Several specimens were collected by the Levis from under rocks on a dry hillside, altitude 7100 feet, at Sunwapta Pass, Vaspar National Park, Alberta, Canada, August 10, 1951.

THE DORSAL HAIRLESS SETAL RING OF MOSQUITO PUPAE

(Diptera: Culicidae)

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The "dorsal hairless setal ring", as the name implies, resembles an alveolus of a bristle but lacks a projecting seta. In most mosquito pupae there is a pair of these structures on the dorsum of each of the abdominal segments III to V, usually in more or less close association with one of the regular bristles. In some forms the "setal ring" is lacking on segment III *(Wyeomia)* or segment V (subgenus *Rachisoura* of *Tripteroides)* and may be even completely absent *(Trichoprosopon, Sabethes)*. This "setal ring" has usually been interpreted as a reduced bristle, and some workers have been of the opinion that, on segment II it is represented by a fully developed hair and that on the segments beyond V it has been completely lost (Baisas, 1938; Edwards, 1941; Penn, 1949; Darsie, 1949, 1951). Such an opinion appears to be supported by the fact that in the pupae of many common mosquitoes there is one more pair of fully developed hairs on the dorsum of segment II than on the following segments. On the other hand, the above mentioned workers did not study the chaetotaxy of the venter of the abdomen and it has been shown by Knight and Chamberlain (1948) beyond any doubt that the extra hair of the dorsum of segment II is actually one of the ventral hairs (10) which has moved dorsad in these forms while in several groups it has retained its primitive ventrolateral opposition (e.g. *Chagasia, Sabethes, Wyeomyia, Limatus, Topomyia, Harpagomyia, Tripteroides* [*Rachisoura*], *Culiseta, Ficalbia, Aedeomyia, Mansonia, Opifex, Deinocerites)*. Accordingly Knight and Chamberlain assigned the designation O to the "dorsal hairless setal ring" and did not con-

sider that it was represented by a serial homologue on abdominal segments II and VI–VIII. Their inclusion of this structure in the terminology and its name presupposes that the "setal ring" has arisen as a modification of a regular bristle. In my review of the pupal chaetotaxy (Belkin, 1952), I disregarded this structure completely for it has apparently no homologue in the larva and does not seem to fit in at all in the general chaetotaxy pattern, but I failed to indicate my reasons for this action. Additional evidence is now at hand and indicates that the "setal ring" is probably a sense organ and has no homology at all with the regular bristles and should therefore be disregarded in the nomenclature of the chaetotaxy.

Recently, in studying the pupae of the anophelines of California, I have encountered a race of *A. occidentalis* Dyar & Knab, 1906 in which this "dorsal hairless setal ring" occurs sporadically on abdominal segment II. Of ten specimens examined two showed this structure on both sides of the segment and two additional ones on the right side only. The setal rings are indistinguishable from those of the following segments, occur in the same position on the segment, and are located between hairs 4 and 5. This evidence is a further support for the interpretation that the "setal ring" is not represented by one of the fully developed hairs on abdominal segment II, for the hair interpreted as homologous with the setal ring (hair 4) by Baisas, Penn and Darsie is also fully developed on segment II along with the "setal ring".

The question still remains as to the nature and origin of the "setal ring". Two general explanations are possible: either it is developed from a regular bristle or it is a new structure bearing no relationship to the bristles. The first alternative will be examined first. There is no way in which the "setal ring" can be homologized directly with any regular hair without disrupting completely perfectly evident homologies already established but this structure may have arisen either as a duplication of one of the hairs or it may represent one of the transitory larval hairs that are occasionally carried over to the pupa. I have noted earlier (Belkin, 1952:128) that both phenomena occur rather frequently in the pupae of some mosquitoes and that some of these anomalous hairs are represented by alveoli only. In all duplications observed by me the twin hairs always retain a very close relationship and generally exhibit a similar degree of development. If the "setal ring" has arisen as

a result of the duplication of one of the dorsal hairs, I believe that it is very likely that it would have remained in close association with this hair on all segments and in all mosquitoes. Such is not the case, for it may be variously associated with hairs 3, 4 or 5 or any combination of these, although it may seem at first glance to be most frequently associated with hair 5. It appears rather that the "setal ring" has a characteristic position on each segment and in each group, and that its apparent association with a particular hair is due secondarily to the presence of that hair in the same general area. The transitory larval hairs which are occasionally retained in the pupa are all ventral in position, but there is a possibility that one of them may have migrated to the dorsal surface as has been the case with hair 10 on abdominal segment II of some forms. That the "setal ring" could not have arisen through the retention of one of these transitory hairs is demonstrated in the pupae of *A. occidentalis, A. punctipennis* (Say), 1823 and *A. freeborni* Aitken, 1939 in which both pairs of transitory hairs may be occasionally present on the venter while the "setal ring" is present simultaneously on the dorsum (Belkin, 1953). Finally, if the "setal ring" has arisen as a result of either a duplication or a retention of a transitory hair one would expect occasional anomalies of this structure which would be in the form of a reduced bristle. To date no such anomalies have been seen in the examination of over a thousand "setal rings". Thus it is probable that the "dorsal hairless setal ring" is new and peculiar to the pupal stage and bears no homology to any element of the chaetotaxy. On the chance that it did arise from one of the bristles, we should watch for anomalies.

At present nothing is known of the function of the "dorsal hairless setal ring". Its structure suggests a sense organ, possibly one associated with the orientation and the movements of the pupa, since it occurs on the segments exhibiting the greatest curvature in the abdomen. In this connection it is interesting to note that, in those sabethines (restricted to small containers of water) which possess very sluggish pupae, it may be completely absent *(Trichoprosopon, Sabethes)* or lacking on III *(Wyeomyia)* or V (subgenus *Rachisoura* of *Tripteroides)*. It would be of considerable interest to determine experimentally the function of this structure.

Since the "setal ring" apparently does not represent a reduced hair and since it appears to be a sense organ, I suggest that the

cumbersome and ambiguous term "dorsal hairless setal ring" be dropped in favor of the simpler "dorsal sensillum" and that it should not be included in the nomenclature of the pupal chaetotaxy. As pointed out above, its occurrence and distribution may be of value in separating mosquito groups and therefore it should be studied and recorded as in the past.

Addendum

In June, 1954, William A. McDonald of our Department noted in the fourth instar larva of *Culex tarsalis* Coquillett, 1896 a minute sensillum on abdominal segments III–V between and slightly cephalad of hairs 3 or 4. I have examined representative species in several genera and have found a similar sensillum in approximately the same or in a more cephalic, caudal or lateral position. Since there is a close correspondence between this larval sensillum and the pupal dorsal sensillum in regard to occurrence on specific segments and relation to hair 4, I consider these sensilla homologous.

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