talc is a hardness-reference mineral (Mohs scale) with the nominal value of 1, its practical rating is 1–1.5 (Dana 1932). The quartz content varies from practically nothing to a conspicuous amount. Yet to many of us talc is talc. Rock species with long or cumbersome names, on the other hand, are commonly known by catchy brand names.

Among the mineral names that are inadequate characterizations in themselves are "fuller's earth" and "bentonite." These two products are prominent in connection with granulated insecticides. Some fuller's earths are essentially montmorillonite; others are mainly attapulgite. The total number of species that exist as components of fuller's earth is estimated to be in the dozens (Ries 1927). Some fuller's earths on the market have six or eight times the surface mean diameter of others. Differently processed products from the same company differ significantly in sorptive capacity and in breakdown of granules under the action of water. Bentonite is composed largely of montmorillonite, but many other components and impurities may be present, and products from different sources vary in exchangeable bases, pH value, and capacity for swelling in water.

Botanical carriers, such as rice hulls, are used occasionally in granulated insecticides, but their characterization offers no serious problem.

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ECOLOGICAL DATA ESSENTIAL TO EFFECTIVE AND ECONOMICAL CONTROL OF LITTORAL MOSQUITOES AND NUISANCE FLIES

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The biological gradient prevalent on the marshes scattered along the Massachusetts coastline constitutes an intriguing phenomenon. Although variations in the general appearance of individual marshes are rather obvious, the orderly distribution of aquatic organisms inhabiting these areas is somewhat obscure. Probably the most striking characteristic is the predominating floral species associated with each type of marsh. Since the distribution of both flora and fauna depend to a considerable degree upon marsh elevation, salinity, and moisture content, these dominant floral species might serve as floral labels for the various marsh types and indicate, also, the presence of the less conspicuous organisms common to their respective areas. Past experience has emphasized the value of some system, such as floral labels, which would furnish ready information relative to the ecological conditions and the probable fauna existing in areas where control treatments are contemplated. Although marsh classification, based on the presence of dominant floral species, appears fundamentally sound some adjustments should be anticipated when the suggested method is applied in a different biological or geological zone.

A brief basic conception of the geological activity which resulted in the formation of the Massachusetts marshes serves to provide a more thorough understanding of present conditions. This may be obtained from a review of that section of geological history, usually referred to as the glacial periods, when the eastern portion of the state was overlaid with glacial drift to a depth of from 100 to 300 feet. These glacial deposits consisting of sand, gravel, rubble, and clay, filled the old river valleys and extended well out into the ocean to form a continental shelf. After the glaciers receded, wave erosion produced numerous sandy peninsulas along the principal coastline. In time, the areas between these peninsulas and the mainland were built up by organic accumulations to form marshes which vary in elevation from 4 to 11 feet above mean low water. Similar accumulations produced marshes, also, in the existing estuaries and about the mouths of streams which discharged into the ocean. Since all these marshes are underlaid with a considerable depth of loose glacial drift, the water table simulates the surface of a huge water reservoir with an imperceptible surface fluctuation.

Although standardized ditches, 10 in. wide and 24 in. deep, have been installed on our coastal marshes their effectiveness varies considerably from one marsh to another. As a rule the higher marshes, i.e., those with maximum or near maximum elevation, respond to drainage sufficiently to eliminate all standing water and produce a dry firm sod. On others at lower elevations drainage is rather sluggish, and although standing water is eliminated, the actual modification in the height of the water table is so slight that the marsh surface tends to retain its original spongy condition. Those located in estuaries, or at the mouths of streams, definitely resist drainage by ditching since the stream discharge, between high tide periods, serves to hold the marsh at the saturation point—while those located on the sandy peninsulas are not subject to this drainage method because the ditching is economically impossible to maintain. Occasionally, small marshy inlets are closed off by the vagaries of loose sand accumulations or by dikes, resulting in the conversion of these areas to brackish or fresh water ponds which harbor extensive floating marshes.

The different types of marshes are described in the paragraphs which follow:

HIGH MARSH—Low water table, elevation 9–11 feet. Dominant salt marsh floral combination: primary, consisting of salt meadow grass *(Spartina patens)* and high tide shrub *(Iva oraria)*; and secondary, consisting of black grass *(Juncus gerardi)*.

Along the coastline, from Cape Cod Bay north to the New Hampshire state line, tides vary from 8 to 11 ft. and the marshes have been built up naturally to exceed 9 ft. in elevation. The dominant vegetative growth is salt meadow grass *(Spartina patens)*, although areas of maximum elevation may support patches of black grass *(Juncus gerardi)*. At the upland borders, the high tide shrub *(Iva oraria)* grows in profusion, and serves to anchor the thatch piles which function as harborages for the advanced larval stages and the pupae of the greenhead fly *(Tabanus nigrovittatus)*. In addition, the larvae of the nuisance gnat *(Dasyhilea mutabilis)* frequent the moist soil along the edges of those lateral ditches which are flushed daily by incoming tides. During the period of extreme spring tides, these larvae may be found, also, in moist areas located immediately adjacent to the lateral ditches. Whenever the temperature is favorable, and high tides or abundant rainfall produce standing water in existing depressions, the true salt marsh mosquito *(Aedes sollicitans)* may find temporary breeding sites in these high marshes.

INTERMEDIATE MARSH—Low water table, elevation to 9 feet. Dominant salt marsh floral combination: primary, consisting of salt meadow grass *(Spartina patens)*, without the high tide shrub *(Iva oraria)*; and secondary, consisting of cord grass *(Spartina alterniflora)*.

On the south shore of Cape Cod which borders Nantucket Sound, and along the shore which skirts Buzzards Bay, tides are reduced and vary from 3 to 6 ft. while the marshes show a corresponding reduction in elevation. Since the run-off is sluggish, the surface tends to retain a high percentage of moisture and large areas of cord grass are not uncommon. Occasionally, firm surfaces are encountered on the narrow marshes which show a noticeable pitch. Under these conditions, the salt meadow grass may be interspersed with patches of black grass. In instances where fresh water streams discharge on to salt marsh, the growth of three square grass *(Scirpus spp.)* may be encouraged. This condition is most prevalent on those back reaches subject to a constant flow of fresh water. Although neither the greenhead larvae nor the larvae of the nuisance gnat frequent these freshened areas, they do constitute sites for prolific breeding of the brown salt marsh mosquito *(Aedes cantator)* and the unbanded salt marsh mosquito *(Culex salinarius)*.

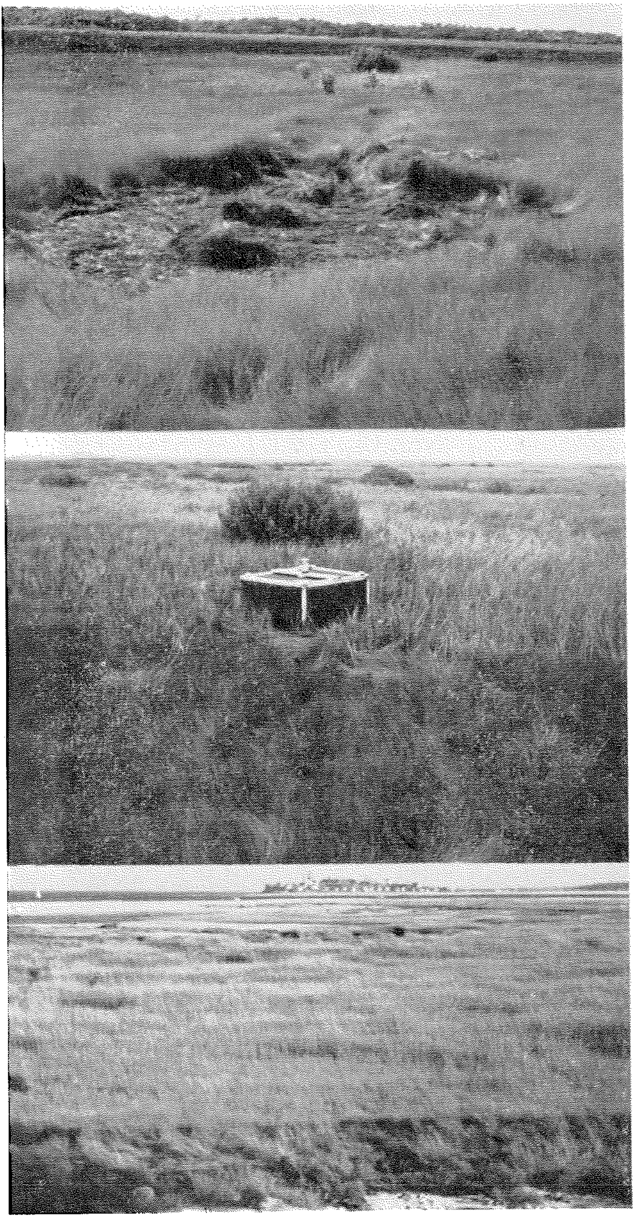
SATURATED MARSH—Natural water table, elevation to 9 feet. Dominant salt marsh floral combination: primary, consisting of cord grass *(Spartina alterniflora)*; and secondary, consisting of reed grass *(Spartina cynosuroides,* sometimes called *S. polystachya)*.

The saturated marshes are usually located in estuaries, or at the mouths of streams, where the constant discharge of fresh water maintains the water table at its maximum height. Although the ditching in these areas has little if any effect upon the height of the water table, it does reduce the amount of standing water and as a consequence limits breeding of both the brown salt marsh and the unbanded salt marsh mosquito. The permanent brackish pools which persist as the result of existing pot holes produce heavy broods of the biting gnat *(Culicoides obsoletus)*, and the extensive cord grass areas favor the production of a heavy population of the salt marsh tipulid *(Limonia Dicranomyia haeretica)* which often appears in quantity sufficient to constitute a real nuisance.

FLOATING MARSH—Ponded areas, elevation to 9 feet. Dominant floating marsh floral combination: primary, consisting of cattail *(Typha angustifolia)*, and secondary, consisting of water willow or swamp loosestrife *(Decodon verticillatus)*.

Because of the loose glacial drift existing along the Massachusetts coast, changes in the shore line occur frequently. In some instances inlets have been closed off by wave action or by the shifting of sand dunes, while others have been closed off deliberately by dikes. When the salinity of these isolated bodies of water falls below 100 parts per million, cattail growth *(Typha angustifolia)* may invade the water area and produce an extensive floating marsh. The suspended roots of this aquatic growth provide ideal attachments for the larvae of the irritating mosquito *(Mansonia perturbans)*, with the result that a prodigious population of this particularly vicious pest may occur. In some fresh water ponds this pest inhabits, also, the root systems of the water willow *(Decodon verticillatus)*, the button bush *(Cephalanthus occidentalis)* and various species of manna grass *(Panicularia spp.)*. Where these closed inlets receive salt water by seepage or by an indirect connection with the ocean and the salinity approaches 3,000 parts per million, only highly organized algae or pond weeds, such as *Chara* and *Potamegeton,* may persist. In these instances mosquito breeding usually becomes a minor problem, and the major nuisance is created by a mosquito-like midge *(Tendipes stigmaterus)* and a gnat-like midge, *Lauterborniella varipennis,* which appears in dense swarms from early May well into September. The latter species is particularly obnoxious, because of its ability to pass through the finest window screening in its efforts to invade the illuminated interiors of cottages.

CONCLUSION: It is evident that the control of littoral insect nuisance pests is a



Top: High marsh bearing clear stand of *Spartina patens.*
Middle: Transition from high dry marsh bearing *Spartina patens* to low moist marsh bearing *Spartina alterniflora.*
Bottom: Saturated brackish marsh at mouth of river bearing *Spartina alterniflora.*

complex problem, the solution of which requires detailed knowledge of the life history and bionomics of each individual species concerned. However, when adequate information is available, one may then concentrate attacks at those vulnerable points which provide the most effective and most economical control. To illustrate: (1) in control of the greenhead fly, only that small portion of marsh marked by high tide shrubs and the thatch piles from which the majority of adults emerge, need be treated; (2) in the control of the biting gnat, treatment is confined to that section of saturated marsh containing pot holes, and the vegetative borders of the slightly brackish ponds located adjacent to the seashore; and (3) in *Mansonia* control, treatment is limited to those hard bottomed ponds or lakes containing floating marsh, since the irritating mosquito cannot survive on cattails or water willow when their roots are imbedded in a hard bottom.

AN *ANOPHELES QUADRIMACULATUS* LARVA WITH THREE INNER CLYPEAL HAIRS [1]

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In checking over some fourth instar larvae of *Anopheles quadrimaculatus* Say, which were collected in 1944 at the Naval Advance Base Depot, Davisville, Rhode Island, an abnormal specimen was found having three inner clypeal hairs instead of two (Fig. 1).

Under the compound microscope, it was seen that the two outer hairs are the normal ones, whereas the middle one is in excess. The outer ones are wider apart than is usual for the species. The tubercle of the middle hair lies ventrad to the other two tubercles at a distance equal to one-half the diameter of a tubercle. All the other hairs and characteristics are normal.

This larva was collected in a large, clear pond having grassy margins, together with about fifty other larvae of the same species, but no other abnormal specimen was found.

The writer has seen mosquito larvae with abnormal gills, siphons, siphonal hairs, and anal segments, but this was the first one seen having a third inner clypeal hair.

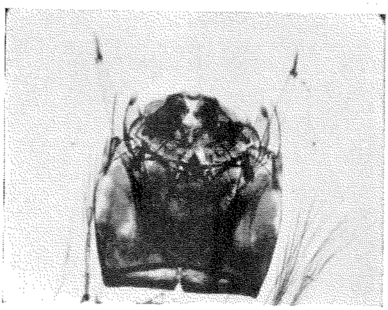

Fig. 1. Fourth-instar larva of *Anopheles quadrimaculatus* Say having three inner clypeal hairs.

[1] The material presented here in no way constitutes an indorsement by the Department of Defense.