cline in premises positivity for each treated area as compared to the control area. Data from oviposition traps in the area treated twice weekly with malathion showed that oviposition by *Ae. aegypti* was totally interrupted for 10 weeks during the 11-week treatment period, whereas in the untreated control area during the same period, oviposition rates ranged from 50–80 percent each week. Reductions in oviposition rates in areas treated weekly with malathion or with Abate:malathion combinations were comparable, but these rates were lower than those obtained in the area treated twice weekly with malathion. The biweekly treatments with Abate alone gave the least consistent reductions in oviposition of the toxicants and formulations tested.

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THE USE OF PARASITIC WATER-MITES FOR AGE-GRADING FEMALE MOSQUITOES

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In a recent note to this journal, Graham (1969) recorded the presence of parasitic mites on female adults of 9 or 10 species of mosquito, classifying the hosts according to whether they were nulliparous or parous. His aim was to determine whether or not such mites would provide a useful means of age-grading for Alberta mosquitoes. Because he found them on relatively few individuals, and on parous, as well as on nulliparous females, Graham concluded that "mites would appear to be ruled out as indicators of nulliparity in Alberta." He qualified this conclusion with the observation that the work of Corbet (1963) in Africa "shows that they might be useful in certain areas."

When external characters, such as parasitic water-mites, are to be used for age-grading mosquitoes, it is essential that a clear distinction be made between two concepts: the *reliability* of such characters as indicators of physiological age; and their *practical usefulness* for age-grading. Because Graham fails to make this distinction consistently, his note could create an erroneous impression among entomologists unfamiliar with the rationale of this method of age-grading. The purpose of the present communication is to prevent this, because the critical use of external characters can make an important contribution to the logistics of age-grading programs.

RATIONALE. For an external character to be of any use at all it must be a reliable indicator of the nulliparous (or parous) condition. However, such a correlation need not be reciprocal. Thus, although all mite-bearing females might be nulliparous, it need not follow that all nullipars bear mites. If there is a reliable correlation one way (i.e., mites are found only on nullipars), this has immediate value in so far as every mite-bearing female can be classified without dissection. This operation alone will not of course tell the investigator what the *proportion* of nulli-

pars is; but it will save time by reducing the number of nullipars that have to be dissected. The second aspect—the extent of this usefulness from a practical point of view—will (as Graham correctly observes) be proportional to the frequency with which the external character occurs in the population under study.

RELIABILITY. Gillett (1957) proposed that the presence of parasitic mites (hydrachnids) on female mosquitoes might indicate that the latter were nulliparous because of the mites' life-history: many such mites attach to the mosquito host before it emerges, and drop off when it first oviposits. The point was well taken, but Gillett's hypothesis could not be tested until a few years later, when suitably rigorous and rapid techniques for age-grading became available (Corbet, 1960). In 1963 I published the results of such a test, undertaken on more than 20,000 females of 10 species of mosquito in Uganda. For the test to be meaningful, Gillett's hypothesis had to be modified so that it applied to "parasitic water-mites" and not to "hydrachnids" which, as it happens, do not parasitize mosquitoes. Although Graham cites the account of this test (Corbet, 1963) he omits mention of its main finding, namely, that parasitic water-mites *can* provide a reliable means for recognizing nulliparous individuals of certain species of mosquito, but *only* if two variables are taken into account: (1) the kind of mite; and (2) whether the mite is alive or dead at the time of the mosquito's capture.

The Uganda work showed that when these two variables were taken into account, larvae of two kinds of mite were found only on nullipars of two species of mosquito. For example: living Type B (hygrobatid) mites were found on 53.6 percent of 2,086 nulliparous *Mansonia fuscopennata* (Theobald) but on none of 814 pars; similarly, living Type D (hygrobatid) mites were found on 61.2 percent of 771 nulliparous *Culex annulioris* Theobald but on none of 223 pars. On the other hand, Type C (thyasid) mites, which have a different life-history, occurred in the living state at least as often on 66 pars as on 2,081 nullipars of *Mansonia pseudoconopas* (Theobald). Although this work showed that the reliability of parasitic water-mites (as indicators of the nulliparous condition) cannot be tested meaningfully unless both these variables are allowed for, Graham makes no mention of either in his note, beyond stating that the mites he recorded were not identified to species. Moreover, he quotes Detinova (1962) as having found that "the presence of parasitic mites was not a reliable indicator of nulliparity in Russia." However, as Detinova did not make allowance for the two variables on which effective application of this method depends, the reliability of mites as age-indicators cannot be determined from the cited account of her work. As it happens she reported that, although some parous females bore mites, in an overwhelming majority of cases only nulliparous females were infested. This pattern of infestation is closely similar to that encountered in *Mansonia fuscopennata* and *Culex annulioris* in Uganda, and strongly suggests that the mites Detinova was observing would have provided reliable indicators if their kind and condition had been recorded. Further evidence is therefore needed before one can accept Graham's statement that mites are not reliable indicators of nulliparity in Alberta.

INCIDENCE. Only 4.3 percent of the 983 females recorded by Graham bore parasitic mites. The proportion of each species that was infested cannot be determined from his published table because this does not include the totals examined for each species. Because the proportion of females infested varies widely according to species (2.3–64.2 percent in my experience), one is left uninformed regarding the incidence of mites on the several species examined in Alberta. For example, the significance of Graham's finding that 15 *Aedes excrucians* bore mites would have to be interpreted differently depending on whether the total he examined

of this species was (for example) 20 or 200. The fact remains that, in aggregate, Graham found mites on less than 5 percent of females and on only ⅓rd of the species he examined. So (except possibly for *Aedes excrucians*) the practical usefulness of mites for age-grading at George Lake, Alberta is, as he concludes, very small.

CONCLUSIONS. Graham (1969) provides no incisive evidence regarding the reliability of parasitic water-mites as indicators of the nulliparous condition of mosquitoes in Alberta. On the contrary, it remains probable that, had the relevant facts been recorded, mites *would* have constituted reliable indicators in at least some species. On the other hand, Graham's work leaves little doubt that, whether they be reliable indicators or not, mites occur on too few females at George Lake for them to be of practical use for age-grading. This serves to emphasize a point that has been made before (Corbet, 1963): that mites are only likely to be useful for age-grading common species on which they have a fairly high incidence. This is because, to check the mites' reliability, extensive trials must be undertaken to determine patterns of infestation before the method can be used with assurance. Such heavy investment of effort is seldom justified except as a prelude to a long-term investigation or to one involving an abundant species of mosquito.

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OVIPOSITION RESPONSES OF *CULEX PIPIENS QUINQUEFASCIATUS* AND *CULEX SALINARIUS* IN THE LABORATORY

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Culex pipiens quinquefasciatus Say commonly breeds in foul water in street gutters, catch basins, cesspools, open septic tanks, artificial water containers, and polluted ground pools (King *et al.*, 1960; Carpenter and LaCasse, 1955). *Culex salinarius* Coquillett generally breeds in unpolluted (fresh or brackish) water, and the larvae are found in grassy pools, ditches, marshy places, and occasionally in water barrels (King *et al.*, 1960), and treeholes (Petersen and Chapman, 1969). The literature contains inconsistent reports about the preference of *C. salinarius* for fresh or brackish waters, but Williams (1956), Darsie and Springer (1957) and Chapman (1959) all established that the species breeds in both fresh water and in water that has relatively high salinity.

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