# Proceedings of first annual convention of the Wisconsin State Drainage Association. Madison, Wisconsin: December, 9-11, 1914. 1914

Wisconsin State Drainage Association
Madison, Wisconsin: The Association, 1914

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PROCEEDINGS OF

# FIRST ANNUAL CONVENTION

OF

# The Wisconsin State Drainage Association

MADISON, WISCONSIN

DECEMBER, 9-11, 1914

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**OFFICERS FOR 1915**

PRESIDENT — H. H. Sherwood, Mauston
VICE PRESIDENT — W. B. Coddington, Plover
TREASURER — A. C. Willard, Necedah
SECRETARY — E. R. Jones, Madison

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# PREFACE

The movement for a convention of drainage commissioners, drainage engineers, drainage attorneys and land-owners and town supervisors interested in drainage districts and town ditches met with response in every part of Wisconsin. It resulted in the three-day convention and the organization of a permanent association that will hold a convention every year.

The papers and discussions published herein represent only a small part of the discussion that actually took place. On the way to the meetings, in the street cars, and at the hotels drainage was discussed from its several aspects. Men were ready to give and to receive new ideas.

Special commendation is due to the commissioners who at the expense of their own time, effort and money, took part in the convention. Those who prepared special papers for the convention felt amply repaid by the excellent spirit in which their papers were received.

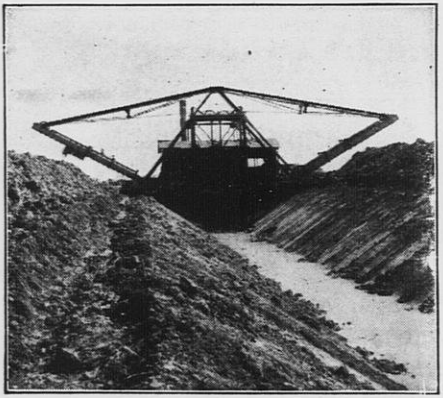
Two thousand copies of the Proceedings of 1914 will be distributed in drainage centers. The advertising columns containing a directory of enterprising firms inviting correspondence from the drainage public form a most valuable part of the publication. For the purpose of ready reference to such firms this pamphlet should be preserved.

Copies of the Proceedings will be sent to any address upon receipt of twenty cents. Those wishing to join the association should send the secretary fifty cents. Copies of the Proceedings of this association, and those of similar associations in adjoining states on our exchange list, are sent to each member. The next convention will be held at Grand Rapids, Wis., on Jan. 19, 20 and 21, 1916. An expression of opinion as to the time and place for the proposed summer field meeting is invited.

The cooperation of all who helped to make the convention of December, 1914, and this publication, a success is gratefully acknowledged.

E. R. JONES,
*Secretary.*

Madison, Wis., March 13, 1915.



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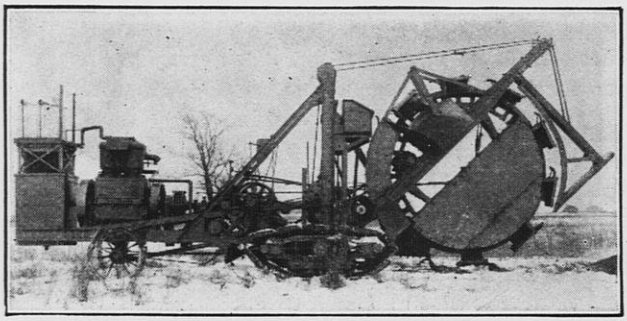
**Austin Wheel Ditchers** with bank sloping device reduce to a minimum the cost of digging small lateral ditches.

**The New Austin Farm Tile Trencher, Wheel Type,** will dig under suitable conditions up to 4 1-2 ft. deep, 11 1-2 inches wide, at rate of 10 lineal feet per minute. Has multi-pedal traction; grading device; ditch-cleaning shoe. **Buckets are absolutely self-cleaning**—a novelty in machines of wheel type.

**One man** controls the machine and attends to keeping grade without necessity of moving from platform.



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**Railway Exchange Bldg., Chicago, Ill.**

## THE MARCH OF THE MARSH

John Johnston, he of Scottish birth,
  Brought tile and tiling West.
And while he tiled, his neighbors smiled,
  But John laughed last and best.

Ohio and the Hoosier state
  Were next to fall in line.
They drained their fields for better yields
  Of corn for thee and thine.

Then tile invaded Illinois.
  In answer to her pluck
Came cornfields broad and solid sod,
  To pools where swam the duck.

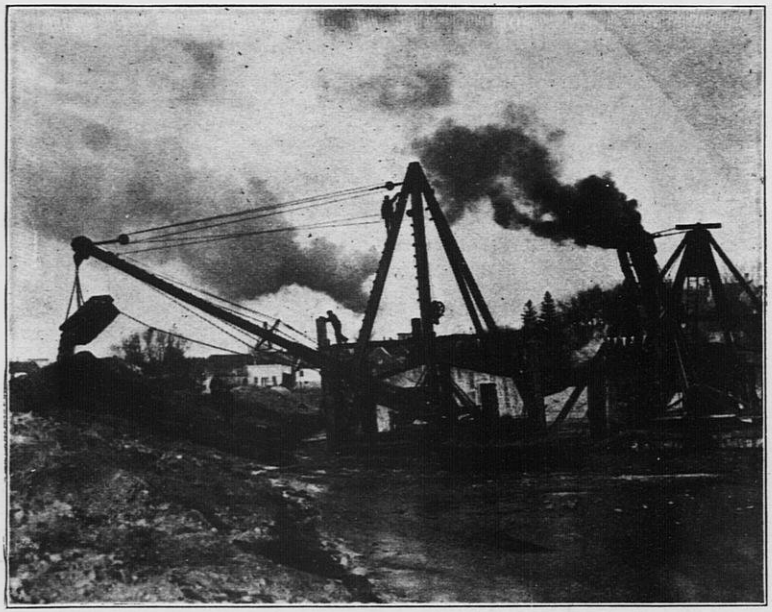
Iowa, she who justly boasts
  Of soil and farmers rich,
Then played the game and won her fame
  By tile and drainage ditch.

Wisconsin has the habit now,—
  She's draining by the mile;
Where mammoth dredge has killed the sedge
  She follows up with tile.

Her shallow streams did wind and spread,
  But now the rain may pour.
Where once was mud, she rules the flood,—
  And Noah did no more.

And from his lips they say there fell,
  'Mid forty days of rain,
Just one remark: "Oh, take the ark;
  I'd rather have a drain."

McWilliams plant engaged in widening and deepening Rock River through the City of Horicon, Wisconsin, to depth of 8 ft., with average width of 130 ft., serving outlet for drainage system reclaiming 40,000 acres of marsh land heretofore known as "Horicon Marsh."



If you have a ditch contract to let, involving the use of floating or dry land machinery, let us submit you a bid for doing the work.

If your ditches need cleaning out or outlet river or creek needs straightening or deepening submit us your proposition.

If you have drainage bonds to dispose of or large tract of marsh land which you desire to sell, write us.

For twenty years we have been actively engaged in all classes of ditch contracting, embracing work in the Mississippi Valley from the Gulf to Canada and employing nearly every type of ditching machinery. Our principal aim is to do PRACTICAL DRAINAGE WORK and GET IT DONE. If you are interested it is an easy matter to ascertain what extent we have succeeded in this aim.

Correspondence solicited bearing on any phase of drainage contract work or land reclamation in general.

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## WISCONSIN DRAINAGE DISTRICTS AND COMMISSIONERS ON APRIL 1, 1915

The commissioner named first in each case is secretary. Districts marked * have important work in process of organization or construction.

ALBION—Dane County; marsh area, 1,300 acres; cost, $14,000; D. P. Devine—H. S. Pomeroy, Edgerton; Wm. Le Fay, Stoughton.

BADFISH—Dane County; 1,000 acres; $11,000; Andrew Madsen—Clarence Hanan—Sheldon Tusler, Oregon.

*BASS CREEK—Rock County; 3,300 acres; $31,000; S. J. Strang—Michael Mulcahy, Footville; Ole P. Gaarder, Orfordville.

BEAVER—Jackson and Juneau Counties; 34,000 acres; $160,000; W. S. Braddock—George Marvin—F. J. Hoffman, Mather.

*BELGIUM AND HOLLAND—Ozaukee and Sheboygan Counties; 650 acres; $8,000; C. F. Liens, West Bend; John Ingelse, Adell; L. G. Kiecker, Thiensville.

BLAEN Y CAE—Dodge, Columbia and Green Lake Counties; 2,000 acres; $14,000; Ezra J. Hughes—F. J. Lee—Al. Bradley, Randolph.

*BROUGHTON—Green County; 1,000 acres; $15,000; Chas. Smiley, Orfordville; E. A. Ross—W. H. Fleek, Brodhead.

CENTER—Outagamie County; 2,500 acres; $18,000; Frank Kohl—Andrew Gehring, Appleton, R. 3; T. H. Ryan, Appleton.

CENTER—Rock County; 3,000 acres; $20,000; R. E. Horne—Warren Andrew—Eli Crall, Evansville.

CENTER No. 2—Outagamie County; 500 acres; $4,500; Wm. Differding—Wm. Temm—Louis Hahn, Appleton.

*CRANBERRY CREEK—Juneau and Wood Counties; 19,175 acres; $59,000 completed; $76,000 more contemplated; Anton Brost—W. H. Bowden, Babcock; Ole Norsby, Miner.

*CUTLER—Juneau County; 21,000 acres; $104,000; 50 miles of

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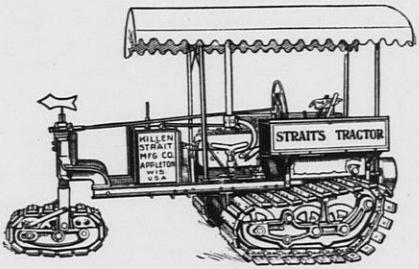


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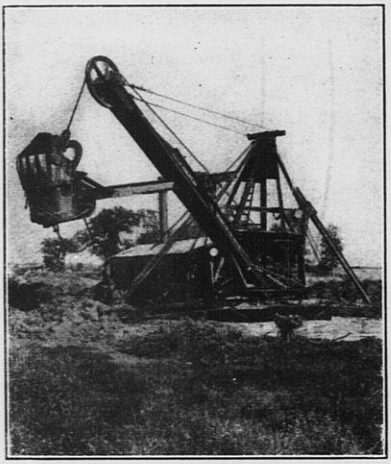

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ditch; H. H. Sherwood—Willard Temple, Mauston; F. J. De Lap, Cutler.

*Dancy—Marathon, Wood and Portage Counties; 33,000 acres; $235,000 completed; $53,000 more in progress; Geo. Knoller, Dancy; H. M. Jones, Auburndale; T. H. Hanna, Stevens Point.

Dandy Creek—Jackson and Monroe Counties; 35,000 acres; $120,000; C. P. Meltesen, Shennington; A. B. Larsen—Nels E. Olson, Tomah.

*Decatur—Green County; 1,900 acres; $23,000; A. P. Pierce—Edward McNair—T. T. Hartman, Brodhead.

Deer Creek—Outagamie County; 3,200 acres; $18,000; J. J. Sherman—Wm. Peters—Wm. Conlon, Appleton.

*Door Creek—Dane County; 3,000 acres; final plans not made; G. E. Brown, Madison; J. C. Olson—John Galvin, Cottage Grove.

*Freedom—Outagamie County; 3,400 acres; final plans not made; Thos. Flannagan, Appleton; John J. McDaniels, Kaukauna, R. 12; Joseph Jaeger, Kaukauna, R. 11.

Hoosier Creek—Racine and Kenosha Counties; 8,000 acres; $45,000; James L. English, Waterford; Chas. Choak, Kansasville; Wm. E. Tucker, Union Grove.

*Juneau County—Juneau County; 14,440 acres; $36,000; Lester Dunn; Mauston; Frank Bullis, New Lisbon.

Kert Creek—Wood County; 10,000 acres; $116,500; Anton Brost—W. H. Bowden—D. P. Gallagher, Babcock.

Koshkonong and Mud Creek—Dane County; 5,000 acres; $32,000; G. E. Brown, Madison; Nels Holman, Deerfield; Julius Cooper, Lake Mills.

Larsen—Winnebago County; 2,700 acres; $14,000; Fred Brooks—Thomas Grundy, Oshkosh.

Lemonweir—Monroe County; 12,000 acres; $25,000; W. G. Wallace, Oakdale; Chris. Wagonsen, Camp Douglas; H. J. Vinz, Tomah.

Leola—Adams and Waushara Counties; 15,000 acres; $121,000; W. H. Pratt—Wm. Smith—Alfred Walker, Plainfield.

*Lima—Rock County; 1,500 acres; $9,000; final plans not made;

C. B. Palmer, Lima; D. F. Zuill, Whitewater; Kimball Killan, Milton.

*LITTLE YELLOW—Juneau County; 55,000 acres; $300,000 completed; $120,000 in progress; 120 miles of ditch; Geo. A. McDowell, Sprague; A. C. Willard—P. C. Fredrickson, Necedah.

MARINETTE No. 1—Marinette County; 3,600 acres; $18,000; W. C. Campbell—J. M. Andrew—Ralph Skidmore, Marinette.

MEDINA—Dane County; 1,000 acres; $15,000; J. H. Auby, Madison; W. H. Tasker, Marshall; A. C. Lindas, Deerfield.

MILLERD—Waupaca County; 900 acres; $9,000; Louis Klem—John Mullarkey—E. H. Tesch, Welcome, R. F. D.

*MOUNT PLEASANT AND SOMERS—Racine and Kenosha Counties; 4,500 acres; $15,000 completed; $18,500 more contemplated. A. J. Piper—De Grove Bull—Henry W. Lewis, Racine.

NINE SPRINGS—Dane County; 1,400 acres; $13,500; G. E. Brown—G. E. Bryant, Madison.

*NORWAY AND DOVER—Racine County; 17,000 acres; $80,000 completed; $50,000 contemplated; John F. Moyle, Union Grove; J. H. Kamper, Franksville; A. R. Hulbert, Burlington, R. 22.

ORANGE—Juneau County; 8,500 acres; $25,500; Chas. Warner—Chris Mortensen, Camp Douglas; Robert Hanson, New Lisbon.

PORTAGE COUNTY—Portage County; 56,000 acres; $245,000 completed; D. H. Pratt, Plainfield; W. B. Coddington, Plover; Wm. Gaulke, Grand Rapids.

RATTLESNAKE—Dane County; 3,000 acres; $22,000; John Auby, Madison; M. Lindas, Deerfield; H. G. Clark, Cottage Grove.

RATTLESNAKE ADDITION, No. 1—Dane County; 1,500 acres; $17,000; same commissioners as Rattlesnake district.

REMINGTON—Jackson and Wood Counties; 42,000 acres; $121,000; Anton Brost—W. H. Boden—J. Q. Daniels, Babcock

*ROCKLAND—Manitowoc County; 2,000 acres; $15,000; construction not begun; W. C. Maertz—M. H. O'Dea, Reedville.

*ROOT RIVER—Racine and Kenosha Counties; 14,000 acres;

$70,000; final plans not made; Henry Pfeiffer, Union Grove; Geo. Beaumont, Kansasville; James L. English, Waterford.

*Shepard—Dane County; 4,000 acres; $27,700; W. H. Tasker—Frank Lazers, Marshall; F. G. Schernecker, Sun Prairie.

*Starkweather—Dane County; 3,000 acres; $30,500; G. E. Brown—Geo. C. Riley—A. K. Reindahl, Madison.

Stokes—Green County; 1,500 acres; $8,000; Ed Ross—Lee Bright, Brodhead; Ole P. Gaarder, Orfordville.

*Three Lakes—Oneida County; 4,000 acres; $30,000; C. G. Kuney—H. N. Aldrich—Ray Parette, Three Lakes.

*Town of Liberty—Outagamie County; 2,000 acres; $12,000; D. M. Torey, Shiocton.

Trempealeau—Trempealeau County; 6,500 acres; $75,000; Wm. Merwin, Trempealeau; Henry Roettiger, Fountain City; Ben Davis, Galesville.

*Troy—Walworth County; 4,000 acres; $60,000; C. H. Nott—Geo. B. Cain, Elkhorn; Walter E. Babcock, Honey Creek.

Turtle Creek—Walworth County; 3,300 acres; $47,000; H. D. Barnes—Charles Dunlap, Elkhorn; John Meadows, Lyons.

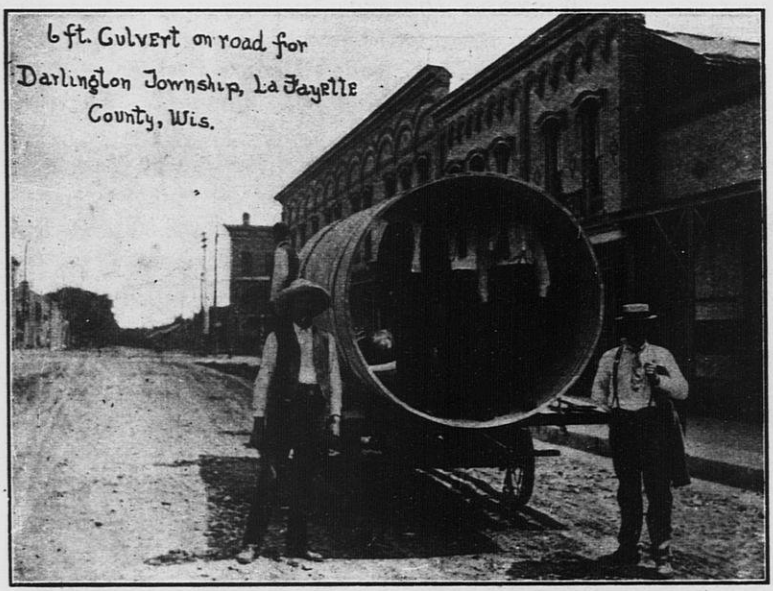
Union—Rock County; 1,175 acres; $9,550; F. M. Ames—Wallace Crocker—Gilbert Amidon, Brooklyn.

*Willow Valley—Waupaca County; 1,680 acres; $5,360; O. R. Schwantes—Albert Kuschel—Geo. W. Schlimke, Clintonville, R. 2.

*Wood County—Wood County; 5,000 acres; $35,000; B. G. Chandos—Chas. Bender, Grand Rapids—H. H. Helke, Nekoosa.

Yorkville and Raymond—Racine County; 4,250 acres; $35,000 completed; $5,000 contemplated; A. A. Fritchen—Hans Kastensen, Franksville; A. P. Nelson, Union Grove.

In these fifty drainage districts there are 480,000 acres and expenditures of $3,000,000. Probably 100,000 acres have been included in drainage districts of which no records are available or have been improved by town ditches. THERE STILL ARE OVER TWO MILLION ACRES OF MARSH LAND IN WISCONSIN THAT HAVE NEVER BEEN TOUCHED BY A DRAIN.

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| Orr, Henry | Eagle Grove, Iowa. |
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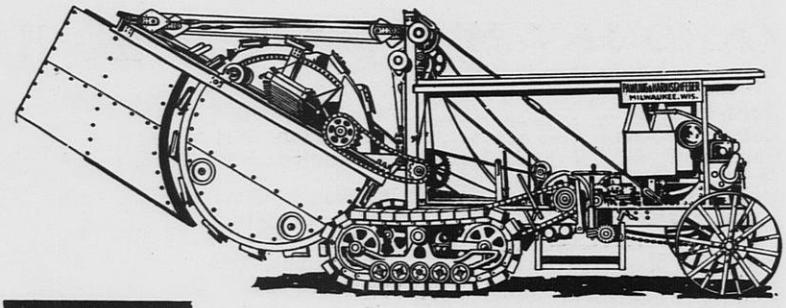

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It's not necessary in this day and age to convince land owners of the advantage of draining land that needs it. Their only problem is how to get the trenches dug and the tile laid right, and at the least expenditure of money, time and labor. If you have a "P. & H." you can solve this problem for them and have all the work you can handle.

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has plenty of power to propel itself over any kind of ground and to drive the excavating wheel through any kind of soil. It has an excavating wheel that cuts straight, smooth trenches—true to line and grade—and cuts them fast. The famous "Corduroy Grip" Traction enables it to gain a secure footing on low, soft or marshy ground. Those are the points that make "digability."

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**They Met to Talk It Over**

# FIRST MEETING OF THE
# Wisconsin State Drainage Association
## MADISON, WIS., DEC. 9-11, 1914.

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The meeting was called to order by E. R. Jones at 2 o'clock p. m., December 9, 1914, in the auditorium of Agricultural hall. Upon motion of B. M. Vaughan, Mr. Jones was made temporary chairman, and O. R. Zeasman temporary secretary. Mr. Vaughan and Mr. Coddington gave their views as to what they thought the convention could accomplish, and Dr. H. H. Sherwood recited the following history of the drainage movement in Monroe, Jackson and Juneau counties:

"During the extreme drouth of the years of 1894–5–6 the water level of the swamp lands in this locality was lowered from two or three inches above the surface to about two feet below. During this time forest fires originated which swept down over this section clearing everything in its wake. After the fires had subsided, we discovered before us a vast area clear of all stumps and grasses, resembling the plowed prairies of Illinois. As this soil had never been cultivated the question arose, was it fertile? Some of the settlers who had more faith than others seeded portions of the burned area with timothy, clover, oats, buckwheat and root crops, and in every instance they received excellent returns. Their experience encouraged others to try the following year, but the results were not so satisfactory, as the soil began to fill with water, and at the end of the third year was too wet for cultivation. As we had proved in a small way that the land was fertile, the problem before us was how to get rid of the water.

"In searching the records to determine the ownership of these lands I found that the state owned about forty thousand acres that were offered for sale for about $1.25 per acre. In my estimation, if these lands had been drained they would have been worth at least $25 per acre at that time, and if the state could

have been induced to drain these lands, the increased price it would have received for them would have repaid many times the cost of drainage.

"So in 1900 I prepared a bill which was presented to the legislature for their consideration, providing for an appropriation of $3,000 to defray the expenses of a commission of three, to be appointed by the governor, to investigate conditions in this section and to determine whether the proposition of drainage was feasible. The bill was defeated, as the state could not lawfully appropriate money for internal improvements.

"Meeting with defeat in my first efforts to secure drainage, I immediately started on an inspection trip through the drainage sections of Illinois and Iowa to learn, if possible, their methods of drainage and organizing drainage districts. At that time Wisconsin had no real drainage district laws.

"I returned with a copy of the Illinois drainage laws in my grip, and in 1901 we circulated a petition for the organization of what is now known as the Dandy Creek Drainage District, comprising about 52,000 acres, situated in Monroe, Juneau and Jackson counties. About this time our neighbors east of us started to organize what is now the Little Yellow Drainage District, of about 57,000 acres. Both of these districts were successfully organized and in 1902 issued district bonds for the payment of their work. When these bonds were offered for sale they were rejected for the reason that they were considered not legally authorized because of the weakness of our drainage laws. Steps were taken at once to put the proceedings on a firm legal foundation and the Little Yellow District, upon its attorney's advice, instituted proceedings against itself in supreme court, and it was there decided that the bonds were a legal lien against the lands in question. Upon this decision we were able to dispose of our bonds.

"By 1903 there were about eight other districts in process of organization. Part of the commissioners of the several districts held a meeting to determine what steps would be necessary to bring about the passage of adequate drainage district laws for the state of Wisconsin. It was decided at this meeting that each district should select one attorney and the attorneys so selected should meet and draft a bill and present it to the legislature for

consideration. In 1904 the attorneys selected met at the office of Judge Gaynor in Grand Rapids and drafted the bill which was enacted as chapter 419, Laws of 1905. Since this time, amendments have been passed, until today the best legal authority on drainage bonds say that Wisconsin has the best drainage law of any state in the Union. But they add: 'If you can only find all of its parts.' Our law should be published in pamphlet form.

"Referring to the matter of the earlier districts, owing to the lack of knowledge and experience and the inability to secure competent advice and counsel, and the fact that drainage had not been considered of enough importance to induce engineers to make it a special study, our efforts were, from a standpoint of today, most crude, and did not produce the benefits we expected.

"Profiting by these experiences, we are not making the same mistakes today that we made in the early days, although we may be making new ones, and in some parts of the state they may be making our old ones. Just what these mistakes are and some of the remedies for them will be brought out in the discussions that are to follow. I think it is a fine idea to get together in this way to exchange ideas on a subject on which all of us have a great deal to learn."

The program prepared for the occasion was then commenced.

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## QUALITY OF SOIL AS BASIS FOR RATING BENEFITS

A. R. Whitson
*Professor of Soils, College of Agriculture*

It has been estimated that there are approximately two and a half million acres of marsh land in Wisconsin, or approximately seven per cent of the land area. Of this about one-quarter has now been organized into drainage districts and plans are under way for its improvement. In the distribution of benefits on which the assessment of the necessary taxes is levied many factors must be taken into account. Not enough study has so far been given to this problem, and one of the most important of

these factors has been entirely overlooked—namely, that of the character of the soil itself. It is of course clearly recognized that the benefits should be determined by estimating the value of the land before and after the improvement has been made, but this has ordinarily been done on the basis of the degree of drainage and the cost to the private individual without considering the quality of the land itself. As a matter of fact there are included in the general classification of marsh lands a great variety of soils, the value and character of which we are only beginning to fully understand. Certain facts stand out clearly which should be taken into account.

The last revision of the state law on drainage specifically includes this matter and requires the college to submit a report on the quality of the soil, and the benefits it will derive from drainage, and the distribution of those benefits, as well as on the plans that are made for drainage. Unfortunately the law does not give to the college any additional funds for this work, so that it has been impossible to do it as satisfactorily or completely as could be desired. We have, in connection with the soil survey, tried to classify marsh lands in such a way as would permit taking their relative value before and after drainage into consideration in the distribution of the benefits. Very often, however, a special examination must be made.

The following provisional classification of marsh or wet lands has been made: first, wet clay loam and sand; second, marsh border soils, which must be subdivided on the basis of their lime content into those high and low in that element, to the former of which the names Clyde and the latter Dunning have been given. These soils all contain from five to fifteen per cent of organic matter; third, muck containing from fifteen to fifty per cent of organic matter and from fifty to eighty-five per cent of earthy matter; and fourth, peat containing more than fifty per cent. of organic matter. With muck should be included peat less than a foot in depth and underlaid by clay, which by working up into the surface soil will supply potash and some phosphorus.

The definition of these terms as here given differs somewhat from those in use in some sections of the country, but in the absence of any uniformity we are making this effort to establish a system which may become general in the state. Much of the

land here included under the terms Clyde and Dunning, occurring along the borders of marshes, has by some been called muck, but the black color is often deceptive, leading one to suppose it to have a much higher amount of organic matter than is really found on analysis. The term muck, on the other hand, is by many applied to marsh soils regardless of the amount of organic matter they contain, provided this organic matter is so finely divided that it does not show the structure of the vegetation from which it was originated. There is relatively little difference in the agricultural value between soils of this character which are high in organic matter and those to which all would apply the name peat, while there is a very important difference between soils that have fifty or more per cent of organic matter and those which have much less. While, of course, the fifty per cent line is more or less arbitrary, it is found to agree fairly well with important field conditions.

*Chemical composition.* The results of chemical analyses of soils can best be expressed in terms of pounds per acre to the depth of eight inches, or a little more than the ordinary plow depth. Expressed in this way we find that light-colored clay loam soils of upland in Wisconsin have shown by the analyses so far made approximately 2,500 pounds of nitrogen, 1,000 pounds of phosphorus, 40,000 pounds of potassium, and 1,500 pounds of calcium. The dark upland clay loam soils contain about 5,500 pounds of nitrogen, 1,200 pounds of phosphorus, and practically the same amount of potassium and calcium. It is true that the subsoil in the southeastern or limestone region frequently contains very much larger amounts of calcium than the figure given, but this is an average for the surface soils. In comparison with these figures we find that the Clyde and Dunning soils contain 8,000 pounds of nitrogen, 1,500 pounds of phosphorus, and 35,000 pounds of potassium, while they differ greatly in the amount of lime they contain, the Clyde having from 10,000 to 100,000 pounds, and the Dunning practically none. The muck soils, that is those containing from fifteen to fifty per cent of organic matter, average 6,500 pounds of nitrogen, 750 pounds of phosphorus, 6,500 pounds of potash, while the peats contain 10,000 pounds of nitrogen, 500 pounds of phosphorus, and from 300 to 1,200 pounds of potassium.

*Agricultural value and fertility of marsh lands.* It is distinctly recognized that a chemical analysis does not always determine the immediate fertility of the soil or that which a field will show during the first two or three years. There is, however, little question in regard to its value as a means of determining the ultimate resources of the soil, and abundant experience both in this country and Europe has demonstrated that the marked differences in the classes of soil above mentioned must be taken into account in their management. It is evident from an inspection of the figures above given that the Clyde soils are high in all essential elements of plant food and can be counted on when properly drained to show a lasting fertility. The Dunning soils have a good chemical composition in all respects except that they are acid, which in many cases must be corrected before satisfactory results can be secured. Muck soils, as defined above, are also high in most of the essential elements, though they differ also in their lime content and will show considerable variability in fertility, especially during the first few years, but when thoroughly drained can be counted on to show a good degree of fertility later on. In comparison with these, peat soils are unusually high in nitrogen, but extremely low in both phosphorus and potassium and are also usually deficient in calcium. It is true that nitrogen is the most expensive element when purchased in the form of fertilizer, but since this element is ordinarily secured on the farm through the growth of legumes, which are essential as stock feed, this element can ordinarily be neglected in upland soils so far as its purchase in fertilizer form is concerned. With reference to phosphorus and potassium, however, we must recognize that these elements are demanded by all crops and that especially phosphorus is continually being sold from the farm. The farmer on peat soils must therefore count on purchasing these in fertilizers. It is true that barnyard manure contains both phosphorus and potassium, but even in the manure itself there is too small an amount of phosphorus to balance the nitrogen, and when manure is added to the soil which is already very much unbalanced, it gives a very unsatisfactory condition for many crops. For this reason it is extremely desirable that as far as possible marsh land be farmed in connection with upland soils so that the manure on the farm be used on the upland

and that fertilizers containing these two elements be used on the peat.

Another important factor which determines the agricultural value of land is the labor necessary in its cultivation. It costs all the way from four to eight dollars per acre to prepare and cultivate different types of soil for the same crop. Those which require the larger amount of labor, other things being equal, should be given a lower value, since the differences in expense involved should be considered as the interest on a principal represented by the difference in value.

*Crop adaptation.* Another matter which must be considered in placing value on marsh lands is that of crops to which they are adapted. There are two factors concerned: first, that of the chemical character; and second, the climatic conditions. The large amount of organic matter with the corresponding high content of nitrogen in these soils makes them especially adapted to rank growing crops requiring large amounts of this element. Such crops as cabbage, corn, and potatoes are especially suited to those lands on this account.

The relation to frost conditions is quite generally known, though there is some danger of confusing two factors involved. The low temperature and tendency to frost on marsh lands is due to two things, first air drainage in which the cool, condensed air in immediate contact with soils on hillsides surrounding the marsh flows down and collects in hollows, thus producing frost conditions earlier there than on the upland. But, besides this, there is another matter to be considered. That is the fact that the light porous material of peat does not transmit the heat downward into the soil as readily as heavier sand or clay soils do, and so a much smaller amount of heat is retained, and what is retained is more quickly radiated during the night so that on this account all marsh soils have a greater tendency to frost. It is probably safe to estimate that the climatic conditions on marsh soils in Wisconsin are essentially the same as those on upland 150 miles farther north having good air drainage.

In estimating the improvement effected by drainage in these various classes of wet land we must first assign a value to each type after the drainage has been perfected to such an extent that all crops to which the soil is otherwise adapted may be

grown. While there will be difference in judgment on the relative value to place on these types of soil, we propose the following estimates: Assuming that well drained upland silt loam soils are assigned a value of 100 per cent, low wet clay or silt loam and the Clyde soils should be given a value of eighty-five per cent, muck seventy-five per cent, and peat sixty. When this relative value has been fixed in each case the cost of the drainage on each tract should be subtracted from the total benefit secured by drainage to determine the improvement effected by the drainage, or, in other words, to determine the difference between the present value of the land and the value it will have after drainage.

DISCUSSION

*Dr. Sherwood:* Do you mean that peat has a value or a productivity only sixty per cent as great as clay loam?

*Mr. Whitson:* Value. The peat may have a productivity greater than the clay loam, but the greater amount of work required on the peat to bring about that productivity reduces its value.

*Mr. Jones:* Are we to understand that the ratio of values you have given are the ratios obtaining when the loam and peat are thoroughly and equally drained?

*Mr. Whitson:* Yes. This assumes that each has perfect drainage.

*Mr. Coddington:* I agree with Professor Whitson in that a chemical analysis is a good index to the value of a marsh soil, but I do not agree with him in the general values he places on drained marsh lands. I want to know the basis of his values.

*Mr. Whitson:* That is too big a question to take up with the limited time we have this afternoon. I suggest that the last session of this convention be devoted to a discussion of marsh land values.

## THE DRAINAGE ENGINEER

GEORGE M. WARREN
*Drainage Investigations, U. S. Department of Agriculture.*

The message I bring you today is along somewhat different lines from the usual optimistic treatment of drainage topics. I shall find fault, but the purpose is that it may help to better work.

Nearly twenty-five years ago a friend of mine for whom I was doing some engineering work said to me: "Engineering is nothing but judicious averaging." Now, I like to think that civil engineering is something more than "judicious averaging" and believe that it is.

In the last few years it has been my privilege to look with more or less care into the history, the costs, and the physical conditions of a considerable number of drainage districts.

The history of the average drainage districts runs about as follows:

A few earnest landowners enlist the services of a surveyor, a civil engineer or an attorney in a proposed reclamation project. Not infrequently some of these professional gentlemen have already canvassed the situation and "nursed up" a fairly favorable sentiment for drainage, or in other words, they have virtually acted the part of promoters. A survey of the lands is made, levels run, the benefits estimated, the cost of the work estimated, the annual maintenance cost guessed at, plans and a report prepared, and the proper legal authority petitioned for the organization of a drainage district. Often the petitioners meet with much opposition from disaffected landowners, entailing heavy legal and court costs, but in the end the district is quite generally established with minor changes. Commissioners are appointed, an assessment equal to the surveyor's or the engineer's estimate of cost is spread, contracts awarded and the construction work begun. Most frequently, before the work as planned and specified is completed, it is found that the cost was underestimated, and that it will be necessary to spread one or two additional assessments and perhaps expend the maintenance

fund, if one has been raised, to complete the work intended to be done.

Nor is this all. The lapse of a very few years is likely to develop defects in various parts of the reclamation. The bottoms of the ditches are found to be higher and the tops of levees lower than anticipated, and possibly the pumping station unfortunately located and poorly built and the whole scheme of drainage less perfect than expected.

With completion of the first construction work, the services of the engineer are terminated. The funds of the district having been exhausted, but small effort is made to keep the system in repair. The ditches especially are neglected, for their integrity, unlike that of levee, sluice or pumping plant, is not absolutely necessary to securing a certain degree of drainage. In the course of eight or ten years, and in less time if there be much hill water entering the district, the reclamation has ceased to be a "going affair." In this condition it may continue indefinitely, or, as is frequently the case, another assessment is spread to clean out and deepen the ditches, raise the levee, overhaul or rebuild the pumping plant, or perhaps lay large sized tile beneath many of the open ditches.

You will think this a discouraging view and yet it is a fair presentation of the facts to be observed throughout much of the middle west, the east and the maritime provinces.

What is the remedy? It seems certain to me that the highest professional skill of engineers and lawyers and the best business judgment of drainage commissioners will never be able to bring forth the ideal conditions and successes we are looking for in farm drainage work. That a big advance can be made seems equally certain, and I believe it is being made now day by day, but it should be hastened in every way possible. The rate of advance in farm drainage is in no way comparable to the rapid advance which has been made in mechanical appliances and most other lines of human development. The faults lie all along the line, with surveyors, engineers, lawyers, contractors, commissioners and upon nature itself. Some of these faults I shall point out.

A large percentage of the engineers engaged in farm drainage work in the middle west have been developed from the land sur-

veyors of this new country and their schooling has been largely in the school of experience. While experience in the end is usually a pretty thorough teacher, it is also a very expensive one. Landowners have in so many instances been unable to distinguish between the work of surveyors and of civil engineers. Usually the surveyor or measurer of land was nearer at hand and would work for a smaller wage. In the nature of things the land surveyor was not accustomed and qualified to design hydraulic constructions and he lacked constructive experience and ability. That he could measure land, set grades, would work for a small wage, and that water would run down hill, was generally sufficient for most landowners and their legal advisers as well. I want to quote to you the words of the head of a large law firm in a neighboring state, a firm which has done the legal work for fifteen or more drainage districts and has successfully fought cases before the supreme court of the United States. Said this lawyer: "All I want of an engineer is to set the grades. I don't take much stock in the theoretical knowledge engineers get out of books. I would rather have the opinion of three or four hard headed contractors, men of experience, as to the size of a tile or ditch needed to drain a particular watershed."

Clearly it needs no argument to show that this attorney was in the wrong and his objects in pursuing such a policy will have to be left to your own inference. It was apparent that his law business was not conducted in that way, for his library was large and particularly well stocked with decisions and law books.

It should need no argument to show that progress in drainage as in other things is in proportion to the thorough, systematic study, thought and investigation which can be brought to bear on the subject, coupled with scientific design, and the constructive experience and ability to honestly work out that design in the field.

We need more engineers in farm drainage work who are well grounded in mathematics, experienced in gathering hydraulic data, accustomed to preparing in a scientific manner competent plans from the data obtained, and finally, who have better constructive ability in the matter of ditches, sluices, levees, pumping stations, tile outlets and minor appurtenances.

Among the engineering faults which I have seen may be men-

tioned the following, and yet it is only fair to say that in numerous instances it is probable that the short-sighted policy of commissioners in financial matters is quite as much to blame:

(1) Formulating plans upon too scanty information regarding the extent of the watershed involved or of the behavior of the present or prospective flow which may come from it. This is a difficult and yet vital line of inquiry, involving measurements of run-off, flood discharges, and sedimentation and filling up of the ditches of a district from hill streams.

(2) Building levees or pumping stations without adequate test borings to determine the character of the subsoil and its suitability for foundation purposes. The result is stretches of sunken levee and undermined walls and foundations.

(3) The building of ditches and tile lines too small and too shallow. In many districts we find that at first ditches were dug with teams and scrapers, and were made two or three feet deep and with wide tops and flat slopes. In the course of time it was found that these ditches were ineffective, and would have to be cleaned out or deepened by dredge or other machinery. Measurements which I have made in a number of districts in central Illinois this season show that often these dredged ditches will fill up one to three feet in a few years, about a foot being the siltage the first year, and probably a large part of that within a few weeks. Ordinary grades in ditches appear to be a small factor in their maintenance. Wherever, with grades up to six or seven feet per mile and the late summer and fall flow is small or disappears altogether, there will be found a rank growth of vegetation, a condition most favorable to the retention of silt and debris which may get into the ditch. Under such conditions there is almost invariably a more or less rapid deterioration of the ditch, and in the end, so far as possible, the open ditches are replaced by tile, a construction which in many cases should have been used in the first place.

How large tile may be used to arrive at a minimum cost in one or two generations is a matter of varying opinion. I suspect we shall find that very large tile will be warranted when a balance has been struck between cost of tile and laying, on one hand, and on the other hand, the cost of open ditches, plus adequate maintenance costs capitalized, plus the inevitable loss in

cultivating land and in crops where open ditches are used. One of the most experienced engineers in farm drainage in this country says: "Wherever a ditch with an eight-foot base will take the flow, use tile."

In this way only can the troublesome and expensive questions of siltage, caving banks, and maintenance be satisfactorily disposed of. The cost of cleaning out ditches has varied from fifteen to fifty and even sixty cents per cubic yard, depending upon the depth and quantity of the deposit. Later the Department of Agriculture hopes to have some reliable data on ditch siltage and maintenance costs for publication. It is a very important subject and one which should have engaged the attention of engineers and landowners more than it has.

(4) Another fault of drainage engineers is underestimating costs. This is bad practice and is not doing right by your clients, yet it is being done right along in two districts out of three. I have heard both engineers and lawyers defend the practice, saying virtually, that it was necessary in order to keep their business going, or that they knew drainage was a good thing for the landowners, and by keeping estimates down, they, the landowners, were more easily induced to "come in," and having once embarked and seen the benefits of drainage would then gladly support it. Such engineer or lawyer is to all intents and purposes a promoter, and he is not treating squarely the man who puts his hands in his pockets and pays the bills. The landowner is entitled to an honest estimate of cost. If the plans must be changed and the cost curtailed, that is surely the privilege of those who pay for the work, but the responsibility should be placed where it belongs and not assumed by the engineer by underestimating. Aside from the moral aspects of the matter, underestimating leads to dissatisfaction all around. Contracts are terminated and vital parts of work left undone or completed by inexperienced hands upon borrowed money or by using the maintenance fund, which should be reserved for maintenance alone.

Why not provide a surplus at the start? In every reclamation project there are sure to be unforeseen costs.

(5) Another and serious error has been the inability of some engineers to secure first class construction work from drainage

contractors. While it is recognized that the excavation of a semi-fluid material can never proceed upon exact lines, there is ample evidence that ditches have been accepted and paid for that were not down to grade. Material has fallen in from the banks, and temporary dams placed in ditches by contractors for purposes of floating their dredges have been allowed to remain in the ditches on the contractor's plea that they would "wash out at the first rain." And finally, that serious defects in pumping station construction or equipment crept in as is evidenced by an examination of the vouchers for repairs and renewals soon after the completion of some of these plants.

(6) There should be effort on the part of drainage engineers to clarify their specifications and omit such provisions as apparently it is not intended to live up to and enforce. The specifications should be drawn not with a view to earning a wage in rewriting some stock clauses, but to secure good material and workmanship in the construction work, which is the end sought.

(7) Finally, the engineer must be accurate in his field work, and as far as possible apply scientific methods to his investigations and deductions. The boundaries of a district must be absolute, and the ditches as staked on the ground must not deviate substantially from what is shown on the plans. Material deviation has frequentlly been the cause of invalidating assessments and occasionally of "knocking out" a whole district.

Run-off from different watersheds and the proper coefficients of roughness in drainage ditches and in title drains need to be more fully understood. In some instances I have noted that surveyors are designing tile drainage systems on the basis of the tables given by tile manufacturers on the last page or two of their catalogues. This may give fair results, but a more scientific method of design should be employed.

This reminds me of an instance ten or fifteen years ago in northern New England, where a board of water commissioners decided to save themselves an engineer's salary in the construction of a system of water supply. The commissioners went straight to the manufacturers of cast-iron pipe and purchased nine miles of it. Later it developed that the pipe was unnecessarily strong and heavy, and that the commissioners had unwittingly purchased many tons of cast-iron pipe at perhaps $25 per

ton. Moreover, the manufacturers saw to it that a large number of pipe having cracked spigot-ends reached the job, and these defective ends had of course to be cut off, a loss both of pipe and in labor of cutting. As I remember now, the efforts of the commissioners to do their own engineering work resulted in a loss of $3,000 or $4,000 on the item of cast-iron pipe alone.

And now for a few random suggestions and comments in conclusion. The duties of drainage commissioner are defined by law. His work is mainly confined to the business ends. This is as it should be. He should not attempt the supervision or even inspection required in construction work, for he is not usually qualified. Neither should the commissioner go over the head of the engineer and decide matters with the contractor and contrary to the advice of the engineer. Such course undermines the usefulness of the engineer. If the latter is not competent, dismiss him and get one who is. Do not, except for exceedingly good reasons, go over his head.

Look well to outlets. Whether tile or open ditch, outlets are one of the most important features of drainage work. I have seen hundreds of tile outlets, but only a comparatively few well placed and properly constructed. Often a concrete retaining wall would be placed high upon the slope of an open ditch, would be too thin and light or too short, or the foundation not deep enough. The result in so many cases was that the light, thin wall was pushed bodily into the main ditch, the short, straight wall was ineffective because the water ran around the ends, while the wall of shallow depth was undermined by water getting behind it and coming out beneath it, after which it cracked by its own weight vertically through the middle and the two pieces fell into the ditch.

Figure 1 is intended to show how not to build a tile outlet protection and also the importance of actual engineering inspection even in the small things of drainage construction. The wall was concrete, was placed by stealth on the part of the contractor and was finished off with a heavy two-foot top. With a neat face, massive top and all back filling completed, the commissioners were deceived into thinking a two-foot wall or stronger extended the whole depth. Note the meagre dimensions, six inches, below the top. The contractor was paid for double the

quantity of concrete put in place. This wall was damaged by blasting in the vicinity and subsequently was washed into the ditch.

Do not fail to place a wire or bar screen over all tile outlets. It costs but little and may avoid a great deal of trouble, for all sorts of small animals, both tame and wild, get in and

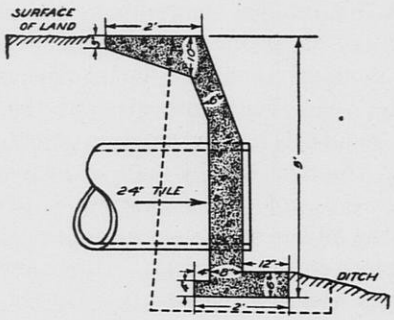


FIG. 1.—*A deceptive concrete wall. The dotted line indicates a better design.*

obstruct tile lines. Just a single illustration: A dog was chasing a rabbit and some boys were following the dog. The rabbit darted into a tile line and proceeded up to a point where he could go no further and was temporarily safe. The dog went as far as he could, but of course not as far up as the rabbit. The boys located the dog by his barking, and digging down and removing a few tile, rescued him. It is almost needless to say that the boys didn't relay the tile to line and grade, but tumbled it and the dirt back into the hole. The result was a stoppage there, and the carcass of the rabbit created another.

Plow back all spoil banks along open ditches and cultivate the land right up to the edge of the ditch. A spoil bank covered with weeds is a haunt for much insect life which practically destroys a ten or fifteen foot strip of whatever useful crop may be alongside. Contrary to general impression and teaching, my observation and measurements on siltage in open ditches indicates that it is better to pasture the lands, banks, slopes and bottom of open ditches, especially if they run nearly dry in the summer and fall, rather than to fence off the ditches and keep stock out and allow vegetation to grow unchecked. I am not at all convinced that it is not better to pasture with hogs rather

than allow a free growth of vegetation in the ditches. The latter is the great evil everywhere.

My conclusion will present a more cheerful view. While the construction and maintenance of drainage works leaves much to be desired, it is a cause for congratulation that there is so little debt amongst districts. Out of 321 drainage districts in Illinois which reported some time since as to their debt, but sixty-eight, or twenty-one per cent had any bonded indebtedness, certainly a very creditable showing. I would like to present this thought and possibly bring out some discussion upon it. If only twenty-one per cent of our railroads had any bonded indebtedness where would be our present remarkable transportation development? Are railroads any better security or more vital to human needs than land, in the aggregate? Are drainage districts about to organize not warranted, therefore, in building in a larger and better way, spending more for up-keep, and if necessary incurring a larger indebtedness in order to secure the better drainage and the larger results?

DISCUSSION

*Mr. Jones:* A drainage engineer is one who designs a drainage structure on the basis of drainage measurements made in the field. But while he is making those measurements in the field he is a surveyor. To be sure, he is something more than a land surveyor. He measures or studies not only the area, but also the fall and the drainage properties of the soil and the surroundings, but until he begins to design the drains he is a surveyor. For distinction let us call him a drainage surveyor. His first requisite is the ability to recognize the features of an area that ought to be investigated or measured, and the extent to which those investigations or measurements should be made and recorded in order to serve their purpose. I believe that the first purpose of a drainage survey is to determine the general feasibility and advisability of the project and its probable cost, and I agree with Mr. Warren that the estimate of cost should be liberal, and that the size of the drains should be scientifically computed. But I believe that there is a place for a preliminary survey and a final survey—the preliminary survey to give the

landowners a basis for deciding intelligently whether or not they care to proceed with the project, and the final survey to determine whether the preliminary location can be improved, and to establish grade lines and locations as guides for the commissioners in the just assessment of benefits, and for the contractor in the faithful performance of his work. Assuming that this distinction between the preliminary and final surveys is correct,

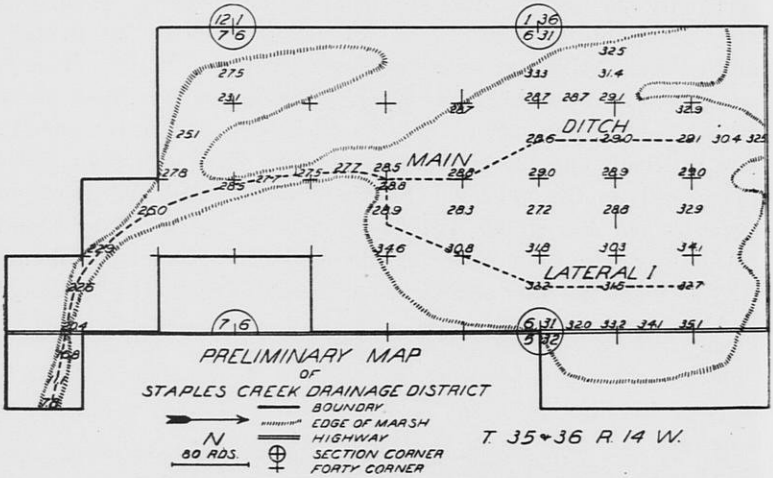


FIG. 2.—*A preliminary topographic sketch.*

Mr. Warren, how would you proceed with the preliminary survey?

*Mr. Warren:* I would use the transit and stadia method. In this way I could run levels and at the same time read the distance and direction of the points observed.

*Mr. Jones:* In using this method you can save time by running only a magnetic traverse. But where almost every forty-line is marked by a fence, you can save still more time by making the preliminary map in the field book, reading only elevations with the instrument and locating points on the map by pacing or estimating distances and directions from known forty-corners.

*Mr. Owen:* To what scale do you make the preliminary map?

*Mr. Jones:* One inch to eighty rods. It is not best to encumber the preliminary map with unnecessary size. Frequently township plats with a scale of two inches to the mile are most

convenient and sufficiently accurate. For the preliminary profiles a horizontal scale of five inches to the mile and a vertical scale of five feet to the inch is a convenient one. The profile I am exhibiting (Figure 2) is worth more for preliminary purposes than one that I have in my office with a longitudinal scale of forty feet to the inch, requiring over ten feet of profile paper to show a mile of ditch. The ridiculous feature was that the ditch was only three feet deep. I am glad the landowners did not waste money putting in an open ditch so shallow, but am

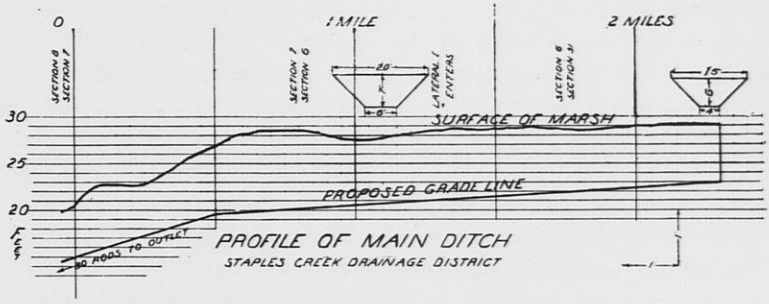


FIG. 3.—*A preliminary profile sufficient in details.*

sorry they wasted so much good profile paper. That engineer wasted his people's money by his poor judgment as to the amount of detail a preliminary profile should show. A slight change in the final location of the ditch will alter that preliminary profile so that it will have to be replotted if the same standard of accuracy is to be maintained. Our engineers generally have used too much time in making pretty preliminary maps and profiles, and have not been careful enough in the final survey and in furnishing the contractor with specifications and in holding him up to the scratch. Mr. Hintze, will you tell us how you mark the final location of the drain and how you establish and check up the grades?

*Mr. Hintze:* In my work on different districts different material has been used, but substantially the same methods. In the Koshkonong-Mud Creek District our main ditches were laid out with 2″ x 4″ for stakes on the center line of ditch and pounded down to within two feet or less of the ground. On tangents

they were set every 200 feet, and on curves generally 100 feet apart. Such stakes were necessary because of the floating ice in the spring of the year, which would have destroyed less substantial ones. This work was done in the winter time on the ice. Levels were not taken until spring. The levels were taken at top and bottom of each stake.

In the Nine Spring District and others we used 1" x 1¾" stakes, but the same methods pursued as in the Koshkonong District.

When running on section lines or sub-division lines at every forty line the corners were moved to an offset either north, east, south or west, depending on the direction and the size of the ditch. When running elsewhere than on section lines, measurements to nearest corners were obtained.

In taking levels and checking up the grades a bench mark was left in such a position that one set-up of the level would bring the elevation to the edge of the ditch or to the water level in the ditch. Then the water level was used as a datum plane for checking up the depths until the next bench mark was reached. These bench marks were left, generally, approximately one-fourth mile apart, but never greater than one-half mile apart. When our bench marks were disturbed by the removal of a bridge we transfered our reference to some point on the bridge which would allow a direct measurement to the water and bottom at that point.

I have tried running the stakes on an offset, but find that the contractors object to this; and have also set hubs in the marsh for bench marks to check up on, but I find that after one winter season they heave and render my elevations worthless.

Upon motion an adjournment was taken to 7:30 p. m.

## WEDNESDAY EVENING SESSION

The convention was called to order by the temporary chairman. B. M. Vaughn and Nye Jordan, as the committee on permanent organization, submitted a copy of the constitution and by-laws, which was read and adopted. Dr. H. H. Sherwood and W. B. Coddington were nominated for president. Mr. Sherwood was elected on the first ballot. The new president was called to the chair.

*Dr. Sherwood:* Gentlemen, I thank you for the honor you have conferred upon me by electing me to be the first president of the Wisconsin State Drainage Association. I shall do everything in my power, with your co-operation, to make the organization a potent factor in improving our drainage conditions, methods and practices.

Moved and carried that the secretary cast a unanimous ballot for W. B. Coddington as vice-president for the ensuing year.

A. C. Willard was elected treasurer and E. R. Jones secretary. The program of the evening followed.

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## BENEFIT ASSESSMENTS TO HIGHWAYS IN DRAINAGE DISTRICTS

A. R. Hirst
*State Highway Engineer, Madison, Wis.*

I don't happen to be aware of any more difficult problem than that of the determination of the benefits to highways due to the running across or along them of drainage ditches. I protested very strongly when assigned to this topic, alleging that I knew nothing of value about this matter, which you will discover is the truth as I proceed.

We have never happened to run across this problem in the construction of our many hundred miles of road. We have, of course, properly drained, and in many cases have had to dig drainage ditches to properly drain, our roads. In doing this, however, we simply figure that we must have the drainage in or-

der to properly construct and maintain the road, and do not figure the monetary value to the road of the drainage, except broadly that the road improvement will stand up and be effective if the drainage is put in, while most assuredly it would not if drainage were not provided for.

As I see it, the determination as to the actual financial value of the drainage of a certain road depends upon several factors, roughly as follows: (1) The prospective travel on the road after the improvement is made; (2) the increased tonnage per load which the road would be able to bear after improvement; (3) the decreased maintenance due to the improvement.

The capitalization of the last two factors marks probably the value of the drainage improvement to the road in question. The difficulty is in ascertaining the sum saved per year which capitalized at five per cent. (five per cent., inasmuch as public money can ordinarily be borrowed for this interest), equals the gross value of the improvement. Obviously, given a road which is a bad one for portions of the year, an impassable one for other portions, and convert it into one easily passable at all seasons of the year, a great benefit is conferred upon the community. The value of this benefit depends entirely upon the amount of travel using the road, and its character. If the travel is light, obviously, even if the road is tremendously benefited as a road structure, the benefit to the public may be small. Before proceeding further with the discussion, it might be well to consider briefly hauling costs.

The United States office of public roads at one time made very detailed inquiries as to the cost of hauling in the United States at various seasons of the year, and determined to their own satisfaction, at least, that the average cost per ton per mile in the United States was 25 cents. Very unfortunately, the conclusions drawn by the tabulators of these figures may be very seriously attacked, (1) because they got figures from all over the country, meager figures from some states, rather full figures from others; then took the state averages, added them together, divided by the number of states and used that as the cost of hauling in the United States. Certainly, if the figure in New York, for instance, was 20 cents a mile, and in Colorado was 50 cents, the average cost is not 35 cents for the two states, inasmuch as

the tons hauled in New York are infinitely greater than in Colorado. (2) A second mistake was made in assuming a fixed value for the time of men and teams occupied in this hauling. The ordinary farmer keeps only the horses required for farm purposes, and very seldom is an extra horse kept for hauling purposes; therefore, whether any hauling is done or not, his team cost may be practically the same per year, and it is hardly proper to say that these horses are worth the commercial rates for the occasional hauling they may do.

It is scarcely necessary to prolong this discussion except to bring out the main point that the cost per ton per mile for hauling over county roads has never been really determined. Our idea is that the average hauling cost in Wisconsin is considerably less than 25 cents a mile for farmers' hauling. This cost varies with the seasons; after freezing up, hauling on all roads is practically identical, no matter what the condition of certain of them during other seasons of the year. During the spring the loads vary tremendously with the character of the road, during the summer very little, and during the fall very little.

My idea as to figuring the value of drainage as far as decreased hauling costs are concerned would be to take the natural traffic tributary to the road to be improved, estimate the tonnage which would naturally pass over this road, and the average cost per ton under present conditions of doing this hauling. Then estimate the load which could assuredly be hauled over the road after the drainage ditch is in. The ratio of this load to the old road would be the ratio of the new hauling cost to the old. For example, if under the old conditions, a ton on the average could be hauled at a cost of 50 cents, and under the new conditions a ton and three quarters could be hauled, the saving per ton would be twenty-two cents, multiplied by the tonnage probably to be hauled would give a certain amount, which capitalized at five per cent. would be the value to the community of the saving in hauling.

The second factor, that of decrease in maintenance, is another that deserves consideration. Probably the only way to estimate this would be to take the cost per mile for maintaining the road in question and the cost of maintenance for a series of years of other well drained roads in the vicinity, bearing

about the same amount of traffic. The difference in these maintenance costs per mile per year would be an additional sum which it would be fair to capitalize at five per cent. as the value to the community of saving in maintenance each year.

These two sums taken together, we believe, would be very closely the value to the community of proper drainage of the road. There are other intangible factors, plainly benefits, which it is practically impossible to capitalize. For instance, an ill-drained road might be a breeding place for mosquitoes, or stagnant pools occur which with the washing from the road might be breeders of disease; the decreased time consumed in passing over the road when in good condition over that consumed in passing over the road in its present condition might be capitalized. The saving in wear and tear on vehicles, on harness, and automobiles due to an improved condition might be capitalized. In certain places where during the spring the drainage conditions were so bad that a long detour had to be made to enable traffic to get from place to place, the difference in hauling or travel cost due to the shorter travel might be capitalized.

There is probably nothing more intangible or more difficult to figure than the actual monetary value of a road improvement of any kind. We know that they are economically worth while, for a multitude of reasons, but to calmly sit down and figure out just how much worth while they are in dollars and cents is an almost impossible proposition. As a matter of fact, the value of any road improvement lies, of course, largely in the saving in hauling cost and convenience to the community, but the factors of increased convenience and comfort, the benefit of increased ease of mixing and visiting, and the moral effect of a good thing where a bad one previously existed are absolutely incapable of precise figuring.

It has been suggested that it might be possible to figure out the value of a drainage ditch to a road on the basis that, given a road of a certain width, and the fact that the water level is lowered say three feet, the value of the drainage ditch to the road is therefore equal to the cost of placing an amount of filling equal to the cubic yardage of road bed made dry where it was previously wet. For instance, given a road bed eighteen

feet wide on which the water level has been reduced three feet, thus making two cubic yards of dirt dry to the linear foot, it would be assumed that the drainage ditch was equivalent to a filling of three feet, or 5280 cubic yards to the half mile, and if this dirt was estimated to cost fifty cents a cubic yard, the benefit to the road of the drainage ditch would be $2,640 for the half mile.

We do not believe that this method of reasoning is advisable for several reasons: (1) The present road might not need this much fill to make it entirely adequate to the conditions; (2) While the road might need this much fill and be improved by it, traffic on it, either present or prospective, would not justify this cost to the community improving it.

If this idea was modified by taking the amount of dirt which would have to be hauled in to produce a good road at this point adequate for the travel, and charge the cost of placing this amount against the public, it would probably be fair. This last statement, however, would have to be modified by consideration of the possibility of the unit of government draining the road adequately by its own ditches, and if this cost of draining, plus the necessary grading in addition, was less than the cost of the filling without draining, the public could of course dig the ditch, and that would be the measure of the value of the drainage ditch.

I think I have said enough to indicate what I intended to indicate, and that is that it is practically impossible to determine the benefits to a highway due to the fact that a drainage ditch is dug, and that the amount of this benefit depends largely upon the saving in hauling costs to the community; upon the prospective travel over the road; and upon the saving in maintenance cost. If I were a drainage commissioner, I would try to capitalize this saving in hauling and this saving in maintenance, add a reasonable amount for the intangible benefits to the public in increased comfort and convenience, and call that sum the benefit to the road, and be prepared to go on the stand to defend it, firm in the conviction that very probably the town board could formulate no better basis of figuring to offset the decision of the drainage commissioners.

DISCUSSION.

*Dr. Sherwood:* If a new state highway costs $1,400 for eighty rods and we build a new road just as good as the state road at the side of one of our ditches out of the clay from the spoil bank, are we not benefiting that road to the extent of $1,400 for eighty rods?

*Mr. Hirst:* Not unless the traffic on the new road is sufficient to warrant such an expenditure.

*Dr. Sherwood:* In the Cutler Drainage District we built twenty-five miles of new road on section lines out of the spoil banks of our ditches. We assessed the town $30,000 for benefits or about $5,000 for construction. Was it worth it?

*Mr. Hirst:* It depends upon the amount of use that will be made of those roads. Yours is an odd case. You changed the entire road system of the town.

*Dr. Sherwood:* It needed changing. They didn't have any roads at all until we made them.

*Mr. Vaughan:* I think the town should be assessed for the probable value of roads yet to be built. I have found from the examination of maps of flat areas in Iowa, Illinois and Indiana that there are roads on nearly every section line and the total length of road is little more than a mile for every mile of section line. If this is the ultimate condition, these proposed roads yet to be built should be assessed. The town can build these roads from one-third to one-half cheaper on the waste banks of drainage ditches than in other places if the soil of the spoil bank is adapted to road building.

Roads will undoubtedly have to be built on those twenty-five miles of section lines that Dr. Sherwood mentioned and the town can be assessed properly.

*Mr. Matheson:* Would not the court say that this is speculative in character?

*Mr. Vaughan:* It is no more speculative than the benefit against any acre of land in the district. I used the average of roads on areas that were once marsh.

*Mr. Matheson:* Suppose a town had a strip of bad highway in a marsh, and the town said, "we don't want drainage" even when you drained it. Is their position sound?

*Mr. Vaughan:* No more sound than the objection of a land owner to having his land drained.

*Mr. Matheson:* I concede the justice of your position, but the court is apt to hold that since the land is there and the roads are not, the two cases are not parallel.

*Mr. Jones:* I plead guilty to suggesting to Mr. Hirst that benefits to highways be computed on the basis of the yardage of new and necessary drained soil in the road bed obtained by lowering the water table, and I believe that it is necessary that the water in the ditches at the side of the road be at least four feet below the surface of the road. If the water is already that low more drainage is probably not necessary and would not constitute a benefit. Or if the town can dig, at a small expense, its own ditch to serve as an adequate outlet for the road ditches it should profit by the fortunate topography that makes such cheap drainage possible and to that extent should go untaxed. Remember, however, that when Mr. Hirst computes the benefits on the yardage basis to be $2,640 for half a mile of road, the tax will be only twenty or thirty per cent. of that—perhaps $600, depending on the ratio of cost to benefits. That is not an unreasonable tax for a half mile of useful road.

*Mr. Lee:* When should this assessment be made against the town?

*Mr. Vaughan:* At the same time that other assessments are made in the organization. If done later it is more expensive.

*Mr. Lee:* If a town has been omitted and later it is evident that there is a great benefit to highways how can you assess the town?

*Mr. Vaughan:* You can reassess the entire district after five years. You can also get them under a supplemental assessment at any time.

*Mr. Ames:* What can a man do for redress if he has been assessed for good drainage and has not been given good drainage?

*Mr. Vaughan:* There is no redress or refund because the original assessment was made and bonds were sold on that basis. The man can, however, insist upon drainage and compel the commissioners to give him an outlet.

*Mr. English:* Suppose a road is built for only three people. Should the town pay for the road?

*Mr. Hirst:* The town pays for it because the entire public has the privilege of using it.

*Mr. English:* Assume that a road across a marsh that is used for only one settler is dangerous to travel. Drainage would remedy this condition and yet you say that the town should be assessed only for tonnage and not for the removal of the unusual risk to life for which the town is responsible?

*Mr. Hirst:* The town should be assessed only on basis of traffic and not for removal of risk.

*Mr. Vaughan:* The removal of the risk constitutes a benefit to the town and it should pay for it just as we pay for fire insurance on our houses. It seems to me also, that when talking about capitalizing on increased tonnage basis, one is on questionable and dangerous ground because much tonnage comes from outside of town, and tangible proof of actual benefit could probably not be presented to the court. Upkeep and some of the construction cost could be taxed against the town, as these two are clear and will be upheld in the courts. There are other intangible factors. Public health should be considered in assessments but definite data cannot be procured as they can in the upkeep and cost of construction.

In this connection I will read a paper written by Judge J. A. Gaynor of Grand Rapids:

When a town drain is laid out, it is often very difficult for the supervisors to say how much should be assessed against the town for benefits. They can form a judgment as to how much will be added to the value of a farm by reason of the drainage, but public highways have no saleable value, and the standard used for estimating benefits on a farm will not apply in the case of highways.

The supervisors of the town of Grant in Portage county laid out a drainage in that town, and after assessing the lands in the drainage area for benefits, they called a meeting of the electors to assist them in determining the amount of benefits that should be assessed against the town on account of the proposed drainage. It was admitted by those outside the drainage area that they would be benefited by the drainage, although

they insisted the benefits would be less than was claimed by those residing in the drainage area.

After the matter had been discussed pro and con at some length, I was called upon to suggest some basis for a solution. It was admitted that two miles of public highway were already built in the drainage district, and it cost the town to maintain this highway about twice as much per mile as it did to maintain highways outside of the marsh. We then called upon the clerk, who had a very full account of all town expenses, to give us the amount of money spent on repair of public highways of that town during the past ten years, and after some figuring and estimating, it was generally admitted that the town spent at least $60 for the annual maintenance of the two miles of road in the marsh more than it would have to spend after the land was drained. In short, it was admitted that the annual expenses of the town by reason of the drainage would be $60 a year less as far as these two miles of highway were concerned.

I then submitted to the electors present that anything that would save the town an expense of $60 a year was as good as a bond that would yield to the town $60 a year, and when money is worth six per cent. per annum, a bond that would yield the town $60 a year would be worth $1,000.

The last part of this solution did not appear clear to all of them at first, but some of them saw it, and after some discussion among themselves, they agreed as to this item of benefit.

But there was half a mile of public highway laid out across this district that was not yet constructed. It was conceded that it would cost $5.00 a rod to construct this highway across the marsh land before being drained, and that after it was drained, as good a highway could be constructed at $2.50 a rod. In short, the town would be saved $2.50 a rod for 160 rods, or $400 in the construction of its proposed highway by reason of the drainage. So the sum, $1,400 was assessed against the town on account of benefits to the highways. The drainage district agreed to assume the expenses of building the bridges required, and the specifications called for standard bridges.

There was another question that came up. It was admitted that other highways might be laid out in the future across this drainage district and the town would derive further benefits on

account of the drainage, but the extent and location of these highways was so uncertain that it was agreed on both sides that that matter should be dropped out of consideration, and a smile of satisfaction passed over the faces of the supervisors and electors. They seemed to think that the solution of the problem that had puzzled them so much was nearly fair, and the supervisors felt very much relieved.

The above figures are not exact, but they illustrate correctly how this problem was solved in the town of Grant to the satisfaction of the supervisors and the electors.

*Mr. Coddington:* Who would be wrong if drainage districts taxed towns on basis of difference in cost of construction and maintenance of highways with and without drainage? Mr. Vaughan, Judge Gaynor and Mr. Jones have arguments for special assessments that I like to support. Roads in our country when we had no drainage cost $1.50 to $2.00 a rod and they had to be made over every five years. Now with drainage we build equally good roads that last longer for 75 cents a rod. In this district we have at least 100 miles of roads that are not laid out but will be built in the future. We assessed these proposed roads. This district spent $17,000 and was three years in court before a single shovel full of dirt was handled. We were overruled in our special assessment against the roads. Now the farmer is forced to give the land for a road and pay $5.62 an acre for the drainage of it. Furthermore a railroad has eleven miles of road through the district. Before drainage they had orders not to exceed a speed of ten miles an hour. Now they have no speed limit yet they are assessed only $5.62 an acre of right-of-way. The basis is not equitable.

*Mr. Sherwood:* This is a good time for the discussion of railroad assessments.

## AGRICULLTURAL DRAINAGE AND ITS EFFECT ON RAILWAYS

L. F. Van Hagan
*Professor of Railway Engineering, University of Wisconsin.*

As an introduction to my subject, I might state that it is one about which the *opinion of railway engineers has not crystallized.* The roadway committee of the American Railway Engineering Association had the subject under consideration for several years without being able to reach any definite conclusions. There are, of course, plenty of opinions about this matter among individual railway men. There is *a lack of definite facts however;* so that these opinions cannot be based upon sure foundations and must be accepted as opinions only. There are reasons for this condition. Up to this time the matter of agricultural drainage assessment has been a minor one with most railways. With a few railways the subject is one of considerable importance as I will explain later; but in the case of these roads the situation is such that they are anxious to have the schemes for drainage carried to success and do not want to quibble about their own share of the expense. Therefore they have not taken the trouble to gather the mass of facts and figures necessary to determine the exact amount of benefits they receive from the projects. At least one of the roads has a drainage engineer who has gathered some data of value; but what he has collected is not more than a fraction of what will be required ultimately if the matter is to be settled satisfactorily. With most roads the matter of drainage assessment is more or less irritating but nevertheless not of sufficient importance to justify the expenditure of money necessary to gather the facts. A railway may feel morally certain that it is being over assessed and yet submit because the amount involved is insignificant. Some of us fight for principle occasionally; but if we attempted to fight for every principle that we felt was being violated we would have no time for our regular business. In brief, there is little definite information in regard to the actual benefits accruing to a railway from a drainage project. WhatI have to say therefore, must of necessity, be a statement of opinion. I might add that I do not pose as an expert in this line.

In discussing this subject, we should keep several points well in mind as we go along.

*First* among these is the fact that the benefits accruing to railways cannot be based upon the same considerations that are used in determining the benefits accruing to farm lands. The reason for this is that the purpose for which the property is used is different for the two cases. In both cases the final measure of benefit is the net income that can be derived from the property. Net income fixes the price or value of farm land just as it fixes the value of the stocks and bonds of a railway company. The income of the farm is derived from the things that the farm produces and anything that increases the productivity of the soil increases the income and so benefits the property directly.

The business of the railway is transportation. The productivity of the soil it occupies—not the productivity of the soil of the farm lands adjacent to the railway, but the productivity of its own right-of-way and lands—is of no importance whatever from a transportation standpoint. If the railway is benefited at all by drainage projects the benefits must be sought in some other direction than that which we follow when determining the benefits accruing to farm lands. In other words the benefits are "special" benefits.

*Second* the benefit *must be a tangible* one before an assessment based upon that benefit can be morally justifiable. Any alleged benefit must justify itself by increasing, in some way, the net income of the road. To place an assessment upon a railway merely upon general principles or because the grass will be greener or the sky more blue will, many times, result in confiscation of the railway's property. This is a violation of the rights guaranteed by the constitution. To plaster a heavy assessment upon a railway regardless of actual benefits simply because the drainage commissioners think they can gouge the money out of a soulless corporation, is plain, everyday robbery. One case has been cited to me in which a drainage commission attempted to assess a railway on a basis of benefits of $85,000 per mile which would amount to about $7,000 per acre. I will not attempt to discuss this assessment because I have not the details of the case and so cannot analyze it. It serves merely to show to what extremes the matter of benefits can be carried.

When I say that the *benefit must be a tangible one I do not mean to intimate that it is always possible to reduce a tangible benefit to a dollars and cents basis.* It is quite possible that the benefits would accrue; but at the same time, owing to the lack of definite data that I have already mentioned, it might be impossible to determine the exact amount of the benefit. For example, it might be quite evident that a given project would sooner or later result in increased business for the railway; but to what extent would be a matter of judgment rather than of fact. That is not an argument however, against making as close an approximation as possible.

*Third* the assessment made against the various parties at interest should be in proportion to the benefits they receive and this means highways and railways the same as it means adjoining landowners. The assessments made against the railway should be to the total assessments as the benefits received by the railway are to the total benefits accruing under the project in question. That point is specifically covered in the Wisconsin Statutes at least.

As before stated, any real benefit must in some way result in increased net revenues for the railway company. Net revenues may be increased in two ways: first, by increasing the gross income of the road and second by decreasing the expenses.

The railway man looks for a benefit under one or the other of these headings.

*Increase of Business.*—This usually is classed as a speculative benefit and some authorities contend that therefore it cannot be assessed. In some cases there is, beyond doubt, an element of speculation about this benefit. For example, if two railways chanced to parallel each other through a drainage district, it would be highly problematical what the benefit accruing to either one would be. There would be, doubtless, an increase in the total transportation business of the community; but one road might obtain a much larger portion of this increase than the other.

At the other extreme we have those railways that traverse long stretches of low rich land that has not sufficient natural drainage to be farmed. The land may be capable of supporting a much larger population than it actually has, if the water can be

removed. In such cases there isn't much question about a benefit actually accruing to the railways and as a matter of fact some of the railways, notably those in the delta region of the Mississippi, take an active interest in reclamation projects and meet their assessments quite cheerfully. They realize that the interests of the railway are bound to those of the community like the Siamese twins; what benefits one benefits the other, what hurts one hurts the other. Sometimes I think that the general public loses sight of this fact which is pretty constantly in the railway man's mind. I have noticed that the railway man, while he fights, and fights hard against what he considers injustice or ill-treatment, is usually quite ready to acknowledge the rights of the public and the obligations of the railway in connection therewith. On the other hand the slogan seems to be "Soak the railway company, for it has no friends." And yet our country probably would not exist today and it certainly would not be in its present state of advancement if the railways had never existed. This subject is too big to attempt to treat here and I mention it merely because it has a bearing upon the matter at hand, and upon what is to follow. What I am aiming at is to get before you as clearly as I can the point of view of the railway man in relation to this whole matter of drainage.

Coming back to the matter of the effect of the increase of population upon the revenues of the railway: an attempt has been made in one instance at least to reduce such benefits to a dollar and cents basis. In a general way the plan followed was to assume a certain population per forty acres for the district. Figures were then gathered showing the revenues per head of population for the state. The revenues were also figured out on an acreage basis. From all these figures a determination was made of the probable benefits accruing to the railway in question. Before the method could be completed it was dropped due to the fact that a satisfactory settlement was made with the railway company. A good many objections would doubtless be raised if an attempt were made to apply this method and yet I believe it has possibilities. It is certain however that each case would have to be considered in the light of the particular conditions surrounding it. Averages that apply to the whole state might be ridiculous when applied to any individual case.

To sum up this item of benefit then, we see that there are cases in which the benefit due to increased business is purely speculative even though it be admitted that the business of transportation will increase as the population increases. There are many cases, on the other hand, about which there can be no doubt that the railway benefits on this account. The method of determining the cash value of these benefits is difficult but not necessarily impossible. Before it can be put upon a satisfactory basis much investigation and study must be made.

*Decrease in Expenses.*—I will name first the various ways in which it has been claimed that a railway will benefit due to decreased expense and will then take them up in detail.

1. It may be possible for a railway to reduce the number or length of its bridges.
2. Flood damages may be eliminated.
3. Maintenance cost may be decreased due to better drainage of the roadbed.
4. Removal of water from the right-of-way beyond the limits of the roadbed may result in benefit.
5. The lowering of the water plane through low lands may be a benefit.

*Reduction in Number or Length of Bridges.*—This is the most tangible benefit of all as the saving to the railway is readily computed. Frequently conditions are such that in order to permit the passage of flood waters or for other reasons, long trestles must be maintained. From the railway viewpoint, these trestles are distinctly an undesirable feature and any opportunity to eliminate them is eagerly welcomed. The cost of any particular type of structure is readily computed and its probable life is known. Let us assume for example that it is possible to fill in 100 feet of timber trestle due to some drainage project: We will say that the trestle costs $20 per foot to build and will have a ten-year life. The yearly cost to the railway company then, of maintaining this structure will be $2 per foot or $200 per year for the 100 feet of trestle. Capitalized at five per cent. this is equal to $4,000; that is to say the $200 represents the interest on $4,000. If the drainage project will save the company $200 per year the company will be benefited to the extent of $4,000. However there is something more to consider. In order to save this

$4,000 the railway company must go to the expense of filling in the trestle and of ballasting and surfacing the track. If this costs say, $1,000 the net benefit would be $3,000 and if the assessment is on a sixty per cent. basis in that particular district, the assessment would amount to $1,800.

The mathematics of this calculation are extremely simple but the problem itself is not so simple. Judgment and experience are necessary for anything like a satisfactory application of this method. In addition to the task of computing the cost of the structure involved and determining its probable life there is the further engineering task of deciding upon how much of the trestle can be eliminated. It is not safe to overestimate in this direction as the roads have found out from experience. One big road does not attempt to reduce its openings until the effect of the drainage ditches is plainly evident. It is thought better to maintain an expensive structure rather than run the risk of a possible washout.

There is also room for difference of opinion in regard to the rate of interest at which the annual saving should be capitalized. This rate varies between four and six per cent. and it makes a very considerable difference which rate is used. For example in the case already considered in which the saving was $200 per year, the use of the four per cent. rate would give us a value of $5,000 for this benefit while the use of six per cent. would give a value of $3,333.

Finally to estimate the cost of filling in the trestle and ballasting and surfacing track requires a knowledge of the conditions and methods obtaining upon the railway in question.

In regard to this last item, namely the deduction of the cost of filling, etc., from the value of the benefits as deduced from the yearly saving in expense, there has been some question. In one case in which this was done it was claimed that this was wrong because to quote the exact language in which I saw the matter stated: "In the interests of general welfare and public safety, the railway company should do this work anyhow." This is one of the things that I had in mind when I mentioned assessing the company because the sky is blue or because the birds sing sweetly. Personally I consider the principle there laid down essentially unjust and economically unsound. In the first place it is not

the gross benefit but the net benefit that is of importance to the railway. In the second place there is no particular reason why the many individual holders of stocks who constitute the railway company should contribute to general welfare and public safety except in proportion to the benefits accruing to them from such welfare and safety. I realize that this is a distinct variance with the popular idea in regard to this matter, which seems to be that it is right and proper to lay as much of the burden of public improvements as possible upon the railways. This might work out satisfactorily, and I don't think even the railways would object to it, if they were permitted to make rates in accordance with such burdens, as in that case the improvements would really be paid for by a sort of general tax levied through the railways so that in the end the public would pay for the public improvements, which would be eminently just. Where the pinch comes is that the burdens thus laid upon the companies are increasing enomorously while the freight rates, which are said to be the lowest in the world, cannot be advanced to meet the increased expense. That means that net revenue is diminished and that the burden of public improvements falls to a large extent upon the particular class of people who hold railway securities.

This is another of the subjects about which there is much to be said, but I cannot attempt to carry the discussion farther in this direction.

*Removal of Cause of Washouts.*—As one engineer puts it "When districts relieve us of flood conditions, we usually have something definite to work upon." Such a benefit is a tangible one and the method of computing it is similar to that followed in determining the benefits arising from the elimination of bridges. If the railway keeps records showing the cost of flood repairs for the piece of track in question the average expense per year for this account capitalized at the proper rate of interest will be the measure of the benefit received.

*Decreased Maintenance Expense Due to Better Drainage of the Roadbed.*—This is an item about which a good deal may be said as it is rather an intangible benefit. In the case of Missouri Pac. et al. vs. Papillion Drainage District, the court ex-

presses the following opinion which represents very well, I believe, the popular view of this matter:

"Who will say that it is not a positive benefit and advantage to have a dry, firm roadbed and right of way rather than a soft and water-soaked one? If this ditch does the work that is expected of it, it will have the effect of draining these railway right-of-ways through this district the same as it will drain the farm lands of the community and it seems to me that an equal benefit is thus conferred upon the railway company's property and ought to be recognized."

Again we meet the green grass and blue sky method of determining benefits. Benefits cannot be determined in this general way. Please keep in mind the point I mentioned before, that all actual benefits will result in increased net revenues for the railway and that all others that do not meet this requirement are merely "conversational" benefits and are not entitled to serious consideration. I want to make this point clear in connection with the benefit we are discussing.

Take the matter of water on the right-of-way. Unless the removal of that water will result in reduced expense in some way such removal cannot be considered a benefit. As before stated the business of the railway is transportation and unless the water interferes with that business the water is no detriment and its removal can be no benefit. Consider the matter from another angle. It is necessary for the business of the railway that its grades should be much lighter than the grades offered by the natural slope of the surface of the ground and so the hills are cut down and the hollows are filled up. Suppose that in carrying out this work of making its grades it was found necessary to construct a high fill and the material taken from the adjoining cuts was insufficient for the purpose and suppose further that the railways were empowered to take this material from adjoining farm lands and to assess the farm lands for part of the cost of construction of the railway "in proportion to benefits received." This may sound fantastical but it is because you are not used to the idea. There are many points of similarity between such a method of constructing a railway and the methods followed in carrying out a drainage project. Now under those

circumstances just suggested suppose that the railway attempted to estimate the benefit to the farm of being leveled off due to the removal of material necessary to make the big fill, basing the benefit upon the theory that a mile of graded line was worth a certain sum and that so many acres of land was equal to a mile of graded line. Talking at the rate of a hundred words per minute how many thousand years would it take to convince the farmer that his farm had been benefited simply by being leveled off? He'd say that he could't raise any more per acre on level ground than he could on rolling land and that his level farm was not a bit more valuable than the rolling farm he had before or the rolling farm of his neighbor who had not come under the beneficent influence of the railway grading crew. In fact, he would want damages for the removal of his top soil. The railway might be a benefit to the community all right but he would not feel called upon to stand for any assessment on that ground.

Just so in regard to removing water from the right of way. We must know that the water is a detriment before we can say that its removal will be a benefit. As a concrete case consider the two railways crossing Lake Monona here at Madison. Those fills are not giving the railways any particular trouble at the present time and the draining of Lake Monona or the lowering of the water level would not affect the maintenance costs to any material extent and would not be of the slightest benefit in itself.

On the other hand such drainage has resulted in serious trouble for the railway. An instance is reported in which such drainage resulted in the settling of the embankment, the disappearance of the ballast and the general demoralization of the line and surface. An extra gang had to be put on and many carloads of cinders used to bring the track back to grade. Four years have elapsed since the ditches were constructed and still this piece of track is much below the condition it was in prior to the drainage work and it is estimated that it will be several years more before it will have reached the old condition of stability. The railway paid several hundred dollars "benefits" in this case.

Railway engineers realize fully the importance of proper drainage to the railway. They do not try to belittle that importance; but to be of benefit to the railway the drainage must be adapted to the needs of the railway. The drainage of em-

bankments is a troublesome problem but it does not depend upon the amount of water upon the right of way but upon the water contained in the embankment itself. The railway drainage problem and its solution is entirely distinct from the agricultural problem.

The drainage of a drainage district is intended primarily to improve farm lands and not for railway drainage and the design of the ditches often is such that the railways are damaged rather than benefited by the project. It cannot be assumed that the railway will be benefited merely because of the drainage project.

As I said before it should be shown that the particular project in question is really a benefit to the railway in question and actually results in decreased expense for the railway. We must look for decreased expense under the following headings:

a. Less heaving of the track due to frost.

b. Less care necessary from the track gang after the water is removed and the track has become firm.

c. Longer life of ties.

d. And, where water before stood over the right-of-way, less trouble in maintaining fences and telegraph poles.

It has also been suggested that after the water plane has been lowered say a foot that it might be possible to compute the value of the benefit accruing thereby, by assuming that the railway embankment has been raised one foot and computing the number of cubic yards that would have been required to raise it one foot above its actual elevation. This yardage multiplied by the cost per yard would be taken as a measure of the benefit.

Now there is no particular benefit in having a high embankment. The railway does not build embankments merely to get its track as high above the surface of the ground as possible. The important thing is the grade or inclination of the surface of the roadbed. You all know that a team can haul a heavier load up an easy grade than it can haul up a steep hill. In the same way an engine can haul a heavier load up an easy grade than it can haul up a heavy one and the greater the load that an engine can haul the less is the cost of hauling. The grade is the important thing not the height of fill. The only case in which it could be assumed that the lowering of the water plane is a benefit would be where the fill was of earth and so low that the

water standing on the right-of-way could be drawn up so close to the ties as to result in what we call "soft track." In such a case there would be a benefit which might well be computed by the method outlined. It should be understood however that as a rule the railway either puts its fills so high above the water level or constructs them of such material that the track has a firm support even though the right of way be covered with water.

As a general rule it cannot be assumed that the cost of maintenance will be lessened by the removal of the water or by the lowering of the water plane. One railway that has made an attempt to determine the effect upon maintenance costs of agricultural drainage reports as follows:

"We have compared actual maintenance expenditures on well drained track in the hills with those on track in the valley both through reclaimed and unreclaimed land but find nothing in favor of the reclaimed land that can be attributed to benefits from drainage ditches."

Summing up this whole matter, I would say that except in particular instances, the actual benefit to the railway resulting from the removal of water from the right-of-way is almost nothing. Railroad men are quite ready to admit the desirability of these drainage projects, and they are ready to contribute toward the cost in proportion to the benefits they receive. They ask merely that they shall be assessed upon actual, material benefits and not upon general, uncertain benefits. Like all good business men they want to be convinced that they are receiving genuine benefits before they pay out their genuine money.

DISCUSSION

*Mr. Jones:* Why is it that some railroad companies pay their drainage taxes without protest while others contest in the courts every drainage assessment placed against them?

*Mr. Van Hagan:* Because some companies prefer to settle at a reasonable figure rather than fight. The others ask to be shown. There is no evidence to show that the drainage of the right-of-way lessens the cost of maintenance. The American Railway Engineering association took up this matter once, but afterwards dropped it.

*L. S. Smith:* Anyone who has travelled the C., M. and St. P. road between Madison and Burke knows that the roadbed is more solid since the Starkweather Drainage District ditch has been put in. Nevertheless before the ditch was dug and when the assessment was contested in the courts, the railroad engineer actually testified that if the water table were lowered four feet it would be a damage rather than a benefit. Railroads not only refuse to co-operate but they do not meet the proposition fairly. The C., M. and St. P. road does not even concede the right to assess for benefits that are evident, and they go farther than that. In a Green county drainage project the railroad engineer testified that drainage to a depth of six feet would cause his track to settle four-tenths of a foot for a mile. This he claimed would be a damage. As a matter of fact, since the settling will be uniform, no damage will be done to the grade.

*Mr. Van Hagan:* There might be a bad "drag" point where the grade leaves the stretch that has settled.

*Mr. Smith:* There are worse "drag" points now on this grade than the one that may be caused by this settling. The fact is that this railroad company is unwilling to be reasonable. In the dozen or more drainage districts in Wisconsin that I have been associated with, I have not found the willing co-operation on the part of railroad engineers that Mr. Van Hagan spoke of. In Illinois the railroads not only pay their drainage tax willingly, but the supreme court has held that they must put in at their own expense the bridges necessitated by the ditches. Furthermore, railroads are given the right of eminent domain. They can run their right-of-way through your front yard, or through the grave yard and you cannot stop them. In return for this and other privileges they owe something to the public. Recently the rate commission ordered a new depot at Mosinee, not because it was absolutely necesary, but because they owed it to the public.

*Mr. Van Hagan:* The railroad company does not need a drainage district in its business, while it does need a depot. To that extent the commission is justified. I will not recede from my position that railroads are inclined to act fairly with you, provided you are square with them.

*Mr. Jordan:* In Arkansas I know a railroad that was built with land-grant money, and is a money-maker for its stockholders, yet it is endangering the lives of passengers every day by its poor roadbed. By actual count I have found forty rotten ties in every 100. Here is a case where the earnings of the road are not cut down by the poor condition of the track. If a farmer lets his farm run down its earnings are decreased. Because of this essential difference between farm lands and a railroad right-of-way, I see no reason why the benefits to the railroad company should be limited to or determined by the tangible increase in net earnings made possible by the drainage.

*Mr. Van Hagan:* Unless the drainage increases the earning capacity of the road it is not a benefit, and should not be paid for. If the public wants a donation from the railroad it should ask for it as such, and not try to get it under the guise of a just drainage assessment.

*Dr. Sherwood:* Drainage of large areas brings in many settlers and leads to more traffic. Does that not constitute a benefit?

*Mr. Van Hagan:* Yes, but it is rather hard to estimate it.

*Dr. Sherwood:* It is certain enough that railroads base their bond issues on the number of people it has per square mile of territory tributary to it, and not on the cost of the road. I happen to know this. In the Cutler Drainage District we figured that the drainage would bring in a family of four people for every 160 acres and that each person nets a revenue of ten dollars a year to the railroad. At this rate the drainage of our 16,000 acres means $4,000 a year to the railroad. Capitalized at four per cent. this is the equivalent of $100,000. To be conservative we cut this to $35,000. The cost was twenty per cent. of the benefits, so the railroad paid $7,000.

Upon motion the convention adjourned at 11 P. M.

THURSDAY MORNING, DECEMBER 10, 1914

The president called the convention to order at 9 o'clock and announced the program of the morning.

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## TOPOGRAPHY AS A BASIS OF RATING BENEFITS

E. R. JONES
*Associate Professor of Soils, College of Agriculture, Madison, Wisconsin.*

The individual landowner scans the assessment roll for a joint drain, long before he counts the bushels of corn he is to raise on the drained marsh. "How much is it going to cost me, and how much will it cost my neighbor?" He is told that his tax will be proportionate to his benefits.

Anything that increases crop production, makes cultivation easier, or increases the selling value of a particular tract is a benefit to it. Each of these forms of benefits have many ramifications all worthy of discussion if time permitted, but all of them are based on the ability of a particular drainage system to keep the particular tract of land free from damaging water. This is the simple duty of the drain, and with due deference to the quality of the soil, its location and surroundings, there will be no benefits at all unless the drain performs this simple duty. It matters not how it performs it—whether the damaging water is kept off, or taken off—the fundamental question is, How much lower will the drain make it possible to lower the water table in the soil, than was possible before the construction of the drain?

The outlet drain works directly and indirectly. The direct benefit may make it possible to raise corn near the ditch the first year after its construction. Forty rods away it may be as wet as it ever was. Nevertheless, the outlet ditch makes it possible to tile the distant land, and renders thereby an indirect benefit. One word I want to call your attention to is "estimate." An estimate is something more than a guess, a good estimate of the

benefits is what we want. A guess, good or poor, is unpardonable.

Poor guessing as to the benefits is the rock that has wrecked drainage districts. It will probably continue to wreck them as long as it is easier to compile figures in somebody's office than it is to go out on the marsh and gather facts, and in gathering the facts topography must not be overlooked.

Drainage and topography are inseparable. Natural topography affords natural drainage. Man-made drains are but modifications of natural topography and artificial drainage is the result.

Land three feet higher than a ditch five feet deep and eighty rods away is topographically equivalent to land that slopes eight feet in eighty rods, and to level land eighty rods from a drain eight feet deep. It is more than the equivalent of a slope of eight feet in 160 rods, and hence more than that of level land 160 rods away from a drain eight feet deep.

In this discussion, the depth of the drain, the slope of the land, and the distance from the ditch are the factors that determine the topography, and by depth, I mean the vertical distance to the top of the water in the drain, and not to the bottom of it.

The high land in a drainage basin whose drainage will not be benefited should not be assessed at all. I have heard it argued that since the upland sheds its water down upon the marsh it should help pay for the outlet ditch. The answer is that the owner of the low marsh got his land for $10 an acre because it was low and wet. The owner of the land that is high and dry paid $100 an acre for his land, because it was high and dry—because it had natural drainage. This man paid dearly for his drainage when he bought his land, and when you make him help pay for the other fellow's drain, you make him pay twice for his drainage. The lower landowner may have land better than the upland after the drainage is perfected, and for that benefit it is right that he should pay. It may be that he paid a high price for the low land unwittingly. In that case he should blame himself for his poor judgment, and not ask a donation from his more far sighted neighbor.

At the edge of almost every marsh there is a belt of high marsh kept wet, not by a poor outlet below, but by too much seepage

from above. Sometimes this belt extends almost to the creek in the center. In the proposed Allen Creek Drainage District in Rock county about two-thirds of the marsh can be tiled now into the creek as well as it could be if the creek were forty feet deep.

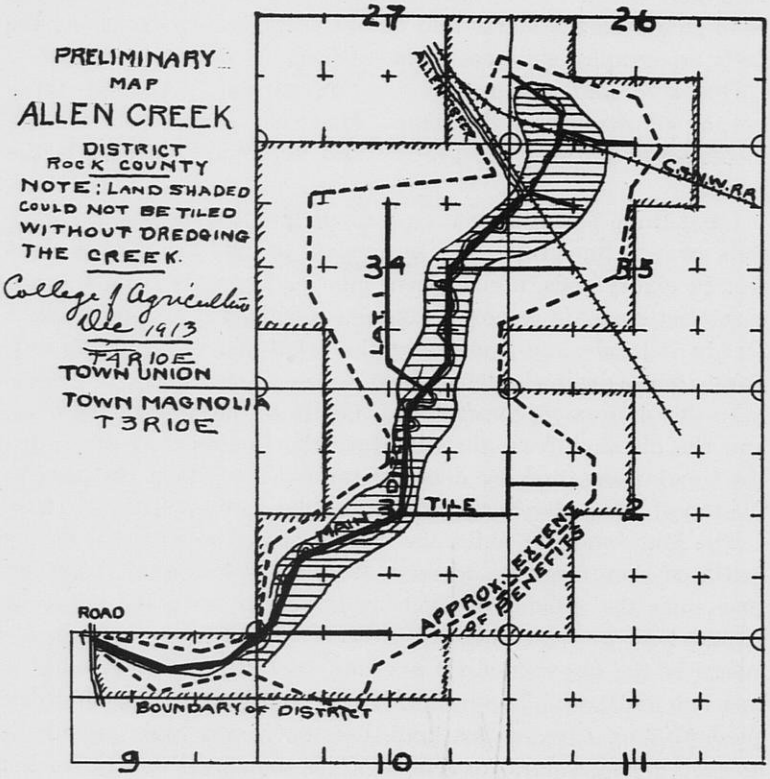


FIG. 4.—*The unshaded marsh is wet but has good fall.*

This means that the burden of the expense of dredging the creek should be borne by the strip of land about eighty rods wide along the creek. The burden is increased by the fact that it must be a large ditch, because the flood water from twenty-eight square miles of land must be taken care of. The burden would be so great that the college advised somewhat against the dredging of the creek at present, and in favor of laying lines of eight and ten inch tile on the higher marsh, to discharge through a make-shift outlet into the creek at its present level. Accessibil-

ity to these lines of big tile should be the basis of assessing the benefits to the higher marsh. The benefits to the lower marsh would be limited to protection it receives by virtue of the tile cutting off the seepage from above. The shallow ditches that would have to cross the low marsh as make-shift outlets carrying the water from the tile to the creek would not help the low marsh

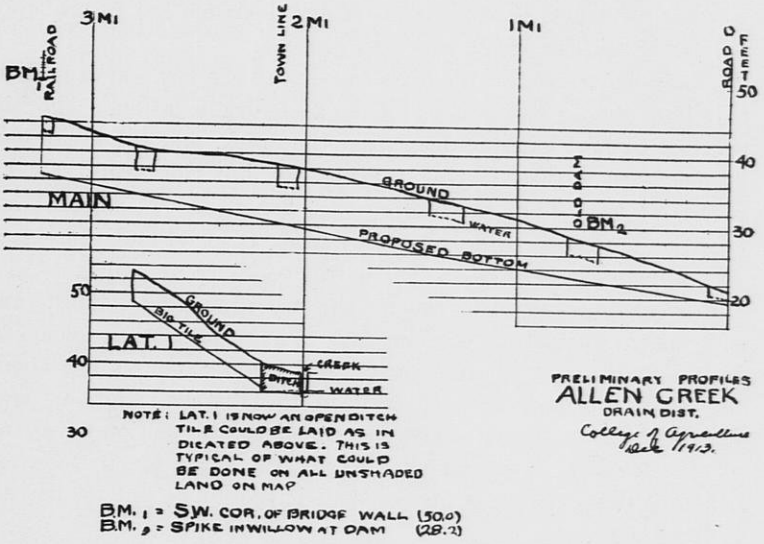


FIG. 5.—*Note the fall in Lateral 1.*

directly to any great extent. A make-shift outlet is merely a ditch dug as deep as is possible from the outlet of the tile to the creek. To economize in fall, it is usually given a level bottom and made to extend toward the higher marsh until the rise in the surface of the marsh gives the ditch a depth of about four feet.

As a subsequent improvement the creek may be dredged. At that time the big tile can be extended to the deepened creek and the make-shift outlet dispensed with. Benefits should be so rated that the higher marsh pays only for the extension of the big tile, together with a limited amount for the insurance of an outlet more easily maintained than the make-shift outlet. The low land must pay the balance at the later date. The only objection

to this plan is the somewhat hazy provision of our drainage law for the re-assessment of benefits on the basis of subsequent improvements made in the drainage system, such as the dredging of the creek would be in this case. Under the present law corrections can be made in five years, but it would seem fairer if the law provided for the readjustment of an assessment whenever a change is made in the plans that will change the benefits. The supplemental benefit clause of our drainage law is probably the better statute under which to proceed.

The inter-relation of the high marsh and the low marsh is such that both should be included in the same organization. The big tile can be laid without deepening the creek, and the creek can be deepened without laying the big tile, but this would not be profitable because of the limited area benefited. It might, however, be profitable to do all of the work at once, and there is a way to rate the benefits so that it will result in an equitable tax.

For convenience let us reverse the procedure and compute the cost before estimating the benefits. The organization expenses, including the cost of engineering and court expenses are about the same for each acre of land in the district, high or low. Furthermore each acre enjoys the same legal protection by virtue of the drainage law, and should pay the same for it. Unfortunately this expense is higher than it should be but let us call it $2 an acre.

The cost of the main ditch is estimated at $12,000 and only about 400 acres is dependent for its drainage on the dredging of the creek. This makes the average cost $30 an acre. About 120 acres of springy marsh land in section thirty-four needs only about eighty rods of twelve-inch tile, eighty rods of ten-inch tile and eighty rods of eight-inch tile for a satisfactory outlet, costing in the aggregate about $960 or about $8 an acre. To be sure, when the creek is dredged, the twelve-inch tile can be extended to the creek and the expense of keeping the make-shift outlet can be thereby eliminated, but if the higher marsh pays $2 an acre for this it is ample. This would make the cost of construction about $10 an acre for the higher marsh and perhaps bring the cost to the low marsh down to $25 an acre. Two dollars an acre added to each for organization expenses makes the cost $12 and $27 respectively.

Our present law prescribes that the cost shall be apportioned in accordance with the benefits, but I maintain that the cost of constructing the drain that will drain a particular parcel of land should be one of the factors in determining the benefit. It can be justified by the legal definition of the term "benefits," which is the increase in value due to the drain. Let us assume that both the high marsh and the low marsh will be worth $64 an acre after each has an outlet for its underdrainage. Assume further that the low marsh is worth $10 an acre before drainage. Then the benefit is $54 an acre or twice the cost of drainage. The higher marsh can be given an outlet more easily than the lower marsh. I am willing to pay more for the high marsh than for the low marsh for that reason, and in placing a "value before drainage" upon it, its fortunate drainage property must be considered. The easiest way to consider it is to assume that here also the benefit is twice the cost, or twice $12 or $24 an acre. This subtracted from $64 an acre leaves $40 an acre as the "value before drainage" of the high marsh. In other words it is easier, and I believe also fairer, to arrive at the benefits on the basis of cost, than to arrive at the cost on the basis of benefits that have been computed independent of the cost.

The same principle can be applied to the forty, eighty rods back from the outlet drain. It can enjoy the benefits of this outlet only by means of an eight-inch tile to connect it with the outlet. This will cost $240 or $6 an acre. Assuming that the soil is the same the difference in benefits should be so fixed as to make the forty, eighty rods back from the outlet pay $6 an acre less than the forty adjacent to the ditch where no tile connection is necessary. The assessment roll need not show the memoranda or computation of the commissioner in arriving at the benefits; but the cost of the tile necessary in the one case and not in the other should figure prominently in the memoranda and computations.

Benefits are complicated further by the depth of the ditch. Assume the top of the water in the ditch to be five feet. Lay a line of tile commencing half a foot above the normal stage of water, and let the grade-line rise at the rate of one-tenth in 100 and if the marsh is level it will be only three and two-tenths feet deep eighty rods away, which is as shallow as an outlet drain

should be. The benefits in the second forty will be diminished by the amount which the tile in it will be less than three feet in depth. If the land in the second forty rises a foot or more in eighty rods the depth of three feet can be maintained in laying the tile, and the possibility of an outlet for the second forty will be the same as that for the first on the basis of depth. But due allowance must be made for the fact that an outlet is made possible for the second forty partly by the slope of the land, and not wholly by the depths of the ditch. The benefits will differ also on the basis of distance from the ditch.

The importance of the topographic survey can not be overestimated. The commissioners should have either their engineer or his topographic map in the field all the time while they are assessing the benefits. A contour map is the most convenient form in which to represent topography. The cost of the topographic map is saved several fold by eliminating the litigation that follows unjust assessments.

DISCUSSION

*Mr. Ames:* Could not the lower landowners build a dam to keep the water from coming on their land?

*Mr. Jones:* As I understand the rulings of our courts, you can build a dike to keep off the surface water, but you cannot stop a steady stream. Dams that have been constructed for water-power purposes are granted the right by the legislature to raise the water to a certain height. Unfortunately that height is specified as being a certain distance above the low water mark in the streams. This is an uncertain mark. It would be better if an iron bench mark were established at every dam in the state to remove this uncertainty.

*Mr. Gault:* If an eight or ten-inch tile were laid around the high marsh to cut off the seepage so that tiling on the higher marsh is unnecessary, how would you rate the benefits?

*Mr. Jones:* I would base them largely on the cost of the eight or ten-inch tile. If a piece of land is so fortunately situated that a single protecting line of tile will give it drainage, its drainage is easy and allowance should be made for this in estimating the value of the land before drainage.

*Mr. Tubbs:* If the higher marsh is underlaid with gravel, it is sometimes possible to make the outlet ditch deep enough to underdrain the higher marsh through the gravel.

*Mr. Jones:* Cases of this kind are not very common. It is seepage water from above that keeps the higher marshes wet and a ditch forty feet deep on the lower side does not generally affect the seepage on the upper side, unless the gravel is very coarse.

*Mr. Matheson:* I think you are rather hard on the owners of the flat land along the creek.

*Mr. Jones:* I would like to help them, but will not do so at the expense of the higher marsh that is entitled to profit by virtue of its higher elevation. Mr. Hyne has tiled part of his higher marsh. He has a good outlet, except for about twenty rods next to the creek. The possibility of laying a big tile for these twenty rods instead of the makeshift outlet he has now, will be the only benefit he would derive from dredging the creek. For this he should be made to pay, but he should not pay $15 an acre for an outlet for his forty acres of high marsh, when he has that outlet already actually working, and he is raising corn on the marsh. Furthermore he is not damaging the land below him any because the water from the tile is carried to the creek by a ditch along a fence where it is not in the way. Of course I realize that the lower land owner has a right to play dog-in-the-manger and keep Mr. Hyne from reaching the creek across those twenty rods. If he plays that game, Mr. Hyne will have to have a drainage district organized so that there will be commissioners to authorize a ditch across those twenty rods, and I have suggested that he be assessed $2 an acre for the privileges coming to him by virtue of the organization, and perhaps $2 an acre more for the improvement he can make in his makeshift outlet, but he should not be assessed a cent for the dredging of a ditch already deep enough to give him an outlet.

*Mr. Matheson:* A lawyer in court would ask you how you arrived at those benefits.

*Mr. Jones:* And I would reply that I had assumed that both high marsh and low marsh would be worth $64 an acre after each had been given an outlet for tiling and that the low marsh was not worth more than $10 an acre before drainage, while the

higher marsh by virtue of its elevation was worth $40 an acre. This means that the low marsh is benefited more than the high marsh. I believe that the ease with which you can ultimately drain a piece of land is a factor determining its value before drainage.

*Mr. Matheson:* But I am afraid that if the court saw that you had figured on the cost of drainage before you figured on the benefits he would lay the assessment aside as illegal.

*Mr. Jones:* Then I would keep those figures in my pocket as my own memoranda and simply say that I had given the higher marsh a higher value before drainage because of its higher elevation, and latent possibilities.

*Mr. Meyers:* Our court would ask you to take your figures out of your pocket and show them.

*Mr. Jones:* I think I could show them and stand back of every figure.

*Mr. Vaughan:* Which marsh produced the more before drainage?

*Mr. Jones:* I think the low marsh was the more productive, because it was free from bogs and the marsh grass could be mowed with horses, while the higher marsh was too rough to mow.

*Mr. Vaughan:* Then you think that the ease with which a marsh can be perfectly drained is a bigger factor in determining its present value than its productivity?

*Mr. Jones:* Generally, yes, because thorough drainage leads to permanent usefulness, while the marsh grass is but a temporary expedient, and a poor one at that.

*Mr. Vaughan:* Do you suppose that a purchaser would pay $40 an acre for the higher marsh rather than $10 an acre for the lower marsh, when the lower marsh is the more productive now?

*Mr. Jones:* He would if he appreciated fully how much easier it will be to tile the high marsh than the low marsh. He would be near-sighted to pay as much for the low marsh as for the high marsh.

*Dr. Sherwood:* If you take market value before drainage, would you take market value after drainage?

*Mr. Jones:* Market value in both cases, but the market value in each case must be scientifically determined, and not guessed

at. The meaning of the term "drainage" is a factor. Do you mean simply an outlet ditch, or do you mean to include the supplementary lines of tile that will be necessary?

*Dr. Sherwood:* I mean sufficient agricultural drainage.

*Mr. Jones:* In tight clay sub-soils that means lines of tile four rods apart.

*Mr. Vaughan:* Undoubtedly the drainage commissioners could go that far. They should use their discretion as to the detail of drainage.

*Mr. Jordan:* What establishes the value of land? Professor Whitson says that fertility does; you say the selling price; and a banker would say the amount you can borrow on the land. Is there not some common ground on which you can all meet?

*Mr. Jones:* By selling price, I mean the market value after it has been considered in the full light of all of the factors that make a particular parcel better or worse than the one next to it. I do not mean the selling price of a cat in a bag, where you have to guess at the value. The banker has in mind the price a piece of land will bring when sold under the hammer, and this is not fair. When Professor Whitson uses the term "soil fertility," he includes in it the drainage of the soil. A soil might be full of plant food, and yet with so much water present that a plant could not grow there, it would not be a fertile soil. But we are interested in values only to arrive at a just assessment of benefits. Drainage ditches are dug to give an area an outlet. The more slope an area has, the less need it has for an outlet ditch, and the less it should pay for the outlet ditch, other factors being equal. A good plan is to take one piece of land in the district as a datum plane and compare all other tracts with this one.

*Mr. Vaughan:* It is extremely important to choose a correct datum plane. The court wants market value. If this value before drainage is estimated too high the benefits will be too small to exceed the cost of construction, and if too low the court will say that it is not a true value and the margin for benefits will be so great that it will scare the average jury.

*Mr. Jordan:* But when one piece of land sells for a dollar an acre, and another just like it sells for $20 an acre, how can you decide upon a reasonable datum plane?

*Mr. Vaughan:* The dollar-an-acre land was sold like a cat in

a bag as has been pointed out here, and the price does not represent its value. The land bringing $20 an acre may have done so for sentimental reasons, and likewise may not represent true value. Somewhere between these two extremes the datum plane should be fixed and comparisons made with it.

*Mr. Matheson:* What are you to do where the court does not allow you to compare one parcel of land with another?

*Mr. Jones:* I would get a new judge, or else amend the law so that the court is compelled to allow a comparison of the benefits between the several parcels of land.

*Mr. Matheson:* The difficulty is not to get the court to see that it is right, but to get the court to see that it is permissible under the statutes. There is not sufficient evidence now to convince courts that your method of figuring benefits is wholly correct. I hope that this organization may study this subject thoroughly and compile some facts that may be used as evidence. We have a great many facts now, but we can not have them accepted as evidence. Something should be done.

*Mr. Vaughan:* All of us admit the reasonableness of the contention that a piece of land should have a lower assessment of benefits because of its fortunate topography. The difficulty lies in getting the court to see it.

*President Sherwood:* It is time to close this discussion and start the next one.

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## BIG TILE VERSUS OPEN DITCHES

J. A. Reeves

*Salesman, National Drain Tile Company, 305 South La Salle Street, Chicago, Illinois.*

I have the privilege of addressing you on the question of "The Use of Big Tile Instead of Open Ditches." I feel a responsibility in talking to you on this occasion, which it is difficult to describe. This is on account of the importance I attach to the subject and the opportunity which this convention affords to accomplish everlasting benefits.

I regard this meeting as of primary importance to the state of Wisconsin in that it is the possible instrument, through the en-

couragement of land reclamation and land improvement, of adding to the wealth of the state, with the attending prosperity which that brings, beyond the most optimistic calculations. Our agricultural development indicates our prosperity.

It is peculiarly incumbent on the people of this nation at this time to produce bountifully, in order that the millions of people whose agricultural pursuits are unfortunately interfered with, may be supplied with food.

My acquaintance with drainage matters in Wisconsin is limited and my opportunity for observation has been confined to that portion of the state lying south and east of Madison. In this territory I believe there are as good opportunities for profits as are to be found anywhere, through the medium of drainage, and, no doubt there are other sections of the state similarly situated.

My work, as a salesman representing a manufacturer of drain tile, has been principally in the states of Indiana and Illinois, with occasional journeys into Iowa and Minnesota, and recently into Wisconsin. I have, therefore, observed the wonderful transformation in a community after the drainage germ has developed.

Mr. Jones suggested to me that in this paper I might draw somewhat on these observations and experiences, but, should I undertake to do so, there would be no end. I will, however, refer to some specific instances, but will emphasize the merits of the drain tile idea, rather than make too many illustrations.

The state of Illinois, although it has been a large user of drain tile for over thirty years, is now buying approximately 25,000 carloads of this commodity per year. Considering that the average cost is $125 per car, this means that over three million is spent annually for tile. To haul this tile and properly lay the same, a fair estimate of cost would be one and one-half million, or a total expenditure for tile drainage of over four and one-half millions annually.

I have never heard of any person who had properly installed a system of drainage, who hesitated admitting that every dollar expended for tile had been worth three dollars to him in results. Therefore, it is fair to presume that Illinois is better off by at least $10,000,000 annually, due to tile drainage.

Those of us engaged in drain tile manufacture and in con-

struction of drainage systems have looked upon the state of Wisconsin as a big prospective customer and, from my experience in the portion of the state where I have worked, I believe the time for dealing is at hand and that Wisconsin will soon be adding millions annually to its wealth, due to land reclamation and tile draining.

My subject has been limited to the use of big tile instead of open ditches, and, in the foregoing I have digressed somewhat, owing to the desire to impress upon you the tremendous advantages of tile drainage. You have access, through this wonderful school, to excellent literature and scientific data concerning this subject, and I must assume in this paper that you are informed or can satisfy yourselves as to the benefits of tile drainage.

We do not advocate the use of big tile indiscriminately and regardless of local conditions. There is a place for open ditches and a place where it is far better to use big tile instead, and the person most competent to advise you correctly is your engineer.

The object of the open ditch is to provide an outlet. We claim that frequently large title may be profitably used instead of open ditches, even though the first cost is considerably more. It is then largely a case of plain mathematics, which, if correctly solved, will surprise you in the result obtained. Any competent engineer can tell you as to the size of an open ditch that will be required for a certain watershed, and also as to the size of tile necessary to render the same service, so that cost estimates may be obtained and compared.

Right here I desire to emphasize the fact that few people realize how erroneous their own estimates usually are as to the size of tile required. To illustrate, take an open ditch having a four-foot bottom, six-foot depth slopes one to one, six-foot berm and space for waste banks, and let the average man make an estimate on the size of tile required to carry the same volume of water. He will hardly believe that tile large enough could be secured, whereas, the fact is, a twenty-inch tile properly installed will be adequate. This makes also a good example in mathematics, as previously referred to, with reference to deciding the comparative cost and benefits.

I desire to give you one illustration as to the average farmer's

estimate of size of tile required, and also as to the way in which results were regarded. About two years ago, a gentleman came into may office and inquired our price on thirty-six-inch tile. I informed him that, while tile of this size was made and even larger, yet we manufactured nothing larger than thirty-inch. He seemed disappointed, and I then asked him if he had caused a survey to be made and knew that thirty-six-inch tile were required. He told me that no survey had been made but that he and his neighbors had an open ditch that they were considering tiling, and that they had estimated it would require thirty-six-inch tile. I inquired his name and was told that he was Mr. Otis Chapman, residing between Marseilles and Seneca in La Salle county, Illinois. I suggested that he employ an engineer to look over the proposition, and that when this was done, I would gladly go up and talk the matter over with him and his neighbors. This he arranged for, and, although figures and tables plainly indicated that a twenty-four-inch tile was sufficient, yet a twenty-seven-inch was decided on for the lower 2,000 feet and the sizes reduced as advisable, ending with twelve-inch at the upper end. This drain was installed, the cost having been arranged mutually between fourteen taxpayers, which was in itself an unusual occurrence, and the means of saving a great percentage of the usual cost. They later formed themselves into a district, for the purpose of permanent organization, with properly qualified commissioners.

To illustrate the feeling over the expenditure, I wish to tell you the sequel. About the first of last July, I was concluding a contract in Ottawa with a Livingston county board of drainage commissioners at the office of Judge Lincoln. At the noon hour, we went to a restaurant where the tables are long and the eats excellent. We seated ourselves along one side without regarding the diners at the opposite side of the table. Directly I was addressed by a Mr. Elias Larsen sitting opposite me and I recognized him as one of the commissioners of the mutual "Chapman" ditch above referred to. I introduced him to my guests, the Long Point Commissioners.

This is what he told them: "This fellow came over into our community and advised us what to do in our drainage proposition and got fourteen of us to agree amongst ourselves as to the

distribution of the cost. He sold us a tile drainage ditch for $12,000 without any competition, but he couldn't buy it back for $30,000." Yet, when I recall the remarks made at the time we were endeavoring to make a deal, one would think that the improvement was to be something in the nature of an art work, intended to beautify the landscape, rather than an investment for profit. It accomplished both results and I am creditably informed that the improvement has already paid for itself.

Few people having open ditches on their farms realize the advantage of closing them with tile, whether in combined drainage or as a private matter. The open ditch, or the big tile ditch is intended to serve as an outlet for the detail or lateral drainage. If, then, there is any justification for detail drainage and the expense incurred in installing the same, it is infinitely more important that this expense be protected and forever insured by making the outlet permanent, so that every dollar invested in tile will produce the results expected at all times. With an open ditch you have no assurance of this result, owing to the agencies which change its original form, capacity, grades, etc., whereas, with a tile ditch, you have absolute assurance of permanency if properly built.

In this connection, I might correctly state that any tile failures may be ascribed to improper construction or inferior materials, for which there is no excuse.

Open ditches waste much valuable land which, after being tiled, becomes the most productive part of the farm. Open ditches must be cleaned out frequently at considerable expense and annoyance. They can not be depended upon when most needed. The waste banks prevent farming close to them. There is the necessity of building and maintaining bridges, and often these are allowed to go too long without repair, inviting accident and loss. Open ditches necessitate long trips to farm the land and fences must be built and maintained, or else a risk be run of losing cattle and stock.

On the other hand, if tile is installed, you not only save these expense items and gain much valuable land, but you are insuring, at slight cost, the permanency of all your tile investment. You have a field which can be plowed and cropped from line to line without obstruction and without waste, earlier in the season,

with no loss of desirable elements from surface washing. You have added wonderfully to the appearance of the place, which fact shows on your valuation should you desire to sell. You have done away with a veritable eye-sore and got rid of a foul-smelling ditch, thereby improving the health of the neighborhood.

Another item we are apt to overlook. You may not feel it now, here in Wisconsin, but it is noticed in many localities. Young people growing up on the farm frequently choose some other occupation and help is often difficult to secure. Whenever the farm is made attractive, remunerative and pleasant, this tendency will be decreased. You can hardly blame them for being vexed at having to contend with inconvenient and unsightly ditches, which, if tiled, would make the farm far more attractive.

Only this week, in my office in Chicago, Mr. Robert Lockman of Wheaton, Ill., owning a farm in Milton Drainage District No. 5, just completed, told me he had rented his farm at $7 an acre cash rent with less trouble than he secured $3 an acre last year. Gentlemen, there are so many advantages of big tile over open ditches that, were a person to supply illustrations, he would never get through.

I want to mention an incident in your own state. You have with you at this time the commissioners of Hoosier Creek Drainage District near Burlington, Wisconsin, and, I think they will substantiate the following: In connection with a drainage system consisting of a large open ditch and numerous open ditch laterals, there was a plan calling for the use of considerable drain tile, the tile lines emptying into the lateral open ditches. In this system, tile was specified up to twelve inches. This would be a rare contract in either Indiana, Illinois, Iowa or Minnesota, where big tile are so generally used, as seldom do we find any district advertised where tile no larger than twelve-inch is specified. Believing this an opportunity for encouraging the use of big tile and that results would follow, I solicited the business and bid successfully on the tile system, being awarded the contract at a price of $7,630. The early part of the work went as planned; but, as time went by, the land-owners became more alive to the advantages of tile instead of open ditches, with the

result that, by special arrangement with the commissioners, landowners along several branches arranged for the use of big tile instead of open ditches and made up the difference in cost mutually. The extras by reason of this change in sentiment totalled over $4,500, and I hardly think that any one here could convince these people that they have made a mistake. On the other hand, based on dollars and cents, they can prove that they have profitably incurred this extra expense and that the big mistake was made by the parties who insisted on the cheaper open ditches.

TABLE I.—COST OF LABOR.

| DEPTH OR CUT | SIZE OF TILE OR DIAMETER | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 8 in. | 10 in. | 12 in. | 14 in. | 15 in. | 16 in. | 18 in. | 20 in. | 22 in. | 24 in. | 27 in. | 30 in. |
| 1 Foot..... | .013 | .014 | .015 | .018 | .02 | .025 | .027 | .03 | .033 | .037 | .04 | .06 |
| 3 Feet..... | .039 | .042 | .045 | .054 | .06 | .074 | .081 | .09 | .099 | .11 | .12 | .18 |
| 3½ " ..... | .046 | .049 | .053 | .063 | .07 | .086 | .095 | .105 | .12 | .128 | .14 | .21 |
| 4 " ..... | .052 | .054 | .06 | .072 | .08 | .098 | .108 | .12 | .132 | .146 | .16 | .24 |
| 4½ " ..... | .059 | .061 | .068 | .082 | .09 | .113 | .122 | .135 | .15 | .164 | .18 | .27 |
| 5 " ..... | .065 | .067 | .075 | .09 | .10 | .125 | .135 | .15 | .165 | .182 | .20 | .30 |
| 5½ " ..... | .072 | .074 | .083 | .099 | .11 | .138 | .148 | .165 | .182 | .20 | .22 | .33 |
| 6 " ..... | .078 | .081 | .09 | .108 | .12 | .15 | .162 | .18 | .198 | .222 | .24 | .36 |

The figures in the table show the price in cents per lineal foot of digging the trench, laying the tile, and back-filling for the several sizes and depths indicated.

In estimating cost of work deeper than six feet and not exceeding ten feet, first figure out cost of such deep work as if six feet. Ascertain average depth in excess of six feet. Double the rate given in table for one foot depth and multiply by the average excess depth over six feet and add to the table rate for six feet. In case of fractions use next higher basis shown in table. To estimate cost of work deeper than ten feet proceed as if for ten foot work and add for average excess depth over ten feet, three time's the rate per foot for one foot as shown in this table.

This plan is intended to be used where good work is anticipated. If difficult work is expected as for instance, "hard pan" or water bearing sand or gravel, use this basis and add such precentage as your judgment will suggest as proper.

Mr. Peter Hurtgen, the efficient engineer at Burlington, whom I see here, would not again encounter the opposition in convincing these farmers as to the advantages of big tile over open ditches.

The question in Illinois is now, and soon will be here, not, "Shall we tile our ditches?" but, "Can we tile them?" It is not always possible, and there is a limit to the size of tile which it would be advisable to install. There must be considered the necessity of sufficient covering for the tile, and in Illinois there are few contracts calling for tile over thirty inches in diameter, but it often happens, in order to provide sufficient capacity and

at the same time have ample covering, that two parallel lines of tile are laid which equals the capacity required.

The Lotus Drainage District in Champaign county is an example, as in this district two lines of thirty-inch were laid parallel rather than to employ an open ditch. This contract required over 500 carloads of tile and cost nearly $100,000. One taxpayer, whose assessment was $3,000 and who had made a bitter fight against the district, claiming it was almost confiscation, told me it had made him wealthy and that he would not return to his original condition for three times what it had cost him.

TABLE II.—COST OF TILE.

| SIZE | Price per 1000 Feet | SIZE | Price per 1000 Feet | SIZE | Price per 1000 Feet |
|---|---|---|---|---|---|
| 8-inch..... | $62.50 | 15-inch ..... .... | $225.00 | 22-inch..... | $475.00 |
| 10-inch..... | 82.50 | 16-inch.... .... | 240.00 | 24-inch..... | 525.00 |
| 12-inch..... | 120.00 | 18-inch..... | 300.00 | 27-inch..... | 850.00 |
| 14-inch..... | 185.00 | 20-inch..... | 400.00 | 30-inch..... | 1100.00 |

These figures show the prices of hard burned shale tile including freight charges to Madison, Wisconsin. For points with higher freight rates than Madison the prices will be from 5 to 10 per cent higher.

Kankakee county, Illinois, is underlaid with rock. The county is generally sandy and scarcely any ditch can be dug without encountering both sand and solid rock. The land has never been considered as equalling the quality of our northern or central Illinois counties. Yet, during the last five years, at least $300,000 worth of tile drains have been constructed and the work is still going on at the same rate. If drain tile systems can be profitably constructed under these adverse and costly conditions, which obtain in Kankakee county, Illinois, surely there is no question as to the justification of your Wisconsin tile drainage systems.

In Kane county, Illinois, near Aurora, I have had the pleasure of being connected as contractor with four separate drainage district systems within a few miles of each other and totaling about $100,000. A passenger on a Burlington train going west from Aurora a few years ago would see cat-tail sloughs for a number of miles on both sides of the railroad. He now sees instead some of the finest corn fields of Illinois, due to tile drainage.

Our northern Illinois counties are installing tile drainage systems extensively. I mention this as some seven or eight years ago they looked on a twelve-inch tile as a big tile and, in response to my inquiries, I was then informed that there was small sale for small tile and practically none for big tile.

Today we are completing one drainage system at Wheeling, Illinois, along the Soo Line, as you go to Chicago, where two strings of thirty-inch tile are laid parallel to provide outlet capacity rather than use an open ditch. There was considerable objection to this when the plans were originally made, but the taxpayers are very much pleased now and feel they were competently advised. Another large district in the adjacent territory has just been organized, and with practically no opposition.

Last week I went down to Terre Haute and on the train I chanced to meet Mr. Goodyear, a well-known attorney of Watseka, Illinois. Watseka is the county seat of Iroquois county, the largest and at one time the wettest county in the state. Mr. Goodyear has been attorney for a geat many drainage districts and his experience makes him well qualified to handle drainage matters. He told me how a district in his county was organized and estimates made on certain plans which to some seemed insufficient. A plan was suggested to increase the capacity of the proposed tile drains, entailing an additional expense of $7,000 but failed on account of the strength of the objectors. The job was, therefore, put through as planned originally. The strange part of it is, that an auxiliary tile drainage system is now proposed in the same district, costing $35,000 and there are no objectors, but on the other hand, everybody is enthusiastically in favor of it.

This suggests to me one difficulty we have had in our earlier districts in Illinois. When tile drainage was planned, there was too great a tendency to keep down the cost thereby permitting systems to be installed of insufficient capacity. Engineers explained this on account of the expense, and maintained that if the system had cost more, they couldn't have been organized. I believe that any objector to the expense of tile outlet as compared with open ditches is objecting for economical reasons and is thoroughly sincere and that, for the same reason, he would be the strongest supporter of tile outlets were the facts and figures

properly and accurately made known to him. He knows the open ditch side of the story but he hasn't heard the tile defense and, therefore, is placed in a similar position to the newly elected German judge who, with practically no legal knowledge and experience, on the occasion of his first court case, listened attentively to the prosecutor. When the attorney for the defense arose, the judge, feeling that his mind was made up and that no argument could affect the result, told the attorney,—"Its no use. He's got it." For some time the attorney for the defense could not induce the judge to listen, but he was finally given permission to talk, more out of courtesy than for reason of argument, as "There is no use. He's got it." The judge listened, however, and, as the attorney went on, he became interested. On the attorney's conclusion, the judge said to him, "Now ain't that a funny thing. A little while ago, he had it—now, you've got it." Gentlemen, it is highly desirable to hear both sides of the story.

Some five years ago the concern I represent sold the tile used in Malta, Milan and Afton Drainage Districts, in De Kalb county, near Malta. This district proved very profitable to the taxpayers and I want to tell you one incident which resulted therefrom.

Mr. Fowler owned lands in this district, and his son Alfred was working for his father on the farm on a monthly salary. Alfred saw the profit which would accrue to his father by reason of this tile drainage and believed he could make money buying a farm needing drainage and then improving it. He arranged with his father for a loan sufficient to make his first payment and went, what he considered a long distance, to look up such a farm. He bought a ticket to Belvidere in the next county north but got off the train at a little town called Herbert where he noticed from the train-window that the land seemed similar to that around Malta, but flat and wet. He looked up a farm there which he bought for $100 per acre. The seller, a banker in Belvidere, thought he had, to say the least, obtained a fair price for the land.

That was five years ago. Today Mr. Alfred Fowler has several farms, owns the general store in Herbert, and has built a fine elevator which wasn't needed before, and, as the result of his belief in tile drainage, is worth over $75,000. He is consid-

ered an authority on drainage among his friends there, which are legion, because he made the community wealthy by showing them how to improve their farms.

I believe that what occurred in that county, will occur in every county in Wisconsin where tile drainage is feasible, and in the light of the wonderful transformation in lands in northern Illinois, accomplished through tile drainage systems, I think I may be excused for estimating Wisconsin as a valuable market for years to come.

The main thing is to get the facts before the farmers. In Illinois, contractors and manufacturers look upon every open ditch which can be tiled as a certain order eventually. We think that any specifications in your Wisconsin work calling for open ditches which can be tiled means an added burden to the taxpayers in paying now for open ditches and later for tiling the same ditches plus the loss they have had in being deprived of the advantage of the use of the land and the tiled outlet, in the meantime.

Gentlemen, in this paper I have not attempted to deal with the subject in a technical manner, leaving such items to men with special engineering qualifications. I would earnestly recommend that each delegate to this convention secure from this college, such literature on tile drainage as it has available and undertake to familiarize the people of your localities with the advantages and benefits of tile drainage.

For years we have made use in our catalog of a little rhyme written by Mr. Meigs and which I think fits in anywhere that drainage is talked about. This is it:

> "Most farmers lament the money they've spent
> For things only made to beguile—
> But never as yet did a farmer regret
> The money expended for tile."

Upon motion to continue the discussion of big tile at the afternoon session, an adjournment was taken for the noon recess.

## THURSDAY AFTERNOON SESSION

The president announced a continuation of the discussion.

### DISCUSSION

*Mr. Jones:* What do you think of a surface-run in connection with a big tile?

*Mr. Reeves:* This is quite common. The Burlington District installed a flood ditch with nearly every large tile.

*Mr. Jones:* It appears to me to be a matter of choosing between an extraordinary large tile with no surface-run for relief, and a tile of moderate size with a surface-run. If you have a surface-run for relief, a suprisingly small main tile will take care of the ordinary seepage. By a surface-run I mean a well sloped groove about ten feet wide and a foot deep or fifteen feet wide and two feet deep, depending upon the demand. You can sod a run like this and cut hay there. It will carry water perhaps a dozen days in the year and be dry and crossable the rest of the time.

*Mr. Ames:* We have a large ditch in the Union Drainage District that runs through a rotted peat soil with a subsoil of clay and sand. Weeds have grown in the bottom of the ditch and the floods are bringing in large amounts of silt. The ditch is filling fast and has stopped the outlets of several lines of tiles discharging into it. I know Mr. Jones thinks we should have put in a fifteen-inch tile in place of the open ditch. I want to know what Mr. Warren thinks.

*Mr. Warren:* I am not sure whether a big tile would be the more economical in your case or not. I merely quoted an eminent engineer when I said that a big tile was the more economical where a ditch with an eight-foot bottom will carry the flow. It is probable, however, that a big tile would have been the proper thing in the first place.

*Mr. Ames:* Yes, but we have the open ditch, such as it is, and I want to know what to do with it, because they are roasting us commissioners most awfully about that ditch.

*Mr. Jones:* I will illustrate on the blackboard what you can do. Either deepen the center of the wide bottom as shown in Figure A or else lay a big tile as shown in Figure B, leaving the old ditch sloped and sodded to carry the flood water. It is best to have the tile a little toward one side of the center so that it will have more covering. Lines of tile entering the big tile from the other side will have to cross under the rounded surface run. The bottom of this will be dry except during flood flow.

Mr. Zeasman has some photographs showing how the bottom of a ditch in the Koshkonong district was made deeper and narrower under his direction last summer.

*Mr. Ames:* Our big dredge ditch has filled up until it is not much more than a surface-run, but it is not as pretty as the one you describe. I can see now that we should have a big tile to maintain the depth and carry the steady flow so the bottom of the surface-run will dry up. Would you lay the big tile in the bottom of the old ditch or at one side of it?

*Mr. Reeves:* Lay your tile in the solid ground at the side.

*Mr. Coddington:* Have you done tiling where quicksand underlies the soil?

*Mr. Reeves:* Yes, and sometimes to my sorrow. The only way to do this is to put in tapping basins to allow the water to drain away before attempting to lay the tile. In a few cases piling must be driven to support the tile, but waterbearing sand usually becomes firm as soon as the water is taken out. The tile should be surrounded by top soil or clay to keep all sand away from the joints.

*Mr. Coddington:* My experience with drain tile goes back twenty years. We laid tile twenty inches deep at the head and three feet deep at the outlet in peat underlaid by sand and in three years we had to dig up the tile. In the sand, they had filled up with sand, and in the peat they had settled out of alignment. We replaced the entire tile drainage system with open ditches, eight or ten feet deep and about three quarters of a mile apart. They do good work. I believe in tiling clay or hardpan, but in a sandy subsoil deep, open ditches are better.

*Mr. Jones:* If the deep open ditches do the work in a coarse sandy sub-soil without the aid of supplementary tile the thing to do is to omit the tile, of course. But I want to point out at

least two reasons why Mr. Coddington's tile did not work. They were not blinded with peat or clay to keep the sand away from the cracks, and in the peat they were not deep enough. They were laid so shallow that the water table settled down below the tile thus admitting air and causing a decomposition of the peat below the bottom of the tile. This causes settling, and uneven decomposition causes unequal settling. If the tile were laid four feet deep in the peat instead of twenty inches the water table would not be so apt to fall below the tile during the dry part of the year and there would be little or no circulation of air below the tile to cause decomposition there. Furthermore, in Wisconsin tile should be laid four feet deep in peat to get them below the frost line. It does not hurt tile to freeze in clay or mud if they are empty when they freeze, but peat heaves so much upon freezing that the tile should be below the frost line. I have seen tile laid two feet deep in peat heave in three years' time so that the plow struck them. Of course such tile do not work. Another thing: Four feet of peat will settle to three feet with ten years of drainage. But this settling is above the tile and does not disturb the tile.

*Mr. Ames:* In our district we have some ten-inch tile emptying into the outlet ditch but the water has washed in so much sediment below the outlet because of a caving of the banks, that the ditch is nearly filled up there. How can you fix the outlet of a big tile so that it will not cave in?

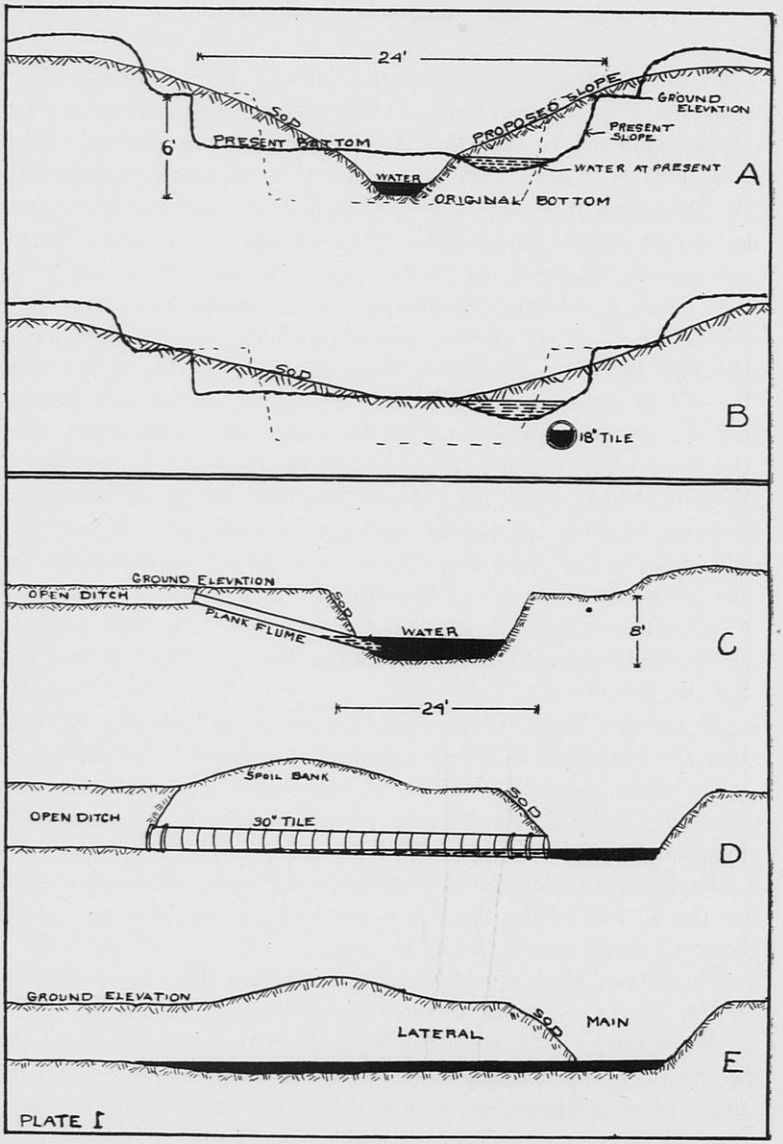
*Mr. Warren:* A concrete retaining wall and a concrete apron on the bottom of the ditch is a good thing provided you get an honest contractor to put it in.

*Mr. Ames:* How much does a fortification like that cost?

*Mr. Warren:* Twenty-five or thirty dollars.

*Mr. Daniels:* In our district we protect the sides of our ditches where the water from a road ditch empties by making a wooden flume about sixteen feet long to carry the water from the small ditch down below the surface of the water in the big ditch. The water in the latter acts as a cushion to protect the sides of the ditch. The planks will rot in time but they are not expensive.

*Mr. Vaughan:* If glazed sewer pipe were used instead of the wooden flume it would still be inexpensive and would last forever cement them together at the joints.




A and B show what could be done with the ditch described by Mr. Ames on page 87. The original bottom was too wide. The 18" tile should have been put there in the first place, with the sodded surface run made by a road grader to remove the surface water.

C shows the method of letting water go from a shallow ditch into a deep outlet ditch, described by Mr. Daniels on page 89.

D and E are designs for the outlets of deep laterals entering an outlet ditch, without injury.

*Mr. Ames:* If you had hardpan eighteen inches below the surface would you lay the tile below the hardpan or on top?

*Mr. Coddington:* On top.

*Mr. Ames:* That makes me think of another question. Can you let the water down through the hardpan into the lower layers of soil?

*Mr. Jones:* Every piece of land must answer that question for itself. A vertical drain has two requisites. There must be a layer of coarse soil below the hardpan or clay and there must be room for more water in this open layer. I have seen holes dug through the hardpan where the water came up instead of down. On page 22 of Bulletin 229 of the Wisconsin Experiment station there is a design of a simple vertical drain that is about $6.98 cheaper than a fancy patented drain-head that a certain company is making, and as far as I have been able to learn, the simple device is just as good. The talking point for the patented device is that it provides a settling trap for the silt and has a wide opening through which the water can enter at the top of the vertical drain. The facts are that after water has filtered through a fine soil there is no silt in it to settle, and secondly if water can find its way through several feet of fine soil to the vertical drain, it can easily tumble into the vertical drain through the cracks between the tile in the vertical column without the wide opening at the top. These cracks can be kept open by putting a ten-penny nail between the tile where they are put in place. Where conditions in the subsoil are right, a vertical drain can be made to serve as an outlet for a tile drainage system. This may take the place of a long line of big tile and may cut Mr. Reeves and his friends out of a fat tile order once in a while.

*Mr. Reeves:* That is all right. It is to the interest of every tile man to see that thorough, permanent drainage is accomplished as cheaply as possible.

*Mr. Jones:* I do not want to see this discussion closed without taking a rap at the capstan ditches that are butchering Wisconsin marshes. I say "God bless them" on the flat marshes along sluggish streams where there is not fall enough for tile. But on marshes more than four feet above the water in such a stream, if you show me a place where a ditch three feet deep, a foot wide at the bottom and seven feet wide at the top does good

work, I'll show you where an eight-inch tile can be laid for the same money, and do better work. If there is more flood water there than the tile can carry make a deep dead-furrow or a shallow surface-run for relief.

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## THE BRIDGE PROBLEM.

M. W. TORKELSON
*Bridge Engineer, Wisconsin Highway Commission, Madison, Wisconsin.*

I have been assigned a subject called the bridge problem. So far as we are concerned, there is no bridge problem but there is, however, a drainage ditch problem, which sometimes becomes acute. I suspect that this is the problem which I am to discuss. But whether we call it by one name or another, the digging of a drainage ditch across a highway and the subsequent maintenance of the bridge across the ditch is a real problem. I have not read the drainage laws with sufficient care to be well versed with their provisions. It seems that their requirements in this respect are extremely elastic, namely, that the bridge or road shall be left in as good condition after the digging of the ditch as it was before. This is subject to a very wide construction, and it seems to me that the drainage commissioners have been prone to construe it as liberally to themselves as possible. Such conditions have sometimes been brought to our attention by town boards, who felt themselves aggrieved, and very often grievances are very amply justified.

The course which we have consistently recommended on such occasions is for the drainage commissioners and the town boards to get together on these bridge propositions before the ditches are dug so that arrangements can be made immediately after the road is crossed to proceed with the construction of a substantial bridge with the least possible delay and get the cost of this bridge equitably divided between the two.

The mere construction of a bridge across one of these ditches is a very simple problem indeed. It is rare that any spans greater than thirty feet are required, and it is a comparatively

simple proposition to build abutments either of stone or of concrete at the banks and then to build a superstructure either of reinforced concrete or of I-beams on these abutments. The real problem arises a few years later when it is necessary for a dredge to pass up the ditch for the purpose of cleaning it out. Of course, the permanent structure can be removed but this would be at a very large expense. In some cases where permanent steel and concrete bridges have been placed across drainage ditches, I am informed that the dredgers will proceed to dig around the bridges, build a temporary wooden bridge across the opening and fill the same when they return down the ditch.

The problem of building a bridge which shall be permanent and movable and economical for drainage ditches has not been solved so far as I know. The railroads build movable structures frequently. In many places where wooden trestles were built originally and where it is necessary to have a very large waterway for water passing at a very low velocity, the railroads are beginning to build a reinforced concrete trestle, the superstructure consisting of movable slabs of reinforced concrete. These slabs are usually from twenty-five to thirty feet in length, about thirty inches deep and about five or six feet wide, and weigh usually somewhere in the neighborhood of thirty-five tons. They are usually manufactured at some point near the place where they are to be used. The piers to support them are built and picked up bodily, loaded on cars and placed in position by the means of very powerful machinery such as the railroads have at their disposal.

About three years ago the highway commission was asked to prepare the design of a reinforced concrete and steel bridge across a drainage ditch, which should be so designed as to permit its removal to allow the passage of the dredge. We did make a study of a structure at that time, but as it developed that funds would not be available to build even a permanent stationary structure, the design was never completed. It developed, however, that to use the method followed by the railroads in building the concrete trestles would hardly be practicable in a structure of this kind.

Our calculations along this line soon brought us to the conclusion that the lightest concrete slab which would be practical to

use for an opening was still too heavy to be handled properly by the machinery available for dredging purposes. It must be borne in mind that these concrete slabs must be handled with great care. It is not like pulling a dipper full of hardpan out of the bottom of the stream, lifting it up and allowing it to drop. It must be lifted with great care, swung to its exact position and deposited in place with great care, and any carelessness in handling or the attempt to handle it without adequate power could very easily cause a great deal of damage. The attempt to make a design along these lines was then abandoned, but the design was continued, contemplating a steel I-beam bridge with a reinforced concrete floor consisting of movable slabs. Inasmuch as this particular bridge was required to be built with an unusually wide roadway, namely twenty-four feet, the movable slabs were designed twelve feet in length, so that the full width of the floor was provided by two slabs. In order that there might be exceptionally good bearing in the center where the joint occurred, the design provided for two parallel I-beam joists spaced eight inches between centers.

In an ordinary reinforced concrete floor which is built monolithic and without a joint of any kind over the whole span, it is safe to assume that a heavy concentrated load, such as the drive wheel of a traction engine, will be distributed over at least two feet of the width of the floor, but in the case of a floor consisting of movable slabs this load cannot be assumed as being distributed over more than the width of a single slab. We, therefore, figured that the minimum width of slab which could be made safe to carry the entire load of a drive wheel would be one foot. Because of the fact that the slab in being moved would be apt to be placed in almost any position, the design provided for a slab reinforced to resist the dead load stresses in the slab in whatever position it might be placed. This, of course, required reinforcement in the top of the slab as well as in the bottom. The placing of this reinforcement was of advantage in taking care of the regular live loads so that this permitted the slab to be designed of the ordinary thickness of reinforced concrete floors.

The completed design was for a slab twelve feet long, one foot wide and six inches thick, with a curb similar to the curb on a fixed floor, the slab reinforced at top and bottom and with two

hooks set at the quarter points in order to facilitate hooking on to the slab to affect removal. It was the expectation in setting these slabs to put a very thin layer of mortar on each joist, this layer to be as thin as possible in order to give the slab an equal bearing on all the joists. After the slabs had all been placed, it was the expectation to waterproof the top by placing a good coat of pitch or tar, and then to cover the entire floor with a six inch thickness of gravel.

Inasmuch as this bridge never was built, it is impossible to say just how successful the structure would have been, but I cannot see any reason why the proposition is not feasible though I doubt its economy. The weight of the slabs as designed is slightly over 1,000 pounds. The weight of the I-beams which would be necessary in case the slabs were used on a thirty-foot span would be 1,260 pounds. This would not be a heavy load for any dredge to handle. In fact, the slabs were designed with a view of being skidded off by means of a team of horses and placed on skids in a position to be pulled back into place by means of the same power as soon as the dredge should have gone through. It was thought that this might be more convenient than to make it necessary for the dredge to dig itself a hole to permit it to turn around and to replace the superstructure after having gone through. On the basis of $8 concrete, I believe that the total cost of this type of a slab floor in place will be somewhere in the neighborhood of $18 per cubic yard, this including the reinforcement and the initial placing, including tar. It would require an experiment to determine just how satisfactory the slabs would be in actual service. There is a possibility that careless handling might in the course of two or three removals so injure and damage them, that they would not be satisfactory. I am inclined to doubt whether or not they would prove any more satisfactory in actual use on this kind of a bridge than an ordinary plank floor.

Of course, plank floors are exceedingly objectionable, and it is only in very rare instances that they are being used to-day. Since the State Highway Commission began its work in 1911, we have designed approximately 1,600 bridges, and of the total number only two have been designed with plank floors. We know of numerous instances where town boards have removed

perfectly good steel bridges, giving good service, for the reason that it was impossible to install a concrete floor and thus to do away with the item of maintaining the planking. It seems to me that in the case of these drainage ditch bridges which have to be removed in any case, that it would be an equitable arrangement between the town and the drainage district, for the drainage district to assume the maintenance of these floors wherever the installation of one became necessary through the necessity of removing the bridge. It certainly does not seem fair to the town to be required to maintain an uneconomical structure for the benefit of the drainage district.

Another problem which may occur is with regard to foundations. The territory in which a drainage ditch is required is often times of a very mucky, peaty nature, and sometimes underlain with a very fine sand. Our opinion is that the best type of foundation for conditions of this kind is a solid concrete wall, set on good wooden piling, driven to a good penetration and refusal. Where the foundation is muck, careful sounding should be taken with an iron rod to determine the distance to something more solid and the piles proportioned accordingly. Where sand foundations can be confined it is ample to carry the loads imposed upon it by ordinary bridge foundations, but the trouble is that sand is a very hard material to confine. It washes away very easily, and unless these foundations are placed at a great depth, they are apt to be undermined. We find that it is far more economical to drive wooden piling, than to carry the foundations to a great depth in sand, and we believe that it is also more satisfactory, because the piling extends to a depth far below anything which it is possible to reach by any ordinary methods of excavation. It is often difficult to drive piling in sand, but this difficulty can be overcome in the very large majority of cases by seeing to it that the pile driver used is in good condition and of sufficient weight, with leads long enough to permit a powerful blow to be struck, and that the piles are of good, firm timber and straight. They should be ringed at the top to prevent splitting under a heavy blow, and in case the top begins to broom, it should be kept cut off so as to give a good, firm top on which the pile hammer can land. We do not believe that it will be impossible to drive piles under any drainage ditch conditions,

provided good piling and a proper pile driver is used for that purpose. Our experience has been that most of the trouble in driving piles has resulted from a poor driver and from poor piles. Of course, where circumstances are very unusual, a jet of water under pressure can be placed at the point of the pile. This jet of water loosens the sand underneath the pile and it then usually goes down without any trouble whatever. As soon as the jet is withdrawn, the sand settles back into place and the pile is as firm as if it had been driven all the way.

A great deal of trouble due to scouring out of foundations could be avoided in case a little care were taken in placing riprap around the footings of the abutments. I believe any money spent in riprapping any bridge foundations, no matter how well this foundation may be placed, is well spent. The most unusual and unlooked-for things are apt to happen in times of floods. A little riprapping in front of an abutment often prevents scouring altogether, and usually, even if there is some scouring, the stone will settle down deeper than it was originally placed thus becoming even more effective.

It sometimes happens that the deepening of a stream channel through digging a ditch results in leaving the foundations perched up above the stream bed in a condition where it is particularly apt to be undermined. Our experience is that it does not pay to try to save old foundations unless they are very good. Most stone abutments, after they have stood twenty-five or thirty years, apparenly have a large percentage of the mortar placed between them dissolved and most of the stones are so loose that they come down without any trouble, and in such cases we believe that it is better to tear down an abutment and rebuild it rather than to spend good money in fixing up an old job which will be nothing but an old job after it is finished. But where an abutment is good, it can be under-pinned and supported in such a way that its usefulness will not be impaired. In a few instances we have adopted this method where it has developed that foundations were not carried to the required depth, and there is no reason why this scheme will not work just as well where the same result is reached through the deepening of the channel. Our practice is to place sheeting parallel with the wall and a distance of about two feet in front of it, sheet off a

space about six feet long and carry the excavations at this point down to good foundation, removing from under the sections of wall such material as can readily be pulled in. As soon as the excavation on this part of the work has been completed, the hole is filled with concrete, and another section is treated in the same way until the entire front of the wall is under-pinned.

These sections should be placed alternately; that is, if one section has been placed, the one immediatley adjoining should not be started, but a space of about six feet should be left between the first section and the second. In this way the stability of the wall will not be impaired.

DISCUSSION

*Mr. Vaughan:* How long will these movable six-inch concrete slabs last with ordinary traffic?

*Mr. Torkelson:* I do not know because the design was never executed. A solid concrete floor should last many years but I do not know whether the slabs would last this long or not.

*A Member:* Have the slabs any advantage except that they are movable?

*Mr. Torkelson:* No. For this reason, this design would not be advised, except in a place where it is known that a dredge will have to pass within a few years. I can see also how this design might be used with profit within a drainage district on ditches where the dredge will have to pass once more after a few years to clean out the ditch.

*Dr. Sherwood:* It would probably be better still to make the ditches deep enough in the first place and then to take care of them so that they will not fill up.

*Mr. Lee:* To what extent should the town be expected to bear the expense of new bridges necessitated by the ditches?

*Mr. Jones:* In Illinois I understand that the town must move, build or repair without expense to the drainage district the bridges affected by the drainage work on the assumption that the town should have known that some day the ditches and hence the bridges would be necessary. In Wisconsin drainage districts do not get such liberal treatment, the assumption being that if a bridge across the old creek satisfied the requirements of traffic, a new bridge, or any repairs to the old bridge made necessary by

dredging the new channel, should be born by the district. The same applies to a railroad. Since roads and railroads may be benefited by the drainage a compromise may be effected by letting the drainage tax equal the cost of the bridges. If a particular bridge can be made to accommodate the new ditch for $500, let the commissioners rate the benefits to the road so that the drainage tax of the town will be $500. Thus the town pays the district the tax, and the district pays it back to the town to build or repair the bridge. For the town it is like taking money out of one pocket and putting it in another. It may not be legally sound, but since no money has to change hands, it expedites matters, and to that extent is justified.

*Mr. Lee:* We had such an agreement with our town board but it was not put on record. The tax against the town was omitted from our tax roll. Our tax roll was approved by the court and can not be changed now. There is a temporary bridge across the ditch and the town is trying to compel us to put in a permanent bridge at our expense. What shall we do?

*Mr. Vaughan:* The law provides that after five years you may readjust the assessments in the light of actual development. At that time you may assess the town whatever benefits you think just. In the meantime you had better build or repair the bridges at the expense of the district.

*Mr. Lee:* We have no money.

*Mr. Vaughan:* Then I guess you'll have to levy another assessment.

*Mr. Olson:* Two years ago our ditches needed repairs estimated at $700. The court said we would have to notify every landowner in the district before we could raise the money. Ours is a big district and the expense was great. By the time we had complied with all of the requirements of the law we had to raise $2,500 to do work which we could have done for $700 if we had had the ready cash with which to do it.

*Mr. Vaughan:* The court was not fully advised upon the recent statutes simplifying supplemental assessments although I recall that once it cost one of my districts $250 to raise $800.

*Dr. Sherwood:* It would not have cost any more to raise $8,000 than it did for $800. I think the law should permit districts to raise a reasonable margin of money in excess of the actual cost

of construction, so that it will have some money in its treasury to draw on with the permission of the court. It will save expense, and save time where repairs are needed quickly to meet an emergency.

*Mr. Vaughan:* Courts usually permit this now. Where the actual cost falls below the estimated cost, there is money left in the treasury that may be used for any repairs agreeable to the court. The thing to do is to make your estimated cost high enough in the first place and then you will have a surplus for repairs.

*Mr. Hanna:* The district should be able to raise money for necessary repairs without going to court at all, unless there is a remonstrance against the proposed repairs. Let the commissions file with the court a report of the work to be done and its estimated cost. Let this report be published so that the landowners can see it, and file a remonstrance before a certain day. On that day, if there are no remonstrances let the court authorize, by order, the raising of the money.

*Dr. Sherwood:* I have one bridge question for Mr. Torkelson. What do you think of metal culverts? Our foundation is a water bearing sand. Our ditches are about eight feet deep. We have used a great many corrogated galvanized iron culverts, seventy-two inches in diameter and twenty-four feet long. They weigh about 2,500 pounds and cost about $150.

*Mr. Torkelson:* They appear to be an economical bridge. If the dredge ever has to go over the ditch a second time, such culverts are easily removed. With a sand bottom you have a poor foundation for a concrete retaining wall at the ends and it is best to slope the filling from the top of the road to the bottom of the culvert, so that it can be sodded. A slope of one and one-half to one is necessary. If your ditch is seven feet deep and the road is sixteen feet wide, your culvert should be thirty-seven feet long. I do not think that twenty-four feet is enough.

*Mr. Vaughan:* The acid water of Wood county soon eats holes in the metal tile. They will not last more than three or five years.

*Dr. Sherwood:* Will concrete last any longer than that?

*Mr. Jones:* It depends on the workmanship and the quality of the cement. A good cement well mixed with good sand or gravel

should stand. But I do not like to recommend cement for drain tile, because farmers are apt to be careless in making them. In the larger tile with thicker walls, less surface per volume is exposed to the running water, and any concrete is more durable for that reason. I notice that railroads are using these heavy concrete tubes for culverts. They also can be moved easily, if necessary to clean out the ditch.

*Mr. Vaughn:* I would like to hear a discussion on the best machinery for cleaning out ditches.

*Mr. Jones:* What we need is some light, movable machine to deepen a narrow channel in the center of the wide bottoms of our ditches and then to make a slope from this narrow bottom to the shoulder of the bank. This slope should be made useful and durable and pretty by sodding. I have corresponded with several manufacturing firms, but they are slow to make any improvements in the cumbersome machines they now make. On our sand-bottom marshes there are many ditches about twenty feet wide at the top having an over-hanging lip of sod on each side. Beneath this there is a fair slope to a bottom about twelve feet wide and four feet deep. This is not deep enough, but I do not want to see a floating dredge go down these ditches again. That would tear up the good slopes that have now formed. They are made permanent by the mixture of the muck and sand. I would cut off the over-hanging sod at the top with a hay knife and pull it back out of the way and then take some of the sand out of the center of the flat bottom without disturbing the slopes. I think a traction machine working with a dipper from one side would do this work.

*Mr. Hintze:* I am at work on such a machine now and before our next convention I hope to have it perfected.

*Mr. Jones:* Mr. A. J. Bracken, engineer for R. H. & G. A. McWilliams & Co., of Chicago, was to have been here this afternoon to talk about dredging from the contractor's point of view. Unforunately he is not able to be with us. If he were here he could probably tell us why it is that contractors with floating dredges make ditches twenty-four feet wide at top and bottom instead of twenty-four feet wide at the top, eight feet wide at the bottom and eight feet deep. They handle more earth than

they need to, but they give us vertical sides and a wide bottom instead of sloping sides and a narrow bottom. This is responsible for half of the clean-out work that is necessary in Wisconsin. With wide boats they can not make a narrow bottom perhaps, but they can and should be compelled to give us a slope of approximately one to one from whatever bottom they cut. Furthermore the sides of the ditch should be cut ahead of the

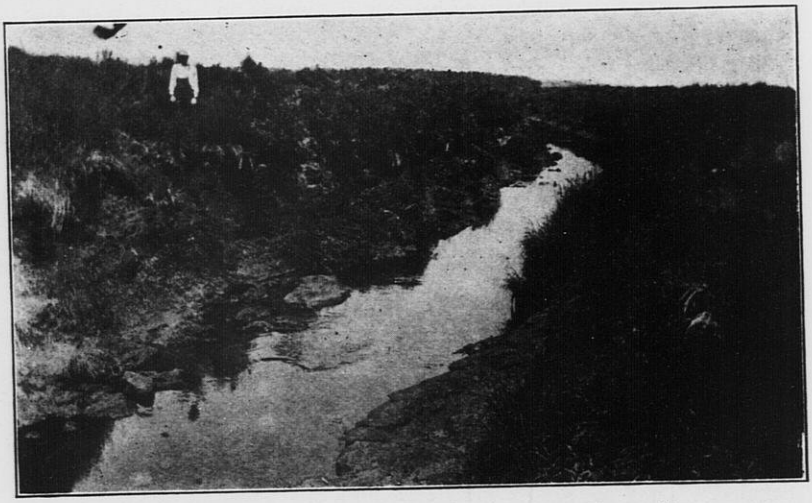

FIG. 6.—*The ditch was filling up. See Figure 7.*

dredge with a hay knife. The dredge will then leave a clean-cut bank instead of an over-hanging lip of sod, or a ridge of "slobbers" at the edge of the bank. Either of these cause big chunks to fall back into the ditch. Another problem is that caused by the slush behind a floating dredge. In the Center Drainage District in Outagamie county behind the dredge the ditch was filled with a soupy mixture of muck and water, a little too thick to drink and a little too thin to plow. As the dredge went down the ditch the water disappeared, but the muck dried out and remained in the ditch, filling to within three feet of the top the ditch that was dug seven feet deep. The commissioners were easy and paid the contractors in full upon the assurance that the first flood would wash out the settlings. But the flood was not sufficient to clean the ditches, ex-

cept in the main ditch. A threshing machine cylinder dragged in the bottom of the ditch to agitate the settlings during a flood would have helped. A narrow trench dug in the center of the wide bottom of some of the laterals gave the moving water a better velocity and has carried out some of the settlings.

*Mr. Myers:* I would like to have Mr. Hurtgen give some of his experience along this line.

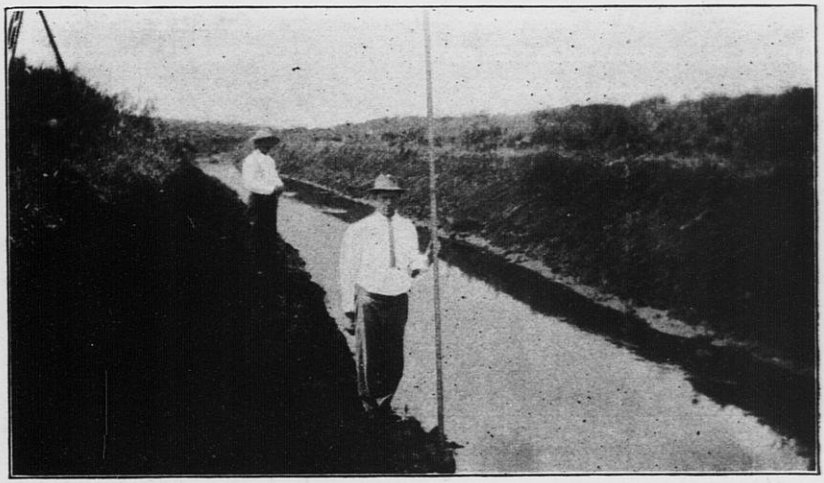

FIG. 7.—*It was trimmed and deepened for 90 cents a rod.*

*Mr. Hurtgen:* In Kenosha county we sent the dredge back over the worst place and after the dredge went through the second time it looked worse than it did before. The muck and peat run into the ditch in a semi-fluid condition. The marsh was a very soft one and the peat is twenty-one feet deep. I have never had this trouble before.

*Mr. Lucas:* In the Mud Creek Lateral of the Koshkonong and Mud Creek District the sides sloughed in very badly, due to the water seeping into the ditch. We required the contractors to go over it a second time in the following spring after the water had drained out of the soil and the banks had settled. No more sloughing has occurred there and the ditch is now in first class condition.

*Mr. Jones:* In such a place as Mr. Hurtgen describes it may be necessary to use sheet piling of cheap inch boards to keep

open a channel, perhaps four feet wide and of required depth. After the piling has rotted the banks will be firm enough to stand alone.

*Mr. Philleo:* In some of the ditches in Wood county, where the peat is from ten to twelve feet deep, the pressure of the

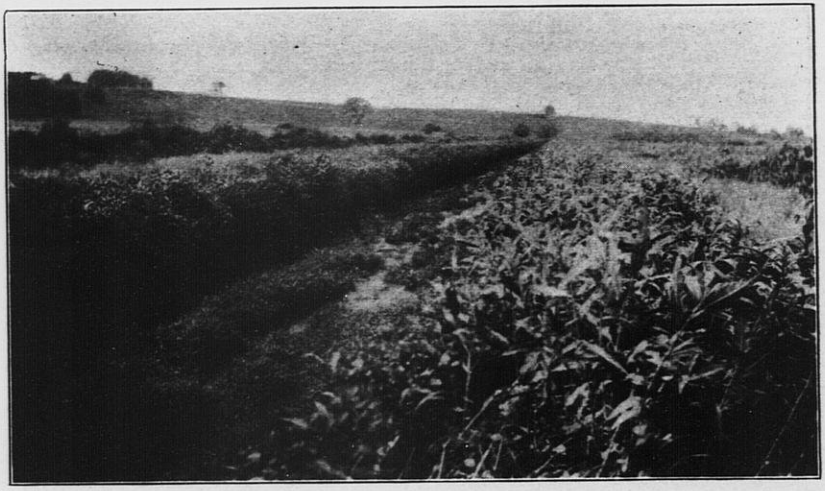

FIG. 8.—*The bottom of this ditch was too wide.*

water in the underlying sand has caused the bottom to bulge up. To prevent this the peat should be dug out down to the sand, even though it is twelve feet deep.

*Mr. Zeasman:* The relief of the pressure in the underlying soil will also help to drain the overlying soil.

*Mr. Ames:* Would a capstan plow pulled up the wide bottom of a shallow ditch help any?

*Mr. Jones:* It might if you take a spade and spread the spoil banks back against the sides of the old ditch. Then sod the slopes.

*Mr. Ames:* On this map the ditches are laid out on forty lines. I think the new ditch should be in the channel of the old stream. We straightened an old ditch and now we have two ditches instead of one.

*Mr. Jones:* On the contrary, you have no ditch at all and never did have one. If your new ditch were deep enough to be called a ditch it would empty the old channel so that it would

be dry. You could plow across the old channel and two or three years of cultivation would fill it. Put the new ditch on the forty line every time you can, but make it deep enough.

*Mr. Ames:* Do not rub it in too hard, because some of my constituents are here and they like to see me roasted too well. The ditch has filled up until it is not deep enough for them and now they want the district to pay them for damages because the drainage was not deep enough to permit them to raise crops. Have they a case?

*Mr. Vaughan:* They may ask the court to compel the commissioners to give them a better outlet, but they can not recover for what loss they have sustained by neglecting to ask for relief earlier.

*Dr. Sherwood:* This map of the Cutler Drainage District, showing its topography, has attracted considerable attention. I am going to ask R. S. Owen how he made it.

*Mr. Owen:* The topographic map of Cutler Drainage District is the result of a survey made by the transit and stadia method. Readings were taken on the division line between marsh and lowland and between lowland and highland. These readings were later plotted and the map was drawn. This survey was made in the late summer and fall before the leaves were off the trees and underbrush, and while the marshes were wet and soft. As many land corners as could be found were located by this survey and plotted on the map. Later in the winter a land survey was made in which all section corners and quarter corners were located. Ties were made onto the topographic survey stations and these corners were plotted on the map. Then the sections on the map were ruled into forties and the area of marsh, lowland and highland in each forty was determined from the map with an instrument for measuring areas, called the planimeter. It might have been better had we made the section line survey first and the topographic map later, but the objections were that in making the topographic survey we could pick out stations and avoid soft ground and heavy leaved underbrush in the late summer and early fall. In the section line survey we had to run straight lines for a half mile, mile, or two miles, and we could run these lines much faster over the frozen marsh and through the leafless woods in the winter.

## THURSDAY EVENING SESSION

The meeting was called to order at 7:30 p. m. by the president.

Upon motion of Mr. Vaughan, Grand Rapids was selected unanimously as the place for the next meeting. Upon motion of Mr. Matheson a committee of three was authorized to draw up resolutions to be presented to the convention at its last session. Mr. Jones announced that the proceedings of the convention would be published in pamphlet form provided sufficient funds could be secured. Mr. Coddington suggested that the pamphlet be made a directory of business firms ready to serve the drainage public, and that the funds secured from such advertisers be used for the publication of the pamphlet. Mr. Reeves assured the association that business firms would be ready to co-operate in this way. Upon motion of Mr. Vaughan by-laws were adopted providing for a Committee on Legislation, a Committee on Standardization of Benefits and an Auditing Committee. The program for the evening then began.

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## HOW TO HANDLE DRAINAGE BONDS

PERCIVAL BROOKS COFFIN
*Room 308 New York Life Building, Chicago, Illinois*

We have thus far uncovered but four ways of taxing land:
*First:* The Ad Valorem Tax
*Second:* The Acreage Tax
*Third:* The Benefit and Damage Tax
*Fourth:* The Commodity Tax

The *Ad Valorem Tax* provides, as you know, for the appraisal or assessment of land and the levy of a tax against it on a percentage basis to an amount necessary to meet the requirements of the entire municipality.

The *Acreage Tax,* which is less seldom used, and is more common in the southern states than in the northern states, provides for a fixed charge per acre of land or per city lot, irrespective

of the improvements upon the property or the value of the land taxed.

The *Commodity Tax* is also seldom used in the northern states, but many of the levees along our great rivers are maintained by a tax on cotton at so much per bale.

It is the *Benefit* and *Damage Tax* to which I particularly desire to call your attention today, for it is through this method of taxation that your drainage districts are supported. This tax, as you all know, is created in order to distribute equally, in accordance with the earning power of the land, the cost of public works, which will tend to increase the earning power of the farm, or the beauty and utility of city property. Methods have been devised to fund into bonds, or in other ways to mortgage the incomes which municipalities derive from these taxes, in order that our works for the public good may be quickly completed and the benefits derived therefrom be in some measure borne by succeeding generations. This theory is, in the main, sound; although legislators are likely to overlook the fact that interest charges for money borrowed, largely increases the cost of public improvements, and whenever bonds are issued maturing for a period of time extending beyond the life of the improvements created from the proceeds thereof, the funding of such a tax becomes a burden to the community rather than benefit to it. In fact, a wise discretion should be exercised by municipalities in the creation of debt and every safeguard should be thrown about them to make the creation of such debt a slow process and prevent foolish expenditures, which in turn come back to plague the municipality.

The laws of this state governing the organization of drainage districts and their administration are, in my opinion, most excellent; although they have the faults which are common to all laws that have been evolved, piecemeal, from the legislature; and although your laws provide a cumbersome and sometimes an impractical way of procedure, which might well be remedied without lessening their efficiency, nevertheless, after your drainage districts have been properly organized and benefits and damages determined, the property owners in such districts have

a fair and more equal distribution of costs than those of the districts in any other state with which I am familiar.

In trying to determine the factors which tend to make drainage district bonds popular I want to call your attention to three features which every dealer in such bonds must recognize:

*First:* Is the bond good?

*Second:* Is the bond merchantable?

*Third:* Is it profitable to deal in such bonds?

The drainage tax is an intimate proposition, for within the limits of the drainage district there are seldom more than two hundred families and it is from the work of these families that the tax, and ultimately the bonds based thereon, must be paid. Therefore, it is well if a drainage district is owned by farmers who are working the soil, who have had some experience in the character of soil contained within that district and who have a loyalty and a belief in the success of the district.

Then, it is necessary to determine the cost of the work necessary to be done to make such lands fertile and, furthermore, the effect that drainage will have upon the soil. The Wisconsin method of referring these matters to the Agricultural College of the State University is, to my mind, a wise safeguard to the bondholder, as well as a profitable one to the landowner.

Having determined these two points, we next seek to know whether the drainage districts have been properly engineered to be effective, and whether seepage, as well as surface water, can be successfully handled. This, of course, involves the study of the subsoil, of the outlets, and of the geologic formation of the district. You will note that I am not discussing levee districts which are organized to guard against the encroachments of a great river or of districts organized to carry off flood waters from a drainage basin, but districts organized primarily to drain marshy soil where the handling of seepage has much to do in determining the success of such undertaking.

Having satisfied ourselves that the farmers want the improvements and will be benefited thereby, we must next determine whether proper steps have been taken to organize this district and to levy a valid tax thereon; for I will ask you to remember that a drainage tax constitutes a fixed fund and any bonds

payable therefrom are payable from that fund alone, and if through any mistakes, either intentional or unintentional, a valid tax lien has not been affixed to the land, then the whole bond structure falls to the ground. Therefore at this stage of the proceedings it behooves us to know that not alone has the benefit tax been properly levied and spread upon the books for collection, but that the taxing power of the district, i. e., the sum total of the benefits determined (not the immediate tax levied), is sufficient to amply provide for the payment of the bonds issued against such tax and the interest accruing to such bondholders.

Having satisfied himself that the bonds are good, the bond dealer must then determine whether they are merchantable. It is seldom that any people have the vision to invest their own savings in bonds issued by municipalities near at hand, and hence your bonds must be distributed to a foreign clientele and therefore must be issued in manner and form to meet their requirements. The availability of your bonds for certain markets depends almost entirely upon the laws governing the investment of trust funds, in the states where capital has accumulated and the demand for long-time investments exists; in other words, the creditor states differ from the debtor states. It is beyond your control to change the requirements made by the boards, commissions, or law givers of any of the states. To illustrate this point succinctly let me take the city of Chicago and the city of Indianapolis. For some reason best known to themselves, the Savings Bank Commissioners of the state of New York do not admit the bonds of the Sanitary District of Chicago as legal investment for such banks, and savings banks of the state of New York have for annual investment $784,000,000. These commissioners have, however, admitted to their list the bonds of the city of Indianapolis, whose bonds are in nowise any better than those of the Sanitary District of Chicago; but by reason of this fact the city of Indianapolis' bonds can be sold at prices to yield a return fully one-half of one per cent. per annum better than Chicago can get for its bonds. Drainage district bonds, because of the fact that they are based upon a benefit tax, and are not payable from ad valorem taxes, are not

available for trust funds or savings banks or fiduciary institutions. In fact are not available for any special markets and must be sold in the open market to investors who can purchase where they please and in competition with mortgages, industrial bonds, public utility bonds, and other like securities.

The third thing for the dealer to determine is whether there is any profit to him in the sale of such bonds. I find it to be a common impression that the dealer in bonds is a parasite, and some method should be devised by municipalities to dispense with his services; but I believe that I can convince you that in our present complicated civilization—controlled by competition and stress—it is necessary for a municipality to have a dealer or a financial agent who will assume the task of studying the markets carefully, and preparing bonds to meet such market conditions as are available, for distributing them with speed and certainty. For this service some one must be paid, since the drainage district cannot under the very nature of its organization do effective work of this kind. The dealer or fiscal agent must also be prepared to advance money to the district as it is needed for purposes of construction, and, if necessary, await his time to distribute the bonds evidencing such indebtedness. In doing this he takes the risk of adverse market conditions arising from unforeseen disturbances, as well as the risk of convincing reluctant investors that securities issued by a distant municipality, of which they know nothing, are suitable for their savings. In fact, bonds cannot be sold without the enthusiasm engendered by personality; and this, again, a drainage district cannot give. Therefore, we find that a conscientious broker can relieve the drainage district of worry, care and annoyance, and can perform a necessary function, for a less cost than such district could do for itself. Please remember that neither the district nor the broker govern market conditions, but are creatures thereof. If the demand for money is greater than the supply, or if the holders of money are mentally depressed, the price of money will be high and bonds will sell cheap. If, on the contrary, money is plentiful in the credit centers where money is dealt in as a commodity and investors

are not under any distress of mind or psychological depression of any kind, then your bonds will sell well.

It only remains for me to suggest to you ways by which you can make your drainage bonds more salable.

First: Do not attempt to burden the farmer with an improvement costing him so much that he will not be able, from his reasonable surplus earnings, to pay for the same.

Second: Be careful to see that your benefits and damages have been properly determined on a scientific basis, based on earning power of the land, at a figure which leaves a margin of taxing power sufficient to provide for the completion of the work undertaken, even if the cost of such work should be more than the original estimates; for, once begun, a drainage district must be led through, until it is a productive municipal unit.

Third: See that all share honestly and equally in the profits of such improvements.

Fourth: See that a fund to care for repairs, depreciation or obsolescence is created and kept distinct from all other funds in order that ditches may at all times be made effective and the farmers may not be in danger of losing an entire year's crop because there is no money in the repair fund to be spent at a time when it is most needed.

Fifth: Be careful to see that the tax is properly levied, and in process of collection, before your first bond interest becomes due; then the municipality will always have a surplus in its treasury and will not have to anticipate the collection of its taxes by local borrowing in order to meet its foreign obligations. Please remember that the holder of your bonds does not know you, that he invests in your bonds not because he desires to engage in a business speculation, but because he desires to conserve his savings, and all he asks of you is to have money in hand promptly to pay the interest on your debt at the place where you have promised to pay it. Each drainage district should have four separate and distinct funds:

1. A bond fund.
2. An interest fund.
3. A maintenance fund.
4. An incidental fund.

Sixth: Continuous employment is more conducive to efficient service than intermittent, or temporary, employment. When your boards and commisioners have become proficient in their work, do not, because of some fancied local grievance, force their resignation. To my mind, it is well that drainage commissioners are appointed by court rather than elected, for the position requires much expert knowledge which can be gained only by experience, and the placing of inexperienced men in positions involving the earning power of your land is certainly very poor business. The drainage commissioners should be held to a strict personal accountability, but they should be given full power to turn this accountability into successful operation.

If you follow these suggestions, which are in no wise revolutionary, and handle the business of your drainage district with the same conscience and care that the wise merchant gives to his own, your drainage district bonds will—as time progresses—become better known, more highly approved and available for larger markets.

DISCUSSION

*Mr. Vaughan:* Mr. Coffin has handled the bond question so well that there is hardly anything to ask or add. We all want to sell our bonds at a good price. Unless it can be established that all of the proceedings in a district are legal, it is hard to sell the bonds. First see that your proceedings are legal. Then see that notices of your bond sale reach the main bond buyers of the country. Advertise in financial periodicals. Upon receipt of inquiries place the merits of your bonds stronly, but truthfully, before the prospective buyer. Tell the bond buyer the form you wish for the bond, but do not print the bonds until they are sold. The buyer may have notions of his own as to some of the smaller details of the bond and he will be better pleased if these are incorporated in the bond when it is printed. Furthermore, he may pay a little more for the bonds for this reason and it does not weaken the bond a particle. One district tried to sell typewritten bonds, but failed.

The bond broker is a middleman and he is useful. He knows and keeps track of the men who have the cash, and it takes men with cash to buy bonds.

The bonds are secured upon the assessments of benefits. They are a lien on the benefits, rather than on the land itself. It is for this reason that the statute prescribes that an assessment of benefits once approved by the court can not be lowered during the term of the bonds issued as a lien on that assessment.

*Mr. English:* Upon the readjustment of the assessment at the end of five years, can not the assessment of benefits against one parcel of land in a district be lowered, provided that on some other is raised a corresponding amount, and the sum of all the assessments is not lowered by the adjustment?

*Mr. Vaughan:* No. In the readjustment we must assume that the parcel of land assessed the highest in proportion to its actual benefits is correctly assessed, and that the assessment against the other parcels is too low and must be raised to conform with this datum plane.

*Dr. Sherwood:* I know of a forty that has benefits of twenty dollars an acre assessed against it and it is all high, dry sand that is half a mile away from a ditch and the benefit does not amount to a cent. It was by an oversight that this benefit was assessed against this forty, yet it crept into the assessment roll and was there when the bonds were sold and is there yet. The benefit to this forty is absolutely zero, yet the drainage tax is five dollars an acre. You would have to raise the assessments against the rest of the land in the district as high as the sky to base them on the datum plane established by this error. If that is the law, it is unjust.

*Mr. Vaughan:* In this unusual case it does seem unjust, but the security of the bonds must be kept sacred.

*Mr. Jones:* If A pays his drainage tax in full and the balance of the land owners choose to sell bonds, are those bonds a lien on the benefits assessed against A's land?

*Mr. Vaughan:* If an additional assessment is necessary to pay the bonds A will have to pay his share of this, and such additional assessment will be a lien on his land. The bonds are a district obligation and in the event of their forfeiture A's land is held as liable as any land in the district. A merely escapes having to pay interest on his drainage tax. He must shoulder his share of responsibility for the security of the district bonds.

*Mr. Hanna:* Our cumbersome law hurts our bonds. If the court instead of the jury adjusted the benefits it would be better. Banks refuse to buy the drainage bonds and that scares the local people. Outside people are buying Portage county drainage bonds, but our own people are buying bonds of distant enterprises.

*Mr. Coffin:* If a local man buys a local bond, the local assessor is apt to hear of it and the bond is taxed.

*Mr. Lucas:* What is the common practice as to the date of retiring the bonds?

*Mr. Vaughan:* In central Wisconsin they run from four to nineteen years, to give the land a chance to pay for its own drainage.

*Mr. Lucas:* Do you cash all of your bonds at once?

*Mr. Vaughan:* We keep enough money in the bank to pay our contractor.

*Mr. Lucas:* I do not sell the bonds at all, but get the local trust companies to loan money upon the bonds as security, with the provision that the whole issue can be retired whenever the land owners choose to pay their drainage tax.

*Dr. Sherwood:* This is the first time I ever heard of a bond being retirable at will.

*Mr. Coffin:* Such a bond would not sell. Furthermore, I think the trust companies are acting illegally when they loan money upon the bond as security.

*Mr. Lucas:* They are glad to do so, and it is the most convenient plan I have hit upon.

*Mr. Ames:* In our district they all paid their drainage tax in cash. We did not have to sell any bonds or else we probably would have made some mistake doing it. We made a mistake with everything else we tackled.

*Dr. Sherwood:* The bonds should be so printed that the interest on them is not due until after tax paying time each year. I made the mistake once of overlooking that. The interest was due each year a few weeks before taxes were due and those weeks were anything but comfortable for me. I usually tried to go deer-hunting at that season of the year, but even then the bond holders looking for their interest found me. You can not

compromise with those Shylocks any more than you can compromise with a town board that is inclined to be mulish. And now I want to forget about drainage bonds for a moment and tell of the bonds of love between me and one town board in this state.

In one district of which I am a commissioner the town board would not agree to anything unless it was to let us do all the work and then they would not agree to it. So we built them three miles of roads on section lines—better roads than they ever saw before. We built the roads out of the spoil banks of our ditch, and we did such a good job that the town board tried to sue us for damages because we had done the job so well. So I picked out the meekest and mildest man I knew as a mediator. He had such absolute self-control that he could sit on a tack for an hour without letting anybody know that anything was hurting him. He had the patience of Job and the diplomacy of an English statesman. Like an innocent lamb he began to bleat with that town board; then he began to flirt with them; then he tried to reason with them, and then the lamb became a roaring bull, but he gave up the fight the maddest man I ever saw. My club was better than his diplomacy and we gave the town the roads in spite of itself. One land company owned about 14,000 acres of land, or about three-quarters of the taxable property in the town. The town board represented a clique that did not own an eighth of the property in the town, and yet they taxed this company for the construction of expensive bridges and macadamized roads that benefited only one small corner of the township. But we finally got the better of them and assessed the town $25,000 for benefits to highways. Of course the big land company had to pay three-quarters of that but it was sweet to know that the enemy had to pay the other quarter, and we got the roads where we wanted them. New and progressive settlers are coming on the land and very soon will be able to control the town election, and then they will get some more good roads for the whole town and not merely for a part of it. I could tell you, too, how that same bunch fought the assessment of benefits. They were perfectly willing to have their land drained, but just as willing that

somebody else should pay for it. They got a jury of their own clan and reduced the assessment of benefits on their lands from thirty dollars an acre to seven dollars an acre. The tax was only about one-fifth of the benefits and so we had a wide margin. We fought the devil with fire and lowered all of the assessment of benefits to this lower plane, and made the tax almost equal the benefits. It does not make any difference whether the benefit is thirty dollars and the tax is one-fourth of the benefit, or whether the benefit is ten dollars an acre and the tax is three-fourths of the benefit. The judge conceded that our arithmetic was correct, and that justice was on our side, but that the law was against us. So they beat us on this point after a merry race.

Juneau county has probably more marsh land than any other county in the state. Drainage is its salvation. Yet in that county we have a county board that voted $500 of county money to defeat the organization of more drainage districts in that county. Add to that a few small-bore lawyers who make their bread and butter inciting opposition to drainage. Add to that jurors who do not know whether they are fixing the assessment of benefits, or the cost of construction, and you see what we are up against in Juneau county. Remonstrances against assessments of benefits should be heard by the court without a jury. Only those who have a poor case demand a jury trial, or rather, a jury lottery.

This convention stands adjourned till nine o'clock tomorrow morning to give the president time to cool off.

FRIDAY MORNING, DECEMBER 11, 1914.

The session began at 9 o'clock with Dr. Sherwood in the chair. He announced the appointment of the following committees:

Committee on Legislation—Chm. B. M. Vaughan, Grand Rapids; P. J. Myers, Racine; G. E. Brown, Madison; W. F. Wolf, Appleton; J. H. Kamper, Franksville.

Committee on Standardization of Benefits—Chm. W. B. Coddington, Plover; A. R. Whitson, Madison; A. E. Matheson, Janesville; T. H. Hanna, Stevens Point; R. S. Owen, Madison.

Auditing Committee—Chm. F. M. Ames, Brooklyn; A. C. Lindas, Deerfield; J. Q. Daniels, Babcock.

The address of the morning was then announced.

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## REVISION OF OUR DRAINAGE LAWS

PETER J. MYERS,
*Attorney at Law, Racine, Wis.*

The subject which has been assigned to me is so very broad that it is going to be rather hard to do it justice. In considering the subject of drainage legislation in our state, certain matters of history and recognized principles of law must be given consideration as controlling and fixing the limits of legislation.

The Northwest Territory, out of which the state of Wisconsin was carved, was organized under the Ordinance of 1787. In that ordinance particular provision was made in respect of the preservation of certain navigable waters. As a part of the organic law, it was ordained as follows:

"The navigable waters leading into the Mississippi and the St. Lawrence and the carrying-places between the same shall be common highways and forever free as well to the inhabitants of said territory as to the citizens of the United States and those of any other state that may be admitted into the confederacy, without any tax, impost or duty therefor."

Wisconsin is noted for the number and beauty of its inland lakes and for its rivers and streams.

The character of the title which the state has in and to these lakes and rivers and its duty in respect of their preservation have been fixed by numerous decisions of our supreme court. The state holds title to the bed of our inland lakes in trust and under the conditions of the Ordinance of 1787, for the use and benefit of all the people of the several states of the Union, and the legislature cannot lawfully authorize the destruction of any of them, for the reason that the state's title is only as trustee and it is charged with the duty of the preservation of these lakes.

When the territory of Wisconsin was formed, the title to all lands not disposed of to individual settlers remained in the federal government, and it was provided in the act enabling the people of the territory to form a constitution and state government and to petition for the admission of the territory into the Union as follows:

"That said state shall never interfere with the primary disposal of the soil within the same by the United States, nor with any regulations congress may find necessary for securing the title in such soil to bona fide purchasers thereof."

The surveys made by the general government of the lands which comprise our state show that very large tracts, aggregating several million acres, were wet and overflowed, and these were returned by the surveyors as swamp lands. The condition of these lands prevented the general government from disposing of them. Their drainage was recognized as essential, not only in order that the lands themselves might be made tillable, but to the health of the people who might inhabit surrounding territory. It was in the very nature of things impossible for the government of the United States to attend to the drainage of these lands, and in order that the work might be accomplished, the acts of September 28, 1850, and of March 12, 1860, known as the Swamp Land Acts, were passed by congress. The purpose expressed in these acts was "to enable the several States to construct the necessary levees and drains to reclaim the swamp and overflowed lands therein." It was provided in the

body of the Swamp Land Act that, as to the states included, the whole of the swamp and overflowed lands made unfit thereby for cultivation and remaining unsold on or after the 28th day of September, 1850, are granted and belong to the several states respectively in which said lands are situated.

Under this act, the state of Wisconsin took title in fee simple to the immense area of land to which reference has been made. Portions of these lands are to be found in almost every county of the state. The state of Wisconsin has since sold these lands and the moneys derived therefrom either have been or remain to be devoted to the reclamation of these same swamp lands. The policy of the state is therefore fixed, in that it is its duty to aid in providing a means for the reclamation of the swamp lands, and it is the duty of the legislature to provide the most practicable and feasible law which can be devised for the carrying out of that purpose.

The question before us is, Are our present drainage laws adequate and sufficiently broad to meet the situation as we find it; and if not, how can we improve the laws within the limitations fixed by the Ordinance of 1787 and the decisions of our supreme court based upon the provisions of the ordinance to which I have referred?

The first question must be answered in the negative. The drainage laws are decidedly inadequate to meet the situation that exists in this state, in that they do not permit us to remove mill-dams from streams which are either navigable in fact or in law. The drainage laws do not expressly authorize the drainage district and its officers to enter upon and destroy any navigable body of water in order to further the drainage of our marsh lands. Our supreme court has gone to great length in construing the trust created in the state by the Ordinance of 1787, and it is certainly holding the trustee to a strict accounting. Perhaps the view of the supreme court is right and that the very strict guarding of the public rights of navigation upon the so-called public waters of the state will result in benefit to a greater number of people than the reclamation and cultivation of our vast areas of marsh lands. But personally, and with all due respect for the court, I am inclined to differ with the court

and to agree with the dissenting opinion of the late Mr. Justice Bashford in the Horicon case.

In our future legislation, however, we must carefully consider and keep within the bounds fixed by our court, and not put upon the statute books of our state a law which the court would not sustain. It seems to me that there is a middle ground pointed out by the decisions which can safely be adopted by our legislature, and which I believe the supreme court would hold to be valid, and which would protect the public rights of navigation and would also bring about the reclamation of the greater portion of swamp lands. I will refer to this later on and will first consider with you the decisions of our supreme court bearing upon this question. It may seem to be out of place to refer to these decisions before lawyers who have had to do with the organization of drainage districts in this state and who have been bumping their heads against mill-dams and other lesser obstructions to drainage. These decisions, however, are the law of the land and our legislation must be framed to meet the situation as it exists.

It has been held by a long line of decisions that the rivers and streams of this state capable of floating the products of the country, such as logs and rafts of lumber, to mill or market, are common public highways, even though these streams were never meandered and were never declared navigable by statute.

Whistler vs. Wilkinson, 22 Wis. 572.

Sellers vs. Union Lumber Co., 39 Wis. 525.

In the case of Olson vs. Merrill, 42 Wis. 203, it was held that it was not essential to the public easement that this capacity be continuous throughout the year, but that it is sufficient that the stream have periods of navigable capacity ordinarily recurring from year to year and continuing long enough to make it useful as a highway.

These decisions make nearly every stream and creek in the state of Wisconsin a public highway. The usual drainage proceeding consists of deepening, widening and straightening one of these streams and in the construction of lateral ditches leading into the streams. The bodies of marsh land sought to be drained are usually located near the headwaters of one of our

streams or rivers or of a creek emptying into one of our streams or rivers. What we seek to do in all drainage proceedings is to lower the line of saturation in the soil and remove the surplus water. In order to do this we usually lower the bed of the river by dredging the same and by removing obstructions. Generally, and except in the case of the removal of a mill-dam, the straightening, deepening and widening of the watercourse results in improving the general navigability of the creek or stream in question.

In the later cases of Horicon Drainage District, 136 Wis. 227, and Shepard Drainage District, 140 Wis. 327, the court has gone even further than in the earlier decision and has held that where a mill-dam had been erected and maintained across a non-navigable stream for more than twenty years, but where the pond created by the dam was navigable in fact (in the Shepard case the pond was not more than two hundred feet wide and something over a mile in length), the artificial condition became the natural condition, and that the dam could not be removed and the pond destroyed by a drainage district.

In both the Shepard and the Horicon cases the court decided that the statute authorizing drainage commissioners to condemn "riparian rights, rights of flowage and water power" does not authorize the destruction of bodies of water which are navigable in fact. In both of these cases the court intimates that an act of the legislature authorizing the destruction of navigable waters by a drainage district could not be upheld. Such an act has never been passed by the legislature and the question as to whether or not the legislature has power to authorize the destruction of any public waters has never really been decided by our supreme court, and all that was decided was that the existing laws did not authorize the removal of the mill-dams under the circumstances of those cases. What the court would finally decide upon this question were it presented is merely a matter for speculation, and I refuse to speculate further than to say that in my opinion and in the light of the former decisions I believe that the court would not sustain such an act of the legislature.

The case of Trempealeau Drainage Dist., 146 Wis. 398, de-

cided June 1, 1911, seems to throw some light upon the subject, and I think constitutes a guide for future legislation upon this subject. In that case the drainage district sought to change the course and deepen and widen a stream emptying into the Mississippi River. There were several shallow bodies of water called lakes, ponds or sloughs, scooped out in the bed of the river by heavy rainfalls and freshets. The work proposed by the commissioners was confined within the broad bed of the river as it then existed and consisted of excavating a channel and confining the waters which naturally spread out over the ground and formed the so-called lakes, to a narrow channel. The trial court found that the proposed change in the channel of the Trempealeau river would greatly improve its navigability. The drainage law authorizes and clearly confers upon drainage commissioners the power to change the course of a navigable stream when such change would improve its navigability. The act also provides that the course of no navigable stream shall be changed unless such change will improve the navigability thereof, and further provides for the cleaning out and removing obstructions from the course of navigable streams. The supreme court held as follows:

"We think that the state, as the sovereign authority, with power to regulate and keep free the navigable waters of the state, may grant the authority conferred by this statute. It has always been deemed the right of the state to do whatever might be appropriate to regulate and improve navigation."

The question of hunting and fishing rights was also considered and disposed of in this case, in the following language:

"The public rights of navigation and of fishing both exist in the navigable waters of the state, each independent of the other, and the state holds title to the beds of such waters in trust for such public purposes. The state also has the power as such trustee for the public to regulate these public uses of navigable waters as to best accomplish and promote the public interests. The legislature has provided that drainage schemes may be undertaken if they promote the public health or general welfare. To accomplish these in regions connected with navigable waters may in some respects affect the public rights of

navigation and fishing. As to the rights of navigation the legislature specifically provides the restriction that no change shall be made in the course of a navigable stream unless the change will improve navigation. We have found that this right will be improved by the contemplated improvement. The rights of fishing and hunting will be affected by the contemplated improvement in that the present navigable waters in the district afford a superior condition for hunting and fishing to that which will exist in the condition of the navigable waters after the proposed changes in the course of the Trempealeau river have been made. The legislature must naturally have contemplated that hunting and fishing might be impaired in some degree as an incident to such a regulation of navigation and in promoting of the public health and general welfare by a system of drainage. It must be assumed that the legislature in executing its governmental functions intended to guard the public uses of navigable waters against unauthorized improvement and subjected them only to such regulations as the public interests require and as are consistent with the preservation of public rights. Can it be said in the instant case that the state in authorizing this drainage scheme, acting through the agency of a drainage commission, has infringed on the public rights of fishing and hunting in violation of the trust for the public to which the state holds the beds of navigable waters? To constitute such an infringement of the rights of fishing and hunting, it must appear from the facts and circumstances presented that there is an unauthorized impairment thereof in the light of the duty of the state to regulate other public interests. Applying these considerations to the situation presented here, is the difference in the fishing and hunting in the drainage district, as they are and as they will be hereafter, so substantial as to violate the trust to the public in this regard? True, hunting and fishing will be somewhat impaired in the navigable waters of the drainage district, but not to an extent amounting to a substantial infringement on the right when considered in connection with the regulation and guarding of other public interests here involved. The restriction on fishing and hunting under the present conditions is not in its nature and magnitude

such a deprivation to the public as to be a violation of the trust to the public. It cannot be said therefore to be an unauthorized exercise of the legislative power for carrying out the functions and duties of the state consistently with such public trust."

The statement of the law with reference to navigable waters would be incomplete if I did not refer to the Water Power Act passed by the legislature of 1913, and being chapter 69—M of the statutes, sections 1596—50 to 1596—79. Under this act the question of erecting, maintenance and improvement of mill-dams, together with the regulation and control of the navigable waters of the state, are placed in the hands of the railroad commission, and the railroad commission now constitutes the court to which dam owners and others must apply for permission to erect and manner of control of mill-dams. Now as to the remedy.

The legislature of 1910 appointed a committee on water powers, forestry and drainage, which made a very thorough investigation, and among other things recommended the creation of a conservation commission to have charge of the forestry and navigable waters of the state. They also reported a drainage bill, being Exhibit E of the report. The original draft of that bill was made by me. It did not provide for any material changes in the then existing law, except in so far as it related to navigable waters; and the following are the changes provided by that bill:

"8. If it shall appear from said report, or upon the hearing upon said report, that it will be necessary to enter upon any of the navigable waters of the state or remove any mill-dams or obstructions from navigable streams, or clean out, widen, deepen and straighten any navigable stream, the said drainage commissioners shall, within thirty days after the filing of the order confirming the preliminary report, file with the conservation commission of the state of Wisconsin, a certified copy of the petition and of all other papers and orders filed with the circuit court in said proceeding, together with an application setting forth that the public health and the public welfare demand that certain mill-dams or other obstructions shall be removed from a navigable stream, or that it is necessary to

enter upon any navigable stream for the purpose of straightening, cleaning out, deepening and widening the same, and that said proposed work will not permanently obstruct or impede the general navigability of such navigable waters, which application shall be duly verified and shall be accompanied with detail plans, profiles and specifications of the work proposed in and upon said navigable waters.

"9. Upon receiving an application under the provisions of this act, the conservation commission shall forthwith set a time and place for the hearing of such application, which time shall not be less than three weeks nor more than eight weeks from the date of the filing of the application, and the place shall be at the court house at the county-seat of the county in which such proceeding is pending, or at some other place if the commission shall deem the latter more convenient.

"10. The conservation commission shall thereupon give to the drainage commissioners a notice of the time and place of said hearing, which notice shall be published by the drainage commissioners at least once each week for two successive weeks preceding such hearing in one newspaper in each county in which any part of said proposed district is located, and satisfactory proof of publication of the notice of hearing on such application shall be filed by the applicants with said conservation commission. Said drainage commissioners shall also serve a copy of said notice of hearing upon the secretary of state of Wisconsin, and also upon the attorney general of the state of Wisconsin at least ten days prior to such hearing, and satisfactory proof of such service shall be filed by the drainage commissioners with said conservation commission.

"11. At such hearing or any adjournment thereof, the conservation commission shall carefully consider such application and shall hear such drainage commissioners by counsel or agents in support thereof, and any person, corporation or municipality in person or by counsel or agents in opposition thereto, and upon demand of the drainage commissioners or any person or corporation or municipality appearing in opposition, take evidence and testimony, orally or by deposition, in support of the application or in opposition thereto.

"12. Said conservation commission shall have power to subpoena witnesses and to compel the production of books, documents and papers, to administer oaths, and to punish for disobedience of any order of the commission or any commissioner, or of a subpoena, or for refusal of a witness to be sworn or testify.

"13. If it shall develop upon such hearing that the plans, profiles and specifications proposed and submitted by the drainage commissioners are not best adapted for the work proposed on such navigable waters, then said conservation commission may modify, amend or make new plans and specifications, and approve such plans, profiles and specifications as in their judgment are best adapted for such work.

"14. Upon the conclusion of the hearings on said application as above provided, said conservation commission shall carefully consider all the evidence submitted, and if said conservation commission or a majority of them shall find that the work proposed is necessary and will promote the public health or will promote the public welfare and will not permanently obstruct or impede the general navigability of any such navigable waters, the said conservation commission shall forthwith grant and issue a certificate that the work proposed is necessary and will promote the public health or will promote the public welfare, and will not permanently obstruct or impede the general navigability of such navigable waters, which said certificate shall be filed in the office of the secretary of state, and a copy thereof, certified by the secretary of state, shall be filed in the office of the clerk of the circuit court in which said drainage proceedings are pending and in the matter of said proceedings.

"15. The said conservation commission shall also approve the plans and specifications and profiles for the work proposed upon and in such navigable waters, or such amended and modified plans, specifications and profiles which they may adopt, and shall file the same in the office of the secretary of state, and shall file with the clerk of the circuit court in which said proceeding is pending, and in the matter of said proceeding, a duly certified copy of said plans, specifications and profiles.

"16. Such certificate and the plans approved shall constitute

conclusive authority to such drainage commissioners to do any acts necessary in and about the surveying, laying out, constructing, repairing, altering, enlarging, deepening, widening, protecting and maintaining any ditch, drain, levee, or other work upon the navigable rivers, streams or other navigable waters both within and beyond the limits of the drainage district; the procuring, purchasing or condemning under proceedings similar to the proceedings had under the award of damages hereunder, of riparian rights, rights of flowage, dams and water powers in such navigable streams, channels and waters, both within and beyond the limits of the drainage district.

"17. If upon the conclusion of said hearing on said application, said conservation commission or a majority of them shall find and determine that the work proposed in said navigable streams and waters is not necessary and will not promote the public health or will not promote the public welfare, or will permanently obstruct and impede the general navigability of such navigable waters, then said conservation commission shall refuse to grant said certificate and refuse to approve said plans and specifications and shall make an order refusing to grant the same, and shall file said order in the office of the secretary of state, and a copy thereof, certified by the secretary of state, shall be filed in the office of the clerk of the circuit court of the county in which said drainage proceeding is pending; and upon the filing of such certified copy of said order, if it shall be made to appear to the court that the objects of the petition cannot be accomplished without entering upon such navigable waters, then the court shall make and enter an order dismissing the petition and all proceedings had thereon, and costs shall be taxed against the petitioners and judgment entered therefor as in section 1379—21 hereinafter provided.

"18. If said conservation commission shall grant and issue to the drainage commissioners a certificate that the work proposed is necessary and will promote the public health or will promote the public welfare, and will not permanently obstruct or impede the general navigability of such navigable waters, then and upon the filing of such certified copy of said certificate in the office of the clerk of said circuit court in which said

drainage proceeding is pending, said drainage district shall be and is hereby declared to be organized as a drainage district, by the name mentioned in said petition, or such other name as the court shall fix, with the boundaries fixed by the order confirming the report of such commissioners, to be a body corporate by said name fixed in said order, with the right to sue and be sued, to use and adopt a seal, and to have perpetual succession, and all proceedings in said matter shall be stayed until after said conservation commission shall have rendered its decision.

"19. The commissioners appointed as aforesaid and their successors in office shall, from the entry of said order or confirmation and the filing of such certificate of the conservation commission, constitute the corporate authority of said drainage district and shall exercise all the functions conferred on them by law, and do all things and perform all acts necessary to the construction and preservation of the proposed work."

The succeeding legislature did not see fit to adopt the recommendations of this committee, and no conservation commission was ever created. At the following session of the legislature, the writer prepared a bill along these same lines, identical in form, except only that the railroad commission was substituted in the place of the so-called conservation commission. After conferring with Mr. B. M. Vaughan of Grand Rapids and other lawyers interested, this bill was introduced in both the senate and assembly, but for some reason it failed to pass. In view of the fact that the railroad commission has now been given jurisdiction over navigable waters by the Water Power Act, it certainly seems to me that at this time there would be no difficulty in securing the passage of this law. If such a law is enacted, I believe that we will have surmounted a very great difficulty. Plans can be prepared and the work so executed that even where a mill-dam is removed, the stream can be left in as good or better condition as to navigability than before, and in fact the same depth of water that may have existed above any mill-dam prior to its removal can still be left there by deepening the channel and by providing for a submerged dam, as was done at the city of Horicon, where Mr. A. J. Bracken was in

charge of the work and so successfully accomplished the drainage of the greater part of the Horicon Marsh since the decision of the supreme court.

Since the enactment of the Water Power Act, the hunters have had the Horicon proceeding before the railroad commission, and the commission has sustained the work done, on the ground that it will improve the navigability of Rock River up through the Horicon Marsh.

If we are going to accomplish anything along the line which I have suggested, we have got to work together. The amendments which we desire to the drainage law should be worked out and agreed upon before the bills are introduced into the legislature.

This plan would necessarily involve the repeal of chapter 633 of the Laws of 1913, in which the preliminary report is done away with. It is my experience in working under the provisions of chapter 419 of the Laws of 1905, in which the preliminary report was first provided for, and which law was drafted by a committee of drainage lawyers who understood the necessary steps of a drainage proceeding, that the preliminary report is a very important step for the reason that it fixes for all time the feasibility of the drainage scheme, and under the law, as it existed prior to the amendment of 1913, the preliminary report became final and conclusive excepting only as to new parties who might be brought in later on, unless an appeal was taken to the supreme court within thirty days. Under the amendment of 1913, the burden of establishing the feasibility of the entire scheme is placed upon the petitioners in the first instance. My objections to this amendment are:

First: That it places a great burden upon the active petitioners in any drainage proceeding, who are usually only one or two in number.

Second: The proceeding is complicated from a legal standpoint and will prevent and has prevented within the last year the institution of proceedings looking towards the organization of drainage districts.

Third: It makes it compulsory upon the petitioners to have a survey made under the supervision of the college of agricul-

ture and the securing of a report from the college of agriculture as to the quality of soil, feasibility of draining the area proposed to be drained, the benefits, cost of construction and distribution of the benefits. I wish to say here that I have a great deal of respect for the college of agriculture of our state and the work it has been doing, but I regret to say that I have found a great deal of hostility among some of our farmers towards the college of agriculture and the so-called "book farmers."

The college of agriculture is doing a great work, not only along the lines of reclamation, but also along other lines equally important. However, we have got to meet a practical situation in dealing with land owners who are often ignorant and forty years behind the times in their methods of farming. The intelligent, up-to-date farmer is never a remonstrant in a drainage proceeding where a competent engineer has laid out the work. Or, if he does have a real grievance and files a remonstrance, the commissioners usually meet him and adjust the differences out of court.

Our drainage laws have got to be so framed and we must be so organized that we can meet and successfully combat with the ignorant and prejudiced land owner and his high-priced lawyer on the question of assessment of benefits. It is a fact to be regretted that the great majority of the farmers in our state are not as successful as they would be if they applied some of the so-called book-farming to their work. Nevertheless, this condition exists and it has got to be recognized. To illustrate some of my experience along this line: Within the last year Brother Matheson and myself were trying a case in the circuit court of Walworth county, which involved the assessment of benefits in the Troy Drainage District, now being organized. In support of the assessment of the commissioners, we produced the testimony of two of the best farmers in Racine county, who have had actual experience upon their own farms with reference to the reclamation of marsh lands, to testify as to benefits which would result to the tract of land in question. Both of these men had a thorough knowledge of the science of farming and a thorough knowledge of soils. These men were criticized as being imported book-farmers from Racine county and their testi-

mony ridiculed by the attorneys for the remonstrant; and what hit us the hardest was that the jury saw fit to adopt the position of the attorneys for the remonstrant and cut down the assessment of benefits from $7,200 to approximately $1,300.

I fully realize the necessity in some portions of the state of having a report on the quality of the soil from the college of agriculture, but I think that this report should be made a part of the preliminary report of the commissioners.

There is also one other important amendment to the law which I would suggest, and that relates to the form of the remonstrance on assessment of benefits. Section 1379—20 provides:

"Any owner of lands or any easement or interest therein within said district, or any person or corporation affected by the proposed work, may file a written remonstrance five or more days before the day set for hearing on said report, and therein remonstrate against the whole or any part of the proposed work or any change of boundaries. Such remonstrance shall be verified by affidavit and shall set forth the objections of the affiant, whether they go to the jurisdiction of the commissioners or the court, or whether they rest on any other fact, as that some lands or corporations are assessed too high or too low or improperly, or that lands are assessed which ought not to be assessed or that lands or corporations should be assessed which are not assessed. * * *

"The circuit court for said county or the presiding judge thereof may fix a time at any term of court or appoint a special term for hearing the remonstrance, and on demand of any person or corporation assessed for benefits or awarded damages, may frame issues in said matter, impanel a jury and take its verdict upon the trial of said issues: (1) whether the amount of the damages awarded by the commissioners upon any land is excessive, or whether the damages allowed to any remonstrant's lands are inadequate; and (2) whether the assessment of benefits to any remonstrant demanding review by a jury is too high or too low; and the jury may award and assess the same." * * *

In the preliminary report the commissioners are required to

find and report whether or not the benefits will exceed the cost of construction. This is one of the issues upon the confirmation of the preliminary report, and if the proceeding is to go on, both the commissioners and the court must find that the benefits will exceed the cost of construction. If the commissioners and the court so find the drainage district is established and the commissioners ordered to proceed. The only thing that is left then is to lay out the work, award the damages and distribute the cost of construction in proportion to the benefits which in the judgment of the commissioners will be sustained by each tract of land in the district. The order confirming the preliminary report is final and conclusive, unless appealed from to the supreme court within thirty days. It seems to me that the question of proportionate distribution of the assessment of benefits should be in a case where the question of the assessment of benefits is being litigated by any individual property owner. Upon the trial which I have hereinbefore referred to, the trial court sustained objections to testimony which we offered tending to show that the assessment of benefits levied by the commissioners against the lands of the remonstrant were in proportion to the other assessments of benefits levied by the commissioners against the other lands in the drainage district. The court sustained this objection and we were held strictly to the proof of the probable increase in the reasonable fair market value of the land in question by reason of the proposed drainage plan. If the question were whether or not the lands of the remonstrant are assessed too high or too low in proportion to the assessments for benefits levied against the other lands in the drainage district, the question would be more fair and would protect the land owner who does not remonstrate. I would therefore suggest that section 1379—20 be amended so as to read as follows:

"Any owner of lands or any easement or interest therein within said district, or any person or corporation affected by the proposed work may file a written remonstrance five or more days before the day set for hearing on said report, and serve a copy thereof upon the attorneys for the commissioners, and therein remonstrate against the whole or any part of the proposed work or any change of the boundaries. Such remonstrance

shall be verified by affidavit and shall set forth the objections of the remonstrant, whether they go to the jurisdiction of the commissioners or the court, or whether they rest on any other fact, as that some lands or corporations are assessed too high or too low in proportion to the assessments for benefits levied against other lands in said district or improperly, or that lands are assessed which ought not to be assessed, or that lands or corporations should be assessed which are not assessed, or that damages allowed to any parcel, tract or easement in land or to any corporation are excessive, or that the plans for said proposed work should be changed, or that the boundaries of said district should be altered so as to include or exclude certain lands; or any persons or corporations to whom damages are allowed may remonstrate because they are inadequate. The circuit court for said county or the presiding judge thereof may fix a time at any term of court or appoint a special term for hearing the remonstrance, and on demand of any person or corporation assessed for benefits or awarded damages may frame issues in said matter, impanel a jury and take its verdict upon the trial of such issues: (1) whether the amount of damages awarded by the commissioners to any land is excessive or whether the damage allowed to any remonstrant's land is inadequate; and (2) whether the assessment of benefits against the lands of any remonstrant demanding the review by a jury is too high or too low in proportion to the assessment of benefits levied by the commissioners against the other lands in said district; and the jury may award and assess the same."

I wish to refer briefly to section 1379—25 of the statutes, with reference to the sale of lands for assessments. This section of the statutes provides for a departure from the general statute with reference to the sale of lands for taxes in the case of drainage assessments. My actual experience with reference to the sale of lands for drainage assessments has been very limited, and in the discussion I would like to hear from the attorneys who have had actual experience in the operation of this section of the law. I appreciate the fact that the purpose of this section has been to relieve counties from the payment of drainage

assessments and to place the burden entirely upon the land. Paragraph 2 of the law provides as follows:

"2. After the expiration of three years from the issuing of said certificate, a deed shall issue upon any certificate of sale for unpaid drainage assessment, in the same manner and upon the same notice or affidavit of non-occupancy now required for the issuance of tax deeds, which deed shall be in the form substantially the same as tax deeds, provided that no such drainage assessment deed shall cut off or adversely affect any drainage assessment or installment of any assessment falling due after the assessment or installment on which such deed was issued, or shall cut off or adversely affect any additional assessment or assessment for repairs that may thereafter be made or fall due. No tax deed shall cut off any drainage assessment, nor shall any drainage assessment cut off any tax except as otherwise provided by this section."

Paragraph 4 provides:

"In case that any of the lands so bid in by the county shall not have been redeemed or certificates assigned within the period prescribed by statute in relation to general taxation, the circuit court may, upon the application of the county commissioners or of any creditor or bondholder of the drainage district within which said lands are located, direct the treasurer of such county to offer such lands for sale at public auction in such manner as the court shall direct and upon the notice provided in section 1379—30*b*, report shall be made and deed issued in manner provided by sections 3168 and 3169 of the statutes, and from the moneys received from the sale of said lands the county treasurer shall first deduct any unpaid general taxes due the county and the costs of such proceeding and shall pay the balance of such moneys in the manner and to such creditors or bondholders as the court shall direct."

I can see no valid reason why special assessment for drainage should be put in a different class from any other special assessments, such as assessments for sewers and street improvements. I can see no reason why the general taxes should be made a first lien upon the lands ahead of the special assessment for drainage. This section certainly militates against

drainages bonds as a salable security. I can conceive of the origin of the provisions of this section. I believe it should be repealed and that we should get back to the original provisions of chapter 419 of the Laws of 1905 with reference to the sale of lands for drainage assessments.

There may be many other details in which the drainage law can be amended. It has been criticized by the supreme court as being loosely drawn. However, much good has been accomplished under the law. The subject is of vast importance to the state and to the people of the state. We are here without compensation, endeavoring to act for the public good. I believe that in the past there has been altogether too much tinkering, changing and fixing of the drainage law. I would suggest that at this meeting a committee be appointed whose duty it shall be to draft and present to the legislature such amendments to the drainage law as are desirable, after a full and complete discussion of the same, and that no bill seeking to amend the drainage law should be presented to the legislature for enactment unless the amendments have been passed upon and have the sanction of this committee as being necessary and proper. I do not wish to be understood as criticizing anyone. We have lacked an organization and organized effort. I have personally been just as guilty of attempting to secure amendments to the law, if not more so, than anyone here.

*Mr. Lucas:* I think I am conservative in regard to drainage matters. I think most attorneys who have been engaged in drainage work have also become conservative. I know Mr. Vaughan and Mr. Matheson are. One thing we dislike is to see the law changed at frequent intervals. We do not know what to depend on. I do not like to see the law tinkered with, although I must admit that I have done my share of tinkering with it. I prepared the law of 1911 under the direction of a sub-committee of the legislature, but I was not satisfied with it and neither was Mr. Vaughan or Mr. Meyers. It was merely to tone down a whim of Senator Teasdale. Some more changes should be made. The law should provide for drinking places for cattle, but it should prevent the pasturing of cattle on the lands adjacent to the ditch, unless the ditch is fenced. I would like to hear this question discussed.

At the session of 1913 I opposed the amendment striking out the first report of the commissioners. I told the committee of the legislature while I had sought the advise of those connected with the university in every district I had organized, yet I objected to being forced to go to the college of agriculture to get its judgment on the merits of a drainage proposition. I know that this has interfered with the organization of drainage districts since the passage of that law. I object to it. It is just as unreasonable as it would be to be compelled to obtain the judgment of the University on every foot of highway built in the state.

Last week I talked with an attorney who argued that a petition for a drainage district should be declared competent if signed by a single land owner, provided he gave a bond to cover the cost of the hearing in the event of dismissal. I am loath to reduce the number of petitioners below the majority now required. Unless a majority are in favor of the organization, there will be so many remonstrances that the litigation will make the work expensive. In such a case it is better not to attempt drainage until a majority can be secured.

*Mr. Jones:* It is due to the college of agriculture to say that the legislature of 1913 thrust a responsibility upon the college of agriculture, but did not provide any funds to aid in meeting that responsibility. The college has had to do the work with its regular staff in connection with other work of the Department of Soils. Since the passage of the law it has reported on fifty-nine drainage organizations, and no charge has ever been made by the college for its services. It has used the Soil Survey men to make the soil examination, and has been compelled to charge for the railroad and hotel expenses of these men. In one case it amounted to about thirty dollars, but it was usually less than ten dollars, and where the examination was made by a member of the regular staff no charge was made even for traveling expenses. To economize in time and travel some applicants for reports have been made to wait a month or two in some cases, but that delay is small in comparison with the delays that always do occur after the matter gets into court. In justification of the substitution of the report of the college of agriculture for the first report of the commissioners, I can say that

in the last year two drainage districts had the dredge on the ground and at work ninety days after the application for a report came to the college. In many cases the college has advised drains much deeper than those contemplated by the petitioners. The petitioners may disregard the advice of the college if they want to, but generally they have taken kindly to that advice. If they have not adopted the improved plans, they have frequently decided to wait until the time is ripe for the installation of the better drains recommended. Even this is better than to be plunged into court with half-formed plans. Under the old law the preliminary report of the commissioners was a farce. In many districts this report was only a form to be complied with, and did not furnish the court much data on which to base its judgment as to the merits of the proposition.

*Mr. Vaughan:* That has not been the case in my districts.

*Mr. Jones:* All districts have not had so good an attorney as yours had. I know a district in which the petitioners did not know which way the water would run on a particular marsh when they signed the petition. The commissioners were appointed and they reported to the court that the project was profitable and feasible, when neither the commissioners or the petitioners or the judge knew any more than they did in the first place concerning the feasibility or advisability of the project. It is a good thing to know these things before the petition is drawn, or any other expense is involved. Personally, I prefer to see the land owners engage a private engineer to make preliminary plans for them and to let the college help them if they desire it, by offering suggestions to the engineer, or by going over the ground with him after he has made his preliminary map. But in many cases a preliminary topographic survey can be made in but little more time than would be required to make the general examination of the area, and in such cases the college has made a practice of making the preliminary survey itself.

*Mr. Coffin:* I want to say that a report from the college of agriculture on the merits of a drainage proposition carries more weight with bond men in the sale of bonds than perhaps any other one thing.

*Mr. Matheson:* When I received notice of this convention I asked Mr. Oakley for suggestions. You all know that Wood and

Oakley examine the validity of more drainage bonds than any other law firm in the country. Mr. Oakley speaks from the standpoint of the man who examines bonds. He complains of the necessity of having to serve each landowner with a personal notice of his assessment. It is almost impossible to check that kind of a service of notice, and he feels that it ought to be sufficient to publish such a notice. He objects to the provision in our law which allows us to go ahead with only a part of the assessment confirmed. I differ with him.

Commissioners should have a term of five years at least. It will make them more efficient and cut out the expense of changing commissioners.

I think that we ought to be permitted to compare the benefit assessed to one parcel with that assessed to another. Our judge would not let us do that. He tied us hand and foot and then put us into a bag and then tied the bag. I think he is wrong and would like to carry the case to the supreme court. But if he is right the law should be worded so that it not only permits but requires a comparison of the benefits assessed to the several parcels of land in the district.

*Dr. Sherwood:* The jury is not the proper body to determine the benefits. I have the affidavit of two jurors showing that when they voted on the benefits, they thought they were voting on the drainage tax.

*Mr. Tubbs:* I think that drainage commissioners should receive at least five dollars a day.

*Dr. Sherwood:* After the law is in final form it should be printed in pamphlet form.

Gentlemen, the hour of twelve has arrived and we had better conclude the discussion.

*Mr. Matheson:* I have the following resolutions to offer:

Resolved by the Wisconsin State Drainage Association, in convention assembled, at the city of Madison, Wisconsin, December 9, 10 and 11, 1914, as follows:

We congratulate those interested in the drainage and reclamation of lands in Wisconsin on the success of our first convention.

We extend our thanks to all who have had a part on our pro-

gram and who have contributed by discussion to the success of our meetings.

To the authorities of the University of Wisconsin, and particularly to the College of Agriculture, we express our gratitude for their hospitality and courtesy.

We have especial pleasure in giving expression to our appreciation of the zeal, industry, tact, ability, public spirit and disinterested activity of Mr. E. R. Jones, not only in planning this convention and guiding its deliberations, but also for his labors in behalf of drainage in Wisconsin.

We congratulate ourselves on having as our president Mr. H. H. Sherwood, a pioneer in drainage work in Wisconsin. We also deem it a privilege to have the benefit of the legal knowledge of Mr. B. M. Vaughan.

Finally, we pledge ourselves to work together to the end that our Wisconsin lands in need of drainage may be made most productive, thereby enriching the private owners, and at the same time promoting the public welfare.

ALEXANDER E. MATHESON,
W. B. CODDINGTON,
Committee.

December 11, 1914.

The motion was put by Mr. Matheson and the resolutions were unanimously adopted and the convention stood adjourned subject to the call of the president. Delegates who remained for the afternoon made a tour over the university campus and visited the pumping station used for draining the university marsh which is about level with Lake Mendota. They also visited several of the university buildings, including the Museum of Historical Library.

## Chas. Oellerich

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**Attorney at Law**

Attorney For the Larsen Drainage District

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**Attorneys for Drainage Districts Under Wisconsin Drainage Laws**

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Stokes Drainage District.
Broughton Drainage District.
Taylor's Creek Drainage District.

Brodhead, Wisconsin

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## Buell & Lucas

**Drainage Attorneys**

Attorneys for the Koshkonong-Mud Creek, the Nine Springs, the Lodi and the Blooming Grove Drainage Districts.

By reason of our experience we are prepared to counsel with and advise other attorneys in all phases of drainage procedure and litigation.

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M. Am. Soc. C. E.

**Hydraulic Engineer**

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## P. J. HURTGEN

## Civil Engineer

Engineer for:

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The Oak Creek Drainage District
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## SUMMARY OF WISCONSIN DRAINAGE LAWS

There are many areas in Wisconsin for which an outlet can be secured by only digging a big ditch or laying a big tile through the lands of several land owners. A single land owner inclined to play dog-in-the-manger can obstruct the entire drain, unless there is some well organized co-operation between all of the land owners. To prevent such obstruction there are three common methods of procedure.

*Mutual Agreement.* Any number of land owners may at any time by a mutual agreement among themselves as to what portion of the cost each is to bear, construct an open ditch or lay a main-tile to serve as a common outlet. Such a drain may discharge into a running stream or a dry water course, but allowance for damages, although seldom occurring, should be included in the cost. An agreement of this kind requires the consent of all land owners concerned. Unfortunately this harmony among farmers is hard to obtain, and it is then necessary to force the unwilling land owners to co-operate under state laws, if it can be proven that the benefits of the proposed work will exceed the costs.

*The Town Ditch Law.* Small marshes may be organized under the town ditch law. Six or more free holders in any town in Wisconsin may petition the town board to lay out a ditch or main tile, according to plans based on a survey which the land owners have caused to be made of the marsh land whose drainage is proposed. If the supervisors of the town favor the plans, or if they are forced to act by a successful appeal to the county judge, they let the contract for the construction of the drain, allow damages to parcels of land damaged, and apportion the cost among the several parcels of land benefited whether the ditch or tile actually touch a particular parcel or not, and whether the owner is willing or not. They should, however, assess the land touching the ditch or tile higher than that farther away, and they should also allow for the drainage possibilities that a particular parcel of land has before the construction of the outlet ditch. If any of the roads in the town are benefited by the drain, the town should be assessed as an individual, but

R. S. Owen L. F. Pope

Madison, Wisconsin

# Engineers for Drainage Districts

Broughton

Cutler

Little Yellow

Rockland

Taylor Creek

Stokes, etc.

## Philip H. Hintze

### Civil and Drainage Engineer

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## EARL J. HOPE

Evansville, Wis., R. F. D.

PRACTICAL TILER

Write Me For Terms

After you have tiled your marsh it may be too boggy to plow. Get a steel frame bog-cutter.

For Circulars and Information Write to

## Neupert & Budig

Waterloo, Wis.

## Adam Channing

### For Farm Draining and Tile Laying

Thirty years of practical experience in Wisconsin. I run my own levels and do my largest contracts with the machine. Work guaranteed.

**Whitewater, Wis.**

if no roads are benefited, the town, as such, pays no portion of the cost of the drain, and all bridges made necessary by the drain are paid for by the benefited land owners.

*The Drainage District Law.* A far better law than the town ditch law for large marshes is the drainage district law, under which the petition for the drainage district, containing the preliminary plans which are based on a survey, and signed by a majority of land owners or by the owners of more than half of the land, is presented to the circuit judge. After a well advertised hearing on the merits of the preliminary plans, if it is proven that the benefits will exceed the cost, the judge appoints three commissioners to make the final plans, execute them, and assess benefits and damages to each parcel affected. Then follows another well advertised hearing on the assessments, and all persons having a grievance are heard, before the assessments are approved by the court. The commissioners are responsible directly to the court, and for this reason everybody is assured of fairer and wiser treatment than a town board is apt to give.

The commissioners are commonly men recommended to the court by the land owners—frequently some of the land owners themselves. They retain their responsibility for the ditch after construction is completed, but it does not require more than a few days' time each year to see that all of the drains in the district are in a good state of repair. They may re-assess benefits at the end of five years, if they see that they made a mistake in their former assessment. They may annex and assess adjoining lands where such land receives benefits from the district drains, but they can not include and assess any land of which the drainage is not materially improved by such drains. The commissioners may condemn a right-of-way across any land in the district to give distant pieces of land access to the outlet, and they may install these lateral drains, levying a supplemental assessment on the land immediately benefited. In other words, the commissioners are to see that every land owner gets what he pays for.

# List of Tilers

## To get your tiling done right, write to one of the following practical tilers who have crews for installing tile systems quickly.

Wm. Bestman, Randolph, Wis.
Phillip Cronk, Brodhead, Wis.
Adam Channing, Whitewater, Wis.
L. M. Cox, Martinsburg, Iowa.
W. O. Durbin, Backus, Minn.
L. J. Fairman, Brodhead, Wis.
A. P. Harrison, Reedsburg, Wis. R. 1.
Earl J. Hope, Evansville, Wis.
B. J. Hoveland, Clinton, Wis.
Frank Lackman, Columbia, Wis.
National Drain Tile Co., 305 So. La Salle St., Chicago, Ill.
Elmer Netland, Eagle Grove, Ia.
Will Opitz, Elkhorn, Wis.
Fred Orr, Blair, Wis.
Henry Orr, Eagle Grove, Ia.
Ed. Reichenbach, Jefferson, Wis.
Schultz & Bieck, So. Milwaukee, Wis.
John Smith, Chebanse, Ill.
Chas. A. Smith, Brodhead, Wis.
Ed. Uvaas, Larsen, Wis.
James H. Welsh, 35 Macy St., Fond du Lac, Wis.
Wisconsin Drain Tile Co., Elkhorn, Wis.

# CONSTITUTION OF THE WISCONSIN STATE DRAINAGE ASSOCIATION.

## ARTICLE 1.

This Association shall be known as the WISCONSIN STATE DRAINAGE ASSOCIATION.

## ARTICLE 2.

The object of the Organization is to promote closer acquaintance between those interested in the drainage of Wisconsin lands, and especially the Commissioners of Drainage Districts, in order that ideas may be compared, problems pertaining to land drainage discussed, and the general proficiency of members increased on matters topic.

## ARTICLE 3.

An Annual Meeting shall be held at some central place to be determined in advance at each annual meeting for the election of Officers and discussion of matters as shall be for the best interest of the Society.

## ARTICLE 4.

Any person interested in this movement shall be an eligible member in this Society on the payment of Fifty Cents, in advance per year, and the money thus raised is to be used for postage, printing and other expenses of the Society.

## ARTICLE 5.

The Officers shall be President, Vice President, Treasurer and Secretary, each to hold Office for one year or until his Successor is elected and each Officer shall file a written annual report on affairs pertaining to his office. The President shall preside at Meetings, enforce order, and appoint Committees as the welfare of the society may demand.

The Vice President shall in the absence of the President fill his Office.

The Secretary shall keep all records, arrange for meetings,

send out notices and other literature and labor for the welfare of the Society.

The Treasurer shall collect fees and pay out funds belonging to the Society only on Orders drawn by the Secretary and signed by the President.

ARTICLE 6.

This Constitution may be amended at any Annual Meeting by a two-thirds vote of the members of the Society present.

## BY-LAWS.

SECTION 1. The committees authorized by the by-laws shall be appointed by the President and approved by a two-thirds vote of the Association as soon as may be after the commencement of the President's term, and the committeemen shall serve until their successors are appointed.

SECTION 2. There shall be a Committee on Legislation composed of five members, whose duty it shall be to aid in the framing of laws that will aid the drainage movement.

SECTION 3. There shall be a Committee on Standardization of Benefits composed of five members whose duty it shall be to compile and place at the disposal of the Association and of courts all available data on the actual benefits that have resulted from outlet drains.

SECTION 4. There shall be an Auditing Committee composed of three members whose duty it shall be to audit the financial accounts of the Treasurer before each Annual Meeting.

SECTION 5. The President, Vice President, Secretary and Treasurer shall constitute the Executive Committee of the Association.

SECTION 6. Vacancies may be filled by appointment by the President.

SECTION 7. With the approval of a majority of the Executive Committee the President may call a special meeting of the Association, but all members shall be notified of the time, place and reason for such meeting.

# Drain Your Lowlands

Proper drainage increases crops on low and high land. Deepens fertility—prevents washing—lengthens the season from one to three weeks—promotes absorption of fertilizers.

As an example of increased crops, a lowland pasture after being tiled, produced 51 1-4 bushels of winter wheat per acre.

Write for the advice of our Service Bureau and learn without obligation how to secure the best results with

# DENISON Double Process Tile

This tile is made of genuine blue shale clay, recognized as the best material. Denison's tile is hard burned, making it impervious to water, frost or other exposure. Every piece is uniform in hardness. We guarantee you against loss by breakage in shipment.

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