The two most important factors relating to any malaria control drainage project are the ultimate cost, and the permanency of the system. When properly planned and executed, underground drains are not expensive to construct and will give many years of satisfactory service free from maintenance. In view of these points, underground drains should be used for malaria control drainage whenever conditions indicate the feasibility of this method.

OLD SALT MARSH DITCHES

By William Thom
Middlesex County, N. J.

Why is it that old Salt Marsh Ditches do not function as well as new ditches, even though they are cleaned at frequent intervals?

As time goes on this question will become more paramount in the minds of mosquito control workers throughout the state; at least in Middlesex County we have already discovered its importance, because many of our ditches were installed more than forty years ago and we have observed during the past few years that the marsh areas encompassed by the older ditches do not drain off as rapidly as similar areas surrounded by ditches of recent construction. In many cases, wet areas may be found within a few feet of the old ditches long after the tides have receded and it is apparent that evaporation, rather than percolation, plays the greater part in the removal of water in these areas.

Our marshes are now pretty thoroughly covered with ditches: In fact, we have reached the point where the further extension of laterals would seriously interfere with the harvesting of the Salt Hay Crop. Consequently, we must find other means of draining the marsh surface, or resort more and more to the use of oil and larvicide.

In the approach to the question we have raised, I believe that it would be well, first, to review briefly the structure of a salt marsh.

Salt Marshes are built by the action of the ocean's tides in the deltas of rivers where the silt laden current of the river is retarded by the incoming tide and fans out, depositing silt on either side of its channel. The heavier materials, gravel and sand, find bottom first, usually in the channel and on either side farther up stream while the finely pulverized materials are carried off by the receding tides to be finally deposited in the still water along the more sheltered areas of the shore. As these areas fill up, the deposits are carried further and further outward toward the headlands or to a point where wave action keeps the silt in solution until carried in again by the rising tide.

This process is carried on until the silt has been deposited to such a height that it becomes exposed at low tide, forming what is commonly called a mudflat or young marsh. It is at this point that vegetation first appears. This first vegetation is almost purely aquatic and contains little if any fiberous material.

This growth screens the incoming tides of flotage and by impeding the tidal flow causes a more rapid deposit of fine silt. Evaporation of the tide water now begins to take place and the resulting residue of various salts mingles with the silt. Marsh sod now begins to form. It consists of a more or less porous mass of flotage, roots, etc. held together in a matrix of silt heavily impregnated with brine. This sod layer continues to rise until only occasional tides cover it. As the period of time between covering tides lengthens, the type of vegetation changes and becomes more fiberous with longer and more numerous roots.

I have often noticed while walking over a salt marsh that the sod seems to be firmer and somewhat higher near the banks of natural streams while near the upland the marsh appears to be lower and much softer under foot.

This, I believe, is due to the fact, especially where there is a long reach between shore and upland, that trickling tides deposit the greater part of their suspended matter close to the river bank while only the very finest matter can be carried in suspension long enough to reach the edge of the upland where it is generally kept moist by ground water seepage.

At this point one might well ask why it is that the surface of the marsh does not take on more of the characteristics of common top soil, now that it has reached a height where it is inundated only during periods of extreme high tides. I can only answer this question by saying that whereas topsoil is the result of nitrification of vegetable matter plus the action of animalcula in the sod, there appears to be an almost total lack of living organizisms in salt marsh sod while the excessive amount of chlorine present acts as a sterilizing agent there by retarding the disintegration of root stock.

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The rate of percolation of water through Salt Marsh sod into intercepting ditches has not yet been determined with sufficient accuracy, so far as this writer knows, to permit one to quote velocity of flow in feet per hour or discharge in gallons per acre per hour, for many factors are involved; to wit: Spacing of ditches, their depth, period of time between high and low water, density of the sod, type of vegetation and weather conditions. Hence, the proper spacing of ditches to obtain maximum effect depends entirely upon the experience of the designer. In some areas, ditches spaced as much as three hundred feet apart seem to work as well as those spaced at one hundred feet in other areas. When laying out drainage systems on virgin meadows, some designers install only alternate laterals and later add to the grid as conditions warrant.

Water is removed from the surface of a ditched marsh by a number of natural forces: It flows over the surface directly into the ditches: Evaporation may remove as much as fifty percent of it. Percolation through the sod to the ditches accounts for the balance of it except that portion which is removed by the capillary action of plant life and as this action exerts an upward force, it probably retards percolation to some extent.

In endeavoring to answer the question posed at the beginning of this article, I believe we can safely confine ourselves to a study of the processes of percolation and its concomitant, "leaching." Having no authentic data at hand, the argument must be based entirely upon supposition.

Due to tidal action on the Salt Marsh, percolation is intermittant; the hydraulic gradient and the velocity of flow is constantly changing and the direction of flow may even be reversed for a short period near the peak of high tide.

As the water moves through the sod toward the ditches it carries with it the finer particles of silt and salts which are deposited in the ditches in the form of a soft sludge. As the tide rises in the ditches this discharge (leaching) is checked, and the suspended material slowly fills the interstices of the sod along the edges of the ditches, thereby gradually "raising and reducing" the hydraulic gradient of the sod.

It is this intermittent process of leaching that slowly increases the density of the soil along the edges of ditches, thereby reducing their efficiency and is, I believe the chief cause for the appearance of false alders.

In seeking a remedy for this trouble with our ditches, we sliced the sides of our older ditches with a hay knife but found that the improvement was negligible. We have now resorted to the use of a mole plow to restore the efficiency of our ditching systems and so far as we are able to judge at this time, it appears to be the answers to our problem.

In using the plow, the mole is kept up in the sod and cuts are made at intervals of about twenty-five feet, cut through from ditch to ditch, so if we assume that the mole hole drains both ways from its mid length, each cut would drain about twenty-five hundred square feet of meadow surface. By this means, the direction of flow of water through the sod is changed and the length of flow is reduced from approximately one hundred feet to twelve feet. As the blade of the plow cuts a slot only about two inches wide, no damage is done to meadows where hay is harvested.

We are not prepared to state how long these mole holes will remain effective but even if we have to open new cuts at intervals of three years we believe that we will have reduced the amount of oiling necessary to maintain control, to such an extent that the mole plow will prove to be the more economical method of control.

MALARIA CONTROL FROM A SANITARY ENGINEERING POINT OF VIEW

By Edward Wright, Chairman
Massachusetts State Reclamation Board
July 9, 1943

History has been made by engineers and physicians in the control of malaria and other mosquito-borne diseases in such mosquito-infested regions as Cuba and Panama and in other tropical countries. Monuments have been erected to the pioneers such as Ross, Reed, Gorgas and LePrince. In fact, it can be considered that the Panama Canal is a monument to the mosquito control work carried on by the American engineer after the French had abandoned the work as hopeless because of the mosquito.

We in Massachusetts have not thus far been seriously concerned with malaria except in comparatively minor instances and for some years there has been practically no malaria in Massachusetts other than that imported from other countries. The picture changes with the war as it did somewhat during World War No. I when over 25,000 soldiers who had malaria were invalided home from tropical countries. The records show, according to Dr. L. T. Coggeshall, Professor of Epidemiology, School of Public Health, University of Michigan, that malaria is the most important and most deadly disease in many tropical countries. He has stated that there are over 3,000,000 cases of malaria in Russia, for example, and that at one time there were 88 cases per thousand of population in Panama. There are indications that over 50 per cent of our soldiers in the South Pacific and in tropical Africa now have various forms of malaria. It has been stated that in Liberia 70 per cent of the population have malaria parasites in their blood. The supply of quinine is becoming quite limited in various parts of the world and it is understood that in one tropical country the supply has been sufficient to treat only 40 per cent of the cases. Upon the return of our soldiers from the tropical battlefields to their homes and particularly to the general hospitals now being operated by the U. S. Army, such as those at Camp Edwards, Camp Myles Standish, Fort Devens and that being constructed in Framingham, there is a possibility of a spread of this disease to the civilian population unless the patients are treated in hospitals that are thoroughly screened to prevent access of potential malaria-bearing mosquitoes to the patients, and provided the species of malaria mosquitoes are present in any considerable quantities. Because the parasites may exist in the blood for some years there is also the danger of the spread of this disease when the patients are released if the Anopheles mosquitoes are present in any considerable numbers.

In the report of the Department of Public Health on "The Prevalence of Mosquitoes in the Commonwealth," House Document 2260 of the Legislature of 1941, reference was made to the vectors of malaria; and, the most probable vector, Anopheles quadrimaculatus, was found in that survey in all counties in the State excepting Dukes and Nantucket. The numbers found