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CHAETOTAXY OF THE FIRST INSTAR LARVA OF *HEMIARGUS CERAUNUS ANTIBUBASTUS* (HBN.) (LYCAENIDAE)

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The first instar larvae of the Lepidoptera appear to be very conservative in their evolution of setal pattern and are as a group remarkably similar. Subsequent instars may show considerable ontogenetic differences as secondary setae and other integumentary structures become highly modified and admixed with the primary setae so as to obsure the latter. The chaetotaxy of the first instar larvae of the Lycaenidae are thus significant to the understanding of taxonomy and phylogeny, and it is important that researchers have a basic morphological platform from which comparative work might proceed. The present study is a step in that direction.

Five setal types are present on first instar larvae of *H. antibubastus*: *1*) primary or major setae, which are rather long, finely serrate setae with pointed tips: these are borne on a chalaza, a pimple-like tubercle or nipple (Fig. 1) into which they fit with a membranous joint between; the chalazae are smooth and unstructured, and generally conform to the rule that the longer the seta, the longer and larger is its supporting tubercle; *2*) pegged or clubbed setae, which are relatively short, clavate structures (Fig. 1) with serrate or grainy-textured surfaces; they may exit from the chalaza at an angle giving them a slightly elbowed appearance; these are modified major setae, as suggested by the changes in serially homologous elements, particularly in the lateral series; *3*) microscopic setae, very small proprioceptors distinguished from the above mostly on the basis of size and position, where they may touch surfaces that oppose one another (Fig. 2); *4*) sensory setae, extremely fine, hair-like structures, lacking external bases, and so far limited to the prothoracic shield (XD2) and *5*) tufted setae, described herein for the first time, medium-sized, hair-like setae, borne on a chalaza, and distinguished by a cluster of tentacle-like spiculi at the apex giving them a tufted appearance.

Body Chaetotaxy

Prothorax: Shield not markedly sclerotized (Centerfold); D2 with base equidistant from midline and anterior margin; bases of right and left D2 separated by a short

distance equal to their own chalaza width; SD1 the longest of the prothoracic setae close to posterior margin of shield and about equidistant from midline and lateral margin; SD2 slightly smaller, and arranged on a tolerably straight line half-way between SD1 and D2; posterior and lateral to D2 is a lenticel LP, about twice as large as the base of D2, and on the margin of the shield; a thin sensory seta, XD2, is lateral and anterior to SD1 and lacks a chalaza; it is difficult to detect with light microscopy as is the integumentary pore through which it emerges.

On the anterio-lateral margin of the prothorax are four long setae which project forward; MD1 is the most mesial and anterior of these setae, located on a line bisecting SD2 and LP; MD1 is three times as long as D2; MSD1 is a slightly longer seta posterio-laterad of MD1, but still anterior to D2 of the prothoracic shield; MSD2 is of equal size to MSD1 and L1 is the largest and most posterior of this group of four major setae. L1 is nearly on a straight line between SD1 and LL.

Setae L2 and L3, together with the lateral lenticel, LL, describe a second diagonal line on the lateral margins of the prothorax just anterior to the spiracle. The latter is slightly larger than the lenticel, and LL is only slightly larger than the chalaza of L3. Beneath the sublateral fold SV1 and SV2 are obvious in a position apparent on the centerfold.

Mesothorax: MD1 and D1 are the major setae with the former arching upward and cephalad and slightly smaller than the latter, which projects upward and caudad; MD1 becomes much reduced on posterior segments; the subdorsal lenticel SDL is just laterad and slightly anterior of MD1, and is distinctly more anterior on this segment than others; SD1 is a pegged seta just laterad of SDL in a position much more dorsal than on following segments; D2 is a pegged seta ventrad and slightly posterior of D1; a posterior arch gives it an elbowed appearance; MSD2 is a pegged seta about half the distance between SD1 and the other lateral setae; L2, L3 and L1 are subequal in size; SV1 is two-thirds the size of SV2 and both are about one-half the distance between the lateral setae and the mesothoracic leg.

Metathorax: MD1 reduced to proprioceptor; D1 and D2 in same position which is almost constant through A6; SDL laterad and only slightly anterior to D1; SD1 lateral and anterior to MSD2; L2 reduced to pegged seta (only segment with this condition); L1 as large as L3; SV1 and SV2 as on mesothorax.

Abdomen, first segment: dorsal and subdorsal elements as on metathorax; small supraspiracular lenticel, SSL, midway between SDL and MSD2; spiracle in middle of segment half the distance between MSD2 and the lateral setae; lateral lenticel, LL, unique to this segment and slightly larger than the spiracle; L2 slightly laterad of those on thorax, bringing it more in line with lateral series; L1 pegged as on other abdominal segments through A8; SV1 lost; SV2 large and directed latero-caudad.

Second segment: all setae as on A1; SSL, SDL and spiracle in same position as on A1; no LL.

Third to fifth segment: all setae, lenticels and spiracles as on A2, except SV1 present, though extremely small; SV2 directed latero-cephalad; microsetae P1, P2 on lateral surface of proleg.

Segment 6: same setae, lenticels and spiracles as A5 except there is a marked increase in size of SSL (is larger than spiracle instead of smaller); SDL has migrated to a position posterio-laterad of D2.

Segment 7: same as A6 except D2 is missing; SDL abuts posterior-lateral margin of D1; SV1 absent; SV2 directed posterior-laterad; sublateral lenticel posterior and dorsad of SV2.

Segment 8: only D1 persists in dorsal series, with SD just lateral and adjacent to it; subdorsal elements missing; spiracle slightly anterior in segment; sub-lateral lenticel present; ventral microsetae present.

Segment 9: all setal and lenticular elements missing except one seta from lateral series, presumably L2; mostly coalesced with A10 and A9-A10 segmental border obscure; the base of L2 closer to 8L3 than to 10L2, the next most posterior seta.

Segment 10: D1 is the only remaining element in the dorsal and subdorsal series (see insert, centerfold); 10L1 is anterio-laterad of D1; between the right and left D1 the

much smaller SP1 setae may be observed in dorsal view; their bases are just ventral and mesial of D1, SP2 is just ventral and lateral of 10L1; 10L3 is pegged (it is elongate on all other segments); 10L2 and the more posterior setae all project posterior and posteriolaterad and would serve a tactile function for signals coming from that direction; SV1 and SV2 are present on the lateral prolegs; one or two microsetae usually occur on the anterior surface of the anal proleg; two small, spiculate subanal setae are prominent on the posterior top of the prolegs; a very slightly sclerotized anal shield is present which is void of structure and has a smooth surface; it tends to fold and wrinkle on fixation, as can be noted in the centerfold.

Opinions of the chaetotaxy of the coalesced ninth and tenth segments as expressed here require appropriate changes in setal identification in Downey and Allyn (1979, p. 12) and Lawrence and Downey (1966, p. 84). Basically the modifications reduce themselves to the decision that segment 9 contains only one lateral seta (not three) irrespective of the serial conformity of location and setal size of the numbered setal elements after segement 8. We were mislead in *cassius* for example by the fact that the proper number of lateral elements could be located (6), to incorrectly suppose that three 9L and three 10L setae were present. To arrive at this number we had to assume the tufted anal setae belonged to the lateral group, rather than a subventral element. Their position, however, below the lateral body fold, and their lack of alignment with the other setae suggests that they do not belong to the lateral series. This was called to our attention by David Wright in his work on *Lycaena*, where there is a distinct separation of A9 and A10, with only a single lateral seta on A9 (presumably 9L2).

Tufted Anal Setae

SP1 (mesial) and SP2 (lateral) are unique tufted setae located just ventral of 10D1 and 10L1 and above the anal slit (**centerfold**). The apex of these setae, particularly on their mesial and ventral surfaces, has a cluster of from 10 to 16 short, tentacle-like outgrowths giving their tips a tufted appearance (Fig. 2). The size of the setae and the location of the tufts would place them in such a position that they would come in contact with the distal margins of frass pellets being voided, and or serve to detect undetached pellets. With modest contractions of segment 10, their assumed tactile function could be enhanced, and may even serve to assist in dislodging pellets. An additional pair of setae, here designated sub-anal setae and presumably with similar function as SP1 and SP2 are located high on the posterior margin of the anal proleg, and while they also have enlarged tentacular appendages, the latter seem to be more scattered along the length of the setae, rather than in a terminal clump; hence their appearance is much less tufted than the dorsal pair. The tiny processes forming the tufts are presumed to have derived as extensions or outgrowths of the numerous serrations present along the entire length of all the primary setae.

Tufted anal setae were subsequently detected in first instar larvae of the blues, *Leptotes cassius theonus* (Lucas) and *Plebejus (Lycaeides) melissa* (Edw.) as well as the hairstreak *Chlorostrymon simaethis* (Drury). *Strymon melinus* Hbn. appears to lack the tufts on the end of the setae in comparable positions on the anal area, but has setae of comparable length and position which resemble miniature versions of the typical elongate setae on the dorsum of A9 and A10. We assume most Lycaenidae will eventually be shown to have frass detecting setae such as described herein.

Both the supra- and the subanal folds are covered with numerous short recurved spicules (Fig. 2) which would appear, with appropriate internal muscular contractions, to push the frass through the anus and beyond. Interestingly the specules on both the supra- and subanal areas are recurved dorsally, rather than in opposite directions on either side of the anal slits as one might have supposed for technical reasons. Such a curvature would serve to lift or elevate the frass pellet upward and outward as it is being voided, thus facilitating its being dropped further away from the anal prolegs. The anal tufts described above are about the same length as a fresh pellet and could, in addi-

tion to any mechanical assistance in the voiding process, serve as a detector to signal a limit to the size of the pellet or for appropriate detaching movements.

Literature Cited

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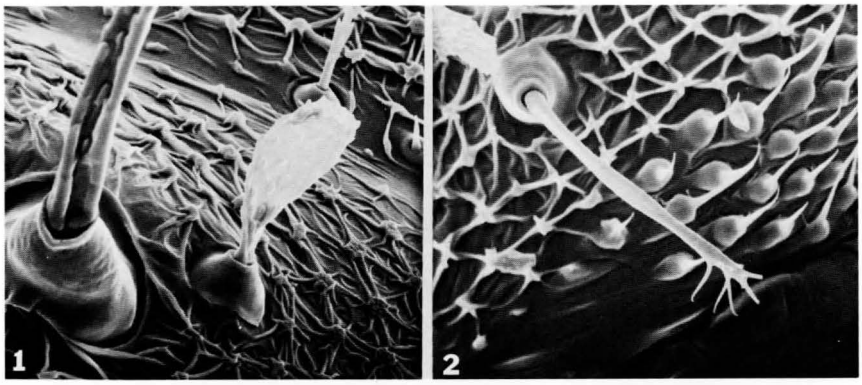
Abbreviations

A = abdominal segments; **D1, D2** = dorsal setae; **L1, L2, L3** = lateral setae; **LL** = lateral lenticel; **LP** = lenticel, prothoracic shield; **MD1** = microdorsal seta; **MSD1, MSD2** = microsubdorsal setae; **P1, P2** = proleg microsetae; **PS** = prothoracic spiracle; **S** = spiracle; **SD1, SD2** = subdorsal setae; **SDL** = subdorsal lenticel; **SLL** = sublateral lenticel; **SP1, SP2** = supra-anal tufted setae; **SSL** = supra-spiracular lenticel; **SU1** = subanal tufted seta; **SV1, SV2** = subventral setae; **T** = thoracic segments; **XD1, XD2** = prothoracic microsetae.



Figures 1-2. Setae of *Hemiargus ceraunas antibubastus* larva, first instar. **1.** Dorsal seta D1 and D2 (clubbed) of first abdominal segment. The microseta MD1 of A2 is in the upper right; (850 X). **2.** Tufted anal seta SP2. Slightly recurved anal spiculi are apparent dorsad of the anal slit; (850 X).

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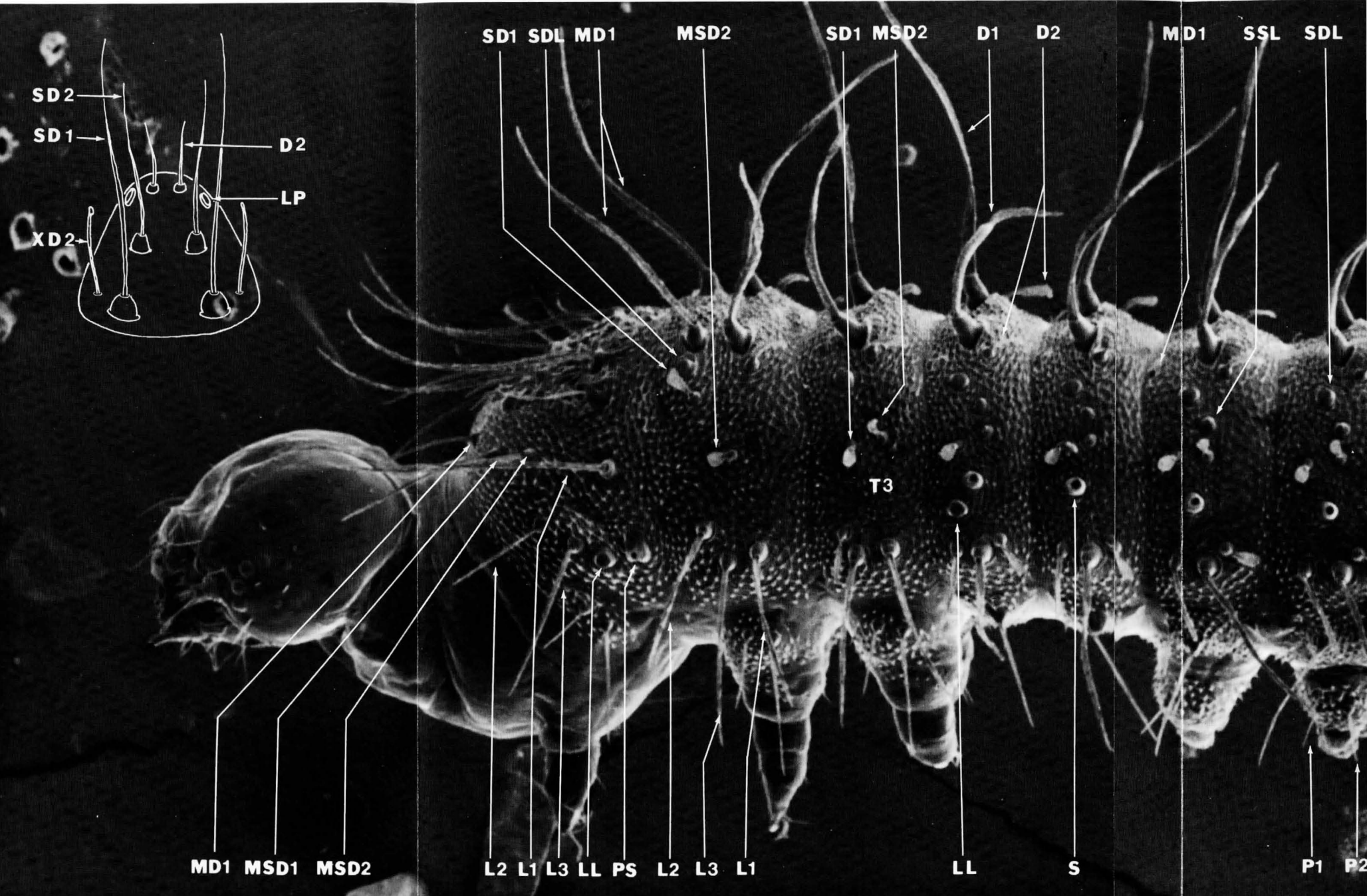
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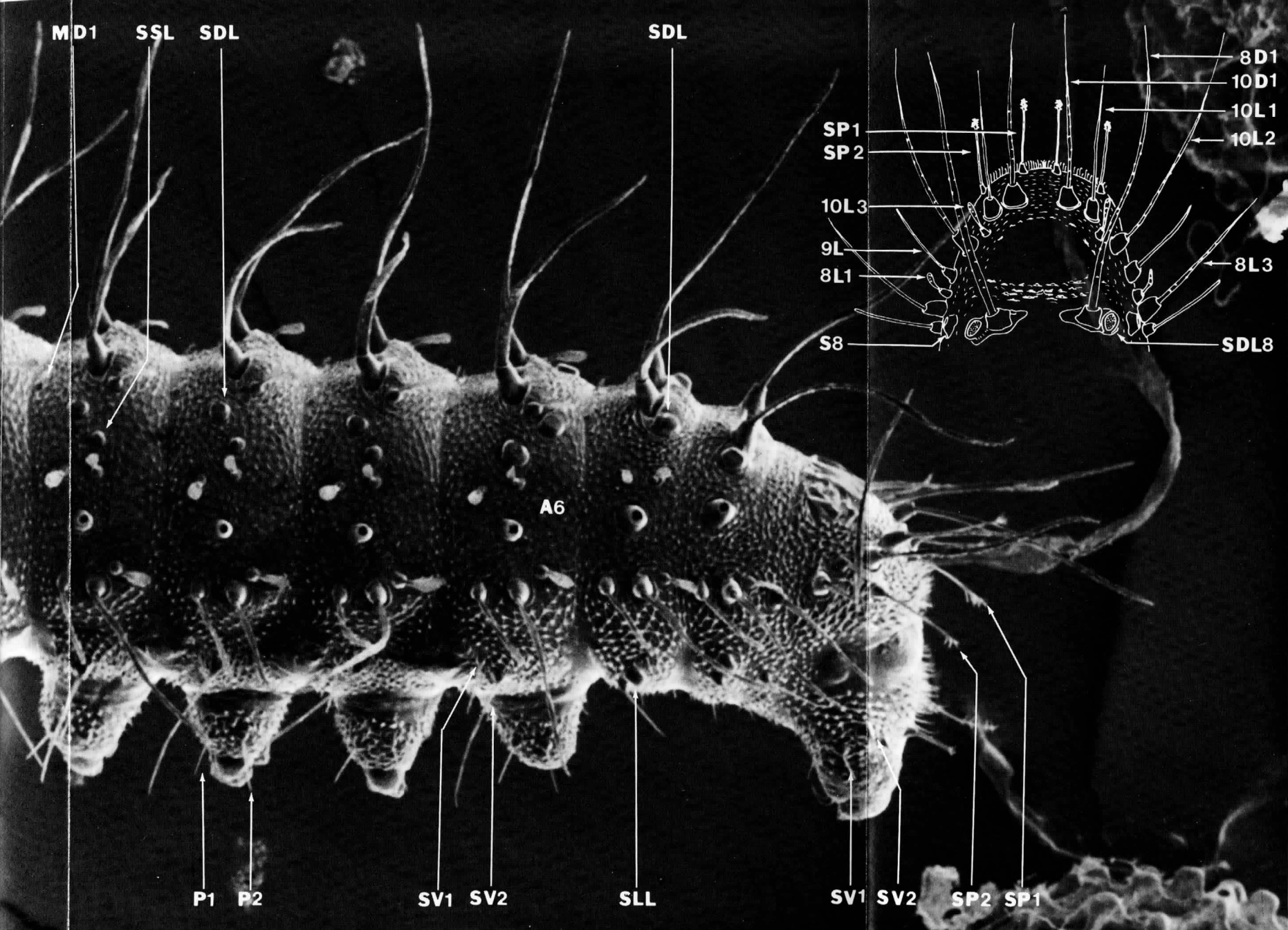
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