DESCRIPTION OF THE PREPARATORY STAGES OF PAPILIO ZOLICAON, Boisd.

By W. H. Edwards.

Egg.—Spherical; smooth; color yellow-green. Duration of this stage about ten days.

Young Larva.—Length .1 inch; cylindrical, the anterior segments somewhat thickened, the back and sides tapering to 13; when at rest the dorsum is hunched, the head bent down; color black; on 7 and 8 a gray-white dorsal patch, sometimes mottled with black; this patch is irregular, but does not descend below the middle row of tubercles; some larvæ have a little mottling with white on dorsum of 11 to 13, or perhaps one or two segments only, and some have one or two white dots on 2 and 3 in line with the upper row of tubercles; the tubercles form three longitudinal rows: one sub-dorsal, one on mid-side, one infra-stigmatal; these run from 2 to 13, on 2 the tubercles of lower two rows being below the lines; the sub-dorsals are large, slender, tapering, those on 3 to 5 and 11 to 13 larger than the rest and of about equal size; from the apex of each rises a long straight black hair knobbed at extremity, and five or six shorter hairs are irregularly placed about the sides on the upper half; the next two rows are of rounded knobs; on the middle one the knobs on the anterior segments give out four hairs each, but after 3, three hairs; on 2 and 3 the hairs are turned forward, but on the remainder are erect; the knobs of lower row are smallest of all, except on 2 and 3, where they equal in size those of the middle row; the hairs as in that row, but after 3 all are turned down; on the anterior side of each knob, and a little above it, are two hairs to each segment; along base of body a tuft of hairs on each segment from 3 to 12; between the sub-dorsals are two rows of tiny points, from 3 to 12, each with one short hair, but on 11 and 12 the hairs are wanting; feet black; pro-legs greenish brown; head rounded, somewhat flattened frontally, bilobed, the vertices well rounded; color shining black; beset with many black hairs from fine points; the scent organs or tubercles from 2 are stout at base, slender, tapering to a point and bent like an ox-horn; color pale yellow. Duration of this stage four days.

After first Moult: length .16 inch; similar shape; color black-brown; on 8 the dorsum and side are white; on 7 partly mingled with black, but sometimes 7 is white also; on the side of 11 and 12 are usually two or three small white patches, but sometimes there is but one on 10 and

11 each, none on 12; on dorsum of 3 one, two, or three similar patches, but sometimes none; the rows of tubercles as before, but all are conical, with hairs from apex and sides; the sub-dorsals on 3, 4, 5, 11, 12, orange at base; the middle row black to base; the lower row orange from apex to base; the double dorsal row of small spines as before, but those on 3, 4, 5 are larger in proportion, the rest minute; on 2 is a black chitinous collar and a compressed ridge in front; this ridge is whitish, in the middle black, and at each end is a large spine in line with the middle row; back of and between these on same segment a smaller pair (in sub-dorsal row); head rounded, bilobed, black, shining, in front face a whitish chevron; surface beset with short black hairs. Duration of this stage three days.

After second Moult: length .3 inch, same shape; color black; the white patch on 7 and 8 as before, variable in same way; so the spots on 10, 11 and 3; the tubercles as before, the orange at base reddish; some larvæ have the middle row orange, but usually it is black; the anterior spines of the two mid-dorsal rows now conspicuous, largest on 4; the other rows either minute or on last segments almost suppressed; head shaped and colored as before, with similar mark in front face. Duration of this stage about three days.

After third Moult: length .54 inch; same shape; color deep brown-black; the patch on 7 and 8 much broken up, and usually restricted to upper part of sides; on 7 sometimes a bar covering last ridge on dorsum; on 8 dorsum mottled black and white; on 11 and 12 each a small round spot in front of and just below the tubercle of middle row; sometimes an additional spot in line with these back of the tubercle; a small patch on 3, sometimes bisected by the medio-dorsal line, and a small spot on side of 2; over shield on 13 a white cross-bar; over feet and legs each a white patch, and a smaller one on each intervening segment; some examples have two small spots on dorsum and one on side of 6; but others have no white spots on either anterior or posterior segments, very little white on 7 and 8, and no white along base (one had white over legs on 7 and 8 only); the ridge of 2 either whitish or yellow; the sub-dorsal tubercles yolk-red at base except behind, where the color is black, but on 7 and 8 the bases are yellow; the tubercles of middle row are large on anterior segments, the rest small, and all have red at base on dorsal side only; those of lower row are minute except the anterior ones, and all are red to base; the tubercles of the dorsal rows are mere points except on 3, 4, 5, and those on 4 are twice the size of the others; head as before with whitish mark in front and a white patch on side cheek.

At 24 hours later: length .6 to .64 inch; the bases of upper two tubercles on 7 and 8 light yellow; the chevron on face yellow, though the cheek mark is white; before end of the stage the length was .7 at rest. To next moult four days.

After fourth Moult: length .8 (all the foregoing measurements are taken at twelve hours from the beginning of the stage, the larva at rest); banded black and pale blue-green, the band in middle of each segment velvety-black, at the junctions dull lustreless black; the spots clear yellow. As the stage proceeds the green has less blue, more yellow, and this shade spreads over the white along base and under surface. In from three to four days the larvæ were fully grown.

MATURE LARVA.—Length at rest 1.5 to 1.8 inch; greatest breadth .28 inch; cylindrical, stout, somewhat thickened on 3 and 4; color green, banded with black; on the middle of each segment a broad transverse velvet-black band, generally reaching to base, variable in width and often irregular, sometimes broken on mid-side in two or three of the middle segments; the extreme ends of each segment bordered by a velvet-black line or narrow stripe; the junctions dull black; the anterior part of nearly all segments yellow-green, the posterior blue-green; the light parts of base whitish blue-green; on under side a broad ventral black band, and the segments 5, 6, 11, 12 are almost wholly black; 2 has near front a compressed square ridge, the top arcuate, the corners elevated into low rounded knobs, the top yellow, the knobs and sides orange; before this is the black ridge in front of the scent-organs which shows two yellow cross-bars on summit; 3 has two rounded ridges, between which is the black band; the front ridge yellow, the other divided by the narrow green band; on the remaining segments to 12 there is but a single broad rounded ridge to each; 13 has a broken black bar on dorsum, over the shield, and one bar on the side; over the pro-legs on 7 to 10 are two large rounded black spots to each; on 5, 6, 11, 12 one large, one small; on the sides of each pro-leg, as also on that of 13 a black spot; feet black, the ground over them black; in the first part of this stage the sub-dorsal and part of the lateral tuberculations are distinctly seen, but at maturity there is merely a slight rounded sub-dorsal elevation on either side of 3, 4, 5, and on 11 and 12; also on 3 and 4 in each of the two lower rows; on either side are three rows of yolk-red spots, the upper one running from 4 or 5 to 12, the middle row from 2 to 11, in 2 covering the knob on cross ridge; the lower row from 2 to 12; these are placed on the front of the black middle band on each segment, or if the band be broad, near the middle of it; in this last case, they are rounded; but where the band is narrow, a sinus of same color from the front leads to the spot; the spots of sub-dorsal and middle row on 3 and 4 are minute, the first named often wanting on 4 and usually on 3; surface covered with fine short black hairs; head rounded, bilobed, the vertices rounded; yellow in front, yellowish on sides; from the suture at top two black bars pass down, one on front face ending at mandibles, the other down the cheek behind the ocelli; ocelli black on a black patch.

Black Variety.—Extreme: The middle black bands on all segments so broad as to extinguish the white bands more or less completely; what remains of these bands is also broken into short bits over dorsum; a white patch on each segment along base, large over pro-legs. Examples also appear in which the black is less extended, but nearly all the larvæ observed were of the green type in last stage.

Chrysalis.—Length 1.2 inch; greatest breadth, across mesonotum, .48 inch; greatest depth .3 inch; cylindrical, thickest in middle segments; the surface rough, granulated and on all ridges corrugated; head-case produced, ending in two sub-triangular processes which are but little divergent, the space between them incised at a right angle, and the slopes made irregular by one small knob or tooth on each; mesonotum prominent, pointed forward, sub-pyramidal, the top blunt and rough, the edges thickened and rough; on abdomen two sub-dorsal rows of low blunt tubercles; on fourth segment a cross row of four small tubercles; on the ventral side six small black tubercles between the antennæ and tongue-cases, three on either side in longitudinal row; color light wood-brown, the ventral side of thorax darker, the wing-cases with black lines indicating the neuration of the wings; a slightly darker band than on rest of abdomen along the side from wing-case to last segment.

Or the color is green, the whole dorsal area from mesonotum down being bright yellow over a green ground, which ground shows most clearly between the rows of tubercles on last three or four segments; the tubercles all yellow, and the granulations of surface yellow, head and wing-cases one shade of green with a light brown tint; the ventral side of abdomen yellow-green; no side stripe. Duration of this stage in the only example which gave imago the same year fourteen days. The others hibernated and gave imagos in following spring.

Zolicaon flies at least from Oregon to Arizona and through the Rocky Mountains, being taken occasionally from Colorado to Montana. But it is at home on the Coast. Mr. W. G. Wright, at San Bernardino, is of the opinion that it is a single-brooded species, though now and then an individual is seen as late as July, and it would therefore be of a second brood. But the larger part of the chrysalids hibernate. The flight of the butterfly is in March and April, according to Mr. Wright. I received from Mr. Wright, April 2, 1883, a number of eggs which had been laid seven days before, on carrot, by a female tied over the plant. On the 5th, these began to hatch, and by 7th all had hatched. The young larvæ look like those of *Asterias* at same stage, and behaved in same manner. I noticed one of them in its first day thrust out its scent-organs, on being touched by another larva. (All *Papilio* larvæ, however, have this power from the egg.) By 13th most had passed the second moult; on 15th some were passing the third moult. After this moult varieties were observed, some larvæ

lacking the white spots over feet and legs, and on the anterior and posterior segments; on 19th and 20th four had passed the fourth moult, and came up pale green, as did all the other larvæ of that brood; on 29th the first one fixed itself for pupation, and pupated 30th; making the whole larval period twenty-three days.

On April 14th came a lot of eggs on parsnip. All the larvæ of both lots had been fed at first on fennel; later, on parsley also. On May 3d four of last larvæ passed fourth moult, two coming up green, but two black, one of them very black, the bands almost excluding any white, the other less so, the bands not so broad. The usual green was changed to white or whitish. Part of the chrysalids were wood-brown, part green. One imago only came from chrysalis this year, a female, on May 29th, from pupa formed May 15th, and the rest hibernated, giving imagos in March, 1884. Mr. Wright was surprised at hearing of the rapidity of the stages of my larvæ, inasmuch as some retained by him from the lot received by me April 14th did not pupate till June 9th, or one month later than the last of my larvæ. Why this should be so I do not know, as the climate at San Bernardino is warmer than in Virginia in April and May.

The habits of these larvæ were in all respects like those of *Asterias*. They are sluggish at all stages, remaining long in one place, moving merely to feed.

NOTE.—While this paper was passing through the press, I received from Prof. J. J. Rivers, some notes on *Zolicaon* as it appears at his residence, Berkeley, Cala. He says: "Here at the end of April the first appearance of the butterfly takes place, and again in June come fresh examples; and from that time till the end of August fresh specimens occur frequently."

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Steps are now being taken by the American Entomological Society, of Philadelphia, that will doubtless end in the endowment of a permanent Curatorship. This will place the Society in the front rank in this country and entitle it to the first consideration as a worthy beneficiary for Entomological material. As a Section of the Academy of Natural Sciences of Philadelphia the Society has the advantage of a fire-proof building, the benefit of collections and library surpassed by none in America, and, with their own and the Academy's, the most complete Library of Entomological works, as well. These advantages with the endowments left them by the late Dr. Thos. B. Wilson—which enable them to publish their Transactions, and purchase desirable publications, —will place them, so soon as the Curatorship is established, on a firm footing.