiping the disease off the face of the earth largely through the use of quarantine and vaccination, the law lags far behind the science. There are still six states where there are statutory provisions against compulsory vaccination, some even in the face of epidemics. It would require a treatise to give even a rough summary of the laws and regulations of states and local governments bearing on the subject of small-pox control and vaccination. The laws of the several states vary all the way from those requiring compulsory vaccination of all citizens or as a prerequisite for school attendance, through various stages of administrative discretion in different fields, to those which prohibit compulsory vaccination, and three of the states which seem to have no important law on the subject. The statistical studies have been legion proving that the incidence of the disease decreases in direct proportion to the strictness of the laws or

32 Jenner, An Inquiry into the Causes and Effects of the Varioulae Vaccurae (1798); Clendening, A Source Book of Medical History 291 (1942).
34 See Clendening, op. cit. supra note 33, at 301-305.
35 2 Stat. 806 (1813).
regulations requiring vaccination. In Germany where compulsory vaccination for the army was adopted in 1845 and for civilians in 1875, the disease has practically disappeared.

Yet, in spite of all this scientific proof, there remains much active opposition to vaccination not only among the Christian Scientists and other religious sects, but by many others some of whom even masquerade under the banner of science. A recent carefully conducted public opinion poll showed that eighteen per cent of mothers regarded vaccination as "worse than the disease itself," twenty-four per cent of the people did not know or did not believe that vaccination could prevent smallpox. Even though doctors advise infant vaccination, thirty-five per cent of the mothers refused to have their children vaccinated before going to school and sixty per cent of the population said vaccination could not prevent smallpox but thought it might lessen the disease.

Although there is an encouraging tendency to delegate the regulation and enforcement of vaccination and other contagious disease controls to competent scientific bodies, this adverse public opinion, spurred by a hard core of fanatics, is resulting in the weakening of the enforcement of compulsory vaccination laws. In the six states where there are limitations on the power of the authorities to enforce vaccination, it has actually caused the repeal or watering down of the statutes. In Arizona for example, the compulsory vaccination law was repealed by popular initiative. In Utah such repeal was passed over the veto of the Governor; and in the remaining four states, the previous power of the authorities to enforce vaccination was taken away by ordinary legislative action. It would take a much wider survey than is possible here to determine whether or not vaccination laws and their enforcement as a whole are being relaxed throughout the country. But these specific instances show that popular opposition and ignorance of the scientific facts could easily reach alarming proportions.


Steadman, op. cit. supra note 44.

See Byrd, Health Instruction Yearbook 106 (1943).

Ariz. Laws (Referendum and Initiative) p. 21 (1919).

Utah Laws c. 18, p. 15 (1901); cf. State v. Bd. of Ed. of Salt Lake City, 21 Utah 401, 60 Pac. 1013 (1900).

See Minn. Laws c. 239 (1903); cf. Note, 8 Minn. L. Rev. 453 (1924). See N.D. Laws c. 236 (1919); S.D. Laws c. 223 (1903); Wash Laws c. 90, § 9 (1919). For this same tendency, see Mass. Laws c. 337 (1906), repealing in part compulsory vaccination laws.
That this situation could exist in the United States where small-pox still continues in spite of the fact that there are scientific methods for completely eradicating it calls for serious thought. Although public health authorities have been making steady progress in eliminating the disease through quarantine, compulsory statutes and persuasion, there are still many places in this country where the disease is being preserved and where the latent possibilities of epidemics are present. In Idaho and Nevada in which there are no compulsory vaccination statutes, between the years 1945 and 1950 there was one case per 100,000 of population every year. In the state of Pennsylvania as recently as 1943 there was an outbreak of the disease, brought in from outside the state, which when studied showed that all but five of the cases were among non-vaccinated persons, and of the five all of the vaccinations were over thirty years old.

In spite of the fact that science undoubtedly has the means of completely eradicating small-pox, and although this has been one of the most successful fields of the operation of public health administration, the laws of the several states are still in such a state as to preserve this deadly scourge of mankind for possible future epidemics. There is considerable evidence that the lawmakers, administrators and the public, no longer driven by the lash of the fear of epidemics are becoming more lax, thus falling farther and farther behind the scientific developments.

Fluoridation of Water to prevent dental caries is one of the recent discoveries of science and also a good example of what can be done with experimental jurisprudence.

Dentists and research scientists first began to notice the relation of mottling on the enamel of children's teeth to dental caries about 1928. Further study of this phenomena revealed that children with mottling on their teeth showed a marked absence of decay. About 1939 there was developed an hypothesis that fluorine in solution in the water supply was responsible both for mottling of teeth and reduction of dental caries. A further examination of this theory showed that there were approximately fourteen hundred communities in the United States where the public water supply contains more than a trace of fluorine compounds in solution. The percentage of such solution varies from five tenths up to five parts of fluoride compounds to a million gallons of water. As shown by Table One, a study of tooth decay in these areas proved that noticeable mottling occurred only when there were more than two parts of fluoride compounds to a million gallons of water

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52 Dean, Epidemiological Studies in the United States in Dental Caries and Fluorine 5 et seq. (1946).
### TABLE ONE

**Relationship of Dental Health to Fluoride in Drinking Water**

<table>
<thead>
<tr>
<th>Cities</th>
<th>No. of Children Examined</th>
<th><strong>No. D.M.F.</strong> Per 100 Children</th>
<th>Incidence of Permanent Teeth Enamel</th>
<th>Fluorine Content of Water p.p.m.***</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colorado Springs, Colo.</td>
<td>404</td>
<td>246</td>
<td>Slight</td>
<td>2.6</td>
</tr>
<tr>
<td>Galesburg, Ill.</td>
<td>273</td>
<td>236</td>
<td>Slight</td>
<td>1.9</td>
</tr>
<tr>
<td>Elmhurst, Ill.</td>
<td>170</td>
<td>232</td>
<td>.....</td>
<td>1.8</td>
</tr>
<tr>
<td>Joliet, Ill.</td>
<td>447</td>
<td>323</td>
<td>.....</td>
<td>1.3</td>
</tr>
<tr>
<td>East Moline, Ill.</td>
<td>152</td>
<td>303</td>
<td>Borderline</td>
<td>1.2</td>
</tr>
<tr>
<td>Aurora, Ill.</td>
<td>635</td>
<td>281</td>
<td>.....</td>
<td>1.2</td>
</tr>
<tr>
<td>Maywood, Ill.</td>
<td>171</td>
<td>258</td>
<td>.....</td>
<td>1.2</td>
</tr>
<tr>
<td>Kewanee, Ill.</td>
<td>123</td>
<td>343</td>
<td>.....</td>
<td>0.9</td>
</tr>
<tr>
<td>Pueblo, Colo.</td>
<td>614</td>
<td>412</td>
<td>Negative</td>
<td>0.6</td>
</tr>
<tr>
<td>Elgin, Ill.</td>
<td>403</td>
<td>444</td>
<td>.....</td>
<td>0.5</td>
</tr>
<tr>
<td>Marion, Ohio</td>
<td>263</td>
<td>556</td>
<td>.....</td>
<td>0.4</td>
</tr>
<tr>
<td>Lima, Ohio</td>
<td>454</td>
<td>652</td>
<td>.....</td>
<td>0.3</td>
</tr>
<tr>
<td>Middletown, Ohio</td>
<td>370</td>
<td>703</td>
<td>.....</td>
<td>0.2</td>
</tr>
<tr>
<td>Zanesville, Ohio</td>
<td>450</td>
<td>733</td>
<td>Negative</td>
<td>0.2</td>
</tr>
<tr>
<td>Quincy, Ill.</td>
<td>330</td>
<td>706</td>
<td>.....</td>
<td>0.1</td>
</tr>
<tr>
<td>Portsmouth, Ohio</td>
<td>469</td>
<td>772</td>
<td>.....</td>
<td>0.1</td>
</tr>
<tr>
<td>Elkart, Ind.</td>
<td>278</td>
<td>823</td>
<td>.....</td>
<td>0.1</td>
</tr>
<tr>
<td>Michigan City, Ind.</td>
<td>236</td>
<td>1037</td>
<td>.....</td>
<td>0.1</td>
</tr>
<tr>
<td>Evanston, Ill.</td>
<td>256</td>
<td>673</td>
<td>.....</td>
<td>0.0</td>
</tr>
<tr>
<td>Oak Park, Ill.</td>
<td>329</td>
<td>772</td>
<td>.....</td>
<td>0.0</td>
</tr>
<tr>
<td>Waukegan, Ill.</td>
<td>423</td>
<td>810</td>
<td>.....</td>
<td>0.0</td>
</tr>
</tbody>
</table>

*The children examined were of the 12 to 14 year age group all of whom had lived in that particular locality all of the time.

**D.M.F. per 100 means the number of decayed, missing or filled permanent teeth per 100 children examined.

***p.p.m. means parts of fluoride to million parts of water.

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but was almost entirely absent when the percentage of solution was below that amount.\(^53\) An actual study of the decay of children's teeth set out in Table One in the various cities where there was a natural water supply containing fluorides showed that where there was about 1.2 parts of fluoride compound in solution in a million gallons of water there was no mottling on teeth and that the number of decayed teeth was at the lowest in these areas.\(^54\) A comparison of the cities of Madison, Wisconsin, and Colorado Springs, Colorado, set out in Tables Two and Three, shows that the advantage of fluorine content extends to all age groups. There was over six times as much damage from decay per person in Madison where fluorides were absent from the water as in Colorado Springs which contained more than the optimum

\(^{53}\) For the geographic distribution of these areas see Am. Dent. Ass'n Infor. Bull. 2 (May, 1952).

\(^{54}\) Cf. Carr, Dentistry, An Agency of Health Service 157 et seq. (1946), and authorities there cited.
# TABLE TWO

Comparative Loss of Teeth and Dental Decay Experience

<table>
<thead>
<tr>
<th>Ages</th>
<th>High Fluoride</th>
<th>Low Fluoride</th>
<th>Number Examined</th>
<th>Number with No decay</th>
<th>Decayed and Filled Teeth</th>
<th>Extracted Teeth</th>
<th>Average Number of Permanent Teeth Per Person</th>
<th>Average Number of Extracted Teeth Per Person</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-14</td>
<td>479</td>
<td>848</td>
<td>294</td>
<td>500</td>
<td>481</td>
<td>45</td>
<td>1.10</td>
<td>0.09</td>
</tr>
<tr>
<td>15-19</td>
<td>372</td>
<td>310</td>
<td>161</td>
<td>360</td>
<td>690</td>
<td>73</td>
<td>2.05</td>
<td>0.20</td>
</tr>
<tr>
<td>20-24</td>
<td>108</td>
<td>265</td>
<td>36</td>
<td>469</td>
<td>259</td>
<td>13</td>
<td>2.51</td>
<td>0.12</td>
</tr>
<tr>
<td>25-29</td>
<td>95</td>
<td>174</td>
<td>20</td>
<td>230</td>
<td>367</td>
<td>19</td>
<td>4.01</td>
<td>0.20</td>
</tr>
<tr>
<td>30-34</td>
<td>54</td>
<td>117</td>
<td>11</td>
<td>169</td>
<td>204</td>
<td>21</td>
<td>4.16</td>
<td>0.39</td>
</tr>
<tr>
<td>35-39</td>
<td>43</td>
<td>115</td>
<td>8</td>
<td>144</td>
<td>162</td>
<td>17</td>
<td>4.17</td>
<td>0.39</td>
</tr>
<tr>
<td>40 &amp; over</td>
<td>78</td>
<td>300</td>
<td>10</td>
<td>271</td>
<td>452</td>
<td>54</td>
<td>6.49</td>
<td>0.70</td>
</tr>
</tbody>
</table>

Six times as much decay experienced per person
Five times as many extracted teeth per person

Six times as much decay experienced per person
Seven times as many extracted teeth per person

Seven times as much decay experienced per person
Twenty-three times as many extracted teeth per person

Four times as much decay experienced per person
Twenty-four times as many extracted teeth per person

Five times as much decay experienced per person
Fourteen times as many extracted teeth per person

Five times as much decay experienced per person
Nineteen times as many extracted teeth per person

Three times as much decay experienced per person
Seventeen times as many extracted teeth per person

(Third Molars Excluded)

* All Causes.

Frederick S. McKay, D.D.S. 
John G. Frisch, D.D.S.
Colorado Springs, Colorado October 1949
Madison, Wisconsin

Nebraska State Department of Health
Division of Dental Health
Comparison of the Resistance to Dental Caries Between Colorado Springs, Colorado, with fluorine of 2.6 p.p.m. and Madison, Wisconsin, with less than 0.05 p.p.m. of fluorine.

<table>
<thead>
<tr>
<th>Ages</th>
<th>Average *DMF Permanent Teeth Per Person</th>
<th>Average Number of Permanent Teeth Extracted Per Person</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-14</td>
<td>Madison 7.1</td>
<td>Colorado Springs 1.1</td>
</tr>
<tr>
<td>15-19</td>
<td>12.9</td>
<td>2.1</td>
</tr>
<tr>
<td>20-24</td>
<td>17.6</td>
<td>2.5</td>
</tr>
<tr>
<td>25-29</td>
<td>18.3</td>
<td>4.0</td>
</tr>
<tr>
<td>30-34</td>
<td>20.1</td>
<td>4.2</td>
</tr>
<tr>
<td>35-39</td>
<td>19.9</td>
<td>4.2</td>
</tr>
<tr>
<td>40 and over</td>
<td>21.3</td>
<td>6.4</td>
</tr>
</tbody>
</table>

* D.M.F. means Decayed, Missing or Filled Permanent teeth per person.

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amount. After these discoveries in 1943, there was a suggestion by Dean, one of the principal research scientists in the field, to the American Water Works Association that fluoride compounds be added to the water of certain cities for the purpose of improving the structure of the teeth of the population.\(^5\)

Controlled experiments, as suggested by Dean, by adding fluorides to the water supply have been made in a number of widely scattered states, among others in Wisconsin, New York, Michigan, Texas and Idaho. Before and after studies of the condition of children's teeth and comparison of decay, both in the cities where the experiments were conducted and in controlled cities operating under like circumstances except for the addition of fluorides to the water, shows that the percentage of caries-free teeth in children increased from fifty to three-hundred per cent and the number of decayed or missing teeth dropped from twenty-three to sixty-five per cent due to the addition of fluorine compounds to the water.\(^6\) The charts set out in Figures 1 and 2 indicate graphically a rough summary of all these experiments compiled by the American Dental Association.\(^7\)

As a result of these operations combining dental research with experiments in the laws governing the operation of water works by authorizing the addition of fluoride compounds to the water, it has


Percentage of first permanent molars free of decay among children residing in city after water supplies were fluoridated and those living in nearby city with fluoride-free water.

**FIGURE 1**

<table>
<thead>
<tr>
<th>Year</th>
<th>Fluoridation City</th>
<th>Control City</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st year</td>
<td>60%</td>
<td>55%</td>
</tr>
<tr>
<td>2nd year</td>
<td>75%</td>
<td>65%</td>
</tr>
<tr>
<td>3rd year</td>
<td>80%</td>
<td>70%</td>
</tr>
<tr>
<td>4th year</td>
<td>85%</td>
<td>75%</td>
</tr>
</tbody>
</table>

50% 55% 60% 65% 70% 75%

**FIGURE 2**

Non-Fluoride City ***** DECAYED, MISSING AND FILLED TEETH per child in typical city with water supply containing 1.2 parts per million fluoride and a city with fluoride-free water.

<table>
<thead>
<tr>
<th>Age</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>(5)</td>
<td>**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(6)</td>
<td>***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(7)</td>
<td>*****</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(9)</td>
<td>****</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(10)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(11)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(12)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


been determined that the best procedure to reduce decay in teeth is to create a percentage of approximately one and two tenths parts of fluorides to a million gallons of water. This program is now unqualifiedly recommended by the American Dental Association and by numerous scientific societies, not only in the field of dentistry, but in medicine, nursing, and many allied professions. Among these are: Am. Dental Ass'n; Am. Medical Ass'n; Am. Water Works Ass'n; Am. Pub. Health Ass'n; National Research Council; United States
that proper fluoridation of public water supplies ultimately will decrease dental caries about sixty-five per cent, and the scientific literature supporting this conclusion is legion.59

The opposition to fluoridation comes, as in the case of small-pox, from religious sects, a few doctors who talk about socialized medicine and socialism, and from miscellaneous other groups. Many objections have been raised of dangers from fluoridation including some twenty-five or thirty arguments, among others that it creates brittle bones, increases cancer, heart disease and the like.60 Each of these allegations has been carefully checked in communities where fluoride compounds exist in the water and have been found to be absolutely baseless. There it no proof that fluoridation of water is harmful in any fashion and overwhelming evidence exists that it is a tremendous boon to the health of the teeth of both children and adults in the areas where it is now in use.

The cost of fluoridation is very low. The actual experience of a number of cities shows that the cost of installing and maintaining a proper fluoridation system runs from three to twelve cents a year per capita.61 Thus, the expense of a lifetime of fluoridation of water, which would produce an expected reduction of about two-thirds in the dental caries of the citizens drinking the water, would be less than the average cost to each person of one visit to a dentist. Fluoridation can accomplish an immense improvement in individual health and a tremendous savings in dental bills. The supply of soluble fluorides to be used in water is adequate. Fool proof machinery for creating proper solutions has been invented.62 So there seems to be every reason why public water works should be subjected to a fluoridation treatment.

The legal machinery for adopting fluoridation, like that for controlling smallpox is in widely divergent conditions. Laws providing for public water works were passed long before modern chemistry devised means for artificial purification either by fluoridation, chlorina-
tion, or any other similar process. In fact, the process of creating a community water supply goes back as far as people have lived together in cities and towns.

The control of public water supply in America today is vested by law in a number of various governing bodies. In some instances public water supply is provided by private corporations under the control of public service commissions or private corporations holding franchises with municipal authorities or both. In other instances the water supply is created and managed directly by municipal authorities set up by state law which provides for different governmental units of control in cities of different classifications throughout the state. Power to add chemicals to the water may rest with the city councils, water commissioners, or local health officers but in almost all instances approval of the state board of health is necessary before final action can be taken. Thus, the initiation of such a program may rest with appointed officials, city councils or in some instances it must be determined by popular referendum subject to approval of the state board of health.

Boards of health themselves are also a recent phenomenon found on national, state, and local levels. Most of them came into the law after the Civil War. The National Board of Health, now the Public Health Service, was started in 1879, and offers valuable advice in the field both of purification and fluoridation of water. Most states have some centralized public health authority which makes rules and regulations for the water supply of the entire state, but many have statutes providing that city councils and health bodies are more or less independent of the state centralized authority.

A distinction must be drawn between purification of water, such as chlorination, and the addition of certain valuable solids to the water of which fluoridation is an excellent example.

Chlorination of public water supplies started in about 1910 and many statutes passed since that time specifically provide for purification processes. But since fluoridation is not a purification process, a number of legal technicalities stand in the way of any movement for adding fluorides to the water. There are questions of legal authority

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64 See Wis. Stat. § 66.071 et seq. (1947).
67 20 Stat. 484 (1879).
70 See statutes cited supra note 65.
to add chemicals to water for other purposes than purification. Also there is the difficulty of divided authority. The problem of initiating fluoridation thus may involve convincing public health authorities, city councils, appointed officials, the electorate, or a combination of two or more of these groups. Where the public health authorities have the power to initiate the decision, which seems to be normal in Ontario but which is an exception in the United States, the movement for fluoridation has been quick and easy because the scientific value of the process has been completely established and the average public health official is well versed in the science of his trade.

The problem of convincing city councils and the electorate is much more difficult. Progress along these lines over the last nine years seems to have been fairly rapid. According to the American Dental Association, which is actively pushing the movement for fluoridation in cooperation with United States and state public health officials, four hundred twenty-three communities covering thirty-five million people have instituted or are about to institute fluoridation. This seems like a sizable number; but when there is added to it the two and one half million people who drink water fluoridated by nature, the total still represents less than fifty-three per cent of the population being supplied by public water systems and only eleven per cent of the cities and towns which will have to give approval before a fluoridation program is uniformly adopted, as science shows it clearly should be. Thus it will be seen that a tremendous amount of propaganda is necessary to overcome public inertia and opposition in this field.

A recent Gallop poll shows that only fifty-six per cent of the public have even heard of fluoridation and that three-fifths of these or only thirty-five per cent of the whole favor it; that four per cent of the population oppose and the rest have no opinion on the subject.

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74 In 1933 over eighty-five per cent of the urban population was supplied with purified water systems. Am. Water Works Ass'n, Census of Municipal Water Plants 26 (1933). The urban population of the United States is now about eighty-eight million, U.S. Census, Prelim. Count (1950).
75 In 1933 there were 3,015 purification systems in the United States. Am. Water Works Census, supra note 74, at 28. The number today is much larger. The American Dental Association estimates that there are 16,747 public water supplies in America, 45 J. Am. Dent. Ass'n 556 (1952). There are 6300 communities with public water supply of which over 5,000 have less than the optimum of fluorides, Am. Dent. Ass'n, Fluoridation in the Prevention of Dental Caries (1951). If these figures be used, then the percentage drops to eight per cent, but if the later figure of 16,747 public water systems given by the Journal be used, the percentage is only three.
Therefore, those desiring action where public sentiment is required face an inertia of ignorance in about sixty per cent of the population. The extent of this obstacle has been shown by the fact that twenty-three out of forty-five cities where there have been popular referenda, have voted down fluoridation of the water supply. A striking example of this difficulty occurred in the city of Seattle. Due to the fact that its water supply is almost pure snow and rain water, it has one of the worst instances of dental caries in the United States. But in spite of this condition, the public voted two to one against fluoridation in a recent referendum. The governing bodies of seventeen cities have also voted against fluoridation. This makes the total population of communities where there have been rejections over two million four hundred thousand, including such other great cities as New Orleans, Minneapolis, and Memphis. Many of the others are refusing to act simply due to inertia. In spite of the fact that both science and experimental jurisprudence have demonstrated the value of fluoridation, and even though it is supported by practically all the organized scientific bodies in the country, this inertia remains a block to progress. Here again, the adoption of scientific protective measures for the benefit of the health of the entire community is being hampered by the fact that our legal system has placed the initial decisions in the hands of the people in the community who are least qualified to resolve the issue. Again legal action lags far behind the results of science.

*Milk Purification* is another field in which experimental jurisprudence has made great progress.

The United States Public Health Service, since the turn of the century, has been studying the science of pasteurization and sanitation of milk, its relation to disease and the effect of statutes and ordinances upon the incidence of milk-born epidemics. As part of this study, in cooperation with local governments, they have developed a standard milk ordinance and code. The latest figures show that as of 1950 it had been adopted in fifty-five cities with a population over one hundred thousand, in thirty-eight with a population between fifty and one hundred thousand, and in fourteen hundred municipalities. It covers over eight hundred and eighty counties scattered throughout thirty-eight states. There are also thirty-two states which have adopted statutes on the subject with partial coverage and thirteen which are completely covered. In all, fifty-nine million people are receiving the benefit of the law.

77 Life, March 24, 1952, p. 42.
79 The figures on acceptances and rejections are from Phair and Driscol, The Status of Fluoridation Programs, 45 J. Am. Dent. Ass'n 555 (1952).
TABLE FOUR
Adoption of United States Public Health Milk Ordinance, Progress Chart

<table>
<thead>
<tr>
<th></th>
<th>Adopted or Covered</th>
<th>Total</th>
<th>Per cent not Covered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Population</td>
<td>59,000,000</td>
<td>150,000,000</td>
<td>60</td>
</tr>
<tr>
<td>Urban Population</td>
<td>59,000,000</td>
<td>88,000,000</td>
<td>33</td>
</tr>
<tr>
<td>Cities over 100,000</td>
<td>55</td>
<td>106*</td>
<td>48</td>
</tr>
<tr>
<td>Cities 50,000-100,000</td>
<td>38</td>
<td>125*</td>
<td>61</td>
</tr>
<tr>
<td>Counties</td>
<td>887</td>
<td>3,050*</td>
<td>70</td>
</tr>
</tbody>
</table>

1 Taken from F.S.A., Pub. Health Serv. Release (Nov. 1950).

This is a very impressive showing; but as indicated by Table Four there are approximately ninety-one million, or sixty per cent of the population, who are not receiving this benefit. While it is doubtful if all the population could ever be covered, there still remains much to be desired. Table Four shows that a third of the urban population, forty-eight per cent of the cities over one-hundred thousand and sixty-one per cent of those between fifty and one hundred thousand, and the population of seventy per cent of the counties of the country are not subject to the law. There are over seventy-six cities in the United States without any requirement of pasteurization, and it should be noted that in the first nine months of 1950, six counties and twenty-three municipalities with a population of over two hundred thousand people repealed the ordinance. This is the greatest number that have dropped it in any one year since its original adoption.81

Disregarding the quality of enforcement, in spite of a half century of experimental scientific work and over twenty-five years of experimental study behind the statute, this unquestionably excellent and scientifically sound law is still only about fifty per cent enacted. According to the last figures, it is just slightly better than holding its own with the local legislative bodies.

Public Safety

The enforcement of public safety stands on middle ground in so far as research and institutions are available for collecting scientific material and transferring it into the legal system. In areas of traffic control, the technique, research, education and government experimentation have reached a degree of perfection. The apprehension, punishment and control of the criminal population in some areas is on its way to much scientific exploitation; in others it has scarcely progressed beyond the middle ages. There has been some government action but little thorough experimentation. In all, the lag between scientific knowledge and its use in the legal system is apparent.

81 F.S.A. Release, supra note 80.
Traffic Control is a field where the methods of experimental jurisprudence have made startling advances.\textsuperscript{82} Here there has emerged a complete experimental social science in which the institutionally trained traffic engineer becomes the person to whom law making power is most effectively delegated. Under such a system the progress of traffic control and safety measures have been phenomenal. Twenty-five percent of the cities over one hundred thousand population have delegated the law making power to experts,\textsuperscript{83} but it is significant that the remaining seventy-five percent have not. On the state level there is no unified legal control. In approximately half of the states the department of highway control or its equivalent has power to conduct research and make statistical studies and recommendations,\textsuperscript{84} but in the other half such a department is little more than a police unit with some additional record keeping duties. In almost all the states the power to change the law remains with the state legislatures or local bodies, and except for one-fourth of the larger cities noted above, there is little delegation to experts, who normally serve only in an "advisory" capacity.

The net result of the traffic system as a whole shows a shocking failure to live up to the potentialities of modern scientific knowledge. Traffic deaths and injuries in the United States during the first two years of the Korean war were much greater than the American casualties at the front. There have been over three times as many deaths and twenty-five times as many injuries in traffic as there were on the battlefield.\textsuperscript{85} The accumulation of accidental deaths during little more than fifty years of use of automobiles has been over a million, which is greater than all the deaths from war in this country since 1776.\textsuperscript{86} But in spite of these appalling facts which are being spectacularly exposed by the Federal Government through the National Safety Council, over three-fourths of our legal system as it affects traffic still limps along failing to adopt the proven measures which the science of traffic control offers to reduce this slaughter.

The Problem of Crime Control easily breaks down into three areas, crime detection, the law and methods of punishment, and crime prevention.

\textsuperscript{82} Beutel, Traffic Control as Experimental Jurisprudence in Action, 31 Neb. L. Rev. 349 (1952).

\textsuperscript{83} Smith and LeCraw, Speed Laws and Enforcement, Traffic Q. 117, 121 (April, 1947).


\textsuperscript{85} Deaths from traffic accidents in the last two years have run over 76,000 and injuries over 2,300,000; Accident Facts, Nat'l Safety Council F.S.A. (1950-51); Econ. Almanac 30 (1951-52). The casualty figures from Korea at the end of two years fighting were approximately 110,000, of whom less than 20,000 were killed; see 112 Facts on File 149 (1952).

\textsuperscript{86} The Millionth Man, 59 Scholastic 10 (1951).
In crime detection there has been considerable progress in bringing science to bear upon the problem of identifying criminals. Due to pioneering work at the University of California, Northwestern University and in the laboratory of the Federal Bureau of Investigation, the apprehension of individual criminals has now taken on many of the aspects of an applied science. Most of this development, however, is quite recent.

Crime detection methods which use scientific information are well publicized. Knowledge of finger print identification and some other similar scientific devices appear far back into the nineteenth century. But serious and widespread official adoption of these and other scientific methods for crime detection date from the creation of the Federal Bureau of Investigation's Laboratory in 1932. At that time the Federal Government, building upon the pioneering work of some universities and a few city police departments, began the central laboratory which has grown until it now employs over three hundred scientists in many fields to aid in the detection of crime. This central bureau now offers national services to police departments to identify criminals, soil, fabrics, paint, auto headlights, tire tracks and thousands of other clues. Over twelve thousand local police departments have called upon this service in a single year and as many as seven thousand criminal suspects have been apprehended yearly through the central finger print office, which now contains nearly one hundred million individual prints classified so that any one may be identified from a sample in a few minutes.

The Laboratory is limited to the application of scientific technique for the solution of crimes and identifying criminals. There is no direct research into the success of the methods themselves as is the case in traffic studies, and there are no scientific tests of the social effect of criminal law. There is a section which collects criminal statistics but these are used largely for propaganda effect upon Congress and others to sustain the large appropriation necessary to operate the whole Bureau. The validity of the figures so produced for scientific purposes is subject to serious question.

The National Police Academy, which is also a branch of the F.B.I. is devoted primarily to training police officers and not to scientific

87 The Federal Bureau of Criminal Identification was started in 1904. Lowenthal, The Federal Bureau of Investigation 360 et seq. (1950).
88 Lowenthal, op. cit. supra note 87, at 386; Floherty, Inside the F.B.I. 47 et seq. (1943).
89 Floherty, op. cit. supra note 88, at 49.
90 Floherty, op. cit. supra note 88, at 88.
91 For an example of this sort of propaganda see Collins, The F.B.I. in Peace and War (1943).
92 Lowenthal, op. cit. supra note 87, at 395 et seq.
93 Floherty, op. cit. supra note 88, at 187.
research. The phenomenal progress of the Laboratory and the Police Academy together with the work of universities like Northwestern, which trains police officers and prosecutors, has raised the art of the law enforcement officer to the status of a profession.  

There is still a tremendous lag between the applied science so developed and the level of knowledge of police forces generally. Although there is considerable doubt about it, the F.B.I. itself is generally recognized as a highly trained professional organization, but it constitutes less than eight per cent of the national police force. Some of the large cities like New York, Philadelphia, Chicago and Cincinnati have excellent scientific identification laboratories and police schools as do many of the states. But the local sheriffs, city, town and county police forces are still elected or dependent upon politics for their position. Although crime detection is adopting scientific gadgets and methods, the majority of enforcement officers are still non-professional and there is no experimental science in the field beyond that produced in the crime detection laboratories. Even this information has not yet become a tool of the majority of law enforcement officers.

Conduct of the Coroner's Office is an example of the almost complete failure of modern scientific methods to penetrate our legal institutions. Since the twelfth century it has been the duty of the coroner to hold inquests into unexpected deaths and otherwise to assist the sheriff in the execution of the criminal law. Originally the coroner, who was a layman, impaneled a jury, also of laymen, to aid him in finding the facts surrounding unexpected or unexplained deaths, to bring in verdicts and to initiate criminal charges or investigations. In the absence of medical knowledge characteristic of those times, this method was as good as any for getting at the facts. But since the development of the science and art of pathology, it is foolish to charge either a single layman or a jury of laymen with such duties.

The books are full of startling cases where crimes have been missed or innocent people convicted by failure of un-trained officials properly to examine into the cause of death. It is now common knowledge

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94 Cf. O'Hara and Osterberg, An Introduction to Criminalistics (1949).
95 This controversy is discussed at length by Lowenthal, op. cit. supra note 87.
96 Figures are hard to get and this estimate is probably too large. Cf. Lowenthal, op. cit. supra note 87, at 1, 397; 6 Floherty, op. cit. supra note 88, at 18.
97 Soderman and O'Connell, Modern Criminal Investigations (1945).
98 1 Holdsworth, History of English Law 82 et seq. (3d ed. 1922) (The coroner originally had many other duties; but many of these have gradually disappeared.).
99 A few of these are: The Coroner's Office, Efficiency Series, Rep. No. 2. Municipal Ass'n of Cleveland (1912); Adler, Medical Science and Criminal Justice, Part V, Cleveland Survey of Criminal Justice in Cleveland (1921); Wickersham, Should the Coroner's Office be Abolished, 1 Minn. L. Rev. 197 (1917); Breyfogle, The Laws of Missouri, Relating to Inquests and Coroners,
that pathological examinations are the only sure and scientific method of uncovering all of the causes or nature of unexplained deaths.

In light of these well-known facts, one might expect that the duties and procedures of the coroner would have been revised to keep up with the development of modern medicine. Unfortunately, the state of the law is just the opposite. In thirty-nine of the forty-eight states,\textsuperscript{100} the coroner is still a layman, usually elected but sometimes appointed. He continues to hold inquests over the dead much as he did in the twelfth century and to impanel juries to determine the cause of deaths as he did then.\textsuperscript{101} In only nine states is there any state-wide requirement that the coroner or an official performing his duties have any medical training or assistance.\textsuperscript{102} In two of these \textsuperscript{103} the medical man is merely an aid to a layman; in one he is required to be a professional man only if a physician is available for the purpose;\textsuperscript{104} in five he must


\textsuperscript{101} In twenty-seven of the states cited supra note 100 there seems to be clear authority to hire medical assistance or witnesses; see Jackson, The Law of Cadavers 171 (1950).


\textsuperscript{104} Connecticut and Rhode Island statutes, supra note 102.

\textsuperscript{104} Louisiana statute, supra note 102.
be a licensed physician; but in only two is there any mandatory provision for the services of a trained pathologist. Maryland is the lone state requiring, as it should, that such procedures are under the direction of a board headed by a competent pathologist.

Thus there exists the unjustifiable condition that in the overwhelming majority of cases untrained laymen are determining the causes of violent and unexplained deaths, often under conditions where even a doctor who is not a pathologist would not be competent to solve the problem. Criminals are daily escaping detection and innocent men are charged with crimes where trained pathologists would reveal the true state of facts. Mortality statistics are also being contaminated by laymen's judgment as to the causes of many reported deaths. Here again the dead hand of the middle ages operates one of the important facets of our legal system, ignoring the enlightened and easily available scientific methods.

The Substantive Criminal Law and Administration of The Penal Systems are areas into which scientific methods have almost completely failed to penetrate.

It has been nearly a half century since ex-president and Chief Justice Taft, not a noted radical or reformer, said, "I grieve for my country to say that the administration of the criminal law in all the states of the union is a disgrace to our civilization." Little has happened to render this indictment any less true than it was then. The substance as well as the procedure of the criminal law is a direct survival of the pre-scientific era. Our rules of criminal intent and the other basic concepts of responsibility and punishment are based upon ancient theological concepts that have no place in modern psychology and psychiatry. The field of insanity as a defense is a good example of the condition of the entire criminal law. In a recent murder case where the defense of insanity was offered, there was the familiar spectacle of experts testifying for both sides; but upon inquiry it developed that the five experts, though differing widely in their conclusion as to the effect of legal rules on the defendant, all agreed completely on the psychiatric diagnosis. The trouble, of course, was that the substantive legal rules had no meaning to the modern medical practitioner.

In like manner ideas of responsibility, punishment and reform are also untouched by science. There have been statutory attempts at reform by do-gooders and scientists which have been pushed through the legislatures with little regard for further study and often with in-

105 Maine, Maryland, Massachusetts, New Hampshire and Virginia statutes, supra note 102.
106 Maryland and Virginia.
107 Maryland statute, supra note 102.
sufficient financial support for proper administration.\textsuperscript{100} Weihofen, in his excellent discussion of insanity as a defense, summarizes the situation as follows: \textsuperscript{110}

Our criminal jurisprudence today presents a patchwork pattern of these competing theories. Specific reforms have been enacted into law, but the underlying conception which inspired these reforms has not usually been given much thought, and has certainly not been accepted as the basis of our methods of dealing with offenders. “All theories on the subject of punishment,” said Sir Henry Maine in 1864, “have more or less broken down; and we are at sea as to first principles.” In 1925, Lord Oxford, quoting these words, added, “Nothing has since been said or written that has brought us any nearer to these principles.”

In other areas of the criminal law there has been even less research, reform or effort to bring the criminal law in line with modern science. Much has been written about theories of penology, psychology and psychiatry as applied to crime, but with rare exception\textsuperscript{111} there has been little cooperative research or experimentation in this field. The modern prison remains substantially a medieval dungeon with plumbing, electric lights, a machine shop and a few modern gadgets for opening gates or sounding alarms. It is a pity, in this field where by the force of law the criminal loses his liberty and where experimentation is therefore easiest, that there has been little application of applied experimental science.

Crime prevention as a science is still in the realm of speculation. Juvenile courts have been one attempt to implement some theories but the statistics and studies on the subject are still inconclusive\textsuperscript{112} or entirely missing.

Science in the Judicial and Legislative Systems

When one approaches what is generally regarded as the heart of the law making and enforcement machinery, the legislatures and the courts, the absence of scientific progress, machinery to support it or institutions devoted to research is shocking.

The Judicial System has failed completely to pick up any of the available scientific advances to improve its procedure. This was graphically illustrated in a recent case. According to radio reports Senator McCarthy, in defending himself against a libel suit, wanted to use a wire recorder to take a record of the testimony. Although no possible harm could be done by the introduction of such a device and

\textsuperscript{100} For example, see the discussion of the “Briggs Law,” Weihofen, Insanity as a Defense in Criminal Law 401 et seq. (1933).

\textsuperscript{101} Weihofen, op. cit. supra note 109, at 441; see also Weshlsler, The Challenge of a Model Penal Code, 65 Harv. L. Rev. 1097 (1952), and authorities there cited.

\textsuperscript{111} One example of good scientific work is Ohlin, Selection for Parole (1951).

\textsuperscript{112} A good beginning is Tappan, Delinquent Girls in Court (1947).
much time could be saved, the court summarily denied the request.

Similar unreasonable refusal to adopt scientific advances appears throughout the entire system. The determination of the facts underlying litigation is archaic. The jury which remains the chief fact-finding device of courts has come down from the days of the Carlovigian kings.\(^3\) In its inception it was, of course, an advancement because it replaced trial by battle, oath and ordeal. Although it was originally made up from a group of neighbors who knew all of the facts, it has gradually become a body of twelve men who are entirely ignorant of the subject matter of the litigation. By the end of the fourteenth century the English jury had developed all the principal characteristics which it still retains. Although the average American lawyer today would be shocked by the statement, the modern jury as an institution is almost as antiquated as was trial by battle and oath and ordeal, which it replaced. Since the seventeenth century in the principal European countries, experts have been designated by the parties or by the court from approved lists finally to determine scientific or complicated contrivances within the field of their special knowledge.\(^4\)

Illustrations of this dogged and unreasonable refusal to replace the jury with modern devices for finding the facts are legion. Only a few need be set out here. Sometimes the judges use the Constitution as an excuse for refusing to allow change. One of the most complicated and technical problems of fact-finding to come before the legal tribunals are those surrounding valuation of electric and other utilities for rate making purposes. Early in this procedure the courts held that placing the final determination of the fact of value in the power of an expert commission was a denial of due process of law and therefore unconstitutional,\(^5\) but giving an inexpert jury of twelve good and true men this final power was proper.\(^6\) The mess which followed in the regulation of private utilities is current history.\(^7\)

\(^1\) Holdsworth, History of English Law 312 et seq. (3d ed. 1922) (setting out this history).

\(^2\) The European procedures are summarized briefly in Engelman, History of Continental Civil Procedure (Millar’s transl. 1927); 7 Continental Legal History Series 557, 563 (Germany), 762 (France), 789, 816 (Italy).

\(^3\) Ohio Valley Water Co. v. Ben Avon Burough, 253 U.S. 287 (1920); Chicago, M. & St.P. Ry. v. Minnesota, 134 U.S. 418 (1889); see Buchanan, The Ohio Valley Water Case and The Valuation of Railroads, 40 Harv. L. Rev. 1033 (1927), and authorities there cited.


\(^5\) Beutel, Due Process in Valuation of Local Utilities, 13 Minn. L. Rev. 409 (1929); Mr. Justice Black’s dissent, McCart v. Indianapolis Water Co., 302 U.S. 419, 423 (1938).
In like manner blood tests to aid in the determination of parentage have now been developed by medical science to a point where it may be possible to prove conclusively by comparing blood samples that a certain man is not the father of a certain child. These tests have been adopted all over Europe as conclusive in cases of disputed paternity but not in the United States. Matters of this sort are still submitted to juries in all the states, and they have been authorized by statute in only eight, to determine that a man is not the father of an illegitimate child in cases where the blood tests showed conclusively that this was an impossibility. In spite of the fact that in the city of New York alone blood tests have shown conclusively that thirty per cent of the examined men accused in paternity cases and who denied it were actually not the fathers, only a few courts in this country even rely upon such evidence. In many cases the juries have been allowed to hold men as fathers where the blood tests showed this to be impossible.

Another example is the use of scientific methods to determine the truth of statements made by witnesses and suspects. Mechanical lie detectors have been developed which have been proved to be accurate in over seventy-five per cent of the cases, but no such proof is available for the accuracy of verdicts of juries in judging the veracity of witnesses. In a recent test under controlled conditions where a crime was staged by the writer, and investigated by the standard devices, out of five guilty persons only one was apprehended by ordinary criminal investigation. He was tried and found not guilty. Afterwards a lie detector operator, by testing the suspects and a number of innocent parties reproduced the crime in most of its details, identifying three principals and one accomplice. The fifth guilty party was able to beat the lie detector by taking an over-dose of aspirin but the operator also discovered this fact, and on re-test after the effects of the drug had worn off, he could undoubtedly have found the fourth principal guilty. So far as the writer knows this is the only situation in which the lie detector has been used in competition with criminal investigations, judge and jury. Further experiments of this nature are, of course, possible and ought to be conducted at once.

As things stand, the lie detector is rapidly becoming one of the most important means of crime detection; but it is not yet tolerated in the courts even to be introduced as evidence to a jury to say nothing of

118 Schatkin, Disputed Paternity Proceedings 211 et seq. (2d ed. 1947).
119 Schatkin, op. cit. supra note 118, at 183.
120 Ploscowe, Sex and The Law 124 et seq. (1951); Schatkin, op. cit. supra note 118.
121 Numerous cases are collected by the authorities cited supra notes 117 and 120.
122 Inbau, Lie Detection and Criminal Interrogation 77 (1948).
standing on its own merits to replace the jury as a fact finding device, and there seems to be little research in progress to develop it further as an evidentiary device.\textsuperscript{123}

There are thousands of other scientific means in physics, chemistry and other sciences for determining basic facts of litigation which are far more efficient; but none of these devices are used by the courts who still follow the plan of submitting expert testimony to inexpert jurors without any qualifications for distinguishing between the scientist and the charlatan. What is worse, there are apparently no institutions in this country devoting any objective social research to the problem of correcting and improving this antiquated court procedure.

Professor Smith at the University of Texas\textsuperscript{124} has begun some work along this line, but at present he is devoting most of his attention to enlightening the legal and medical professions on the means of using the present obsolete court fact finding machinery. It is hoped that his work may soon be the beginning of a procedural reform in the courts themselves.

The Legislatures as indicated above have no continuing research organization and therefore no machinery for bringing scientific discoveries into the legal system. Like the courts they have little inclination or equipment to take on new procedures. These facts stand as a direct block to the adoption of scientific methods by law.

The examples listed here are a mere drop in the bucket to the number of instances where the legislative system is behind or unconscious of scientific development. To the items discussed there could easily be added such subjects as tests for intoxication; the use of truth serums; the revision of sex, marriage and divorce laws; sterilization, artificial insemination; the adoption of intelligence tests in the educational process, in fact, the overhaul of the entire educational sysyem to conform to the known dictates of science; economic valuations for tax purposes and thousands of others, many of which the reader can name at will, in which scientific information is developed and waiting to be adopted into our legal system.

\textbf{American Law Institute}

No discussion of the lag between science and law would be complete without noting the work of the American Law Institute. Although there are other organizations and foundations of considerable size devoted to the problem of modernizing the legal system,\textsuperscript{125} the

\textsuperscript{123} See Inbau, op. cit. supra note 122, at 88 et seq.
\textsuperscript{124} Bull. Law-Science Short Course (1953).
\textsuperscript{125} Among these are: Am. Bar Ass'n, Commissioners on Uniform Laws, Am. Institute of Crim. Law and Criminology, Louisiana Law Institute, Council of State Governments, and Survey of the Legal Profession.
American Law Institute is the principal one devoted to this task and has probably turned out more concrete work in this direction than all the others put together. Founded in 1923 as the blue ribbon organization for the legal profession for the purpose of modernizing the law, it is made up of leaders of the organized bar, the judges of the federal and state supreme courts and outstanding law professors. The judges and deans of law schools are ex officio members, the leaders of the bar and professors are elected on the basis of their scholarly and professional achievements. In all, its membership constitutes about fourteen hundred prominent lawyers, judges and professors from all over the country. According to its charter, it is organized “... to promote the clarification and simplification of the law and its better adaptation to social needs, to secure better administration of justice and to encourage and carry on scholarly and scientific legal work.”

During the twenty-nine years of its existence it has spent, in addition to the dues of its members and other miscellaneous accounts, over three million dollars granted to it by a number of large foundations in its effort at improvement of the law. Great progress should be expected from the efforts of so prominent a group of men and the expenditure of such a large amount, and considerable progress has been made.

Over three-fourths of the funds expended and energy of the organization has gone into the Restatement of the Common Law. This corresponds roughly to step two in the methods of experimental jurisprudence explained elsewhere, except that it is not an accurate statement of the law as applied to social problems of a particular jurisdiction, but rather a synthetic creation of a law common to all. The project was not an attempt to codify the complete law but only to restate the common law as it appeared in decided cases in Anglo-American jurisdictions. The Restatement is not a code because it is not for official adoption and ignores the statutes, merely attempting to survey and state the holdings of thousands upon thousands of court decisions. The technique of compiling the law resembles very closely that used by Justinian in formulating the Digest and the Corpus Juris of the Roman law in the Sixth Century. The work was done largely

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127 The list of members is set out in the programs of the annual meetings. See A.L.I., Twenty-ninth Annual Meeting 9–28 (1952).
129 See 1 Wigmore, A Panorama of the World’s Legal System 444 (1928). The difference is that the Digest compiled legal writings; the Restatement, cases.
by paid law professors called Reporters working in their spare time with the aid of volunteer committees of lawyers acting as advisors. The drafts were then discussed and approved by the members of the Institute in convention assembled. There was no attempt to get the social facts and no use of the technique of any other science. The completed Restatement makes up a library of over twenty-two volumes covering more than sixteen thousand pages together with a lot of smaller miscellaneous publications, annotations, indices, and the like. Although it does no more than attempt to state unofficially the result of court decisions, it has secured wide recognition as the authoritative statement of the law in the fields which it covers, and has done much to reduce the confusion in the court decisions. Without attempting to improve, reform or modernize, it crystallizes the common law and no more.

Efforts at law reform have occupied less than one-fourth of the energy of the Institute, but now that the Restatement is out of the way it is hoped that this aspect of the work may receive major emphasis. Outside of the educational program which is no more than technical training for lawyers in the use of the present legal machinery, the Institute has undertaken the drafting of five statutes which are a frank attempt at improving the law corresponding roughly to step six in the process of experimental jurisprudence, but without the trouble of doing the research and thinking involved in steps three through five. These proposed laws are the Code of Criminal Procedure, the Youth Correction Authority Act, the Model Code of Evidence, the Uniform Commercial Code and the Federal Income Tax Statute. In attempting to create these codes the Institute unfortunately adopted the same sort of procedure which proved so successful in the Restatement of the Common Law. The work on each project was under the direction of a group of law professor Reporters surrounded by committees from the bar who relied upon the Reporters’ knowledge to draft the new statutes. There was practically no social research or no cooperation with other sciences or groups of scientists. So these statutes are primarily ex cathedra pronunciamentos by great authorities in the law teaching profession, but little attention has been paid to problems of science or social science.

In the compilation of the Youth Correction Code, there was some ex cathedra advice from social scientists in other fields, but little effort at research beyond the determination of the state of the law.

The drafting of the Commercial Code was done on the same pattern as the Restatement but in cooperation with the Uniform Laws.

Commission of the American Bar Association which is a voluntary organization of lawyers closely resembling in its deliberations the procedures of a legislative body. In the drafting of the Commercial Code the aid and advice of various business associations was sought and received, much in the way in which lobbyists appear before legislative committees; and as indicated elsewhere, in one instance, that of Article 4, Bank Deposits and Collections, the control of the project was taken away from the Institute and the Commissioners on Uniform Laws by the bank lobby.

The work of the Institute has had little effect in changing the law. The Restatement of course, intended no such result and the model codes have had little influence. By 1921, after twenty-eight years of work by the Institute, the Code of Criminal Procedure, which attempted no more than to remove some of the anachronisms from the criminal practice, was adopted almost completely in only five states and in some of its detail in the others. The Model Youth Correction Authority Act which attempts some inconsequential reform in the handling of young criminals has been adopted with a number of changes in only five states. The Model Code of Evidence which was an *ex cathedra* authoritative compilation built upon the present rules of court procedures with only a few minor changes has not been adopted any place. The Uniform Commercial Code which is a huge undertaking, but not a particularly satisfactory one, has been completed two years but has received the approval of the legislature of only one state. The Federal Income Tax Statute which, as its title indicates, is an attempt at recodification of parts of the Internal Revenue Code, is not yet finished, but it is being compiled by the same procedure as the Restatement.

The creation of a Model Penal Code which has been under discussion for twenty years, is now being attempted with funds donated by the Rockefeller Foundation. From the statement by the Reporter of the problems involved, there is hope that some real scientific research into the social problems and the results of the present criminal law may go into this work. The group is of approximately the same type as that used for the Commercial Code and it is doubtful whether any Model Penal Code could ever be drafted before there has been far reaching research into the new scientific discoveries surrounding the field of penology and into the comparative effects of various statutes now in existence.

2. Pennsylvania, to become effective July, 1954. At the present writing it has been introduced in the New York, Massachusetts, and Georgia legislatures, but no action has been taken.
As shown by the results of the work on the Commercial Code, the domination of the American Law Institute by a group of blue stocking lawyers makes it subject to the pressure of the interests of their clients. But the compilation of a penal code does not include a direct infringement upon these interests as was the case in the Commercial Code. It may be that the Reporters, who realize the difficulties involved in the application of the law which they are attempting to codify, will be able to obtain real scientific aid from other fields. The Institute as now organized is not likely to push this effort; but since there is little direct financial interest among the members of the bar in this field, they may not be unwilling to accept help from outside scientists.

Thus, there is still a chance that the Institute may go on to the adoption of truly scientific and experimental methods after it has done the necessary job of fighting its way through the confusions in the law. Already there is a projected study of the effects of adoption of the Model Youth Correction Authority Act in the various states. When this is undertaken the Institute will be embarking on the last step in the process of experimental jurisprudence, the re-study of the effect of a reform. If this work is successful, it should encourage further application of complete experimental method by the Institute.

If the codes serve no other purpose than to present methods of formulating a statement of the law as it applies to various problems discussed in the long commentaries attached to the various section, they will, to some extent, result in the completion of step two in the procedure of experimental jurisprudence. From that, the American Law Institute may move on to the discoveries of the social needs and the creation and real area of scientific legislation or the intelligent use of the fruits of science in other fields; but, as the Institute is now constituted, it partakes more of the nature of a social gathering and an unofficial but skilled legislature than it does of a scientific organization. It still has a long way to go before it even begins to cut down on the lag between the developments of science and the condition of the law; but there are indications that its continued efforts at law reform may eventually drive it to significant developments in this direction. At the present writing it represents the one institutionalized hope for bringing scientific developments into the law.

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134 See material cited supra note 130.