in Central America, along with studies of carbamate and phosphorus insecticides as residual adulticides. In Iran, monthly drug distribution is being used to suppress malaria in the areas of double resistance.

Technical problems will continue to arise, but we are confident that research and development studies will produce new ideas and new products to solve them. So far as administrative obstacles are concerned, they too will be eliminated by the national and international personnel working together. Malaria eradication is being achieved in ever-expanding areas which constantly are coalescing. As these areas expand into nation-wide coverage, expert personnel are made available to work in other countries which, in turn, receive more and more attention. By continuing to give this disease high priority attention, it will be eliminated forever as a public health problem.

WATER MANAGEMENT ON THE SALT MARSHES OF NEW JERSEY

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In New Jersey, approximately 80 percent of our control methods may be classified as "water management." Because of the economic importance of usable wet lands in our state we realize the feasibility of control in conjunction with recreation, wildlife management and the possibility of land reclamation.

Tried and tested methods over a great number of years have given us some guides for the most practical and beneficial types of control. There are several control measures used, remembering that all methods will not work on all marshes. They are listed as follows:

1. Drainage on open salt marsh.
2. Dikes and tide gates.
3. Dikes and pumps.
4. Tidal outlets.
5. Vertical drainage.
6. Dredging and filling.
7. Outlets through barrier beaches.
8. Experimental impoundment, with water level and water quality control, by the New Jersey Agricultural Experiment Station.

1. DRAINAGE ON THE OPEN SALT MARSH follows much the same pattern on all firm marshes. Most ditches are installed parallel, spaced 100 to 200 feet apart depending on the soil permeability in the area to be treated. These ditches should not be more than 2500 feet long, with outlets at each end, and, if possible, they must also be connected to a band ditch which is installed at the low area of the marsh near the upland to insure circulation. This also allows the natural enemies of the mosquito to circulate throughout the entire marsh and assist in the control measures. These ditches are from 10" to 40" in width. The depth depends on the depth of the sod roots in the area concerned. Ditch size should be kept at a minimum to assure the lowest possible maintenance costs. If this procedure is followed the vegetation on the open marsh changes very little. Pollution should be separated from salt water in all cases and not allowed to spread over the marsh area. The principal reason for band ditching is to intercept upland run-off waters and keep them from covering the marsh. Secondly, they serve as a receptacle for upland weed seed and traveling vegetation, and promote greater circulation of water. This is done by separate outlets to deep water, and if necessary, by dikes.

2. DIKES AND TIDE GATES are installed where a combination of heavy rains, high tides and pollution are the cause of an emergence of mosquitoes. A study is made of the area to be diked noting its size, the intensity, duration and frequency of rainfall, sources of water and amount of water received from the upland. These are the factors which govern the amount of water that must be removed and at what rate. A fair figure under average conditions is one square foot of orifice for every twenty acres of meadow land. The flow line is set at one foot below the average low tide. In most cases two sets of gates are installed to assure circulation. These gates are made of creosoted materials to insure durability.

Sewage must also be separated from the clean water. The system must be watched very closely for meadow shrinkage. From our experience in New Jersey water level greater than three or four inches below marsh level would constitute too great an extreme and detrimental shrinkage would result.

3. SOME AREAS ARE DIKED completely with the pump running 24 hours per day and some are set to run at certain water levels by automatic floats and switches. These areas are controlled by pumps from 6" to 36" in size depending on the amount of water to be removed.

4. TIDAL OUTLETS. These outlets to the bay or river are installed for enclosed marshes. They usually enter a bay and are set at a grade to insure the minimum loss of drainage from the marsh. The grades are usually set according to the following formula: loss of time on drainage: 1½ hours on the incoming tide, 1 hour on mean high tide and 1 hour on the outgoing tide. The incoming tide will help to flush the meadow and allow for water circulation. This outlet is used where we have tidal action of from three to four feet. On marshes where the tide fluctuates from four to twelve inches, namely, in the back bay areas, the outlets must be placed at a grade suitable for some circulation. Vegetation with this type of installation seldom changes. No tide gate is used with this method bu ice breakers must be installed to prote the pipe on the outer end.

5. VERTICAL DRAINAGE is used on certai marshes where the character of soil co tent will not allow sub-surface drainag or quick surface run-off. A groun breaker is used for this purpose, draw by a small tractor. A 4 to 8" plug "mole" is attached to the blade and is s from one to two feet below the meado surface depending on the depth of t salt marsh roots. The mole holes a connected with the smaller ditches and t bar which is attached to the groun breaker will have a vertical cut from t top of the salt marsh to the mole ho thus affording vertical drainage. Systems this type remained in operation for at lea six and in some cases seven years aft installation. The mole holes are plac from twenty-five to fifty feet apart depen ing on the character of the soil.

6. DREDGING AND FILLING—the best a most permanent method—will give son trouble some time after filling if the su face cracks. These cracked areas must harrowed as soon as the surface will allo a light tractor to travel the area. By di ing the cracks are filled and breedi ceases.

7. OUTLETS THROUGH BARRIER BEACH lead fresh water to salt bays, and may clude 200–300 foot channels through dun and mud to reach the outlets. Outflow accomplished by long sluice boxes or c rugated pipe which is supported on cradle. In addition to head walls and wi walls on the fresh water side it is practice to locate a sump pit in the barr beach or dune as a protection from sto waves, and also to give access for main nance. The sump pit varies in constr tion from a wooden box to pour concrete.

In this box or sump is located the t gate. The location of the gate here p vents the freezing of the moving pa and facilitates cleaning the long sluic

On the bay or sea side the outlets extended well into the area of wave acti

to prevent silting. The outlets are protected by piling, as an ice breaker.

8. NEW JERSEY AGRICULTURAL EXPERIMENT STATION. Water management on seasonally flooded marshes is of two types: (#1), Management for wildlife protection; (#2), Management for salt hay production.

Concerning (#1), where tide range is slight and drainage uncertain, it has been found advantageous in New Jersey to dike along the upland marsh at the line of transition of vegetation to create fresh water impoundments. This encourages growth of food plants for birds and animals, and where fresh water is adequate, it offers some advantage for fish.

In areas exposed to storm tides, New Jersey is experimenting with a second, lower dike in front of the fresh water impoundments. This low dike which, impounds a "cell" area, can be flooded with salt water by high tide or pumping, and can be flushed by winter tides sweeping over the top of the diked areas. The creation of sheet water in these areas during mosquito breeding season has discouraged salt-marsh mosquito production, encouraged the maintenance of killifish and provided added nesting areas for ducks. The low dikes are equipped with conventional sluice gates to facilitate water management. Studies are under way for large areas to be cut into cells which will make water level controls possible.

With respect to (2), harvesting salt hay requires long periods of dry meadow with a minimum of lateral ditching, which interferes with cutting. At the present time, the New Jersey Agricultural Experiment Station is developing flooding schedules for seasonal introduction of salt water through double banked ditches connecting with band ditches along the upland to narrow the transition zone of plants, where both *Aedes* and *Culex* species are troublesome.

Where these methods are not effective large scale chemical control is the only method of adequate treatment. Usually, hay meadows are not high value wildlife areas because of the harvesting of the crop and dearth of food organisms. Seasonal flooding makes them desirable resting grounds for migratory birds.

The Experiment Station is making studies on management of these areas for production of food organisms of high value to fish and wildlife.

It is interesting to note that no permanent damage to key organisms has been observed resulting from the currently used high-oil granular insecticides, with DDT and related materials.