Report of the State Conservation Commission. 1911

Wisconsin. State Conservation Committee (1908-15)
Madison, Wisconsin: Democrat Printing Company, State Printer, 1911

https://digital.library.wisc.edu/1711.dl/2VUH3BCIOMR3B9D

Report

of the

State Conservation Commission.

Printed in Pursuance of Jt. Res. No. 50, S.

MADISON
DEMOCRAT PRINTING COMPANY, STATE PRINTER
1911

TABLE OF CONTENTS.

REPORT

OF THE

STATE CONSERVATION COMMISSION.

Introductory.

The state conservation commission of Wisconsin was appointed by Governor James O. Davidson, June 24, 1908. Since the legislature of 1909 was to meet in less than six months from that time, the first report of the commission was very partial and was confined to those subjects in reference to which immediate action seemed desirable,—water powers, forests, and soils. The report of the commission was published by the order of the legislature.

In reference to water powers it was recommended that hereafter special franchises be not granted for their development, that a general statute be framed upon the subject, and the granting of franchises be given by some commission under this statute. A number of recommendations were also made in reference to state forests. The legislature of 1909 followed these recommendations to the extent of granting no water franchises during the session. A special recess committee upon water powers, forestry and drainage was created by the legislature, to investigate these subjects and prepare a complete report, together with appropriate general bills to present to the legislature of 1911. The recommendations of the commission both with reference to water powers and forests went to the committee for consideration.

The recommendation of the commission that a state soil survey be undertaken was adopted by the legislature and an ap-

propriation of $10,000 per annum for two years was made for this purpose. In consequence of this action co-operation has been secured with the United States Soil Survey, under which the government spends a like amount in Wisconsin, so that there has been available for the soil survey work for the year 1909–10, $20,000, and a similar amount will be available for the current fiscal year.

The subjects which naturally come before the commission for consideration are the resources of the state with reference to (1) minerals, (2) waters, (3) forests, and (4) lands. The relations of these resources to mankind with reference to the enjoyment of them by humanity through the ages to come is regarded by the commission as a special purpose for which it exists. A fifth branch of the subject,—the conservation of man himself,—might be interpreted as a field which the commission should enter. This field, is, however, one of such enormous extent and complexity, and enters the work of other divisions of the government, such as the state superintendent, dairy and food commission, the labor commission, the state board of health, the state park commission, etc., that it has not been regarded as advisable to enter it.

If anything like a full treatment of the four classes of natural resources mentioned were made with reference to their conservation, this would involve writing an elaborate treatise. The commission, therefore, has confined itself to those parts of the field in which concrete suggestions or recommendations could be made advantageously. The brief report of the commission is largely based upon a number of special papers which are appended to its report under the names of their authors.

MINERALS.

The chief exhaustible minerals of the state are those of iron, zinc, lead, and sulphur. The only underground fuel of the state is peat.

Iron.—In reference to iron, the state contains a considerable quantity of ores which are available at the present time, and vast quantities which are likely to be available in the future. With reference to this metal, it may be said that the methods of mining of ore are such that there is little or no criticism to be offered, no suggestions to be made from the point of view of con-

servation, except that a detailed survey of the districts in which the ores may occur should be made by the geological survey with reference to the estimates of the quantity and quality of the iron ores. Such a survey would be most advantageous in reference to the further development of the iron ores of the state.

Zinc, Lead, and Sulphur.—The zinc, lead and sulphur ores occur together in the southwestern part of the state, in the counties of Grant, Iowa, and La Fayette; the zinc as sphalerite, also called "blend" or "jack;" the lead as galena; and the sulphur as pyrite. In reference to these, the losses in exploitation and extraction are great,—unnecessarily great. There are serious wastes which may be prevented by intelligent mining. Of these products the most important is zinc. Mr. Hotchkiss' report shows that under the present practice the total loss of zinc is, in some cases, as much as 48 per cent; in other words, the recovery as metal is only a little more than one-half of the total. These losses are due to poor mining, poor milling, poor separation, and smelting. The losses in mining, estimated at 13.4 per cent, in milling estimated at 16.4 per cent, and in magnetic separation estimated at 10.1 per cent, all may be reduced, and with an increase of profit.

The loss in mining occurs largely in connection with the lease system of small parcels of land under which a flat percentage of the concentrate recovered is paid as royalty, commonly ten per cent. The lease holder is interested simply in securing the maximum profit in the shortest possible time. He therefore takes out of the ground only the richer ores. If the land were owned by the operator and the product was not subject to a lease charge, large quantities of ore could be profitably handled which are now left in the mine. Indeed, in the zinc districts closer mining is done in the case of those companies who own the fees of their own properties than by those operating on the lease system. Especially is this likely to be the case if the company which mines also smelts its ore, for it is an advantage under such circumstances to take out all the material which can possibly be mined, even to the extent of a slight loss for the lower grade material, if such loss may be more than compensated by the gain in smelting.

It is not supposed that it will be practicable to change at

once from the method of mining by lease to that of mining by the fee holder, or even in the distant future; but the above facts clearly point out the necessity for remedies in operating under the lease system. The rate of royalty should decrease with the grade of the ore. The relation of the richness of the ore to the royalty to be paid is very carefully discussed by Mr. Hotchkiss in his report. He shows that a ten per cent royalty should be limited to ores which contain not less than 8.62 per cent of zinc; but it may be suggested as fair that a ten per cent royalty should only be paid on ores which contain as high as ten per cent zinc; and that for lower grades the rate of royalty should not be a flat rate upon the quantity of zinc, but a percentage of the total profit.

There are difficulties in putting such a plan into operation because the different grades of ore underground cannot easily be separated. But the same end might be met by changing the form of leases so that the rate royalty shall be on a sliding scale dependent upon the average richness of the ore, as in the case of many leases for iron ores. To such leases detailed provisions could be added as to the nature of the material which must be mined. By a change in the practice along the lines suggested the total profits of the fee holders could be made somewhat more than they now are; the profit of the miner would be as large or larger than at present; and the amount of material left underground could be greatly decreased.

Mr. Hotchkiss estimates that of the total concentrates, 14 per cent are lost in roasting and magnetic concentration. Nearly half of this could be saved if the ores were handled by a few large efficient plants instead of by many small inefficient ones. The principles of conservation in this matter clearly point either toward consolidation or co-operation of the different interests. The same thing is true, as already pointed out, with reference to mining and smelting.

Further, Mr. Hotchkiss recommends that the fine tailings from the mills be kept separate from the coarse material, since the former contains the chief values not extracted. In the future, improvements in the methods of extraction may be made so that the values may be partially recovered.

Peat.—Peat might appropriately be considered in connection with minerals or in connection with the land, since peat bogs

may be drained and used for agriculture, or they may be held for the future extraction of the peat. What should be done in reference to this matter is a question on which it is difficult to make definite statements. While this generation should undoubtedly consider later generations, future wants cannot be placed upon exactly the same basis as present needs. The subject is quantitatively discussed by Mr. Hotchkiss in his report. He reaches the conclusion that the peat bogs which are well adapted to crops are probably more valuable for agriculture than they would be if they were held as a possible future supply of fuel. Therefore, natural development should be allowed to take its course.

WATERS.

Water Powers.—Under waters, water powers are the most important subject considered by the commission. The commission made recommendations in reference to the water powers in its first report to the last legislature. These recommendations were again considered in reference to their modification and reaffirmation at a meeting of the commission, July 14, 1909, after the legislature adjourned, at which meeting there were present several members of the special legislative committee upon water powers, forests, and drainage. The subject was again considered at a later meeting. While no change is made in the fundamental principles recommended two years ago, as summarized in the first page of this report, after careful consideration changes were made in reference to the character of the leases. The recommendations of the commission with reference to water powers as amended are as follows:

Recommendations Concerning Water Powers.—1. That franchises for water powers be granted under a general statute.

2. That the issuing of such franchises be placed in the hands of the railway commission, or similar board, under conditions to be provided by a general statute.

3. That such franchises be granted by one of two methods: (a) Leases for a reasonable period of years, such leases to be renewable on equitable terms; or (b) indeterminate franchises carefully safeguarded and under the general principles of the public utilities act. In either case rentals or a tax should be charged, the income from same to go to the state. The rate of rentals or

taxes should at first be low; and should be readjusted at definite and reasonable periods.

4. That the survey of the water powers of the state be completed in co-operation with the United States Geological Survey.

Artesian Waters.—There are many other questions of importance with reference to the waters of the state which in the future will require consideration. At the present time only two of these will be considered. The first of these is the waste water in connection with artesian wells. An accompanying paper by S. Weidman, of the state geological survey, shows that many cities and towns in the state derive their water from the underground supply and especially from the deep seated artesian source. The value of this water is estimated by him at a number of million dollars per annum. Contrary to the general belief, the supply of this artesian water is strictly limited; therefore, it should not be wasted. At the present time, many such wells are so constructed as to have leakage in the pipes, or water is allowed to flow from them without being used, and the wells often are so located as to interfere with one another.

In 1901 a law was passed by the state legislature prohibiting the waste of artesian water. This law is as follows:

"Where there are two or more artesian wells in any vicinity or neighborhood, one or more of which are operated or used by any person or owner, the person or owner of such well shall use due care and diligence to prevent any loss or waste or unreasonable use of any water therein contained or flowing from the same, as would deprive or unnecessarily diminish the flow of water in any artesian well, to the injury of the owner of any other well in the same vicinity or neighborhood.

"Any person who shall needlessly allow or permit any artesian well owned or operated by him, to discharge greater quantities of water than is reasonably necessary for the use of such person so as to materially diminish the flow of water in any other artesian well in the same vicinity, shall be liable for all damages which the owner of any such other well shall sustain." (L. 1901, chap. 354.)

The above law apparently was based upon the principle that it should be unlawful needlessly to waste a natural resource which is limited in quantity. From the point of view of conservation, which is the same as saying from the point of view of

the people of the state, and therefore from the point of view of the public welfare, it would seem that this principle is incontrovertible. The progress of the state is dependent upon the useful use of its resources. When a natural resource limited in quantity is unnecessarily wasted some portion of the people of the state and indirectly the welfare of the commonwealth are injured.

In a case which arose under the above law with reference to an artesian area, in which according to the statement of facts, the supply of water at any one time was limited and waste of water at one well lessened or destroyed the flow of others, an opinion given by the supreme court of the state in 1903 holds that such artesian water may be wasted even if in so doing the person is actuated by malicious motives. Says the opinion: * * * "The owner of the land had, at common law, a right to sink wells thereon and use the water from them, supplied by percolation, in any way he chose, or allow it to flow away, even though he thereby diminished the water in his neighbor's wells, and even though in so doing he was actuated by malicious motives.

"3. Such right of the landowner is a property right, which cannot be taken away or impaired by legislation, unless by the exercise of the right of eminent domain or by the exercise of the police power."

It is further held that this law "takes private property for private use and without compensation, and is therefore void."

Huber vs. Merkel, 117 Wis. 355.

Since your commission does not presume to discuss the opinion of the supreme court of the state from a legal point of view, it must be content merely by presenting the case as it appears to laymen interested in the future welfare of the state, and with citing decisions which seem to point in a different direction from that of our state court. It does seem to your commission unfortunate that the court has felt constrained to declare void a law which was clearly in the interests of the commonwealth, was clearly favorable to the greater good of the greater number, and the enforcement of which would in no way injure anyone.

Even granting, as the court says, that at common law a land

owner has the unrestricted right to make such use of the percolating water under his land as he pleases, even though he acts maliciously, such a right exists only against other land owners. Apparently, however, the court by its decision extends this right and makes it good even against the public. Is such an extension defensible?

Further the question arises as to the relations of the common law, that is the law made by the courts, and statute law. The decision cited makes no direct reference to any provision of the United States or state constitution which is clearly violated by the state law declared to be unconstitutional.

Nor does the opinion of the court explain how the prevention of the needless waste of property takes away private property. To your commission it appears that to prevent the waste of water does not take away property; it merely prevents its useless dissipation. This is a wholly different thing, as it seems to them unfamiliar with the law, from taking private property without compensation. The commission fail to comprehend how prevention of needless waste can be construed as taking private property. Such prevention seems to them to be the control of the use of property rather than the taking of property, and the former is may be suggested is legitimately within the conceded scope of the police power.

The views, that a law, the enforcement of which would be clearly for the public good, should only be set aside on the ground of a clear constitutional prohibition and that needlessly to waste a natural resource is not a taking of private property are not merely the opinion of the commission; they are fully confirmed by opinions of the supreme courts of Massachusetts. Maine, and Indiana, and by the opinions of the United States supreme court.

In Massachusetts a law was passed, the object of which was to protect Boston harbor by preserving the integrity of its beaches providing that "Any person who shall take, carry away or remove, by land or by water, any stones, gravel or sand, from any of the beaches in the town of Chelsea, shall, for each offense, forfeit a sum not exceeding $20.00." The statute was violated and the party so doing "'defended on the grounds that he was the owner of the land in fee and the statute did not intend to prohibit the owner from taking gravel from it; and if the stat-

ute did so intend it was unconstitutional under article ten of the declaration of rights, which provided that 'no part of the property of any individual can be taken from him or applied to public uses without making him reasonable compensation therefor.' '' Chief Justice Shaw, in 1846, more than fifty years ago, delivering the judgment of the court, said: ''The court are of opinion that such a law is not a taking of property for public use, within the meaning of the constitution, but is a just and legitimate exercise of the power of the legislature to regulate and restrain such particular use of property as would be inconsistent with, or injurious to, the rights of the public. All property is acquired and held under the tacit condition that it shall not be so used as to injure the equal rights of others, or to destroy or greatly impair the public rights and interests of the community.' * * * ''

Commonwealth vs. Tewksbury, 11 Mete. (Mass.) 55.

Answering questions propounded by the senate of the state of Maine to the justices of the supreme court the following declarations were made by the court in 1908:—

1. ''The legislature of Maine has by the constitution of Maine, full power to make and establish all reasonable laws and regulations for the defense and benefit of the people of this state, not repugnant to this constitution, nor that of the United States.

2. ''It is for the legislature to determine from time to time the occasion and what laws and regulations are necessary or expedient for the defense and benefit of the people; and, however inconvenienced, restricted, or even damaged particular persons and corporations may be, such general laws and regulations are to be held valid, unless there can be pointed out some provision in the state or United States constitution which clearly prohibits them.

3. ''Legislation to restrict or regulate the cutting of trees on wild or uncultivated land by the owner thereof, etc., without compensation therefor to such owner, in order to prevent or diminish injurious droughts and freshets, and to protect, preserve, and maintain the natural water supply of springs, streams, ponds, and lakes, etc., and to prevent or diminish injurious erosion of the land, and the filling up of the rivers, ponds, and lakes, etc., would not operate, to, 'take' private property within the inhibition of the Constitution.

4. "While such legislation might restrict the owner of wild and uncultivated lands in his use of them, might delay his taking some of the product, might defer his anticipated profits, and even thereby might cause him some loss of profit, it would nevertheless leave him his lands, their product, and increase untouched and without diminution of title, estate, or quantity. He would still have large measure of control and large opportunity to realize values. He might suffer delay, but not deprivation. While the use might be restricted, it would not be appropriated or 'taken.' Such legislation would be within the legislative power, and would not operate as a taking of private property for which compensation must be made."

69 Atlantic Reporter, p. 627.

The above answers of the supreme court of Maine show that that court fully accepts the principle for which the commission contends, viz.: (1) That a law should not be declared unconstitutional unless there is some provision of the state or United States constitution which is clearly contradictory to it; and (2) That an owner of private property may lawfully be severely restricted in the way he uses a natural resource which is his property, and that such restrictions are not a taking of private property.

The legislature of Indiana has passed two laws concerning the waste of natural gas, a natural resource limited in quantity; the first prohibited the waste of natural gas; the second limited the time during which gas or oil may escape into the open air to two days. Both of these have been declared to be constitutional by the state courts.

In reference to the first of these, in 1897 the Indiana supreme court made the following declaration: "A statute prohibiting the waste of natural gas being within the police power, a determination by the legislature that the burning of natural gas in flambeau lights is a wasteful use is conclusive on the courts."

In answer to the contention that the law was a deprivation of private property the court said: "The act in no way deprives the owner of the full and free use of his property. It restrains him from wasting the gas to the injury of others, to the injury of the public." * * * "It (the statute) was to prevent him from needlessly wasting the gas which he is draw-

ing from the general reservoir which nature has furnished and which experience and prudence teach is liable to be exhausted." * * * "The rule that the owner has the right to do as he pleases with or upon his own property is subject to many limitations and restrictions, one of which is that he must have due regard for the rights of others."

Townsend v. The State, 147 Ind. 624.

By the United States supreme court in reference to the second of the Indiana laws concerning natural gas, in 1900 it was declared to be "not a violation of the constitution of the United States; and its enforcement as to persons whose obedience to its commands were coerced by injunction, is not a taking of private property without adequate compensation, and does not amount to a denial of due process of law, contrary to the provisions of the Fourteenth Amendment to the Constitution of the United States, but is only a regulation by the State of Indiana of a subject which especially comes within its lawful authority."

Ohio Oil Co. vs. Indiana, No. 1, U. S. Reports, Vol. 177, p. 190.

The above citations clearly show that the supreme court of Indiana holds the prohibition of the waste of a natural resource to be within the police power of the state, and that such restraint is a proper limitation and restriction of the rights of private property; and furthermore the United States supreme court concurs in this opinion.

The decisions in the Indiana gas and oil cases are very important since they deal with substances which are in many respects similar to underground water. Oil and gas like water are mobile. Underground they move from place to place. A given particle of oil or gas or water today may be below the land of one man, tomorrow below that of another. Because of this fact waste of any of these producers by a party owning any tract of land is an injury to parties holding tracts of land adjacent into which the underground liquid or gaseous bearing stratum extends, and because a natural resource is destroyed, is an injury to the public. The only difference with reference to the point at issue between oil or gas and water is that they are

renewable at different rates; oil and gas slowly, water more rapidly. But the renewal of underground water is a slow process. An artesian basin once exhausted may take years to be refilled; and therefore the principles of law which apply to the conservation of oil and gas should apply to underground water.

Finally with reference to the principle of conservation under discussion, the prohibition of needless waste of a natural resource, Mr. Justice Holmes in an opinion of the United States court given in 1908 has given a most sweeping pronouncement. He says:

"The state, as quasi-sovereign and representative of the interests of the public has a standing in court to protect the atmosphere, the water and the forests within its territory, irrespective of the assent or dissent of the private owners immediately concerned.

"The public interest is omnipresent wherever there is a state, and grows more pressing as population grows, and is paramount to private property of riparian proprietors whose rights of appropriation are subject not only to rights of lower owners but also to the limitations that great foundations of public health and welfare shall not be diminished.

"A state has a constitutional power to insist that its natural advantages remain unimpaired by its citizens and is not dependent upon any reason for its will so to do. In the exercise of this power it may prohibit the diversion of the waters of its important streams to points outside of its boundaries."

Hudson County Water Co. vs. M. Carter, 209 U. S. Rep. 349.

While in the opinion just cited, it appears that the question before the court was one of riparian rights, the principle which evidently guided the court in its decision was the broad one which we hold,—that the state, as representing the interests of all the people, has the power, by appropriate laws, to protect the community from unnecessary or wilful waste of any natural resource within its limits perpetrated in the name of private property. The pronouncement of the supreme court of the United States is clearly in harmony with the general welfare of the country; and now that it is realized that many of our natural

resources are severely limited is likely to have a far reaching effect on the development of laws concerning conservation.

The law has developed as one of the institutions of the state to advance the common weal, but in the case of the artesian waters of Wisconsin, the decision of the Wisconsin court seems to the commission to be directly athwart the path of progress of the conservation movement; whereas the statute of the legislature was in the direction of progress.

It may be that the commission has failed correctly to interpret the significance of the decision, and that the court has not intended to hold to the principle that needless or willful waste of a natural resource is unconstitutional; also since the decision was rendered the opinion of the supreme courts of the state of Maine and one of those of the United States court cited have been rendered.

Recommendation Concerning Waste of Natural Resource. Therefore, your commission recommend that the legislature pass an act making it unlawful unnecessarily or willfully to waste a natural resource, and providing proper penalties for violation of the same.

Contamination of Water. Underground waters may be contaminated by careless disposal of sewage and in other ways; as may also the streams by the refuse from mills, factories, and sewage. Usually it is true that a community suffers by allowing the underground waters or the streams to become polluted. Already we have laws with reference to a very limited aspect of this subject, (Wisconsin Statutes 1898, pp. 651, 1065), but in the near future it is certain that the state will be obliged to consider the formulation of proper general laws preventing the pollution of such waters as are likely to be used as a water supply for the people, or which in any way may endanger the health of the community, along the lines of those already adopted in a number of states, such as Connecticut, Massachusetts, and Minnesota.

Forests.—The state forester submits a report which discusses the present situation in reference to the forests of Wisconsin, the importance of the industries connected with the same, and the necessity of so managing the forests as to yield a supply of raw material to continue these industries. The chief losses at the present time are those due to fire and to waste, the first

being of far the greater importance. In reference to the practice of forestry, the chief difficulties are fires and taxes. Because of these difficulties, if forestry is to be practiced, there is very great advantages in state ownership, since under such ownership the difficulty of taxes is altogether eliminated, and the amount of land which the state holds will warrant the establishment of an efficient system of fire protection for state forests. The utilization of waste is a matter for scientific investigation which is now being carried on in the forest products laboratory at the university. In this summary no attempt will be made to give an argument in favor of the conclusions which have been reached by the commission. The reasons for them are to a large extent given in the appended paper of the state forester.

The recommendations made are in accordance with the resolutions adopted at the Lake State Forest Fire Conference held at St. Paul, December 6 and 7, 1910, at which there were present representatives of the forest services of the three states of Michigan, Wisconsin, and Minnesota; also representatives of the lumber, transportation, and insurance interests of those states.

The recommendations submitted are as follows:

1. That a state tax of two-tenths of a mill be levied and collected annually for a period of twenty years for carrying on the work of the state board of forestry.

2. That the state constitution be amended so as to admit of a more rational method of taxing timber land, in order that it may be practicable for owners to hold growing timber on land not primarily available for agriculture.

3. That an efficient system of state fire patrol be organized under the charge of the state board of forestry, and that the burning of slashings be under the charge of the same board.

4. That the cost of this system be defrayed in the first instance by state funds under the charge of the state board of forestry, and that so far as practicable the cost of the protection of forest lands, privately owned, be charged back to the owners of such lands.

Lands.—Of the natural resources of the state the land is that of immeasurably the greatest importance; indeed it is more important than all other resources. Hence of all the problems of

conservation, the conservation of the soil is the one of supreme moment. From the products of the land of this and other states the people of the nation must derive their food and clothing; all of their other needs are subordinate to these. It was considerations of this kind which led the commission to make the recommendation to the past legislature for a soil survey.

One of the main functions of agricultural education from the rural school to the university is that of teaching the farmer to save his soil from destruction by erosion, and to prevent it from becoming depleted in its fertility. To treat this part of the subject with fullness and adequacy would require an extensive monograph. The report of the commission will therefore be mainly confined to those phases of the subject in reference to which immediate improvements may be made thru education and investigation. The first step to be made is an investigation of the actual condition of the land of the state with reference to erosion and depletion, the causes which have led to deterioration, and the methods of restoring the soil to its virgin fertility. The second step is to get this knowledge to as large a proportion of the farmers of the state as is practicable. As yet the subject is not in a stage of development in which legislation is advisable with reference to any but some special phases. This report will confine itself to the subjects of erosion, depletion of the soil, the losses thru weeds, and the influences of the tenant system of farming.

The soil survey already begun shows that a very considerable percentage of the land of the state is on slopes so steep as to be subject to serious erosion. In Iowa County, the only one in which the soil survey has made a determination on this point, it is found that 11.5 per cent of the area is so steep that it should not be cleared and cultivated, but should be left for forests; that 24.9 per cent of the land, while not so steep as to make it necessary to retain it in forests, is subject to such serious erosion that exceptional methods of cultivation and crop growing should be practiced.

It is not possible in this report to enter into the details of these methods, but in other parts of the country, where surfaces as steep as these obtain, contour plowing and terracing are usual. In our own state these processes for preventing erosion have scarcely been undertaken anywhere. In many other

counties of the state the proportion of lands of these two classes is not so large as in Iowa County, but it is certain that a considerable area in the state on account of the steepness of the slopes is better adapted to forestry than to agriculture; and that another considerable area has slopes so steep that the most advanced knowledge for preventing erosion should be applied.

In the larger area of Wisconsin the slopes are not so steep that erosion has been regarded as serious; that is, there is not a sufficient amount of erosion so that the loss in any one year is noticeable. While this is the situation it does not at all follow that erosion of the soil is not taking place on relatively gentle slopes much faster than it is being manufactured. Indeed it is probable that taking the state as a whole the apparently very slight erosion of the great area of moderate slope represents a more serious loss of soil than the more rapid erosion of the limited area. Land which may not lose a serious amount of its soil in ten years may do so in one hundred years. Therefore every practicable effort should be made to reduce the erosion to a minimum on the lands, the slopes of which are gentle. This subject cannot be discussed in detail, but it may be said that the problem is to make each acre of land which is cultivated take care of the precipitation of that acre; that is, not to allow the water to gather into streams which carry the soil away. Since this state is one in which throughout almost every growing season there is a deficiency of water, the accomplishment of this, which would involve getting a larger proportion of the water to go underground, would result in increased crops, and would more than pay for the extra trouble involved by the superior methods of cultivation.

The soil survey has gone far enough to show that the lands of the state vary greatly in their amount of phosphoric acid, the crucial element in soil fertility. The studies which the state agricultural college has made show that land which has been cropped for fifty years in this state has in some cases already lost one-third of its phosphorus. Some fields which had originally a sufficient amount of phosphorus are now short in it, and others originally were deficient in this element. (See appended report of Professor Whitson). In such cases it is necessary that phosphorus fertilizer be applied; not only so, but every effort should be made to prevent further losses of phosphorus. At

the present time these losses are due to wash and waste of farm manure, to exploitive farming, that is to the growth of such crops as tobacco, and to losses through the crops being sent to the cities, the phosphorus of which mainly goes into the sewage.

If the soil is so cultivated that each acre takes care of its own water, this will reduce the amount of phosphorus lost by wash. If the manure produced upon the farm is saved as far as practicable, this loss, which at present, according to Professor Whitson's report, amounts to not less than $10,000,000. to $12,000,000. per annum, may be reduced by at least one-half. By proper rotation of crops the loss of phosphorus through leaching will be reduced. The loss of phosphorus caused by tobacco cultivation can only be stopped by eliminating the crop. A preliminary investigation at Madison of the losses of phosphorus from sewage shows that it may be possible to recover at least one-half of the phosphorus in this material.

Many of the lands of the state are also deficient in humus, and the remedy for this consists mainly in the cultivation of leguminous crops and plowing them under.

In the state there are some three or more millions of acres of marsh land. In a great many cases the improvement of these lands is impraticable, since so to do will require the removal of dams. Here we have opposed to each other conflicting values, that of the land and that of the water. In such cases, some commission should have authority to determine which is the more valuable, and to provide for the removal of the dams in case the agricultural interest is greater, with, of course, proper compensation to such vested interest on the part of the owners of the dams as they may show to exist under the law.

A report submitted herewith by A. L. Stone shows that one of the greatest losses to agriculture, and one which is a serious menace to the fertility of the soil, is the rapid extension of noxious weeds in the state. This report shows that for some 500 farms, reported upon by the Wisconsin Experimental Association, on an average thirty acres are infested with Canada thistle, quack grass, and mustard, and that more than 5½ per cent of the pastures are spoiled by weeds. The struggle to eradicate weeds from these farms has cost the farmers one-half as much as they paid for taxes. In the farms reported upon in eight adjacent counties in the northeastern part of the state,

where the average farm contains 129 acres, 35 acres, or 27 per cent are occupied by noxious weeds. In the widely separated counties of Eau Claire, Iowa, Langlade, St. Croix, and Sheboygan, 404 farms, reporting to the department of agronomy in the college of agriculture, containing 60,025 acres, 3,073 acres, or 5 per cent was seriously infested with noxious weeds. While the weed survey has not yet been completed, it is safe to say that the annual loss to the state as a whole through noxious weeds is several millions of dollars per annum.

Realizing the seriousness of the situation, the legislature of 1909 passed a law preventing the importation into the state of seeds containing noxious weeds and placing the administration of this law in the hands of the agricultural college. Since imported seeds have been the main source for the introduction of such weeds in the state, the enforcement of this law will prevent further extension of the weed infested areas from outside sources. The problem therefore before us is preventing the farmers from using the seeds they themselves grow containing noxious weeds, and to eradicate the weeds from the infested areas.

As with reference to the other measures for the conservation of the soil, the most important remedial measure is the general education of the rural communities with reference to the recognition and eradication of noxious weeds. As one factor in the campaign of education it is believed that it would be advisable to publish a large edition of a book, under the direction of the college of agriculture, which shall describe each of the noxious weeds of the state, indicate how they may be eliminated, and to send copies of such book to every school and library of the state.

There already exists a statute which requires that noxious weeds be prevented from seeding either upon publicly or privately owned land. The enforcement of this law is placed upon the weed commissioners in township, village, or city. It is a dead letter, because it requires local officials to take actions which may arouse the antagonism of their neighbors. This weed law should be so amended as to be made clear as to its meaning and efficient as to its enforcement. Its enforcement should be placed in the hands of some state official, similar to the dairy and food commissioner, who shall have the power to

appoint inspectors, the duty of whom shall be to see that the laws are enforced.

The report of Professor H. C. Taylor shows beyond question that to the present time tenant farming in this state leads to exploitative farming, illustrated by single cropping and selling grain from the farm as its chief product. It is certain that in this and other states tenant farming is likely to increase rather than diminish. Since this is the situation the elimination of exploitive farming by tenants should be considered seriously. As yet no definite recommendations can be made upon this subject, except that the system of tenancy which prevails in other countries where tenant farming has been carried on without deterioration of the land should be investigated in order to learn how to remedy its defects in this country.

As already indicated the practice of farming so as to retain the fertility of the soil is not mainly to be accomplished by legislation but by education. If each boy who is to become a farmer can be taught not only the duty of maintaining the fertility of the land of which he has charge, but can be shown that by so doing his own profits will be increased, we shall have gone a long way toward preventing the depletion of the land.

To apply the principles in reference to erosion and depletion of the soil, it is necessary to have a full knowledge of the soil and of the topography of the state.

Recommendation Concerning Lands. In view of the foregoing, the commission submits the following recommendations concerning lands:

1. That the recommendations of the committee on industrial education as to increasing the efficiency and scope of agricultural education especially in the rural school, the country graded school, the township high school, and the county training school, be provided for by appropriate legislation.

2. That the soil survey be continued, and that the appropria tion of $10,000 a year for two years be extended for such length of time as is necessary to complete the soil survey of the state; indeed it would be advantageous to increase the annual sum available for a soil survey in order that the work may go on more rapidly and especially to classify the lands with reference to the use to which they are better adapted,—agriculture or forests.

3. That provision be made for a topographic survey with the

condition that the work be done through coöperation of the state and the United States government, under which the government and the state shall each furnish half of the funds.

4. That the state provide for the publication of a large edition of a weed manual.

5. That under the police power of the state, there be created a state office to be known as a weed commissioner; that such officer shall be an expert; that it shall be his duty to direct the campaign for the eradication of noxious weeds from the state; that he have authority to appoint inspectors to work under his direction; that the laws be amended so as to indicate clearly the weeds which are noxious under its terms the noxious weed be declared to be a menace; that the commissioner and his inspectors have adequate authority to require communities and individuals to eliminate noxious weeds from the lands for which they are responsible; and that the state make a sufficient appropriation to carry out the act.

THE CONSERVATION OF MAN

A number of reports were submitted to the commission in reference to the fifth branch of the subject,—that of the conservation of man himself. These reports came from the following officers: The Dairy and Food Commissioner, the State Superintendent, Chairman of the State Park Commission, the Chairman of the State Board of Health, the State Fire Marshal, and the Commissioner of Labor. Since it is the understanding of the Conservation Commission that these papers with accompanying recommendations are to be published by the state in the reports of the officers submitting them, they are not here included. The subject presented and their recommendations are of great importance, but the commission decided that it would be wise to limit their report to the consideration of and recommendations concerning the natural resources.

Very respectfully submitted,

CHARLES R. VAN HISE,
Chairman,

H. P. BIRD,
E. A. BIRGE,
E. M. GRIFFITH.

Madison, Wisconsin, January, 1911.

REPORT OF GEORGE A. WHITING AND WILLIAM IRVINE.

We were not present at the meeting of the Commission in Madison, December 16, 1910. Mr. Whiting, owing to a delayed train, was unable to reach the meeting before its adjournment. Mr. Irvine was unable to attend owing to absence from the State. The members of the commission who were present, have submitted to us a report for our consideration. Many of the general features of this report meet our approval. It will not be necessary to discuss these in detail.

The industrial development of the State has been and will be greatly aided by proper educational methods. All educational efforts on the part of the State through the departments of the University and the various boards and officials to prevent waste or destruction of property and to promote efficiency and economical production should be encouraged. We approve that part of the report relating to this subject.

Wise police regulations for the prevention of forest fires are also within the province of the State. We believe that the subject of forest fires should receive the immediate attention of the legislature and adequate laws should be framed that will prevent much of the loss from this source.

We are also strongly in favor of a large State Forest Reserve and the promotion of forest protection and planting on the part of private land owners.

We believe that any interference on the part of the State with the property or liberty of the citizen except under the taxing power, the police power or the power of eminent domain, will be harmful and will greatly retard industrial development. Consequently we take issue with that part of this report which

assumes that the State has any other or different authority over persons or property within the State. We therefore criticise the following proposition of the report:

"The laws already passed in reference to water clearly show that the State of Wisconsin is committed to the doctrine that no one has a right to waste a natural resource."[1]

This language is used in reference to chapter 354 of the Laws of Wisconsin for 1901. This law regulates the use of artesian wells.

A law which has been declared unconstitutional and void does not commit the State to the doctrine of the law. This act of the Legislature was declared unconstitutional in Huber vs. Merkel, 117 Wis. 355. We cannot do better than to refer our colleagues to the syllabus of the opinion of the Court in this case, which reads as follows:

"Chapter 354 Laws of 1901 (providing that any owner or operator of an artesian well who permits it to discharge more water than is reasonably necessary for his use, thereby materially diminishing the flow of water in any other artesian well in the same vicinity, shall be liable for all damages thereby sustained by the owner of the other well) is not a proper exercise of the police power, in fact it takes private property for private use without compensation and is therefore void. Such right of the land owner is a property right which cannot be taken away or imperiled by legislation unless by the exercise of the right of eminent domain or by exercise of the police power."

We take the liberty of referring our colleagues to another instructive case which they could hardly have had in mind when they prepared their report. Chapter 470 of the Laws of Wisconsin for 1901 declared in express terms that the ice formed upon the meandered lakes of the State was the property of the State and that it could not be cut except under certain regulations and upon payment to the State of a certain amount per ton as compensation. This law was also held unconstitutional by the Supreme Court of Wisconsin in Rosmiller vs. State. 114

[1] The sentence here quoted is not found in the report of the commission, although it was contained in a preliminary draft of it. The fact that the report was thus changed was communicated to Messrs. Whiting and Irvine, but they decided to make no change in consequence thereof. The views of the majority of the commission in reference to waste of natural resources are fully given on preceding pages.

Wis. 169. In both of these recent cases the seven judges of the Court were unanimous in their condemnation of these laws.

If the statement in the report of our colleagues that the State is committed to such interferences with the rights of the citizens is correct, the exercise of such authority would be intolerable under free government. The assumption that the State has the right to prevent waste would mean that it could through some board of official dictate the method of planting, the rotation of crops, methods of fertilizing the soil, and a thousand other matters, to the farmers of the State, making their lives one round of petty interferences on the part of officials. The State could enter the shop of the artisan and manufacturer with similar dictation. In fact there would be no limits to this dictatorship except the changeable will of the majority. It would place every man's properties under the control of some other man and many times this other man would be the incompetent result of a political accident. These are matters that should be controlled by an enlightened public sentiment, rather than by mischievous statutory enactments.

We differ from our colleagues on the subject of water power. Water Power, e. e., the right to the use of the energy of the water in streams for power purposes by the shore owner, has been recognized as his property from time immemorial. Repeated laws and repeated decisions of the courts of our own state and of the United States, have unequivocally declared such ownership. No dissenting decision from this proposition has ever been renderd in this country. Vast sums of money have been expended in our State in the development of these water powers, and in the building of industrial plants, to use them. This expenditure has been made in honest reliance upon the long established rules of law which have positively asserted such ownership of this property, and have made such investments as secure as in any species of property. It is conceded by all investigators that this development in Wisconsin has uniformly been productive of incalculable good, and in the recent thorough investigation made by a special committee of our legislature, not one word of criticism has been offered in evidence in relation thereto. The only way to conserve water power is to use it. It wastes only when it is idle. There is much remaining undeveloped water power in this state, and this is all waste,

Our colleagues have outlined plans and methods, and have made suggestions for the prevention of agricultural waste, waste of minerals, and waste of timber, but we do not find in their report one suggestion that has any value whatever in preventing the waste of water power. On the contrary, the method outlined in their report for dealing with water powers must inevitably lead to the continued waste and disuse of such power. There have been few cases where a market existed for the energy created. In most cases it is necessary to build large manufacturing plants in connection with the water power in order to make such development useful, and less than one-fourth of the entire capital invested is required to develop the water power and get it ready for use. What incentive is there for business men to build up such an enterprise on any basis of accepting the property under lease, or with the knowledge that the state claims the right to place a special tax upon the enterprise, subject to readjustment from time to time, as it may ordain? Having some practical knowledge of water power development we believe such development cannot be promoted by establishing over water power owners a system of landlordism or of special and extraordinary taxes and restrictions that would not be tolerated if applied to any other form of industrial development. Practically no industrial plants in this state or in any other state are built on leased property. No community could secure the establishment of permanent industrial plants within its limits under a mere lease. In all such enterprises men demand the free and undisputed ownership and right to the site upon which they build costly structures. No water power owner in this state can lease an undeveloped water power on the terms and conditions outlined by our colleagues. It is only where the owner develops the power and fits it for use that he can lease it, and this the state does not propose to do. We cannot hope to develop water powers on any other principles than those applicable to other industrial development. Water powers are already taxed, the same as all other property in the state. This is right. The tax raised is applied to state, county, and municipal uses, as it should be. This species of property should not be discriminated against. In our judgment it is false statesmanship and unsound public policy to enact any legislation in Wisconsin that will not encourage the development of the water powers of our state in all fair and honorable ways.

We believe in encouraging water power development, not in retarding it. We believe that true conservation means that such development should be encouraged and that the great vital question is the encouragement of this development and that attempts to secure some small sums of money for the State in the way of impositions should not be tolerated. We believe in true conservation, not waste. We believe in making it possible for capital to engage in the development of our unused and wasting water powers.

These are briefly the reasons which compel us to differ with our colleagues and to appeal to the people of this State to join in true conservation and to prevent the waste of water power which is now going on and will go on indefinitely under a system of unjust and unfair restriction and discrimination such as that which is proposed by our colleagues

GEO. A. WHITING,
WILLIAM IRVINE.

THE MINERAL RESOURCES.

By W. O. HOTCHKISS, State Geologist.

In a consideration of economic geologic resources, they are conveniently divided into two classes. The first class consists of those materials which occur in such immense quantities, as compared to any probable amount that can be used, that they may be considered as inexhaustible. Good examples of materials of this kind are water and building stone. The second class consists of those materials which exist in such limited quantities that we can predict with assurance that at some future time they will be exhausted. Examples of this kind are the ore minerals, such as iron, lead and zinc.

The inexhaustible economic geologic resources of Wisconsin include:

Water,
Stone,
Sand and Gravel,
Abrasives.

The exhaustible resources of Wisconsin include:

Iron,
Lead,
Zinc,
Pyrite,
Peat.

The value of these products for the years 1907 and 1908 is given in Table I.

TABLE I.—ECONOMIC GEOLOGIC PRODUCTS OF WISCONSIN.
From "Mineral Resources" U. S. G. S.

	1907.		1908.	
	Amount.	Value.	Amount.	Value.
Clay Products (short tons)	.....	$1,127,819	....	$958,395
Glass Sand (short tons)	2,970	1,930	3,750	2,812
Lead (short tons)	3,551	376,406	4,013	337,092
Lime (short tons)	219,644	733,996	235,538	831,792
Mineral Water (gallons)	6,839,219	1,526,703	6,084,571	1,413,107
Sand and Gravel (short tons)	964,689	280,394	858,297	309,943
Stone: total	.....	2,492,141	.....	2,850,920
Granite	.....	[1,228,863	.....	[1,529,781
Sandstone	.....	236,183	.....	219,130
Limestone	.....	1,027,095]	.....	1,102,009]
Zinc	15,273	1,802,214	17,538	1,648,572
Iron Ore (at mine)	838,744	2,665,737	733,993	2,027,208
Other Products*	.....	5,494,652	.....	2,699,518
	.....	$16,502,092	.....	$13,079,359

* Natural cement, graphite, metallic paint and pigments, pig iron, pyrite, quartz abrasives, sand lime brick, zinc lead pigment, and zinc oxide.

Among the inexhaustible resources there is one the supply of which may be seriously impaired if it is not properly treated. The artesian water of Wisconsin is one of the important sources of supply for municipal and manufacturing uses. This supply comes chiefly from two sandstone formations. The thicker and more important is the lower one, the Potsdam sandstone. Above this Potsdam sandstone is a more or less impervious limestone which is of variable thickness, sometimes as great as 250 ft. Then comes the second water-bearing sandstone formation, the St. Peters. In many parts of the state the St. Peters is so much cut up by stream valleys that the water is drained out of it and it does not serve as an artesian reservoir.

By careless methods of drilling, by failure to fit the casing tightly into the drill hole, by blasting which breaks the rock, and by other methods, channels of escape for the water from the artesian reservoir may be created, and in many cases these channels will increase with age. Furthermore, abandoned artesian wells, if they are not thoroughly plugged near the top of the water-bearing formation so as to prevent the escape of water,

may become serious drains upon the artesian supply. If such abuses are permitted to go on indefinitely, the effective head of the water in any particular locality may become so seriously lowered that artesian water as a source of supply may become valueless.

In many states, both in drilling for oil and water, effective regulations as to the number of wells that may be put down within a given area and the care of these wells are being put into effect. While there is not the necessity in this state for the stringent regulations that must be made in more arid countries, the artesian water supply is still of sufficient importance so that sooner or later the drilling and care of artesian wells should be put under some effective regulations so as to prevent undue waste.

See Laws of Wisconsin, 1901. Chapter 354.

IRON.

Among the exhaustible economic geologic resources iron is undoubtedly the most important. In one of the bulletins issued by the United States Geological Survey* an estimate is made of the amount of iron ore which will probably be available in Wisconsin in the future. This estimate, however, is considerably too low as it gives Wisconsin credit for only a portion of the iron bearing formations which exist in the state, and so it is desirable here to call attention to the magnitude of this resource. In considering the statements which follow, it must be remembered that the ore available under present conditions is only a small fraction of that estimated to be available ultimately.

The iron ores of the Lake Superior type occur in certain kinds of rock which are called "iron formations." The method used in the bulletin above referred to for determining the amount of iron ore which will ultimately be available, is to figure the total tonnage of these iron formations (which can be done within reasonable limits of error) and then by a study of the records of mining to date, find approximately what portion of this rock will be sufficiently high in iron to be ultimately used.

---

* Papers on The Conservation of Mineral Resources, Bulletin 394, U. S. G. S.

Using this method we can arrive at an estimate of the amount of iron ore which will ultimately be available in Wisconsin. The bulletin above referred to assumes that all iron ores containing 35 per cent or more of metallic iron will ultimately be used. It also states figures from mining operations which would indicate that the iron formations, including both rich and lean portions, will average about 36 per cent metallic iron. The total tonnage of iron formations in Wisconsin is approximately as given in Table II for the different districts.

TABLE II.

District.	Tons of iron formation.
Gogebic (including only that part which is in Wisconsin)	14,500,000,000
Baraboo	7,000,000,000
Florence	1,750,000,000
Dodge County	50,000,000
Total	23,300,000,000

The bulletin above quoted states that there will be ultimately available in Wisconsin 4,525,000,000 tons of iron ore containing 35 per cent or more of metallic iron. This estimate means that it has been assumed that approximately one-fifth of the total tonnage of iron formation will be available as iron ore.

From the figures given we have a means of checking this estimate. If there are 23,000 million tons of iron bearing formation averaging 36 per cent in metallic iron, there are in the Wisconsin iron formations 8,400 million tons of metallic iron. If those portions of the iron formation containing 35 per cent or more of metallic iron be assumed to average 45 per cent in iron (this being the portion which will ultimately be used as iron ore) and the remainder of the formation which will never be used be assumed to average 30 per cent in metallic iron, the following equations would be true:

$$.45\,x + .30\,y = 8,400 \text{ million tons}$$
$$x + y = 23,300 \text{ million tons}$$

in which x is the number of tons of ore containing an average of 45 per cent and y the number of tons containing an average of

35 per cent metallic iron. Solving these equations, it is found that there would have to be 9,400 million tons of ore averaging 45 per cent. and 13,900 million tons of lean formation averaging 30 per cent iron.

The assumption that the ore ultimately available would average 45 per cent is too high, however. If this is the average of all ore averaging from 35 to 50 per cent in metallic iron, it would probably be too high even to assume 40 per cent as the average iron content. It is also highly improbable that after the available iron is removed, the remainder of the iron formation would average 30 per cent metallic iron. But taking these as correct percentages in order to be conservative and throw as little as possible of the total metallic iron into that part of the formation which will ultimately be available and as much as possible into the lean part that will never be used, it is found in the same manner as above that from these assumptions there must be in the iron formation in Wisconsin:

14,100 million tons of ore averaging.....40% iron
9,200 million tons of lean formation averaging.....30% iron

From the foregoing it is apparent that there probably is in this state much more iron ore that will ultimately be used than was estimated by the United States Geological Survey in the bulletin referred to. From data as hand it is conservative to estimate that there will be mined ultimately in Wisconsin 10 billion tons of iron ore.

The iron ore available under present conditions is of course a much smaller amount. The bulletin referred to estimates that it is forty million tons, but as the estimate of the United States Geological Survey for the total amount of ultimately available ore is probably less than half of what it should be, it is likely that there is also at least twice the tonnage of available ore estimated by them. In making an estimate of this sort, it must be remembered that two iron districts in Wisconsin,—Baraboo and Iron Ridge,—are much closer to the furnaces than any of the other Lake Superior districts and lower grade ores can be shipped at present in consequence of easier transportation. It is probable, therefore, that there are seventy-five to one hundred million tons of iron ore available at the present time in this state.

Recommendations.—Development of this industry is obviously worthy of considerable attention from the state. Methods of mining iron have reached a high state of efficiency so there is little need of recommendations for doing away with waste. The way in which the state can best foster this important industry is by providing such geological work as will be necessary to furnish a guide to intelligent prospecting. For this purpose it will be a wise policy for the state to provide sufficient funds so that the State Geological Survey may carry on this work in an adequate manner.

This is not a matter of the indefinite future, as might be supposed, but is important at present. The average grade of ore shipped from the Lake Superior district is rapidly becoming lower. A few years ago an ore with less than 60 per cent iron was hard to sell. Now, if it is of good physical character, it is not difficult to sell 50 per cent ore. If this rate of decrease continues, it will be but few years before all the ore containing 45 per cent iron will be in demand and there will be a great development of the districts where the states have shown forethought and pointed out that certain districts are suitable for exploration work. This state has large amounts of territory that should be developed and undoubtedly will be if the knowledge is made available to those interested in exploring for iron.

ZINC, LEAD AND PYRITE.

The production of these three ores in Wisconsin comes entirely from Grant, Iowa and Lafayette counties.

Lead production is comparatively small and little is known concerning the amount lost in mining and treating. This is due to the fact that it is recovered chiefly as a by-product in connection with the mining of zinc. It is probable that the loss is very small, however.

Pyrite, occuring without any associated zinc ores, has been mined to a small extent for use in the manufacture of sulphuric acid, but the greatest amount—that found with zinc ores O has been lost in separating it from the zinc. This is due to the fact that the only satisfactory method of separating it from the zinc is to roast off a large part of the sulphur and then separate the remaining sulphur and iron magnetically. An

important saving which has been effected through the use of Huff electric separating machines is evident from the production of pyrite given in the following table. This table shows the productions of the year stated only to the latter part of November so that they may be compared with the production of 1910, for which, of course, complete figures are not available at the time of submitting this report.

TABLE III.—PRODUCTION OF PYRITE.

		Lbs.
1908	Total for year up to November 21	4,164,604
1909	Total for year up to November 20	13,960,545
1910	Total for year up to November 19	23,813,950

Owing to the inefficiency of this method of electrically separating, only the low grade ores which are high in pyrite can be economically treated. The greater part of the ore is roasted and separated magnetically in which process the pyrite present is wasted. Owing to the comparatively small production of the district, it is doubtful if at the present time anything can be done to avoid the waste. If the production of any one company were large enough to justify it in spending money in experimenting with different methods of ore treatment, it is possible that some method of separating zinc and pyrite could be devised in which the pyrite would not be wasted.

Zinc.—Of the ores considerable under this heading zinc is by far the most important, as can be seen by referring to Table I, and the wastes connected with the mining and treating of the ore are by far the most serious. The losses are greater than those which occur in the mining and treating of the ores of any other common metal. In order to assist in understanding the losses which occur, a brief description is given of the various processes through which the ore passes until it is finally reduced and ready for market.

The first operation which the ore undergoes is mining, in which the ore is blasted out, broken up into pieces of a size convenient to handle, loaded into cars or into buckets and hoisted to the surface. In this process some ore is lost by becoming mixed with the waste rock, some is lost by being left in pillars to support the roof, and some is lost because the beds are too thin or lean to pay for extraction.

After it is brought to the surface the ore is crushed and concentrated in jigs in the mill. In this process it is impossible to effect a complete separation of the waste rock from the valuable mineral, so a considerable percentage of the zinc goes off with the tailings.

The ore as it comes from the mill usually contains a considerable amount of pyrite. If the percentage of pyrite is at all high the ore must be roasted and the pyrite separated magnetically or it must be treated by an electrical separator which separates the pyrite without roasting, and in either process there is considerable loss. Most Wisconsin zinc ores must be treated in one of these ways.

From most of the mills ore is then loaded by hand into wagons and from them shoveled out into cars to be shipped to the smelter. There is a small loss in this transportation.

The final operation—zinc smelting—is also a very inefficient process. Ingalls in his book "The Production and Properties of Zinc," assumes a recovery of 86 per cent of the metal in the ore charged into the retorts.

In order to arrive at a satisfactory conclusion as to the efficiency of the methods used in the Wisconsin district, a list of questions covering the losses in processes above mentioned was sent out to a number of prominent mining men in Southwestern Wisconsin. A number of them were very courteous in replying to these questions quite fully, and the average of their estimates of the losses at each step of the process of mining and dressing zinc ore is given in the following table. There is included the average estimate of the percentage of metallic zinc in the "mill dirt"—the ore as mined and ready to be treated. They were also asked to estimate the average life of the mines at present operating, and the average of their several estimates is given.

TABLE IV.—LOSSES OF ZINC.

	%	% of original zinc in ore remaining after each process.
Zinc in ground before mining		100.0
Loss in mining	13.4	86.6
Loss in milling	18.9	70.2
Loss in magnetic separation	14.4	60.1
Loss in transportation	0.5	59.8
Loss in smelting	14.0	51.4
Total loss of original zinc		48.6

Average zinc content of mill-dirt..... 8.62%

Average estimate of life of mines at present operating..... 6.8 years.

It must not be taken from this estimate of 6.8 years that all mining will cease in this district. New mines are being constantly opened and it is the general opinion of the most conservative and best informed men in the district that the discovery of new ore bodies will at least keep pace with and will probably exceed and loss due to working out of old mines, for many years to come.

Recommendations for Conservation of Zinc. Considerable experimentation has been carried on by various companies both in Wisconsin and other states with the purpose in mind of reducing some of these heavy losses. It is highly improbable, however, that under present conditions these losses can be materially reduced. Tests made in Southwestern Wisconsin show that most of the material lost in the milling goes off in the slimes, and experiments have been made to see if the use of slime tables would be profitable. It has been found in practically every case, however, that the use of such tables at present is not profitable.

The loss in roasting and magnetic separation is heavier than is necessary for the reason that the separating plants are small and it is impossible to operate them with as high efficiency as larger plants can be operated. It is quite probable that of the 14.4 per cent lost in roasting and magnetic concentrating, nearly half could be saved if the ore were handled by a single efficient plant. As a matter of fact, the tendency of operations in the district is in this direction and there are at present only two mines operating their own plants. A few years ago there were a considerable number of mines roasting and separating their

own ore. It is possible also that future developments in the method of electrical separation will permit the treatment of high grade ores so as to save a larger percentage of the zinc and also to save the pyrite which it contains which at present is wasted.

There is one policy which with comparatively little expense can be put into effect at the present time to conserve the zinc ores of Southwestern Wisconsin. Instead of running the tailings from the mills all into a single waste heap, they should be separated, the coarse material containing practically none of the value being kept by itself and the fine material, in which practically all of the values lie, preserved until future improvements in milling processes or the development of new methods may make it profitable to treat these fine tailings.

One of the heavy losses of zinc, according to Table IV, is that occasioned by mining. In the Wisconsin zinc district the miner usually operates under a lease which requires him to pay to the fee owner a royalty of 10 per cent of the gross output. A large number of computations were made to discover what effect this royalty would have on the grade of ore that could be mined profitably. In making these computations it was assumed that the average cost of mining and hoisting was $1.25 per ton, and the average cost of wet concentrating $.30 per ton of mill dirt. These figures were taken from authorities on the subject and are probably sufficiently accurate for this purpose. Taking figures for an ore with the average zinc content as shown in Table IV, 8.62 per cent, with a royalty of 10 per cent and a selling price for the concentrates of $30 per ton, the approximate profit can be readily figured. The average loss in concentrating is 18.9 per cent so 100 tons of the average ore would yield 6,975 tons of concentrates.

Mining 100 tons of mill dirt at $1.25	$125.00
Milling 100 tons of mill dirt at .30	30.00
Royalty on 6,975 tons of concentrates at $3.00 per ton	20.92
	$175.92
Selling price at $30 per ton	209.25
Profit	$ 33.33

The accompanying diagram was made from many similar computations, using different percentages of ore, selling prices of $30, $26 and $22 per ton of concentrates and royalties of 10 per cent, 5 per cent and no royalty. On the diagram it will be found that the intersection of the line for $30 ore at 10 per cent royalty and the line for the average ore of 8.62 per cent zinc gives a profit of between $33 and $34 for 100 tons of ore, and the royalty of $21 is given by the length of the vertical line extending above that point to the line for $30 ore with no royalty. The relative royalty and profit can be found similarly for other percentages of ore and royalty at the different prices stated.

It must be borne in mind that this diagram is accurate only where the costs are those assumed, viz: $1.25 per ton for mining and hoisting and $.30 for milling.

It appears from the diagram (by following the horizontal line to the left from the intersection mentioned above) that if an average ore will yield $33.33 profit on one hundred tons, an ore containing about 1 per cent less zinc—7.75 per cent to be exact—could be mined at the same profit if no royalty were paid. In general the payment of a 10 per cent royalty means that in order to give the same profit as would result if no royalty were paid the ore must contain 1 per cent more zinc. In other words, the average ore mined at the same profit as at present would be 7.75 per cent zinc instead of 8.62 per cent zinc. There is an element of inaccuracy in this statement, for it might be possible to mine cheaper if lower grade ores could be mined (higher faces being workable on this account) but the gain so made would probably be offset by the greater loss in concentrating the lower grade ore.

Conservation of zinc would undoubtedly result if the royalties could be lowered. If the royalty for the average ore containing 8.62 per cent of zinc and ores of higher grade, were maintained at 10 per cent, and that for lower grades made some definite percentage of the total profit, it would be possible to extract lower grades of ore with profit both to fee-holder and miner. The royalty of 10 per cent on the average ore at a price of $30 per ton is 38½ per cent of the total difference between selling price and cost of mining and milling. If this percentage were to hold for all ores below the average, the relative amounts

of miner's profit and royalty on ore at $30 per ton would be shown respectively by the vertical distances from the zero line to the dot-dash line and from that line to the $30-no royalty line. Under such an arrangement a miner could mine ore as low as 7 per cent in zinc at a profit of $10 per hundred tons, and pay a royalty to the fee-owner of $6 per hundred tons, while with the straight 10 per cent royalty, 7 per cent zinc would mean a loss to the muner of about $1.50 per hundred tons mined. He would have to leave in the mine as unprofitable all ore containing less than 7.5 per cent zinc.

Similarly, conservation of zinc,—in other words the mining of lower grade ores—would result if the royalties were to be lowered as the selling price of cencentrates decreases.

There is not sufficient data to tell to what extent such readjustments as these would result in profit to the fee-owner and miner, but it is evident that it would be possible to mine lower grade ores at a profit, and therefore some such readjustment should be made, if possible.

"Mineral Industries" of 1908 gives the uses of spelter as follows:

TABLE V.

	%
Galvanizing	62.2
Brass	17.2
Sheet zinc	14.1
Lead desilverizing	1.3
Other purposes	5.2

This table does not include the zinc which is made directly from the ore into pigment. For this same year, according to Mineral Resources, the zinc in zinc pigments was 22.8 per cent as much as was made into spelter. Revising the figures to include this, the uses of zinc are as given in Table VI.

TABLE VI.

	%	
Galvanizing	50.6	Practically never recovered
Zinc pigments made from ore	18.6	Never recovered.
Brass	14.4	Usually recovered.
Sheet zinc	11.5	Usually recovered.
Lead desilverizing	1.0	Always recovered.
Other purposes	4.2	Seldom recovered.
	100.0	

From this table it is quite evident that our zinc supply is being used up in such a fashion that most of it is permanently lost. It is, however, not so alarming as it might appear at first thought. There are now available practical substitutes for all of the larger uses of zinc with the single exception of brass making. Paint can be used for protecting iron from oxidation instead of galvanizing, and as a matter of fact, the sale of galvanized sheet at the present time is seriously affected by any marked advance in the price of zinc. Up to a certain price the trade will use galvanized sheet in preference to painted sheets, but above that price the preference is for painted sheets and the sale of galvanized sheets falls off. The purpose for which sheet zinc is used can be easily supplied by other metals, and furthermore, the zinc used in this manner is probably to a large extent recovered.

The use of zinc for galvanizing and paint should be discouraged so as to conserve the supply for use in brass making, the one purpose for which zinc is pre-eminently necessary.

PEAT.

PEAT is a resource which often times may be used in either of two ways. Peat land in many cases may be drained and used for agricultural purposes, thus destroying the fuel value of the peat, or these lands may be held until the natural increase in the price of coal due to the gradual disappearance of the supply will permit of a profitable development of peat for fuel pur-

poses. It is impossible to state in general which is the most profitable use to which to put the peat land.

The Wisconsin Geological and Natural History Survey has had under progress for some time a study of the peat resources of the state and a report of this study is being prepared by Mr. F. W. Huels. From this report the estimated area of peat lands in the state is 1,800,000 acres. The average depth is estimated from soundings to be 6 feet and the average number of tons of finished peat per acre as 1,250. This would give a total tonnage of finished peat of 2,250,000,000. Much of this peat land is suitable for drainage and use for agricultural purposes, but a large part of it probably never will be suitable for this purpose. If we have, then, a given peat bog which might be used either for the manufacture of fuel or as agricultural land, the question which must be settled is, which use will be the most profitable and which will therefore be the course of the owner who wishes to conserve his property. We may make certain assumptions which will be fairly within reason. From these assumptions we can roughly estimate the amount of profit to be made by using the land for either purpose.

Assumptions:

I. That commercial conditions will be such that peat can be profitably manufactured and sold at the end of 50 years at a price of $3.50 per ton, of which 50 cents may fairly be considered as profit.

II. That interest on the investment will be 6 per cent and that taxes will continue to average 1.1 per cent of the total value, as at present.

III. That the present value of peat land if held for fuel manufacturing will not increase in 50 years.

IV. That land can be drained and made available for agricultural purposes at a cost averaging $25 per acre and will be worth $150 per acre at the end of 50 years.

V. That the annual profit of farming these drained peat lands will average $7 per acre above taxes and interest on the investment.

VI. That worked out peat land can be drained and fitted for agricultural purposes at a cost of $50 per acre and will then be worth $150 per acre at the end of the 50 year period.

VII. That $10 per acre and $40 per acre be taken as the limits of value of peat land at the present time.

With these assumptions the relative profitableness for farm purposes and fuel manufacture can be estimated. These figures are necessarily only a rough example of the way in which the use of each peat bog should be studied. The total tonnage of finished peat and the present value of the land would be important factors in determining the use to which a particular boy is to be put. The profits in peat manufacture are entirely problematical and the figures assumed here would not be true in general.

PROFITS IF USED FOR AGRICULTURAL PURPOSES:		
Present value of peat lands	$10 00 to	$40 00
Cost of draining per acre	25 00	25 00
Cost ready for agricultural purposes	$35 00	$65 00
Average annual profit per acre	7 00	7 00
Profits for 50 years	$350 00	$350 00
Value of land at end of 50 years	150 00	150 00
	$500 00	$500 00
Subtract original cost	35 00	65 00
Total profit per acre in 50 years	$465 00	$435 00
PROFITS IF USED FOR FUEL MANFUFACTURING: Present value of peat lands	$10 00 to	$40 00
Cost of holding for 50 years, interest at 6%, taxes 1.1%, compounding at 7.1% for 50 years, gives as total investment per acre	$320 00	$1,280 00
Average tonnage of finished peat per acre		$1,250 00
Cost of holding 50 years per ton of finished peat	$0 26	$1 02
If cost of manufacturing and marketing are equal in both cases it is evident that if there were a net profit of 50c in the first case there would be a loss of 26c per ton in the second case providing the selling price were the same. If net profit in the first case were $1.00 there would be a profit of 24c in the second.		
Profit per acre on peat @ 50c per ton	$625 00	$312 00 loss.
Value per acre after removal of peat	100 00	100 00
Total profit in 50 years	$725 00 to	$212 00 net loss.
Profit per acre on peat at $1.00 per ton	$1,250 00	$307 00
Value per acre after removal of peat	100 00	100 00
	$1,350 00	$407 00

It is evident from these figures that there is a conservative profit in the use of peat land for agricultural purposes amount-

ing to something better than $400 per acre in the course of the next 50 years. Under the most favorable conditions there is a speculative profit of $725 per acre and upwards in holding the peat for use as fuel. This speculative profit, however, disappears very rapidly as the initial investment in the land increases, owing to the great expense of holding. It will be evident on inspection that the assumptions made are, if anything, more favorable to the use of the peat bogs for fuel purposes than to their use as farm land. As a general proposition, it appears from present information that the wisest use of peat lands of the state that can be so used is for agricultural purposes. Other uses—for production of coke in by-product ovens, for paper, for litter for packing and stable use and for fertilizer filler—may make peat more valuable, but there is not data for making any statement with regard to this at present.

COAL AND PETROLEUM PRODUCTS.

The manufacturing of coal and petroleum products in Wisconsin is an important industry which depends entirely for its continuance upon the wise conservation of the natural resources of other states. A table showing the value of this industry to Wisconsin is given here for the purpose of showing the dependence which the industries of one state have upon the action of other states in conservation of their resources.

TABLE VI.—COAL AND PETROLEUM PRODUCTS.

	1907.		1908.	
	Amount.	Value.	Amount.	Value.
By product oven gas..... (in 1,000 cu. ft.).....	3,050,700	$1,810,324	3,341,224	$1,731,942
Water gas (in 1,000 cu. ft.).....	422,788	417,495	290,535	318,355
Coal tar (gallons).....	5,436,098	129,556	5,557,537	135,311
Ammonia (in pounds of anhydrous NH_3 equivalent).....	3,116,070	265,563	3,415,632	205,856
Coke (short tons).....	534,040	2,572,896	501,752	2,270,516
Total coal products.....	.....	5,195,834	.....	4,761,980
Coal used for above purposes, value @ $3.50 per ton.....	705,902	2,470,657	703,373	2,461,802
Gross profit.....	.....	$2,725,177	.....	$2,300,078

By comparing with Table I it will be evident that the gross profit to Wisconsin industries in the manufacture of coal and petroleum products is very important and in fact is practically as large as the gross proceeds from any other single economic geologic resource, the gross proceeds from this industry being exceeded only by the value of the stone products. On account of this industry it is very important to this state the coal of Illinois, Ohio, Pennsylvania and the other states shall not be wasted in mining.

THE FOREST RESOURCES.

By E. M. GRIFFITH.

The northern portion of Wisconsin, comprising a land surface of some 18 million acres is still largely covered with forest growth, though approximately 80 per cent of the merchantable saw log timber has been cut and removed. Only about 8 per cent of this territory is now under cultivation. Millions of acres have been swept by heavy recurring fires, and are rapidly being reduced to almost barren wastes. The great problem of forest conservation in Wisconsin is the prevention of the enormous annual loss from fire, for if the second growth timber lands, and those which have been reduced to nearly a waste condition are protected, they will produce as fine forests in the future as Wisconsin has been noted for in the past.

The value of the timberlands of northern Wisconsin is enhanced from the fact that they are situated very largely upon the headwaters of our most important rivers, and thereby promote uniform stream flow, greatly enhance the value of water powers, increase the navigability of the streams, and also prevent disastrous floods, and excessive soil erosion. The forests and lakes of northern Wisconsin make this region one of great natural beauty, and if protected they will be the means of making this a famous resort region, for thousands of people who will spend millions of dollars annually.

To estimate the area covered by the forests, the species represented and the total amount of timber, will entail an enormous amount of very careful field work, and yet such a timber census must be made in order that we may know the amount of our forest capital and how rapidly we are exhausting it. The Forest Service of the Federal Government stands

ready to bear half the expense, and it is recommended that the State Board of Forestry should be given sufficient funds to carry on its part of the work. Statistics covering the production of lumber and other products of the sawmill and woods of the United States are compiled and published annually by the Bureau of the Census in co-operation with the Forest Service. "In 1860 Wisconsin ranked seventh in the list of states arranged according to the quantity of lumber produced. Ten years later fourth place was occupied, third in 1880, second in 1890, first in 1900 and 1904, second in 1905, third in 1906, and fifth in 1907 and 1908. For the last mentioned year figures were furnished by 899 sawmills in Wisconsin, reporting a total production of 1,613,315,000 board feet, or 4.9 per cent of the total output of all the mills in the country." Though showing a decrease in production in comparison with the figures of the preceding year, 1907, Wisconsin retained its relative position among the state for production. The cut of white pine in the state has decreased largely in the last few years, though this loss in production has been offset by the increased output of hemlock and hardwoods. The state ranked second in the cut of white pine, first in hemlock, third in maple, first in birch, basswood, and elm, fifth in ash and second in tamarack in 1908.

During the winter of 1910 the State Board of Forestry, in co-operation with the Federal Forest Service made a detailed study of the present requirements of the wood using industries of Wisconsin. Chiefly by reason of its proximity to raw material, its excellent shipping facilities by rail and water, its geographical position in relation to consuming markets, and the existence of skilled labor, Wisconsin assumes an enviable position among the states wherein wood forms a large part of the manufactures. The study of the wood using industries showed that more than 930 million board feet of timber, valued at approximately $20,000,000 is utilized annually in the numerous lines of manufacture carried on. This is but part of the lumber industry of the state, as the figures given do not include the vast volume of material turned out by the sawmills as well as other forest products which are not considered as raw material for further manufacture. The value of the raw material only is set forth; were the labor expended upon and the cost of other materials with which the lumber is combined, included, however, the total value of the finished prod-

ucts would soar into additional millions. Of the 930 million feet reported, a little more than one-half of that quantity originated in the state. The figures by no means represent the total amount of wood used, as finished products such as staves and heading used by the cooperage trade and complete wheels and gear used in assembling carriages and wagons were no included in the investigation. Neither was there included in the totals the heavy volume of lumber that goes into flooring, ceiling, siding and other products of the planing mill.

The investigation shows that of the 930,382,000 feet used, at a total cost of $20,293,034, 51 per cent of the total quantity, or 474,494,820 feet, was cut from the forests of the state and 49 per cent or 455,887,180 feet was cut in other states or countries. When the figures on the quantity grown in the state and out are considered in connection with the position Wisconsin holds in comparison with other lumber producing states, it will be seen that the supply of timber in Wisconsin is being rapidly exhausted and that we must stop all possible forms of waste. Three of the industries utilized nearly two-thirds, or 64.89 per cent to be exact, of the total quantity of raw material reported. The largest of these is the pulp industry consuming 33.35 per cent, followed by the sash, door and millwork factories credited with 18.72 per cent and the box making plants using 12.82 per cent. The average prices per thousand feet paid for raw material by the pulp and box concerns are among the lowest, $15.54 and $13.09, respectively. The nominal prices are accounted for by the fact that in the pulp industry the material is utilized in the forms of bolts and logs upon which no charge of manufacture into lumber is added, while in the box industry low grade lumber is employed chiefly, and sometimes even the waste of the sawmill is utilized. In the manufactures of sash, doors, and millwork a high grade of lumber, clear or select stock generally, is necessary and which brings the average cost up to $30.10 a thousand feet. The smallest of all average prices is that paid by the manufactures of excelsior—$9.89—and, as in the case of the pulp mills, low grade bolts or logs are used exclusively.

In point of the volume of raw material used, as well as in the aggregate cost of the material, the pulp industry stands first among those of the Badger State. To the pulp manufacturers

the forestry problem is of vital importance because of the dwindling supplies of suitable pulp timber in the United States. The manufacturers also are deeply interested in the protection of the watersheds of Wisconsin because of the utilization of so much of the available water power by the mills. Three species were reported entering into the production of ground wood pulp—spruce, pine and poplar. While all of the pine was reported as white pine, a small per cent of the total was Jack pine with which experiments have been carried on for some time. Spruce is the chief species used for ground wood pulp, 96,204,000 feet having been reported used and of which amount 27,066,000 feet or 28 per cent was secured in the state and 69,138,000 feet, or 72 per cent bought outside the state. The difference in the average price a thousand feet of the material bought in and out of the state was but four cents— $20.21 and $20.17, respectively. For the 1,610,000 feet of pine cut in the state an average price of $10.06 a thousand feet was paid, while for the 1,418,000 feet coming in from other sources, $9.52 a thousand feet was paid. The average price a thousand feet paid for the 2,264,000 feet of popular originating in the state was $10.11, as compared with $9.24 a thousand feet paid for the 206,000 feet bought outside.

In the production of sulphite fibre the Wisconsin mills reported the use of three species, hemlock, spruce and balsam, amounting in all to 208,591,000 feet and aggregating $2,822,-987 in cost. The quantity given above is more than double of that which entered into ground wood pulp. The average cost a thousand feet of the hemlock, spruce and balsam was $13.53, in contrast with the average cost of $19.63 for the species used in grinding. Hemlock amounting to 116,570,000 feet was used, of which amount 75,268,000 or 65 per cent, was grown in the state, and 41,302,000, or 35 per cent came from other states. The average price a thousand feet paid for Wisconsin hemlock was $12.02 and but $11.93 of the wood secured elsewhere. For spruce an average price of $17.41 a thousand feet was paid for the 18,746,000 feet reported originating in Wisconsin, and $17.02 a thousand feet for the 48,685,000 feet of spruce coming from other states. The average price for the 12,854,000 of balsam secured in Wisconsin was $11.00 a thousand feet, while $10.98 a thousand feet was the average price for the 11,736,000 bought outside.

In both the ground wood pulp and sulphite fibre a total of 163,635,000 feet of spruce were used. Of this volume Wisconsin furnished but 28 per cent. The total amount reported for all species was 310,293,000 feet, aggregating in value $4,819,081. Of the total number of feet consumed Wisconsin contributed 44 per cent, and from other states was drawn 56 per cent.

The second largest industry in Wisconsin in the matter of consumption of raw material is the manufacture of sash, doors, blinds, and interior and exterior finish. Although the pulp mills utilized over 100,000,000 feet more timber than the sash, door and millwork factories, the total cost of the lumber used by the latter exceeded that of the pulp industry by nearly $500,000.

These figures will give you some idea of the great importance of the wood using industries to the state, but they cannot continue unless we see to it that our forest resources are so managed as to yield a continuing supply of raw material. The state now has a forest reserve of some 325,000 acres and the state board of forestry hopes to increase this area to 2,000,000 acres so that the headwaters of our important rivers may be protected, our wood using industries supplied with a considerable amount of raw material and at the same time the great beauty of our northern lake region will be preserved as a resort region for the people of our own and neighboring states. However, the state cannot own and control but a small portion of the timberlands of Wisconsin and therefore the private owner must be brought to realize that his best ultimate return will come from managing his forests so as to give a constant and increasing yield.

The two great obstacles to the practice of forestry by private owners are fire and taxes. Our state board of forestry in cooperation with the Forest Service is now making a careful study of forest taxation, in the hope that our legislature may give some relief to private owners who are almost forced to cut their timber on account of taxation.

Through the establishment of the Forest Products Laboratory at Madison, plans are being worked out for an extended inquiry into the closer utilization of waste, with a view of increasing the profits of the lumbermen and the saving in cost of raw material to the various industries. The faculty of the University of Wisconsin have introduced courses in the training

of young men in wood utilization, so that within a few years men having intimate knowledge of the qualities and uses of wood may be at the service of the manufacturers. With knowledge of the needs of the manufacturers and knowledge of the timber resources, a rational forest policy can be outlined so that the producing and consuming industries dependent on wood may be perpetrated and enlarged.

The severe forest fires during the summer of 1910, which have done an enormous amount of damage in many of the northern counties, have again emphasized the urgent necessity of a patrol system, which backed by the necessary laws will largely prevent the starting of forest fires. The present town fire warden system, though far from perfect, has nevertheless been the means of extinguishing a very large number of fires after they had usually gained considerable headway. That is the great weakness of the system that it simply makes provision for putting out forest fires after they occur and does not prevent their starting in the first instance. Only a well organized system of patrols or forest rangers can accomplish this and such an organization will cost from $250,000 to $300,000. These are large sums but when it is remembered that the losses from forest fires in 1908 amounted to $9,000,000 and that the losses in 1910 will be nearly as heavy, it is seen that the state is amply justified in spending large sums to prevent such losses, and that a well organized patrol system is really insurance at a relatively low cost.

It should also be remembered that there are some 13,000,000 acres of wild and unimproved lands in northern Wisconsin, covered for the most part with forest growth, which must be patrolled and protected, and that therefore the actual cost of the patrol system will be only about two cents per acre, which is the lowest possible figure that any adequate protection can be provided. The present system of town fire wardens should be abolished and instead county fire wardens should be appointed, to form an auxiliary fire fighting force, under the direction of the patrols, and these county fire wardens should be empowered to fight fire anywhere in their own or adjoining counties.

The state as a whole is directly and financially interested in protecting the great wealth of our forest resources, and therefore it is just and reasonable that the state as a whole, by

means of a general tax such as is proposed, should bear the cost of a protective patrol. However, the counties in northern Wisconsin, and especially the lumber companies and timberland owners in these counties, are more directly interested and benefited by the protection of their forests than the counties or taxpayers in other portions of the state. Therefore it is recommended that each of the counties covered by the patrol system should be obliged to raise and set aside each year a fire fighting fund, for the county fire wardens not less than $300 per township, or thirty-six sections. Thus, if a county contained twenty townships, the fund would amount to $6,000, but if only $2,000 were expended in any year in fighting fire, the county should only be obliged at the beginning of the next year to raise that amount. In this way the state as a whole would bear the cost of fire prevention, but the counties and citizens most directly benefited would pay all the expense of fighting fire. No fairer, or more equitable, plan for distributing the cost of protecting the forest resources of the state has been found.

The special legislative committee on Water Powers, Forestry and Drainage, have recommended that the State Board of Forestry should be given the proceeds of a general state tax of 2/10 of a mill. The proceeds of this tax would be used to purchase the lands which it is necessary that the state should own in order to consolidate the forest reserves, and thus make possible systematic forest management, and also to pay for the patrol system.

The lands within the forest reserve area, which are not owned by the state, are largely held by non-resident owners, are absolutely unprotected and therefore the danger point from which start most of the destructive forest fires. No systematic forestry management is possible until these lands are acquired by the state and it is the poorest possible kind of economy to put off their purchase from year to year, as they are deteriorating in value through recurring fires, and in their present condition they block all forestry progress. Private owners must be encouraged to practice forestry through the enactment of just and reasonable timber taxation laws. The present system of annually taxing growing timber is of course one of the strongest incentives to the owner to cut the timber

and thus escape such taxation which is fundamentally unjust when applied to a timber crop requiring many years to reach maturity. The land itself should bear an annual tax equal to other lands similar in character, but the timber crop should not be taxed until it is harvested. Such a law would at once strongly encourage forest conservation instead of leading directly to forest destruction, as is now the case.

THE SOIL SURVEY.

By A. R. WHITSON.

A survey of the soils of the state was authorized by the last Legislature and funds provided for two years. This work has been under the co-operative administration of the Geological and Natural History Survey and the College of Agriculture. A second co-operation between the state organizations on the one hand and the Bureau of Soils of the United States Department of Agriculture on the other has also been arranged and the work of the past two years has been carried on under this co-operation. The plans outlined at the beginning of this work included the making of a reconnaissance survey of the portion of the state lying north of the areas of which a preliminary map of the soils had already been made by the Geological and Natural History Survey, and a detailed map of all the older sections of the state. During these two seasons approximately 3,200 square miles have been covered in the reconnaissance survey and 3,500 square miles in the detailed survey. Detailed maps have been completed in Waushara, Iowa, and Waukesha counties and the map of Fond du Lac is nearly completed, while those of La Crasse and Juneau are about half finished. These maps cannot be published until the chemical analyses of the soils of these counties are completed. It is of the greatest importance that the work of the preliminary survey in the northern part of the state especially, be completed as rapidly as possible. There is a great demand for such soil maps from intending settlers and it is very desirable that accurate information be available.

Supply of Plant Food in Wisconsin Soils.

One of the most important objects of the soil survey is a full determination of the amount of the essential elements present in the various soils of the state which are necessary to plant growth. Exact knowledge concerning all parts of the state can only be had after the soil survey is completed, but some estimate of the amount of phosphoric acid, which is apt to be the limiting factor in most soils, can be made in some of the more important classes. The analyses so far made on the clay loam soils and types closely connected with these, occurring in the north central part of the state, including Marathon, Lincoln, Taylor, and Clark counties, show an average of .16 per cent while the subsoils show .134 per cent. The silt and clay loams of the north western portion of the state, including Chippewa, Gates, Barron, Polk, St. Croix, and Pierce counties, have an average of 13 per cent in the soil and .107 per cent in the subsoil. The sandy soils of this section of the state have an average of .10 per cent in the surface and .108 per cent in the subsoil. The average in the Marinette clay loam soils is .11 per cent and the sands. .08 per cent. The red Superior clay of the Bayfield region averages .09 per cent and the sands .07 per cent. The clay loams of Waushara county average .09 per cent and the sands .06 per cent. The clay loams of Waukesha county average .17 per cent and the sand .04 per cent.

But a matter of even greater importance than the average amount of this essential element is the variation in the amount shown by different fields. In the clay loam soils in the northwestern area, for instance, the total phosphoric acid ranges from .08 per cent to .17 per cent. The sands of Waushara county vary from .01 per cent to .15 per cent. The clays of the Superior region range from .07 per cent to .13 per cent while the sands of that area range from .05 per cent to .10 per cent. Still greater variations are shown in the soils of the sections which have been cropped for a longer period. The sands of Waushara County, for instance, vary from .01 per cent to .15 per cent, while those of Waukesha vary from .01 per cent to .06 per cent. Such variations show the necessity of large numbers of determinations, especially of phosphoric acid in all the important soil types mapped. Effective effort by the state to aid her farm-

ers in the maintenance and increase of her soils will only be possible after a comprehensive knowledge of their chemical composition has been gained.

Extent of Land Subject to Erosion.

In making up the following estimate of the land subject to erosion in the state the work of the soil survey has been used as a basis. In this survey two classes of land subject to important degrees of erosion are defined and mapped; first, those areas on which erosion is so serious as to practically prevent clearing and cultivation; and second, areas subject to serious erosion determining to a considerable extent the plan of rotation and crops grown, although not actually preventing cultivation. Moderate erosion takes place on a considerable portion of the land not included in these two classes. In Iowa county the area belonging to the first class amounts to 11.5 per cent of the total area of the county and that belonging to the second class amounts to 24.9 per cent. This is the only county on which we have at present complete data for this use. Based on that and considering all available data regarding topography and physical character of the soil, it has been estimated that the land subject to severe erosion amounts to one and one half million acres, while that subject to serious erosion is two and a half million acres in extent. While it is true that these areas which are subject to very severe or to quite serious erosion do not form a very large fraction of the state, there is a very much larger area on which the erosion is important. Although this erosion is of less damage to any given farm, the total loss over the whole state is undoubtedly several times that on the area where it is locally much more pronounced.

There are two ways of lessening loss by erosion. One is by its prevention through the use of such devices as terracing, deep plowing, and various plans for preventing the development of gulleys. The other is the adopting of a more extensive type of farming in which the steeper portions of the land can be used for pasturage so that the soil has constantly a protecting sod. It must, of course, be recognized that our rainfall, on account of its distribution largely in the early summer and being quite light in the late summer and fall months, is one not calculated

to produce the best pasturage, so that the use of much land for pasturage purposes is not usually considered profitable. Undoubtedly, however, material improvement can be made in our pastures. There is perhaps no other subject of equal importance which has had so little consideration in agricultural literature as the treatment necessary to the maintenance of good grasses.

It seems to the writer impracticable at present to attempt to prevent these losses by enacting laws which would require farmers to follow specific instructions for their prevention. But certainly the importance of this matter is so great that full data bearing on it should be gathered and careful studies made to determine methods for its prevention under the conditions of our agriculture, and these should be followed by a proper educational campaign. The collection of this data is one of the important objects of the soil survey, so that as this survey progresses, the state will have on hand more and more complete knowledge of the extent of this loss in the various sections of the state.

Development of Marsh Lands.

The three or more million acres of marsh lands in the state awaiting development offer large opportunity for increasing the agricultural lands of the state and the population which may be supported. While it is true that these lands have some drawbacks in regard to fertility, it is believed that the great majority of marshes will yield satisfactory results when properly handled, that is, when given the right kind of fertilizers, and planted to the crops to which they are adapted. Nevertheless, there are two or three conditions which are clearly retarding the rate at which these lands are being drained and developed. The most important of these is the condition of our drainage law which at present makes it impossible to condemn or remove by any proceeding dams which interfere with proper drainage of many marsh areas. It is, of course, true that much land must necessarily be included in the flowage of valuable water power sites and that in many cases the value of the water power is much greater than that of the land flowed. On the other hand, there are, undoubtedly, many marshes the drainage of which is now impossible where the value of the land which

could be reclaimed is far greater than that of the water power which has been or could be developed. It would seem that some provision should be made for the determination of which of these interests is the more important by a properly constituted state commission which would have power to act in individual cases brought before them.

Another very serious difficulty in the organization of drainage districts and in fact, of any co-operative method of drainage is that met with in the legal proceedings necessary to effect proper organization. The very nature of the work is such as to make co-operation necessary and to give the corporation when organized, power to control all lands within the district. This, of course, necessarily gives rise to suits for damages by individuals remonstrating against the organization of the district. Unfortunately, however, many attorneys have so low an idea of legal ethics that they go to practically any limit to continue or develop a feeling of dissatisfaction among a minority of the farmers in the region to be organized into the drainage district. In many cases farmers have seemed to be practically at the mercy of attorneys although they were clearly anxious to avoid litigation at the beginning. As an illustration of the expenses of one of the first drainage districts may be mentioned one in which the money actually expended on digging amounted to $9,800 and all organization expenses amounted to $9,900, of which $4,000 was for attorney's fees. The writer has no suggestion to make in regard to the prevention of this difficulty but desires to call attention to it distinctly as the one factor which probably more than anything else is delaying the development of our marsh lands.

It is of the utmost importance that, if possible, something be done to remedy these two difficulties and so to make possible the drainage of a large part of our valuable marsh lands. These lands would be rapidly developed were it not for these difficulties since, in large part, they occur as portions of farms the uplands of which have already been developed. This relation of marsh land to upland gives marsh land a much greater value than it would have if it were all in one body so that entire farms would consist of marsh land.

Experimental and Demonstrational Farms.

In order to make effective the work which the state is doing through the soil survey and the Experiment station to aid in the development of her agricultural resources, it is important that a number of experimental and demonstrational fields be located on each of the chief types of soil. The success of the few such fields now in operation is such as to warrant a very considerable increase in their number. One such farm has been located on the sandy soil of the northwestern part of the state at Spooner—but the need for help on the older soils of the great central sandy section including Waushara, Adams, Portage, Juneau, Monroe, Jackson, and portions of adjoining counties, is much greater. Two or three demonstrational fields or marsh soils should also be established. Most of the land needed for such experimental and demonstrational fields could probably be secured free of cost so long as used for such purposes, and the expenditure of a few thousand dollars in the maintenance of these demonstrations would be repaid many fold in a single decade by the improvement in the management of these and other special types of soil.

Loss of Fertility in Manure.

The state of Wisconsin has encouraged all lines of live stock farming and especially dairying for a number of years through its support of the Agricultural College and various agricultural societies. This has unquestionably been a large factor in the development of the wealth of the state and is a matter of good business judgment. It is probable, however, that a misconception has developed as to the possibilities of maintaining the fertility of the soil in systems of farming where stock raising predominates. It has been so generally stated in the Agricultural Press that by feeding all crops grown on the farm to the stock maintained and returning the manure to the soil the fertility of the soil could be indefinitely maintained, that it is necessary to call attention very distinctly to two radical sources of error in this conclusion. First, there are losses, which are in part avoidable but in part unavoidable, of the chemical elements contained in the crops used for feed when removed from the soil, before they can be returned to the land in the form of

manure. These are through the fermentation and leaching of the manure in the stables and yards. A conservative estimate indicates that the annual loss of fertility from the manure produced by all classes of animals in the state has an actual value on the farm of between ten and twelve million dollars. It is highly probable that one half of this could be saved by the use of proper methods for the handling of the manure. Our climatic conditions are such as to render the use of the liquid manure cisterns, so commonly used in European countries, out of the question during the winter season. The problem of properly taking care of manure in our stables in one yet unsolved for our conditions. With the decrease in the amount of stock produced on the farms, the amount of bedding is frequently insufficient to absorb the liquid manure and some material suitable for this use should be, if possible, provided. The immense quantities of peat and moss accessible in the state exceptionally well adapted to such use would seem to warrant a thorough study of its suitability for this purpose. Not only will the peat prevent the loss of the most valuable part of the manure, but it will add large quantities of nitrogen and organic matter.

Second, the humus or organic matter of the soil which is so essential to the maintenance of a good tilth and to the water-holding capacity of the soil as well as for its chemical action on the rock particles of the soil itself, cannot be maintained on the average stock farm by the use of barnyard manure alone. Careful studies have shown conclusively that even the use of heavy applications of manure on land in tilled crops such as corn or tobacco, for twenty to thirty years has resulted in a constant loss of humus. A very much more effective method of maintaining the vegetable matter of the soil is by plowing under of green manuring crops. In climates which make possible the growth of two crops in a season, the regular or money crop can be grown during the first part of the season and this followed by a legume crop to be used as a cover and green manuring crop and turned under the following spring. The short season of Wisconsin together with the frequent lack of rain during the latter part of the summer makes this practice largely out of the question. It will, therefore, frequently be necessary, where the development of humus is a matter of prime importance to give

up the use of the land for a season or two to the growth of a leguminous crop, all of which is to be plowed under, or to plow under the second crop of clover rather than to cut it for feed or seed. It must also be realized that soils which are deficient in organic matter are usually deficient in available supplies of phosphate and frequently potash, so that the use of some mineral fertilizers for the growth of these green manuring crops will be desirable. However, these elements applied in this form will become again available to other crops by the decomposition of the organic matter later on. The agriculture of Wisconsin probably demands nothing more important today than an active educational campaign emphasizing the importance of humus in the soil and effective methods of maintaining and increasing it.

FERTILITY LOST IN CITY SEWAGE.

A preliminary study is now in progress planned to determine the amount of phosphoric acid, nitrogen and organic matter being lost in the city sewage and the possibilities of its recovery for use in agriculture. This work has been done on the Madison Sewage Disposal Plant by Dr. P. P. Peterson of the soils department. The raw sewage is found to contain approximately 82 lbs. of P_2O_5 per million gallons and the sewage of the city amounts to 2.3 million gallons per day, indicating a total content of approximately 190 lbs. of P_2O_5 daily or approximately 70,000 lbs. annually. This would be equivalent to 500,000 lbs. or 250 tons of acid phosphate fertilizer containing 14% P_2O_5.

The raw sewage is first allowed to settle for 24 hours in the settling tank after which it is drawn off and passed through the filter beds. The sludge which settles in these settling tanks is drawn off once each year and allowed to run to waste in the marsh. The sludge contains a large amount of organic matter containing, of course, large quantities of nitrogen and about 2% of the organic matter in phosphoric acid. This represents a little over one-third of the total. Another portion of the phosphoric acid is absorbed by the filter beds as the effluent passes through it. Somewhat more than half of the total phosphorus in the raw sewage is left in the sludge and in the cinder beds which would be the amount that could with comparatively little difficulty be recovered for use. The nitro-

gen and organic matter would also have considerable value. In all probability the use of limestone filter beds would be more effective in absorbing the phosphorus than the cinder beds, and if that could be removed more often than is now the practice it is quite probable that their content of phosphoric acid would be important and certainly the use of the limestone itself on agricultural lands would be helpful. Further work is necessary before practical methods of recovering and handling the sludge and the filter bed material can be devised. If it should prove practicable to recover at small cost half or more of the phosphorus now being lost in the sewage of cities, a very important advance will have been made in the conservation of this important element.

THE WEED SITUATION.

By A. L. STONE.

The permanence of profitable agriculture in Wisconsin is being seriously threatened by the rapidly increasing spread of weeds, noxious and otherwise. Weeds are active agents in profit reduction in several ways; they absorb plant food and moisture which otherwise would be available for crop use; they are hardier, grow more rapidly, usually have greater leaf expansion and so crowd, shade, and dwarf the cultivated crop. Many weeds are poisonous when eaten by live stock and cause losses of thousands of dollars annually. Many weeds act as hosts for the fungous diseases such as smuts and rusts. Thus the treatment of seed grain for smut proves effective for but two or three years at the best, causing additional expense in labor and material for a repetition of the treatment. Largely increased expense in harvesting and curing cereal or forage crops is engendered by the presence of weeds in additional wear and tear on machinery, twine for binding, and labor for curing. The quality or grade of grains or hay grown under weedy conditions is greatly reduced. Grain is docked in the markets for weed seeds present, the dockage being proportional to the amount of weed seeds. Hay containing weeds like Canada thistles or similar weeds is also graded low. Weeds have a toxic effect on the soil, strongly affecting many grain crops following and thus reducing yields. Finally, the annual cost of controlling weeds by the usual methods of cutting, digging, and cultivation is an enormous tax on the farms of the state.

Just how great is the annual profit reduction from all these causes is impossible to accurately or definitely determine. The

gravity of the weed problem has become so great that there is pressing need of actual facts which may be used to convince the farmer. The farmer is by nature conservative, his life and vocation making him so. His life is strenuous and he will be far more like to take time to consider the weed problem, if it be demonstrated that this will be profitable to him.

In dealing with the weed problems there are two necessary lines of action, viz., eradication of the weeds already existing and prevention of further introduction. To successfully attack the first phase of the problem, it is necessary to present convincing proof of its necessity as has been stated once before. In an attempt to obtain adequate and convincing data the agronomy department has co-operated with members of the Wisconsin Experiment Association. For two years data have been collected with the following results.

RESULTS OF WEED INVESTIGATIONS.

Wisconsin Experiment Station and Association.

1. Total number of reports received	499
2. Number of counties from which received	57
3. Average size of farms in acres	167
4. Total cost of weed eradication	$11,134 23
5. Total amount of town taxes on farms	27,362 42
6. Average cost of weed eradication	38 83
7. Average amount of tax	69 08
8. Adjudged value of weed infested farms per acre	53 12
9. Troublesome weeds in order of numbers:	
Quack Grass—No. Reports	228
Canada Thistle—No. Reports	262
Wild Mustard—No. Reports	112
Sow Thistles—No. Reports	81
Burdock—No. Reports	72
Yellow Dock—No. Reports	115
Cockle Burr—No. Reports	31
Snap Dragon—No. Reports	26
Ox-eye Daisy—No. Reports	14
10. Average area of Canada Thistles in acres	5.6
Average area of Quack Grass in acres	3.32
Average area of Mustard in acres	20.50
11. Average per cent of pasture spoiled by weeds	5.48
12. Number of farmers willing to assist in enforcing better weed and seed laws	443

The total cost of weed eradication on the 499 farms above reported upon was nearly one-half the amount paid as taxes for the support of public institutions; and this does not include the cost of cultivation necessary to control weeds in cultivated crops, like corn, potatoes and sugar beets. Although information on

the latter point was asked in almost no instance was it furnished. Of the 499 farmers 228 report quack grass with average area of 3.32 acres; 262 Canada thistles with an average of 5.6 acres: 112 wild mustard with an average of 20.5 acres per farm; and other weeds in gradualy lessening areas. In the farms reported upon in one block of eight counties in the northeastern part of the state where the average area was 129 acres an average area of 35 acres of noxious weeds per farm was reported. Beside damage to cultivated crops these 499 farmers report 5.48 per cent of their pastures as lost because of weed growths.

WEED CENSUS.

In addition to the co-operative work with the experiment association, the agronomy department of the university conducted a careful weed census in five somewhat widely separated counties of the state. This work consisted of a farm to farm canvas of as large a portion of each county as could be covered in the time at disposal of the department for the purpose.

The counties were selected as typical sections of the state and the results of the census are given in the following table:

County.	No. of farms.	Total area.	Av. area of farm.	Total weed infested area.	Av. area of weeds per farm.
		Acres.	Acres.	Acres.	Acres.
Eau Claire	17	3.280	193.0	516.0	30.3
Iowa	137	22,478	164.0	1,360.77	10.1
Langlade	76	6,086	80.0	137.12	2.77
St. Croix	130	24,832	179.4	582.39	4.46
Sheboygan	44	4,849	110.2	440.75	9.08
	404	60,025	145.3	3,073.03	11.34

From this table it appears that four hundred and four farms were examined including a total area of 60,025 acres, of which 3,073.03 acres of 11.34 acres per farm was seriously infested with noxious weeds. It is noticeable that the weed areas per farm are much larger in some sections than others due to variation in length of time for which agriculture had been established and for various other causes. Whatever the cause, there is op-

portunity to prevent introduction and spread of noxious weeds in these localities, where at present the area is small.

TABLE III.—IDENTITY AND AREA OF THE WEEDS IN THE VARIOUS COUNTIES.

County.	Canada thistle.	Quack grass.	Wild mustard.	Sow thistle.	Ox-eye daisy.	Snap dragon.
	Acres	Acres.	Acres.	Acres.	Acres.	Acres.
Eau Claire	50.0	432.00	.....	.....	.....	89
Iowa	55.2	388.92	685.42	.....	5	.....
St. Croix	20.4	52.01	.....	24	.....	.....
Sheboygan	402.5	.....	.....	38.25	.....	.....
	483.1	1,372.93	685.42	38.49	5	89

It will be seen that in Iowa, Eau Claire and St. Croix counties, quack grass composes the largest portion of the weed infested area; in Sheboygan county, Canada thistles, and in Iowa county charlock or wild mustard. Other data gathered from the experiment association reports, indicate that Canada thistles are most troublesome along the Lake Michigan shore and adjoining counties, quack grass throughout the north central and northern portion, sow thistles through the central portion and mustard in the northeastern and southwestern portions of the state.

This study of weeds summarized above as related to farm profits, etc., show the extreme gravity of the situation. The study will be continued but the data already obtained lead to some definite conclusions.

First.—Noxious weeds are present in large areas in many sections of Wisconsin.

Second.—They are rapidly being introduced into new sections.

Third.—They cause serious loss wherever present.

Fourth.—Some immediate action should be taken in the way of preventive and remedial measures.

Preventive measures must take into account two principal methods of weed introduction.

(1) Many weed seeds are carried from weedy areas to uninfested farms by such agencies as wind, wind and snow combined,

water in streams or spring freshets, by animals in the fur or the droppings, and by human beings on the clothing. Instances are known where Canada thistles, quack grass and other noxious weeds have been carried many miles by the first three of the above mentioned agencies. This could not have occurred had not some one carelessly permitted the seeds or roots of these weeds to remain in such locations and in such condition as to allow their roots or seeds to be thus distributed.

Noxious weeds ought never to be allowed to stand in the fields and along fence rows where the plants may mature their seeds for the wind and water to carry to "pastures new." Such a sentiment must be created that a farmer would no more permit noxious weeds to seed than he would poison his neighbor's stock or burn his buildings. It ought to be considered only slightly less criminal. Laws, properly enforced, would be of some assistance and this phase will be considered more in detail a little later.

(2) The weeds which are most pernicious are those which have been introduced into Wisconsin largely in importations of agricultural seeds. Any labor expended in weed eradication will avail little as long as farmers persist in sowing seed containing the seeds of noxious weeds.

The gravity of the situation seems to have been recognized by members of the state legislature in 1909 for a law was passed establishing a state seed inspection division at the experiment station. This law requires that all field seed sold in Wisconsin be labeled with the per cent of purity and actual germination test of the seed contained in all packages over one pound in weight. The enforcement of the law was entrusted to the experiment station under the supervision of the director. As a result a total of 1813 official tests were made by the seed inspection division of the agronomy department, during the year beginning July 1st, 1909, and ending June 31st, 1910. Of these 1386 tests were made for seed dealers and the remainder for farmers. The fact that farmers were able to buy tested seed from their dealers greatly decreased the number of samples of seeds sent in by the farmers.

Grains, clover and timothy seed composed the bulk of the samples tested, complete tests being made on 271 cereal, 520 red and mammoth clover, 301 alsike clover, 430 of timothy and 97

alfalfa, a total of 1619 samples. Of this number 36 samples or 2.22 per cent were condemned because they contained the seeds of noxious weeds. Unfortunately the law does not require a statement from the dealer as to the quantity of any given lot of seed he may have similar to the sample tested. For this reason it is impossible to make an exact statement of the amount of the noxious weed infested seed which was kept off Wisconsin farms. The quantity was undoubtedly large enough, however, to make the results of inspection extremely valuable. Had the noxious weed seeds contained in the above listed field seed been sown it is hard to estimate the tax in reduced crop production and in cost of weed eradication, which would have resulted.

The seed inspection law with its accompanying educational campaign will undoubtedly be able to cope with this phase of the preventive work.

REMEDIES.

Any remedial measures are liable to failure which are not supported to a large extent by public opinion. The first step then is to educate the farmers concerning the actual harm which is being done and the consequent loss of profit. This is being done as rapidly as possible by the agricultural college, in its extension work and by the experiment station in its demonstrational work as well as through the publications of both. But this line of effort reaches but a small proportion of the farming population. What else can be done?

In the first place the subject must be properly presented in the public schools, particularly those situated in rural sections. The pupils in those schools must have this interest aroused in the subject and this will be comparatively easy if the teacher has the right spirit and the material with which to work. It devolves upon some department of our educational system to supply the necessary material.

The child has lived among weeds all his life but has never realized their economic importance, has known the names of but few of them and has never associated the weed and its seeds. The country teacher likewise is lacking in knowledge to adequately present the subject in an interesting and instructive manner.

To meet the difficulties there should be placed in every school

library in the state a publication containing reproductions in actual colors of the most common and noxious weeds with which the farmers have to contend. Such a book should also contain plates showing the seeds of these weeds in their natural colors and with the characteristic markings. Such a publication has already been issued by the Canadian department of agriculture at a cost of a trifle over one dollar per copy. The book contains seventy-five plates with all necessary information concerning the habits of the plant and methods of eradication. Such a book should be published in Wisconsin.

The U. S. Department of Agriculture puts up two cases containing one hundred vials of seeds each, primarily for educational institutions. One of these cases contains one hundred samples of weed seeds the other one hundred samples of seeds of economic plants. These sets of seeds are furnished free to schools.

Supplied with the above named illustrated text and the seeds of the weeds an energetic teacher can easily arrange a series of exercises in which children will be greatly interested and every school be made a point from which the war against weeds may be prosecuted. Weeds which are troublesome on the home farms may be brought to school. Collections of weed seeds may be made and exercises arranged to associate the weed and its seeds. There is no surer and better way of reaching the parents than through the children and those engaged in pedagogical work well know the crying need at present is the publication of a satisfactory text for the use of teachers. The agronomy department stands ready to supply material for such a work but finds no funds available. An edition of at least twenty-five thousand copies of such a book would be none too large to supply the demands of educational institutions, libraries, etc. These plans if executed would give at least a working basis for attacking what what is rapidly becoming one of the most serious agricultural problems.

There are some men, however, who cannot be reached by a campaign of education particularly if they are living upon rented farms and have no interest in the farm beyond the one or two years which they expect to spend there. Such men must be treated in a different way so it is probable that education must be supplemented by wise laws, properly enforced.

There are laws upon our statute books which require that all noxious weeds be prevented from seeding and weed commissioners are appointed in each township, village, or city ward to see that the laws are enforced. The law is practically a dead letter because it calls upon local officials whose action will arouse the antagonism and possible enmity of his neighbors if he attempts to see that the law is enforced.

The present laws are neither wise nor efficient. They should be amended in such a manner as to allow of no possible misinterpretation. Their enforcement should be placed in the hands of a state weed inspector who should have power to appoint subordinate inspectors similar to those in the employ of the Dairy and Food Commission. Men should be appointed who have no interest in any special community but who will see that the laws are enforced without fear or favor and without respect to person or influence. They must be men with a knowledge of weeds, their habits and a practical knowledge of the necessary and most economical remedial measures.

AGRICULTURAL ECONOMICS.

BY HENRY C. TAYLOR.

Conservation should be interpreted as relating to the utilization of our resources in such a manner as will in the long run yield the maximum of human well being. Conflicting opinions on the subject of conservation arise from the variety of estimater of the relative importance of present wants as compared with future wants. No individual gives as much thought to future wants as to present wants. No nation should count the future equally important with the present. To do so becomes absurd when its significance is realized. Take the coal supply for example. The state that counts future wants for all time to come just as important as present wants could make no use of coal whatever, for the whole supply divided over an infinite period would give an infinitessinal quantity for the present.

In the conservation of the elements of soil fertility the result of absolute maintenance of the mineral elements in their present quantities would mean that even though a soil is richly endowed with potasium and phosphorus the farmer could not take from the soil more than he returned of these elements. This would in most instances result in the buying of these elements at a cost greater than the present capital value of the same elements in the soil. So long as present wants are counted more important than future wants the whole trend will be towards a gradual reduction of the absolute supply of the mineral elements of fertility. If there is sufficient phosphorus in the soil, which will gradually become available and be utilized to produce good crops, for forty years without any supplies being purchased, the whole tendency of economic life is to postpone the purchase for forty years. A dollar to be expended forty years from now,

when discounted at the current rate, is valued variously from ten to fifteen cents according to the rate.

So long as lands are cheap the idea of maintaining an equilibrium between what is taken and what is returned from the soil is utopian. Obviously the state should count the present more important than the future and the whole problem of conversation centers about the question of how much or how little the future should be discounted in comparing present and future wants. That policy which in the long run will give the people of a nation the maximum well being is undoubtedly a policy which places a lower rate of discount upon the future than the current rate of interest which individuals pay. The individual considers a relatively short span of years when figuring upon the policy which will yield him maximum satisfaction.

That method of utilization which conforms to the national ideal of maximum well being, may be in conflict with the immediate interest of every individual in the nation. Conservation will, therefore, always be fought by men who think only of themselves and of immediate gain. Conservation is a patriotic ideal. The more slowly nature gives up the scarce elements of fertility and the higher the value of the land the greater the inducement to farm conservatively. When the subject is viewed from the standpoint of the landowning farming, the present high land values indicate that the time has come when he will find it to his own interest to farm more conversatively. But with the tenant farmer this inducement is not so effective. The lower valuation which the individual places upon the future is due in part to the uncertainty of the future, as well as to a more keen appreciation of present than of future wants, the tenant farmer, who leases land from year to year has no permanent interest in the maintenance of the soil, and the inference that tenants farm more exploitatively than owners of land seems to be borne out by the evidence available.

The total number of tenant farmers in Wisconsin was relatively small in 1900 aggregating only 22,996. This represents about 13½% of all farmers in the state, but while the percentage is small for the state as a whole, it is rather high when individual counties in the southern part of the state are considered, as is shown in the following table which gives the percentage of rented farms for 1880 and 1900 in twelve counties:

County.	1880.			1900.		
	All tenants.	Cash tenants.	Share tenants.	All tenants.	Cash tenants.	Share tenants.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Dane	15.7	3.4	12.3	26.2	8.8	17.4
Grant	14.6	4.4	10.2	20.7	11.7	9.0
Green	14.9	4.0	10.9	26.5	14.1	12.4
Iowa	12.9	4.5	8.4	18.9	14.1	4.8
Jefferson	9.0	2.1	6.0	18.2	8.7	9.5
Kenosha	16.3	7.5	8.8	29.1	22.0	7.1
Lafayette	18.3	9.5	8.8	27.6	21.0	6.6
Milwaukee	14.7	12.2	2.5	31.2	29.1	2.1
Racine	13.3	9.0	4.3	24.8	18.1	6.7
Rock	21.0	5.5	15.5	35.4	9.0	26.4
Walworth	13.5	4.0	9.5	29.7	13.0	16.7
Waukesha	13.3	6.9	6.4	20.0	14.9	5.1

Rock county has the highest percentage of tenancy with 35.4% of her farmers belonging to this class. Not only are tenant farmers very numerous in the southern part of the state but they are increasing from decade to decade, as is shown by comparing the percentage of tenancy in the southern counties for 1880 and 1900 as given in the table.

The rented area in the state of Wisconsin in 1900 aggregated 3,355,024 acres, which was 16.9 per cent of the farm land of the state of Wisconsin.

The significance of tenancy from the standpoint of conservation arises out of the fact that tenant farmers farm more exploitively than do land owning farmers. This is shown by census statistics to be true in the various states of the Union. The following figures are intended to show the extent to which this is true in the state of Wisconsin.

TABLE SHOWING THE PROPORTION OF THE IMPROVED AREA DEVOTED TO DIFFERENT LINES OF PRODUCTION, CLASSIFIED BY TENURE.

Crop.	Owner.	Cash tenant.	Share tenant
Barley	5	4.8	5.4
Corn	12.3	14.7	20.2
Oats	20.7	23.7	22.5
Rye	3.5	1.9	2.5
Wheat	5.5	2.6	3.5
Total grain	47.	47.7	54.1
Hay and forage	22.1	19.1	18.4
Tobacco	23.	39.	78.
Meat cattle per hundred acres of hay and corn	62.8	59.	45.
Hogs per hundred acres of corn	141.6	161.3	97.

These figures show that in general tenant farmers devote more of their area to grain crops and less to hay and forage crops than do owners. They also show that tenants keep fewer cattle in proportion to the hay and corn produced and that share tenants keep fewer hogs in proportion to the acres of corn produced, which seems to imply that they more often sell their corn than do owners and cash tenants. In general the data points to the conclusion that tenants farm more exploitively than do farmers who own the land they operate.

The following table throws further light upon this subject. In 1900 farms were classified on the basis of the principal source of income. Any farm having 40 per cent of its income from one source and not having this large a proportion of its income from any other one source was put in the class of farms having this principal source of income.

PERCENTAGE OF FARMS HAVING SPECIFIC PRINCIPAL SOURCES OF INCOME.

	Hay and grain.	Live stock.	Dairy.	Tobacco.	Miscellaneous.
Owners	18.1	35.	14.9	1.4	26.5
Cash Tenants	22.	36.8	18.9	1.5	15.1
Share Tenants	30.3	31.	13.8	7.	13.9

This table shows that owners are put more often in the Miscellaneous class, but in spite of this, a higher percentage of owned farms have livestock as their principal sources of income

than do share tenants and a much smaller percentage of owners receive their principal income from the sale of hay and grain than is true of cash or share tenants. This points to the same conclusion as the above table, namely, that tenant farmers devote more of their land to producing crops to sell than do owners, hence inasmuch as they buy little or no fertilizer their type of farming is more exploitive.

The tenant problem is related to the problem of the encroachment of noxious weeds upon the farm land of the state. The tenants' interest in the farm is a temporary one. The fact that his negligence in allowing weeds to seed will give more labor or less profit to his successor is not an effective force leading him to cut the weeds in season. It often happens that the land is infested with quack grass or Canadian thistles when the tenant enters upon the farm. The tenant should not be expected to clear the land of weeds of this class without special compensation for his labor.

The fact that the tenant who holds land from year to year finds little inducement to farm in accordance with the principles of a permanent agriculture suggests the desirability of investigating the systems used in other countries to induce tenants to invest their labor and capital freely in and upon the land without fear that others will reap the rewards of their effort. The system of compensation for unexhausted improvements in use in England is worthy of consideration with a view to improving conditions in Wisconsin.

The more exploitive type of farming commonly practiced by tenants may be due in part to the fact that tenant farmers as a class are younger and have less capital. It is obvious that less capital is required to produce hay and grain to sell than is required to produce these same commodities and feed them to livestock. This suggests the desirability of investigating the various farms of credit, which facititate the securing of the necessary capital with which to carry on farm operations. In this connection the co-operative credit association of Europe are worthy of consideration. Any thing which will add to the security of the tenant's investment, and every thing which will lower the rate of interest which he must pay for the use of capital the lower the rate at which he will discount the future and the more neary he will comform to the national ideal of

conservation in his farm operations Besides those remedied which will put the tenant in a position to farm conversatively (which at best means, exploit less rapidly). An investigation should be made of the causes of the increase in tenancy with a view to the maintenance of the class of landowning farmers the true conserves of our rural life and our national life, as well as the soil basis of agriculture.

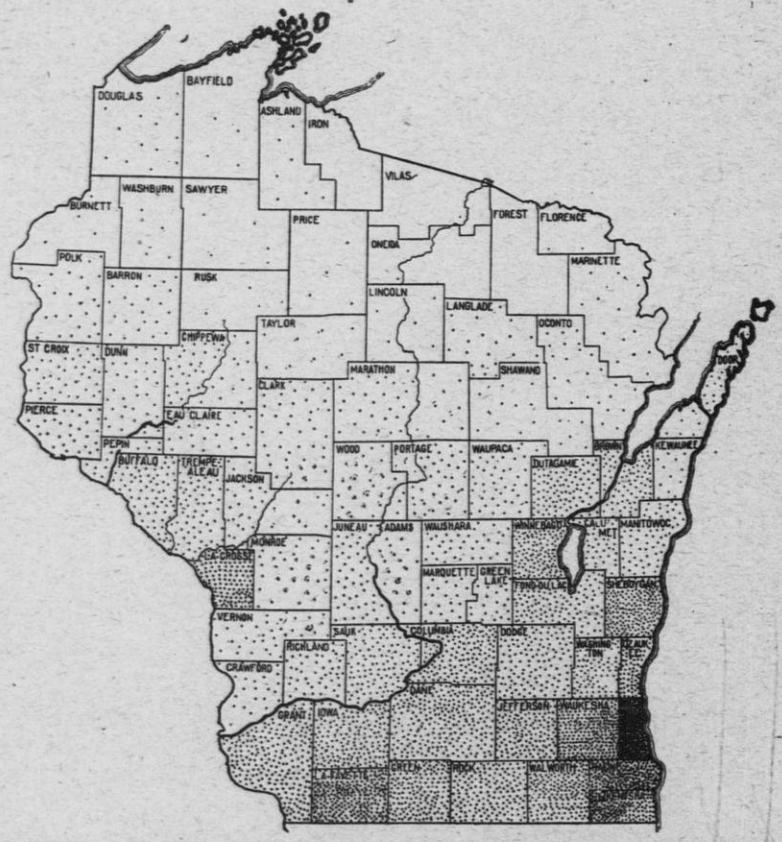

Figure 1. Distribution of cash tenants in Wisconsin, 1900. One dot represents two tenants. It will be noted that cash tenancy is most generally practiced in Milwaukee and adjoining counties in the southeastern part of the state, and in La Crosse and Lafayette counties. Compare this map with Figure 2.

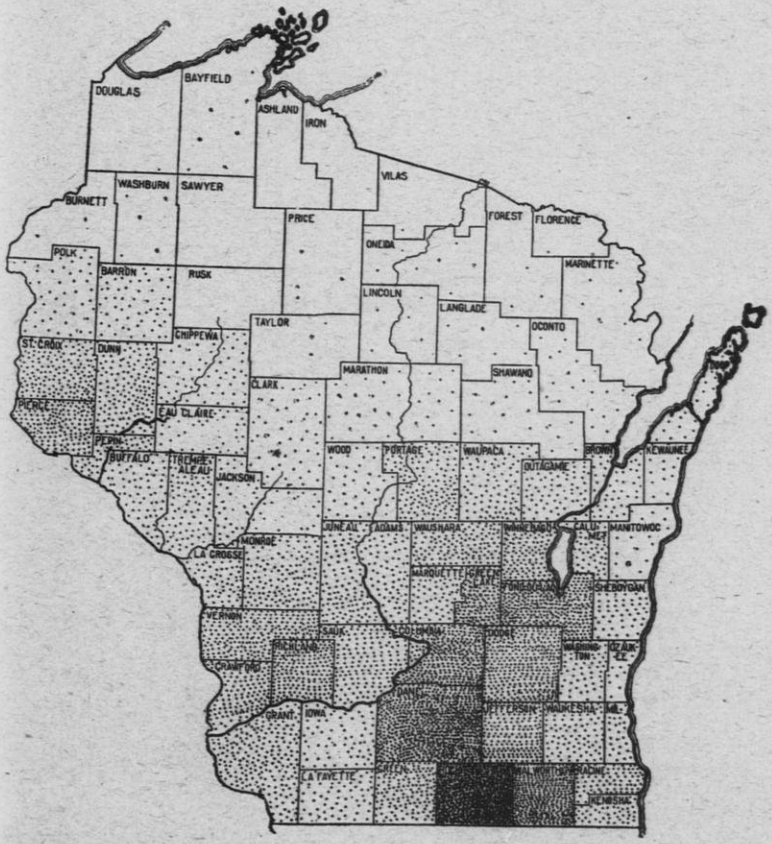

Figure 2. Distribution of share tenants in Wisconsin, 1900. One dot equals two tenants. It will be noted that share tenancy is most generally practiced in Rock, Dane, Columbia, and Fond du Lac counties, although this system is well distributed throughout the state.