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Mr. Jonathan Alston

Little Creek,

At a meeting of sundry persons, owners of and interested in the marshes lying in the necks of Duck Creek Little Creek and St Jones Hundreds, held, pursuant to public notice, in the Town of Dover on the 24th Novr 1818. for the purpose of taking into consideration the propriety of petitioning the General Assembly for a law authorising the embankment of all the said marshes; Henry M. Ridgely was Chosen Chairman, and Jos. H. Raymond Secy, of said meeting; it was then resolved that John Cowgill Abraham Allee John Raymond, Thomas Rothwell Jacob Stout Elias Vandain Jonathan Alston Manlove Hoays Jonathan W. Mifflin John Bell Alexander P. Laws and Cornelius P. Comegys should be, and they were appointed, a Committee, to act separately or together, for the following purposes, to wit; to ascertain, as far as practicable, the condition quality and quantity of the said marshes; the names of the several owners thereof; how much is vacant and where the vacant parts lie; the width and depth of the several creeks and cuts running through them; the height and strength of Banks that will be requisite to secure them against the highest tides; the length of Banks necessary to enclose them; and generally such further information as may throw light on the subject, and as it may be in their power to obtain; and the said Committee was further authorised to prepare a petition to the General Assembly praying such legislative aid in reclaiming the said marshes as may be right and proper; and the said Committee are requested to submit the said petition and a report of the information they may obtain on the subject above mentioned, to a meeting, to be holden in Dover at the house of Josiah Buckmaster on Tuesday the 5th day of next month at 10 Oclk A. M. to which time and place this meeting stands adjourned.

Jos. H. Raymond Secretary
Novr 20. 1818.

H. M. Ridgely Chairman

W.R. Benjamin, N.Y.C.,
May 15, 1940, #2.00

DRAINING MARSH AND MEADOW LANDS.

THE COST OF DRAINING MARSHES.

THE STATE BOARD OF AGRICULTURE,—*Gentlemen:*

Your circular letter of the 26th ult., with the question list, is before me, especially calling attention to Question 14th, and requesting a written reply. Having had an experience of more than twenty years last past in reclaiming low lands, marsh and meadows, adjacent to the Delaware River, Bay and tributary waters, I feel warranted in saying, that in all cases where the work has been systematically and fairly done, such lands, marsh and meadow, have been enhanced in value many times the cost of their improvement. This varies very materially per acre, according to locality, quantity (*i. e.* area) that may be inclosed by a given length of embankment, or drained by a simple main trunk canal, and tidal gate. The cost of embankments against tidal overflow is from \$3,000 to \$10,000 per mile, and of drainage canals, from \$1,500 to \$3,500 per mile; of tidal gates, \$500 to \$2,000 each. Tracts of low lands or marsh having comparatively narrow frontage on tidal streams, and extending back into and between fast lands, may be more readily and cheaply improved than those having greater exposed frontage and less depth. The cost of maintenance is also relatively less. Small tracts, adjacent to tidal waters and skirting the shores, are usually the most valuable and productive, and many such tracts in the vicinity of cities and towns would pay handsomely the cost of reclamation and cultivation.

Embankments and drainage canals above referred to are made by machinery, and when so made require little or no expense for renewal or repairs. As to embankments, would refer to those on Schuylkill river below Gibson's Point, Finn's Point, N. J., Hog Island or Black's Island, Philadelphia, Brandywine Marsh Co. and Lobdell Car Wheel Co., of this city. As to drainage by machinery, Repanpo Meadow Co., Salem Creek Canal Co., Town Meadow Co. of Salem, all of New Jersey, St. Georges Marsh Co., Dragon Marsh Co. and Narrow Dyke Marsh Co., all of Delaware, and others.

Main drainage ditches should be made of such width, not less

From: St. Bd. of Agriculture
Annual Report
1888-89

than 20 feet, and such depth, not less than 5 feet below the ordinary surface of the marsh when drained, as to prevent the growth of docks, reeds or grasses, and permit of the free and rapid flow of water to the outlet gates. The extra width and depth of such drainage canals also proves beneficial in affording reservoir space for holding an accumulation of water during storms and in the event of a series of high tides.

Ordinarily, hand-made ditches 9 to 12 feet wide and 3 feet deep, costing from \$250 to \$400 per mile, will be found to be sufficient for draining adjoining areas into the main canal. These will require cleaning or scouring every third year, to keep them in fairly good order.

As to approximate number of acres reclaimed or improved, of which I have knowledge, can only say that they aggregate many thousands, in bodies of from eight to three thousand acres each, at a cost of from three to thirty dollars per acre. The writer has good reasons to believe that a very large majority of the lands and marshes in this State may be readily reclaimed, drained and rendered suitable for easy and profitable cultivation, thereby enhancing the prosperity and health of all the people.

I should be pleased to have the opportunity of showing the individual members of your committee works herein referred to, and others in progress.

Very Respectfully,

F. B. COLTON,

610 Market street, Wilmington, Del.

DRAINING MARSH MEADOW NEAR NEW CASTLE.

THE DELAWARE STATE BOARD OF AGRICULTURE.—*Dear Sirs:*

My farmer friends who have noticed the dredge working in the canal of our marsh company during the past two years, while passing over the railroad or along the public roads, have so often asked me "did I think it would pay?" that I have determined to comply with your request to give an account of the work from a farmer's point of view and they can then judge for themselves.

I must first remind them that a marsh cannot be regarded as reclaimed and improved, until not only the embankment and sluice through it is made, the main canal opened to head of marsh, and the ditches next fast land on all sides, together with those necessary to convey the water from fast land ditches to main canal, and to furnish an outlet for any springs, rising throughout the marsh, are

opened, but that the banks thrown out of canal and ditches *must be hauled off into the low spots*, and the different lots placed in shape of a turtle's back or inverted plate if possible, the highest in the middle, and giving surface drainage toward the edges.

Heavy dredging is now generally done by the steam dredge, and our managers contracted to have the canal dredged out 40 feet wide by 4 feet deep, below low water mark from the river bank to New Castle and Wilmington railroad, the sluice race way dredged the same width and depth through the "guard" outside the company embankment to low water mark and the river bank raised and widened to 20 feet on the top of the bank, and a new flood gate sluice put in through the bank 14 feet wide in the clear.

This work was done by the Atlas Dredging Company, who began in June, 1887, and had their contract accepted by the managers about a year later.

The dredge "Revolver" taking out the upper layers of mud and removing the obstructions of logs and stones embedded in the bottom when first passing over the canal, and deepening the canal while going over the work the second time.

This dredge worked a series of buckets on an endless chain (on the plan of a straw carrier to a thrashing machine, reversed) emptying the mud and water into a hopper, from which they passed out over side shutes to the banks of the canal.

The dredge could only do a width of 20 feet at a time, and therefore was able to do only one half of the full width of the contract at one through, and the strain of the cog gearing often broke the machinery, and caused great delay in the completion of the job, while waiting repairs.

The work on the outside of race-way, and raising the embankment, was done by a larger dredge of the "clam shell" pattern, which could remove obstructions with comparative ease. This contract cost the managers over \$30 an acre.

After the dredging company is through comes the farmer's turn to solve the problem how best to reclaim the marsh to tillable land, if it is possible to do so at all.

We find marshes along the Delaware have a soil composed of four kinds of mud, blue, gray, peat and coffee grounds.

This last seems practically bottomless, while peat will make a sod on top strong enough to hold up teams, and animals, and produce grasses, giving rough pasturage and hay, while the blue and gray mud will produce more profitable grasses both for pasture and hay, and

fine crops of our ordinary cereals, where the level of the marsh is above the storm flood mark, otherwise one cannot depend on harvesting the crops when tilled, they being drowned out by overflows, and the only course is to seed down to grass, trust to providence for the catch, and plow as seldom as possible.

Our marsh is from one to three feet above ordinary low water mark in canal and ditches, after a week of ordinary dry weather, but ordinary rains fill the canal and ditches and overflows more than half of my 40 acres, while heavier storms have covered nearly the whole, except some two or three acres of the very highest part, and the other owners seem about in the same fix, but have done so little to relieve themselves so far that I cannot say how true the contractor prophesied when claiming that the whole marsh would prove tillable for sweet potatoes and similar crops, but I doubt this very much, as the marsh has to receive the storm drainage from about 800 acres of the surrounding upland and is crossed by two railroads and one public road, which empty an immense amount of water into it during every rain, thereby keeping it soaked to within a few inches of the surface for more than half the time.

My first business was to remove the mud from across the mouths of ditches emptying into the canal, so as to allow the surface water to drain off, and then have the ditches cleaned out, and the banks hauled into the low places over the marsh from the sides of the cleared ditches and canal. So far I have moved the mud from 3334 feet along the canal, and from the sides of 5334 feet of ditches at a cost of about \$1100 for labor done, besides 400 days work of teams.

Probably the cheapest way to move the heavy canal bank, when there was enough of it to do, would be by a small portable railway and dump cars, but as I could not readily procure that outfit I removed 1350 feet by contract with men who wheeled it off on barrows at \$3.50 per rod, for bank averaging about 2 feet 6 inches high by 38 feet wide at base, also 474 feet, averaging 4 feet high by 32 feet wide at \$4.50 per rod. This being towards river end of marsh was blue mud, and much heavier to wheel than the other, which was partly peat.

I found when they began at inside edge of bank to dump, and did not have over 200 feet to wheel, they could move it faster, and cheaper than by teams, but I used oxen and horses the other 1510 feet where the haul was much longer. This cost about \$5.00 a rod for labor besides the keep of the teams.

The contract men worked hard, driving themselves for all they

were worth, and made from \$1.50 to \$1.90 per day at their contracts, while I paid the men working by the day \$1.25 and thought they worked very steady as a general thing for day hands without the constant presence of the "boss," my personal attention being required elsewhere for the most of the day.

The contract work cost about 12c. a cubic yard; the day work over 13c.

The cost of ditching varies according to size of ditches. I had new ones dug along the sides of new "Cut-off" railroad, 9 feet wide by 3 feet deep for \$1.00 per rod, mud thrown equally on both sides, while for one of same size, where over three-fourths of the dirt was thrown on one side away from the railroad I paid \$1.50 per rod.

For cleaning ditches I paid for one 16 feet wide, by 4 feet deep, \$1.50 per rod, a number of 12 by 3 at \$1.00 per rod, 9 by 3 from 75 cents a rod when they were full up with mud, to 50 cents or 40 cents when they were only about half full, and not many springs in them, for those 9 or 8 feet wide by 2 feet 6 inches deep, 40 cents and 35 cents, making separate contracts for each one according to the amount of dirt to be removed. Measurements were made by a rule, not guessed at, as generally done counting a foot to a spit.

My ditching so far completed has cost me \$330, and that still to do will bring the whole up to \$500.

Moving the canal bank, and ditch banks so far as completed, \$1100 besides keep of the teams. The hauling still to do will cost about \$200, making a total cost of about \$1800, or \$45 per acre for labor alone.

Marsh owners can judge for themselves how it will pay them to drain their marshes and put them in order. Some I know of are high blue mud, have little storm water to flow on them, but have a long extent of bank to keep up. Here the chief expense is on the bank and sluice.

Others have a short bank, but run up narrow and deep, far into the country. Here the expense is in their main canal, needed to pass off storm water from the surrounding uplands.

When any owners consider the question of drainage, I should advise them to have the level of the marsh taken the first thing. This will determine how the water will pass off.

The upper end of the Narrow Dyke Marsh was generally regarded by those who had gunned and fished over it as below low tide mark, but engineer's level made it have a fall of 20 inches from Wilmington railroad culvert to river bank, and since the canal is open,

the surface of the marsh west of the railroad is high above the water level in drainage ditches passing through it.

It seems to me very unjust, that the owners of the land below high tide mark should be at the sole expense of marsh drainage, while the high ground adjoining which empties its storm water on the marsh and thereby floods it, should go free of proportionate payment toward keeping up river bank and sluices, and main canal. While public roads, and railroads also discharge much additional storm water by their artificial grades, changing the natural course of drainage. This point should be looked after when forming new companies.

When considering the drainage of marshes besides the question "Will it pay the individual owners?" there is another, and a broader view to be taken, that of the improvement of the public health, and comfort by the removal of the stagnant water.

I have some very distinct recollections of the few visits I have paid "below the Canal" in fly and mosquito time, also heard many stories of the suffering of animals and persons. If these personal sufferings and the general health of the country can be mitigated to any great extent by draining the marshes, would it not be justifiable to do the work at the public expense, either of the State or county, rather than throw the whole burden on the owners alone, as they cannot be expected to do it, unless the pecuniary returns are in sight, and in many cases I know they would never expect to get their money back.

Take our own marsh here. The drainage from several hundred acres of upland besides that belonging to the owners of marsh, two railroads, and a public road is passed into it, free of expense to them, while the drainage of a third of these also discharges into it filth of all kinds, to contaminate the waters, and fester in the summer's sun.

The doctors say the stagnant waters of the marshes around our city are in their opinion the main cause of the malaria in the form of chills and fevers, which has affected our neighborhood for the past twenty years to a much greater extent than formerly.

I have not had as much personal experience in underdraining of uplands as my father before me.

Many years ago he laid some underdrains of brush along the edges of upland next the marsh. These answered a good purpose for some years.

Later, he laid others of hemlock fence boards, one five inches wide, the other six inches, nailed at right angles, and having two supporting strips across to hold them in place. These seem to still

do the work when their outlets are kept open.

Still later when drain tiles could be obtained he used them with satisfactory results and within the past ten years has thoroughly drained an upland farm of 240 acres, with soil naturally good, but containing in many places flats and swale holes having no outlet on the surface, and too wet to perfect their crops.

He used small tiles for branches, running them together into larger ones for the main drains, and these into an open ditch,

These seem to do the work, effectually taking out the sour spots.

Of course there are occasional stoppages, from filth filling up tiles, and even grass and tree roots, or neglecting to keep the outlets clear, but these are easily remedied by prompt attention.

Sometimes swale holes can be best drained by wells sunk, either in their middle or along one side, down to sand strata, and running the tile into that for an outlet.

When surrounded by a large extent of higher ground this is the cheapest way. At other times it may be necessary to sink a leading drain through a hill 10 or 12 feet deep to give it the necessary fall, also where the ground is quicksandy supporting boards should be laid underneath the tiles to keep the level.

January 28th, 1889.

JULIAN D. JANVIER,

New Castle, Delaware.

DRAINING THE "COW MARSH" DISTRICT.

DELAWARE STATE BOARD OF AGRICULTURE, — *Gentlemen:*

The practice of draining wet lands by artificial means is one in which men differ as widely as in almost any thing else, and when you ask my views upon this very important matter, I can but give my personal observations, together with the hearsay of my father (Robert W. Reynolds) and ask you to draw your own conclusions.

I was born in A. D. 1838—was raised and have since lived bordering upon "Cow Marsh Ditch," which commences in Kent County at the ridge dividing the waters of the Delaware and Chesapeake Bays, flowing in a southwesterly direction and forms the head or source of the Choptank River.

My father was a great man to trace back the pedigrees of men and public improvements as well, and often, in his lifetime, he told me the history of this marsh and the history of its present artificial ditch, as told to him by his father (Thomas Reynolds) and it is this:

Originally this marsh was a wet, mucky commons but abounded in wild grass of an excellent sort, and farmers used to drive their cattle long distances here to graze, hence the origin of its present name, "Cow Marsh." These cattle, it was said, did well nearly the year round with the single charge of looking after and occasionally pulling one of their number from the mire.

In the year A. D. 1793 the present Cow Marsh Ditch Company was formed by an Act of the General Assembly. It was a new thing and a majority of those who lived about here looked upon it as of doubtful good, and then, as now, in all public enterprises, a few miser spirits had to drive the work.

They commenced digging down about what had been the disputed line between the States of Delaware and Maryland, and worked upwards, following the natural stream of the marsh in part, and dug a ditch eighteen feet wide and eighteen inches deep, a distance of about five miles to a point near where the village of Petersburg now stands. Here the marsh divides, the one part extending in a southeasterly direction and by reason of the presence of much iron ore is called the "Iron Mine Prong." This prong was dug twelve feet wide and eighteen inches deep a distance of about four miles to what was then called and known as "Pewter Forest." The other prong continues in about the same direction as the main ditch and is called the "Main Prong." This prong, like the "Iron Mine Prong," was dug twelve feet wide and eighteen inches deep a distance of about two miles to a point near where the village of "Willow Grove" now stands. Here the Main Prong divides, the one part extending in a southeasterly and the other part in a northeasterly direction. These prongs were dug tapering to about five feet in width and the usual depth, a distance of about five miles each to the dividing ridge as heretofore stated.

The reader will bear in mind that the twenty-one miles of ditch now described form and constitute what was the "Cow Marsh Ditch" as was originally laid out and made in 1793. This original ditch has been extended below to the Chopank River, and to which has been added, from time to time, many other and smaller ditches, until today the "Cow Marsh Ditch" Company has, within its incorporation, full fifty miles of public ditch into which flow more than a hundred miles of private ditch, and drain at least fifty thousand acres of land. The officers of the company consist of a treasurer who is also collector, a secretary whose duty it is to keep the books, four managers and two auditors. The company meets annually in April, and

each member is entitled to one vote for every hundred dollars or aggregate fractional part thereof to which he or she stands assessed; females and non-residents are permitted to vote by proxies. At these annual meetings the company elects its officers, levies taxes and does all other business necessary for the ensuing year. Occasional extra meetings are provided for by law.

I neglected to state that the main trunk of the ditch has, by the wear of time and the throwing out of bars that collect, become much wider and fully twice the depth as originally dug in 1793, and that this vast length of public ditch, draining fifty thousand acres of land as it does, is maintained and kept in reasonable repair at an annual expense of not more than twelve hundred dollars.

Now what shall I say for the benefits derived? To say that we folks here could hardly live without this ditch would be putting it mild indeed. Our lands, that are most benefited by the ditch, are our best lands. We grow grain and grass to the water's edge, and where our ancestors used to pull their cattle from the mire—where our fathers even fifty years ago, used to mow wild grass and fork it off to fast land to be carted away—we now drive the iron harvester and gather our very best crops of grass and grain. In fact what was then "Cow Marsh" proper—boggy and mucky as it was—is-to-day solid and dry, and is as fine farming land for grass and grain as can be found in the county, and all the result of a company incorporated public ditch.

My experience in undraining by means of tile is not much. I have done some of it, however, enough to know that it is buying farm, it is infinitely better to undrain it at almost any cost than to continue cultivating it to no purpose, or continue cultivating around it, as many do.

I hinted, at the outset, that I would offer no argument and make no controversy with those who deny the practice of thus draining wet lands by incorporated ditches, and neither will I, for I have lived to learn how vain it is to argue with a person of this kind. It is like administering medicine to a dead man, or attempting to convert an atheist by quoting Scripture.

The moral of my story is, that the taxes to maintain this ditch are collected from the pockets of only those who own the land and mostly go into the pockets of those who do day's work for their daily bread, and while we receive our taxes back ten fold in our crops we

also render assistance to those whom we are already morally bound to assist. Very Respectfully,

ROBERT J. REYNOLDS,
Petersburg, Delaware, Feb. 15th, 1888.

In answer to your further inquiry as to the estimated or probable cost of making a new ditch twelve feet wide and five feet deep, I hardly know what to say, but I would fix the average cost at about three dollars per rod. Of course everything depends upon the character of the soil to be moved and the fall the water has, for a ditch that won't empty itself as it is being dug would be more expensive, and a ditch that won't empty itself after it is dug is no ditch. My estimate above is for digging with the shovel and the spade, as I know nothing about ditching with machinery. In 1793 when the Cow Marsh Ditch was dug labor was very cheap, and even if we knew its cost then we could not estimate much from it now, for besides low wages then a man did more work in a day than two men will do of the same kind of work now-a-days. Then men worked to get the ditch done, now they work to put in the time and contractors would have to put in their bids accordingly.

Yours Truly,

ROBERT J. REYNOLDS.

NOTE.—The following papers, by Messrs. A. Colburn, William Reybold, and Franklin B. Colton, all of New Castle county, were written in 1885, and published by the U. S. Department of Agriculture in a volume entitled "Tide Marshes of the United States."

PAPER BY A. COLBURN.

The soil of the embanked lands along the river in the vicinity of Delaware City is what we term blue mud. It is formed of sediment from the river, and reeds, flag, and other water grasses, of which there is a rank annual growth on the river shore. This soil varies in depth from 1 foot to 20 feet. An excavation to the depth of 12 feet showed no difference in the nature of the soil. Piling was then driven 20 feet deeper without finding bottom. Soundings in other places show blue mud from 6 inches to 2 feet, then 2 to 4 feet of black muck or peat, which is nothing more than partially decayed sea-weed. This is very light and will readily float on water. Next

is sea-weed in a perfect state of preservation, to the depth of several feet, resting on sand or gravel, which indicates sea-bottom.

Our reclaimed lands vary from 2 to 6 feet above low-water mark. In some sections the ground has formed so high outside that a 6-foot tide flows only to the foot of the dikes, in others the tides rise from 1 to 2½ feet on the dikes. The ordinary rise and fall of the tides is 6 feet. Eight to 9 foot tides occur during heavy easterly storms. Eleven-foot tides are recorded, but they are not frequent.

All the dikes with which I am familiar have been built with material taken from the marsh, and it should be taken from without the inclosure. A ditch on the guard will soon fill up, while one in the meadow will always remain open. A section of bank was built by the Saint George's Marsh Company in 1879 by means of a dredge. The ditch was dug in the guard, 24 feet wide and from 10 to 20 feet deep. That ditch is now full of good mud, and should occasion require we could again dredge it out and get an equal quantity of better banking material than that excavated four years ago. The filling of the ditch is facilitated by building a stand across, leaving both ends open.

Locating the dikes is of the greatest importance. Much money has been wasted by building too near the stream. Where the dikes are washed by the sea they should be 15 to 30 rods back from low-water mark. This allows plenty of material for building and repairing, and the growth of reeds tends to prevent washing and cutting by the sea.

If a dredge is used it should be provided with an extra arm, so that the ditch may be as far as possible from the dike.

The sluices used in this section are built of wood, about 2 feet in depth and wide enough to vent the water. If a greater width than 3 feet is required they are divided into sections about 3 feet wide, in each of which is hung a self-acting gate. The sluices are placed below low-water mark. Great care is required to prevent the water running under or over them.

The Saint George's marshes contain some 2,000 acres, and are drained by the Saint George's Creek, which also drains many thousand acres of upland, and empties through sluices into the Delaware Bay. These lands are low, and during the prevalence of easterly winds the tides do not fall low enough to allow the sluices to vent the water. A wheel was erected and driven by steam, which threw over the bank 35,000 gallons per minute, all that was claimed for it; but there was too much water, and it was abandoned. A portion of

the same land, some 500 acres, was then imbanked from the creek; sluices were put in and a wheel erected for the purpose of carrying the surplus water into the creek. This wheel, which is run by an engine of 15-horse power, has 10 feet diameter, 12 feet face, and 9 inches depth of bucket, and a speed of 10 revolutions per minute. It lifts the water from 1 to 2 feet, according to the height of the water in the creek, and throws 15,000 gallons per minute. This land has no water-shed draining into it and the sluices do all the work the greater part of the year; consequently the wheel need be run but little, say two to three weeks each year. This plan of drainage has proved fairly successful. We lift the water only 1 to 2 feet, instead of 8 feet, as formerly; consequently less than one-fourth the power is required to lift an equal amount of water.

We are not obliged to embank against a wash from the sea, and as small dikes answer the purpose, the expense of building them is trifling.

Muskrats are very abundant and destructive if the dikes are left without protection. They can be protected from rats by sheet-piling. For this purpose use 1-inch boards, 4 feet long, and drive a double row, breaking the joints. If they cut through one row, they will strike the center of the board of the next row, which will stop their progress, as they cannot gnaw through the center of a board. Some 3 miles of this piling, driven two years ago, has in no place been cut through. The piling should be driven as near the foot of the dike as practicable, and the space between the piling and the dike so graded that no water can stand on it, else the rats will work in back of the piling.

The cost of building a dike, by wheeling the mud is from 10 to 18 cents per cubic yard, according to the wages paid and the distance the mud must be wheeled. It can be built by a dredger for 8 to 10 cents per yard. This cost does not include sluices, sheet-piling, or stoning. The dike should be faced with stone wherever it is exposed to constant washing by the tides. The cost of ditching is about 40 cents per rod for an 8-foot ditch, and wider ditches cost in proportion.

The first thing to be done with the embanked lands is to dig ditches. Drain the marsh and the water grasses will cease growing, and rain, sun, and frost will sweeten the land. Then sow grass seed and you will soon have a meadow. A liberal use of lime will hasten the sweetening process. After two or three years the land can be successfully cropped where there is good soil 18 inches deep, if wa-

ter does not stand too near the surface. The smallest ditches should be dug 8 feet at the top, 4 feet at the bottom, and 4 feet deep, and as the ditches serve for fences, they should be so laid out as to make the fields desirable in size and shape where this is consistent with thorough drainage, which should always be the first consideration.

The soil, in common with all clay soils, is baked by exposure to sun and drought, and at such times it is difficult to prepare the land and put in crops; but after they have fairly commenced growing they endure drought as well as, if not better than, on the best uplands. For general farming these lands are far superior to poor or even fair uplands, but on the whole I think our best upland is preferable. By the best I mean land which will yield from 25 to 35 bushels of wheat and 50 to 65 bushels of corn to the acre. Not that the upland will produce more, but crops are more certain. For instance, if the summer be cold and wet, corn will not do as well on the meadow. Wheat grows very rank, and the straw is liable to be beaten down by wind and rain, which interferes with its filling and maturing. For meadows and pastures they are superior to the best uplands.

On newly drained lands sow herd seed for the first crop, as that grass will grow on damp and sour land. When rotating crops, sow clover and timothy. The crop will be immense, but coarse and not quite so good as that raised on upland. The grass most natural here is called green grass (*Poa pratensis?*). This and white clover come in and supersede all other grasses in three to five years. Hay made from this grass is not as marketable as clover and timothy, but it makes excellent and abundant pasture. The greatest advantage high marsh has over upland is that the soil is practically inexhaustible. We have lands which have been under cultivation for more than a century, still they show no signs of exhaustion. There are no fertilizers used excepting lime, and a difference of opinion exists regarding the benefits derived from it.

The greatest benefit of the *low marshes* is gained by using them in connection with upland. They cannot be cropped, but will support cattle, and the cattle will support the upland. The 500 acres before alluded to have pastured 100 cattle all summer and furnished the principal feed for 300 the following winter. These lands not only pay, but help to make the upland profitable.

Any marsh having 1 foot or more of blue-mud soil would be profitable if reclaimed. Lands lying as low as 2 feet above low-water mark may be reclaimed and drained by sluices, providing they are

located on small streams, where they are not subjected to washing by the sea and receive little or no drainage from upland. It will not pay to reclaim very low lands on large streams, unless they should be so situated that a short dike would protect a large amount of land. It is practicable to reclaim any good marsh where the dike can be located some distance back from the stream and on ground from 4 to 6 feet above low water.

There is only one tract of good unimproved marsh in this neighborhood, and that was improved and in profitable cultivation for many years, but the dike, being in an exposed situation, was carried away by a storm, and has not yet been rebuilt, owing, it is supposed, to disagreement among the owners or to the inability of some to pay their shares of the expense. I do not know of any unsuccessful attempt to reclaim marshes in this section.

The marshes here can hardly be termed salt, as the waters of the bay are only slightly brackish. The low undiked marsh supplies very good pasture, and cattle thrive on it. Milch cows pastured on it give a little less milk than on upland pasture, and the milk is 20 per cent. poorer in cream. If the grass is cut at the right time and properly cured it makes very good hay, and cattle wintered on it alone keep in fair condition.

This State reserves no rights in submerged lands; owners control to low-water mark.

There is no evidence of any settling in the embanked lands, and there can be no elevation unless they are again overflowed. It is fancied by some that the tides rise higher and do not fall as low as they did thirty years ago, and that consequently the sluices do not drain these low lands so effectually as they did. We think, however, that the difficulty is in the ditches and water-courses. The sluices cannot vent the water unless the water gets to them. I have seen water at the sluices 18 inches lower than at the head of the water-course, less than 1 mile away, and the sluices were then doing not more than one-third the work of which they are capable. A difference of more than 3 inches in the level within 1 mile indicates that the sluices have not been properly cleaned.

Lands covered by the tides are not considered unhealthy, neither are drained lands. If, however, the lands be only partially drained, and water be allowed to stagnate upon them, malaria will result.

Respectfully,
A. COLBURN.

PAPER BY WILLIAM REYBOLD.

With us marsh lands are designated by the character of the soil. The best (No. 1) are called blue or gray mud meadow. Meadows of good mud, 18 inches above water in ditches, are known as high meadow. Marsh lands (No. 2) with no superincumbent blue or gray mud consist of *peat* or vegetable matter, and are generally called *peat* or *horse-dung* marsh. There is a (No. 3) marsh with soil resembling coffee-grounds, which is nearly worthless.

Nearly all the meadows in this county have been embanked. The abundance and cheapness of upland farms, and liability of marsh lands to overflow, may be considered the reasons why capital has not sought to improve marshes elsewhere.

Banks should be strong and have the protection of a guard of reed marsh next the river, or if there is no reed guard the bank must be faced with stone. It is of the first importance that no holes *always containing water* be allowed near the bank, either inside or outside. All water should run off at low tide; otherwise muskrats will at once take possession and weaken the bank with their holes.

Where banks are placed at a greater distance than one-fourth of a mile from the river, the mud of which they are constructed should come from *inside* of the bank altogether, because there is so little time between the ebb and flood tides that an outlet of a fourth of a mile long will often not empty the ponds or rod-holes, and they can be drained into the sluice drain or inside creek. On the other hand, where banks are placed near the river the mud should come from the *outside*, for then drainage is readily had and all the surface inside the bank can be kept for farming purposes. Only a gutter for carrying off leakage water should then be allowed at the inside foot of the bank. The more a bank is trodden by cattle the better, as it not only makes the barrier firmer, but cattle drive "fiddlers" away by filling their holes and smothering them.

On reclaimed salt water meadows corn does not thrive until the rains have leached the salt out thoroughly, but they grow heavy crops of wheat, rye, and oats.

There has never been any decided sinking of meadows or banks, as far as I have observed, excepting such as is caused by the decay and shrinkage of *peat* above the water line.

The best sluice is the one that is best in its foundation, well piled beneath the sluice and wings. The doors open and shut with the tide, and can be either of the "barn-door" or "trap-door" kind.

I think all our marsh lands were parts of original grants, and titles were made to subsequent purchasers. In New Castle County deeds always cover title to *low-water* mark. I have been informed that in Kent County deeds convey "to the water." Nearly all our meadows are controlled by marsh companies (composed of the owners) with special charters.

If, after reclamation, marshes are kept well drained, there is less of malarial disease than when not reclaimed, and the pest of mosquitoes is almost done away.

What hinders the more rapid improvement of marsh lands in Delaware? Banking out rivers and venting the waters that fall upon the lands is a contest with nature, and the individual is often unequal to the task. The *State* generally not only does not assist him, but taxes his reclaimed land, in addition to the river bank tax. The late John M. Clayton frequently said in my hearing that, as a settled principle, the State and county should never exact taxes of meadow lands.

The best high meadow is as valuable as any upland for agricultural purposes. Below the best may be found every grade of value, and some good for nothing.

Respectfully,
WILLIAM REYBOLD.

PAPER BY FRANKLIN B. COLTON.

In compliance with your request for a statement covering the tide marshes bordering on the Delaware Bay and River and tributary waters, &c., I would say that for many years the subject of their formation, reclamation, improvement, maintenance, and value has been of great interest to me, as I have been engaged in a business closely allied.

From observations and experience I am clear that the "tide marshes," or "river meadows," as they are called in this vicinity, may be made the most valuable, safe, and reliable lands for farming, trucking, gardening, &c., and also be rendered entirely healthful for the occupants.

Such lands on the Delaware as are now embanked have been reclaimed (until within a few years) piece meal, by hand. The material for banks (say 12 feet wide at base, 3 at top, and 6 to 8 feet high) was taken from the marsh on either side, on the outer or the water side leaving irregular sinks or rod-holes, and on the inner or land side a ditch, commonly called "leak water ditch." Before the days

of steam machinery this plan of banking was excusable, but should now be abandoned, and as far as possible the inner ditch should be filled to at least the height of the land inclosed. Beside weakening the original foundation for the embankment by cutting the surface turf or crust, the ditch becomes a harbor for rats, that burrow from thence into and through the banks, causing leaks, breaches, and "blow-outs." The small dimensions of the old hand-made banks rendered them insecure, and they required constant watching and repairs. The marsh lands are controlled and managed largely by incorporated companies, with managers who levy tax per acre as may be required for the making or maintaining of banks, sluices, and ditches for the general good.

A custom prevailed among the "old settlers" that I am convinced was detrimental to their best interests, *i. e.*, cutting ditches for boundaries, to serve in place of fences, in addition to ordinary drainage and main-trunk ditches. With large, tight embankments and good sluice-gates very few ditches are required in ordinary situated marshes, and, as a rule, the fewer ditches the better.

In some cases a ditch is necessary at or near the junction of the upland and marsh to cut off springs; otherwise one good ditch will be sufficient for a tract of 100 to 500 acres. Ditches made by machinery are better and cheaper than the common ditches made by hand. The latter require to be scoured or deepened at least once every two years, by reason of the rapid growth of rushes, reeds, docks, &c., that obstruct the flow of water and fill the ditch. Ditches can be made so deep by machinery that vegetation will not take root; therefore shoaling is very slow and water flows freely to the sluice-gates.

Automatic sluices are generally used in this vicinity; but, as a rule, they are not so well constructed or imbedded as they should be to insure the best results or greatest durability. The best known to the writer were constructed under the direction of the late Strickland Kneas, civil engineer. These were of heavy oak and yellow-pine timber, lined inside with heavy sheet-iron, and had double gates of boiler-plate iron. The foundation was prepared by driving piles, spaced 30 inches centers and cut off 18 inches below ordinary low water. All interstices were filled with concrete, well rammed, and this foundation covered with 3 inch plank, forming a platform, on which the sluice trunk was placed. Sheet-piling was then driven across the face at either end and at least 4 feet from the side of the trunk, forming wings. The sluice trunk was about 18 feet wide, 40

feet long, and 30 inches deep; and had three longitudinal bulkheads or partitions, forming four openings 2 by 4 inches in the clear. The inner doors were placed about the center of the trunk, where they were exempt from interference of unauthorized or meddling people.

So far I have referred to the old reclaimed marshes. The value of those still lying out depends upon their location, depth, extent, and exposure. Those having the greatest depth, least frontage on tide water, and located within a reasonable distance of good markets are the most desirable for reclamation for agricultural purposes. The cost per acre depends upon the number of acres that may be shut off from the tidal waters by an embankment of a given length. In many situations banks require facing with stone to protect them from wash caused by storms, steamboat swells, &c. Embankments may be built by machinery at from 8 to 12 cents per cubic yard. Stone facings in ordinary places and conditions cost from \$10 to \$15 per lineal rod of bank. From the above it will readily be seen why it should not be profitable to reclaim long, narrow strips of marsh bordering on our rivers or bay for *agricultural* purposes.

One principal reason why large areas of good marshes are allowed to remain unimproved and comparatively unproductive is that their value is little understood, especially by farmers.

Nearly all farmers who have land near the rivers either own or rent a piece of "marsh," which they value for the "rough stuff" they may cut and haul into their barn-yards, a portion of which cattle may eat and the balance form manure. Many of these large tracts are owned or controlled by a number of people, and an attempt to purchase and improve the whole will prove futile, as a rule. As yet there is a large percentage of agriculturists opposed to innovation.

There are very many admirably situated tracts of wild marsh lands on the Delaware and Chesapeake Bays and their tributaries that may be, and in the future will be, reclaimed, at a very low cost per acre, and when so reclaimed and cultivated will prove to be garden spots at once bountiful, reliable, and exhaustless.

These marshes in their unimproved condition are anything but a blessing, breeding miasma, mosquitoes, and nuisances generally. All this may be remedied profitably by banking, draining, and cultivation; the stagnant pools and decaying vegetation of these pest-breeding haunts need not be tolerated.

Very Respectfully,

FRANKLIN B. COLTON,

General Manager of the National Dredging Company.

TRANSACTIONS
OF THE
PENINSULA HORTICULTURAL SOCIETY.
