مجلة جامعة الملكة أروى العلمية المحكمة

QUEEN ARWA UNIVERSITY JOURNAL

Light and Scanning Electron Microscope Study of Morphology of Viny Advent Yemenensis Beetles "Basharatuleneby" (Coleoptera: Lycidae)

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ISSN: *2226-5759* ***ISSN Online:*** *2959-3050* ***DOI:****10.58963/qausrj.v1i9.60*

Website: *qau.edu.ye*

Abstract

New species Lycus yemenensis "viny advent" is described from Yemen Diagnosis of important characteristics are illustrated. Head, thorax and abdomen are separately described, with light and scanning electron microscope exposures.

Introduction:

The following important additions have been completed successfully on the materials collected in the same season of their appearance in recent years. Such appearance of viny advent have no far been described these species known in Yemen as Basharutuleneby "the Viny advent" the local name. The massive distribution of Viny advent over the country of Yemen for a short period of time" nearly 2 – 3 weeks duration every year has not been published by any entomologist, and this is the first study of new species of Lycus yemensis (Lycidae). Review of Malaysian and Sumatra species was followed by descriptions of several new species of beetles of Ateliinae from Philippines and China (Bocák, 1997). The same study of Lycus ibbiensis has been fully described from midland heights of Ibb province by (Abboud, 2011). All above mentioned references were on net-winged Lycidae. This new species belongs to the non-net-winged Lycid, since their elytra have no cross veins, which divide elytra into cells (Kazantsev, 2005).

Materials and Methods

Beetles used for this study were collected from different areas of the Yemen, within the period of their appearance, kept in 70% ethanol with few drops of glycerin. Some were kept in jars individually, since they fight each other if they were kept together. Specimens for light microscope were taken directly for characteristics diagnosis, using binocular and eye piece gride. Specimens for scanning electron microscope for detail observations.

Bionomics: Lycidae are usually flowering three visitors, since they are nector feeders, so where flowering trees occure in all major regions of the world, there are several lycides will be found. Also Lycids are found in Palaearctic, Oriental, Austrian, Afrotropical and Neotropical Regions (Lawrence et al, 2007).

Larvae occur in wood bark or in leaf litter since they liquid feeders. In Yemeni Lycids, Basharatuleneby females are slightly wider than males, but not longer. Their occurrence in April for nearly 2 -3 weeks duration as adults. Larvae of all instars leave in decayed litter or under the trees culticles.

Body description: body is dorsoventrally flattened, moderately slender, body capable to bend its last abdominal segment till touch the head. Body moderately sclerotited, amber pronotum- scutellum light, elytra, anterior third is to slightly brown, the middle part of the elytra jet colouration, gradually become fully black at the posterior part (the dark area is more than third of the elytra) Fig. 1 and 2. Body measurement ratio male to female, body length 17/14mm. body width 3/4mm at the middle of the abdomen, pronotum 2/2.5mm, width of the pronotum 1.3/1.8mm, elytra length 8/10mm.

Compound eyes very protuberant, no interocular, both compound eyes occupy the whole head capsule (Figs. 1, 2 and 3), both compound eyes fused at the midline, vertical diameter of the compound eyes longer than the horizontal diameter 14/10 (Fig. 3), and the maximum diameter of compound eyes 0.75mm, ocelli diameter 199 um (Fig 9 b). Ratio transverse diameter of compound eyes to vertical 1/1.24,leg length 7.08mm, femur 2.5mm, tibia 2.7mm to vertical tarsus 1.8mm, claw 199 um.

Head: is fully coverted by the compound eyes all around the transverse diameters, which hold the whole head at the equatorial line of the head, except that at the frons and occipitus area, which form two triangular areas due to merge line of compound eyes, at dorsal and ventral sides (Figs. 1 , 2 and 3).

Mouthparts: They are disclosed vertically and dorsally they are situated in front of the compound eyes and freely and strongly projecting onward (Figs. 3, 4 and 6). Head and compound eyes are narrower than half of the pronotum, antennae are raised from the sockets located laterally at a distance in the front of the compound eyes, they are long, serrate, scape is 4 times longer and twice wider than pedicel, which is compressed between the scape and 1st segment of the flagellum (Figs.1, 2 , 4 b) 3-10 of the antennal segments (antennomeres) are similar in size and shape, and the terminal segment of the flagellum (No. 11) is longer but not wider, than any one of antennomeres and has a waist at the middle, this observation was noticed in all collections of Viny advent Lycids. (Figs. 1 , 2 , 3 , 4 a and b) antennae reaching beyond the thorax (two third of mesothoracic segment). Mandibles are small, curved, located under the maxillae, each mandible has very harp on sickle –like shape, which resemble Lesser Spotted Eagle beak, and are stout, thickly sclerotized and armed with 3 different reduced grinding teeth, which do extra intestinal job of digestion (Fig. 5b). Maxillae are the longest parts of all mouthparts, are composed of basal, well developed round cardo, stipe is long and large, with lacinia, which fused with galea, lacinia has a dense bands of long setae covering all of its surface and has also strong sclerotized straight and hooklet-like spurs or setae situated dorsally at the base area of the lacinia (Fig. 4 b). The articulated 5 segmented maxillary palpi (palpomeres), basic segment, which is long, followed by short elbow segment, the middle segment is long and has club shape, widened distally to about twice as proximal end, the 4th segment is short, and slightly wide. The terminal segment with dorsal edge slightly straighten and ventral edge curved (Figs. 4 and 8 a and b). Scanning electron micrsope expases the maxillary palpus appearance, which is very distinct, that the surface of all palpomeres have spines rising from all surface of the palpus, also has a wallet-like opening lead to a cavity full of sensory polyps, which are of chemical receptois. The polyps are arranged as a zip fastner teeth (Fig. 8 a and b).

The labium is quite modified articulated, with clypeus by clypeolabrate suture surface, and has characteristics: smooth outer surface that has been derived from the clypeus.

Labium, submentum, mentum, and prementum, the labidal suture joins the mentum and palpiger (Palpifer) above it located the tree segmented labial pulpus; the glossa is located inbetween the lobes of paraglossae. The labial palpus consists of 3 palpomenes, all 3 segments have on their outer surface thick cuticular hairs and spines or spurs, the base segment has triangular shape (Fig. 4, 9 and 10), the middle segment has a club shape, widened distally to about twice as is at the proximal end, it holds the third segment (terminal), which has the inner edge straighten (adaxial edge) and outer edge is curved and longer than the inner edge. This segment has a unique crochet like knitted basket, has a thick cuticle hairs and spines on its surface (Figs. 4 a & b and 9 and 10).

Elytra: The elytra of the female have rounded anterior ends, slightly widened posteriorly due to the chink between them and not to real side, they have a curved mims at

the posterior ends, elytra of both sexes have solidly built longitudinal primary costal round each elytron and 5 weakly visible longitudinal veins, cross veins absent at low magnification, but scanning electron microscope exposes that the elytral surface has rough irregular and disconnected net, which are, in reality, dense and short pubescence (Figs. 13 a , b , c , and d). This dense pubescence makes elytra soft leathery touch. At the anterior area of the elytra just below the junction of pronotum and elytra a slightly heapped area under the right membranous wing, this area is composed of pseudo-ocelli (their function is hitherto unknown. It could be related to light) (Figs. 13 a ,b , c) arrow and enlarged figure, which is very clear ocelli- shaped (Fig. 13 c).In some literatures theses ridges are called translucent. These organs may be sensitive to light and function as light receptors if cuticular part of the sensilla is translucent; such photoreceptors apparently occur in many larvae, but not generally called "eyes". Translucent cuticle allow light to pass through, but not transparent.In some refereneces, the outgrowth ridges have pseudoocelli appearance, could cells of storing heat during flight. At first observation pseudoocelli, but in reality are ridges of outgrowth.

The male elytra has a spear shape ratio of elgral width to its length 1:5.8 ratio of elytral length to pronotic length 5: 1. Elytra do not widen posteriorly, their colouration at the anterior third area is shiny amber to slightly brownish, when are attached, but, when removed their colour become yellow, the posterior third is dark black. Their posterior ends have curved brims, the females elytra when at rest the area just below the notum has 3 light squeezed circles in a triangular shape which form colouration areas. The anterior area is dull amber, the middle part with jet colouration, and the posterior is dark black area and shiny. (Kazantsev, 1998,1999,2005).

Hind wind: The metothoracic wings when in response are folded beneath the elytra. They are well developed, with no transverse folds. Ratio of the apical area to the whole wing length 0.3. The apical area is not sclerotized and has no veins. C vein is joining with the AR at the apical hinge, Sc short and separate, Cu vein is not connected neither to M or to A veins. No crossing veins are seen at all.

The ventral view of the ving advent. The 1st sternite or the 1st sternal segment is shiny amber colour, bears the 1st pair of legs (fore legs), has rectangular shield occupies almost the whole surface of the 1st sternite, rounded anterior edge, posterior edge is concave, lateral sides are nearly straight (Figs 2 and 3). The scanning electron microscope exposes that the fore legs situated at the top half of the shield and taking a triangular spots, its base underneath the coax, the 3rd endosternite is at the peak of the triangle, in the middle line of the shield (Fig. 3). These endostermites are ingrowth or invaginations from parts of the endophragm skeleton to which important muscles are attached (Abboud, 2011; Bocák, L. , 1995; Leftwhich, 1977; Kazantsev 1998, 1999, 2005, Waterhouse, 1878). The prosternal process is on the middle of the prosterrum between the coxal cavities. In Viny advent yemenensis Lycid this is not narrow to make the middle edge of the coxae on touch. In the mesosternite

this process in narrow, but not enough to make the medical line in touch, also in the metasternite this process is lightly wider than the prosternal midline edge of the coxae.
The mesosternite is twice longer as the prosternite and 1.5 wider at the posterior edge, it bears the middle legs, which are located at the middle of the anterior part of the mesosternite. Both sides of the pronotum are sharply bent, curved at the shoulder.

The Mesopleuta are divided into two sclerites anterior and posterior/front and hind sclerites or mesepister num and mesepimeron) (Boca'k, 1998, Bocák, L. and Bocákov M.,1989 , Kazamtsev, 2005, 1990, Lawrence 2007). The prosternum process is on the midline of the prosternum between the coxal cavities. In Viny advent Yemenessis this process is not very wide separating the coxae and is not narrow to make the midline edge of the coxae in touch, also in the metasternite this process is slightly widen than the prosternal midline edge of the coxae never touch on the midline (Figs. 7 a , b and c).
Abdomen: The abdomen of the Viny advent yemenensis composed of 8 segments, the 1st 6th segments are almost similar, suture separates the last thoracic sternite and 1st abdominal segment distinct, and suture separate the 1st and 2nd abdominal sternites are distinct, also the suture separates the 3rd and 4th abdominal sternites are clear. Suture separates 5th and 6th abdominal sternites distinct, 7th and 8th stermites are modified for a purpose of reproduction (Fig. 11c). The female last abdominal segments are modified into a pocket, which formed from an in folding of the body-wall around the genital aperture, which adapted for receiving the intromittent organ of the male (Fig. 11a). The male's last 2 abdominal segments are visible (tergite and sternite segments or hypopygidium and pigydium), which are pulled posteriorly to form external genital apparatus (intromitant organ) of the male which a dapted for transferring sperm cells into the female during copulation (Fig, 11 b).
Legs- are articulated walking legs. Coxae in lycids are externally attached to the sternites. In Viny advent lycids are externally attached. Paired procoxae separated by distance less than coxal diameter, paired proventral procoxal rest rounded. Both mesoventral procoxal rounded. Anterior edge of mesoventrite obtusely angulate, holding the prosternal posterior shield, which is brighter yellowish colour (pale amber) (Fig.16 a). Mesoventrite long, widened posteriorly to become divided by longitudinal groove. Posterior edge of mesoventrite more elevated than the anterior edge. At the middle line of mesovantrite there is an endosternal groove or invagination, which forms part of the endophragmal skeleton to which important muscles are attached. Mesocoxae globular attached externally. Mesoventrite separated by complete suture from mesepisterna, without deep pockets, mesepimeron visible from below. Exposed portion of the mesepimeron long and narrow. Metacoxae separated by distance less than diameter of the basal metacoxa, metacoxae extending laterally to meet sides of body obliquity oriented (obtusely angulate) (Fig.7 a +b).

1st trochanter in all 3 paired legs has a tuber-lime shape joining the coaxa and 2nd trochanter, which is in fact a part of the femur (Chapman, 1998). 2nd trochanter of all legs is twice longer than 1st trochanter, apex half of the second trochanter is twice wider than 1st trochanter, posterior half is joining to the femur from below, outer side of the 2nd trochanter is convex, inner side attached to the femur slightly oblique. Femur of the fore leg three times wider

than tibia, both femoral length and tibial length are similar, femur of the midleg twice wider than tibia, but their lengths are similar, femur of the hind leg twice wider than tibia, but they are equal in length. Hind leg similar to the midleg and the midleg is similar to the foreleg. Femur of the hind leg not wider than femur of the midleg. Femur of the fore leg is slightly wider than mesofemur, also wider than metafemur. Metafemur slightly longer than mesofemur, also slightly longer than femur of the fore leg. Metatibia also slightly longer than mesotibia and tibia of the fore leg.

The mesotibial thorn (tooth) is located just at the inner apical angle of mesotibia, which sharply pointing backward, such tibial thorn has a glandular opening in the concave side and is known to be site of pheromone release (Holloway 2007). (Figs. 2 and 11d). Tibia has short pubescence. Tarsi, each leg is five segmented (distinct tarsomeres) ,1-3 tarsomeres are similar in shape and size, in each leg, the 4th tarsomeres is shorter than any one of 1st previous 3 tarsomere, but it resemble them in shape, each basal end is less in width, but the apex of each segment is wider with obliquity orientation. 5th tarsomere longer than any one of previous 4 tarsomere, slender, covered by cuticular spurs, with 2 terminal claws, these claws have no cushion between them (Figs3 and12). Tarsomere length ratio:1:1:1:0.75:1.75.

Eggs. Eggs are laid in soil or hunid litters, and spend their intirely period of embryo development in soil, when eggs hatch, larvae move to the wood bark or decayed wood. Eggs incubation period and larval stages period and pupation period are around a year, since lycid beetles appearance every year at almost the same period, which last two to three weeks during April. Number of larval moulting unknown, pupation period unknown. The last larval instar seems climbing the walls of terraces, and sometime in houses, larva of the last instar has long body 20 mm, 3mm wide at the middle of the abdomen. Head 1.5mm, all 3 thoracic segments, each has pair of articulated legs with one claw, 1st thoracic segment has two black bows shape, mesothoracic, and metathoracic segment each with two black spots near sides, 9th modified to a ball shape, 10th segment modified to two terminal claws or cerci, which are well sclerotized. The last larval instar, which ready to pupate migrate to suitable places for spending pupal duration. Pherate pupa become shorten with curved body, but still shoft, posterior abdomen bent and two small thickened pods of etytra are rising just under the 1st thoracic sternite. During April which is the optimum time for the viny advent Lycids population explosion, which fill all areas of the country, this population explosion lasts 2-3 weeks during April, then gradually disappear.

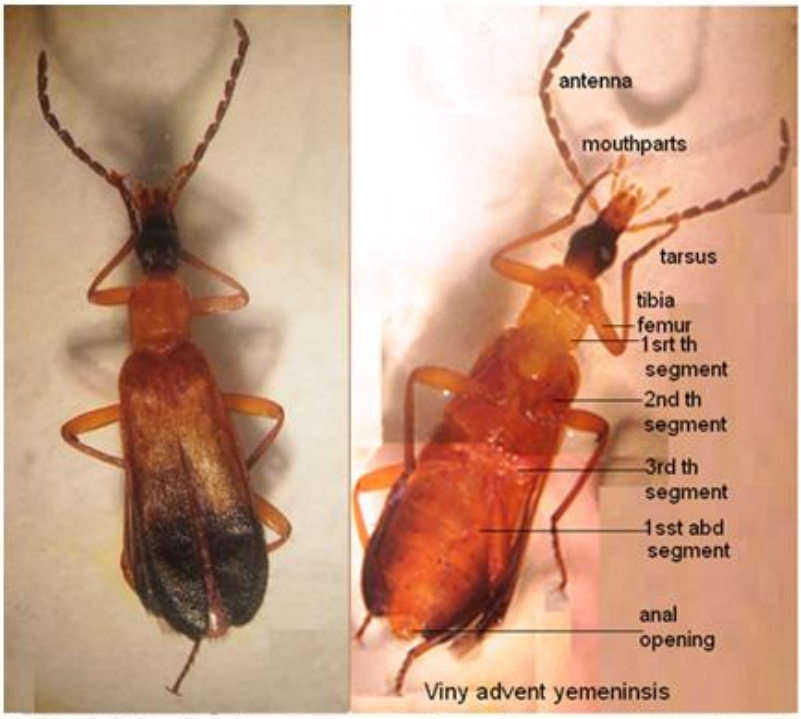


Fig.1&2: light micrography shows ventral and dorsal view of the Viny advent yemenensis Note the mouthparts, antennae,serate, consists of 11segments, are similar accespt the scape which pressed between the the head and pedicel; the farmost segment has club shape.The pedicel is slightly longer. 10x

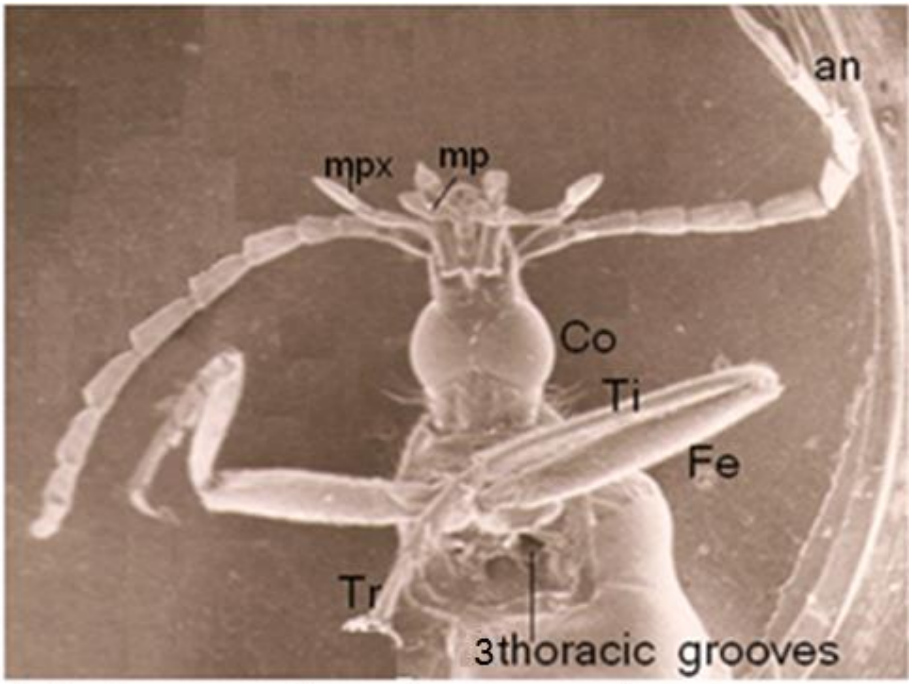


Fig 3 scanning electron microscope exposure shows the ventral side of the head and the 1st thoracic segme nt. Note the mandipular palpi mp; maxillary palpi mpx; the 11antennal segments an.Observe 3 thoracic grooves; sensory hairs at both sides of the knec.

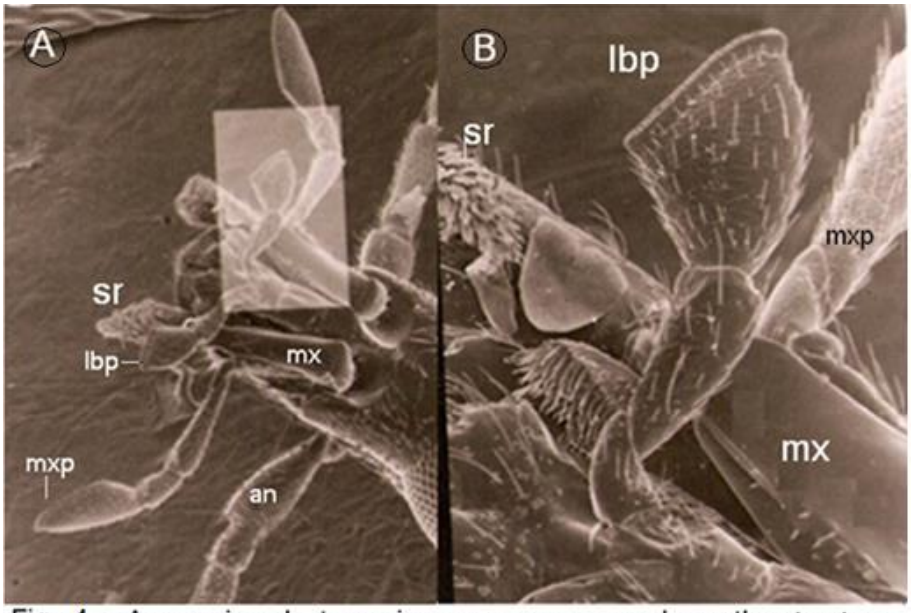


Fig. 4 : A scanning electron microscope exposure shows the structure ventral view of the mouthparts of the Viny advent yemenensis. Note the maxillae mx; maxillary palpus mxp; labial palpi lbp; sensitive receptors hairs sr. B : enlarged exposure of the shaded rectangular area. Observed the 5 segmented maxillary palpus mxp. 25.4 X

2MM——————————— Z00M 4X

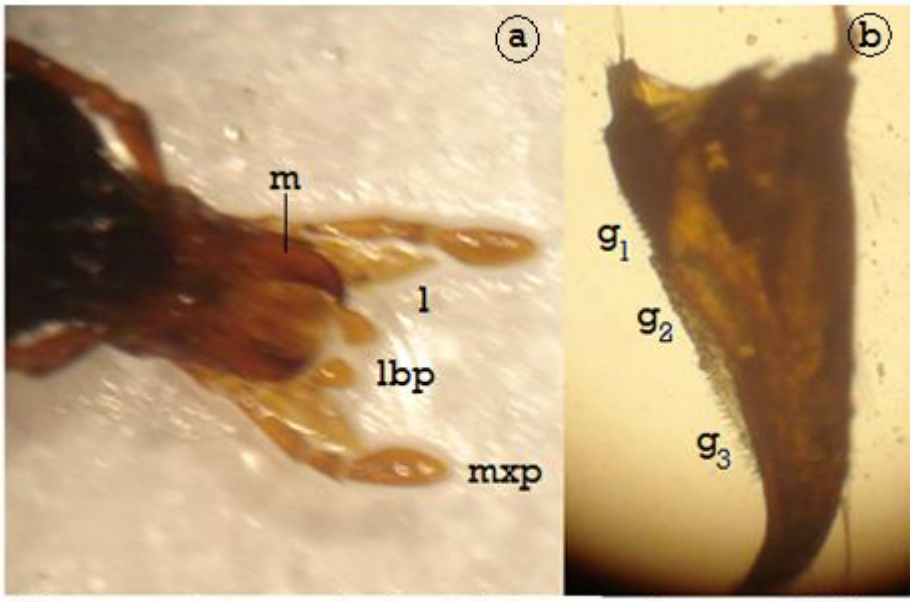


Fig. 5 a & b : ventral view of the mouthparts of Viny advent and its enlaged mandible. Note grinding teeth g_1 g_2 g_3. Observe the maxillary palpi mxp; lacinia l; mandibles m; labial palpi lbp.

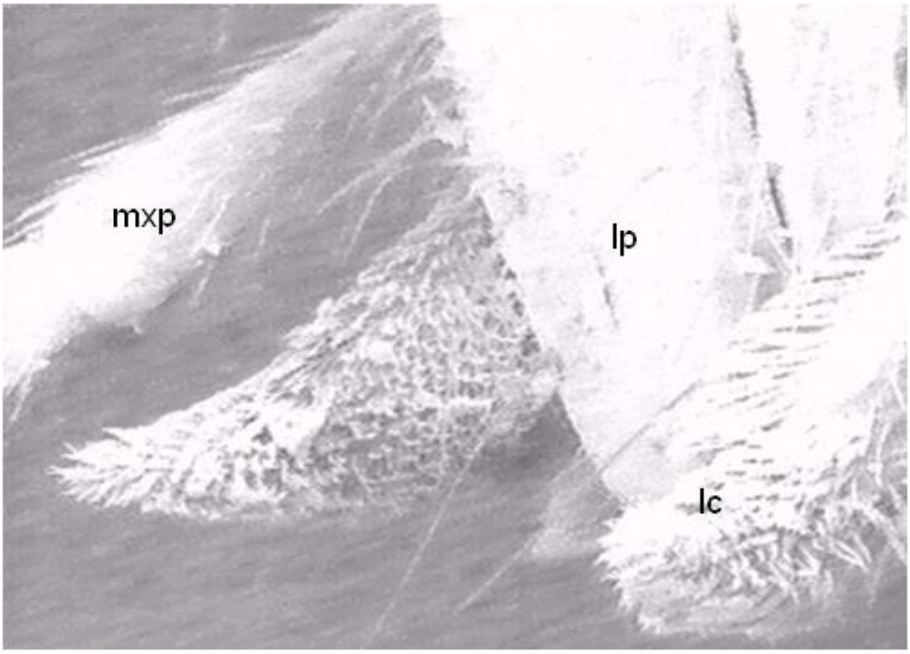


Fig. 6 : scanning electron microscope shows parts of the mouthparts,which exposes the lacinia of the maxillae. Note the labrum lp; lacinia lc; maxillary palpus mxp.
200UM ——————; 146x

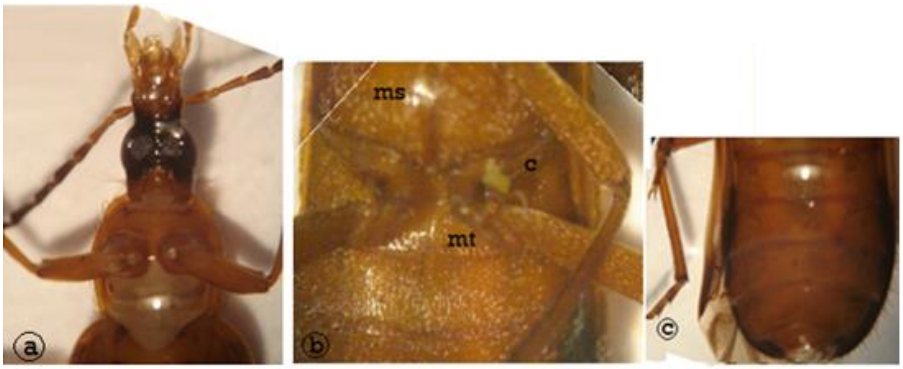


Fig. 7 a: prosterni; b:mesosternite ms & metasternite mt abdominal sternites. Note the coxae c, and distenec bet-ween the coxae of the fore legs and the sheild just under neath. The trochanters 1,2 and the coxae of metasternite extending laterally to meet the body sides.

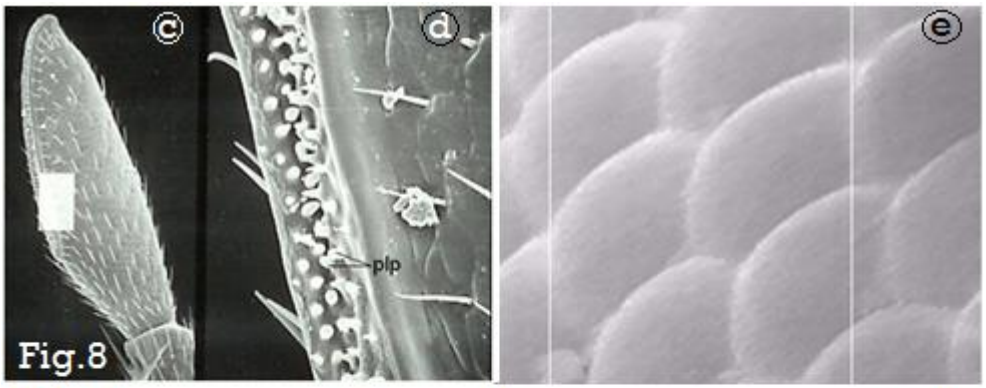


Fig.8

200UM ——— ; 138x , 398,5 ——————— ;1130x

ZOOM x8

Fig.9:frontal lateral view of the head shows the mouthparts; the labial palpi with 3 segments

500UM ———; 28,5x

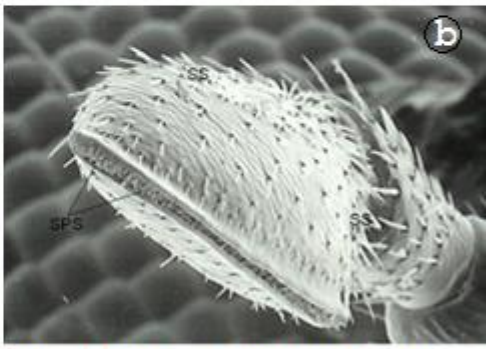


Fig.10: the terminal palpo mere. Note the spurs and the polyps sps;

100UM ———;23,8x

Fig.a: frontal and lateral view of the head. Note the 3 labial palpomeres lp; antennae SC; labium lb; labrum lbr; and compound eyes CE.

Fig. b: scanning electron microscope shows the last labial palpomere with spurs and sensitive receptor polyps, which appear clearly at the opening of the wallet-like basket SPS.

Fig.c: scanning electron microscope exposure shows the Last maxillary palpomere; Fig.d is the enlarged portion with the receptor polyps plp;

Fig.e: scanning electron microscope exposure shows the compound eye's ocelli and its enlargement.

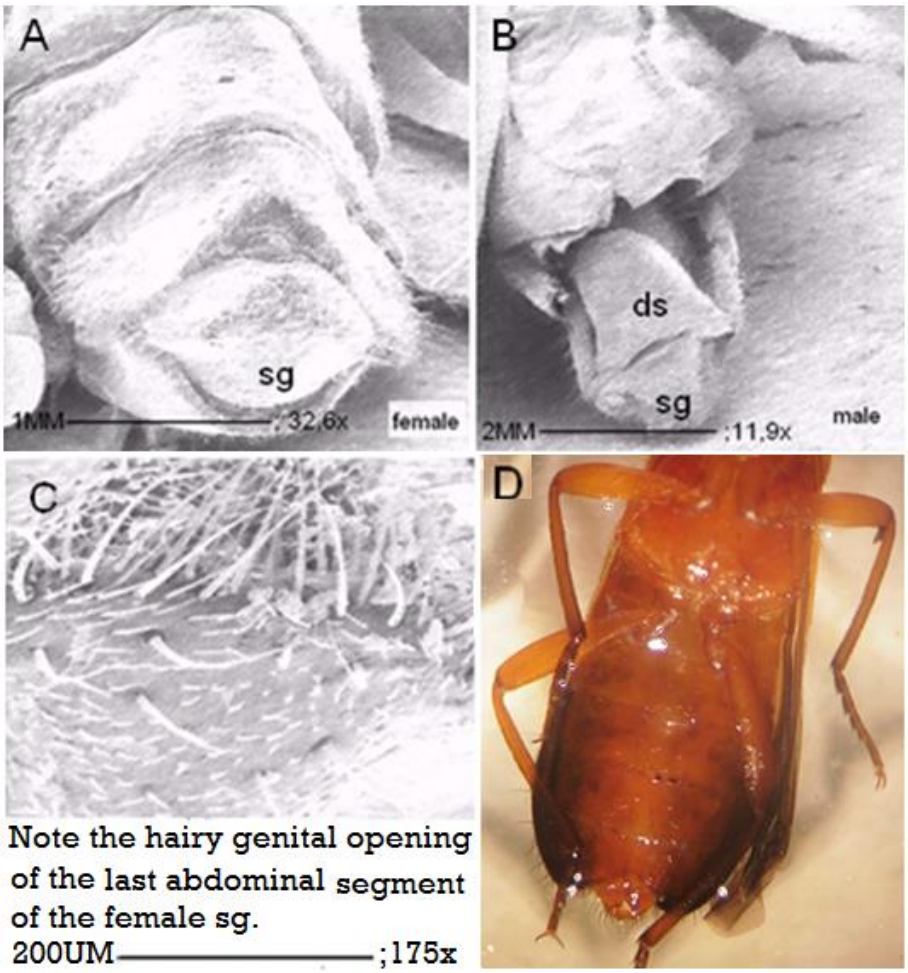
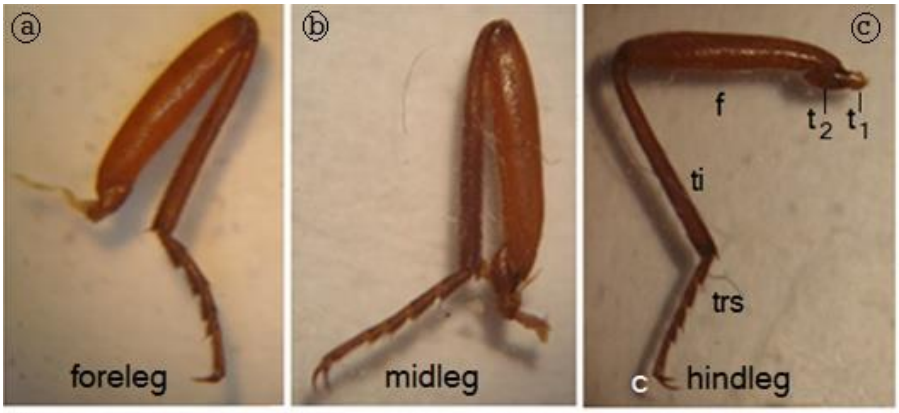


Fig.11 scanning electron microscope exposure shows the abdominal segments(D) of both sexes of Viny advent beetle (Lycidae).Note the rounded terminal segments of both sexes sg; the dorsal plate of the male ds.



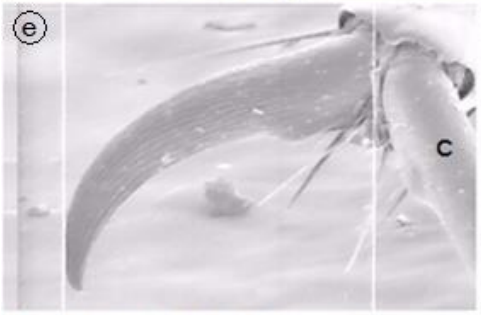


Fig.12: a,b,c,d, & e:trochante t_1 $t_2$femur f; tibia ti; tarsi trs
Claw of the right hind leg of the Viny advent yemenensis.
298UM ——————————, 228x

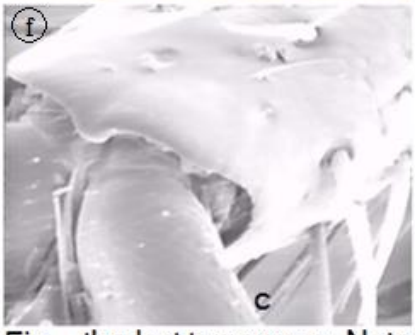


Fig : the last tarsomere. Note the spurs and the sockets that they rise from
100UM ——————————, 489x

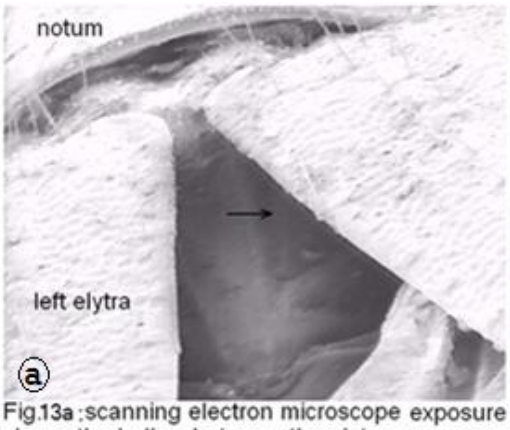


Fig.13a :scanning electron microscope exposure shows the hollow between the elytra . poiting at the pseudo-ocill(the arrow).
500UM ——————— ; 53,4x

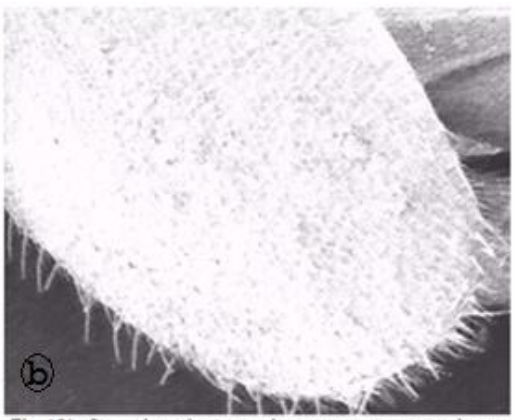


Fig.13b:Scanning electron miroscope exposure shows the elytral structure, which rough surface sructure and the absence of the logitudinal veins.
500UM ——————— ;50,0x

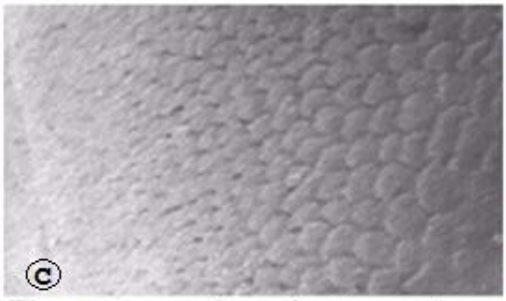


Fig.13c: scanning electron micro scope exposure shows the pseudo- ocillithat hiden under the membranous wing. of Viny advent yemenensis.
50UM ——————; 619x

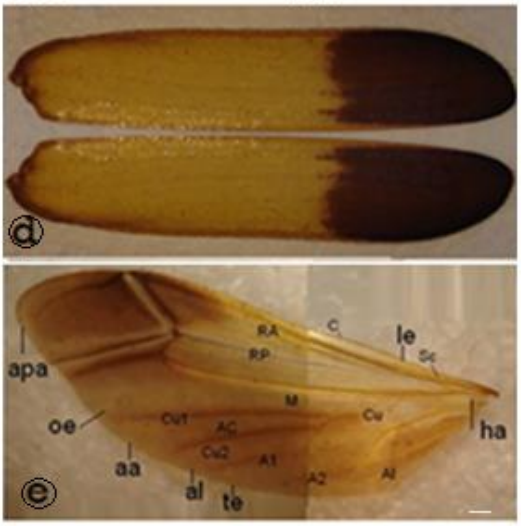


Fig.13dthe elytra of the viny advent yemenensis Note the 7 longitudinal veins,also there are no cross veins, which divide the elytron into cells as in net-wing beetle.Lycidae.

Fig.13 e: the hind wing and its venation.Note the veins: costa C; subcosta Sc; radius anterior RA; radius posterior RP; midia M; cubitus Cu, Cu Cu anal cell AC; anal lobe AL; Observe the apical angle apa; outer edge oe; =apical margin; anal angle ana; anal lobe al; trailing edge te=anal margin;humeral angle ha.

Fig.14. the last larval stage. Note the left mesothoracic leg with one claw ,the black spotson each segment. Observe the thoracic, abdominal segment, cerci, the black spots on each segment.

Discussion

The external morphology of the head and its appendages, antennae and mouthparts, have a unique structure and their externally attached, which are freely pointing onward in front of the head capsule and in front of the compound eyes. The head appendages appear under the SEM with unique anatomical structures, three segmented labial palpomeres, maxillae with paired 5 maxillary palpomeres, both maxillary palpomenes are clothed with cuticular spurs and both labial polpomeres have spurs at their outer surfaces. Lacinia, the inner hairy lobe is heavily covered with sensory hairs, which have nerve ending close to their bases and are extremely sensitive to touch and vibration. Mandibles have sickle-like shape resemble the lesser spotted eagle peak, which have three type of reduced grinding teeth. Antennae with four different type antennomeres. Compound eyes are fused dorsally and ventrally, occupy the whole head capsule except the area of occipital region. The elytra and hind wings, body segments of male and female of the viny advent yemenensis recorded in this study were largely in conformity with those reported by(Kazantsev, 2005.). Terminal antenaomere has a waist (this observation was found with all collections of Viny advent). Notum is rectangular separated from elytra by 3 circles, their unity form a triangle shape. These circles compose scutelum, which is slightly brighter than elytra. Elytra with very developed peripheral costae, 5 weakly visible longitudinal veins, no cross veins, which divide the elytra into cells, so the Viny advent belong to the non-net-winsed lycids (Boca'k, 1998, Bocák, L. and Bocákov M**.** ,1989, 1990, Kazantsev,2005,Lawrence,2007**,**Lawrence and Britton,1994). 1st thoracic sternite has two different areas, anterior area bears the fore legs, posterior area with a shield in which 3 endosternites that form part of endophramal skeleton to which important muscles are attached (Leftwhich. 1977).

Bocák, L. and Bocákov M. Mesosternite is the longest and widest sternite in the thorax, all coxae, which externally articulated are located at the anterior areas of the 3 thoracic segments. Mesosternite widened posteriorly to become 1.5 as wide as its anterior edge, Mesosternite is divided longitudinally by a middle line groove, from the middle area till the posterior end. At the end of this groove is endosternite at the posterior edge of mesosternite. Metasternite coxae extending laterally to meet sides of body.

Abdominal sternites are similar except that of the last 2 terminal segment, which are modified to fit reproductive organs of male and female (Figs. 11 a and b). A greater number of sensilla in the female paraproct segment, while the last visible tergite and sternite of the male are forming the copulatory organ, which is round, has no sensilla.

Lycid larvae were considered as predatory insects. Some of them were found in molluscas shells. Where they will pupate. Larvae colour creemy white (Fig.14) Larvae pit smalls, inject saliva into molluscas body, which paralyze them, feed on them, then use their shells for pupation (Arnett, 1973; Borro et al,1981;, Britton, 1970; Crowson, 1969, 1972, 1981;

Gravely, 1915), some author found lycid larvae living on decomposing wood (Mjorberg, 1925; Withycombe 1926; McCabe and Johnson, 1979, 1980), Lawrence, 1982 found that lycid larvae living on fungi, which occur on damped wood.

Study of widespread lycids, Viny advent yemenensis in light and scanning microscope pointed out many morphological modification of the head and mouthparts characterized by the head capsule, where the compound eyes covered the whole head. The long maxillae, maxillary palpi, labial palpi and their externally attachment to the head (their undressed position) provide better reception of the offensive odour or of the surrounding chemical stimuli (Fig. 1, 2, 3, 4, 6, 9, 10b, and 15a). Mandibles with 3 different denticles lead to that the beetle are classified among polyphage: Elateriformia (Fig.5b).

Acknowledgement: My thanks are due to Amran Shabbain and Nabila Al-do-ice for their all helps.

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