BLEACHING OF ADULT MOSQUITOES WITH DAYLIGHT AND ITS BEARING ON NOMENCLATURE IN *AEDES (NEOMELANICONION)* (DIPTERA: CULICIDAE)[1]

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ABSTRACT. Museum specimens of *Aedes (Neomelaniconion) circumluteolus* (Theobald, 1908) and *unidentatus* McIntosh, 1971 and museum and living specimens of *Ae. (Neo.) mcintoshi* Huang, 1985 were exposed to daylight. The yellow or golden yellow scales of the vertex and scutum and all pale scales on other parts of the body were completely or nearly completely bleached to white or silvery white in eight days in males and in 14 or 15 days in females. In some specimens the integument faded and in *circumluteolus* the brown scales of the scutum became paler. The bleached museum specimens of *circumluteolus* and *mcintoshi* agree in all significant details with the types of *Ae. (Neo.) albothorax* (Theobald, 1907) and *pallidus* (Theobald, 1907), respectively. The names *circumluteolus* and *mcintoshi* are, therefore, junior subjective synonyms of *albothorax* and *pallidus*. Reasons for conserving the names *albothorax, circumluteolus* and *mcintoshi* are given.

INTRODUCTION

Neomelaniconion is a moderately large subgenus of *Aedes*. The group is chiefly Ethiopian, but it extends into the Oriental, Australian and southern Palearctic regions. Most species in the subgenus have a conspicuous longitudinal stripe of white to bright golden yellow scales on the sides of the scutum. These stripes not only identify these mosquitoes as *Neomelaniconion*, but also help distinguish the species.

Although several details of the stripes vary from species to species, their color has been considered particularly important. All existing keys to species of *Neomelaniconion* include couplets using it. Although color of the scutal stripes is a valuable species character, rare specimens with white or silvery white stripes key to species they clearly are not when comparison is made to accurately identified specimens. Upon further study, these specimens with white or silvery white stripes usually can be identified as species that normally have yellow or golden yellow stripes by using other characters such as the distribution of thoracic setae, size of pleural scale patches and extent of light scaling on the femora, wings and abdominal sterna. It has not been known if the variation in color of the scutal stripes is genetic or environmental or if the color can fade after death.

McIntosh (1971), in his valuable and insightful study of the *Neomelaniconion* in southern Africa, concluded: "The colour of the scales of this stripe, which match those of the vertex in each species, is apparently subject to fading in some individuals, probably as a result of ageing in nature." Two female specimens of *Neomelaniconion* from South Africa with white to pale yellow scutal stripes that had been identified and reported as *albothorax* (Theobald, 1907) by Muspratt (1955) were redetermined as pale specimens of *lineatopennis* (Ludlow, 1905) by McIntosh (1971).

In 1986 I also became suspicious that the color of the scutal stripes could change during the lifetime of an adult mosquito. Two female *Neomelaniconion* collected near Karen, Nairobi District, Kenya (KEN 41-2P, -7P), in late June of that year appeared to be *unidentatus* McIntosh, 1971 in all respects except the white color of their scutal stripes. Since all progeny reared later in the year from eggs laid by these females had the golden yellow stripes typical of

[1]The views, opinions and/or findings contained in this report are those of the author and should not be construed as an official Department of the Army position, policy, or decision unless so designated by other documentation.

unidentatus, it seemed probable that the field-collected females had faded before they were caught.

Two of the oldest species group names now included in *Neomelaniconion*, *Banksinella luteolateralis* var. *pallida* Theobald, 1907 and *Banksinella luteolateralis* var. *albothorax* Theobald, 1907, were based on specimens with pale silvery grey (*pallida*) or white (*albothorax*) scutal stripes. The types of both varieties were collected at Inkutu, The Gambia, by Dutton and Todd. In 1915 and 1932 Edwards treated both *pallida* and *albothorax* as varieties of *lineatopennis* instead of *luteolateralis* (Theobald, 1901). In 1915 he stated: "The species is rather variable: sometimes the yellow scales of the thorax are replaced by whitish ones (vars. *pallida* and *albothorax*) and sometimes there are a few or numerous yellow lateral scales on the second and fourth longitudinal veins." In 1936 Edwards concluded: "Theobald's varieties *circumluteola* and *albothorax*, and perhaps also *pallida* are better treated as of specific rank . . ." Later Edwards (1941) treated *albothorax* as a distinct species, with *pallida* as a synonym, and used the name for a species with white scutal stripes that, except for the types from Inkutu, was known only from East Africa. Edwards mistakenly believed there was a difference between both types and the specimens from East Africa in the color of the plume scales on the forked veins (R_s and M) of the wing, so he recognized "Gambia" and "Eastern" forms of the species.

I examined types of the nominal species of *Neomelaniconion* as part of a taxonomic study of the subgenus. The holotype of *albothorax* and the single extant syntype of *pallidus* appeared to be identical to the holotypes of *circumluteolus* (Theobald, 1908) and *mcintoshi* Huang, 1985, respectively, in all significant details other than the color of their pale scales. The scutal stripes of *circumluteolus* vary in color geographically, but are normally yellow in West Africa; those of *mcintoshi* are normally golden yellow. If the types of *albothorax* and *pallidus* are specimens of the species currently called *circumluteolus* and *mcintoshi*, then it becomes necessary to explain why their scutal stripes are white or pale silvery grey instead of yellow or golden yellow. One possible explanation is that the pale scales of the types have faded. Because of the nomenclatural importance of determining unequivocally if *albothorax* and *pallidus* are senior subjective synonyms of *circumluteolus* and *mcintoshi*, I decided to perform simple experiments to see if exposure to natural daylight could bleach the yellow or golden yellow scales of *Neomelaniconion* adults.

MATERIALS AND METHODS

To see if museum specimens could be bleached by daylight, four pinned specimens each of *circumluteolus* from near Kong, Ferkessedougou Prefecture, Ivory Coast (IVR 77-5), *mcintoshi* from near Onderstepoort, Transvaal, South Africa (SAF 35-1), and *unidentatus* from Olifantsvlei, Transvaal, South Africa (SAF 33-8), were chosen for experimentation and controls. The specimens of each species were siblings reared from eggs in the laboratory at the University of San Francisco; two males and two females were selected on the basis of the identical color of their scutal scales. One male and one female of each species were pinned into a small (11.1 X 4.8 cm) white unit pinning tray. The unit tray was covered with Glad Cling Wrap and placed on the sill of an unshaded south-facing window at 1600 hours on 5 February 1989. The specimens were examined in eight days (1000 hours on 13 February) and 15 days (1030 hours on 20 February). The other male and female of each species were kept as controls stored in a unit pinning tray in a glass-topped insect drawer that was kept in a closed insect storage cabinet.

To determine if live mosquitoes could be bleached by daylight, a single female *mcintoshi* from Sukari Ranch, Central Province, Kenya (KEN 150-4), was put into a small (500 ml), translucent polyethylene plastic cup that was placed on the sill of the same unshaded south-facing window on 11 October 1990. The cup contained 2.5 cm of commercial potting soil that was kept saturated with tap water. The top was covered with white nylon netting, upon which a moistened raisin was placed as a carbohydrate source for the mosquito. After 15 days, the

mosquito was killed and pinned for study. Three female siblings of the experimental mosquito were killed and preserved immediately after rearing and used as controls.

RESULTS

After eight days' exposure to daylight, the male museum specimens of *circumluteolus, mcintoshi* and *unidentatus* were completely to nearly completely bleached and the females were partially bleached. In *circumluteolus* the pale scales of the vertex and scutal stripes had changed from yellow to silvery white in the male and from yellow to yellowish cream in the female. In *mcintoshi* most of the pale scales of the vertex and scutal stripes of the male had changed from golden yellow to silvery white, but a few were still yellow, and all of these pale scales had changed from golden yellow to bright silvery white with a slight yellowish cast in the female. In *unidentatus* the pale scales of the vertex and scutal stripes had changed from golden yellow to silvery white in the male and from golden yellow to creamy white in the female.

After 15 days' exposure to daylight, all the museum specimens were completely bleached and the experiment was ended. In *circumluteolus* the pale scales of the vertex and scutal stripes of the female had become snow white. In both the male and female, all pale scales had become lighter than they were in the controls. This included not only the scales of the vertex and scutum, but also the pale scales on the sides of the head, on the rest of the thorax and on the femora, wings and terga. The brown scales on the scutum had become slightly paler, but those on other parts of the body had not. The integument had also become paler. In *mcintoshi* the pale scales of the vertex and scutal stripes of both the male and female had become completely silvery white. Other pale scales on the head, thorax, femora, wings and terga of both sexes had become lighter than they were in the controls. The dark scales and integument were scarcely affected. In *unidentatus* the pale scales of the vertex and scutal stripes of the female had become silvery white. Other pale scales on the head, thorax, femora, wings and terga of both sexes had become white. The pleural integument had become paler, but the scutal integument and the dark scales of the body were scarcely affected.

The live female *mcintoshi* that was exposed to daylight for 15 days was nearly completely bleached. When this specimen was examined alone, the pale scales of the vertex and scutal stripes appeared to be silvery white. However, when it was examined beside a bleached female museum specimen, it was obvious that these pale scales still had a very slight yellowish cast. Other pale scales on the head, thorax, femora, wings and terga were lighter than in the controls. The integument of the pleuron was also paler.

DISCUSSION

The results proved beyond doubt that both living and pinned adult *Aedes (Neomelaniconion)* can be bleached by exposure to daylight. The time required to change the yellow or golden yellow scales of the vertex and scutum to white or silvery white was remarkably short, even as far north as San Francisco (37° 46' N) in February and October when days are short. The pale scales were completely to nearly completely bleached in eight days in males and in 14 to 15 days in females. In locations where the sun is more directly overhead or in seasons when the days are longer, the time required to bleach specimens is probably even less.

Although the most conspicuous effect of exposure to daylight was alteration of the color of the yellow or golden yellow scales of the vertex and scutum, other pale scales and sometimes the integument faded and, in *circumluteolus,* even the brown scales of the scutum became paler.

The pinned females of *circumluteolus* and *mcintoshi* that were bleached became almost identical in color to the types of *albothorax* and *pallidus*. It seems likely that the types of the latter species must have been exposed to bright daylight before they were described by Theobald. They may have been bleached in The Gambia before being sent to the British Museum. Since the bleached female of *circumluteo-*

lus agrees with the type of *albothorax* and the bleached female of *mcintoshi* agrees with the type of *pallidus*, there is no doubt that *circumluteolus* and *mcintoshi* are junior subjective synonyms of *albothorax* and *pallidus*, respectively.

Strict application of the Principle of Priority of the *International Code of Zoological Nomenclature* (International Commission on Zoological Nomenclature 1985) would require synonymizing *circumluteolus* with *albothorax* and *mcintoshi* with *pallidus*. I believe synonymizing *circumluteolus* would be a serious mistake. This species is one of the most common and most widespread *Aedes* in Africa. The name *circumluteolus* has been used continuously since 1908 and appears frequently in nontaxonomic literature because this species is associated with numerous arboviruses (McIntosh 1971). Furthermore, synonymizing *circumluteolus* with *albothorax* would have the effect of transferring the name *albothorax* from one species to another. For years to come, confusion would surround use of the name because it would not always be possible to determine if an author using *albothorax* was referring to *circumluteolus* or to the undescribed East African species currently called *albothorax*. For these reasons, I am preparing a proposal asking the International Commission on Zoological Nomenclature to conserve the names *albothorax* and *circumluteolus* in their accustomed usages by replacement of the holotype of *albothorax* with a neotype. Existing usage of both names is to be continued until the ruling of the Commission is published.

I also believe it would be a mistake to synonymize *mcintoshi* with *pallidus*. The species in question was known as *lineatopennis* until Huang (1985) concluded that it was distinct and named it *mcintoshi*. If the name *pallidus* were to be used, it would be the second name change for this common, widespread African species in less than a decade. Like *circumluteolus*, *mcintoshi* is mentioned frequently in nontaxonomic literature because of its association with arboviruses. I think another name change would place an undue burden on those nontaxonomists who rightly expect a stable name for this species so they can communicate biological information about it. Nontaxonomists would, in effect, be inconvenienced for the mistakes of Edwards (1941), who erroneously synonymized *pallidus* with *albothorax*, and Huang (1985), who created a junior synonym. To promote stability, I will ask the International Commission on Zoological Nomenclature to conserve the name *mcintoshi* for this species by suppressing *pallidus*. Existing usage of the name *mcintoshi* is to be continued until the Commission has published its Opinion.

ACKNOWLEDGMENTS

I thank Bruce C. Townsend for the loan of types from the British Natural History Museum and Ralph E. Harbach for the loan of the holotype of *mcintoshi* from the United States National Museum. I also thank my wife Sandra and two anonymous reviewers for suggesting improvements to the manuscript. This work was supported in part by the U.S. Army Medical Research Acquisition Activity, Contract No. DAMD17-86-C-6134.

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