PART II

WORKMEN'S COMPENSATION AND RADIATION INJURIES
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I. INTRODUCTION

Because of the extensive harmful potential of the materials and techniques involved in utilizing atomic energy and radioactive materials, radiation injuries to employees must be avoided wherever possible. To this end, atomic industry may be required to follow a number of unique personnel procedures not encountered in other industries. For example, consideration must be given to revision of the work week if radiation exposures become too hazardous for normal periods of time. Employers must also ascertain the significance of the age and sex of employees in relation to potential radiation exposures. It is generally believed that, due to rapid rate of development, persons under eighteen should not be employed in work requiring exposure to ionizing radiation. Moreover, the idea has been advanced, although it has not received any great degree of acceptance, that persons over forty-five may be able to tolerate doses of radiation double those considered safe for younger adults. Still again, pregnant women should not be exposed because prenatal sensitivity to radiation is high. These and other related factors obviously must be evaluated by employers in the assignment of work and personnel.

Once employees have been assigned to jobs associated with radiation, suitable monitoring apparatus is essential. Any employee apt to be working in locations where he will be exposed to radiation should be issued a personal monitoring device, such as a film badge or a pocket dosimeter, to measure the radiation received by him. Special problems arise in connection with the handling of radioactive equipment and materials. Remote control devices have been developed which permit handling of objects by means of tongs, mechanical hands, etc., while the operator remains behind suitable shielding. Specialized tools and methods have been devised to permit radioactive liquids to be handled; pipetting, filtering, precipitation, and the like can thus be carried out

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with minimum hazards to the operator. Employers must provide the necessary equipment and facilities to avoid or to minimize radiation exposure.

From the point of view of protecting employees from radiation hazards the waste disposal problem is also highly significant. Not only must wastes be disposed of at no risk to the surrounding area, but also methods for accomplishing this must be devised with a view to protecting employees while handling the wastes or while working in the vicinity of disposal sites or along the routes selected for transportation of wastes. All areas involved in the disposal process will require regular monitoring to assure that the level of radiation is not such as to imperil employees. Wastes accumulating in work areas must be stored in suitably shielded containers.

An overriding consideration in this field is that of supervision and training. Employees will require constant supervision to make certain that they understand and will take the necessary precautions. Specific persons must be assigned the responsibility for radiation protection measures, including checking the efficiency of protective devices as well as detecting, with the use of the monitoring apparatus, the possible presence of contamination.

Since the effects of radioactivity on the human body are cumulative, at least when irradiations of a certain intensity occur and possibly also regardless of the minuteness of the amounts received, it will become necessary to maintain permanent records for the workers concerned, so that their exposures may be adequately and accurately followed throughout the course of their various employments. Just as radiation hazards must be given a long-term evaluation, so too will long-term personnel records become an integral part of operations in the atomic industry. Complete medical supervision, covering not only the period of employment but also the prior medical history, will permit detection of conditions rendering a person unsuitable for work in a radioactive environment. Such evidences may be provided by examinations of skin, bone, gonad, blood, and lung conditions, and complete records should be kept as a matter of personnel routine.

Although the first line of defense for atomic industry will be the avoidance of radiation injuries by utilization of adequate radiation safety measures, we must recognize that despite these efforts some such injuries will be inflicted. For industrial accidents, in general, workmen's compensation has been evolved as the method of supplying economic protection to employees. The existing workmen's compensation statutes
warrant re-examination to determine their adequacy in dealing with the
new hazards created by the advent of industrial application of atomic
energy. In identifying and discussing the problems likely to be raised by
specific provisions of the workmen’s compensation laws in relation to
atomic energy injuries, it will be helpful to review briefly the several
types of statutes providing relief for injuries which might occur in
atomic industry. It is, of course, to be expected that the bulk of existing
legislative provisions in this field can be adapted to radiation injuries
without undue stress and will serve substantially the same policy ends
as effectively as under present conditions. Atomic industry will doubt­
lessly have its share of typical industrial accidents whose nature and
circumstances will not present any unusual difficulties. The fact re­
mains, however, that the potential industrial applications of nuclear
energy may precipitate situations of unusually complicated and unex­
pected character and of sufficient frequency to warrant concern over the
adequacy of certain aspects of present day compensation legislation. The
following review has the purpose of presenting a selective illustration
of areas of workmen’s compensation law that may require amendment
so that we may not be totally unprepared for the proper disposition of
industrial radiation injury cases.

II. SCOPE OF COVERAGE UNDER EXISTING LAWS

Workmen’s compensation legislation, now enacted in every state, im­
poses, in effect, strict liability for certain injuries arising out of the em­
ployment relationship. Under workmen’s compensation the losses are
distributed throughout the industry by a liability insurance system with
the theory being that the consumer should eventually bear the financial
burden for injuries to employees. As we have already seen in connection
with common law tort liability rules, the peculiarities of atomic energy
and radiation injuries raise several new legal problems. An examina­
tion of selective workmen’s compensation acts from the standpoint of
atomic energy and radiation injuries also, as we shall see, uncovers new
problems that must be resolved in the atomic age.

Since our discussion will be limited mainly to the possibilities of re­
covery for radiation injuries under existing compensation statutes, it
may be helpful to define the several types of radiation injuries with
which we are concerned primarily. For purposes of convenience, four
types of radiation injuries warrant attention. First, there is the “im­
mediate radiation injury” which is occasioned by a harmful exposure
to radiation, fixed in time, and which results in radiation sickness or
death, cotermindously or shortly after exposure. Second, there is the “delayed radiation injury” for which the cause (the harmful exposure) can be fixed in time but in which the effect develops over a period of time, or, conversely, the effect may be fixed in time but the harmful exposure occurs over an extended period. Third, there is the “cumulative radiation injury” where the cause occurs over an extended period and the effect also gradually develops. Fourth, there are the “distinctive radiation injuries” which have unusual effects, not normally encountered in other industrial pursuits, such as shortened life span, temporary or permanent sterility, probable or possible genetic damage, or increased susceptibility to disease, and which may occur as a result of any of the three other types of injury.

Under most workmen’s compensation acts the statutory language covers two broad types of injuries; namely (1) “injuries by accident” “arising out of and in the course of employment” and (2) “occupational diseases.” To be compensable, any injury suffered by an employee subject to the act must come within the definitions established for these two general categories of injuries by the statutes. Therefore, in respect to radiation injuries, we will first examine the extent to which current statutory provisions provide coverage. Secondly, problems arising out of successive injuries and successive exposures culminating in occupational diseases will be explored. Thereafter, the statutory provisions relating to the bases of compensation awards will be examined to ascertain their adequacy when applied to radiation injuries.

A. General Accidental Injury Coverage

1. Injury by Accident

Nearly all compensation statutes require that an injury be “accidental” to be compensable. “Accidental injury” or “injury by accident” is not defined in the statutes, with the result that judicial construction of these terms has been essential. In construing these terms the courts have universally required an element of unexpectedness, and most courts have added the further requirement that an accidental injury must be reasonably traceable to a definite time, place, and occasion or cause. In respect to “immediate radiation injuries,” where both the cause and effect can be ascertained immediately, there appears to be no doubt that the statutory language is sufficiently broad to provide coverage. However, in applying traditional court tests difficulties are encountered in respect to the “delayed radiation injuries.” In specific non-radiation
cases, the courts have reached divergent results in attempting to apply definitions of "accidental" to similar injuries. The common but troublesome issue is the question of whether the injury must have resulted from an unexpected and traceable external cause, or, in the alternative, whether it is sufficient that the injury was sudden and unusual though the immediate cause was not an external and unexpected event. The resolution of this question, is of course, crucial if the radiation injury is not compensable as an occupational disease.

In respect to "delayed radiation injuries," the cases of routine exposure, either to the elements or to conditions peculiar to the employee's environment while at work, provide some analogies. Many courts have distinguished between abrupt results on the one hand and subtle physiological disturbances on the other. For example, prolonged exposure to either heat or cold, resulting in heat prostration or frostbite respectively, has been held by most courts to give rise to an accidental and compensable injury, though some courts stress the need for the existence of unusual conditions as contrasted with the usual exposure of the general public. A minority of courts have, however, refused relief on the ground that in certain jobs there is nothing unusual in being exposed to heat or cold whether in greater or lesser degree in relation to the normal exposure of the public, and thus the injury is held not to be a sudden and unexpected accident, and no compensation is allowed. In atomic industry comparable cases may take the form of acute radiation sickness caused not by sudden excessive irradiation, but by the effect of cumulative exposures normal for the kind of employment. If the degree of usual exposure in the particular employment test should be imposed when dealing with immediately discernible radiation injuries, compensation may be unavailable. Such a result, however, may be seriously questioned, and it is doubtful that even courts following the minority rule would apply the same test in radiation cases.

In contrast to cases of immediate, tangible injury, cases involving routine exposures to the elements or to artificial conditions causing a latent disease or the formation of degenerative conditions in the organs or tissues, have found the courts much more reluctant to find an "accident."

2 Beadle v. Bethlehem Steel Co., 172 Md. 541, 193 Atl. 240 (1937) (heat stroke suffered by employees whose duties were to remove heavy pieces of metal from furnace with temperature of 1300 degrees); Savage v. City of Pontiac, 214 Mich. 626, 183 N.W. 798 (1921) (freezing suffered by fireman whose wet clothes froze on him and whose neck was covered by ice).
When an employee incurs a disease from exposure to heat, cold, dampness, fumes, or dust, and the disease is not covered as an occupational disease under the statute, a majority of courts deny compensation for lack of accidental character of the injury. The rule is tempered sometimes by the implication that if the exposure is of unusual occurrence for persons engaged in the victim's type of work, the disease can be held accidental.

A typical case illustrating the chief objection to the recognition as accidental of slowly developing injuries from exposure to the weather or to noxious substances, and indicating that the difficulty springs solely from the traditional definition of "accident," is *Deyo v. Village of Piermont*. In that case a policeman's arthritis was aggravated from standing for hours in wet and freezing weather to direct traffic. The court denied compensation, saying: "... [W]e do not think the interpretation of what constitutes an 'accident' should be extended to fringe cases such as this, where there is no single incident which would be regarded as an accident by the common man. There must be some element of suddenness—something catastrophic—and some incident immediately noticeable."

A minority of courts hold compensable, as accidental, slowly developing injuries that result from greater exposure than that to which the general public is submitted even if the exposure is a matter of routine in the victim's type of employment. The fact that the exposure is peculiar to the employment is often a corroborative factor in favor of compensability for courts following this approach.

Any "delayed radiation injury" not compensable as an occupational

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8 Powell v. Taylor, 177 Pa. Super. 647, 112 A. 2d 415 (1955) (carpenter employed for over 3 years during which he used dusty and mouldy lumber which required brushing and scraping before use, breathed and inhaled this material and became totally disabled and afflicted with moniliasis. Medical expert was unable to state whether a single contact with fungus spores or exposure over a period of time had caused the disease. Held: compensation denied since neither an accident was shown nor a scheduled occupational disease); Davis v. Sunshine Mining Co., 73 Idaho 94, 245 P. 2d 822 (1952) (miner's tuberculosis from neither unusual conditions nor fortuitous event); Hasbrouck v. Goodyear Tire and Rubber Co. (Ohio, Ct. Com. Pleas) 99 N.E. 2d 329 (1951) (victim overcome by fumes while mixing vat of alcohol and benzol; recovery denied for lack of suddenness and unforeseeability and thus of accidental nature of injury); see also citations by state in 1 Larson, *supra* note 1 at §38.50, n. 21.


6 Black v. Creston Auto Co., 225 Iowa 671, 281 N.W. 189 (1938) (lead poisoning from inhaling poisonous fumes over a period of time); Webb v. New Mexico Pub. Co., 47 N.M. 279, 141 P. 2d 333 (1943) (dermatitis from 6 months' use of irritating soap); see also citations by state in 1 Larson, *supra* note 1 at §38.50, n. 21.
disease would presumably receive similar judicial treatment whenever
the injury was in the form of an aggravation of a latent disease or a
slowly developing deterioration of tissue or organs. The fact that radia­
tion-caused ailments may include disorders heretofore beyond scientific
expectation and of a kind which may not be included within restrictive
lists of occupational diseases suggests a reappraisal of policies of the
law in this area for atomic energy industry.

“Cumulative radiation injuries,” not covered as occupational diseases
under the statutes, raise similar problems of coverage under existing
legislation. The chief obstacle under many American statutes to com­
ponsability of gradual injuries of a clearly occupational nature consists
in the difficulty experienced in determining the exact time of their oc­
currence. This is essential for the purpose of satisfying the require­
ment of proving an “injury by accident,” which has been generally
interpreted as calling for an accident and not including cases of slow
and often imperceptible deteriorations. When the element of suddenness
is totally absent for the reason that neither is the cause of an injury
an untoward and unexpected event nor is the result a clear-cut collapse
(for example, in a case of heat prostration), compensability has been
granted and denied alternately in the same state.

These cases are often difficult to distinguish from the accidental dis­
eases discussed above. They include situations in which protracted ex­
oposures result in gradual physical deteriorations or diseases but where
both the cause and effect are gradual and span a considerable period of
time. Some courts have granted compensation in these cases by as­
similating gradual injuries to the traditional conception of “injury by accident,” saying that each exposure produced a new trauma and con­
stituted a small accident the repetition of which finally led to a com­
ponsable injury. But some of the same courts have denied compensa­
tion in other similar cases because of absence of an accident sufficiently
definite in time.

Most of the radiation injuries caused by repeated exposures are, of
course, of a nature that would qualify for compensation under statutes
providing coverage for all occupational diseases, and the problem raised
by gradual injuries in the atomic industry can perhaps be solved best by
the amendment of compensation statutes where necessary to effect com­

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7 E.g., Pan American Airways v. Willard, 99 F. Supp. 257 (1951) (skin disease
from exposure to tropical sun); Batesville White Lime Co. v. Bell, 212 Ark. 23, 205
S.W. 2d 31 (1947) (inhalation of excessive dust for 23 years causing heart injury).
8 Compare cases listed by jurisdictions in 1 Larson, supra note 1, at §39.10, notes 16
and 17.
prehensive occupational disease coverage. Otherwise unexpected gradual radiation injuries would be likely to remain uncompensated and thus produce an incongruity difficult to defend when we realize that constant though minimal and supposedly safe exposures to radioactivity are apt to be routine for employees in atomic industry.

2. "Arising out of and in the Course of Employment"

Another all but universal coverage provision in American compensation statutes is the requirement that the industrial injury must be one "arising out of and in the course of employment." Forty-one states and the Longshoremen's and Harbor Workers' Act use this test. Utah has modified the formula to read "arising out of or in the course of the employment." The statutes of North Dakota, Pennsylvania, Texas, and Washington, and the United States Employees' Compensation Act do not contain the "arising out of" portion of the formula. West Virginia requires an injury "resulting from" instead of "arising out of" employment. Wyoming has rejected the entire traditional approach and requires that the injury be "incurred in the employment." Wisconsin has replaced the "course of employment" phrase with the requirement that the employee be injured "while performing service growing out of and incidental to his employment," and the United States Employee's Compensation Act covers injuries "sustained while in the performance of duty."

"Arising out of and in the course of employment" is normally said to indicate two separate tests which must be met before an injury may be held compensable. An injury is said to arise out of the employment when a causal connection between the conditions of work and the resulting harm is apparent to the rational mind. While restrictive interpretations of this phrase in earlier years interposed additional obstacles to compensability (such as the doctrine that an added peril resulting from the conduct of the worker himself excluded the requisite causal connection and the view that a hazard common to all mankind did not

satisfy the "arising out of" test), the trend of recent decisions is to the effect that it is enough if the employment was a contributing cause. Generally whether the employment is a sufficient contributing factor becomes a simple question of proof not subject to the ordinary tests used to determine the presence of proximate cause in tort cases. Insofar as it relates to the problems confronting atomic energy industry, this phase of the law will be considered when we deal with the modes of establishing a causal relation between the work and the injury or disease.

The part of the coverage formula which may work a hardship in certain radiation cases is the requirement that an injury arise "in the course of employment." This phrase implies that to be compensable, an accident must overtake an employee during working hours, or at a place where he is reasonably expected to be while carrying on an activity incidental to his job. Generally the courts have held that manifestation of the injury as well as origin must occur during the course of employment. This approach is likely to be unsatisfactory in atomic industry for the reason that the effects of an overexposure may make themselves felt hours after the workman leaves his place of employment.

There are at least two judicial decisions which, when considered in relation to comparable radiation injury situations, illustrate the awkward solutions which the present coverage formula may inspire. In *American Motorists Insurance Co. v. Steel* 16 an employee whose job required the drilling of holes in metal suffered a severe injury when sharp shavings, which had lodged in his eyebrows, fell into his eye. The accident took place about fifteen minutes after the end of working hours while the workman was on his way home. Because the harmful result did not occur "during the course of employment," the injury was held non-compensable. Again in *Gill v. Belmar Construction Company* 17 the workman had negligently left a dynamite cap in his pocket and was badly injured when it exploded the next morning while he was dressing in his hotel room. The time and place of the accident not coinciding with the employment, compensation was denied.

It is not difficult to imagine situations in atomic industry in which delayed-action injuries will occur. Indeed, without resorting to imagination, it is already possible to advance hypotheses based on actual events as reported in the press. For example, a worker on a construction project in Connecticut innocently carried away in his trousers pocket a capsule of cobalt 60 which was being used on the job for radiography of

16 (Tex. App.) 229 S.W. 2d 386 (1950).
welds. The workman was interested in using the long string from which the small, one and three-eights inch cylinder of deadly cobalt was hanging, and he was unaware of the radioactive nature of the contents. After a general alarm had been given and a thorough search started, the cobalt was found in the glove compartment of the worker's car. Final information on the physical effect of this episode is lacking, but the construction worker is suing for $200,000 damages. If he and perhaps some of his companions in his car suffered radiation injuries, the rule of the above two cases would probably exclude compensability.

3. Summary

Existing statutory provisions relating to accidental injuries appear to cover adequately "immediate radiation injuries." However, in respect to "delayed radiation injuries" or "cumulative radiation injuries," statutory language requiring an "accident" probably cannot be relied upon, except in a minority of courts, as a basis for awarding compensation. Whenever the cause of an injury occurs over a prolonged period of time or whenever the injury develops at a remote time, the courts have often denied compensation because no "accident" can be established. Where both cause and effect span lengthy time periods, even the more liberal courts have found considerable difficulty in awarding compensation. Therefore, for many radiation injuries, the general statutory provisions relating to accidental injuries do not provide satisfactory coverage if it is deemed desirable that radiation injuries be afforded the same treatment as other types of industrial injuries. However, satisfactory compensation for radiation injuries may be available under occupational disease coverage provisions of the workmen's compensation acts.

B. Occupational Disease Coverage

Although they may occur occasionally, radiation "accidents" in all probability will not constitute the major source of atomic energy injuries. Of greater concern are the "cumulative radiation injuries" caused by chronic exposure, such as cataract, cancer, leukemia, leucopenia, bone necrosis, sterility, genetic mutations, shortened life span, epilation, or injury to any of the various organs within the body. While all these injuries can be caused by a single large dose of radiation, as in the case of an accident, most of them can also be caused by repeated exposures to low amounts of radioactivity.

Because of the manner in which these injuries develop, they resemble those injuries which have typically been classified as occupational dis-
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eases under workmen's compensation statutes. Occupational diseases, which ordinarily develop gradually, generally lack the character of unexpectedness typical of industrial accidents. They are recognized as a hazard inherent in continued exposure under the peculiar conditions of the specific employment. The statutes which provide compensation for occupational diseases, either by defining "injury by accident" to include such diseases or by separate specific coverage, must be examined in each state to determine their effectiveness as a means of providing compensation for "delayed" or "cumulative" radiation injuries for which compensation would not be awarded under the "accidental" injury provisions.

Some of the statutes literally provide compensation for "all occupational diseases" and leave it to industrial commissions or the courts to decide which diseases fit within the terminology. Others provide full coverage by including within the scope of "injury" all known or even unknown diseases which result from employment. A variation of this type of legislation is found in statutes which include a list of diseases for which compensation is provided, this device being known as "the schedule type of coverage." The lists may be exclusive or non-exclusive. Full coverage is achieved by those statutes which adopt a definite list of diseases and then add a general clause which usually reads: "any and all occupational diseases" or "all other occupational diseases." A variation of this type of legislation is found in statutes which include a list of diseases for which compensation is provided, this device being known as "the schedule type of coverage." The lists may be exclusive or non-exclusive. Full coverage is achieved by those statutes which adopt a definite list of diseases and then add a general clause which usually reads: "any and all occupational diseases" or "all other occupational diseases." 18

A number of states, not having full coverage for occupational diseases, have adopted statutes providing coverage, specifically and apparently exclusively, for some radiation diseases. 20 The statutes of six states that provide for occupational disease coverage by use of a schedule do not cover radiation-induced diseases expressly, and it is doubtful

18 Alaska, Arkansas, California, Connecticut, Delaware, District of Columbia, Florida, Hawaii, Illinois, Indiana, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, New Jersey, North Dakota, Oregon, South Carolina, Virginia (alternative coverage), Washington, West Virginia, Wisconsin. Under federal legislation civil employees as well as workers falling under the Longshoremen's Act are similarly covered.

19 New York, Ohio, Nevada, Rhode Island, and Utah.

20 Arizona (ulceration of skin or destruction of tissue due to roentgen rays or radium emanations), Colorado (poisoning or disease caused by exposure to radioactive materials, substances, or machines, or fissionable materials), Georgia, Kansas, Louisiana, Oklahoma, Texas, Vermont (diseased condition caused by exposure to X-rays or radioactive substances), Idaho (radium poisoning or disability due to radioactive properties of substances or to roentgen rays), New Mexico (all diseases directly traceable to fissionable materials or radioactive materials), North Carolina (radium poisoning or injury by X-rays), South Dakota (ulceration of skin or destruction of tissue due to prolonged exposure to roentgen rays or radium emanations).
whether they can be construed to include such disorders. Two states provide no coverage for occupational diseases.

1. General Coverage

In respect to those statutes providing full coverage by the use of the language "all occupational diseases," it is obvious that anything that can be classified as an occupational disease will be compensable. This, of course, leaves open the question of what constitutes an "occupational disease," so as to come within the meaning of the statute. An occupational disease is generally defined as a disease which is peculiar to a particular industrial process, trade, or occupation and which does not arise from any single occurrence in the employment, but develops gradually.

The problem of defining an occupational disease is one of attempting to draw a distinction between those diseases to which the human race as a whole is constantly subjected, and those diseases which are distinctively connected with the conditions under which the employee works. Consequently, most of the definitions place emphasis upon the causal relationship of the particular disease to the employment.

The occupational disease statute of the state of Illinois defines occupational disease as follows:

In this act the term "Occupational Disease" means a disease arising out of and in the course of the employment. Ordinary diseases of life to which the general public is exposed outside

21 Alabama (specified dust diseases such as pneumoconiosis including silicosis, anthraco-tuberculosis, aluminosis, etc.), Iowa (16 specific diseases), Maine (15 specified diseases), Montana (a separate statute provides for payment of $60.00 a month from state funds for workers totally disabled from silicosis if they are residents of the state of 10 years standing), New Hampshire (silicosis and other pulmonary diseases, anthrax, lead poisoning, dermatitis venenata, and diseases caused by inhalation of poisonous gas and fumes), Tennessee (full coverage permissible).

22 Mississippi and Wyoming.

23 "... an occupational disease is one which is due wholly to causes and conditions which are normal and constantly present and characteristic of the particular occupation; that is, those things which science and industry have not yet learned how to eliminate." Cell v. Yale and Towne Manufacturing Co., 281 Mich. 564, 568, 275 N.W.250 (1937), quoting from Seattle Can Co. v. Dept. of Labor & Industry, 147 Wash. 303, 309, 265 Pac. 739 (1928).

24 Many of the cases which are used to define occupational disease are cases in which the distinction between an occupational disease and an injury by accident was drawn so as to label the particular injury uncompensable. This occurred in the situation where there was no occupational disease law, and if the particular injury of the employee was labeled as an occupational disease, it could not be compensated as an "injury by accident." Thus in reading cases, it is important to keep in mind the purpose for which the distinction or definition of occupational disease is being made.
of the employment shall not be compensable, except where the said disease follows as an incident of an occupational disease as defined in this section.

A disease shall be deemed to arise out of the employment, only if there is apparent to the rational mind upon consideration of all the circumstances, a direct causal connection between the conditions under which the work is performed and the occupational disease, and which can be seen to have followed as a natural incident of the work as a result of the exposure occasioned by the nature of the employment and which can be fairly traced to the employment as the proximate cause, and which does not come from a hazard to which workmen would have been equally exposed outside of the employment. The disease must be incidental to the character of the business and not independent of the relation of employer and employee. The disease need not to have been foreseen or expected but after its contraction it must appear to have had its origin in a risk connected with the employment and to have flowed from that source as a rational consequence.

Some state statutes are briefer. For example, the Nebraska statute reads:

The term "occupational disease" shall mean only a disease which is due to causes and conditions which are characteristic of and peculiar to a particular trade, occupation, process, or employment, and shall exclude all ordinary diseases of life to which the general public are exposed.

An even briefer statute defining "occupational disease" in terms of causal connection is that of the state of Connecticut:

The words "occupational disease" shall mean a disease peculiar to the occupation in which the employee was engaged and due to causes in excess of the ordinary hazards of employment as such.

In addition, some statutes provide coverage for occupational diseases without providing any definition of what is meant thereby. In these states it has been left to the courts to decide the limitations of the statutory language. The New York court, in Harman v. Republic Aviation Corp., was required to define what was meant by the scheduled item "any and all occupational diseases." Expressing itself in terms of causal connection, the court said:

An ailment does not become an occupational disease simply because it is contracted on the employer's premises. It must be

one which is commonly regarded as natural to, inhering in, and incident and concomitant of, the work in question. There must be a recognizable link between the disease and some distinctive feature of the claimant's job, common to all jobs of that sort. As this court observed in *Matter of Goldberg v. 954 Marcy Corp.* (276 N.Y. 313, 318-319), an occupational disease is one "which results from the nature of the employment, and by nature is meant * * * conditions to which all employees of a class are subject, and which produce the disease as a natural incident of a particular occupation, and attach to that occupation a hazard which distinguishes it from the usual run of occupations and is in excess of the hazard attending employment in general." 28

In contrast to the foregoing statutory and judicial definitions of occupational disease emphasizing an "affirmative" showing of the causal relationship between the disease and the job, the state of South Carolina has taken a negative approach. Its statute provides:

The words "*occupational disease*" mean a disease arising out of and in the course of employment, which is due to hazards in excess of those ordinarily incident to employment and is peculiar to the occupation in which the employee is engaged. A disease shall be deemed an occupational disease only if caused by a hazard recognized as peculiar to a particular trade, process, occupation or employment as a direct result of continuous exposure to the normal working conditions thereof.

No disease shall be deemed an occupational disease when:

1. It does not result directly and naturally from exposure in this State to the hazards peculiar to the particular employment;
2. It results from exposure to outside climatic conditions;
3. It is a contagious disease resulting from exposure to fellow employees or from a hazard to which the workman would have been equally exposed outside of his employment;
4. It is one of the ordinary diseases of life to which the general public is equally exposed, unless such disease follows as a complication and a natural incident of an occupational disease or unless there is a constant exposure peculiar to the occupation itself which makes such disease a hazard inherent in such occupation;
5. It is any disease of the cardiac, pulmonary or circulatory system not resulting directly from abnormal external gaseous pressure exerted upon the body or the natural entrance into the body through the skin or natural orifices thereof of foreign organic or inorganic matter under circumstances pe-

The basic question is: Do statutes, which theoretically provide full coverage of occupational diseases, adequately cover radiation injuries? As we have seen, the crucial element is the showing of causal connection between a particular disease and the job. We must, then, determine the extent to which causal connection between radiation injuries and the occupations in which they are incurred can be proved. Consider, for example, the diseases of cancer and leukemia. These are diseases to which the general public is exposed, quite apart from employment. They are also diseases which are caused by exposure to radiation. While it has been shown that radiation does cause cancer, the mechanics of this causation have not yet been thoroughly understood. It is impossible, then, for even a medical expert to point to a particular case of cancer and assert with confidence that it was caused by exposure to radiation. The same is true of leukemia. While a higher than normal incidence rate of leukemia can be shown to occur among persons exposed frequently to radiation, such as radiologists, it is still impossible to point to any specific case of leukemia and conclude that it was caused by exposure to radiation. Thus, though we know that exposure to radiation can cause these diseases, it is impossible at present to testify that the occurrence of any of them in any individual employee is traceable to radiation exposure.

It may in fact be easier on the basis of statistics for an employer to disprove causation in radiation cases than for an employee to prove it. For example, to satisfy the causation requirement under the Illinois statute, it is necessary that the disease be one which can be "fairly traced to the employment as the proximate cause, and one which does not come from the hazards to which workmen would have been equally exposed outside of the employment." In respect to the first requirement, would it be sufficient to offer testimony to the effect that, because there is a higher leukemia incidence rate among workers who deal with radiation, the occurrence of a particular case was incident to the employment? To answer affirmatively to this question, would, in effect, make the employer an insurer against the risk of his employees coming down with this particular disease. This would result from the fact that even though the incidence rates themselves show that causes other than radiation produce a majority of the cases, the employer probably will be un-

able to prove that any particular case of leukemia or cancer was caused by circumstances external to the employment.

The second statutory requirement, that the disease be one which does not come from a "hazard to which workmen would have been equally exposed outside of the employment," presents another troublesome problem of fact. The question is whether the cause of cancer or leukemia can be said to be due to the same "hazard," whether that "hazard" is inside or outside of the employment. From available evidence, it definitely appears that radiation can cause cancer or leukemia. However, the sources of radiation are not confined to those artificially produced in atomic energy plants alone. Everyone is subjected to the radiation that comes from outer space and to the natural radiation caused by the deterioration of the composition of the earth's surface. The amount of such radiation to which a person is subjected varies according to the location. Decomposition of the materials of the earth's surface in some areas is higher than in others, and a person receives more natural radiation from outer space when he is in the higher altitudes. It is very questionable therefore whether cancer or leukemia could be said to be due to a radiation "hazard" to which the workman would not have been equally exposed outside of the employment. The Atomic Energy Commission has pointed out that the average dosage of radiation within its plants is no greater than people generally receive from natural radiation. As more is learned about the nature of these diseases and their causes, it may be disclosed that natural radiation is too low to be a significant factor. It could be true that cancer is caused by subjecting to radiation on an "exponential" basis and follows inevitably after exposure to a certain amount of radiation, or that possibly it is caused by a "chance" passage of radiation at any time. At the present time, however, adequate information concerning the significance of natural radiation simply is unavailable. Moreover, X-ray radiation to which people subject themselves voluntarily for medical or other purposes, also must be considered. Such exposure could qualify as a "hazard to which workmen have been equally exposed outside of the employment." Therefore, the problem of proving the causal connection essential to classifying a radiation injury as an occupational disease may prove insuperable.

A recent Illinois case, *City of Chicago v. Industrial Commission et al.*, 80 indicates the nature of the proof that probably will be required to show the causal connection in radiation cases where compensation is sought under the occupational disease provisions of the statute. In that

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80 403 Ill. 105, 85 N.E. 2d 665 (1949).
case, an employee of the city's sewer department died from Weil's disease, a disease commonly transmitted from contact with the excreta of diseased rats. The presence of rats near or around the sewers where the decedent had worked was made to appear in the evidence. In affirming the denial of an award by the Industrial Commission, the court said:

The evidence in the case at bar clearly falls short of establishing such a causal connection. In its aspect most favorable to plaintiff in error it shows merely that the disease from which the death resulted is commonly transmitted from contact with the droppings of infected rats, and that rats exist in the sewers where decedent worked. There is no evidence that any such rats were diseased or that the decedent came into contact with any rat droppings. A mere possibility of contamination in the course of employment is not sufficient to support an award of compensation. . . . In the case at bar the presence of spirochetes at decedent's place of employment can be inferred only by speculation. This cannot serve as proof of a direct causal connection.81

Thus the court required a showing of actual contact with the disease, or the cause of the employee's disease, at the place of employment. The fact that there were rats at the decedent's place of employment and that these rats could have carried the disease was not sufficient. It was necessary to show that there were diseased rats at the place of employment. The court distinguished this case from an earlier one, Arquin v. Industrial Commission,82 where the disease had been treated as an injury by accident. In that case, the court held that there was a causal connection where an intern treating meningitis cases in a contagious ward had died from meningitis. The evidence showed that the employee had been in actual contact with the disease in the course of his employment.

Although no court demands absolute certainty in establishing the occupational origin of a disease, the problems of causation are bound to be very serious in atomic energy compensation cases especially because the diseases caused by radioactivity are the same as those originating from other causes. In other types of cases the courts have permitted reasonable inferences drawn from medical testimony of probabilities to justify the finding that certain diseases are occupational in nature. For example, in Travelers Ins. Co. v. Donovan,83 the claimant, an employee of the Red Cross, was assigned to duty in Kyoto, Japan, where he contracted tuberculosis. The evidence showed that the incidence rate of

81 Id. at 107-108.
82 349 Ill. 220, 181 N.E. 613 (1932).
tuberculosis at Kyoto in 1951 was 1040 per 100,000 population, and 1090 per 100,000 population in 1952. This compared with an incidence rate of 220.9 per 100,000 in 1951 and 215.7 per 100,000 for 1952 in the District of Columbia, the employee's residence in the United States. An award made on this basis was affirmed. The court remarked that it was reasonable to conclude that the disease was contracted not only in the course of the employment but also out of the employment, because there was an aggravated risk as a result of work in an area with a high incidence rate of tuberculosis. The chances were five times those in the District of Columbia. Further, the court stated that, although in an action for damages governed by common-law principles the causal relation between the employment and the disease could not be deemed to have been established, different principles govern under workmen's compensation laws.

In Zaepfel v. E. I. DuPont de Nemours & Co. the deceased had been employed as a chemist by four successive employers. He had worked for DuPont from 1936 to 1943, for a second employer from 1944 to 1946, for a third from 1947 to 1948, and for a fourth for two months in 1948. He stopped work in 1948 because of illness, and in 1949, at the age of thirty-nine, he died of aplastic anemia, a disease which impairs the function of the marrow in producing blood. A claim was filed against all the employers, and it was alleged that exposure to chemicals during deceased's employment caused the disease. The compensation board found that the total disability was the result of poisoning from benzoI and benzine derivatives contracted while in the employment of DuPont and causing an occupational disease. An award was made against DuPont only, for no causal relation was found between the disease and the employment with the other three defendants. An autopsy disclosed no trace of chemicals left from other employments. The medical testimony was conflicting as to the cause of the anemia. But in view of the general paucity of experience with aplastic anemia as an industrial disease, the court expressed a willingness to accept less than positive proof of causation. A physician's testimony to the effect that "... the picture could well have begun at the time he was employed handling the benzine ring products at DuPont" was held sufficient to support the board's award. As to the use of the word "could," the court remarked that it is highly probative, and that indeed such evidence is preferable to a glib manifestation of certainty in these cases. Asked whether other employments had anything to do with the disease, the

medical expert refused to exclude them but maintained that the disorder was attributable to constant exposure to chemicals during the period of employment. He could not, however, give details as to how other employments could have contributed to or aggravated the disease. In justifying the decision of the board, the court pointed out: “Neither the spirit, purpose nor the language of the Workmen’s Compensation Law requires that, to become entitled to compensation his widow must establish the precise exposure which caused his death to an absolute certainty.”

It is interesting to observe that if any trace of other chemicals had been found in the deceased’s body, other employers would probably also have been held liable.

On the question of causal relationship, therefore, it is possible for a court to take the view that a showing of exposure to radiation during the course of employment and a showing of subsequent development of a disease, which can be caused by radioactivity, satisfy the requirements of proof of the occupational character of the disease. This approach, however, will tend to make the employer in atomic industry an insurer against certain diseases such as cancer. On the other hand, if a greater burden of proof must be sustained by the employee to establish the causal connection, it is doubtful whether many of the cumulative radiation injuries will be found compensable as occupational diseases because of the lack of sufficient scientific and medical evidence. It is to be hoped that further discoveries of the specific nature of atomic energy injuries will diminish the area of conjecture. For example, if it can be shown by statistical evidence that it takes a cumulative dose of ninety roentgens to cause a certain type of cancer, such as cancer of the breast, then unless the employee could show that he was exposed to this much radiation during the course of his employment, he would have difficulty in proving a causal connection. In the absence of such conclusive scientific data, however, it seems preferable to err on the side of providing compensation for atomic injuries. If the existing statutory or judicial rules relating to proof of causal connection appear to create an insuperable burden for possible victims of radiation injuries, appropriate revision of the statutes appears desirable.

2. Schedule Type of Coverage

As previously mentioned, some statutes, instead of providing coverage for “all occupational diseases,” purport to compensate for only a prescribed, exclusive “list” of such diseases. There are several policy rea-

85 Id. at 696.
sons underlying the adoption of the schedule type of legislation. Primarily, it is an attempt to limit the employer's liability, so that industry will not be burdened with the cost of compensation for those diseases to which the human race as a whole is subject. Another important consideration is that of "definiteness," which serves the worthy purpose of reducing the amount of time and money employed in litigation over the question of whether the disease involved in the case is or is not a compensable occupational disease.

An examination of the various statutory lists of the occupational disease laws reveals a considerable variation concerning both the items included and the language employed. As indicated previously, in some states no item of the schedule relates to radiation injuries. In other states the schedules do incorporate items that have some relevancy to atomic injuries and these will be examined with a view toward determining their adequacy.

a. Examples of Older Legislation

North Carolina. The North Carolina statute enacted in 1935 reads:

The following diseases and conditions only shall be deemed to be occupational diseases within the meaning of this article:

. . . (15) radium poisoning or injuries by X-rays. 86

Unless a particular disease appears on this list, it is not compensable. Twenty-six different items are listed as occupational diseases in the North Carolina statute and only item 15 pertains to radiation injuries.

Since today the use of X-rays in industrial processes probably exceeds the use of other radioactive materials or equipment, "injury by X-rays" probably will, numerically speaking, cover the greatest share of actual radiation injuries. However, as the use of newer atomic energy devices becomes more prevalent, the inadequacies of the North Carolina statute will become more apparent.

The statute also covers what is termed "radium poisoning." The use of the generic term "poisoning" raises the question of whether the "poisoning" referred to is that of a toxic nature, or one due to radioactive properties of the material mentioned in connection with it—in this case, radium. The dictionary definition of a poison is "any agent which, introduced into an organism, may chemically produce an injurious or deadly effect." 87 Adopting this definition, the term radium

87 Webster's New Collegiate Dictionary.
poisoning would make compensable only those diseases wherein some toxic consequences were produced chemically from the ingestion of radium compounds, thus excluding injuries caused by external or internal radiation. However, most of the statutes which adopted the words "radium poisoning" did so after the injuries suffered by the radium dial painters in New Jersey were publicized. Thus, it would appear that this language was directed toward covering that sort of injury. Since the injury was not due to the toxic nature of the radium material, but due to its radioactive properties, it is quite likely that the legislature meant to provide compensation for any harm caused the body by ingestion of radium. However, this is a disputable point. Some of the statutes have avoided this difficulty through the use of the word "disability" instead of the word "poisoning." Regardless of the scope of the term "poisoning," the language of the statute is obviously limited to injuries involving use of radium compounds only, and the language could be construed to exclude compensation for occupational diseases due to contact with other radioactive substances.

Accordingly there are several types of radiation injuries not covered by the North Carolina statute. One class not covered is that caused by the particle accelerators which produce high energy radiation, such as the cosmotron, the betatron, the cyclotron, the synchrotron, and the Van de Graaff machine. The development of cataracts due to chronic exposure to neutrons suffered by the scientists who experimented with the cyclotron at the University of California illustrates the possibility of such machines producing injuries which under a properly drafted statute could be classified as occupational diseases. Similarly, the statute does not cover injuries caused by types of radiation other than X-rays, such as alpha, beta, and gamma radiation.

Another type of radiation injury not made compensable under the language of the North Carolina statute is that which might be caused by the nuclear reactor or atomic pile. The nuclear reactor and the chemical separation plant needed to process the fuel elements are sources of tremendous amounts of radiation. Since it is anticipated that nuclear reactors will be used extensively in research, in the production of electricity, and otherwise, it would seem that a considerable number of injuries might be anticipated from these sources. The North Carolina statute makes no reference to injuries from such sources either specifically or by reference to "fissionable" material.

Texas. The state of Texas provides another variation in the statutory language concerning the atomic energy injuries considered com-
pensable as occupational diseases. The Texas occupational disease law reads in part as follows:

Wherever the terms "injury" or "personal injury" are used in the Workmen's Compensation Law of this state, such terms shall be construed to mean damage or harm to the physical structure of the body and such diseases or infection as naturally result therefrom. Unless from the context the meaning is clearly to the contrary, such terms shall also be construed to mean and include occupational diseases, as hereinafter defined. The following diseases only shall be deemed to be occupational diseases: (a) Poisoning by: (separate and distinct items are listed including, for example, arsenic, chlorine, cyanide, hydrochloric acid, lead, nitric acid, phosphorus, sulphuric acid, and zinc) . . . (h) Diseased condition caused by exposure to x-rays or radioactive substances . . . .

Under this language it is readily apparent that the coverage is much broader than that afforded under the North Carolina legislation. Although the Texas occupational disease law was enacted in 1947, indicating that the legislature should have been aware of the possibility of injuries through the new uses of atomic energy, a number of problems may be raised concerning the adequacy of the language. For example, do the words "diseased condition" apply only to a degenerative physical condition so that atomic injuries such as cancer and leukemia are covered but sterility is not? In resolving this question, it should be kept in mind that some of the early cases of injury from radioactive materials involved scientists who had experienced dermatitis and cancer. Also, the nature of the injuries received by the radium dial painters was such that the injury or disease grew progressively worse as time passed. In view of the fairly recent date of the Texas legislation, it is likely that the term "diseased condition" would be broadly construed to include all atomic energy injuries otherwise compensable under the statute. Moreover, the tendency on the part of the courts to give a liberal interpretation to the language of the workmen's compensation and occupational disease statutes could induce a court to take this broader view.

A number of questions may be raised concerning the meaning of "exposure to x-rays or radioactive substances." It may be argued that the language covers only exposures to external sources of radiation. Because the radiation injury which is compensable, i.e., the "diseased condition," is accompanied by the phrase which links exposure to X-rays

and exposure to radioactive substances conjunctively and because exposure to X-rays can only be by external exposure, it may be that only external exposure to radioactive substances was contemplated. Moreover, because those instances of poisoning intended to be compensable are grouped together under another subheading, the failure to include certain radioactive materials which also have toxic effects may be interpreted to mean that, if such materials should result in toxic damage, the poisoning would not be compensable. Therefore, the scope of coverage for injuries resulting from ingestion of radioactive materials, either because of their emission of radiation or because of their toxic effect, remains conjectural.

More important is the question as to whether or not the fuel which "burns" in a nuclear reactor, or the nuclear reactor itself, can be termed a "radioactive substance." A radioactive element such as radium, or an artificially produced radioisotope like cobalt 60, is designated as radioactive because it is undergoing internal decay and in the process is giving off radiations of one kind or another. But what about neutron bombardment from a nuclear reactor? It is questionable whether the nuclear reactor itself could be thought of as a radioactive substance, because, for one thing, the reactor needs more than simply "a substance," i.e., the uranium metal, in order to operate. Highly refined moderators, control rods, and cooling devices are essential to the operation of a reactor. Conceding that the uranium or plutonium is radioactive, and that the nuclear reactor would give off some radiation from "substances," this would be insignificant compared with the radiation resulting from neutron beam exposure. The functioning of the nuclear reactor does not depend upon the radioactivity of uranium 235, but upon its fissionable quality. Therefore, it would be more correct to speak of radiations given off from a nuclear reactor as being due to "fissionable substances" rather than to radioactive substances. On this basis, the statutory language "radioactive substances" seemingly would not include exposure to neutron radiation from a nuclear reactor. Similarly, the Texas statute apparently provides no coverage for those injuries which may be due to exposure to radiation produced by any of the high energy machines, such as the cyclotron.

Arizona. Another example of a statute supplying coverage for occupational diseases by setting forth a schedule of compensable diseases is that of the state of Arizona. This statute which was adopted in 1943 reads:

For the purposes of this Act only the diseases enumerated in this section shall be deemed to be occupational diseases: . . .
The injuries covered under this statute are limited to only those caused by prolonged exposure to either X-rays or radium emanations. This limitation means the exclusion of many potential radiation injuries previously discussed in respect to other statutes. The different concept introduced by the Arizona statute is that of "radium emanations." There are two possible meanings of this term. The one which seems most plausible is that radium emanations are the rays given off by a source of radioactivity consisting only of radium. In other words, the emphasis is on the material, radium, and not on the qualities of the radiations. The other possible interpretation would include in the term all rays given off from any radioactive material, not only those from radium. The question is: Were the words "radium emanations" intended to mean the "type of rays" given off by any radioactive material or just those from radium? Would gamma and beta rays given off from cobalt 60 come within this language as well as gamma and beta rays given off by radium? An affirmative answer would appear to be an unwarrantable construction of the language. When the language was adopted in 1943, not much was known about the possibility of using other forms of radioactivity. The fact that other radioactive substances could be produced, which would give off the same types of rays as are given off by radium, was not general knowledge. Therefore, the coverage of occupational diseases provided for by this act is probably limited to those injuries caused by exposure to either X-rays or radium.

Another limitation is imposed by the statement of the nature of the injury for which recovery will be permitted. The act lists as compensable items, "ulceration of the skin and destruction of tissue." Since an ulcer is described as anything that festers and corrupts like an open sore, "ulceration of the skin" should cover an injury, such as cancer, that could occur to the skin through exposure to radioactivity. Whether heavy scar tissue would be included is questionable. There is also a question concerning the language "destruction of tissue." Is this broad enough to cover an injury that occurs to the cells, to internal organs such as the spleen or liver, or to the bone marrow? Tissue is defined biologically as an aggregate of cells, with its intercellular substance, constituting one of the structural materials of a plant or animal: for example, epithelium tissue, nerve tissue, muscular tissue, and connective tissue.

40 "Roentgen rays" are X-rays.
Thus, since tissue encompasses any of the structural materials of the body, it probably is broad enough to cover injury to any of the organs of the body and to the bone. It would not include damage to individual cells, as in the blood, but since blood deficiencies and excesses are usually a consequence of damage to blood producing organs, adequate coverage may also be provided by the definition. Though some of the atomic energy injuries, such as cancer, are not really a destruction of tissue but rather a malignant growth of tissue, they probably would be covered if the statute is given a liberal interpretation.

In summary, the Arizona statute covers only injuries caused by exposure to either X-rays or radium. It does not cover injuries from other sources of radioactivity now available in the form of radioisotopes, nor is there coverage for injuries due to such instrumentalities as the nuclear reactor. Except for the X-ray machine, no coverage is provided for injury which can be traced to radiation given off by any of the high energy machines.

Idaho. The schedule set out by the Idaho statute to provide compensation for radiation injuries reads as follows:

Compensation as provided in this chapter shall be payable for disability or death of an employee resulting from the following occupational diseases: . . . (6) radium poisoning by or disability due to radioactive properties of substances or to Roentgen ray (X-ray) in any occupation involving direct contact therewith, handling thereof, or exposure thereto.  

This language, although adopted in 1939, would appear to cover most of the possibilities of injury by radium, X-rays, or radioactive materials, because it speaks of both poisoning and disability. However, toxic injuries are not included because the “poisoning” or disability must be due to the radioactive properties of substances, not their chemical properties. Thus radium poisoning is made to refer expressly to the radioactive injury caused. There is nothing in the language which would cover the neutron radiation given off from a nuclear reactor, because such injuries would not be “due to radioactive properties of substances,” but to their fissionable qualities. Nor is there any coverage provided for injuries due to high-energy machines.

This statute, by using the words “in any occupation involving direct contact therewith, handling thereof, or exposure thereto,” makes compensability also depend upon employment in such an occupation. Would this statute provide compensation for the office worker who happened

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41 Idaho Code §72-1204 (1949).
to be in an area close to a radioactive substance? Would his occupation be deemed to involve "exposure" to the radioactive material? His exposure would simply result from his having performed his duties in a radioactive area. If the statute is interpreted to provide compensation only for those occupations where, as a part of one's duties, there is direct contact with, handling of, or exposure to radioactive materials, it is conceivable that many radiation injuries will be excluded.

b. Recent Legislation

*New Mexico.* Some of the states which have utilized the schedule type of compensation law have attempted recently to modify their statutes to provide more complete coverage for radiation injuries. The New Mexico law, as amended in 1957, serves as an example:

For the purpose of this act only the diseases enumerated in this section shall be deemed to be occupational diseases: . . .

(27) ulceration of the skin or destruction of tissue due to prolonged exposure to roentgen rays or radium emanations . . .

(32) diseases contracted by virtue of work connected with and directly traceable to fissionable materials or radioactive materials and not specifically listed herein.42

Since we have discussed statutory language similar to that used in item 27 of this statute, we will not dwell upon the scope of its coverage, except to say that it is apparently limited to injuries caused by exposure to radiation either in the form of X-rays or that emitted by radium. The new provision in item 32 includes any diseases which can be traced directly to "fissionable" materials. Undoubtedly the legislature had in mind the desirability of adding injuries resulting from the new uses of atomic energy. Any injury due to an explosion, such as the setting off of an atom bomb, or even the inadvertent reaching of the critical mass of fissionable material, probably would be pin-pointed in time and would doubtless be covered under the workmen's compensation law as an "injury by accident," as distinguished from an occupational disease. Therefore, it seems that the legislature intended to make compensable occupational diseases caused by the operation of a nuclear reactor.

What is the meaning of "fissionable"? Does it include any element which can undergo the fission process, in the sense of being split into two or more fragments, or does it apply only to those elements able

42 N.M. Stat. §59-10-45; N.M. Laws 1957, c. 246, §10.
to sustain a chain reaction? A statement from Glasstone indicates that the word is used by scientists in the former sense:

Until 1947, fission had not been observed in any element of atomic number less than 90, but in that year successful fission of bismuth, lead, thallium, mercury, gold, platinum and tantalum was achieved in the Radiation Laboratory, Berkeley, by means of alpha particles, deuterons or neutrons of very high energy. . . .

If this broad meaning is given to the word "fissionable," then the statute would cover diseases caused by many of the elements. However, it would seem more likely that the legislature intended to adopt the interpretation of that word as it is used in the Atomic Energy Act of 1946. They probably meant to include within the term "fissile materials" only those materials capable of sustaining a chain reaction, such as thorium, plutonium, or uranium 235. Another question raised by the language of item 32 is: Would an injury caused by fissionable material be compensable when caused by radioactivity or toxicity, rather than by the fissile quality? For example, when plutonium is ingested, it has a very deleterious effect upon the body, both of a toxic and of a radioactive nature. The language is probably broad enough to include such injuries. It should be noted, however, that injuries arising in connection with thermonuclear (or fusion) processes may not be covered.

**Colorado.** On March 28, 1951, the state of Colorado added item number 22 to its list of compensable occupational diseases:

The following diseases only shall be deemed to be occupational diseases, and compensation as provided in this act shall be payable for disability or death of employee resulting from such diseases and from no others: . . . (22) poisoning or disease caused by exposure to radioactive materials, substances, or machines, or fissionable materials.

The words "poisoning or disease" are comprehensive enough to cover the possibility of injury by exposure to an external source of radiation. Also covered are injuries by ingestion of the material, causing either toxic or radiation damage or both. The descriptive wording of the sources of injury intended to be covered, i.e., "radioactive materials, substances, or machines, or fissionable materials," is quite comprehensive. This language should be adequate to cover any disease or injury caused by exposure to any of the radioactive or fissionable materials.

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with which we are now acquainted. On the whole, this statute represents one of the better attempts to describe comprehensively the instrumentalities which may produce radiation injuries.

Conclusion. In nearly every state having schedule type coverage for occupational diseases, the existing statutory language is either non-existent or unduly restrictive in coverage of atomic injuries that may be classified as occupational. In view of the fact that many delayed and cumulative radiation injuries will often not be compensable as "injuries by accident," amendatory legislation broadening the coverage for radiation injuries as occupational diseases is indicated, following the example of Colorado.

c. The Requirement of Causal Connection in Schedule Type Statutes

The showing of causal connection between the injury or disease and the employment is a requirement which appears to be highly regulated in some of the statutes providing for a schedule of occupational diseases. An example is the statute of New Mexico which reads:

The occupational diseases hereinafter defined are deemed to arise out of the employment only if:

A. There is a direct connection between the conditions under which the work is performed and the occupational disease; and

B. The occupational disease can be seen to have followed as a natural incident of the work and as a result of the exposure occasioned by the nature of the employment; and

C. The occupational disease can be traced to the employment as the cause; and

D. The occupational disease does not come from a hazard to which the employee would have been equally exposed outside of the employment; and

E. The disease is incidental to the character of the business and not independent of the relation of employer and employee, (the disease need not have been foreseen or expected, but, after its contraction, it must appear to have had its origin in a risk connected with the employment, and to have flowed from that source as a natural consequence). . . .

Under this law an employee with a radiation injury may have extreme difficulty proving causation even though the injury appears on the schedule. The same considerations discussed previously in connection with the proof of causal connection under statutes providing coverage

of all occupational diseases apply in the case of statutes employing schedule type coverage.

3. Voluntary Coverage

Finally, some of the states have provisions whereby the employer may elect coverage of "all occupational diseases" in lieu of the schedule. The Tennessee statute provides:

Any employer may, in lieu of the schedule of occupational diseases enumerated in section 30-1101, reject the same and elect by written declaration filed with the division of workmen’s compensation, department of labor, on a form provided by it, to be bound in accordance with the Workmen’s Compensation Law by the provisions of this section and section 30-1104 relating to full coverage of all occupational diseases. Thereupon the employer shall be liable for all occupational diseases arising out of and in the course of the employment pursuant to all the provisions of the Workmen’s Compensation Law.46

This provision has already been acted upon by the contractors of the Atomic Energy Commission operating the Oak Ridge installations, thereby affording compensation for radiation injuries not covered by the compulsory coverage provisions of Tennessee law. In those states where there may be some reluctance to expand the occupational disease statutory provisions to include all types of atomic radiation injuries, it would be desirable to at least permit expanded voluntary coverage, and it is to be hoped that atomic energy entrepreneurs would take advantage of the opportunities thereby afforded for satisfactory compensation of such injuries.

C. Successive Injuries and Second Injury Funds

Among the problems besetting modern workmen’s compensation legislation is the case of two physical disabilities overtaking one man at different times and while in the employ of different employers. The combined effect of the injuries may be catastrophic although each accident by itself would give rise only to partial or total but only temporary disability. The typical example is the case of a man who loses the sight of one eye at one job and his other eye later at another job, thus becoming permanently and totally disabled. The vexing question in such instances is whether the last employer should bear the cost of compensa-

tion for the whole final result or whether a system of apportionment of
the loss among several employers ought to be used. The consequence of
failing to provide a sharing of the cost may be the resort to discrimina-
tory practices against previously injured workers, who present too great
a financial risk, by refusing employment because of a prior minor injury.

Three general approaches to this problem are followed in American
compensation statutes. The so-called “full responsibility” rule prac-
tically ignores the difficulty and places liability for the entire result on
the employer in whose employment a worker became disabled. At the
other extreme under some apportionment statutes the last employer is
held liable only for the amount of the injury suffered in the second
mishap, and the cumulative effect of the accidents is ignored.

Most states, including several having apportionment statutes, the
District of Columbia, Hawaii, Puerto Rico, and the Longshoreman’s
Act, have sought to achieve equitable compensation for employees and
fair relief for employers by instituting so-called second injury funds,
under which usually an employer is held liable for the portion of dis-
ability arising out of the injury which occurred in his employment,
while the fund contributes the difference between that amount and the
total amount to which the combined effects of the two injuries entitle
the worker. These funds are financed in different ways. Usually they
are supported by charges imposed upon employers or their insurance
carriers in cases of death of employees without dependents. Some states
provide funds by assessments against carriers based on total premiums
collected or on compensation payments. A small number of states sup-
port the funds by special appropriations from the legislature.

In appraising the adaptability of existing second injury fund pro-
visions to injuries suffered in private atomic industry, it should be noted
that some of the second injury fund provisions apply only when the
first injury consists of a listed injury, such as loss of use of an eye, leg,
arm, or other member of the body, which causes a permanent partial
disability, and the second injury produces the cumulative result of
permanent total disability through loss or loss of use of another member.
In other states, however, the second injury fund provisions are not
limited in their application to listed injuries compensable under the
fixed schedule of benefits. But even where the statutes are not limited,
some courts have stressed that the prime objective of the statutes is
maintaining the unimpaired competitive position of workmen in the

47 The only states which do not provide for a second injury fund are Florida,
Georgia, Louisiana, Nevada, New Mexico, and Virginia.
labor market and have denied the applicability of second injury fund provisions where the prior injury had no effect on the subsequent employment or where the "second injury" caused a prior non-disabling injury to become disabling. If the second injury fund provisions are not applicable, the last employer is held liable for the whole injury since the nearly universal principle is that an employer takes an employee as he finds him, and if an injury causes a disability aggravated by a previous latent condition, the entire disability is compensable without weighing the relative contributions of the two injuries. 48

Illustrative of the cases imposing liability on the last employer for the entire extent of the ultimate injury is the case of Scott v. Alaska Industrial Board. 49 There the worker had been employed in mines since 1906 with the exception of several years in construction work. Prior to his disability he had worked in plaintiff's mine for thirty months. His prior injury was silicosis which, however, had not yet manifested itself at the time plaintiff hired him and therefore could not have placed him at a disadvantage when seeking new employment. The new injury was pneumonia, which, superimposed on silicosis, caused permanent total disability. The employer was held not to be entitled to recover from the second injury fund the portion of compensation covering effects in excess of the disability caused by pneumonia only. The court was clear that recovery could be had under the statute only when the prior disability or injury was "obviously manifested" so that the employer may have been deterred from hiring the worker. In addition, where the second accident or disease merely precipitates and renders disabling a prior non-disabling condition, it was the opinion of the court that the second injury fund legislation was inapplicable.

Radiation injuries are known to cause gradual deterioration of human tissues, and often the date of disability is postponed indefinitely. Certainly they are not of the type that will normally cause the immediate loss or loss of use of a member of the body except when amputations are necessary. Moreover, the possible cumulative effects of irradiation are not yet easily assessable. It is impossible for employers to appraise the financial risk involved in employing personnel with prolonged experience in atomic energy work, and yet skilled and experienced men offer the highest technical value. We must add to this the fact that the nature of atomic industry is such that irradiation of personnel often

48 Only three states have special statutes on aggravation of disease: California Labor Code §4663; Kentucky Rev. Stat. §342.005(1); North Dakota Rev. Code §65-0102(8).
cannot be totally eliminated, but only reduced to levels believed to be safe. Consequently, a person applying for work in other than his original place of employment in atomic industry may be suspect to a prospective employer by reason of his experience in the field. If he has by chance been involved in minor radiation accidents, but has never been disabled even temporarily, it may nevertheless be unsound business practice for the employer to consider him for employment even in those states that do not place full responsibility on the last employer. Such hesitation is made more understandable when we realize that the state of present day knowledge of the biological effects of radiation is far from perfect, and thus atomic industry is deprived of a basic yardstick for calculating the gravity of the risk and the duration of possible complications and their financial import in terms of workmen's compensation liability. Nevertheless, if the lack of adequate second injury fund provisions, as applied to atomic energy injuries, tends to restrict the potentialities of employment of employees suffering prior radiation injuries, liberalization of the applicability of the second injury funds seems warranted.

D. Apportionment of Liability in Occupational Disease Cases

The problem of occupational diseases incubating for years before they cause a disability, with the victim engaged in several employments in the meantime, is similar in nature to the difficulties which inspired the creation of second injury funds. Its significance in relation to private atomic energy industry is apparent, for radiation diseases frequently and, indeed, normally develop slowly, a fact which is demonstrated by the medical histories of persons exposed to excessive amounts of radioactivity. Such cases threaten to be among the most troublesome from the compensation point of view.

Under present American statutes most courts impose liability on the employer or insurance carrier who assumed the risk as of the time when the disease caused the disability, so long as the employment at that time was of a kind contributing to the disease, regardless of the fact that the condition was caused in part through employment by more than the last employer. As an example, Willingham v. Bryan Rock & Sand Co. may be cited.\(^6\) In that case the deceased worker died of silicosis. He had previously been twenty years in the employment of the person against whom the claim for compensation was filed. Following his first employment, he was hired by a second employer for five months, and it was

\(^6\) 240 N.C. 281, 82 S.E. 2d 68 (1954).
during this employment that he became totally disabled from the disease. The second employer was joined as a defendant in the pending compensation case against the first employer and was held solely liable.

Though the last employer is held liable to the employee for the total effect of a gradually maturing disability, several statutes nevertheless provide for procedures whereby an apportionment of liabilities may be had among previous employers whose employments contributed to the disease. The contribution to which each of several employers is subjected normally depends on the length of time spent in each employer's service, although Minnesota has adopted a system under which the compensation board can take into account the safety standards maintained by each employer in computing the share of contribution of each employer. This system ought to appeal greatly to framers of compensation legislation for the atomic industry because of the incentive it provides to maintain the highest safety standards.

California has adopted an apportionment scheme by judicial decision. Under it a worker may recover fully from any insurance carrier who has assumed the risk at anytime during the long period of incubation of the disease, and the carrier may recover contributions from other carriers who insured the worker at some time during the several employments.

The administrative difficulties of the apportionment rule in cases in which the period of incubation may last for years or even decades, as it may in radiation diseases, and the virtual impossibility of showing the proper causal relationship between injuries and employments in which exposures to radioactivity occurred years prior to the disability, may render the apportionment system as applied today rather unsatisfactory when the attempt is made to enforce it in radiation injury cases. But, on the other hand, the adoption of the rule imposing liability only on the last employer who may have employed a workman for a relatively brief period of time may be unfair. Statutory provisions to create devices similar to those used in connection with second injury funds and intended to cover cases of slowly maturing occupational radiation-induced diseases are deserving of consideration for they may reduce the problems of providing adequate compensation for employees of atomic industry.


E. Disability and Loss of Earning Capacity

i. General Principles

Workmen's compensation and occupational disease statutes are subject to a limitation which permits compensation only for those injuries resulting in total or partial disability. Unless an injury falls within the definition of "disability," it is not considered compensable regardless of its seriousness. This restriction springs from the very basic policies underlying the adoption of the workmen's compensation and occupational disease acts.

Among the reasons for the adoption of workmen's compensation legislation was the fact that the cost of common law litigation often defeated its purpose. In many cases it consumed a good share of the proceeds of the final recovery of the workman. The time consumed in such litigation, moreover, made it difficult for the employee to pay his medical bills or support his family pending the outcome. Furthermore, the application of common law defenses to an action based upon negligence of the employer made recovery highly speculative. Confronted with the ever increasing number of injuries due to expanding industrialization, the legislatures concluded that the cost of support and medical care resulting from these injuries should be borne by the industry which created them. Workmen's compensation and occupational disease laws were thus intended to make industrial employers "pay their way" and to reduce litigation to a minimum.

Notwithstanding these factors underlying the adoption of all workmen's compensation and occupational disease legislation, there has been confusion regarding the basis for making awards for injuries. Some legislatures have been concerned with making awards for injuries which left employees in an impaired physical condition. Other legislatures have been more concerned with whether the employee was subsequently able to maintain his prior earning power, regardless of the injury he had received.\(^5^a\)

In a tort action for personal injury, an "injury" to the person must be shown. Under compensation statutes a showing of "disability" is required to support an award. "Damages" in tort law and "compensa-
AND RADIATION INJURIES

Injuries under the statutes are different concepts. Therefore the extent to which atomic energy injuries will constitute compensable disabilities, taking into consideration the definitions used by the legislatures and the interpretations of the statutory wording by the courts, warrants examination. Generally speaking, a personal injury, while normally sufficient grounds for tort liability in another setting, may not be enough to entitle the injured person to compensation.

In deciding what constitutes either a total or partial disability, it should be recognized that there are two determinants: (1) actual physical disability which is determined by the reduction in ability of the claimant to use his body after the injury, e.g., the inability to see because of cataract or to move because of muscular damage; and (2) loss of earning power which is determined by the extent to which claimant's injury subtracts from his attractiveness in the labor pool. These factors are corollary to the policy considerations which prompted the adoption of the workmen's compensation and occupational disease acts.

In most instances, both physical disability and inability to earn the same wages occur simultaneously. But this is not necessarily the case. At one extreme, it is conceivable that a workman can be made an almost totally handicapped person, such as a quadruple amputee, but yet, by perseverance and ingenuity, he may be able to earn a livelihood. Common sense would suggest that a man who has lost his arms and legs has suffered a serious decrease in his earning capacity. It would seem that the harm he has suffered physically should entitle him to compensation on the ground that his capacity to earn has been destroyed so far as his competitive position with his fellow workers is concerned. To deny him compensation because he develops a new means of earning a living would be to penalize a person who is more industrious and imaginative than the average. On the other hand, it is likely that a worker who has suffered an injury which only slightly impairs his physical activity may not be able to find employment, and therefore has suffered a severe diminution of his wage-earning capacity. This latter situation may very well be the case when occupational disease is involved, especially if this is likely to be true in radiation overexposure cases. Since such radiation exposures have a cumulative effect, another atomic energy employer may refuse to hire a man who has been previously overexposed, for only a little additional exposure, even though small in amount, may produce disability. The last employer may have to bear the compensation payments because, as was noted in the preceding section, under most of the occupational disease laws the last employer is responsible for the entire compensation.
For classification purposes a four-fold subdivision of compensable disabilities has been established. These are temporary total, temporary partial, permanent total, and permanent partial disability. Ordinarily, there is little controversy regarding the loss of earning power under the categories of temporary partial or temporary total disability. The actual wage loss of the disabled employee can be determined directly from the amount of time and wages the employee has lost. Permanent partial and permanent total disabilities raise more complex questions in both accidental injury and occupational disease areas. In these instances, it becomes necessary to determine the employee's earning capacity after the condition created by the injury has stabilized.

The first problem in dealing with atomic energy injuries is to determine how they will be classified as disabilities. Then, it must be determined whether the disability is to be measured under the statutes on the basis of physical condition or loss of earning power, or both, in order to appraise the suitability of the solutions in respect to radiation injuries.

2. Application of General Principles to Atomic Injuries

a. Temporary Disabilities and Atomic Injuries from Accidents

Typical of the atomic energy injuries, which seem most likely to fall into the category of temporary disabilities, either partial or total, are the aftereffects, other than death, of a large single accidental over-exposure to radiation. Radiation illness, due to a large overexposure to radiation, goes through four phases within a period of months, after which the immediately apparent effects either disappear or are latent. During this period, the employee may be totally incapacitated. In determining the amount of compensation for temporary disabilities, the problem becomes one of ascertaining the extent of the "disability" (unless this particular injury has a prescribed compensation listed in a statutory schedule). "Disability" as used in a particular statute might mean either or both of the factors hitherto named, i.e., physical incapacity or loss of earning capacity. However, in the temporary disability situation, the emphasis will be on loss of current wages. No forecast as to the employee's loss of earning capacity in the future is

Typically, workmen's compensation statutes provide a specified weekly benefit for temporary disabilities requiring loss of earnings and prescribe a maximum total compensation. For example, see N.Y. Workmen's Comp. Law §15. It would be possible to prescribe a fixed number of weekly benefits for a specific injury, however.
necessary as would be true in the case of a permanent disability. In the case of acute overexposure to radiation, the effects are likely to be severe enough to warrant the assumption that the claimant will not be able to earn anything for the period of the disability. If the particular injury does not cause any loss of wages, compensation probably will not be awarded because of the emphasis in temporary disability cases on actual wage loss.

b. Permanent Disabilities and Atomic Injuries from Accidents

The atomic energy injuries which seem more likely to fall into the categories of permanent partial or total disabilities are those of sterility, genetic damage, leukemia, leukopenia, cancer, and shortened life span. The "distinctive radiation injuries," such as sterility, genetic damage, or shortened life span, may not fall within what is generally considered a "disability," although the damage is permanent. This results from the fact that these injuries may not result in wage loss or physical deterioration which affects the overall earning capacity. If the particular requirements of the statute as to a loss of earning capacity are not met, then regardless of whether the statute otherwise includes such an injury within its scope, no recovery will be allowed.

In respect to those radiation injuries, such as cancer, which may be classified as permanent partial disabilities, most states determine benefits on the basis of decreased earning capacity, disregarding actual wage loss. This will create some problems in relation to radiation injuries unless they are covered by a schedule which provides a definite amount of compensation. For example, certain seemingly permanent atomic energy injuries, such as cancer, leukemia, leukopenia, and bone necrosis, while definitely constituting physical impairment of the body, may not result in decreased earning power in the immediate period after they are contracted. That these injuries should qualify as physical disabilities affecting earning power can be illustrated by the likelihood that if a person had cancer, even though medical treatment temporarily arrested its development, his chances of future employment would be lessened. Since another employer would not be likely to hire him, the cancer would cause an actual decrease in the employee's earning potential thus warranting compensation.

The experience in Illinois demonstrates the typical judicial construction given to statutes which determine disability in terms of loss of earning capacity. Prior to 1955 the Illinois statute read:

If, after the accidental injury has been sustained, the employee as a result thereof becomes partially incapacitated from pursu-
ing his usual and customary line of employment, he shall, except in cases covered by the specific schedule set forth in paragraph (e) of this section, receive compensation . . . equal to fifty per centum of the difference between the average amount which he earned before the accident and the average amount which he is earning or is able to earn in some suitable employment or business after the accident.\textsuperscript{56}

The purpose of the statute was stated in \textit{Ridge Coal Mining Co. v. Industrial Commission}:

The purpose of the act is to as nearly as possible give the injured employee fifty per cent of the difference between what his earnings would have been had he not been injured and what he is earning or is able to earn subsequent to the injury.\textsuperscript{56}

In that case an employer sought to terminate compensation payments on the theory that the employee subsequently was earning higher wages. The employer did not introduce any evidence of the employee's physical condition. The court held that:

Since the plaintiff in error has contented itself with presenting testimony only concerning the wages of the defendant in error, and has offered no other evidence concerning the condition of the defendant in error, its evidence is not sufficient to justify a holding that the disability of the defendant in error has ended.\textsuperscript{67}

Thus the court interpreted the statute to mean that the employee's physical condition must be ascertained, regardless of his earnings, before an award will be terminated.

In a decision rendered by the same court the following year upon a petition to reduce an award on the ground that in a new position the employee had been able to work more days and thus earn more money than he would have earned had he continued in his former occupation, the court said: "Compensation is not based on physical or mental disability, except as it affects earning capacity, nor on opportunity to work, but is based on previous earnings and earning capacity and is measured by the loss of such earning capacity due to the accident."\textsuperscript{58} In a very recent case, however, involving an attempt by an employee to base his


\textsuperscript{57} Id. at 517.

\textsuperscript{58} Consolidated Coal Co. of St. Louis v. Industrial Commission et al., 314 Ill. 526, 528, 145 N.E. 675 (1924).
claim for compensation upon the fact that his wages were now less than formerly, if overtime pay were excluded, the same court stated: “The object of this provision is to compensate the injured employee for his reduced earning capacity and, if any injury does not reduce his earning capacity, he is not entitled to compensation.” From these cases, it can readily be seen that the earning capacity test cannot be easily applied in instances where there was no actual wage loss although some physical impairment could be demonstrated. For “distinctive radiation injuries,” such as shortened life span and sterility, providing compensation under the loss of earning capacity test will be even more difficult unless statutes are amended to cover such cases in schedules or otherwise.

Wisconsin has a provision in its statute which may have the effect of permitting coverage of most atomic energy injuries. The Wisconsin statute establishes a schedule of specific disabilities and relative disabilities and makes allowance for disfigurement. It also states:

For permanent partial disability not covered by the provisions of sections 102.52 to 102.56 [schedule, application of schedule, and disfigurement] the aggregate number of weeks of indemnity shall bear such relation to the number of weeks of indemnity set out . . . as the nature of the injury bears to one causing permanent total disability and shall be payable at the rate of 70 per cent of the average weekly earnings. . . . By this language, an injury is made compensable on the basis of how much the injury tends to impair, percentage-wise, bodily function. Interpreting this language, the court has stated that the legislature intended to put this kind of permanent partial incapacity on the same plane with scheduled injuries. The effect of this is to make an injury compensable much in the same manner as is true in the case of the regular scheduled injuries. In a recent case the court stated:

The general scheme of the statutes following the development of schedule and relative injuries, all of which constituted a permanent partial disability, indicates that the legislature was concerned with bringing nonschedule and nonrelative disabilities into conformity with schedule and relative disabilities. . . . Such a construction leaves no disparity between schedule and relative injuries on the one hand, and nonschedule injuries causing permanent partial disability on the other. This also conforms to the practical necessities. During the healing period it is possible to establish a wage loss because that is a past event. But since an award for permanent disability is to

89 Sroka v. Industrial Commission et al., 412 Ill. 126, 128, 105 N.E. 2d 716 (1952).
be made for all time at the end of this period it must be based upon some sort of prediction as to impairment of earning capacity. It appears to us that the legislature has specifically chosen in the case of nonschedule permanent partial disabilities the method of comparing the severity of the injuries causing such a disability with those causing permanent total disability.\(^{61}\)

The case involved a salesman who had injured a vertebral disc while lifting a refrigerator during a demonstration for a prospective customer. Following an operation to alleviate his condition, he again resumed his occupation as a salesman at higher wages than before the injury. In this situation, the employee continued in the same work as prior to the injury, and he earned more money, yet he was classified as permanently partially disabled to the extent of twelve and a half per cent, due to the loss of some motion in the spine. It would seem that the award was really made because of the physical disability with its resulting effect on the competitive earning capacity of the employee.

Since the court construed the statute to mean that the legislature intended to put nonschedule injuries on the same plane with schedule injuries, it appears that the award was made without reference to whether any diminished earning capacity is foreseeable. This treatment would permit compensation for atomic energy injuries because the commission could simply consider the particular injury the employee had suffered and could decide that it amounted to some percentage of total disability. The employee would then be compensated on this basis without having to overcome the obstacle of showing his earning capacity had been specifically decreased. The effect is similar to that of listing atomic energy injuries in the schedule. Even this type of statutory provision, however, may be difficult to apply in respect to such injuries as shortened life span and sterility. Moreover, as applied to atomic energy injuries, insurance companies may have difficulty in preparing contracts that are actuarially sound.

Generally, the post injury earnings used as the basis for computing decreased earning capacity are those the injured employee is able to earn in “any” kind of employment. However, a few states use earning capacity “in the same employment” as the basis for computing the difference between prior and subsequent earnings. The advantages of the latter approach to an employee are apparent. It would be quite possible for a highly skilled craftsman to receive injuries that compel

\(^{61}\) Northern States Power Co. v. Industrial Commission, 252 Wis. 70, 75-76, 30 N.W. 2d 217 (1947).
him to discontinue his particular craft. However, if he is able to obtain employment as a common laborer, he might be able to earn some wages for the period which elapses before he has to file his claim. If wages earned in "any" employment were the criterion, the commission would be obliged to use his potential earning capacity as a common laborer in determining the disability award. In respect to atomic energy workers, the advantage of special training might be lost if an overexposure is suffered which prevents continuing in the same job. The loss of the value of this special training might go uncompensated if the employee were able to earn equivalent wages under a statute which used "any employment" as a basis of comparing a loss in earning capacity.

Michigan defines disability by reference to the same employment. The statute states:

The word "disability" means the state of being disabled from earning full wages at the work in which the employee was last subject to the conditions resulting in disability. . . .

In a case which arose under this statute an employee who had been employed as a motor tester suffered an arm injury which rendered his arm useless. Subsequent to his injury, he was employed as a motor inspector at a slightly higher rate of pay. The court held that though the occupations of the employee prior and subsequent to his injury were closely related, they were not identical and the statute explicitly provides that ability to work at the same employment is the statutory test. The court stated:

Again, we must hold that this raises an equitable question barred from consideration as the law now stands, and we cannot hold that it was error for the board to award him compensation on the ground that from the time of the accident he was wholly incapacitated from earning any wages in the employment in which he was engaged at the time of the accident.

Therefore, under Michigan law, an employee suffering an atomic energy injury preventing continuation in the same work would qualify as disabled.

While the preceding discussion concerning the Michigan treatment of compensability is limited to a consideration of whether the injury is within the statutory definition of a compensable disability in the first

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instance, subsequent earnings of the employee are taken into consideration under that part of the Michigan statute which provides:

The weekly loss of wages referred to in this act shall consist of such percentage of the average weekly earnings of the injured employee computed according to the provisions of this section as shall fairly represent the proportionate extent of the impairment of his earning capacity in the employment in which he was working at the time of the injury, the same to be fixed as of the time of the injury, but to be determined in view of the nature and extent of the injury: Provided, The compensation payable, when added to his wage earning capacity after the injury in the same or other employment, shall not exceed his average weekly earnings at the time of such injury.64

Interpreting this proviso, the Michigan court in Markey v. S. S. Peter and Paul's Parish65 held that where the employee was regularly earning more money in a new and permanent employment subsequent to the injury, the proviso became operative, and the employer was entitled to an award stopping compensation.

At first glance it would seem that under this type of legislation if the employee subsequently earns equivalent or better wages, he will be denied compensation. However, in Michigan, once the employee is classified as having a compensable disability because he can no longer earn full wages at his old employment, he becomes entitled to compensation. From this point on, in order to stop payments, it is necessary for the employer to show that the employee is again holding a job which yields equal or higher wages. If such employment should cease, the employee does not have to show any actual change of physical condition to have the compensation restored. The policy underlying this approach is to encourage rehabilitation of the injured employee. This system would seem highly suitable to meet the needs of employers and employees in private atomic industry where, undeniably, injuries may have a marked impact on one's earning capacity in the indefinite future though no serious diminution of earning ability may result in the immediate or intermediate future, and, yet, on the employer's side, it may be considered fair not to burden an enterprise on account of damages which have not yet materialized. Of course, an extension of the limitations period for recovery may be necessitated to render these remedies meaningful when applied to radiation injuries.

Another provision in many of the statutes which may provide compensation for some of the atomic energy injuries is that which deals with "disfigurement." Under these provisions, compensation is usually allowed, with a maximum limit, in case of any disfigurement to the face, head, neck, or hands, when such disfigurement interferes with the employee's future earning capacity. Such a provision may be used to cover such disfigurements as resulted from the accident which occurred during the Eniwetok experiments. In that case some of the personnel employed during the experiment picked up some "hot" equipment, seriously exposing their hands to radiation. The hands were scarred. If a statute provided compensation for disfigurement to the hands, then such an item would be compensable if it interfered with the individual's earning capacity. Another item which might be included within the term "disfigurement," is that of epilation, or loss of hair. This would depend upon whether the loss of hair is permanent and whether or not it could come within the definition of disfigurement. Where a loss of hair could be shown to result in decreased earning capacity, it might be compensable. Generally, the statutes do not define disfigurement, but instead leave it to the discretion of the commission in each case. The only general limitation is that the disfigurement must be such that it may affect the future earning capacity of the employee or influence a subsequent employer in deciding whether or not to hire the claimant.

c. Occupational Diseases and Atomic Injuries

The question as to the meaning of "disability" also arises in connection with radiation injuries that may be classified as occupational diseases, and problems similar to those discussed in connection with accidental radiation injuries are encountered. Generally speaking, in occupational disease legislation the emphasis is also placed upon diminished earning capacity.

In Michigan, disability is defined in terms of being unable to earn full wages in the same occupation, but the compensation therefore is measured by loss of earning capacity. The statute reads:

The word "disability" means the state of being disabled from earning full wages at the work in which the employee was last subjected to the conditions resulting in disability. . . .

If an employee is disabled or dies and his disability or death is caused by a disease and the disease is due to the nature of

the employment in which such employee was engaged and was
contracted therein, he . . . shall be entitled to compensation
. . . for his disablement . . . all as provided in part 2 of this
act, except as hereinafter stated in this part: Provided, how­
ever, That if it shall be determined that such employee is able
to earn wages in another occupation, which shall be neither
unhealthful nor injurious and such wages do not equal his
full wages prior to the date of his disablement, the compensa­
tion payable shall be a percentage of full compensation propor­
tionate to the reduction in his earning capacity. 67

Thus, when the employee is unable to earn full wages at the work
in which he was last subjected to the hazards of the disease, he will be
considered disabled. However, the compensation he receives will de­
pend directly upon the loss of earning capacity he has suffered.

Under the Wisconsin statute, compensation for occupational dis­
eases is handled the same as for injuries by accident. “Injury” is de­
fin ed as mental or physical harm to an employee caused by accident or
disease. 68 Therefore, the compensation provisions which are applicable
in the case of disability resulting from an injury by accident would
also apply to the case of an occupational disease. The Wisconsin ap­
proach, as discussed in the preceding section dealing with injury by
accident, is that of basing disability payments upon the percentage of
the actual incapacity as related to permanent total disability. The
employee is not disqualified from compensation simply because it can
be shown that at the time of filing the claim he is able to earn more
money than he did at the time of the injury.

In the occupational disease area, some states limit compensability to
those occupational diseases as a result of which the individual is totally
incapacitated, as distinguished from partial incapacity. A reason for
so distinguishing between partial and total incapacity probably lies in
the fear that, if partial incapacity were also made compensable, the
employer would be subjected to many claims for compensation based
upon minor difficulties. For example, the Idaho statute provides:

Except as hereinafter otherwise provided in this chapter,
“disablement” means the event of an employee’s becoming
actually and totally incapacitated, because of an occupational
disease, from performing his work in the last occupation in
which injuriously exposed to the hazards of such disease; and
“disability” means the state of being so incapacitated. 69

69 Idaho Code §72-1205 (1949).
Thus in Idaho the employee who is only partially disabled from an occupational disease would not be able to recover compensation for his disability.

3. Summary

Under both the injury by accident and the occupational disease statutory provisions, there is a requirement that for the injury or disease to be compensable, there must be a "disability." The general approach taken is that a showing of decreased earning capacity satisfies the requirement of a disability. Most of the states also employ schedules which set out specific injuries and the amount of compensation which will be awarded for them. Under the schedule system, it is usually immaterial whether or not any decrease in the earning capacity can be shown. Thus if an item appears on the schedule, it may be compensable whereas otherwise it is not. It should be noted, however, that most of the injuries caused by radiation do not fall within the present coverage of the schedules unless amputation may be involved. In the occupational disease area emphasis is placed upon whether or not the disease only partially disables the employee. Some states require that the employee be totally disabled from performing his last occupation for his disability to be compensable. The extent to which the atomic energy injuries will be prejudiced by statutory language requiring a disability will depend upon the extent that the atomic energy injuries result in disabilities not affecting earnings, or not wholly incapacitating the employee. As of this time, not enough is known of the atomic energy injuries to be able to say positively just what their effect will be. From general considerations of the nature of these injuries, and from the extensive use of monitoring systems, it would seem that many cases of overexposure may be caught in the early stages and result in a job shift of one kind or another. Also some of the atomic energy injuries, such as sterility, will not result in any decreased earning capacity. Therefore, it seems that the disability requirement may exclude some of the atomic energy injuries from compensability.

III. MEDICAL BENEFITS

A. Hospitalization and Treatment Costs

In addition to financial assistance to injured workers, workmen's compensation statutes in the United States provide for hospital and medical care in varying degrees. Roughly one-half of the statutes
grant unlimited benefits as to both amount and period of time, while the remainder limit benefits to certain maximum amounts and periods of time.

In some states full benefits are authorized directly by statute, and in other states, although the statutes set maximum costs or periods of time, equivalent unlimited benefits may result because the workmen's compensation boards are given authority to extend medical aid up to such amounts and for such times as they may consider necessary.

In many of the statutes prescribing medical care that is limited in terms of time or costs, or both, the maximum rates are such that it seems obvious that this legislation was conceived and enacted without consideration being given to the unique needs of private atomic industry. Although many of these statutes were enacted years ago when the legislatures could not have taken into account the problems likely to arise from the utilization of the atom, several states have only recently increased their rates to levels that are still very modest notwithstanding the fact that the legislatures presumably were aware of the forthcoming advent of private atomic industry.

When we consider the imperfect state of present day knowledge concerning biological effects of radioactivity, and the further fact that such knowledge as we now possess indicates that radiation injuries and diseases frequently develop gradually and, even after resulting in disability, may extend over long periods of time, it seems unquestion-

70 California, Connecticut, District of Columbia, Hawaii, Idaho (for occupational diseases only for a reasonable length of time), Illinois (up to six months only in case of silicosis or asbestosis), Massachusetts, Minnesota, Nebraska, New York, North Dakota, Puerto Rico, Washington, Wisconsin, United States Longshoremen's Act, and United States Civil Employees Act.

71 Arkansas, Delaware, Florida, Indiana, Maine, Maryland, Michigan, Missouri, New Hampshire, New Jersey, New Mexico, North Carolina, Ohio, Oregon, Pennsylvania, Rhode Island, and South Carolina.

72 Alabama (maximum period 90 days; maximum amount $1000), Alaska (maximum period 4 years), Colorado (maximum period 6 months; maximum amount $1000), Georgia (maximum period 10 weeks extendable once; maximum amount $1125; board may permit additional $375), Iowa (maximum amount $1500; commission may permit additional services up to $1000), Kansas (maximum period 120 days; in case of occupational disease commission may authorize additional 90 days; maximum amount $2500), Kentucky (maximum amount $2500), Louisiana (maximum amount $2500), Montana (maximum period 18 months; maximum amount $2500 which may be increased by $1000), Nevada (maximum period 6 months, may be extended additional year; maximum amount in case of silicosis $1250), South Dakota (maximum period 20 weeks; maximum amount $1000); Tennessee (maximum period 1 year; maximum amount $1500), Texas (maximum period 180 days), Vermont (maximum amount $2500), Virginia (maximum period 1 year), West Virginia (maximum amount $1600; additional $800 may be authorized).
able that they may result in extraordinarily high medical and hospitalization costs to be borne by afflicted employees. The inadequacy of the arbitrary limits on medical benefits set by many statutes seems obvious when applied to accidents and diseases caused by overexposure or by the cumulative effects of normal exposure to radioactivity.

There is another consideration indicating that full coverage for medical benefits would be advisable in connection with radiation injuries. If experts in atomic medicine can be obtained to assist state boards in radiation compensation cases, and if unlimited medical aid is extended, publicly supervised treatment of such injuries and diseases will in the course of time make available to the states a backlog of experience which can be used to advantage in regulating atomic industry with respect to health and safety problems. This may well result in increased efficiency in the prevention and cure of the major effects of overexposure to radioactivity and in consequent savings to private atomic industry and to society generally.

B. Rehabilitation Provisions

Statutory provisions for the rehabilitation of disabled workmen are relative newcomers to American workmen’s compensation statutes. Already more than twenty states as well as the federal compensation acts provide varying degrees of assistance to injured employees for training purposes aimed at returning them to useful lives in the same or other employments which they can fill despite their disabilities. Artificial limbs and other appliances are included within the medical benefits available under practically all compensation statutes.

Many argue that this feature of workmen’s compensation acts results in eventual savings to employers and insurance carriers who can thereby avoid the expense of supporting permanently and totally disabled workers. In addition, under the Vocational Rehabilitation Act, as amended in 1943, a cost-free state-federal program of vocational rehabilitation is open to patients unable to pay.

The states are becoming increasingly aware of the advantages of rehabilitation provisions and many already provide allowances for maintenance and travel while in training. One of the greater obstacles to the full development of this legislative device to offer more meaningful compensation to men handicapped by industrial injuries is the continued presence on the statute books of provisions limiting medical

57 Stat. 374.
benefits to certain plainly inadequate maximum amounts and periods of time.

Viewing the workability of present legislation on rehabilitation as it concerns private atomic industry, it seems indisputable that the more complete programs currently available will be highly useful. It is entirely possible that the sum total of irradiation of certain workmen in atomic industry may, as the result of repeated accidents or accumulation of low level exposure, render them unfit to pursue further work in exposed areas, for additional exposure might tip the scales so as to precipitate serious disabilities. And yet these men may still be physically and mentally healthy enough to fill positions not involving exposure to radioactivity. When we consider that technicians and even rank and file personnel in atomic industry must at present and in the foreseeable future be possessed of skills which are acquired only through long periods of training and application, it is readily understood that the sudden destruction of their professional capabilities stemming from the necessity of relinquishing their old pursuits may entail severe displacements in their economic life. Adequate provisions for the rehabilitation of such highly qualified personnel may well be deemed a method of effectuating more fully the underlying policies of workmen's compensation legislation.

IV. LIMITATIONS PERIODS ON NOTICE OF INJURY AND FILING OF CLAIMS

A. General Principles in Relation to Radiation Injuries

Among the restrictions, which may add difficulty to the compensability of injuries or diseases caused by the unique qualities of atomic energy, are the requirements of giving notice to the employer and filing of a claim for compensation within a specific time limit. Generally, depending on statutory variations, the injured or diseased employee must give his employer notice of such injury or disease within a specified short period of time, or as soon as practicable. Also, the injured employee must file his claim for compensation within a definite fixed period ranging between three or six months and two years.

The objective of requiring notice to the employer is to enable him to protect himself both by seeing that the injured employee gets adequate medical treatment, so as to minimize damages, and by determining the cause of the injury. This latter point serves the dual purpose of providing the employer a better opportunity to defend himself and of giv-
ing him knowledge of any dangerous condition within the plant which might be corrected before other employees are injured. For example, an unduly delayed notice of an alleged occupational disease might prevent the employer from making a reliable investigation. This would prejudice the employer, for he would be unable to gather the facts with which to defend the claim.

Time limitations upon giving notice and filing claims may prove especially troublesome because of the peculiar nature of atomic injuries. In an article dealing with the latent biological effects of radiation, Dr. G. Failla of Columbia University wrote:

Radiologists in the early days, when the question of protection was not under study, got their hands particularly exposed to large doses of radiation. They did not see much change at first, but gradually skin changes started to appear. Warts began to develop, and sometimes open sores started to develop. It did not incapacitate them, but perhaps ten or fifteen years later cancer developed in those regions which had shown a considerable change in the appearance of the skin. Thus, you see the latent period can be even twenty-five years. As a matter of fact, there is a case on record in which cancer developed forty years after treatment. This patient was treated in the early days for an abdominal tumor. It probably was not a tumor because she lived forty years after the treatment. In those days X-rays were not very penetrating and the treatment could not possibly have cured the tumor.

It is the latent period which makes the problem of protection extremely complicated, because the worst effects may not appear until twenty-five or thirty years later. To predict the dose today that would produce effects, or rather would not produce effects, twenty-five years later is quite a problem. It would be hopeless if we did not have the experience of many radiologists who have been overexposed to radiation. We have been able to watch them for long periods of time and see what has happened to them, and thus we may arrive at our permissible limits.

Cataracts are another result of overexposure. They do occur from exposure to X-rays, and it also seems that neutrons produce cataracts more readily than X-rays. As you probably read in the papers, individuals who have worked with cyclotrons and had considerable local exposure to neutrons have developed cataracts of various degrees. Some are rather badly affected and some rather slightly. It takes, roughly, three years following the exposure for cataracts to appear. The latent period can be shortened if the dose is very large, but
the height of the reaction really occurs at about the same
time. 74

In the atomic energy field, for such latent radiation injuries as cancer,
leukemia, leukopenia, anemia, cataracts, genetic damage, or sterility,
compensability may be barred, depending upon the nature of the ap-
pllicable statute of limitations. Consideration must therefore be given
the various types of limitations expressed in the statutes regarding
notice and filing of claim.

B. Notice and Claims for Accidental Injuries

The problem arising under statutes granting compensation for ac-
cidental injuries is two-fold. Some states commence the running of
the period from the time of the “accident” which caused the disabling
condition. Other states date the claim period from the time of the
“injury.”

Under the former type of statute, notice must be given to the em-
ployer within so many days after the “accident,” namely the harmful
exposure in the case of radiation injuries, and the claim must be filed
with the commission within a number of months or two years at the
most after the same date. Under the “injury” type of statute the courts
are almost unanimous in holding that notice and claim periods begin
to run from the time a compensable injury becomes apparent. 75

An example of the “accident” type of statute is the Kentucky one
which reads:

No proceeding under this chapter for compensation for an
injury or death shall be maintained unless a notice of the acci-
dent shall have been given to the employer as soon as prac-
ticable after the happening thereof and unless a claim for
compensation with respect to such injury shall have been made
within one year after the date of the accident, or, in case of

65-66.

75 Compare the following: Under “injury” type statutes: Acme Body Works v.
Industrial Commission, 204 Wis. 493, 234 N.W. 756 (1931) (cataract developed 6
years after accident compensable), English v. Industrial Commission, 73 Ariz. 86,
237 P. 2d 815 (1951) (injury from inhalation of gas fumes 5 years after leaving
employment; claimant entitled to a hearing). Under “accident” type legislation:
(cataract developed 5 years after accident; claim barred), Whitted v. Palmer-Bee
Co., 228 N.C. 447, 46 S.E. 2d 109 (1948) (cataract developed 18 months after steel
chip hit claimant’s eye; claim barred), Central Locomotive & Car Works v. Ind.
Comm., 290 Ill. 436, 125 N.E. 369 (1919) (blindness 3 years after accident; claim
barred).
death, within one year after such death, whether or not a claim has been made by the employee himself for compensation.\textsuperscript{76}

Any recovery for latent accidental injuries caused by nuclear radiation may well be barred under such a statute. Or at most, in the absence of square precedents on the point, it may be an open question whether the later development of an injury due to exposure to radioactivity can be compensated in cases in which a workman was never aware of any harmful effect until he became disabled. This happens to be the present state of authority in Kentucky where it is clear that if a worker has suffered a minor compensable accident he is absolutely barred later from recovery for the worsening of his condition after the running of the period of limitations. Thus, in \textit{Fiorella v. Clark}\textsuperscript{77} the claimant knew immediately after a fall of about five feet from a grease rack that he had suffered minor compensable injuries and received payment from his employer in compromise of his claim. More than one year later it became apparent that the worker had suffered severe spinal injuries. The statute was held to bar this claim, the court saying: "The word 'accident' as used in our Statute does not mean the resulting injury, but means the occurrence itself, the happening of which causes the injury.\textsuperscript{78}"

In the more recent case of \textit{Goode v. Fleischmann Distilling Corp.},\textsuperscript{79} the court, in reaching a result similar to that of the \textit{Fiorella} case, expressly left open the question whether, in the case of a latent injury of a kind which was never preceded by a harmful event noticed by the claimant, the statutory period would be tolled until it became reasonably apparent that a compensable injury had been sustained.

The policy argument concerning the choice of the date of the accident as the time from which the period should begin to run, rather than the time when the employee should become aware or actually becomes aware of the fact that he has an industrial injury, probably lies in the fact that the risk of permitting questionable claims to be compensated would be much greater under the latter situation. In the case of latent injuries, intervening factors beyond the employer's knowledge might

\textsuperscript{76} Ky. Rev. Stat. §342.185 (1956).
\textsuperscript{77} 298 Ky. 817, 184 S.W. 2d 208 (1944).
\textsuperscript{78} \textit{Id.} at 824. See also Rutledge v. Sandlin, 181 Kan. 369, 310 P. 2d 950 (1957), where workman suffered a severe blow which several months later required surgical removal of a malignant tumor. In denying compensation, the court held that the statutory period started running with the day of the blow rather than with the day of the discovery of the injury.
\textsuperscript{79} 275 S.W. 2d 903 (Ky. 1955).
subsequently cause the injury. Further, with the passage of time it becomes increasingly difficult for the employer to defend.

In other "injury by accident" states, the period for giving notice and filing claim commences as of the time of the injury. Thus, where an injury is latent, compensability is not barred because the injury develops some time later.\textsuperscript{80} The Mississippi statute, which starts the period from the date of the injury, reads as follows:

No claim for compensation shall be maintained unless, within thirty days after the occurrence of the injury actual notice was received by the employer or by an officer, manager or designated representative of an employer. . . . Regardless of whether notice was received, if no payment of compensation (other than medical treatment or burial expense) is made, and no application for benefits is filed with the commission within two years from the date of the injury or death, the right to compensation therefor shall be barred.\textsuperscript{81}

Since the emphasis here is not upon the date of the accident but upon the occurrence of the injury, latent atomic energy injuries should not be denied compensability.

There is a further problem created where the employee does not realize the occupational connection of his injury within the statutory period following the manifestation of the injury. Does the period commence running as of the time the employee knows that his injury has an occupational connection, or when as a reasonable man he should have known of the occupational connection? For example, the statute of Missouri reads:

No proceedings for compensation under this chapter shall be maintained unless a claim therefor be filed with the commission within one year after the injury or death, or in case payments have been made on account of the injury or death, within one year from the date of the last payment.\textsuperscript{82}

The court, in interpreting this statute, which then had a six months limitation, said: "It seems to be a well-settled rule in respect to latent injuries that the six months' limitation for filing claims for compensation commences to run from the time it becomes reasonably apparent, and discoverable, that the employee has sustained a compensable in-

\textsuperscript{80} This, of course, is subject to some other limitations within the statutes. For example, the claim must be filed within 5 years after leaving the employment.

\textsuperscript{81} Miss. Code Ann. §6998-18 (1952).

\textsuperscript{82} Mo. Rev. Stat. §287.430 (1949).
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jury."  

Under this interpretation of the "injury" type of statute, the period begins to run from the date the employee reasonably should know of his injury. This is important in the radiation injury field since the cause of some injuries may be difficult to determine.

Some states have attempted by statute to meet the problem of latent injuries. In Louisiana compensation claims generally must be filed within one year after the "accident"; however, in the case of latent injuries that statute is extended to two years. The Louisiana statute reads:

In case of personal injury . . . all claims for payments shall be forever barred unless within one year after the accident or death the parties have agreed upon the payments to be made under this chapter or unless within one year after the accident proceedings have been begun as provided in Parts III and IV of this Chapter. Where such payments have been made in any case, the limitation shall not take effect until the expiration of one year from the time of making the last payment. Also, where the injury does not result at the time of, or develop immediately after the accident, the limitation shall not take effect until the expiration of one year from the time the injury develops, but in all such cases the claim for payment shall be forever barred unless the proceedings have been begun within two years from the date of the accident.  

The Louisiana court, in applying the above statute, has held that a suit for a latent injury is maintainable only if it is commenced within one year from the time the injury manifests itself, and within two years of the date of the accident. The limitation to two years, of course, would be inadequate for some radiation injuries, but the statutory approach might be employed for a further relaxation of the notice requirements in respect to latent radiation injuries.

Massachusetts has a provision for ameliorating the harsh effects of the running of the period for the giving of notice and the filing of claim. The law reads in part:

Failure to make a claim within the time fixed by Section 41 shall not bar proceedings under this chapter, if it is found that it was occasioned by the mistake or other reasonable cause, or if it is found that the insurer was not prejudiced by the delay. . . .

83 Cleveland v. Laclede Christy Clay Products Company, (Mo. App.) 129 S.W. 2d 12, 16 (1939).
The effect of this provision is to allow an even more liberal period of time in which to file a claim, if the statutory excuses can be shown. The statutory excuses give the court a wide area of discretion and, in one case, were the basis for holding that seven years' delay in filing a claim was not prejudicial as a matter of law. It has also been held that delay in filing a claim until the employee learned from his doctor that his injury was probably caused by his work was for reasonable cause. On the other hand, the court has held that where delay is due to mistake, the claim must be filed within a reasonable time after the mistake is discovered. The court said that since the statute is silent, a reasonable time will be assumed, and all circumstances should be considered.

New York has recently amended its statute creating a two year statutory limitation period to exclude expressly certain types of atomic energy industry injuries from the scope of the limitation. The New York statute reads as follows:

The right to claim compensation under this chapter shall be barred, except as hereinafter provided, unless within two years after the accident . . . a claim of compensation shall be filed . . . . The right of an employee to claim compensation under this chapter for disablement caused by . . . blood or lung changes or malignancies due to occupational exposure to or contact with . . . beryllium, zirconium, cadmium, chrome, lead or fluorine or to exposure to x-rays, radium, ionizing radiation or radioactive substances, shall not be barred by the failure of the employee to file a claim within such period of two years, provided such claim shall be filed after such period of two years and within ninety days after disablement and after knowledge that the disease is or was due to the nature of the employment.

This New York legislation obviously anticipates the problem of potential injuries and warrants consideration by other states. However, it is unfortunate that the exception is phrased in terms only of "blood or lung changes or malignancies" since these may be restrictively interpreted so that the exception may not apply to some atomic energy injuries such as sterility, damage to bone marrow, or cataract.

87 The court would not overrule the finding of the commission that the employer was not prejudiced by the long delay in Morris Gaffer's Case, 279 Mass. 566, 181 N.E. 763 (1932).
88 Wheaton's Case, 310 Mass. 504, 38 N.E. 2d 617 (1942).
90 N.Y. Workmen's Comp. Law §28, as amended by N.Y. Laws 1957, c. 411.
C. Notice and Claims for Occupational Diseases

Since occupational diseases are the result of chronic exposure to hazards over a long period of time, one anticipates more variety in the selection of the particular event which will start the running of the period. It is possible to choose (1) the time of the last exposure to the hazardous conditions, (2) the time of termination of the employer-employee relationship, (3) the time of the actual disability, or (4) any set period of years following exposure to the conditions which created the disease.

In Arkansas, which treats occupational diseases as injuries by accident, the notice and filing of claim requirements are:

A claim for compensation for disability on account of injury which is either an occupational disease or occupational infection shall be barred unless filed with the Commission within two years from the date of the last injurious exposure to the hazards of the disease. . . . 91

This statute commences the running of the period as of the time of the last injurious exposure. Thus, it would cover those injuries which manifested themselves while the employee was still exposed to the hazard, or within two years thereafter. If the employee continued to work on the job and continued to be subject to the hazard, his latent injury would be compensable. The statute does not cover the situation where the employee was transferred to another department, or where the operation creating the hazard was changed, if the incubation period is longer than two years. Since radiation and ingestion of radioactive materials can have a much longer latent period of development, the relation of the statutory period to the last exposure is inadequate. 92 Under Utah law 93 a limitation is imposed upon "partial" disability cases; the partial disability must result within two years following the last day of exposure to the occupational disease to be compensable. If the manifestation of the disease or injury simply resulted in a partial disability two years after the last exposure to radiation or radioactive materials, it would not be compensable.

A slightly different approach is taken by the Arizona statute which

92 Some other states also have statutory language which sets the period of the statute running, in relation to the time of the last exposure, but which cuts the period off at different times, such as 1 year or 3 years.
93 Utah Code Ann. §35-2-56(c) (1953).
The right to compensation under this act for disability or death from an occupational disease shall be forever barred unless written claim is filed with the commission. . . . (2) If the claim is made by an employee and based upon a disease other than silicosis or asbestosis it shall be filed within sixty days after the employee first becomes disabled. . . .

Under this statute, it would make no difference when the latent injury or disease occurred because the period of the statute does not commence running until the employee is actually disabled. This could be at any time after the employee had ceased to be exposed to the hazards of radioactive materials. The language should cover all latent injuries, including toxic or radiation ingestion injuries and injuries caused by external exposure to radioactive materials.

However, there is the possibility that the employee, even after his disability occurs, may not discover its relationship to his employment until the sixty day period has elapsed. This is especially true in the case of latent injuries caused by internal irradiation. In many cases the injury may not appear for years after the exposure to radiation or radioactive materials has ceased. Also, radiation-induced diseases such as cancer or leukemia are not peculiar to persons working with radioactive materials. When the factor of time is coupled with the factor of ignorance, the occupational link between the disease and the employment may be difficult to discover even by competent physicians.

Would the discovery of occupational connection between the work and the injury after the sixty day period had elapsed bar the claim? This raises the question of whether “disablement” means not only the actual condition of the injury, but also awareness of its cause. The Pennsylvania court, under a similar statute which cuts off compensation unless notice is given the employer within ninety days after the beginning of disability, has held in Roschak v. Vulcan Iron Works that where an employee did not realize the industrial connection of his disability within the time limit set by the statute, the date of disability was the date he learned the occupational nature of his disease. In the case, the physician did not inform the employee of the occupational nature of his disease until seven months after he had discontinued work, although he had been under constant medical care in the mean-

time. The court adopted a liberal rule of construction, stating that the legislature could not have intended that the employee do the impossible, \textit{i.e.}, file a claim when he was unaware that he had one. The court did suggest, as a limitation on this doctrine, that a possibility that the employee should have known of the industrial connection of the disease would start the statute running. This construction gives the disabled employee a reasonable opportunity to ascertain the industrial connection of his disablement before he is barred by the running of the period.

The Ohio court by way of dictum took the opposite approach in \textit{Raymond v. Industrial Commission} \textsuperscript{96} applying the statute literally without considering whether knowledge was present or not, saying, "Just why these claimants indulged in these delays is a matter about which this court is not informed nor permitted to concern itself." Under a statute which required that a claim must be filed within six months following the injury, "injury" being interpreted to include occupational diseases, the California court said in \textit{Marsh v. Industrial Accident Commission}: \textsuperscript{97} "Rather, according to our view should the date of the injury be deemed the time when the accumulated effects culminate in a disability traceable to the latent disease as the primary cause, and by the exercise of reasonable care and diligence it is discoverable and apparent that a compensable injury was sustained. . . ."

In Connecticut the statute does not commence to run until the employee is aware of the industrial connection of his disability:

\begin{quote}
No proceedings for compensation under the provisions of this chapter shall be maintained unless a written notice of claim for compensation shall be given within one year from the date of the accident or from the first manifestation of a symptom of the occupational disease. . . . For the purposes of this section, "manifestation of a symptom" shall be deemed to mean its manifestation to the employee claiming compensation, or to some other person standing in such relation to him that the knowledge of such a person would be imputed to him, in such manner as is or ought to be recognized by him as symptomatic of the occupational disease for which compensation is claimed.\textsuperscript{98}
\end{quote}

The Connecticut court has interpreted this language by stating that: "The other implication arising out of the phrase in question is that there

\textsuperscript{96} 140 Ohio St. 233, 42 N.E. 2d 992 (1942).
\textsuperscript{97} 217 Cal. 338 at 351, 18 P. 2d 933 (1933).
must be a clear recognition of the symptom as being that of the occupational disease in question; however plain is the presence of the symptom itself, unless its relation to the particular disease also clearly appears, there cannot be said to be a manifestation of a symptom of that disease." 99

The Wisconsin statute is similar to the Connecticut statute and reads:

No claim for compensation shall be maintained unless, within 30 days after the occurrence of the injury or within 30 days after the employee knew or ought to have known the nature of his disability in its relation to his employment, actual notice was received by the employer. . . . Regardless of whether notice was received, if no payment of compensation . . . is made, and no application is filed with the commission within 2 years from the date of injury or death, or from the date the employee or his dependent knew or ought to have known the nature of the disability and its relation to the employment, the right to compensation therefor shall be barred, except . . . if the employer knew or should have known, within the 2-year period, that the employee had sustained the injury on which the claim is based. 100

This legislation has been interpreted fairly literally. In the case of a nurse who had acquired tuberculosis by working in a hospital, but who knew of its connection to her employment more than two years before filing her claim, the court said in Reinhold v. Industrial Commission: 101 "The statute does not require absolute knowledge of this relationship but simply that the applicant know facts indicating its likelihood. What she probably did not know at that time was that she could get compensation. This is an error of law that we cannot relieve against." In Trustees, Middle River Sanitarium v. Industrial Commission 102 where a nurse did not know she had contracted tuberculosis the court said: "What an employee thinks must be based on something more than suspicion and conjecture in order to start the running of the statute of limitations. Such thought must be based upon knowledge of, or upon reliable information regarding the nature of his disability and its relation to his employment."

Utah commences the running of the period from the time of the accrual of a cause of action, the statute reading:

101 253 Wis. 606, 34 N.W. 2d 814 (1948).
102 224 Wis. 536, 542, 272 N.W. 483 (1937).
The right to compensation under this act for disability or death from an occupational disease shall be forever barred unless written claim is filed. . . . (b) If the claim is . . . based on a disease other than silicosis it must be filed within 60 days after the cause of action arises. . . .

Since the statute permits the filing of the claim up to sixty days after a "cause of action arises," it could be quite unlimited in scope of coverage for latent occupational diseases, depending upon when a cause of action accrues in an occupational disease case. Such language could be interpreted to mean that the period commences running as of the time of the last exposure, as of the time of the disability, or as of the time the employee is not only disabled but knows of the industrial connection of his disablement. How the Utah court will interpret this language in atomic energy injury cases is not known, but the present attitude of the court is enlightening. In State Insurance Fund v. Industrial Commission a welder became disabled due to the inhalation of fumes over a period of twenty-two years, but was unaware of the industrial connection of his disability; the court held that the period of the statute had run against him. The welder had not filed the claim within the sixty day limit, although the full facts or reasons therefor did not appear. The court, in reaching its conclusion, said:

The cause of action arises in this kind of case when the employee suffers compensable disability under the act and could by reasonable diligence ascertain that his disability was employment caused and by its nature compensable. . . . But if on account of his own failure to press his case or have a complete examination made under circumstances which would reasonably put him on notice that he was probably entitled to compensation, he failed to discover that this disability was compensable, then the fault is his own and he cannot recover. 108

Thus Utah tends to take care of the situation where the individual, even though he is disabled, does not know of the industrial connection of his disease in much the same manner as those states which use the term "disability" and interpret it to mean the time when a disabled employee, as a reasonable man, should know of the industrial connection.

Besides the limitations of the previously discussed language relating

103 Utah Code §35-2-48(b) (1953).
105 Id. at 284-285.
to the time when the period commences to run for the giving of notice 
or the filing of a claim, there are other broad limitations, often in the 
same statutes. These limitations are designed to cut off liability at 
some final point, regardless of the fact that the statute may speak in 
terms of the date of injury or disability as the point from which the 
statute commences to run.

The statute of Connecticut contains such a limitation:

No proceedings for compensation under the provisions of this 
chapter shall be maintained unless a written notice of claim for 
compensation shall be given within one year from the date of 
the accident or from the date of the first manifestation of a 
symptom of the occupational disease . . . provided no claim 
on account of an occupational disease shall be made by an 
employee or his dependents against the employer in whose 
employ the disease is claimed to have originated, except while 
the employee is still in such employ, or within five years after 
his leaving such employ.\(^{108}\)

The additional limitation that the claim has to be filed during the em­
ployment or within five years after its termination has the effect of 
cutting off the period during which the claim may be filed, perhaps 
even before it has begun to run. If the claim must be filed within one 
year after the first manifestation of the disease and if the disease does 
not even materialize within five years after the employment terminates, 
then liability is cut off without regard to the period.

A distinction would probably be advisable in atomic energy industry 
between employees still employed and employees who have left for 
more than five years. Most of the concerns dealing with atomic energy 
are keeping records of the amount and types of exposure to radiation 
to which an employee is subjected. This is being done through the use 
of film badges and various monitoring devices. Therefore, the em­
ployer may have some material available in the form of records to use 
as evidence in disputing latent injury claims by disabled employees. 
This is a different situation from the case where the employer (\(e.g.,\) in 
a stone cutting or grinding operation) does not have any records of 
the amount of dust to which any employee was exposed, and has, 
therefore, to conduct the initial investigation when the claim is made. 
In the atomic energy field, it would seem that since the employer should 
maintain records, there would be less reason to cut off liability because 
the passage of time operates to the prejudice of the employer.

The Michigan statute serves to illustrate a slight modification in those provisions which might affect atomic energy injuries. The Michigan statute reads:

No proceedings for compensation for an injury under this act shall be maintained, unless a notice of the injury shall have been given to the employer within three months after the happening thereof, and unless the claim for compensation with respect to such injury, which claim may be either oral or in writing, shall have been made within six months after the occurrence of the same. Provided, however, That in all cases in which the employer has been given notice of the injury, or has notice or knowledge of the same within three months after the happening thereof, but the actual injury, disability or incapacity does not develop or make itself apparent within six months after the happening of the injury, but does develop and make itself apparent at some date subsequent to six months after the happening of the same, claim for compensation may be made within three months after the actual injury, disability, or incapacity develops or makes itself apparent to the injured employee, but no such claim shall be valid or effectual for any purpose unless made within two years from the date the personal injury was sustained. and Provided further, That in all cases in which the employer has been given notice of the happening of said accident within three months after the happening of the same, and fails, neglects, or refuses to report said injury to the compensation commission as required by the provisions of this act, the statute of limitations shall not run against the claim of the injured employee or his dependents, or in favor of either said employer or his insurer, until a report of said injury shall have been filed with the compensation commission.\textsuperscript{107}

Provision is made for an extended time in case of latent injuries, provided that the employer has been given notice of the injury within three months of the happening thereof. This statute also provides that the statute of limitations will not run in the event that the employer has notice or knowledge of the happening of the accident or notice of the happening of the injury and does not report this information to the industrial compensation commission. The notice requirements in respect to occupational diseases are made applicable by another section which reads in part:

The requirements as to notice as to occupational disease and death resulting therefrom and the requirements as to the bringing of proceedings for compensation for disability or

death resulting from such occupational disease shall be the same as required in section 15 of part 2 of this act, except that the notice shall be given to the employer within one hundred and twenty days after the disablement.\textsuperscript{108}

Under the requirement of this section that notice of occupational disease be given to the employer within 120 days after disablement, the court has held that notice must be given within such time after the employee has knowledge or reasonable ground for knowledge of his disability.\textsuperscript{109} The provision of the Michigan statute which does not allow the employer to plead the statute of limitations in regard to the giving of notice unless he has filed a report of the injury, is somewhat unusual. In a case involving benzol poisoning, where the employee subsequently interviewed an official of the defendant company, and the official had made the comment that he did not believe there was any of the “stuff in the finishing room,” the court said:

The reference to the “stuff in the finishing room” demonstrates that the official had knowledge of the fact that the plaintiff attributed his condition to a substance in the room in which he had worked, and, therefore, the defendant employer cannot successfully claim in this case, ... that, although informed of plaintiff’s condition, the employer was not told that it arose out of and in the course of the employment. ... In the instant case, the employer had knowledge of the plaintiff’s contention within 73 days after the occurrence of the disablement. It filed no report with the department and, therefore, is estopped to plead the statute of limitations.\textsuperscript{110}

It should be noted that in accordance with an amendment made subsequently the commission promulgated a rule stating when and what reports of injuries and accidents should be made. Thus, unless the conditions of such injury or accident are such that a report has to be made, the employer is not estopped from using as a defense the statute of limitations.\textsuperscript{111} The pertinence of this particular provision to atomic energy injuries lies in the fact that it will give relief from the notice requirements of the statutes in those cases where the employer, with notice or knowledge of the disability, fails to file a report. This might be especially important in the cases of atomic energy injuries because even though the employer may know of the disability, there may be considerable confusion regarding the industrial connection of such disability.

\textsuperscript{110} Nicholas v. St. Johns Table Co., 302 Mich. 503, 516-17, 5 N.W. 2d 442 (1942).
\textsuperscript{111} Amamotto v. J. Kozloff Fish Co., 317 Mich. 641, 27 N.W. 2d 118 (1947).
D. Summary

From the available evidence, atomic energy injuries often may be of a latent nature. In workmen's compensation laws the "injury by accident" statutes generally start the period for notice and the filing of claims as of the date of the accident. However, some states start the period running from the date that the injury appears. Another course is that of making a statutory exception in the case of latent injuries. Also, whereas some states do not start the period running until the injury develops, others go one step further, and do not commence the period running until the employee would also know of the industrial connection of his injury. As for occupational diseases, some statutes start the period running as of the date of the last injurious exposure to the condition or hazard which caused the disease, while others commence it as of the time the disability appears. At least one statute starts the period when a cause of action accrues. Many other limitations appear even where these requirements which concern the running of the period are met. Some states impose an over-all limitation, such as one year or five years, following the occurrence of the disability. Others cut off the claim within so many years after termination of employment. Of possible significance in atomic industry is the use of a provision that the employer may not use the defense of the statute of limitations if he does not file a report with the industrial commission. It may be concluded, therefore, that the amount of coverage afforded latent atomic energy injuries will depend in most cases upon the period of time allowed, after exposure to radiation, for filing the claim or giving notice. The application of notice and claim provisions to atomic energy injuries can be determined fully only by experience. It already seems evident that even on the basis of present knowledge of the nature of these injuries, and the causal relation between them and atomic radiations, amendments of the more restrictive statutes are desirable or essential.

V. RECOMMENDATIONS

Since atomic energy is already a significant factor in industrial operations and is destined to become even more important in our society, it seems clear that workmen's compensation laws should be amended to accommodate radiation injuries to the existing statutory patterns. There seems to be no reason at this time to conclude that an entirely separate compensation system is essential to deal adequately with the
peculiar features of atomic energy. Therefore, we conclude that each state should amend its laws to attain the following objectives:

1. Complete coverage of all radiation injuries sustained as a result of an accident.

2. Complete coverage of all radiation injuries which may be classified as occupational diseases.

3. Satisfactory second injury fund provisions in order to assist persons who have suffered prior radiation injuries to secure additional employment.

4. Apportionment of liability among employers where the worker has been exposed in a number of employments and a cumulative radiation injury results. (More accurate scientific and medical data are required before a satisfactory method of handling this objective can be resolved.)

5. Medical benefit payments in a sufficient amount and for a sufficient period to provide essential medical care for persons suffering radiation injuries.

6. Limitations period for filing notice of injury and claims sufficiently flexible to permit recovery for latent injuries and to permit recovery when the injured person discovers the connection of his employment to his injury.

It may be argued that these extensions of existing legislation will unduly burden atomic energy entrepreneurs. However, it must be remembered that employees may still face serious handicaps in proving that a particular injury was caused by radiation exposure. In fact, at some future date it may become necessary to change the burden of proof in respect to certain radiation injuries. Necessarily the workmen's compensation boards will have to exercise considerable discretion to assure that all real injuries are compensated and at the same time deny compensation in those cases having tenuous or even imaginary bases. The boards have had considerable experience in drawing similar lines under existing legislation, and it appears that they will be able to administer efficiently statutory provisions designed to handle radiation injuries. Furthermore, as experience is gained and as more scientific information concerning radiation injuries is developed, it will be possible to revise the governing legislation accordingly. Meanwhile, both employers and employees in atomic energy industry will find it beneficial if the state legislatures adopt statutes sufficiently broad to award compensation for those sustaining injuries during the infancy of the industry.