NOTES ON THE CHEMICAL CONDITIONS IN THE MOSQUITO LARVAL ENVIRONMENT

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The first oil field in Nebraska was developed in Richardson County in 1940. In the ensuing years large amounts of saline water were pumped with the oil. The oil and water form an emulsion which is separated by a demulsifying agent into a two-component system. De Groote (1948) has described in detail the commercial chemical demulsification process.

In the Richardson County oil field, no provision was made to dispose of the saline water resulting from the desalting process and it was allowed to drain to the nearest available low area where it formed ponds or marshes.

In recent years the wells in Richardson County have been pumped only several days a week with the result that there has not been enough water to form well defined ponds; instead, there have been formed small marshy areas with an aquatic flora of cattails, sedges, rushes, smartweed and arrowhead.

During routine mosquito surveys it was found that these marshes were supporting a fair population of mosquito larvae. The principal species found were *Culex restuans, Culex tarsalis, Anopheles punctipennis* and, after heavy rains, *Aedes vexans*.

Two marshes formed by the effluent of demulsification plants were studied, one located 3.3 miles south of the Village of Barada and the other 4.5 miles south of the Village of Dawson. As a control, a spring-fed pond and marsh located at Preston Corner approximately a mile north of the Village of Preston was also studied.

From January until December the areas were visited monthly and gallon samples of water were taken. Dipping for mosquitoes was done during the mosquito season. At Dawson, the oil well and separator were in use only from February until May so that only four months' data are used. During January and February the Preston pond and marsh was dry due to an extremely dry fall.

All three areas were producing the same mosquito species; yet, the chemical composition of the water from the marshes, oil separators, and natural spring-fed pond, varied greatly. Table 1 is a summary of the chemical analysis of the three areas expressed in parts per million.

The demulsifying agents used to separate the oil and water are organic compounds. De Groote's study shows they combine with the oil rather than water; therefore, it can be assumed that the increase in mineral content found in the Barada and Preston waters is due to the high mineral content of the oil well brine.

Although much has been written about the larval environment, only a little amount of work has been done on the chemical make-up of the environment.

Bates (1949) states: "Many studies have been made of the hydrogen-ion concentration in mosquito breeding places, partly because pH is an important factor in many biological processes, but also partly because it is the most easily measured of the physicochemical factors of the aquatic habitat." Wigglesworth (1942) demonstrated in the laboratory that variation in pH had no ill effect upon larval development. The field results reported in this study agree with Wigglesworth's study and also with that of Kirkpatrick (1925) who found no correlation between pH and species of mosquito.

What effect the total solids in the water has on mosquito production is difficult to determine from this study. It is interesting to note that the water at Barada and Dawson has over 90 percent more solids than the naturally occurring water at Preston.

TABLE 1.—Chemical composition (ppm) of larval environments

	Barada	Dawson	Preston
pH	8.2	7.6	7.4
Total Solids	3973.0	7652.0	391.0
Total Alkalinity	303.0	266.0	128.0
Chlorides	1392.0	2499.0	7.9
Sulphates	880.0	1900.0	53.0
Potassium	33.0	38.0	7.3
Sodium	1248.0	2098.0	11.0
Calcium	60.0	347.0	41.0
Magnesium	32.0	81.0	16.0

Since in coastal areas there is a marked difference between the mosquito faunas of fresh and brackish water, the relationship of salinity tolerance of larvae has been studied by several workers. It will be noted that the water at Barada has 176 times more chlorides and the water at Dawson has 316 times more chlorides than the naturally occurring water at Preston. There is also a very marked increase in the sulphates and in the sodium content.

From the studies of Beadle (1939) and Wigglesworth (1950), there appears to be some mechanism which controls the regulation of osmotic pressure in the haemolymph of mosquitoes which live in water with a high salt concentration.

CONCLUSIONS. It would appear that larvae of *Anopheles punctipennis, Culex restuans, Culex tarsalis,* and *Aedes vexans,* are not affected by high concentrations of inorganic salts. This study agrees with Kirkpatrick's (1925) Egyptian study which showed that: "The differences among mosquito species in the upper limit of salt tolerance may be great, but that relatively few of any species are strictly confined to waters of high salinity." Thus it would appear that oil well brine seepage pits are just as suitable larval habitats as naturally occurring ponds and marshes.

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