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WATER LAW
WITH SPECIAL REFERENCE TO
GROUND WATER

By

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INTRODUCTION

This report was prepared in July 1950 at the request of the President's Water Resources Policy Commission. It followed the report entitled "Water facts in relation to a national water-resources policy," which, in part, has been published as Geological Survey Circular 114 under the title "The water situation in the United States, with special reference to ground water."

The only changes made in preparing this report for publication as a circular were revision of the sections on Idaho, Indiana, Massachusetts, Montana, New Mexico, Oregon, and Texas, to bring them up to date.

This report discusses some of the problems in the field of water law and summarizes briefly the laws providing for the acquiring of water rights in the different States. The need for consideration of the subject is brought out in Circular 114. In that report it was pointed out that: (1) The use of water in the United States is increasing rapidly and undoubtedly will continue to do so; (2) ground water must meet a large and perhaps an increasing share of our water demands;

(3) the full development of the water resources of ever more numerous and larger areas will require manipulation of stream systems and ground-water reservoirs to protect them from overdevelopment or pollution and to increase and maintain their yield of water of good quality; and (4) such manipulation, as well as the protection of existing rights, requires control of water use by means of hydrologically sound statutes.

What is a "hydrologically sound statute"? A report so brief as this can hardly give a complete answer, but it can be said that, among other things, such statutes would: (1) apply the same rule of law to all ground water, rather than attempt to distinguish between supposedly different kinds of ground water which do not exist in nature; (2) further, apply the same rule of law to surface water, recognizing the widespread interconnection between ground and surface water and the necessity of treating the common supply as a whole where such interconnection exists; and (3) be as consistent as possible, both in principle and in major provisions, from State to State where interstate water

sources and problems are involved, and provide machinery for facilitating settlement of interstate disputes by negotiation and compact.

It is the belief of the Geological Survey that the required legal control can be achieved most effectively at the State level; further, that the restrictions on water use should be the minimum consistent with effective control, and that maximum reliance should be placed on voluntary cooperation of water users based on adequate public information on the hydrology of each area.

The Geological Survey has no part in the enactment and enforcement of water law. It acts as an impartial source of basic hydrologic data. However, it has an important advisory function, for it is in a position to comment on the hydrologic feasibility of proposed water laws and thus to contribute to their effectiveness.

The subject of water law is significant wherever conflicts have arisen between users of water. Important in the past in many parts of the United States, especially in the West where water is the chief limiting factor in agricultural and industrial development, water law is bound to be increasingly important everywhere in the future as our water demands increase. The subject of the law of watercourses has been discussed at length in many excellent reports and papers. The subject of ground-water law has not been covered so completely; for example, there has never been a comprehensive Nation-wide survey of existing ground-water law.

There has not been time nor is there justification for an attempt to cover the subject of water law fully in this report. Reference will be made to a number of the previous reports, to the various principles of water law in use in the United States, to some of the obstacles and problems involved in the formulation and enforcement of effective laws, and to the current water-law situation in the various States insofar as information on it is available to the Geological Survey. The discussion will be restricted mainly to control of the diversion of water. The closely related subjects of pollution and flood control, navigation, etc., are generally outside the field of the Geological Survey, and will be mentioned only incidentally. It is obvious that these other phases of water management are as important as, and must be coordinated with, control of diversion of water.

The selected bibliography at the end of this report lists some of the reports and papers on water law prepared to date. The most comprehensive works, as might be expected, deal with the law of water rights in the West, where legal control of water use has been developed most highly. Water law in the East, with certain important exceptions, is in a relatively early stage of development. Ground-water law, though at a considerably advanced stage in several Western States, is incompletely or poorly developed in part of the West and most of the East. However, interest in the subject and activity in the enactment of ground-water laws are mounting

rapidly throughout the country.

A few of the outstanding reports and papers listed in the bibliography might be mentioned specifically. They include Wells Hutchins' "Selected problems in the law of water rights in the West" (Hutchins, 1942),^{1/} published by the Department of Agriculture; "State water law in the development of the West" (National Resources Planning Board, 1943), prepared by a subcommittee of which Hutchins was a member, and based to a considerable extent on his 1942 report cited above; Samuel C. Wiel's "Water rights in the Western States" (Wiel, 1911) and "Fifty years of water law" (Wiel, 1936); "Desirable principles of State water legislation" (National Reclamation Association, 1946), prepared by a committee of which Wells Hutchins was chairman; "Water laws in the United States of America" (Food and Agriculture Organization of the United Nations, Agricultural Development Paper No. 2, March 1950); and treatises by Angell (1877), Baker and Conkling (1930), Bingham (1916), Coulson and Forbes (1924), Farnham (1904), Gould (1900), Kinney (1912), and Long (1916). Among the papers, mostly relatively brief, specifically concerned with ground-water law that have been published in recent years are those by Conkling (1937), Thompson and Fiedler (1938), Tolman and Stipp (1941), McGuinness (1945), the National Association of Vertical Turbine Pump Manufacturers (1947), Black (1947), the Illinois Legislative Council (1948), Williams (1948), and Critchlow (1948).

PRINCIPLES OF WATER LAW

Two major doctrines of water law have been in use in the United States (National Resources Planning Board, 1943, p. 5). One is the common-law doctrine of riparian rights; the other is the doctrine of prior appropriation. The principles of the two doctrines are diametrically opposed to each other. A riparian right is based on the ownership of land contiguous to a stream. Under a riparian right the owner of land adjacent to a stream is entitled to use the full natural flow, undiminished in quantity and unchanged in quality. The next downstream riparian owner of course has the same right. As applied to ground water a "quasi-riparian" right is based on ownership of land overlying a water-bearing formation. A riparian right does not depend upon putting the water to use and thus is not lost by nonuse. An appropriative right is based on appropriation and actual use of water that is declared to belong to the public; he who is first in time has the better right. The right is generally limited to water used beneficially, and generally it is forfeited if the water is allowed to go unused for a specified period.

Before going further it would be well to point out that most water law of the past has been based on an attempted distinction between water of "watercourses"--surface or underground--and so-called underground

^{1/}See publications in bibliography, listed by author or originating agency and date.

"percolating water." In many States one rule of law is applied to surface streams and to "underground watercourses," and another to "percolating waters." Also, different rules of law may be applied to water in "watercourses" and "diffused surface waters" (waters, commonly of floods, not occupying defined watercourses). To spring waters that are the source of streams are generally applied the same rule of law as is applied to watercourses. Water of springs that originates on and does not leave a given property generally is held to belong to the property owner, unless the rule of prior appropriation is followed and the spring water was appropriated while the property was a part of the public domain. These attempted distinctions among waters of supposedly different types lead to many problems, as will be pointed out later.

Common-Law Riparian Rights as Applied to Ground Water

The English Rule

In its elementary form the doctrine of riparian rights to use of the water of a stream was announced in England in 1833 (Mason v. Hill, cited in National Resources Planning Board, 1943, p. 5), and, with use of the term "riparian," in 1849 in Wood v. Waud (cited in Natural Resources Planning Board, 1943, p. 5). With specific respect to ground water the doctrine was established in England in 1843, in Acton v. Blundell (cited in Thompson and Fiedler, 1938, p. 1061).

The application of the doctrine to ground water is shown well by a quotation from Acton v. Blundell: "That the person who owns the surface may dig therein, and apply all that is there found to his own purposes at his free will and pleasure; and that if, in the exercise of such right, he intercepts or drains off the water collected from the underground springs in his neighbor's well, this inconvenience to his neighbor falls within the description of damnum absque injuria, which cannot become the ground of an action."

According to Hutchins (1942, p. 252), "the practical arguments for acceptance of the English rule for 'percolating waters' were: (1) the source and flow of these waters were so unknown that it is impossible to formulate any legal rules governing them; and (2) the recognition of correlative rights (of adjacent landowners) would substantially interfere with many important public projects, such as drainage of lands, etc."

The American Rule of Reasonable Use

The English rule of unlimited or, as it has been called, unreasonable use (Conkling, 1936, p. 503) obviously was not suited to situations where water uses are competitive, as in the West. Indeed, the first major departure from it in this country was in New Hampshire in 1862, in the case of Basset v. Salisbury Manufacturing Co. (cited, for example, in Thompson and Fiedler, 1938, p. 1062), when the State Supreme Court ruled that a man's right to use of percolating water on

his own land is limited by the corresponding right of his neighbor, and "restricts each to a reasonable exercise of his own right, a reasonable use of his own property, in view of the similar rights of others." Thus was announced the rule of reasonable use or the American rule, which since has come to be followed in many States for ground water where the riparian doctrine is in force.

The California Rule or Doctrine of Correlative Rights

The rule of reasonable use was modified to the so-called California rule or doctrine of correlative rights in 1903, in the case of Katz v. Walkinshaw (cited, for example, in Thompson and Fiedler, 1938, p. 1063). The California Supreme Court held, in effect, that not only must one landowner's use be reasonable, in consideration of the similar rights of others, but it must be correlated with the uses of others in times of shortage: "Disputes between overlying landowners concerning water for use on the land, to which they have an equal right, in cases where the supply is insufficient for all, are to be settled by giving to each a just and fair proportion. And here again we leave for future settlement the question as to the priority of rights between such owners who begin the use of waters at different times. The parties interested in the question are not before us."

According to Corpus Juris (67 C. J., p. 840), the doctrine of correlative rights holds that "the rights of all landowners over a common basin, saturated strata, or underground reservoir, are coequal or correlative, and that one landowner cannot extract more than his share even for use in his own lands where the rights of others are injured thereby; nor can he claim more than his share on any ground of peculiar benefit to him from its use... (the) owners' share is determined on the basis of 'reasonable use' under the circumstances. But 'reasonable use' as here used, does not mean, as in other states, a right to take all that is necessary or reasonably beneficial to the owner's lands regardless of the needs of other owners, but only his reasonable share, if there is not enough to supply the needs of all." The use is restricted to the lands overlying the common supply, at times when the supply is insufficient. When the supply is sufficient and no injury to others results, any amount reasonably needed may be taken, for use on lands overlying the common supply or on others.

The Doctrine of Prior Appropriation

The doctrine of prior appropriation was developed under arid conditions--in areas where the water requirement for land suitable for irrigation, or for other beneficial uses to which water could be put, was in excess of the available water supply. With respect to surface water the doctrine goes back to Roman times, and it was followed to some extent in the Southwest before that area became a part of the United States. "However, the appropriative principle in the form in which it

is now recognized throughout the West sprang from the requirements of a mining region for protection in the use of water supplies needed to work mining claims... The first in point of time to put the water to a beneficial use, without limitation of the place of use to riparian land, came to be recognized as the first in right, and the right thus recognized and protected was an exclusive right insofar as the quantity of water put to a beneficial use is concerned." (National Resources Planning Board, 1943, p. 6). The appropriative principle was recognized by the United States Supreme Court in 1874 in the case of *Atchison v. Peterson*; in the same year, denying the claims of mining interests that a valid appropriation could be made only for mining purposes, the court extended the principle to appropriations for irrigation in the case of *Basey v. Gallagher* (National Resources Planning Board, 1943, p. 7). Following the enactment, in 1866 and 1870, of statutes recognizing appropriations of water on the public lands, the Congress passed the Desert Land Act of March 3, 1877, containing the following: "Provided however that the right to the use of water by the person so conducting the same, on or to any tract of desert land of six hundred and forty acres shall depend upon bona fide prior appropriation; and such right shall not exceed the amount of water actually appropriated, and necessarily used for the purpose of irrigation and reclamation; and all surplus water over and above such actual appropriation and use, together with the water of all lakes, rivers and other sources of water supply upon the public lands and not navigable, shall remain and be held free for the appropriation and use of the public for irrigation, mining and manufacturing purposes subject to existing rights." The act named Arizona, California, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming; Colorado was added by means of an amendment in 1891.

The question as to whether appropriative rights could be acquired for use other than on the public lands was treated by the Supreme Court in 1935 in the case of *California-Oregon Power Co. v. Beaver Portland Cement Co.*, when the Court held that "the Desert Land Act applied to all the public domain in the States and Territories named and that it severed the water from the land and left the unappropriated waters of nonnavigable sources open to appropriation under the laws of the several States and Territories. In this case and in other cases the United States Supreme Court has repeatedly recognized the right of each State to adopt its own system of water law, whether or not public lands are involved" (National Resources Planning Board, 1943, p. 8).

The two most important universally recognized features of an appropriative right are (1) that he who is first in time is first in right; in time of scarcity the later appropriators must cease their use in reverse order of priority; and (2) the use must be a beneficial one; no right is acquired to water that is not used beneficially.

PROBLEMS

No attempt can be made in this report to discuss all the facets of the different doctrines of water law, or all the features of existing laws. However, some mention can be made of a number of the problems that must be considered in the formulation and enforcement of a water law.

To What Kind of Water Shall the Law Apply?

One of the most serious problems in water law, and one of the chief stumbling blocks in the enactment of past and--quite probably--future legislation, is that there is widespread public belief, and recognition in existing law, that different kinds of water exist to which different rules of law can be applied. Such a belief is only natural, for conflicts over the use of water arose long before the nature and occurrence of water, especially underground water, were well understood. Various decisions have referred to surface water in watercourses; diffused surface waters; spring waters; subterranean watercourses; artesian waters; underflow dependent on surface streams; and percolating waters--diffused, tributary to springs, supplying surface wells, and just plain seepage waters going nowhere in particular (Thompson and Fiedler, 1938, p. 1059). Is there any wonder that confusion has developed?

With respect to ground water, Thompson and Fiedler (1938, p. 1061) state: "We believe, as a matter of fact, that from a scientific point of view such an elaborate classification of ground water is neither justified nor necessary. All water in the part of the earth known as the zone of saturation is purely and simply ground water, moving according to certain well-recognized laws of physics.... This point of view is in contrast to such unscientific descriptions as 'percolating waters' in judicial decisions as the following: 'vagrant wandering drops moving by gravity in any and every direction along the line of least resistance'.... and 'the physical laws governing underground water and its subterranean progress being irregular and unknowable with certainty, and such water being changeable and uncontrollable in character subject to secret incomprehensible influences....'."

Thus it is apparent that, to be workable, a ground-water law must apply to all water in the zone of saturation. Further, all water law should recognize the interconnection between ground and surface water. In a number of States where existing law is based on the doctrine of prior appropriation, the law applies specifically to all water in the zone of saturation (Idaho, Kansas, Nevada, Utah, Washington, and Wyoming) or to essentially all such water (New Mexico and Oregon). In Colorado, though "percolating water" not tributary to a watercourse still might be held to be exempt from appropriation, all recent decisions on "percolating water" have held it to be subject to appropriation; it seems reasonable to assume that the doctrine

of appropriation applies to essentially all ground water in that State. In some other States where the appropriation doctrine is recognized, however, such as Arizona and Oklahoma, there still is an attempt to distinguish between waters of different classes.

With respect to interconnection between surface and ground water, most States that have laws based on prior appropriation apply them to water of "subsurface watercourses" in contact with streams, but some still attempt to distinguish "percolating waters" that are not subject to appropriation; in many cases, however, "percolating waters" that can be proved to be tributary to surface or subsurface "watercourses" are subject to appropriation.

For successful formulation of water law, there is a great need, in all but a few of the States, for recognition of the fundamental facts that water in the underground reservoirs all follows the same physical laws and cannot be subdivided successfully; and that ground water and surface water are interconnected and cannot be treated separately.

What Principle of Law Shall Be Followed?

A fundamental problem in formulating a water code is that of deciding which rule of law to follow--that of common-law riparian rights or that of prior appropriation. The rules are diametrically opposed; where they come in conflict one must give way or both must be modified. In a number of the Western States both rules are followed to some extent; though the tendency has been to weaken riparian rights in favor of prior appropriation, the appropriation principle in these States and also in States where it is followed exclusively has been modified by ever-greater stress on reasonable and beneficial use, in the light of current conditions. In California, the leading State in total use of water, the rule of riparian rights is still paramount, but even there the right has been limited to reasonable and beneficial use and, according to a 1928 amendment to the State constitution, a riparian landowner cannot enjoin an appropriation of water if it cannot be proved to injure his riparian right.

It is the general belief of most members of the Geological Survey who have given thought to the subject that the doctrine of prior appropriation has fewer defects than the riparian doctrine and can be made to lead to a greater degree of development and greater protection of vested rights. However, the doctrine admittedly has some important defects and must be modified under certain conditions to meet these objections; in certain cases the necessary modification may lead to or nearly to an adoption of the riparian-rights principle. Also, appropriative rights can be modified successfully, to prevent waste of water, by laying great stress on the reasonableness of a given use, no matter what its priority, in consideration of the public welfare.

Among those who recommend the rule of prior appropriation as the best available method of establishing water rights are

Hutchins (1942) and the National Resources Planning Board (1943). The National Reclamation Association (1946) does not specifically recommend the rule of prior appropriation to the exclusion of that of riparian rights, but it does so by implication and presents detailed recommendations of features that an effective law based on the appropriation doctrine must have.

Authority for Enactment of Laws

The activities of man on his own property are limited in various ways and to varying degrees in the common interest. Thus, a man in the enjoyment of his property rights must not infringe unreasonably upon the similar rights of his neighbors. For example, he must not maintain a nuisance on his property, nor a menace to public health, nor build a structure of a type or size outside the limits specified by zoning laws.

So it is with control of water use. A man may be required to carry on his water-using activities within limits set by law, but for the establishment of those limits there must be legal authority. This is especially true where it is desired to enact a water-use law based on the principle of prior appropriation. That principle assumes that water is not a part of the land on or under which it occurs but, like the air, passes from the property of one to that of another and, thus, belongs to all the people.

There is widespread belief that, where existing statutes or legal precedent follow the English rule or its American modifications, where the right to the use of water is a riparian right based on ownership of property contiguous to the water, declaration of the doctrine of prior appropriation would violate the part of the 14th amendment to the Constitution which provides that no State shall "deprive any person of life, liberty, or property without due process of law." Nevertheless, decisions of the Supreme Court show that there is nothing to prevent a State from declaring the principle of prior appropriation, as discussed by Thompson and Fiedler (1938, pp. 1071-1091). For example (p. 1088), they cite the decision in the case of United States v. Rio Grande Irrigation Co.: "The unquestioned rule of the common law was that every riparian owner was entitled to the continued natural flow of the stream . . . while this is undoubted, and the rule obtains in those States in the Union which have simply adopted the common law, it is also true that as to every stream within its domain a State may change this common law rule and permit the appropriation of the flowing water for such purposes as it deems wise. . . ." Again, in the case of Trenton v. New Jersey, the Court said: "The diversion of water from the sources of supply for the use of the inhabitants of the State is a proper and legitimate function of the State. This function may be left to private enterprise, subject to regulation by the State; it may be performed directly; or it may be delegated to bodies politic created for that purpose, or to the municipalities of the State."

The constitutions of a number of the States, particularly in the West, specifically abrogate the riparian rule and declare that water belongs to the public, or that it is available for appropriation. Some others are less definite but contain a phrase that has a similar effect. The constitutions of several others contain some reference to the right of the State to develop or conserve water, or natural resources in general. For example, in Ohio the State constitution declares that "laws may also be passed to.... provide for the conservation of the natural resources of the State...." The Massachusetts constitution as amended states that "the conservation, development, and utilization of the agricultural, mineral, forest, and water and other natural resources of the commonwealth are public uses...." (Thompson and Fiedler, 1938, p. 1081).

Even where no specific or helpful statement is present in the State constitution, a declaration that water is subject to control may be possible under the police power of the State. The law providing for control of use of ground water on Long Island by the New York Water Power and Control Commission, passed in 1933 by the State legislature, states: "Facts having been presented by the Water Power and Control Commission and the United States Geological Survey which indicate that the depletion of underground waters under Long Island is such as to threaten the adequacy of water supply for domestic consumption of the inhabitants thereof, this enactment is made in the exercise of the police power of the State and its purposes generally are to protect the public health and public welfare in conserving the supply of water for domestic consumption." In several other States the police power was invoked specifically or by implication in the enactment of laws providing for control of water use.

Thus, it appears that, if water-use statutes are drawn carefully, and especially if they are moderate in scope and if they specifically invoke the police power, there is every reason to expect that they would be upheld in the State supreme courts.

Allocation of Water Among States

Allocation of water of interstate streams involves a Federal question, in part because of the provision in the Federal Constitution that the Congress must approve interstate compacts. However, the Supreme Court has held: "But resort to the judicial remedy is never essential to the adjustment of interstate controversies, unless the States are unable to agree upon the terms of a compact, or Congress refuses its consent." (Hinderlider v. La Plata River & Cherry Creek Ditch Co.; cited in Hutchins, 1942, p. 411.) Thus, it appears that the States are free to make compacts regarding the distribution of the water of interstate streams, subject to the approval of Congress. If interstate agreement is not possible, then issues between States can be settled only by the Supreme Court. A complicating factor is the question of ownership of unappropriated waters of nonnavigable streams on the public domain,

still unsettled. (See next section.)

In the case of *Hinderlider v. La Plata River & Cherry Creek Ditch Co.* the Supreme Court established certain principles, among which are (Hutchins, 1942, pp. 412-413):

(a) Each State is entitled only to an equitable share of the water of an interstate stream, and an adjudication decree in one State cannot confer water rights in excess of its share.

(b) Adjustment of rights in controversy may be made by compact as well as by a suit in the Supreme Court; the Court recommends the compact method to avoid litigation.

(c) Whether made by compact or Supreme Court decision, the apportionment is binding on the citizens of each State and on all claimants of water rights.

(d) The apportionment may provide either for a continuous division of water or for rotation in use of the stream.

(e) No claimant has any right greater than the equitable share to which the State is entitled, so that no claim can be made that a vested right is taken away by apportionment, if the compact is otherwise upheld.

(f) The assent of Congress to a compact does not make the compact a "treaty or statute of the United States."

Apportionment by compact or court decision of water between or among States on interstate streams, even where all the States follow the appropriation principle, does not necessarily involve recognition of priority of appropriations for a stream system as a whole (*Nebraska v. Wyoming*, 325 U. S., p. 618). Priorities are judged in relation to others in a given State, and to the amount of water available to that State under compact at a given time, but the terms of the compact may apply the principle of priority between States in whole, in part, or not at all. That is, A may have appropriated water from a stream in one State in 1900 and B from the same stream in the adjacent State in 1920, yet under the terms of a compact between the States the relation of the priorities of A and B to others in their own States might be such that B would get water in a dry year when A would not.

The compact method, which in effect breaks up a stream system into segments, removes one of the difficulties in administering water rights on a long stream system. Assuming that the terms of the compact are such that the total average use of water is held within the limit of replenishment, such division of a stream into segments does not tend to promote overdevelopment. Under certain conditions it may be desirable for a State to provide for breaking up a stream system into segments within its boundaries, as well as between States, each segment having its own list of priorities (*National Reclamation Association*, 1946, p. 19). Where natural conditions are such that an advantage

would result, it may be desirable to provide by interstate compact for joint administration of a single set of priorities in a particular segment that happens to cross a State line.

Problems of interstate allocation of ground water have not been serious so far, but they are bound to come to the fore in the future as there is increasing development of ground water from aquifers that cross State lines. The problem of making compacts will be complicated by the necessity of determining perennial or optimum yield and by the fact that withdrawal of water from storage delays the overlapping of cones of depression spreading out from areas of withdrawal on either side of the line. However, if the hydrologic facts are determined with the required accuracy, there need be no insuperable difficulties in making interstate compacts for allocation of ground water, or of interconnected ground and surface water, between States. Though decisions of the Supreme Court on the subject of allocation relate to interstate streams, there is no reason to believe that the Court would not apply similar reasoning to ground water where there is an adequate showing of fact.

Ownership of Unappropriated Waters on the Public Domain

There has been considerable dispute over the ownership of unappropriated waters on the public domain. In the case of *Nebraska v. Wyoming*, involving apportionment of the waters of the North Platte River, the United States was granted leave to intervene. The United States maintained that neither Wyoming nor Nebraska was willing to defend the appropriations made by the United States in Wyoming for use in Nebraska, that the United States is the owner of all unappropriated water in the North Platte River, that the title of the United States to such water is involved, and that the United States is entitled to have apportioned to it, free from the sovereign control of any State, the water already appropriated by it and all the remaining unappropriated water, if any (Hutchins, 1942, pp. 423-424). The United States maintained that it was not divested of title to the water by creation of the States, regardless of any declarations in the State constitutions that the waters within the States belonged to the States or to the public; and that desert-land legislation and the Reclamation Act of 1902 permitted or required the appropriation of water in accordance with the laws of the States but, though the Reclamation Act directed the Secretary of the Interior to conform to State laws in appropriating water, such conformance was a "matter of comity" and was directory, not mandatory (Hutchins, 1942, pp. 425-427). The United States maintained that it did not propose to interfere with private rights acquired under State laws, but wished to determine whether the United States is subject to State control in the use and distribution of waters it has appropriated.

The decision of the Supreme Court in *Nebraska v. Wyoming* (325 U. S., pp. 611-616) stated that it was not necessary to determine the question of ownership of the unappropriated

waters, inasmuch as the water rights for the Federal projects depending on the North Platte River had been acquired in accordance with State laws; the appropriations were made to individual landowners under the Reclamation Act and were as definite and complete as if obtained by direct cession from the Federal Government. "But we do not stop to determine what rights to unappropriated water of the river the United States may have. For the water rights on which the North Platte Project and the Kendrick Project rest have been obtained in compliance with State law. Whether they might have been obtained by Federal reservation is not important. Nor, as we shall see, is it important to the decree to be entered in this case that there may be unappropriated water to which the United States may in the future assert rights through the machinery of State law or otherwise."

The question as to management by the Federal Government of water it has appropriated was held not to be involved in the decision, but the Court said, "We do not suggest that where Congress has provided a system of regulation for federal projects it must give way before an inconsistent state system."

Rights to Use of "Diffused Surface Waters"

"Diffused surface waters" are generally defined as "waters which in their natural state occur on the surface in places other than in watercourses of lakes or ponds" (National Resources Planning Board, 1943, p. 60). They are commonly waters resulting from rainfall or snow melt, floods, or seepage, and typically are temporary bodies of water somewhat indefinite and fluctuating in size and shape. Rights to the use of such waters are difficult to determine because of the inherent difficulty in determining whether or not they occupy a watercourse or form a lake or pond. They generally gather eventually into definite channels and contribute to the flow of a stream; once they so gather they are subject to the law of watercourses. Those which have not yet so gathered, however, are treated somewhat differently in different States, but even in many appropriation States they have been held to belong to the landowner. They are somewhat similar to "percolating" ground waters, in that they are held not to occupy a definite watercourse, but nevertheless are truly tributary to watercourses; however, they are not as permanent or predictable as "percolating" waters.

The difficulty in applying a strict rule of priority to the use of such waters is recognized in the report of the National Resources Planning Board (1943, p. 60-65). The report, which advocates adoption of the appropriation doctrine for water in general, recommends "that the owner of land should be accorded the right to make some use of the waters which are in the process of flowing in a diffused state across his land, and the right to control such waters in the reasonable use and improvement of his land. What are reasonable uses and reasonable methods of control will necessarily depend upon the facts in each case, in the determin-

ation of which the effect upon rights of use in the lower stream should be given consideration. It is suggested, for example, that the landowner might be permitted so to prepare his land as (1) to protect it from injury, (2) to absorb all rainfall and diffused water passing over the land as it will hold, and (3) to effect such redistribution of the diffused water for crop production as may be feasible; and he might be permitted to capture rainfall in small reservoirs for stock watering or for crop production, without being required to make an appropriation therefor. On the other hand, he might be permitted to capture and store, for future use, diffused surface waters passing over his land from higher lands only if this will not affect adversely and substantially the rights of lower appropriators; and to accomplish this purpose, he would be required to make an appropriation for this storage for future use, the priority of which would relate to existing priorities on the stream and its sources of supply."

The report of the National Reclamation Association (1946, p. 56) follows the same line of thought:

313. Diffused surface waters. The owner of land upon which diffused surface waters...occur may make reasonable use of such waters in the protection of such lands from injury and in the furtherance of vegetative growth upon them, without making an appropriation of the waters therefor.

314. Such water may not be diverted for the irrigation of lands other than those on which they occur, except under an appropriation therefor.

The question of damage to lower lands by diffused surface waters passing onto them from higher lands is generally settled by holding the owner of the higher lands responsible if the damage is caused by improper discharge onto the lower land of diffused surface water collected by the owner of the higher land in an artificial reservoir or channel; but the owner of the higher land is not held responsible if the discharge occurs in the natural course of events, without intervention of any collection structures, or if it occurs from his collection structures but not in an unreasonable or improper way (National Resources Planning Board, 1943, p. 60).

Priority of Rights to Use of Interconnected Surface and Ground Water

The report "Water facts in relation to a national water-resources policy" pointed out the extent to which surface and ground water are interconnected and interrelated. Where ground and surface water are interconnected, any withdrawal of ground water that otherwise would discharge into the stream, or any withdrawal that increases the rate of seepage from an influent or "losing" stream, eventually results in a depletion of stream flow, to the extent that the water does not return to the aquifer or is not discharged into the stream, and to the extent that the withdrawal does not salvage water

formerly discharged by evapotranspiration. Where the doctrine of prior appropriation is recognized and where a withdrawal of ground water reduces the flow of a stream to less than the amount to which a prior appropriator has a right, the later appropriation generally can be enjoined (Conkling, 1936, p. 510). Such situations are potentially very common in the West, where appropriations of surface water antedate ground-water appropriations in most areas. Yet the interfering ground-water withdrawals may be creating additional storage space in the aquifer and may result in the salvage of "rejected recharge" which otherwise might be lost as flood flow; thus the ground-water withdrawals may result in an increase in the total useful water yield of the basin during most years. But the pumping may cause the stream flow to be less than normal during the irrigation season, when the water is needed; the increase may occur during the winter, when the prior appropriator of surface water for irrigation may have no need for it; in order that he may have it when he needs it, storage facilities may have to be constructed.

It seems fairly well established in the water law of the West that a prior appropriator of water from a stream is entitled to reasonable protection of his means of diversion (Hutchins, 1942, pp. 169-173), but not to unreasonable protection. Thus, if he is forced to make changes in his method of diversion because of the effects of a later appropriation, whether of surface or of ground water, he must do so if he can at reasonable cost; if the cost is unreasonable, the later appropriator may be required to pay for such changes to the extent that their cost is unreasonable.

In recent cases of planning for integrated development of stream basins, the question generally has been disposed of by providing for adequate surface storage facilities to serve existing surface-water rights, so as not to interfere with the phases of the project providing for an increase in the total water yield through increased use of wells. However, in places where such integrated projects are not provided. Some equitable means must be worked out to protect existing rights to a reasonable degree, yet not impede the additional development of ground water that will ultimately result in a greater total yield of water for the basin.

Protection in Means of Diversion

Cases involving the effect of new appropriations of water, mostly surface water, on the means of diversion used by a prior appropriator of surface water generally have been relatively clear cut; in general the courts have not had much difficulty in deciding whether the effect was such as to involve a substantial or unreasonable cost to the prior appropriator in modifying his means of diversion.

Four decisions, respectively in Arizona, California, Colorado, and Idaho, cited by Hutchins (1942, pp. 173-176), appear to apply the same general rule to ground water; that is, that a prior appropriator is entitled

to continue a reasonable means of diversion and to be protected against a substantial or unreasonable increase in his cost of diversion as the result of the inevitable lowering of water level caused by new withdrawals. However, full development of the water resources of a basin may require great periodic or permanent lowering of the ground-water levels to provide additional underground storage space or to induce maximum recharge and cut down waste by evapotranspiration. Under such conditions a more liberal interpretation by the courts of the terms "reasonable" and "substantial" may be necessary if the maximum use of the ground-water resources is to be achieved; otherwise the development may be stifled by the requirement that later appropriators must pay for any substantial increase in the cost of diversion by prior appropriators. Such a modified interpretation would not seem to be unreasonable. It might be based on a determination that, under the economic conditions existing in the area, other ground-water users are successfully lifting their water from depths as great as or greater than the new, lower level from which the prior appropriator now finds he must lift his water. Under such conditions pumping from the older, higher level might be held to be an unreasonable or nonbeneficial use of water, even though pumping from the lower level found to be economically feasible in the community would increase the prior appropriator's cost of diversion substantially. Reasonable, beneficial use of water has come to be an essential element in any water right under the appropriation doctrine and under the American rule and its California adaptation as well, and no one can acquire a right to an unreasonable, nonbeneficial use. Nevada's ground-water law as amended in 1949 provides that an appropriative right "must allow for a reasonable lowering of the static water level at the appropriator's point of diversion; and provided, that in determining such reasonable lowering of the static water level in a particular area, the state engineer shall consider the economics of pumping water for the general types of crops growing and may also consider the effect of water use on the economy of the area in general."

Note that the factor of economics enters strongly into the ground-water picture in relation to protection of the means of diversion. Though present in cases involving surface-water diversion, this factor has been much less important in surface-water decisions made to date. In determining what is a reasonable means of diversion of ground water, a decision is needed as to the economic practicability of withdrawal under the conditions that would result if a pending application for a new water right were granted (as, for example, under the Nevada law).

Not only new applications are involved. The present rate of pumping from a basin may be already in excess of that which can be maintained indefinitely within the economic limit of pumping under present economic conditions, and to bring the pumping within the "safe" or "optimum" yield may require a cutback in pumping, in accordance with whatever rule of law is followed in the State concerned. The subject of economics in rela-

tion to existing and new applications for water rights is treated in "Desirable principles of State water legislation" (National Reclamation Association, 1946, pp. 12, 21-22, 67-68, 72-73).

Excessive Early Appropriations and Channel Losses

Closely related to the problem of protection of means of diversion is that of excessive early appropriations. In many cases appropriations of water were made at a time when methods of use were not as efficient as they are now, and these early appropriations cover supplies substantially greater than would be needed if the most efficient practices were followed. Yet the holders of the early rights are loath to reduce their use of water for fear that their rights will be reduced, so they continue to use quantities of water that not only are not needed but may even be harmful, as by causing waterlogging of irrigated land. Generally where cases involving such excessive and wasteful use have reached the courts the right has been reduced on the basis that waste is not a beneficial use and the use must be reduced to the amount reasonably needed for the purpose for which the appropriation was made. However, much more could be done to reduce excessive appropriations to the amount actually needed to meet the highest standards of efficiency common to the area concerned. For example, the supreme court of one State held "that an acquired right in waters is limited to the amount that is reasonably necessary for the beneficial purpose for which it is diverted," yet, as pointed out by the National Resources Planning Board, its decision upheld one by a lower court granting the plaintiff the right to use a quantity of water greater than could conceivably be used beneficially under even the lowest prevailing standards of irrigation practice (Toerger v. Pacific Gas & Electric Co., cited in National Resources Planning Board, 1943, pp. 42-43).^{2/}

A closely related subject is that of excessive channel losses. A downstream appropriator may be protected from diversions by later upstream appropriators even if the water they must release for him is largely dissipated by evaporation and seepage from the channel before it reaches him. (In the case of seepage from the channel, of course, the water may not be "lost," as it may travel to some point where it is available for useful purposes.) There is a trend toward limitation of such rights on the basis that the water released at the upstream point must reach the downstream prior appropriator's diversion works in such quantity as to be capable of beneficial use (Hutchins, 1942, pp. 306-309). In an Idaho case in 1922 the State Supreme Court stated that the appropriator is entitled to a reasonable allowance

^{2/} The decision related to a specified number of "miner's inches" during the "irrigating" and "nonirrigating" seasons. The actual amount of water awarded would depend upon which of the various definitions of "miner's inch" was used and upon the length of the "irrigating season" assumed; it might be anywhere between 25 and 44 acre-feet per acre per year.

for loss in his distribution system after diverting the water, but that the estimated loss of 50 percent in the case in point was not a reasonable loss (*Basinger v. Taylor*, cited in Hutchins, 1942, p. 308). However, so long as the doctrine of prior appropriation is followed strictly, it would not seem possible to extend the principle of prohibiting unreasonable losses to a channel loss of 50 percent between an upstream point where water must be released and the diversion works of a downstream prior appropriator, so long as the remaining 50 percent is sufficient to be put to beneficial use. Reduction of such losses by legal means is a problem for the future.

Regulating Aquifers of Small Perennial Yield

The difficulty of regulating ground-water use in areas of small recharge and perennial yield, such as the High Plains of Texas, is mentioned frequently in the report "Water facts in relation to a national water-resources policy." The need for regulation of withdrawals to produce the greatest good for the longest time is obvious; unfortunately, the methods that should be followed in each case are not so obvious.

In the case of water-table aquifers of large storage but low perennial yield, the principle of prior appropriation may not offer the answer. For example, in the High Plains of Texas, application of the doctrine to the aquifer as a whole would mean that those who had first made appropriations aggregating roughly 50,000 acre-feet per year (the estimated rate of replenishment) would be protected, and all subsequent appropriators would have to cease their withdrawals. But the wells of those first appropriators could not conceivably draw on the water supply of the whole aquifer. In order to do so they would have to be relocated and probably increased greatly in number so as to be assured of a perennial supply of 50,000 acre-feet per year. If the wells were spread out over the entire plains area, the stored water would gradually be dissipated by natural discharge at the edge of the plains. If the wells were located at the edge of the plains so as to salvage the natural discharge, the stored water in the middle of the plains would remain much as it is now. In either case the vast amount of stored water would be lost for useful purposes. If it is decided that "mining" of the stored water is economically and socially desirable, then the rate of withdrawal must be much greater than the perennial yield.

It would appear that regulation of withdrawal in an area such as the High Plains might be done by dividing the region into administrative units, insofar as possible on the basis of natural underground boundaries or partial boundaries such as those formed by bedrock ridges, and within such areas by such units as counties, townships, and sections. The amounts of stored water in each unit would be determined by hydrologic investigation, and an administrative decision would be made as to the feasible rate of withdrawal of the stored water in that unit. Perhaps the doctrine of prior appropriation

could be followed within a unit of sufficiently small size that the wells of the earliest users, whose appropriations added up to a total rate equal to the feasible rate of withdrawal, could reasonably be expected to tap all the stored water in that unit lying above the feasible depth of pumping. Such an arrangement would be comparable to breaking up a stream system into segments, each with its own list of priorities. Or, the State might decide to apply the riparian rule to such an extent as to allow each landowner to withdraw the water stored beneath his property. Whether each area of land would get its share of water of course would depend on whether the water was withdrawn while it was available. If not withdrawn it would drain to adjacent lands where wells were being pumped, as in the case of oil and gas, and the benefits of the use of the water would accrue to the neighboring lands.

There would be numerous difficulties in such a procedure, as where the aquifer is less permeable beneath one area than beneath the neighboring one, though the amount of stored water might be as great. Wells in the second area might be able to withdraw the stored water quickly and begin to drain water from the first before the wells in the first area could recover all its stored water.

Whatever the method of regulation chosen for such aquifers, there will be grave difficulties requiring legal, administrative, and judicial thinking and action of a high order. And, of course, any successful regulation will require full knowledge of the ground-water conditions in each administrative area. The experience of Texas, which is considering regulation of ground-water withdrawals in the High Plains, will be illuminating (see section on Texas in appendix).

Even more perplexing problems can be expected in the regulation of artesian aquifers, especially the less permeable ones, where the withdrawals are distant from the areas of recharge and natural discharge. The principle of prior appropriation runs into difficulties similar to those encountered in water-table aquifers of the High Plains type. To protect a prior appropriator might require stopping all the other withdrawals from the aquifer, and even then he may not have a permanent supply because he may reach the limit of feasible pumping depth long before his wells have salvaged enough "rejected recharge" or intercepted enough natural discharge to reach stability. The maximum development of such aquifers requires wells near the recharge area; owners of wells in the areas some distance away may have to depend on artesian storage and to be satisfied with a gradually decreasing yield once the limit of pumping lift is reached. Perhaps in their case the most that can be done is to require the maximum feasible well spacing so as to minimize interference between wells and to achieve the most uniform possible lowering in head over the largest area, to tap the maximum amount of artesian storage. The same requirement for adequate spacing applies of course to wells nearer the recharge area also.

All in all, the problems of regulating ground-water use in aquifers of low perennial yield are among the most difficult with which water administrators are faced.

What is Safe or Optimum Yield?

Regulation of water use to prevent overdevelopment of an aquifer, or a part of it, involves the determination of a safe or optimum rate of withdrawal and the holding of withdrawals to it. This is true whether the doctrine of prior appropriation or that of correlative rights is applied. Such a determination generally is much more difficult for a ground-water reservoir than for a surface stream or reservoir, for it inevitably involves the economic feasibility of a given means of withdrawal or a given pumping lift, not only in an aquifer as a whole but in different parts of it. Because of variations in the cost of withdrawal in relation to the use to which the water is put, it is impracticable or at least very difficult to define by statute the conditions determining optimum yield. For example, a pumping lift of 100 feet may be feasible for all users in a given area, whereas 200 feet may be feasible for some but not for others. Yet the perennial yield of the aquifer may be greatly different at the two pumping levels. Where should the regulating official set the limit of pumping?

Again, in most aquifers the distribution of wells affects the perennial yield significantly. With a given distribution of wells, an enforced reduction in pumping by cutting off the later appropriators (or, under correlative rights, by reducing the pumpage of all in proportion to the estimated perennial yield of the aquifer and to the amount of land owned by each user) may not prevent local overdevelopment. Reducing the pumpage in one part of an aquifer may not result in an equivalent addition to the supply for other wells, either for a long time or, if the reduction simply results in an increase in the natural discharge from the aquifer, possibly not at all.

It is apparent that the regulatory official must be given wide latitude in determining the effect of proposed increased pumping, or the places where and the amounts by which pumping must be reduced to bring the withdrawal within the optimum yield; also, the extent to which existing rights are affected by any given change in rates of withdrawal, and therefore the extent to which compensation may be due the injured parties at the expense of those to which the benefits accrue. His judgment, which should be supported by adequate hydrologic information, should be accorded great weight by the courts, which in the end determine the reasonableness or unreasonableness of any action where there is dispute (National Reclamation Association, 1946, p. 104).

It should be pointed out that the maximum perennial yield of an aquifer can be obtained only by depressing the water levels enough to reduce natural discharge and induce additional recharge to the maximum practicable extent. As the original water levels de-

cline to the ultimate average stage for maximum development, water is removed from storage; the average total withdrawal from the aquifer during this preliminary period therefore is greater than the permissible average for long-term development. There must be recognition that such "mining" of water occurs in the early stages of development of any aquifer, and that what is then a safe and necessary rate of withdrawal would be excessive if continued indefinitely, and thus must be reduced. Whether the reduction should be entirely at the expense of the latest appropriators, or shared by all the users on the assumption that those who participate in enjoying the "cream" should share in the inevitable reduction, is another problem that the lawmaker must face.

Selection of Administrative Areas

One difficulty mentioned above under What is safe or optimum yield? deserves a little more discussion: that of the effect on one part of an aquifer of a change in withdrawal in another. Where the size or geologic and hydrologic properties of a basin are such that a strict application of priorities or of correlative rights in reducing withdrawal would result in a net loss of water for the basin as a whole, through increased natural loss, it may be necessary to subdivide the basin into areas and subareas, each with a given allowance of water and a separate set of priorities or correlative rights. Determination of the amount of water allowed to each area is a difficult question. Generally it must be settled by negotiation among the holders of water rights in the different areas, resulting in equitable agreements similar to interstate compacts. The basis of such an agreement might include the size of each area, the amount of replenishment in or of water contributed by each area to others, the priority of water rights in one area in relation to those in another, the value of water in one area in comparison to that in another, etc. The number and size of areas within a basin should be subject to change as necessary in the light of increasing hydrologic knowledge, which will require equitable adjustment of water rights, in accordance with whatever rule of law is followed.

Designation of administrative areas and determination of the permissible rate of withdrawal are likely to be comparatively difficult in the humid East, where conflicts between water rights have been relatively few so far. Western desert basins generally form individual hydrologic units that can be conveniently administered as a whole, or broken up into areas and subareas based, more or less, on natural hydrologic boundaries, though even here many complex and difficult problems of administration are encountered. In the East, an aquifer may extend across several drainage basins, and though the surface- and ground-water divides within the area of the aquifer generally coincide, there are many places where they do not, or where they do under natural conditions but do not under conditions of heavy withdrawal from wells. Also, in industrial areas the kinds of uses and their relative

economic feasibility are likely to be much more varied than those in Western basins, where the principal use is for irrigation. Problems of interference with stream flow and of the relation of surface-water and ground-water rights in the East have not been serious so far but are bound to become increasingly important as developments based on induced infiltration increase. Determination of areal and regional water-resources potentialities and study of principles of law to be followed in the East are needed, the sooner the better, in order to avoid the development of tangled water-rights situations that will impede the full development of water needed in the future.

One of the potentialities that warrant early consideration is the legal effect of the increasing practice of supplemental irrigation in the East. This increasing use of water will result in much fuller development of the potential water resources of many rural areas in the East where present uses of water are so small in relation to total supply that few or no questions of interference have arisen.

The availability, at least under conditions of full surface-water development, of surplus surface water that can be used for artificial recharge of ground-water reservoirs is a promising factor for the future in the East. In many cases local overdevelopment can be prevented feasibly by artificial recharge, at lower net cost to water users or the community than that of cutting off later appropriators or apportioning the naturally available supply among many users. Formation of water districts is one means of effecting full and economical development of the local water resources, including the practice of artificial recharge as necessary and feasible.

Obviously, in the East as in the West, State regulatory officials will have to be given wide latitude, subject to review by the courts as necessary, in determining the areas to be administered and the amount of water that can be developed in each.

Preferential Uses

Where or when water is limited, the public interest may require that some uses of water be given preference over others which, though beneficial in themselves, result in a lower contribution to the general welfare than others. Ordinarily domestic use is given preference, regardless of priority. This may be done by a specific declaration in the law exempting use for domestic purposes, including the watering of stock or of small gardens. Use for public supply may be given similar preference in time of shortage, but not necessarily without compensation to holders of otherwise superior rights, and with safeguards to prevent use of public water for low-grade purposes, such as lawn sprinkling and street flushing during periods of shortage.

Under an appropriative system, and excluding domestic use, the principle of preferential use would be applied by granting

to all existing or potential appropriators the right of eminent domain, whereby they could condemn a right to an inferior use in order to make an appropriation for a superior use, with just compensation to the holder of the prior right. The principle of priority in appropriation could be protected by reserving to the holder of the prior right the privilege of changing within a reasonable time to a higher use, equal to or higher than that for which the new appropriator seeks the water, so as to avoid losing his right.

Where prior rights are condemned in favor of a new appropriation for a superior use, there is a difficult question of deciding how much compensation should be paid the holder of the condemned right. The report of the National Reclamation Association (1946, p. 31) recommends that "no value, in excess of the actual amount paid to the State in acquiring the right, shall be claimed for either the inchoate appropriative right or the completed appropriative right with respect to the regulation of rates or services to be rendered by the holder of the right or his successors, or with respect to any valuation for purposes of sale to any government agency or entity or in any eminent domain proceeding..." This means that, under this version of the appropriation doctrine, the water is considered public property and the holder of a right is entitled to its use only so long as his right is not condemned in favor of a superior use; his compensation is to be limited to his cost in acquiring the right, and is not to include the value of the water to him as an essential ingredient in the enterprise he has built up through use of the water. Such a provision may seem rather harsh, but where the supply is limited it would insure that the highest possible use would be made of the water.

The report of the National Reclamation Association (1946, p. 38) gives the following order of superiority: First, domestic and municipal uses; second, irrigation and stock-watering uses; third, water-power use; fourth, mining use, and manufacturing and industrial uses that are not implied in an appropriation for municipal use; and fifth, all other uses, without preference as among themselves. The order might be made different in an industrial State where there is little irrigation; indeed, in some States irrigation might be made to rank above industrial use in one part and below it in another.

To What Kind of Water Does a Water Right Attach?

A water right involves more than a specific quantity of water. The water must be usable for the purpose for which it is appropriated. For example, an irrigation right originally may have attached to "new" water whose quality was suitable for irrigation. Later appropriations upstream may have diminished the amount of "new" water reaching the holder of the prior right, and a part of his right now attaches to "irrigation-return" water. Return water is generally higher in dissolved minerals than "new"

water; if the mineral content increases sufficiently the water may be unusable for irrigation, or larger quantities of "excess irrigation" water may have to be applied to prevent damage to the soil. Adjustments in water rights, or compensation for substantial damage, may be necessary in cases where subsequent appropriations result in substantial damage to a prior appropriator because of deterioration in the quality of the water.

So far, in decisions involving ground water, the holders of prior rights have been held to be entitled to reasonable protection of their means of diversion--that is, to have the water level maintained sufficiently high as not to require a substantial increase in cost of pumping. As discussed elsewhere, maximum development of an aquifer may require modification of this rule so that the holder of the prior right will not be held to have been injured so long as his pumping lift remains within that found to be economically feasible in that community. Thus, only within economic limits would a water right be held to include a given head or pumping lift as a characteristic of the appropriated water. The right would attach to a given quantity and quality of water but only within limits to water at a specified level; those limits should be made flexible to allow for changing economic and hydrologic conditions.

Proration in Time of Scarcity

Under the appropriative system, strict application of priorities in time of shortage means that junior appropriators are cut off altogether and senior appropriators get their full share. A system that would provide for proration in time of scarcity, both senior and junior appropriators getting some water and the senior being reimbursed by the junior, merits study (National Resources Planning Board, 1943, pp. 57-58). Where superior uses are involved the law might already provide for condemnation of a prior right to an inferior use, but a proration system would apply to uses of the same kind. The system would have the advantage of forcing the prior appropriator to make the best and most economical use of the water remaining to him; the junior appropriator, getting some water where otherwise he would get none but having to pay for it, obviously would do the same thing. The amount of compensation to be paid is the most difficult problem--whether only the cost of acquiring the prior right, or the full loss of income suffered by the prior appropriator in giving up a part of his water, or something between those limits.

Rights to Use of Return Flow

The law of rights to return flow from irrigation (as would be true for other uses that are nonconsumptive or only partially consumptive) is not fully settled (National Resources Planning Board, pp. 49-52). Return flow results from essentially all irrigation; even under the most careful practices some excess water must be applied to keep salts from accumulating in the soil. In general,

there is a trend toward recognition of the right of the original appropriator to reuse the return water before it leaves his property or enters a watercourse, and even after it enters a watercourse if his original declaration of appropriation specifically provides that he intends to so recapture it. Where the original appropriator makes no attempt to recapture the water, or declares his intention to do so but fails to do so within a reasonable time, the water becomes available for later appropriators.

There is an important distinction between legitimate or inevitable return flow and "waste water" resulting from wastefully excessive application. Under a doctrine providing for reasonable and beneficial use no valid right can be acquired to the excess water over that reasonably necessary for the purpose for which appropriated, so that the original appropriator is under no obligation to continue the waste; in fact, he is bound not to do so. This means that a later appropriator whose supply depends on continuation of the wasteful practices does not acquire a firm right to the water. His right is subordinate to that of an appropriator who is earlier than he though later than the original appropriator, and who would have benefited if the wasteful practices had not been followed and will be benefited when they are stopped. Where an appropriation depends on long-continued return flow from excess--but not unreasonably wasteful or excessive--use for irrigation, the user depending on the return flow is generally held to be entitled to its continuation.

Regulation to Prevent Salt-Water Encroachment

Regulation of ground-water withdrawals to prevent salt-water encroachment presents a somewhat special case. Where there is no danger of such encroachment, a ground-water reservoir can be overdrawn for a time without permanent damage, and later the withdrawal can be cut down to the perennial yield, or below it for a time, to restore the depleted supply and lowered water levels. Where salt-water encroachment occurs, however, all or part of a ground-water reservoir may be lost for useful purposes for a long time or permanently. It is especially important, therefore, to study carefully all useful ground-water reservoirs subject to salt-water encroachment to determine the optimum yield and the necessary methods of development, and to regulate the withdrawals to prevent permanent damage. Thus, all important coastal aquifers, particularly the coastal basins of California and the aquifers of the Atlantic and Gulf Coastal Plains, should be studied and placed under control as necessary to protect them for the future. In the Atlantic and Gulf Coastal Plains many interstate compacts eventually will be needed to govern the amounts of water withdrawn and the proper methods of development to recover the maximum supply yet prevent salt-water encroachment in areas crossing State lines. In the interior of the country the aquifers subject to encroachment of water of poor quality from any source should be similarly studied and regulated.

Restriction of Use of Water for Air Conditioning

Use of water for air conditioning has imposed a heavy load on the public water supplies of many cities. According to Bean (1948, p. 814) about "40 percent of the water supplies of the larger cities should definitely have air-conditioning regulations in effect, although actually only about 10 per cent have any such rules or practice any volume control."

The Illinois Water Service Co., serving Champaign and Urbana, Ill., restricts the use of city water for air conditioning under a 1946 ruling of the State Commerce Commission (Amsbary, 1948, p. 812). Water cannot be used in units where the water is used directly for cooling, or in compressor-type refrigeration units smaller than $1\frac{1}{2}$ tons. Each customer may use water for one compressor-type unit of $1\frac{1}{2}$ to 5 tons. Water cannot be used in units larger than 5 tons unless water-saving devices such as cooling towers are used. The 1946 ruling followed one in 1942 which, in effect, permitted a surcharge on water used for air conditioning; the 1942 regulation was ineffective because it was still found to be cheaper to use the water than to install water-saving equipment.

Reno, Nev., restricts the discharge of air-conditioning water into the sewer system. The State of Indiana restricts the use of ground water for air conditioning, whether from city supplies or from privately owned wells (see section on Indiana in appendix). Pasadena, Calif., prohibits the discharge of waste water from air conditioning into the sewer system, automatically compelling the installation of water-saving equipment (Amsbary, 1948, p. 813).

New York City requires metering of air-conditioning water where the minimum quantity required exceeds half a gallon per minute, and water-saving devices where the use exceeds an annual average of 5 gallons per minute. Philadelphia requires water-saving devices where the use exceeds 10 cubic feet (75 gallons) per minute (sufficient for units up to about 30 tons; the same water, with conservation devices, would be adequate for up to 750 tons). Detroit, Mich.; Newark, N. J.; New Orleans, La.; Pittsburgh, Pa.; and Washington, D. C., grant permission for air-conditioning installations using city water only where the capacity of the mains is sufficient. Wichita, Kans., excludes air-conditioning water from the sanitary sewers if the use exceeds 1 gallon per minute. Ten other water-supply systems have considered regulations but have not adopted them (Bean, 1948, p. 815).

According to Kain (1948, p. 819), Chambersburg, Pa., prohibits the installation of air-conditioning equipment of 5 tons or more unless a water-saving device is used. Miami Beach, Fla., prohibits the discharge of waste air-conditioning water into sanitary sewers if the unit uses more than 2 gallons per minute. In 1944 the Virginia section of the American Water Works Association passed a resolution recommending that

no utility should supply water from the public distribution system for any new, additional, or enlarged refrigeration at a rate in excess of 0.05 gallon per minute per ton of refrigeration.

H. E. Thomas, in a personal communication of July 11, 1950, points out that:

"Air conditioning creates two types of problems that may lead to regulation: One is the taxing of the distribution and disposal (sewage) systems that have to carry the water, so that they become inadequate for their purpose; the other is the drain on water supply. Some cities like Chicago, with a large reserve for public supply, feel the pinch chiefly on their distribution and disposal systems.

"Another point to consider is that 'conservation devices' may reduce the need for 'new' water by as much as 90 or 95 percent, but the water they do use is a consumptive use. Thus, whereas they are an economy measure in New York City, where water after use goes out to sea, they might actually reduce the water resources in Denver, where municipal water after use gets into the South Platte River and can be reused again and again for irrigation."

So far as known, the existing regulations in individual cities have been considered as within the legitimate and reasonable powers of the municipality or utility, to safeguard the adequacy of the public water supply. However, Smith (1948, p. 825) believes that regulations based on quantity used or on a special, higher price for the water are vulnerable to a charge of discrimination if no restrictions are placed on certain other uses, such as for lawn sprinkling, swimming pools, etc. He points out that water-saving devices are almost a necessity for the larger air-conditioning units, even if standard rates are charged for the water used, which reduces the seriousness of the problem.

Summertime restrictions on use of water for lawn sprinkling, automobile washing, etc., of course are common through the United States where public water supplies are inadequate to meet peak demands (Gierlich, 1948, pp. 746-770).

Legislation to Promote Maximum Development

At various points throughout this report there has been some mention or recognition that legal control of water use, if too inflexible, may impede full development of water resources. The subject deserves brief discussion in its own right, in view of the increasing water demands in the Nation and of the full development of water resources necessary to meet them.

The general objective of water law should be to promote full development rather than simply to restrict use to prevent local

overdevelopment. It should be aimed, not only at protecting holders of existing water rights, but at encouraging others to acquire rights where this can be done without serious damage to existing rights. Too strict an interpretation of an existing right may mean that the favored original appropriator may get his full supply under the original conditions of quality, head, etc., though this may mean that no subsequent rights may be acquired because they would interfere substantially with his; thus, a large part of the usable water of a basin may have to be left untapped. This is especially true with regard to ground water where the original means of diversion, by artesian flow or pumping from only a shallow depth, is protected too rigidly. The criterion should be maximum useful development for the public good, with reasonable protection of existing rights, in accordance with the highest possible standards of efficiency of withdrawal and use that can be achieved in the community concerned.

An interesting current example of an attempt to achieve full development of ground water, neither permitting overdevelopment nor restricting use to such an extent that unused water is lost by natural discharge, is afforded by the practice of New Jersey. There the Division of Water Policy and Supply of the Department of Conservation, which has jurisdiction over all ground-water diversions exceeding 100,000 gallons per day in "protected areas," issues permits for new diversions having a definite time limit. At the end of the period the permit is renewed if conditions appear to warrant it; it may be canceled or reduced if the supply appears to be fully developed or overdeveloped. So far as reduction of withdrawal is concerned, the effect of the practice is not greatly different from that in the West, of cutting off the latest appropriators when it appears that the supply is insufficient for all. It serves to put the permit holder on notice that he is acquiring only a limited right--one he is prepared to relinquish if it is shown that the supply is inadequate. Yet the method tends to encourage maximum development, on a basis of "wait and see, but go ahead and use the water while waiting if you want to."

The principle of prior appropriation may prove to be that capable of promoting the fullest and most efficient development of water resources, by protecting and encouraging the investment of money in projects to develop water and in enterprises based upon its use. But the strict application of the principle of priority, no matter what the means of diversion or the use to which the water is put, should be modified--as it already has in many places--to promote the highest beneficial use, the most efficient methods of use, and full yet safe development of the water resources of each area. Water is a public resource. Its use should be regulated to produce the maximum public as well as private good.

Finally, it would be well to emphasize that regulation of water use is most effective when done largely through voluntary

cooperation of water users and the public in general, based upon adequate understanding of the facts. As in all other phases of regulation of human conduct, a law whose purpose is not freely and plainly understood is not easy to enforce. Public recognition of the need for equitable and effective control is the first prerequisite; it can be achieved by adequate investigation of our water resources and free dissemination of the results and their implications. Given such understanding, only a minimum amount of restrictive legislation will be needed.

SELECTED BIBLIOGRAPHY

- *Amsbary, F. C., Jr., 1948, in Rates and regulations for water used in air conditioning: *Am. Water Works Assoc. Jour.*, vol. 40, no. 8, pp. 809-813.
- Angell, J. K., 1877, *A treatise on the law of watercourses*, 7th ed., revised and enlarged by J. C. Perkins, 839 pp., Boston.
- Baker, D. M., and Conkling, Harold, 1930, *Water supply and utilization*, New York, John Wiley and Sons, Inc., 495 pp.
- Bean, E. L., 1948, in Rates and regulations for water used in air conditioning: *Am. Water Works Assoc. Jour.*, vol. 40, no. 8, pp. 813-818.
- *Bechert, C. H., 1949, in Current developments in ground water law: *Am. Water Works Assoc. Jour.*, vol. 41, no. 11, pp. 1002-1004.
- *Bernhagen, R. J., 1949, in Current developments in ground water law: *Am. Water Works Assoc. Jour.*, vol. 41, no. 11, pp. 1011-1012.
- Bingham, J. W., 1916, *Cases on the law of water rights*, 750 pp., Indianapolis.
- Black, A. P., 1947, Basic concepts in ground water law: *Am. Water Works Assoc. Jour.*, vol. 39, no. 10, pp. 989-1001; discussion by S. B. Morris, p. 1002.
- *Burch, Clarence, 1948, *Water laws of Oklahoma*: *Am. Water Works Assoc. Jour.*, vol. 40, no. 4, pp. 454-456.
- Chandler, A. E., 1918, *Elements of Western water law*, revised ed., 158 pp., San Francisco.
- Congressional Library, 1914, *List of references on water rights and the control of water*, compiled under the direction of H. H. B. Meyer, 111 pp.
- Conkling, Harold, 1937, *Administrative control of underground water: Physical and legal aspects*: *Am. Soc. Civil Eng. Trans.*, vol. 102, pp. 753-837 (with discussions by others).
- Coulson, H. J. W., and Forbes, V. A., 1924, *The law relating to waters: Sea, tidal, and inland*, 4th ed., revised by H. S. Moore, 688 pp., London.
- *See appendix.

- *Critchlow, H. T., 1948, Policies and problems in controlling ground water resources: Am. Water Works Assoc. Jour., vol. 40, no. 7, pp. 775-781; Appendix, State ground water laws, 1948, pp. 781-783.
- *_____ 1949, in Current developments in ground water law: Am. Water Works Assoc. Jour., vol. 41, no. 11, pp. 1006-1007.
- Davis, C. F., 1915, The law of irrigation, 346 pp., Fort Collins, Colo.
- Doll, B. E., 1947, Formulating legislation to protect ground water from pollution: Am. Water Works Assoc. Jour., vol. 39, no. 10, pp. 1003-1009.
- Farnham, H. P., 1904, The laws of waters and water rights, 2956 pp. (3 vols.), Rochester, N. Y.
- Fiedler, A. G., and McGuinness, C. L., 1948, Ground-water problems and their relation to Army water-supply installations. Paper presented at Water and Sewage Conference, Office of Chief of Engineers, Baltimore, Md., Oct. 26, 12 pp.
- Fly, J. S., 1938, The role of the Federal Government in the conservation and utilization of water resources: Univ. Pennsylvania Law Rev., vol. 86, pp. 274-294.
- *Food and Agriculture Organization of the United Nations, 1950, Water laws in the United States of America, Agr. Devel. Paper No. 2, 161 pp., March 1950 (Reissue of report completed in 1948).
- Gierlich, O. A., 1948, Meeting the Southwestern water shortage: Am. Water Works Assoc. Jour., vol. 40, no. 7, pp. 766-770.
- *Goudey, R. F., 1947, Developing standards for the protection of ground water: Am. Water Works Assoc. Jour., vol. 39, no. 10, pp. 1010-1020.
- Gould, J. M., 1900, A treatise on the law of waters, 3d ed., 956 pp., Chicago.
- Harding, S. T., 1936, Water rights for irrigation: Principles and procedure for engineers, 176 pp., Stanford Univ.
- Hawaii Univ., 1948, Oahu ground water control. Legislative Reference Bur. Rept. 8, 67 pp.
- Hepler, J. M., 1948, Water legislation in Michigan: Am. Water Works Assoc. Jour., vol. 40, no. 1, pp. 88-96.
- Hutchins, Wells, 1934, Policies governing the ownership of return waters from irrigation: U. S. Dept. Agr. Tech. Bull. 439, 48 pp.
- _____ 1939a, Ground water law in the Western States: Assoc. Western State Eng. Proc., vol. 12, pp. 93-100.
- _____ 1939b, Water rights for irrigation in humid areas: Am. Soc. Agr. Eng. Jour., vol. 20, pp. 431-432, 436.
- _____ 1940, Protection in means of diversion in ground-water supplies: California Law Rev., vol. 29, pp. 1-20.
- _____ 1941, Some defects in Western water law: Assoc. Western State Eng. Proc., vol. 14, pp. 44-61.
- _____ 1942, Selected problems in the law of water rights in the West: U. S. Dept. Agr. Misc. Pub. 418, 513 pp.
- *Illinois Legislative Council, 1948, Control of ground water: Report prepared pursuant to Proposal 266 by Representative Warren L. Wood: Publication 88, 26 pp., May 1948.
- *Johnson, A. H., 1949, in Current developments in ground water law: Am. Water Works Assoc. Jour., vol. 41, no. 11, pp. 1010-1011.
- Johnson, D. W., 1905, Relation of the law to underground waters: U. S. Geol. Survey Water-Supply Paper 122, 55 pp.
- Kain, T. H., 1948, in Rates and regulations for water used in air conditioning: Am. Water Works Assoc. Jour., vol. 40, no. 8, pp. 818-819.
- Kinney, C. S., 1912, A treatise on the law of irrigation and water rights, 2d ed., 4558 pp. (4 vols.), San Francisco.
- Kinyon, S. V., and McClure, R. C., 1940, Interferences with surface waters: Minnesota Law Rev., vol. 24, pp. 891-939.
- *Klein, S. D., 1940, Summary of the statutes affecting water in the 31 Eastern States: Nat. Resources Planning Board, Water Resources Committee, Subcommittee on State Water Law, 117 pp., June 1940.
- *Knapp, G. S., 1949, in current developments in ground water law: Am. Water Works Assoc. Jour., vol. 41, no. 11, pp. 1004-1006.
- Long, J. R., 1916, A treatise on the law of irrigation, 2d ed., 626 pp., Denver.
- *McGuinness, C. L., 1945, Legal control of use of ground water: Water Works Eng., vol. 98, no. 9, pp. 415, 508-512.
- McHendrie, A. W., 1930, The evolution of the doctrine of priority of water rights: Colorado Bar Assoc., vol. 33, pp. 123-141.
- Minard, D. E., 1937, The future of water allocation and developments in interstate agreements: Am. Water Works Assoc. Jour., vol. 29, no. 7, pp. 942-950; discussions, pp. 950-959.
- *Nat. Assoc. Vertical Turbine Pump Manufacturers, 1947, Report and recommended policy: Water conservation codes, 10 pp.

- Nat. Reclamation Assoc., 1943, Preservation of integrity of State water laws: Report and recommendations of committee of Nat. Reclamation Assoc. appointed October 1942, 176 pp., October 1943.
- _____ 1946, Desirable principles of State water legislation. Final report of committee appointed October 1942, 128 pp., October 1946.
- *Nat. Resources Planning Board, 1943, State water law in the development of the West. Water Resources Committee, Subcommittee on State Water Law, 138 pp., June 1943.
- Olsen, R. L. 1926, the Colorado River Compact, 527 pp., Cambridge, Mass.
- Shaw, Lucien, 1922, The development of the law of waters in the West: California Law Rev., vol. 10, pp. 443-460.
- Smith, G. E. P., 1936, The preferential rights in the use of water and their relation to agriculture and authority for enforcement: Am. Farm Bur. Fed., Inst. Irrigation Agr., Proc. Fifth Ann. Conference, 9 pp., March 1936.
- Smith, M. C., 1948, in Rates and regulations for water used in air conditioning: Am. Water Works Assoc. Jour., vol. 40, no. 8, pp. 823-826.
- *Spence, E. V., 1948, Conservation and control of Texas water resources: Am. Water Works Assoc. Jour., vol. 40, no. 4, pp. 445-453.
- Thompson, D. G., and Fiedler, A. G., 1938, Some problems relating to legal control of use of ground waters: Am. Water Works Assoc. Jour., vol. 30, no. 7, pp. 1049-1091.
- *Thompson, J. C., 1949, in Current developments in ground water law: Am. Water Works Assoc. Jour., vol. 41, no. 11, pp. 1007-1009.
- Tolman, C. F., and Stipp, Amy C., 1941, Analysis of legal concepts of subflow and percolating waters: Am. Soc. Civil Eng. Trans., vol. 106, Paper No. 2116, pp. 882-901; discussions, pp. 902-933.
- Trygg, J. E., 1948, State control of Louisiana water resources: Am. Water Works Assoc. Jour., vol. 40, no. 4, pp. 457-460.
- U. S. Dept. Agr., Interbur. Committee, 1941, State legislation for better land use, 122 pp.
- Warne, W. E., 1948, Legal and economic problems associated with excessive withdrawal from ground-water sources: Inter-American Conference on Conservation of Renewable Natural Resources, Proc., Sec. III, pp. 297-304, Denver, Colo.
- Wiel, S. C., 1911, Water rights in the Western States, 3d ed., 2067 pp. (2 vols.), San Francisco.
- _____ 1918, Origin and comparative development of the law of watercourses in the common law and in the civil law: California Law Rev., vol. 6, pp. 245-267, 342-371.
- _____ 1919, Waters: American law and French authority: Harvard Law Rev., vol. 33, pp. 133-167.
- _____ 1929, Need of unified law for surface and underground water: Southern California Law Rev., pp. 358-369, April.
- _____ 1936, Fifty years of water law: Harvard Law Rev., vol. 50, no. 2, pp. 252-304.
- *Williams, O. C., 1948, Ground-water problems of the reclamation States: Assoc. Western State Eng. Proc., 8 pp. (reprint).

APPENDIX

PARTIAL SUMMARY OF EXISTING WATER LAW
BY STATES

Following is a brief summary of existing water law in each State according to data available in the files of the Geological Survey. The statements are based on items marked with an asterisk (*) in the bibliography, and on copies of laws and miscellaneous data in a "legal file" maintained especially with reference to ground water. The Geological Survey has not had time to make a complete canvass of the States to obtain up-to-date information, and the summaries are by no means complete. They are presented simply as a brief and partial picture of the situation in the different States.

The summaries refer generally to legal provisions as they are understood to exist. Few of them reflect the current state of enforcement of the laws described.

The summaries refer largely or exclusively to legal control of diversion of water, and briefly or not at all to the laws affecting flood control, drainage, pollution, sanitary quality of water supplies, etc., that are in force in many States. In practically every State the State health department has jurisdiction over public water supplies, to protect their quality; in a number of States other agencies also have jurisdiction.

The health departments and, in a number of States, separate agencies have control over the pollution of streams and, in some cases, of ground-water bodies. Laws in many States regulate the construction of dams for power production and other uses, formation of irrigation, drainage, and levee districts, navigation, condemnation of land and of riparian rights for public water supply, etc. These subjects could not be covered in the brief time available.

Thus, the frequently used statement "specific statutory control of diversion of water" refers only to the absence of statutes providing for the acquiring of water rights. In States for which such a statement is made, the riparian rule for surface water and the English common-law rule or one of its Ameri-

can adaptations for ground water generally may be considered to apply.

Alabama

No specific legislation controlling diversion of water. Riparian rights for surface water. Common-law rights for ground water. Legislative acts of 1947 and 1949 give Water Improvement Advisory Commission authority to control new pollution, and existing pollution where it becomes hazardous, except for certain named "industrial streams" that are not subject to control.

Arizona

Doctrine of riparian rights abrogated by legislature in 1887; abrogation embodied in State constitution. Water of surface streams, "springs on the surface," and "definite underground streams" subject to appropriation by owner of irrigable land, or possessor having intent and apparent future ability to acquire ownership. Ground water assumed to be percolating unless shown definitely to constitute a "definite underground stream." American rule of reasonable use favored for "percolating waters." State law of 1948, in effect covering only "percolating waters," gives State Land Commissioner authority to declare "critical ground-water areas" and stop further irrigation developments therein. Law exempts domestic, stock, public, industrial, and "transportation" (railroad, etc.) wells; required registration of all existing irrigation wells, and permits for new wells. There is no statutory authority to reduce present overdevelopment, except as water of a given overdeveloped area might be held to constitute a "definite underground stream" and thus fall under the law of watercourses.

Arkansas

No statutory provision for control of diversion of water at present. Bill prepared before the last session of 1948-49 legislature proposed to establish, under the police power of the State, the principle of prior appropriation of surface water for beneficial use, to be administered by State Resources and Development Commission. Ground water was not included, but one of stated purposes of proposed act was to "facilitate the conservation of ground water in many areas" by encouraging surface-water developments. Bill was not introduced to legislature. A similar bill had been introduced in a previous session of the legislature but did not pass. A bill for an act to make the filing of water-well logs mandatory was introduced to the 1948-49 legislature but was withdrawn. Surface-water legislation may be introduced in the 1950-51 session.

California

All water is declared by statute to be property of the people of the State, but available for appropriation for beneficial use, subject to existing rights.

Under California law both riparian and appropriative rights are recognized in water

of surface streams, and also "subterranean streams flowing in definite channels." Riparian rights do not include right to store water for future use. Springs that are the source of streams are subject to the law of watercourses, but a spring from which no stream naturally flows ordinarily belongs to the landowner, except that appropriations of spring water on the public domain are protected against subsequent entrymen. Ground water not shown to constitute a "definite underground stream" is presumed to be percolating. There is no statutory control of "percolating water," but court decisions have established the doctrine of correlative rights, and also have made "percolating water" available for appropriation where there is more than enough for the reasonable use of overlying landowners, or where the landowners are not using it, but subject to their future use at any time. Interconnected surface and ground waters are treated as a common supply, the rights of overlying landowners, owners of riparian rights, and appropriators being correlated on a basis of reasonable beneficial use. All rights of every character are limited to use for reasonable and beneficial purposes under reasonable methods of diversion. All rights are subject to loss in whole or in part by prescription.

By statute, water-right filings made by the State covering surplus or unappropriated waters for a coordinated plan of water conservation may be released or assigned for developments not in conflict with such a plan and not in conflict with the needs for future development of the county in which the water originates. The statute providing for such preferential rights of counties is commonly referred to as the "Counties of Origin" act.

Colorado

The doctrine of appropriation is exclusive for all "natural streams"; the riparian doctrine has been repudiated under the "Colorado doctrine." The statutes provide that a landowner may use spring or seepage water arising on his property if capable of being put to use there, but that which would be tributary to a stream if not diverted is subject to prior rights on the stream. If the flow is shown not to constitute a natural watercourse it may be used by the landowner. "Percolating waters" tributary to a surface watercourse are subject to appropriation. It is not certain what rule would be applied to "percolating waters" not tributary to a watercourse, if there are any such waters, but in all litigation so far involving "percolating waters" they have been held subject to appropriation.

A bill providing specifically for a ground-water code, based on the principle of public ownership and availability for appropriation of all waters except "springs not contributing to a natural stream," was introduced in the State legislature in 1947 but failed to pass.

Connecticut

No general statutory control of the

diversion of water, but the General Assembly has granted such rights in specific cases, such as for public water supply. Presumably the riparian doctrine would be followed for surface water. A court decision reached in 1939, or perhaps somewhat earlier, applied the English rule in permitting withdrawal of "percolating water" from wells by the Cromwell Water Co. for export from the drainage basin of Dividend Brook, notwithstanding the claim by the Hartford Rayon Corp. that the water contributed to the flow of the brook, the full flow of which was used and needed by the corporation. The Board of Health of the city of New Haven has a regulation, effective August 15, 1936, requiring permits for the construction of wells, but it relates entirely to sanitary aspects and not to conservation of ground water.

Delaware

No statutory control of diversion of water. The State Board of Health and the Water Pollution Control Commission, the latter established in 1949, have the customary authority over public water supplies and sewage and waste disposal.

Florida

A 1929 State law that applies in effect only to Sarasota, Manatee, and Charlotte Counties provides that discharge from flowing artesian wells is to be regulated by control structures to the amount needed for beneficial use. Notice of drilling an artesian well ("any artificial hole in the ground, fifty feet or more in depth, made for the purpose of obtaining water supplies from subterranean sources") is to be filed with the State Geological Survey. Wells encountering water unsuitable for human consumption are to be plugged so as to protect the water of other strata. The State Geologist may regulate the withdrawal of all wells in any district in these counties that is threatened by salt-water encroachment.

The Board of Commissioners of Seminole County has the authority to require capping of flowing wells and to prevent waste of artesian water.

The State Board of Conservation has authority to promulgate regulations to prevent activities in one area or watershed that would adversely affect the surface or underground water supply of another area or watershed. However, legal means of enforcing any such regulations are lacking.

Georgia

Riparian rights apply to surface water, common-law rights to ground water, but whether English or American rule would be followed is not known. Riparian owners are empowered to ditch and embank their lands for protection against flooding, so long as stream is not diverted from its original channel. "Trespass may not be maintained for interference with underground streams." Formation of State pollution-control board under consideration, and legislation may be introduced in 1951, possibly including ground water as

well as streams. Law of 1945 empowers State Oil and Gas Commission to regulate drilling of oil and gas wells to prevent waste of these fuels and loss or contamination of fresh water.

Records and cuttings from water wells are to be furnished to the Division of Mines, Mining and Geology. State Department of Health has authority over location of municipal water-supply wells and over wells used for waste disposal. City of Savannah requires permits for new water wells, with special restrictions on additional industrial wells.

There is interest in legislation to prohibit waste of water from flowing wells, or at least to establish an agency to carry on a campaign of education to reduce such waste.

Idaho

The riparian doctrine has been abrogated in Idaho. All water in natural streams, surface or underground, has been held to be subject to appropriation, and "percolating waters" likewise have been held to be subject to appropriation. However, the State may regulate and limit the use of water appropriated for power purposes. Spring water not flowing from a landowner's property can be used by him, unless appropriated by another while the land was part of the public domain.

Waste of water from flowing artesian wells is prohibited.

The State legislature passed a groundwater code, effective 60 days after its signing by the Governor on March 19, 1951. The code affirms the traditional policy of the State of requiring that the waters of the State "be devoted to beneficial use in reasonable amounts through appropriation" and extends it specifically to all ground water. It provides a procedure for appropriation of ground water, under the supervision of the State Reclamation Engineer.

Illinois

Permits for drilling wells are issued by Department of Mines and Minerals; logs of wells and, where desired, drill cuttings must be submitted to the State Geological Survey. Wells tapping oil- or gas-bearing rock shall, with certain exceptions, be cased so as to seal off all fresh water. Abandoned wells must be plugged so as to protect water suitable for domestic use or irrigation. In 1943 a bill was submitted providing for establishment of a Water Conservation Board having rather complete powers over the development and use of all waters in the State, except for water used for domestic or agricultural purposes, where the authority was limited to requiring the furnishing of information, and, for water used for agricultural purposes, to the prevention of excessive waste. The board would have had the authority to regulate withdrawal of water in designated "administrative water areas," in the interest of conservation, and to practice artificial recharge of ground water where reasonable regulation of withdrawal would not meet the

need. The principle of priority was to be followed within the administrative areas, subject to existing vested rights; where the supply was inadequate even for existing rights the water would be apportioned among the users. However, in time of shortage the board would have had the authority to restrict withdrawals on bases other than priority, such as the public interest, relative benefits of use, etc., even in areas where rights based on priority had been acquired. The bill failed to pass. A somewhat similar bill was introduced in 1949 but was withdrawn by its sponsor upon agreement by prominent business and agricultural groups to collaborate in revising it and to support the revised bill.

Use of city water for air conditioning in Champaign-Urbana is restricted by rule of the water utility (see section in text on Restriction of use of water for air conditioning). The restriction was justified on the basis of depletion of the local ground-water supply, and the uneconomic, concentrated loads imposed by air conditioning on the wells and treatment and distribution facilities of the water company.

Indiana

Riparian rights for surface water. Common-law rights applied to ground water until 1947. A law passed in that year by the General Assembly prohibited the use of 200 gallons per minute or more of ground water for air-conditioning and cooling purposes unless the water was recirculated through cooling towers or other devices and reused, or the water was returned to the ground through recharge wells, or a permit was obtained from the Department of Conservation. The Department was to deny such permits only when the available information indicated that a withdrawal in excess of 200 gallons per minute would affect the ground-water resources of the area "to such an extent that it will be injurious to the public health and welfare of the community." The State Board of Health issues permits for the return of water to the ground, requiring methods that will insure protection of the sanitary quality of the water.

The law provided no penalty for violation and no funds for enforcement. For these reasons, and also because the law restricted the use of water for a specific purpose and thus raised a question of constitutionality, it was not enforced strictly. It was repealed by the legislature in February 1951 and replaced by Senate Enrolled Act No. 56. The new law authorizes the Department of Conservation to declare "restricted-use areas" where withdrawal exceeds or threatens to exceed replenishment and to issue full or modified permits, or refuse to issue permits, for new uses exceeding 100,000 gallons per day. The Department is authorized to prohibit waste of ground water in restricted-use areas. Waste is defined to include any non-beneficial use (including permitting a flowing well to discharge more than 1,500 gallons per day of water that serves no useful purpose) and also the contamination of a fresh-water stratum.

Another law passed in 1947 (Chapter 277), and rules and regulations of the Indiana Department of Conservation promulgated thereunder, require a written permit for drilling any well for oil and gas or for secondary recovery, input wells, and wells for the disposal of salt water, brine, or oil-field wastes. It is further required that an accurate log or record of the well be filed with the Indiana Department of Conservation, showing the name, location, and elevation above sea level of the well; the name, character, and thickness of the formations encountered; the position and thickness of coal beds and other deposits of economic value; the kind of well (whether dry or productive, oil or gas) and, if productive, the initial production before and after shooting or acidizing; and the depth of any fresh-water horizon known to have been penetrated and such information as is available as to the volume of fresh water. Such records may be kept confidential upon request for a period of not less than 6 months.

The Conservation Commission also regulates the disposal of salt water and waste liquids, and gas and water input wells, to prevent surface or underground contamination.

Iowa

Legal situation generally similar to that in other States where the common-law riparian system prevails; no specific statutory control of diversion of water. A bill was prepared in 1937(?) and a revised one in 1940 for an act to give the Iowa Geological Survey, State Department of Health, and State Conservation Commission general supervision and control of all methods of obtaining ground water for human consumption, as necessary for the safeguarding of public health and the conservation of ground-water resources. The bill was not passed. In 1941 a bill was introduced to create a water-well committee empowered to establish minimum standards for the construction of wells and the conservation of underground water. The bill failed to pass.

In 1949 the General Assembly created the Iowa Natural Resources Council. It is the duty of the Council to establish a comprehensive State-wide plan for the conservation, development, and use of water resources, including ground water. Legislation doubtless will be recommended by the Council.

Kansas

Prior to 1945 both riparian and appropriation doctrines were followed, with some distinctions on a regional basis. Chapter 390 of the Laws of 1945, however, makes appropriation, by application to the Chief Engineer of the Division of Water Resources of the State Board of Agriculture, the exclusive method of acquiring a water right, except for domestic purposes. The controlling principle for all water, surface and underground, is declared to be priority of appropriation for beneficial use, subject to vested rights to the use of water for beneficial purposes. Preferential uses in the case

of conflicting applications are established as follows: domestic, municipal, irrigation, industrial, recreational, and water-power. Rights, except to domestic use, are forfeited after 3 years of nonuse. Existing common-law rights (the common law was adopted by the first territorial legislature in 1855) are recognized as vested rights, which cannot be impaired except for nonuse.

Kentucky

No specific statutory control by the State of diversion of water. Abandoned salt wells must be filled or enclosed. In the Louisville area the Louisville and Jefferson County Health Department sponsored the adoption of a drilling code which requires a permit for drilling wells to be used for human consumption or for artificial recharge. In the same area the recently formed Metropolitan Sewer District finances its operation by means of a "sewer tax." The effect has been to reduce the pumping of ground water, as the cost of disposing of used ground water into sewers has become a substantial part of the total cost of developing the water.

Louisiana

No specific statutory control of diversion of water. No proposed legislation on ground water. Only pending legislation on surface water is a bill to establish a Sabine River Authority, one of whose principal tasks would be to negotiate a compact with Texas providing for control of the river and distribution of its waters.

State law provides for proper construction of oil and gas wells and protection of fresh-water supplies from contamination, as in many other oil-producing States. The Department of Health can require the sealing of abandoned wells to protect public water supplies.

A bill was introduced in 1938 in the House giving the Department of Conservation authority to make and enforce regulations governing the drilling of wells and the conservation and prevention of waste of ground water. The bill did not pass. In 1944 bills were introduced to establish a State Water Control Authority and to give it power to establish regulations for the use of water in the public interest including the sealing of abandoned flowing wells, regulation of diversion of surface water, and regulation of surface and underground waste disposal. The bills did not pass.

Maine

No specific statutory control of diversion of water. "Named water districts may tap any surface or underground waters within designated areas and may acquire all necessary water rights by eminent domain."

Maryland

Water-resources law of 1933 declares it to be the policy of the State to control the appropriation and use of the waters of the State, both surface and underground, and makes it unlawful to appropriate or use any

waters of the State without a permit from the Department of Geology, Mines and Water Resources. Exempted are the use of water for domestic and farming purposes and the use of water for an approved water supply of any municipality; also uses in existence on January 1, 1934, provided that they are not thereafter abandoned. The act provided for issuance of permits to appropriate water, except where the Department is of the opinion that the proposed appropriation would be wasteful, dangerous, impracticable, or detrimental to the public interest. No enforcement machinery was provided, and the law was not enforced until the water-well law of 1945 was passed. The law provided for the licensing of well drillers and for issuing permits for all wells (water, gas, oil wells, test holes) 50 or more feet deep, except hand-dug wells and drive-point wells. A 1949 amendment requires a permit for all wells drilled with a machine rig, regardless of depth; only hand-dug and driven wells are now exempt.

Massachusetts

Named municipalities, water districts, or water companies may acquire by purchase or condemnation ground- or surface-water sources within defined areas not already appropriated for public water supply; anyone wishing to divert water for public supply must petition the General Court (legislature) except in emergencies. No one shall pollute any public water supply, divert water from any surface-water sources of public water supply, or divert from the distribution system of any public water supply. The existing law has never been interpreted to limit the taking of ground water by private individuals or public agencies, except that public water supplies must have the approval of the Department of Public Health as to location, appropriateness, and safety.

An "act to regulate ground water supplies in the Commonwealth" was introduced at the 1950 session of the General Court; it would authorize the Department of Public Health to take action "to restrain the use of or drawing of water in a manner which may jeopardize the water supply of such public water supply agency" (water company, water district or fire and water district, municipality, or other public agency). This bill resulted in a resolve which provides for an investigation and report by the Department of Public Health on the subject of regulation of ground-water supplies and also "the whole matter of the use by individuals, municipalities, water districts or fire and water districts, water companies, or state agencies, of waters lying below the surface of the ground, and the protection of such ground waters from pollution."

The Department has made its report to the General Court, as authorized by the resolve. The report states that creation of a regulatory body authorized to allocate ground water will be necessary within a generation. It recommends revision of existing legislation to give the Department more authority to restrain pollution of or encroachment on public water supplies. The

report contains a table summarizing briefly the status of water law in the different States.

Michigan

Riparian rights apply to surface water and probably the American rule of reasonable use to ground water. If the waters of any well are put to a use (such as waste of water from a flowing well) that is unreasonable in view of the surrounding conditions, and other wells supplied from the same reservoir are thus injured, it shall be deemed a nuisance and may be abated. The decree "shall specify the volume of water that shall be allowed to flow therefrom. Such decree may be reopened on the question of reasonable use at any time on a showing of change of circumstances."

The State supervises the locating, drilling, operation, and plugging of wells drilled for oil, gas, oil- and gas-field waste input, secondary recovery, and geological information. Such wells penetrating salt or mineral water, when abandoned, are to be plugged so as to prevent contamination of fresh water.

A 1949 law created the Water Resources Commission, which "shall protect and conserve the water resources of the State and shall have control of the pollution of surface or underground waters of the State of Michigan and the Great Lakes...." Regulations covering pollution of ground water have been drafted and are in the process of review.

A bill was introduced in 1947 to require licensing of well drillers and furnishing of well records to the State; it dealt also with conservation of surface water. It did not pass. Now under consideration is another bill for a proposed surface-water law, one of the purposes of which would be to "facilitate the conservation of ground waters in many areas." The bill is based on the police power and on beneficial use and reasonable means of diversion as the limit of any water right. Vested rights, including riparian rights, would be recognized. Water in excess of that needed for those rights would be subject to appropriation by the exclusive method of application to the Water Resources Commission. The Commission would have the power to reject applications in the public interest.

The State and/or the county boards of supervisors have authority to petition the circuit courts for determination of the "normal" level of inland lakes, as shown by existing records and testimony and as affected by the public interest under present conditions, and to build dams or other structures to maintain that level.

Minnesota

A 1947 law provides that any county in which all or part of any body of water is situated, upon issuance of a permit by the Commission of Conservation, "in order to improve navigation thereon, or to promote the public health, safety and welfare, may improve the same and maintain the improvement

and operate control works." The public must be given access to some portion of the shore line of the body of water improved under the law.

The water-resources act of 1947, replacing a similar earlier law passed in 1937, provides that (1) subject to existing rights, all waters in streams and lakes wholly or partly within the State and capable of being put to substantial beneficial use shall be subject to the control of the State; (2) the State, so far as practicable, shall control the appropriation and use of surface and underground waters of the State; and (3) the State shall control and supervise, so far as practicable, the construction, reconstruction, repair, removal, or abandonment of dams, reservoirs, and all control structures in any of the public waters of the State.

The law gives broad powers to the Commissioner of Conservation, who "shall devise and develop a general water resources conservation program for the State. The program shall contemplate the conservation, allocation and development of all the waters of the State, surface and underground, for the best interests of the people. The Commissioner shall be guided by such program in the issuance of permits for the use and appropriation of the waters of the State...." It is unlawful to appropriate or use any waters of the State without the previously obtained written permit of the Commissioner, who "may give such permit subject to such conditions as he may find advisable or necessary in the public interest." Exempted are use of water for domestic purposes for less than 25 persons, use of water for any purpose originating within the geographic limits of any municipality, and beneficial uses and rights in existence on July 1, 1937. Specific authority is included for regulation of artesian wells to prevent waste. Provision is made for appeal to the district court and then to the State Supreme Court from any ruling of the Commissioner.

Under the terms of the law, the State apparently is free to apply any principle, that of prior appropriation or any other, to proposed uses of water not exempted by the act.

Mississippi

No specific statutory control of diversion of water. In 1944 a bill was introduced providing for licensing of well drillers, issuance of a permit by the Oil and Gas Commission for the drilling of any well to a stratum containing water under artesian pressure, and prevention of waste of water from any artesian well, by flow or pumping or by leakage through defective casing. The bill did not pass. A similar bill was introduced at the 1950 session of the legislature; it did not pass.

Missouri

No one may divert water from any stream or spring used for domestic purposes. (Apparently this refers to a diversion that

would interfere with the use for domestic purposes.) Any one owning land on the bend of a river may divert water across the bend to generate power. Sufficient water must be left in the river to satisfy domestic and stock uses of families below the point of diversion. Damages must be paid for any injuries caused by the diversion.

Montana

Water of surface streams is, by statute, subject to appropriation, the riparian doctrine having been abrogated. Water of "definite underground streams" has been held to be subject to the same rule. Spring water may be appropriated.

An appropriator of the water out of a stream has the right to the flow of a spring appearing subsequently in the bed of a tributary as a result of natural causes; however, if the flow would not reach his diversion during the dry season, it could be appropriated during that period by others. Also, an increase, due to return of irrigation water, in the flow of an existing spring at the head of a watercourse on which appropriative rights have been established, does not belong to the one who supplied the irrigation water from which the increase in flow resulted.

Until 1947 the English rule apparently was followed for "percolating waters." In 1947 was passed "an act to provide for the conservation of underground water." It provides that anyone owning land can drill an artesian well or wells on his land for domestic, stock, irrigation, or manufacturing use. However, wells are to be properly constructed to prevent caving and "loss of underground water above or below the surface." Logs and other data on wells are to be furnished to the State Engineer, and, if requested, periodic records of water-level elevations. The statute prohibits waste of water from artesian wells, flowing or nonflowing.

A specific ground-water code was introduced in the 1951 session of the State legislature and was defeated in the House. The code would have made water of "underground streams, channels, artesian basins, reservoirs, or lakes" subject to appropriation for beneficial use. It would have recognized the priority of rights to the use of surface water to which the ground water is tributary. It would have provided a procedure for making ground-water appropriations similar to that in other Western States having ground-water codes.

Nebraska

With regard to surface water, the riparian doctrine was held in a 1903 decision of the State Supreme Court to have been replaced in 1889 by the doctrine of prior appropriation under the Irrigation Act of that year; only riparian rights accrued before that time were valid as against subsequent appropriations.

A riparian landowner who has not made actual use of the water before appropriators acquire rights cannot enjoin them but can

only recover damages for an injury to his right. However, when appropriations are made with his knowledge before he begins to use water under his riparian right, and he is enjoined from using the water under that right, the damages he can collect do not include the cost of ditches he constructed in preparing to use water. Thus, subject to riparian rights existing as of 1889 and to appropriative rights acquired thereafter, surface water is subject to appropriation. The Department of Roads and Irrigation may exercise reasonable discretion in refusing to grant a permit for appropriation, if the public interest demands.

The State Supreme Court in 1936 (1938?) ruled that water could not be appropriated for use outside the watershed in which the appropriation is made. The decision has the effect of blocking several water-development projects that were planned on the basis of interbasin diversions. The term "watershed" is not defined exactly enough to determine whether diversions may be made from one sub-basin to another within a larger basin.

Spring water that forms a stream is subject to appropriation. Ownership of land on which there is a spring that forms a stream gives only a riparian right.

One court decision in 1933 implied that "definite underground streams are subject to the same rules of law as are surface streams." The same decision favored the American rule of reasonable use for "percolating waters"; further, it stated that apportionment in time of shortage would be permissible, thus approximating the California rule of correlative rights.

In 1941 a bill for a ground-water law was introduced in the State legislature. The bill declared all ground water to be the property of the State and subject to regulation under the police power. The bill recognized vested rights and exempted domestic supplies of not more than 100 gallons per minute; also public water supplies. Administrative water areas would be designated, and existing rights certified. Anyone not already using water in such an area could apply for a permit to do so. The Department of Roads and Irrigation would allocate a quantity of water, if unallocated water remained--a "reasonable proportion of the available supply." Such a "reasonable supply" would not extend to more water than needed for beneficial use on land owned or leased by the applicant; in any case, it would not be more than 1 cubic foot per second for each 70 acres or 3 acre-feet per acre per year.

The rights of holders of certificates issued at the time of designation would be superior to those of holders of "allocation permits" or "temporary allocation permits" acquired thereafter. If the supply proved to be insufficient for all, the water surplus to the needs of the certificate holders would be prorated among the holders of allocation permits unless the quantity thus provided to each would be so small as to be useless. In such event, the water would be divided,

in useful amounts, among the earlier holders of permits.

The bill, which combined some features of the appropriation and correlative-rights doctrines, was not passed.

Nevada

The doctrine of prior appropriation for beneficial use is exclusive in Nevada for all water, surface and underground. Domestic uses of not more than 2 gallons per minute from wells are exempted. The State Engineer has authority to distribute the water of adjudicated streams; he also has the authority to regulate permitted rights for use of water of unadjudicated streams. Spring waters are subject to appropriation; those which are the source of a stream are subject to appropriative rights on the stream. The statute of 1913 referred to all water. Legislation enacted in 1915 exempted "percolating water, the course and boundaries of which are incapable of determination." The ground-water statute of 1939 removed that exemption. The act relating to underground waters, as amended in 1949, provides that: "It shall be an express condition of each appropriation of ground water acquired under this act that the right of the appropriator shall relate to a specific quantity of water and that such right must allow for a reasonable lowering of the static water level at the appropriator's point of diversion; and provided, that in determining such reasonable lowering of the static water level in a particular area, the state engineer shall consider the economics of pumping water for the general type of crops growing and may also consider the effect of water use on the economy of the area in general."

As a matter of public policy, in order to insure the largest beneficial use of the natural supply, the State assumes that when the water level declines the burden is upon owners of existing wells, ultimately, to protect their yield by the necessary pumping. It is the policy of the State Engineer to restrict further diversions: (1) when the safe yield has been reached, (2) when the water table has been lowered to a level from which the pumping lift approaches the maximum economical limit, or (3) when further diversion will adversely affect the economy of the area in general, whichever occurs first.

New Hampshire

No specific statutory control of diversion of water use. The riparian doctrine is followed for surface water. "Municipal water companies may appropriate water from streams, springs, ponds, or subterranean sources within the boundaries of the town." Presumably if such an appropriation injured a riparian landowner the right could be acquired by condemnation and payment of damages.

New Hampshire originated the American rule of reasonable use for ground water in 1862, in a case (*Bassett v. Salisbury Mfg. Co.*) that involved not use of ground water but flooding of basements as a result of a rise of the water table caused by construction

of a power dam and raising of the river level. The rule has since come to be followed in a considerable number of States where the common law is in force.

New Jersey

The Division of Water Policy and Supply of the Department of Conservation and Economic Development has general authority to supervise the use and development of all waters of the State and to regulate the construction and maintenance of dams. Public water supplies have been under the jurisdiction of the State since 1907 for surface waters and 1910 for ground waters. In 1947 the legislature extended the control of ground waters to all private, domestic, and industrial supplies. Two "protected areas" were established in 1947, parts of Middlesex and Monmouth Counties and parts of Burlington, Camden, Gloucester, and Salem Counties; within these areas permits are required for new diversions of ground water in excess of 100,000 gallons per day unless the well was in existence, and was equipped with a pump of as great or greater capacity, prior to passage of the act. In protected areas, permits limited to a definite number of years are the rule, and the return of water to the ground is being required in many cases. In 1947 also was passed a law requiring the licensing of well drillers and the obtaining of permits for wells more than 100 feet deep.

New Mexico

The doctrine of prior appropriation is exclusive for surface water and for "the waters of underground streams, channels, artesian basins, reservoirs, or lakes, having reasonably ascertainable boundaries." Inasmuch as all ground-water bodies have boundaries reasonably ascertainable by scientific investigation, the law may be considered to apply to all ground water; however, control is exercised only in basins declared by the State Engineer. The ground-water law was first passed in 1927, declared unconstitutional in view of the constitutional prohibition of extension of legislation by reference, and then reworded and passed in 1931. The appropriation procedure for "watercourses" has been exclusive since passage of the Water Code in 1907 but was in use before that time.

Spring or seepage water arising from an unknown source belongs to the landowner, when such water does not run beyond his property. If it discharges into a defined watercourse, it then becomes public water subject to appropriation.

The ground-water law is applied to areas designated by the State Engineer. It was first applied by the stopping of additional development of artesian water in the Roswell artesian basin, the overdevelopment of which led to passage of the law. Additional development of shallow ground water in the Roswell Basin has now been stopped; also, development in the Salt Creek and Macho extensions of the basin. Development has also been stopped in the Mimbres Valley,

the Lea County Basin in the High Plains, the Hot Springs artesian basin, and the Animas Basin; and the Virden Valley, Carlsbad, Estancia, and Portales Basins have been declared.

A 1935 law regulates the drilling, casing, cementing, and equipping of artesian wells to prevent loss or waste of water.

A law passed in 1949 requires licensing of well drillers and prohibits any person owning or controlling land in basins delineated and declared by the State Engineer to permit the drilling of a well other than by a licensed driller. It prohibits also the application of water to land not having a valid water right for the purpose to which applied.

The ground-water laws were upheld in a decision of a State District Court in 1949 (New Mexico v. Lanning, Dority, and Wiley; three cases heard simultaneously.) The case was appealed to the State Supreme Court, where the decision was upheld. It was then appealed to the United States Supreme Court, which in May 1951 refused to hear it.

New York

The Water Power and Control Commission has general supervision over the water-power resources of streams in which the State has a proprietary right or interest. It also is required to carry on investigations in order to complete for the entire State a comprehensive plan for the conservation, development, regulation, and use of the waters in each of the principal watersheds. Diversion for power or other commercial or manufacturing purposes of waters in which the State has a proprietary right or interest may be made by license.

River-regulating districts may be organized for regulating the flow of rivers when required by the public welfare, including public health and safety. River-improvement districts may be created to improve the channels, construct dikes, or regulate the flow of rivers for protection from damage by floods.

The Commission and its predecessors have had general authority since 1911 over public water supplies. In 1933 the authority was extended to cover new ground-water diversions on Long Island for all purposes except agricultural, where the well is equipped with a pump having a capacity of more than 100,000 gallons per day. In 1935 a law was passed requiring licensing of well drillers on Long Island, and furnishing by them of well data. As a part of the regulation of ground-water use on Long Island the Commission generally issues permits for wells used for cooling with the requirement that the water be returned to the ground through a closed system. Between January 1936 and January 1949 an average of 15 million gallons per day was so returned.

Accelerating the natural flow of mineral-water wells is unlawful, as are the waste of certain classes of mineral waters and the

drawing of mineral waters solely for the purpose of extracting carbon dioxide. In certain cases permits are required for allowing springs to flow at certain rates, and flow at a rate that will deplete a spring is not permitted except in special cases.

North Carolina

No specific statutory authority for control or diversion of water. Permits required for wells drilled for oil and gas. Regulations of the Department of Conservation and Development require that abandoned oil and gas wells be plugged so as to protect ground-water supplies. Legislation providing for licensing of well drillers, furnishing of records to the State, construction of wells to prevent underground leakage, prevention of waste from flowing wells, plugging of abandoned water wells, etc., considered in the past but not yet enacted.

North Dakota

According to the report of the National Resources Planning Board (1943, pp. 106, 123-124) and that of Hutchins (1942, pp. 237-239), both riparian and appropriation doctrines are in force and riparian rights have not been substantially limited in favor of appropriative rights. The State constitution provides that "all flowing streams and natural water courses shall forever remain the property of the State for mining, irrigating and manufacturing purposes." A 1913 statute declares that the landowner owns water standing thereon or flowing over or under the surface but not forming a definite stream. The two reports cited refer to legislation as late as 1939.

The compilation of North Dakota water laws issued by the Water Conservation Commission in 1945 states, in citing laws of 1905, 1913, and 1939, that "all waters within the limits of the State from all sources of water supply belong to the public and are subject to appropriation for beneficial use." No reference to riparian rights could be found, but one to "vested rights" may refer to riparian rights, and there is a reference to "riparian rights" in the index that was not accompanied by any section in the text of the compilation. "Percolating water" apparently is not mentioned in the compilation. It appears, however, that omission of such references from the compilation does not mean that riparian rights and private ownership of "percolating water" have been abrogated.

Use of water for irrigation is limited to 1 cubic foot per second for 80 acres. Any possessor of land may divert water from a "minor stream" --one flowing less than a third of a cubic foot per second for the greater part of the year--without making an appropriation.

The State has authority to control waste of water from flowing wells and has achieved a considerable reduction of waste, largely through an educational program. This would seem to apply the American rule of reasonable use at least to artesian waters.

An act making waters of "underground

streams, channels, artesian basins, reservoirs, lakes and other bodies in the ground" public waters subject to appropriation for beneficial use, subject to vested rights, was considered in 1945 but apparently was not enacted.

Ohio

Riparian rights for surface water and "definite underground streams" and common-law rights for "percolating waters." Ground water is assumed to be percolating unless shown otherwise. American rule of reasonable use applies, though the State conservancy law has been construed not to allow recovery of damages for loss of "percolating waters" as a result of construction of a conservancy project.

Counties are authorized to establish, within themselves or in cooperation with other counties, the State, or the Federal Government, complete systems of water conservation and flood control; to prevent floods, regulate stream channels, reclaim wet and overflowed lands, provide for irrigation where needed, regulate stream flow and conserve the water, divert or eliminate watercourses, provide water for domestic, industrial, or public use, collect and dispose of sewage or other liquid wastes, and arrest erosion (along the Lake Erie shore line). Water rights existing before formation of a district are recognized; additional waters made available through activities of the district belong to the district and rights to them can be leased, sold, or assigned in return for reasonable compensation, those who have been assessed a part of the cost of construction of facilities having the first right to purchase such waters. The district may claim riparian rights also where it is a riparian landowner. In granting rights to use of waters of the district, preference is given first to domestic and municipal use, second to industrial use, steam-power production, and cooling uses, and third to irrigation, hydro-power production, recreation, fisheries, and other uses.

The Superintendent of Public Works also has authority to "construct projects to conserve the waters of the State," including the acquiring of necessary lands, waters, and riparian rights by purchase or condemnation.

The Ohio Water Supply Board was formed in 1941, was succeeded in 1945 by the Ohio Water Resources Board, and is now known as the Division of Water of the Department of Natural Resources. Its duties are to study the water resources of the State. In 1945 it was given authority to regulate the drilling, operation, maintenance, and abandonment of water wells, mainly to prevent contamination of the ground waters of the State. Waste of water from flowing wells is prohibited, as is use of wells for disposal of sewage or other contaminating waste. Artificial recharge is encouraged, subject to the supervision of the Board and the State Department of Health.

A 1945 regulation required filing of logs of water wells, except farm and domestic wells. In 1947 the provision was broadened to include

all wells.

There has been some agitation for control of diversion of ground water in certain heavily pumped areas, but some opposition also. State officials believe that regulation will be achieved through the action of local interests and will be at the local level.

Oklahoma

Both riparian and appropriation doctrines appear to be applied to surface streams, springs forming streams, and "definite underground streams." "Water running in a definite stream, formed by nature over or under the surface, may be used by him as long as it remains there; but he may not prevent the natural flow of the stream, or of the natural spring from which it commences its definite course, nor pursue nor pollute the same." But, "Water running in a defined stream over or under the surface, or a natural spring from which a stream commences its definite course, is public water subject to general appropriation."

Cases involving riparian rights have related to uses other than for irrigation, and it is not certain how use of water by a riparian landowner for irrigation would be viewed in relation to an appropriative right acquired before the riparian began his use of the water.

Prior to 1949 "percolating water" belonged to the owner of the land beneath which it occurred; it was subject to the American rule of reasonable use, but not necessarily to apportionment (correlative rights). In 1949 a ground-water law was passed that is based on appropriation of "percolating water" but excluding water in "underground streams with ascertainable bed and banks." The basis of the law is stated to be public policy "to conserve and protect the ground-water resources of the State and for that purpose to provide regulations for the taking and use of ground water." Nonwasteful domestic and stock use is exempted. Priority of rights relates to established dates of beginning of beneficial use prior to the effective date of the act, and of date of receipt of applications by the State Planning and Resources Board after the effective date. An appropriative right is lost by nonuse for 2 years. The Board can establish "critical ground-water areas," but it is not stated that regulation by the State is limited to such areas, and apparently the rights in any ground-water basin can be adjudicated, and withdrawals stopped in reverse order of priority to bring the withdrawal within the annual replenishment, at the initiative of the State.

The Board has the authority to require reuse or return to the ground of water proposed to be used for cooling, to require certain spacing of wells to bring about the most orderly withdrawal of water, and to require methods of well construction adequate to prevent salt-water contamination of fresh-water aquifers.

Difficulties in application of a law based on prior appropriation to areas of

limited recharge but present or potential heavy use, such as the Oklahoma Panhandle (High Plains), are discussed in the text of this report.

Oregon

The riparian doctrine for surface water has been essentially abrogated in favor of the appropriation doctrine. The water code of 1909 limited riparian rights to the extent of actual beneficial use prior to the passage of the act or within a reasonable time thereafter by means of works then under construction. Certain streams and a section of the Columbia River are exempted from appropriation in order to preserve the natural flow for scenic and other purposes. Springs that are not the source of watercourses belong to the landowner, except where appropriated on public land prior to entry. Springs that discharge into natural streams are subject to appropriation.

"Underground streams, channels, artesian basins, reservoirs, or lakes, the boundaries of which may reasonably be ascertained" in the area east of the summit of the Cascades have been subject to appropriation for beneficial use since 1935, in the same way as surface waters. "Percolating waters" in the area west of the Cascades, and any such waters east of the Cascades in bodies whose boundaries are not "reasonably ascertainable," belong to the landowner. For the area west of the Cascades, a State Supreme Court decision involving the 1909 law held that, if the existence of an "underground stream" can be reasonably ascertained without excavating, such as by growth of tules, application may be filed with the State Engineer for the appropriation of such water. This would be considered not the appropriation of underground water but the appropriation of surface water under the 1909 water code.

As of May 1951, a comprehensive ground-water code, to supplant the law of 1935, was being drafted by a committee of the Oregon Reclamation Congress, with the technical assistance of the Geological Survey.

Pennsylvania

Law passed in 1937 appropriates to the Commonwealth all unappropriated flowing (surface) waters except private springs and private water supplies, and sets up a procedure for appropriation of water for public-supply purposes. Private use is not mentioned.

Bills were introduced into the 1949 General Assembly providing for: (1) licensing of well drillers and furnishing of well records to the State, and (2) regulation of ground-water withdrawals to prevent waste and pollution. The conservation bill would have exempted domestic wells and supplies of 50 gallons per minute or less being used beneficially at the time of passage of the act. Beneficial uses of more than 50 gallons per minute in existence at the time of passage could be continued, but the users and those commencing nonexempted uses in the future would have been required to file declarations of use with the Water and Power Resources

Board, receiving in return a "certificate of beneficial and reasonable use" if the Board considered the use beneficial and reasonable; others making declarations would receive only a "certificate of use." Ground-water conservation districts would be declared where the withdrawal was exceeding or threatening to exceed replenishment; permits would be required for new withdrawals of more than 50 gallons per minute. The bills did not pass.

Rhode Island

No specific statutory control of diversion of water, except that the owner of a dam may not "detain waters for more than 12 hours out of 24, except Sundays, when requested by the owner of a dam within one mile below on the same stream to let the natural flow of the stream pass his dam." The Blackstone Valley Board was created to cooperate with a similar agency in Massachusetts to regulate pollution, stream flow, and the floods in the watersheds of the Blackstone and Seekonk Rivers.

South Carolina

No specific statutory control of diversion of water. Comprehensive new water-pollution law approved May 4, 1950; applies to all water, surface and underground, and to practically all polluting substances. Language might be interpreted to include prevention of contamination of fresh-water wells by water from saline aquifers. Legislation to require control of waste from flowing wells has been considered but not yet enacted.

South Dakota

Both riparian and appropriation doctrines apply to water of surface streams and "definite underground streams." Subject to vested riparian rights and prior legal appropriations, water of watercourses is subject to appropriation for beneficial use. Riparian rights accrue at the time of settlement of the riparian land; they are lost only by adverse use, grant, or actual abandonment.

"Percolating water" and springs arising from it belong to the landowner. He does not own a spring arising on his land and forming a watercourse, but he has a riparian right to use of the water, and may also make an appropriation of it; another may appropriate it if he does not, but subject to his riparian right and any other existing riparian rights or prior appropriations.

Artesian water is subject to appropriation under the general provision (section 61.0122) that "anyone intending to acquire the right to the beneficial use of any waters shall..." (proceed in accordance with the provisions governing appropriation). Authority exists or formerly existed to regulate artesian wells to prevent waste, but at least the provision requiring the capping of "wild" wells was repealed in 1941 as not enforceable. It is provided that "each landowner by virtue of the existence of subterranean waters on his property which communicate with similar waters on adjacent lands, has certain rights

in the same and certain civil obligations to all sharing in such under-ground water..." The State Engineer under certain conditions may order a change in the location of a proposed artesian well to minimize interference with others. A considerable reduction in waste from flowing wells has been achieved, largely by means of education rather than arbitrary enforcement.

Tennessee

No specific statutory provision for control of diversion of water in the State as a whole, except for condemnation of water rights needed in the diversion of water for power production. "No dam, appurtenant works, or other obstruction affecting navigation, flood control, or public lands or reservations shall be constructed, and thereafter operated or maintained across, along or in the Tennessee River or any of its tributaries until plans for such construction, operation, and maintenance shall have been submitted to and approved by the board." (Board of Directors of the Tennessee Valley Authority).

A law passed in 1949 creates the Memphis and Shelby County Board of Water Control, with "powers to regulate, limit and prohibit the drilling of wells in Memphis and Shelby County; to regulate the exploitation and consumption of artesian water under the land in said City and County....." The authority extends to the fixing of the size and depth of wells and the quantity of water pumped from them; to require a permit for the drilling of a well and to grant or refuse such a permit; and to exempt wells of less than a certain size and depth, or all wells in certain areas. All municipal wells, existing or future, are exempt from the provisions of the act.

Somewhat similar regulations were established for the City of Memphis by ordinance in 1935, modified in 1940.

Texas

Both riparian and appropriation doctrines are applied to surface streams and the "underflow" of streams and lakes. Domestic uses take precedence over irrigation and manufacturing uses. Subject to these domestic rights of others, a riparian owner is entitled to a reasonable use of the stream for irrigation, but his right extends only to the ordinary flow and underflow, not to flood water. Water in excess of the reasonable requirements of riparian owners, including flood water, is subject to appropriation. Under the statute of limitations an appropriator may acquire an exclusive right by adverse use as against a riparian owner.

Springs that form streams are subject to the law of watercourses; those originating from "percolating water" and not the sources of streams belong to the landowner. "Percolating waters" are subject to the English rule of absolute ownership, except that waste of water from flowing wells is prohibited.

Under the law, water-improvement districts (largely irrigation) and water-control and improvement districts (irrigation, drainage,

water supply, flood control, sewage disposal, power development) can be formed, and have wide powers.

A law passed in 1949 authorizes the formation of such districts, also with wide powers, for "conservation, preservation, protection and recharging and the prevention of waste of underground water." "Defined subterranean streams" and the "underflow" of rivers are exempted. An "underground water reservoir" to be regulated must have ascertainable boundaries and must be capable of yielding at least 150,000 gallons per day to a well. Wells producing less than 100,000 gallons per day are not to be regulated, so far as withdrawal is concerned. Three areas in the High Plains have been designated "underground water reservoirs."

The State Board of Water Engineers, created in 1913, is the agency of the State to administer laws relating to water; this Board has authority to investigate ground-water resources, and to regulate the flow of artesian wells and to prevent waste therefrom; the provisions as to waste are unenforceable owing to the inadequate definition of "waste" contained in Article 846, Texas Penal Code, which in substance excepts the use of water for any lawful purpose from the definition of "waste."

Utah

The appropriation doctrine is exclusive in Utah; riparian rights have never been recognized. Appropriations are made exclusively by application to the State Engineer. All water rights are adjudicated by the courts, at the request of water users or at the request of the State Engineer upon petition from five or more, or the majority of, water users on a stream or in a ground-water basin. Under the 1935 ground-water code all ground water became subject to the law of appropriation. The State Engineer may hold hearings to determine ground-water rights on his own motion, and must do so if petitioned by at least a third of the ground-water users in a designated area. If he determines that the supply is insufficient he must apportion the water in accordance with existing rights.

Claimants of vested rights to uses existing before passage of the ground-water act were required to file notice of such claims; failure to do so was prima facie evidence of intent to abandon the right.

The State Engineer has authority to prevent waste of water from flowing wells. Well drillers are licensed and bonded.

The State Engineer has the authority to recommend the establishment of water-conservation districts designed to develop and make the best use of the water resources of the designated districts.

Vermont

No specific statutory control of diversion of water. Riparian rights for surface water and common-law rights for ground water.

Virginia

No specific statutory control of diversion of water, except for power production, including provision for the condemnation of rights. Riparian rights, limited only to reasonable use in view of the similar rights of others, apply to surface water; the English rule applies to ground water. The State Water Control Law of 1946 sets up the State Water Control Board, with authority to regulate pollution of all water, surface or underground. A 1948 law requires notice to the State Geological Survey of the drilling of any water, oil, gas, or exploratory well, and the furnishing of information on such wells, including water-level data. Domestic and farm wells, driven wells, and wells not more than 50 feet deep are exempt.

Washington

Both riparian and appropriation doctrines apply to surface waters, under the code of 1917, but the riparian doctrine is now of subordinate importance. Riparian rights attach only to waters that can be used beneficially on or in connection with riparian lands within a reasonable time, the excess being subject to appropriation. Thus protection of the right of a riparian owner requires that he show that he is now making or in the near future will make beneficial use of the water. Riparian rights in navigable waters are not recognized, nor may a riparian owner, under his riparian right, store water for future use. In recent years few, if any, water users have depended on riparian rather than appropriative rights to protect their diversions.

The ground-water code of 1945 makes appropriation for beneficial use the exclusive means of acquiring a right to the use of ground water. Existing rights are recognized; also recognized is the superiority of prior appropriations of surface water to which ground water sought to be appropriated is tributary. A prior use of surface water under a riparian rather than an appropriative right presumably would be protected also against a subsequent ground-water appropriation, but it is not stated in the ground-water code what relation unused riparian rights would have to proposed ground-water appropriations. Possibly the same rule would be applied as to surface water, under the stated purpose "of extending the application of such surface water statute to the appropriation and beneficial use of ground waters within the state"; that is, a proposed appropriation of ground water would be regarded as superior to a riparian surface-water right not yet put to use, unless a showing was made that the surface water could be put to beneficial use under the riparian right within a reasonable time.

The State Supervisor of Hydraulics is authorized to designate ground-water areas and subareas, and also depth zones, each to contain so far as practicable a distinct body of ground water, and to control withdrawals within such units in accordance with priority of rights. A prior appropriator is entitled to have the withdrawals of junior appropriators

restricted to such an amount as "will maintain and provide a safe sustaining yield in the amount of the prior appropriation." Judgment as to the "safe sustaining yield" and as to the depth below which the ground-water level shall not be drawn belongs to the Supervisor of Hydraulics and the courts, and where data are not adequate for such a determination the judgment shall be reserved in order to protect the rights of the appropriators and to prevent depletion of the ground-water body.

West Virginia

No specific statutory control of the diversion of water. Riparian rights for surface water and common-law rights for ground water.

Wisconsin

Riparian rights apply to surface water; however, diversions by either riparians or nonriparians require a permit from the State, with certain exceptions such as diversions from "any spring or creek within the limits of a public highway." Surplus waters may be diverted temporarily to maintain the level of any navigable lake or stream, or non-surplus waters if the consent of the riparians is obtained and public rights are not injured. (Surplus water is defined as water not being beneficially used; it probably includes that above "normal" flow.) Riparian landowners are entitled to a declaratory judgment affirming their rights. The Wisconsin Valley Improvement Association has authority to construct dams, reservoirs, and other structures to regulate the flow of the Wisconsin River and its tributaries, including authority to purchase or condemn riparian rights.

As of January 1, 1936, the State Board of Health has authority, under a comprehensive Well Drilling Sanitary Code, to register well drillers and to control the construction of all wells to insure protection of the sanitary quality of the water. The code, and regulations issued under it, provide detailed instructions for the construction, finishing, sterilization, and operation of approved types of wells. The code is widely regarded as a model.

A 1945 law gives the State Board of Health authority over new, additional, or reconstructed wells or combinations of wells for use on one property which have a capacity of 100,000 gallons per day or more. If the Board of Health finds that the proposed withdrawal will adversely affect the availability of water to any public utility furnishing water to the public, it may refuse to approve the withdrawal, or grant limited approval.

Wyoming

The riparian doctrine has never been recognized, and appropriation is the exclusive method of acquiring a right to the use of surface water and, prior to 1947, probably of "definite underground streams." Springs are classed as surface water and are subject

to appropriation. A 1919 decision of the Wyoming Supreme Court on "percolating waters" applied the English rule of absolute ownership. However, in 1947 a law was passed that applies the appropriation doctrine to all underground waters. Reasonable use is the "basis, the measure and limit of the right to use underground water at all times." Domestic, culinary, or stock water on ranches or farms, or that used for irrigating a garden up to 4 acres, is exempted. Claims to uses starting on or before December 31, 1947, are to be filed with the State Engineer. Persons beginning use after December 31, 1947, are not

required to obtain a permit but must file a "registration" in the Office of the State Engineer within 30 days after completing construction. The State Engineer is authorized to determine the yield of the various groundwater reservoirs of the State; upon completion of such a survey, the State Board of Control proceeds with the adjudication of the rights. The priority of rights acquired on or before December 31, 1947, relates to the date of completion of the well or other structure; those after that date to the date of filing of the registration in the State Engineer's office.