OHIO FARM DRAINAGE THROUGH THE YEARS–TO 2000

by
Byron H. Nolte*
April 17, 2000

DRAFT COPY–DO NOT DUPLICATE

Drainage, the practice of removing excess water from agricultural land, began more than 2500 years ago when Herodotus wrote about drainage works near the city of Memphis in Egypt. The practice moved to Europe with settlement there and is well know, particularly in Holland and the fens of England. Early authors used the hole in the bottom of a flower pot to illustrate the value of drainage–drainage of tillable land is a small hole at the bottom, just like that of the flower pot.

To early settlers, the northwest quarter of Ohio was originally considered to be a vast mosquito infested marsh . Before white man came it was devoid of permanent settlements. The Indians used it as a transitory hunting ground. The first attempt at permanent settlement was after the War of 1812 when the population was less than 2 people per square mile. The next 40 years was a battle against "wet" farmland, mosquitoes, malaria, cholera and the so called "milk sickness." By 1840 much of the Black Swamp still had only 2 people per square mile.

The medical profession recognized the connection between drainage and disease. They saw this before they knew the connection between the mosquito and malaria. They said that drainage "purified the soil." Thus doctors became great advocates of drainage in this area.

So, the idea to improve drainage grew out of the desire to make the land more productive, and life more comfortable and more healthy. In the process, new materials have been developed and old materials have been used in new ways. Machines have been invented and old ones have been made to operate more accurately and faster.

Agricultural drainage has also been a source of conflict since the settlement of Ohio. Early conflicts were between neighbors regarding the flow of water and that conflict continues. Laws were enacted in the 1840's to provide a petition procedure to make improvements of drainage outlets. Early drainage improvements were to solve mosquito and health problems as well as increase agricultural production. In the 1960's opposition to drainage outlet improvement arose because of the destruction of fish and wildlife habitat. The economic and environmental impacts are still the driving forces regarding agricultural drainage decisions.

* Byron H. Nolte is Professor Emeritus, The Ohio State University. He was Extension Agricultural Engineer form 1966 to 1988.

PEOPLE/POLICIES/LAWS

Prof. W. H. Keating of Pennsylvania described conditions near the Ohio-Indiana state line east of Fort Wayne in 1823, " the country is so wet that we scarcely saw an acre of land upon which settlement could be made. We traveled for a couple of miles with our horses wading through water, sometimes to the girth. Having found a small patch of excellent grass(which from the color is known here as bluegrass) we attempted to stop to pasture our horses, but this we found impossible on account of the immense swarms of mosquitoes and horseflies, which tormented both horses and riders in a manner that excluded the possibility of rest." This general area was named the "Black Swamp."

In 1841 the Ohio Legislature passed the first drainage laws. The laws have been amended many times and are still in effect today. They provided a procedure for one or more landowners to petition the county commissioners to make drainage improvements. The largest early project using the petition procedure was the "Jackson Cut-off" in Wood County. It ran 9 miles and diverted 30,000 acres from the Portage river watershed into the Maumee River at a cost of $110,000.(a map could be included showing both the Black Swamp and the Jackson Cutoff and perhaps the Upper Scioto Marsh) Farmers learned that the success of on-farm drainage systems depended on satisfactory outlet ditches. In 1880, the Ohio Society of Engineers and Surveyors reported 20,000 miles of public ditches had been constructed, benefitting 11 million acres of land and improving the health of the citizens.

The rate at which drainage ditches were constructed is illustrated by the work in Wood County, formed in 1820 from old Indian Territory. In his 1847 history, Henry Howe describes the area as an almost unbroken forest covering the Black Swamp and with few inhabitants. The first drainage petition was filed on April 28, 1859. Ten years later there were constructed or in progress 140 ditches with a total length of 495 miles. The projects varied in length: 16 were less than 1 mile long, 95 were 1 to 6 miles long, 20 were 6 to 12 miles long and 1 was just over 37 miles long(designated Ditch No. 12, probably because it was the 12th petition). The drainage ditches are credited for converting the area known as the Black Swamp into a most fertile and productive region with the expectation that it would become one of the most valuable agricultural districts between the Alleghenies and the Mississippi.

In 1890, N. H. Callard of Perrysburg summarized the ditching of Wood County in an address to the pioneers of the county. He estimated that the whole drainage system of Wood County, including both public and private ditches, was 16,000 miles long and their cost was in the millions. These improvements were credited with being the basis for prosperity in the county and without them there could have been little progress in cultivation or growing of crops.

The Swamp Land Acts of 1849 and 1850 were the first important Federal legislation relating to drainage. For many years they were the primary Federal drainage policy. Under this policy vast areas of swamp and overflow lands were transferred to the states on the condition that funds from their sale be used to build the drains and levees necessary to reclaim them. Other Federal legislation that encouraged drainage includes the Reclamation Act of 1902, the Flood Control Act of 1944 and the Watershed Protection and Flood Prevention Act of 1954. In 1969, the National Environmental Policy Act required Federal agencies to consider environmental values,

signaling a shift in policy emphasis. Channel modification guidelines were adopted by the U.S. Departments of Agriculture and Interior in 1979.

In 1850 a group led by Daniel Campbell met at Roundhead in Hardin County and formed the Scioto Marsh Drainage Company. They estimated 15,000 acres of muck soil could be drained. In 1851 they petitioned their senator, William Lawrence, urging the State of Ohio, which owned the marsh land to have it properly ditched. The state obliged by ceding the marsh, mosquitoes, rattlesnakes and all to Hardin County, with the requirement that the county advertise for bids on the drainage work. Ditchers were to be paid in reclaimed land. The county advertised, but nothing happened until 1859. John McGuffy, a Franklin County farmer and promoter was awarded the contract by Hardin County Commissioners. McGuffey imported about 80 English laborers to dig the ditches in his contract. The work was to be done in a few months, but delays and workers problems with malarial fever and ague(a shivering fit) made work move slowly. The ditch, which included about 7 miles in the marsh and 5 miles downstream from the marsh, was finished in 1862. Flooding continued to be a problem.

In 1884, J. C. Banning, Jesse Claypool, Isaac Gilmore and David Baughman petitioned for a dredge to clean out the Scioto River. The Montville dredge, named after its owner, typical of boats used during that time, was built on the river bank near Roundhead. It was 60 to 70 feet long and 20 to 25 feet wide. On the front was a derrick and dipper, powered by a steam engine. Each corner of the boat was equipped with a 12 inch by 12 inch beam that could be raised for the dredge to move and lowered to act as an anchor when the dipper was in operation. The river was dredged by 1890.

The flood of 1913, the greatest flood of record in the Scioto River watershed, showed that the channels needed more improvement to provide adequate farm drainage. The Upper Scioto Conservancy District was formed in 1916 to do the work. W. C. McGuffy was chairman of the 3 man board including, Parlee Robinson and Charles W. Smith. Arthur E. Morgan was employed as engineer. The district made improvements and continues to maintain the improvements today, however excess water is still a problem.(picture, page 57, Water Inventory of the Scioto River Basin)

A problem with early versions of the drainage laws was that no provisions were made for maintenance. When work was needed on the ditch or drain, owners were required to re-petition to get the work done. The petition process often took several years, so owners of land along a ditch needing improvement would suffer loss for several years. In 1957 maintenance provisions were added to the law giving the county engineer responsibility for maintenance of petitioned ditches with assessments for maintenance decided by the county commissioners. By 1985 over 4,000 miles of open drainage ditches and tile outlets were being continuously maintained.

The story of S. J. Woolley of Franklin County shows the importance of drainage outside the Black Swamp. In 1857, Woolley bought 700 acres in Brown Township, about 3 miles from Hilliard , Ohio. His neighbors expected him to “pour money down a rat hole,” because it was exceedingly swampy and rough--apparently about the most hopeless piece of land in that part of the country. Woolley went to work clearing, draining, planting etc. until he created the beautiful,

productive and very valuable "Appledale Farm." In the process he had set up a tile plant on his farm and produced 15 to 16 miles of tile drains for his farm and filled orders for numerous neighbors.

Some object to the word "improvement" being applied to dredging or cleaning a drainage ditch, but Section 6131.01 of the Ohio Revised code defines improvement for this situation. Improvement includes: (1) the location, construction, reconstruction, reconditioning, widening, deepening, straightening, altering, boxing, tiling, filling, walling, arching, or any change in the course location, or terminus of any ditch drain, watercourse, or floodway and the definition continues on for paragraphs (2), (3), (4) and (5).

In 1949, the Ohio Legislature included provisions to protect farm drainage when it authorized the 241 mile Ohio turnpike. The legislation provided that plans for the turnpike would be reviewed by an expert in farm drainage and that any drain interrupted by turnpike construction would be repaired and that no undeveloped land drainage would be blocked.

Conflicts regarding drainage between owners may be settled in the courts, by common law. The reasoning used to settle cases has varied from "common enemy" for urban drainage to the "civil law doctrine", or natural flow rule, for rural areas. In 1980, the Ohio Supreme Court adopted a new approach called the "reasonable use doctrine." They wrote, "a possessor of land is not unqualifiedly privileged to deal with surface water as he pleases, nor is he prohibited from interfering with the natural flow of surface water to the detriment of others. Each possessor is legally privileged to make a reasonable use of his land, even though the flow of surface water is altered thereby and causes some harm to others."

MATERIALS

In 1835, John Johnston of Geneva, N.Y. imported from Scotland patterns from which clay tile were molded by hand and laid on his farm. This was the beginning of tile drainage in the United States. There were 1,140 tile factories, mainly in Ohio, Indiana and Illinois by 1880. By 1882 Ohio had 230 factories.

Early drain tile were made in many shapes. The first ones were a flat rectangle of clay bent into a "U," also called horseshoe tile. The "U" was placed in the trench upside down to provide a channel for the flow of excess water in the soil profile. This worked well, except in unstable soil where the tile would settle out of alignment. To solve the settlement problem a sole plate of wood or clay was added. Later, the "U" tile was made with a bottom, then tile were extruded with a round interior and various outside shapes. Outside shapes include the "U", hexagons and round.(Weaver p.53 and 63. Also Food, Biological and Agricultural Engineering Dept. at OSU has some old tile) Some were even turned on a potters wheel. Finally the round tile, both inside and outside, was adopted, because it required less material, was easily manufactured, could be rotated to get a good fit with the adjoining tile and functioned well. The first tile extrusion machine, the "Scraggs," was brought to America from England in 1848. Many locally manufactured machines followed.

In 1867, Ohio produced over 2000 miles of drain tile per year, mostly from 500 steam-powered tile plants. By 1960 it was estimated that enough private drain tile had been installed to reach from the earth to the moon(240, 000 miles). It is probably not by chance that the headquarters for the two largest corrugated plastic drain tubing and the largest laser grade control manufacturer are located in Ohio.

In areas where clay was not available, concrete tile was popular. They were heavier than clay, but gave good service if properly manufactured. In 1862, David Ogden developed a machine for making drain pipes from cement and sand. Until 1900, concrete drain tile were used primarily where good clay was not available. .

Because of the varying knowledge and experience of the operators of the many tile plants, the quality of drain tile varied widely. Poor quality tile caused drains to fail. A tile break near the outlet can cause an entire drainage system to fail. In 1950, Federal cost-sharing became available for drainage. This program required that the tile had to meet American Society of Testing Materials(ASTM) specifications. This rule and related educational activities helped assure the manufacture of good-quality clay and concrete tile. An important educational program of the Ohio Cooperative Extension Service of the Ohio State University dealt with tile quality. The programs taught farmers, drainage contractors and tile manufacturers to recognize the benefits of good tile quality. Professors Virgil Overholt and Melville Palmer, Extension Agricultural Engineers, were leaders of these educational programs in the 1950's and 1960's.

Clay and concrete tile were manufactured in 1-foot sections. Clay and concrete drain tile were handled piece-by piece for more than a century, but the expected competition with plastic led to innovations in the 1960's. Tile were placed on pallets at the factory for delivery to the field, with about 325 tile per pallet. Fork lift trucks could speed up delivery and reduce cost. Contractors used trailers to haul the tile pallet along the trench, beside the moving trencher, so the tile were handled only once. Tile laying chutes were installed on trenching machines, further reducing the work crew

.

Professor Glenn Schwab installed the earliest known plastic drains in the United States at Iowa State University 1947-56. The smooth walled pipe used in the experiments was supplied by the Carlon Company, Cleveland, Ohio. Some of the early plastic pipe he and his students tested was not successful, but he learned how strong the pipe needed to be and the number and size of holes required in the pipe for adequate water inflow. The first drainage field day in Ohio that included plastic pipe was near Cleveland, Ohio and was attended by Schwab and Melville Palmer, Extension Agricultural Engineer, The Ohio State University.

Corrugated plastic pipe was first developed in Europe. The first research on corrugated plastic drains in the U.S. was in Ohio in 1965. The corrugations and flexibility of plastic made it possible to coil it into large rolls and the corrugations gave it strength to maintain its shape in the soil when properly installed. European manufacturers developed the first machines to make corrugated plastic pipe.

The first commercial installation of corrugated plastic pipe for drainage in Ohio was in 1967

near Toledo, Ohio. The pipe was manufactured by Advanced Drainage Systems, Inc. and installed by Willard Schaller, drainage contractor. Plastic pipe was manufactured in a continuous length. The early corrugated plastic pipe plants coiled 250 feet on a roll for delivery to contractors or customers. By 1977, as much as 3,000 feet called a roll, spool or coil were being delivered to farms

In a very few years plastic replaced clay as the leading material for subsurface drainage. The reasons for the change include the fact that clay tile were 25 times heavier than plastic which allowed fewer plants and longer haul distance, contractors liked handling the lighter plastic because it was easier and took less manpower, farmers accepted the change, and researchers found the materials did a satisfactory job. In 1982, Professors Byron H. Nolte and Glenn Schwab, The Ohio State University and Carroll J. W. Drablos, University of Illinois prepared a slide set on drainage materials to help farmers and contractors make selections. It discusses the quality standards and proper installation of clay, concrete and plastic drainage materials. It states that all three materials will provide satisfactory drainage provided the materials meet the quality standards and are properly installed. Since the materials provided essentially equal soil drainage, market forces made the change from clay to plastic.

The first manufacturer of corrugated plastic drainage tubing in the U.S. was Advanced Drainage Systems, Incorporated in 1967 in Delaware. It was the work of Ron Martin, an Ohio native, and Marty Sixt, formerly plastic engineers with Celanese Corporation, who had gone into business for themselves making plastic tool cases. They talked to Agricultural Engineering drainage researchers at The Ohio State University and decided plastic tubing was much like blow-molding bottles, which they had done, and that a continuous tubing process looked feasible. They did a patent search and found a machine in Germany much like what they needed. It made 2.7-inch polyvinyl chloride tubing and they modified it to make 4-inch polyethylene corrugated plastic tubing. The first tubing was produced in July 1967 in Middletown, Delaware, but by 1968 they started a plant in Malinta, Ohio. Their corporate headquarters moved to Columbus, Ohio. By 1977 they had 20 plants, mostly in the Midwest. Schwab's research, begun 20 years earlier, did much to give the new corrugated plastic drains credibility in the eyes of farmers and the USDA Soil Conservation Service, the technical agency advising farmers on drainage.

The speed of the change from clay to plastic is illustrated by the story of Hancock Brick and Tile Company, Findlay, Ohio, established in 1887. The tile company incorporated a Hancor division in 1969(derived from Hancock corrugated). In 1969 they purchased a corrugator from Germany to make the pipe. In 1970 their first corrugated plastic pipe plant was established in Findlay. By 1974 they had plants in 8 states. In a 1975 merger between Hancock Brick and Tile Company and Hancor, only Hancor survived. By 1983, 95 percent of all agricultural subsurface drains installed in the U.S. were corrugated plastic tubing.

There are two basic differences between plastic drain development in the U.S. and Europe. The U.S. corrugated plastic drains are polyethylene and field drain laterals are usually 4 inches in diameter. In Europe, pipe is made of polyvinyl chloride and field drain laterals are usually 50 or 60 milimeters(near 2 inches) in diameter.

MACHINES

Field drainage is accomplished by a combination of surface ditches and subsurface drains in poorly drained soil. Surface drainage relies primarily on the natural land slope. However, in much of northwestern Ohio, the nearly level land and natural depressions frequently require some surface grading and field ditches for good surface drainage. Early subsurface drainage was done by hand dug trenches. Drains were formed by saplings, poles, stones or wooden planks and the trench backfilled with soil.(drawing Weaver p.39) In the 1860 to 1880 period, before tile were widely available in northwest Ohio farmers used native lumber to build plank subsurface drains. The Wood county Agricultural society report of 1880 describes the plank method: “two boards, one 5 and the other 7 inches wide, are nailed together like an old fashioned eave trough upside down.” Paulding county reported one tile manufacturer and 12 sawmills in 1879, showing that wood was more easily available than clay tile.

Between 1855 and 1900 there were a variety of ditch diggers, tile ditchers, ditching machines and drainage plows. There were 9 patents issued in 1875. However, James B. Hill, Bowling Green, Ohio built the first successful wheel type ditcher in 1892. The design of the digging wheel is substantially the same as used on wheel trenchers today. It was steam powered. Only 36 machines were built in the decade following the original design. It was taken over by the Van Buren, Heck, Marvin Company which later became the Buckeye Traction Ditcher Company.(picture Weaver p.181, Hancock County Historical Society, Findlay has a Buckeye ditcher.) In 1952 there were 44 trenching machines in Hancock county alone.

Charles Thorne, Director, Ohio Agricultural Experiment Station wrote in 1914 that the Buckeye would dig 80 to 100 rods(1 rod = 16.5 feet) a day in ordinary land and that the station had installed forty to fifty miles of tile. Their machine was gasoline powered. Experiment Station Circular 147, issued in 1914, reports a study of the cost of installing 35 miles of tile drains on a farm in Huron County Ohio. The cost of tile and installation averaged about $33 per acre, with 50 rods of tile per acre.

Trenchers or ditchers were the primary method of tile drain installation until the 1960's. The advent of corrugated plastic tubing made it possible to install a continuous drain which led to the development of the high speed trenchers and the drainage plow. The plow works like a “giant” mole plow, however the shape of the plow is designed to lift the soil as much as possible without compacting it around the drain. The advantage of the plow is that it can travel at much higher speeds than the trencher.

Research on the drain plow(picture p.40, Farm Drainage...) was reported by James Fouss, Agricultural Research Service, USDA and The Ohio State University in 1965, however the concept of “plowing-in” subsurface drains dates back to the 1850's. It became practical only after the introduction of corrugated plastic tubing in 1967 and laser grade control in 1968.

Grade control is essential, because nearly all drains flow because of gravity. Uneven grade can cause unsatisfactory drainage and in some cases deposits in the drain can lead to failure. Early drain grade control was determined by the digging crew. During wet times the water level could

be used as a guide. (Include figure showing “span level” from p393, Klippart) Later surveys were used and guide strings were set. Trenching machines were controlled using a sight bar on the machine and a row of targets set by surveys along the planned tile line. In order to use a high speed drain plow an automatic grade control device was needed. This provided the impetus for laser grade control(picture p.43 and drawing p. 44, Farm Drainage...). The laser grade control was adapted to wheel and chain trenching machines to eliminate the need to set targets to control the machine and provide more accurate control.

The laser beam projector patent application was filed in 1966 and the patent was granted to Robert H. Studebaker, Dayton, Ohio in 1969. The idea was called LaserPlane and led to the formation of LaserPlane Corporation, Dayton,Ohio. Manufacturing began in 1965 with four employees: David Studebaker, Larry Looney, Joe Patten and Ted Teach. The knowledge of engineer, Ted Teach, the son of a drainage contractor, shaped the product development during the first 20 years after the initial invention. The commercial application of the laser automatic grade control system was first used on a conventional Speicher tile trenching machine in 1968. The Speicher rubber tired trencher was manufactured at Celina, Ohio. The Speicher Corporation was started by the Speicher brothers in 1937. The laser transmitter rotated so the laser emitted a plane of light. The receiver on the drainage machine was automatically controlled so it was always turned toward the transmitter. The grade of the machine was controlled by signals from the transmitter to the control box, which in turn controlled the hydraulic system which controlled the depth of the digging wheel or plow installing the tile or tubing.

With mechanized tile handling, a trenching machine operator with a one person crew could lay tile at about 25 feet per minute. By the late 1960's higher speed trenching machines were in demand because corrugated plastic tubing was easier to handle. The development of high-speed trenchers, at least 50 feet per minute, with the concurrent development of automatic laser grade control met the demand. The modern high-speed trenchers usually included several attachments; machine mounted coils of tubing, tube feeding and guiding devices, groove devices for the trench bottom, backfilling attachments and automatic laser grade control. It is estimated that there were 2,500 trenching machines installing subsurface drainage in the U.S. in the 1980's.(pictures from USDA Farm drainage)

Fouss reported field trials with a modified mole plow and 2-inch corrugated plastic tubing in Ohio in 1965. Drainage plows were first used commercially in North America in 1969. By 1982 about 350 drainage plows were in operation in the U.S. With their higher installation speed, typically 80 to 150 feet per minute, they were estimated to be used for 40 to 50 percent of agricultural subsurface drainage systems installed annually.

Commercial drainage plows were developed primarily in Europe and Canada. One of the first available, about 1969, in North America was the Badger Minor based on a design developed about 1961 in England. Two similar designs, the Zor Plow and the Krac Plow were developed in Canada in the early 1970's. The Wedge Plow is made in the U.S. and Canada; the Hoes Plow in Germany; and the Hollanddrain, Mastenbroek, Barth and InterDrain Plows in the Netherlands. The later Badger and now the Bron plows are products of Ontario, Canada.

Most drain plows can install corrugated plastic tubing up to 6 inches in diameter. Some plows can go up to 10 inch tubing. If drains are used as the outlet for several smaller laterals, they are often installed with trenching machines to make the connections easier. As a result, many contractors using plows also have a trencher.

GUIDES

Early reports of drainage for the settlement of Ohio have focused on areas such as the Black Swamp and The Scioto Marsh, however soil survey reports show that the majority of Ohio soil is poorly drained or "wet soil." This is the result of the fine textured soil material, its geologic history, the topography and the climate. The 1982 Natural Resources Inventory found about 50 percent(6.2 million acres) of Ohio's cropland(12.5 million acres) was prime(drained) cropland having wet soils. It also indicates that an additional one-third(4 million acres) of the cropland needed drainage improvements for modern farming practices.(show pie chart of acreage or percent)

Early drainage design decisions were based on experience and "rules of thumb." The first Official Drainage Guide for Surface and Tile Drainage Systems was issued in 1958 jointly by the U.S. Soil Conservation Service, Ohio Agricultural Experiment Station, Agricultural Extension Service, The Ohio State University and the Ohio Department of Natural Resources, Division of Lands and Soil. It superseded the Standards for Drainage of Ohio Soils, July 1950 and as revised April 1952. The 1958 guide was prepared by a committee of 16 authors that would represent who's who in drainage knowledge at that time.

One of the factors that has made Ohio stand out in technical development in drainage is the cooperation of personnel employed by the various agencies. This is evidenced by 16 authors from four agencies being willing to share authorship of a technical guide for surface and tile drainage standards. The "Official Drainage Guide for Surface and Tile Drainage Systems" became simply the "Ohio Drainage Guide" when it was revised in 1965, 1973 and 1976. The shared authorship and the joint agency publication have continued through the years. The guides have made recommendations for drain depth and spacing by soil type with increasing detail with each revision. A national engineering handbook on "Drainage of Agricultural Land" was issued by the USDA Soil Conservation Service in 1973.

EDUCATION/RESEARCH

The first comprehensive Ohio book on "The Principles and Practice of Land Drainage" was written by John H. Klippart, corresponding Secretary of the Ohio State Board of Agriculture at the request of the Committee of Agriculture of the Ohio Legislature. It was published by Robert Clark and Co. of Cincinnati in 1861. The book includes extensive material from authors in France and England.

The Drainage Journal published in Indianapolis, Indiana included extensive information from Ohio. The February 1890 issue announces the Ohio Tile, Brick and Drainage Association eleventh annual meeting in Columbus. The program included papers on "Rainfall and

Drainage," "Drainage as a Factor in Farm Economy," and a practical talk by N.S. Townshend, of the State University, at Columbus. The October 1890 issue reports a readers question, "I would like to know why it would not do to make the drains 16 to 18 inches deep and one rod apart. I want the drains to irrigate with as much as drain."

Probably the "Mr. Drainage" of Ohio was Virgil Overholt, Extension Agricultural Engineer employed as a state specialist by The Ohio State University in 1915. That began his 42 year career of outstanding service in education and research. He was a gentle and sensitive person with a high regard for his fellow man. His keen interest in people and helping solve their problems was one of his outstanding abilities. He was highly regarded by his students, his colleagues and farmers throughout the state. In 1979, the Agricultural Engineering Department, The Ohio State University established a "Drainage Hall of Fame" dedicated to Virgil Overholt.

The leading researcher in drainage in Ohio was Professor Glenn Schwab, Agricultural Engineering, The Ohio State University. He worked in Ohio from 1956 to 1985. One of his outstanding achievements was the 25-year "Tile and Surface Drainage Experiment" conducted at the North Central Branch, Ohio Agricultural Research and Development Center, near Sandusky, Ohio. The findings from that experiment defined some of the tradeoffs between surface and subsurface drainage of clay soils, showed crop yields with various levels of drainage, reported on runoff flows and water quality and provided a basis for validating simulation models developed later by Professor Wayne Skaggs in North Carolina.

Educators, drainage equipment and tile manufacturers, and enlightened contractors worked to improve the quality of drainage materials and the ability of contractors to install them. Prior to 1950 some tile manufacturers had drainage contractor customer annual meetings with dinner and a program. These meetings were successful, but did not cover all the subjects of concern to independent drainage contractors.

The first short course for drainage contractors organized by Virgil Overholt in 1953 was held in Ives Hall, Agricultural Engineering Department, on The Ohio State University campus. On his evaluation of the course contractor Fred Galehouse suggested a better job could be done of teaching contractors how to set targets used to control the grade of trenching machines. From that time on Galehouse and other contractors have been included as teachers for part of the course.

In 1950 a group of drainage contractors decided to form The Ohio Drainage Contractors Association in a meeting at Findlay, Ohio. Robert Davis was elected the first president. The group was incorporated in 1954. The name was changed to the Ohio Land Improvement Contractors Association in 1967 and the purpose was broadened. They affiliated with the national Land Improvement Contractors of America which was formed in 1954.

The first trustees of the Ohio Drainage Contractors Association articles of incorporation were Ken Diefenthaler, Virgil Berlekamp, Harold Metzger, John Stackhouse, Marion Inbody and Louis George. Stackhouse later became Ohio Director of Agriculture. The first executive secretary of the Association was Truman Goins who served two years, then Mel Palmer served

for 17 years. Goins and Palmer were Ohio State University Extension employees and a change in policy required Palmer to resign, but he continued as educational advisor until his retirement. Since 1972 the association has hired an executive secretary.

The purpose of the Drainage Contractors Association given in the original bylaws was "to make the general public aware of the benefits of drainage, to encourage the development of high standards among drainage contractors in the state of Ohio in cooperation with agencies that have mutual interests by educational programs and services with the objective of raising the standard of drainage work, and to train drainage contractors in the use of improving practice and methods of land drainage."

SUMMARY

During the settlement and development phase of Ohio , health and economic returns were the primary focus of drainage improvements. By 1969, environmental concerns were added to the factors to be considered in drainage decisions. Man's inventiveness has continually changed the materials and machines used in drainage applications. Even now technology is being introduced to use satellite signals to control machines for surface grading. Population growth will continue to increase the stress on natural resources to produce food, while concern for fish, wildlife and the environment will tend to limit or control land development.

REFERENCES

Drainage Journal, Vol. 12, Indianapolis, Indiana, 1890

Drumm, Carl, A Complete History of the Scioto Marsh(in Hardin County, Ohio), Reproduction, Unigraphics, Inc., Evansville, 1976

French, Henry F., Farm Drainage, Orange Judd Company, New York, 1913, reprint of 1884 edition, first edition in 1859.

Frost, Sherman L. and Nichols, Wayne S., Ohio Water Firsts, Water Resources Foundation Of Ohio, Inc., Columbus, 1985

Galehouse, Fred, OLICA(Ohio Land Improvement Contactors of America) History, private communication, Doylestown, Ohio, Nov. 24, 1999

Giauque, Florien, Drainage Laws of Ohio, Robert Clarke Company, Cincinnati, 1896.

Goddard, L. H. and Tiffany, H. O., The cost of Tile Drainage, Cirdular No. 147, Ohio Agricultural Experiment Station, Wooster, Ohio, 1914.

Hancor 100 Years, 1887-1987, Pacesetter in Quality & Service, Hancor Inc. 1987

History of Franklin and Pickaway Counties, Ohio, Published by Williams Bros., 1880, reproduction by Unigraphic, Inc., Evansville, Indiana, 1974.

Howe, Henry, Historical Collections of Ohio, Laning Printers, Norwalk, Ohio, 1896.

*Klippart, John H., The Principles and Practice of Land Drainage, Robert Clarke and Co., Cincinnati, 1861

Lewington, Peter, No.1 Tries Harder, Drainage Contractor, Hensall, Ontario, Canada, circa 1977

Nolte, Byron H., Schwab, G. O. and Drablos, Carroll J. W., Drainage Materials- Clay, Concrete and Plastic, Script for Slide Set, Agricultural Engineering, Cooperative Extension Service, The Ohio State University, 1982

Ohio map, Principal Streams and their Drainage Areas, Department of Natural Resources, Division of Water, 1973.

Ohio Revised Code, Chapter 6131

Overholt, Virgil, Progress in Drainage Thru the Years, The Hancock Brick and Tile Co., mimeo, Circa 1960

*Pavelis, George A., ed., Farm Drainage in the United States: History, Status, and Prospects, Economic Research Service, USDA, Misc. Pub. No. 1455, 1987

Peacefull, Leonard, ed., A Geography of Ohio, Kent State University Press, Kent, Ohio and London, England, 1996.

Platt, Carolyn, V., The Great Black Swamp, Timeline, The Ohio Historical Society, Vol. 4, No.1, Feb, Mar. 1987

Schwab, G. O., N. R. Fausey, E.D. Desmond and Holman, J. R., Tile and Surface Drainage of Clay Soil, Research Bulletin 1166, The Ohio State University, Ohio Agricultural Research and Development Center, Wooster, Ohio, January 1985

Studebaker, Robert H., The LaserPlane Invention, Robert H. Studebaker, Dayton, Ohio, 1998

Water Inventory of the Scioto River Basin, State of Ohio, Department of Natural Resources, Division of Water, April, 1963.

*Wooten, Hugh H. and Jones, Lewis, A The History of Our Drainage Enterprise, Water, USDA Yearbook of Agriculture, pp. 478-490, 1955

*Weaver, Marion M., History of Tile Drainage(In America prior to 1900), M. M. Weaver, Waterloo, N.Y., 1964

*Wilhelm, Peter W., Drainage of the Black Swamp: Henry and Wood Counties Ohio 1870-1920, Northwest Ohio Quarterly, Maumee Valley Historical Society, Vol. 56, No.3, Summer 1984

* Recommended for further study of drainage history.