



## BIOLOGY AND SYSTEMATICS OF PHYCIODES (PHYCIODES)

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**Abstract.** Phyciodes (Phyciodes) is revised, using numerous new traits of larvae, pupae, hosts, larval webs, antenna color, wing pattern, male and female genitalia, etc. New hosts and life histories are presented. Twelve new names are used: five new ssp. are named (P. batesii lakota, P. b. apsaalooke, P. b. anasazi, P. pulchella shoshoni, P. p. tutchone), three names are resurrected from long disuse due to synonymy (P. pulchella = pratensis = campestris, P. mylitta arida), homonymy (selenis vs. homonym morpheus) and synonymy (P. cocyta = selenis), two new combinations are proposed (P. pulchella montana, P. pulchella camillus), and one name is restored to species status (P. pallescens); P. vesta is removed from subgenus Phyciodes and assigned to the same subgenus (Eresia) as P. frisia. Several new western U.S. taxa proved to be ssp. of batesii based on traits of adults, larvae, pupae, diapause, hosts, and ecology. With some exceptions (antenna, some forewing traits, etc.), the tharos-group taxa form a step-cline in most traits, from P. tharos riocolorado to P. tharos to P. cocyta to P. batesii to P. pulchella; in about 10 characters, riocolorado is a "super-tharos", more extreme than tharos and thus at the end of the step-cline, while pulchella clearly forms the other end of the step-cline. Another cline appears in P. batesii. The P. mylitta-group is similar to tharos-group (mylitta/tharos share similar primitive genitalia) and contains three species that are amply distinct in larvae and male and female genitalia. Farther away, the phaon-group is newly defined by many traits of male and female genitalia and non-Aster hosts: pallescens has the wing pattern of camillus, and picta and phaon complete the group.

### INTRODUCTION

The tharos-group has caused great trouble in the past because the species are similar, and nearly every useful character varies somewhat. Female adults for instance are harder to identify by wing pattern than males. Over the years I have reared nearly every taxon within subgenus Phyciodes, thousands of individuals in all, and have hybridized several species and studied their courtship and biology and have discovered numerous hosts. This paper uses all aspects of their biology and morphology to make sense of the mess that was the tharos-group. I also analyzed the related mylitta- and phaon-groups, and another species (vesta) that proves not to belong to subgenus Phyciodes. This paper presents early stages for nearly all of them (many for the first time) and analyzes characters from all stages. I dissected the genitalia of all taxa, and found good characters in both sexes for nearly every species that proved helpful in determining species relationships.

Most of the names in this group are very old, and many were unfortunately found to be misapplied, so I have been forced to reexamine types and very old papers and dredge up ancient unused names and delve deep into the ICZN Code and designate several neotypes and lectotypes to properly stabilize the nomenclature.

Some corrections of the latest Phyciodes revision (Higgins 1981) were noticed: p. 82 "ostium keel" is present in all Phyciodes (Phyciodes), p. 86 marcia was named 1868 not 1869, p. 86 batesii syntypes are in Field Mus. Nat. Hist., p. 88 camillus is wrongly listed from Calif., p. 90 Scott (1974) gave life history of herlani not orseis, p. 92 New Braunfels not Neu, p. 105 scaphial

extension of tulcis is not wider, and lateral teeth numerous in Jamaica frisia, Fig. 3 is pulchella X montana not montana, Fig. 210 "mylitta" from Golden, Colo. is P. pallida. Some errors in Miller & Brown (1981) are corrected (locations of picta and canace types reversed, various "f." and "ab." names are actually available names under the ICZN Code for use as species/subspecies, etc.).

## METHODS

Larval segments are labeled T1-3 on thorax and A1-10 on abdomen. Larval scoli are named by prefixing B- (for branching spine) to the name of the nearest primary seta, thus BD1 is the scolus near seta D1 (primary setae are present on 1st-stage larvae but are mostly lost in numerous secondary setae on older larvae, whereas scoli are present on 2nd-stage to mature larvae). Upf=upperside of forewing, unf=underside of forewing, uph=upperside of hindwing, unh=underside of hindwing, ups=upperside, uns=underside. All times are given as 24-hour standard time.

I formerly sent primary type specimens to LACM, but the curator of that museum has been laid off, and USFWS has searched and seized specimens in U.S. museums, which means that specimens should no longer be donated to U.S. museums; thus I have donated all primary types to the British Mus. Nat. Hist. (except neotypes designated from AMNH and USNM material are returned to AMNH, and another neotype remains in AMNH).

The overall ranges are given for most taxa, but detailed enumeration of localities and thousands of museum specimens are not given here, because such data is mostly available elsewhere (Scott 1986b, Stanford & Opler 1993, Opler & Krizek 1984, etc.). This paper emphasizes characters such as genitalia and wing pattern and antenna color and early stages, in order to study systematic relationships.

I have not changed the endings of species and subspecies names to match the gender of the genus, because historically this has not been done in butterfly names, the ICZN rule requiring suffix changes has considerable opposition and will not last much longer, and is ludicrous anyway. Most people dislike the practice of constantly changing species/subspecies names to make them conform to the gender of the genus: 1) vast instability of nomenclature ensues as species and subspecies names must be changed as they are constantly shifted between genera or placed in new genera by splitters; 2) almost no one knows latin, so this rule is an anachronism and an insult to most people (the majority of the world's people do not even use the latin alphabet); 3) viewed at its basic level the rule is a perversion, because the practice amounts to the ICZN requiring that genus-species combinations be either homosexual or lesbian, and sex-changes of names are encouraged but--strangely--no heterosexual names are permitted. Who would have believed that our beloved ICZN is the foremost promulgator of instability through double-gay sex changes? Ferris (1989) unjustifiably changed the endings of some of my subspecies names; for instance he changed my orecoasta to orecoastus, on the grounds that he was changing the gender to make the gender of the species name match that of the genus. But 1985 ICZN Code art. 31(b) states that if the name is not a Latin or latinized word it is to be treated as indeclinable and the original spelling is to be retained, with termination unchanged. None of my prior or current names were latinized, because I do not have the slightest knowledge of latin; for instance orecoasta was named from parts of the words Oregon and coast, and the resulting name orecoast sounded awkward so I added an -a at the end merely to make orecoasta sound better (certainly NOT to latinize it, because "-ensis" is the standard way to latinize geographic names); the ending -us (which rhymes with pus) sounds bad and is therefore contrary to my desire to construct nice-sounding names. And the feminine blanca--the spanish word for white (from the White Mts.)--matches the feminine montaña--spanish for mountain--so Ferris' mindless emendation of this name to blanco destroys the proper tense of the name. Thus by art. 31(b) my names must be returned to their original spellings.

## DISCUSSION OF CHARACTERS

**EGG.** Eggs are always laid in clusters on the underside of a host leaf, nearly always on lush leaves, preferably on seedling plants, and generally where other healthy plants are nearby. If most of the plants at a locality are in poor condition (dry or with small leaves), the female will oviposit on the lushest plant available. Eggs are most often laid on lower leaves, such as a lush tuft of leaves in partial shade at the base of a large lush aster, but are sometimes laid up to 60 cm above ground on tall lush asters. The female may spend many minutes (up to half an hour) fluttering about and landing on all the plants at a spot to make sure that they are lush enough and common enough to feed the larvae that will eat the egg plant and then wander away from that plant to adjacent plants. After the 1st-stage, larvae frequently fall off the plants when disturbed (they intentionally curl up and drop off), so nearby plants are important to feed these wanderers. Eggs are always laid in clusters, rarely as few as 6 or as many as 225 eggs per cluster, averaging 62 for P. tharos orange-antenna var., 41 for P. cocyta, 42 for P. batesii lakota, and 60 for P. pulchella camillus. Thus the two species (cocyta and batesii) that are univoltine and specialize on large lush asters at the best time of year lay fewer eggs than the two species (tharos & pulchella) that are multivoltine and polyphagous on numerous asters including small rough asters. The fewer eggs laid by tharos and pulchella can be interpreted as "K-selection" for more eggs laid on worse hosts; or it can be interpreted as cocyta and batesii laying fewer eggs on a large tall few-leaved aster in the hope that all can survive on a single plant, rather than forcing larvae to move to nearby plants (but cocyta and batesii diapause as larvae, forcing all larvae to relocate that plant or nearby ones in spring anyway). The multivoltine P. picta averages 51 eggs/cluster. Little data is available for the mylitta-group, but the multivoltine mylitta laid 115 & 50 in two clusters, the univoltine pallida 114 and perhaps ?30, the univoltine orseis orseis 64; the multivoltine mylitta perhaps lays more. In her lifetime in lab, a single female lays an average of about 246 eggs for P. tharos and 204 for P. cocyta (range 21-821 [Oliver 1972], though the averages ranged from 161-343 in tharos, and ranged from 66-517 in hybrid crosses). Since in nature each female will produce only 1 male 1 female offspring on average (replacement amount), 99% of the eggs fail to survive, because of Trichogrammatids killing the eggs, ants eating eggs and larvae, larvae dropping off the plants and failing to find another host, etc. The impact on the population of collecting 100 eggs--50 if the female only lives half her lab lifespan in nature--is therefore equal to the impact of collecting about one adult.

The eggs are light-green when laid, but turn creamier before hatching, then dark as the larva is about to hatch.

**LARVAE** (Tables 1, 8). **First-stage larvae** have a fairly-strong pattern of brown bands only in P. pulchella (including weak middorsal and nearby tan lines, a conspicuous wide brown dorsolateral band, and a tan sublateral line), whereas this pattern is weak in batesii ssp., weaker or absent in cocyta, and absent in riocolorado/tharos (note that the molting 1st-stage larva appears to have a brown pattern in all taxa, because the 2nd-stage larva had a fairly-strong brown pattern of lines/bands in all taxa, so when the 1st-stage is molting and the 2nd-stage head is visible as a bulge in the prothorax of the 1st-stage larva, the 2nd-stage body pattern is also visible through the 1st-stage skin). The 2nd-stage larva is similar in all species and undergoes a color change, the young larva being greenish-tan with middorsal and nearby darker-green lines and dorsolateral wide lighter-brown band and sublateral darker-green line; but 2nd-stage larvae later turn browner (tan) and the lines become tan and the dorsolateral band becomes brown. Thus the age of the 1st- and 2nd-stage larva is important for studying their color pattern.

1st-stage larvae always eat their eggshells, then they remain together while spinning some silk web on the leaf. This web is very conspicuous in all P. batesii and most P. pulchella, about half the P. cocyta families, and a few P. tharos families; the strongest webs are made by clusters of young larvae preparing to molt. Most larvae rest on top of the silk web, but occasionally some larvae may rest & feed beneath part of it. 1st-stage larvae eat small pits on leaf undersides and stick their heads into these pits, often beneath a cuticle overhang, to feed on the internal leaf tissue. 2nd-3rd-stage larvae continue to eat pits in the leaf, bigger pits by older larvae, and only the older larvae (~4th-stage-mature) eat the leaf from the edge.

**Setae** of first-stage larvae appear identical in all species (figs. 46-49).

**Older larvae** of all Phyciodes have black heads with the cream vertex stripe. All P. tharos-group older larvae have the same dark bands on body, and even larvae of the mylitta- and phaon-

groups have this same banding pattern. But in different species the bands may be darker or lighter and a few dorsal or lateral dark or pale bands may coalesce. The overall body color varies greatly in overall darkness (some *P. batesii* ssp. and *P. pulchella* are darkest) & overall orangeness; the extent and tint of orangish markings, color of scoli, and strength of cream bands also vary. Oranger overall body color (ground color plus color of creamy bands and color of scoli) is correlated with oranger wing color in two ssp. (*anasazi*, *montana*) belonging to species which have most ssp. dark; but in the species with the oranger adults (*tharos*, *cocyta*) the larvae are not oranger. The brown area above BD2 scoli is as dark as the wide brown subdorsal band in most *cocyta*, *batesii*, and *pulchella*, but is usually somewhat paler in *tharos*, and is much paler in *picta/phaon*. The scoli tips are conspicuously (with a little magnification) paler in *riocolorado/tharos/cocyta*, dark in *batesii/pulchella* (they are microscopically paler in these and all taxa). The cream subdorsal band is strong in *tharos/cocyta* and *batesii* and most *pulchella*, strong but varying to nearly or totally absent in the three western *batesii* ssp. and Bighorn Mts. *pulchella camillus*. The head always has pale anterior & ventral areas (frontoclypeus etc.) in *tharos/cocyta*, whereas those areas vary from cream to black in *batesii* ssp. and are always black in *pulchella* (in the *mylitta* group, the frontoclypeus is always black, but there may be a paler patch above the eyes). Some *mylitta*-group taxa may have orange between the BD1 & BD2 scoli, which is unknown in the *tharos*-group.

The **ventral neck gland** is present and sometimes extruded in alcohol in 2nd-stage to mature larvae of all species. 1st-stage larvae have a double-ridged structure in the same position, which must also be the ventral neck gland, but perhaps it is nonfunctional in 1st-stage.

**HIBERNATION STAGE AND NUMBER AND DURATION OF LARVAL STAGES.** Measurements of head capsules in the current paper, and the work of Edwards (1874-1884) and McDunnough (1920), prove that **unfed 4TH-STAGE LARVAE** hibernate in *P. tharos tharos*, *P. cocyta*, *P. batesii batesii*, *P. batesii lakota*, *P. batesii apsaalooke*, *P. b. anasazi*, *P. pallida pallida*, and *P. orseis orseis*. Oliver (1972) reported that *P. cocyta* diapauses as "3rd stage" (actually 4th). I found that half-grown *P. pulchella camillus* larvae hibernate, and Edwards reported that 2nd-4th-stage *P. picta* larvae hibernate. I conclude that 4th-stage larvae hibernate in all species. Oliver (1979a, 1972) erred in stating all *Phyciodes* diapause at beginning of 3rd stage, and Scott (1986a) wrongly listed 3rd stage. Edwards claimed that *P. tharos* (and *Chlosyne nycteis*) that overwinter have a special 4th-stage larva that is specially adapted for hibernation, so overwintering individuals have six larval stages, whereas summer individuals have only five; and the extra stage is the specially-adapted 4th-stage (which in *C. nycteis/gorgone* even differs in color [more reddish-brown]). However, my lab-reared *Phyciodes* that did not diapause still had six stages, and the diapausing larvae I have seen did not look any different from normal 4th-stage larvae. Edwards found that W. Va. *P. tharos* have 3 1/2 generations: the first consists of form *marcia*, the second form *morpheus*, the third *morpheus* (some of whose subsequent larvae hibernate), the partial fourth generation includes many *marcia* (all of whose subsequent larvae hibernate). In the Catskill Mts. N.Y. there are only 2 *tharos* generations, the first *marcia* (some of subsequent larvae hibernate--perhaps some were *P. cocyta*), the second *morpheus* (all subsequent larvae hibernate). In Colo. there are about 3 *tharos* generations, and in SE U.S. probably 5-6. The duration of larval stages seems not to differ much between species, and individual families may differ about as much. Lower temperatures increase duration: under natural temperature/photoperiod conditions, larvae of *tharos* and *pulchella montana* hatching from Aug. eggs take longer because of lower temperature than larvae hatching from June eggs (Oliver 1978). Duration is longer in lab for larvae that attempt to diapause; some of these may grow and pupate after a week or many weeks while others die (Table 4).

Young larvae (prior to 4th-stage diapause) remain on the hostplant all day and night. 1st-stage larvae form a cluster and remain very close to the eggshells, and in some species they often cling tightly to a silk-web. However, after diapause older larvae obviously spend most of their time hiding at the base of the plant, because they are very difficult to find in nature.

**PUPAE** (Tables 2-3). All *Phyciodes* pupae are finely mottled brown, and the pattern details of *mylitta*-group, *tharos*-group, and *phaon*-group pupae are basically the same. The overall color is rather variable, most commonly light-orangish-brown, sometimes light-creamy-brown or occasionally dark-brown, with weak or strong brown areas; the strongly-cream color of many *cocyta* pupae (at least from Colo.) is the only common pattern not often found on other taxa, although Edwards reports cream *tharos* from E U.S. (which may have been *cocyta*) Among the

tharos-group, P. pulchella has the most uniform pupae (several shades of ugly brown). All pupae have similar dark and paler areas on wing, all have ~5 postmedian (in R and M and sometimes CuA cells) and ~7 marginal pale dots on wing, all have the same bands of brown spots and cream markings, all have the same pattern on appendages, all have the same cream-edged brown U-shaped mark around front of head, all have the same transverse crests over dorsal half of body (one curving from tornus to the top of A4 and smaller crests on A5-7 and a small bipartite [strongest at start and end] crest on T2), all have these crests colored the same (front slope of crest orangish-brown, rear slope cream), all have the same dorsal cones on T2-A4 (these cones are homologous to larval scoli) and the same V-shaped mark on top of T2. The pupal ridges & especially the cones are large on riocolorado/tharos/cocytta, moderate on batesii ssp. (whose ridges are not greatly smaller than those of tharos, but whose cones are somewhat shorter), and small on pulchella, while they are very small on picta, fairly small phaon, and large and wide on the mylitta-group. The cremaster is narrow on riocolorado & tharos, a little wider on cocytta, and wider on the others (but narrow on at least some pulchella); it is less winged on riocolorado than the others; it is less rugose on tharos/cocytta and esp. riocolorado, very rugose on the others.

**ADULT WING PATTERN** (Tables 4-5, 9-10). The tables and diagnoses list wing pattern characters, which are useful for identifying nearly all taxa (except ssp. barnesi is very similar to ssp. pallida). Females of the tharos-group are harder to identify than males, because wing pattern traits, especially on unf, are less distinctive; for instance a large spot that is key to identifying a male may be smaller in a female, so P. tharos/cocytta females are often difficult to distinguish, and are sometimes difficult to distinguish from batesii. The antenna club nudum also is a little less distinctive in females.

**ADULT SEASONAL FORMS.** All U.S. Phyciodes (except the subtropical species) show seasonal forms: the spring (sometimes fall) form marcia has the unh marked with a stronger fine network of dark lines and more brown areas and more cream markings (esp. a cream submarginal crescent, and in females whitish median and submarginal bands); the ups black marks may be heavier also and size is a little smaller. The summer form morpheus has a less-marked oranger unh and may be oranger on ups and larger. W. Edwards used the name morpheus for the summer form because in the 1800s morpheus was considered to belong to P. tharos (actually it is a homonym of the mostly-summer P. cocytta) and flies mostly in summer and is orangish like summer P. tharos. Klots (1951) followed Edwards in correctly listing morpheus as the summer form, but Miller & Brown (1981) and Ferris (1989, parroting Miller/Brown) erred in labeling morpheus the spring form. Both marcia and morpheus were named as distinct species, so marcia may double as the orange-antenna ssp. of tharos, whereas morpheus is no longer available for use as ssp./sp. due to primary homonymy so it can only be used as a form name. Edwards (1874-1884) proved the spring and summer forms of tharos belong to one species by rearing both from each other; he proved that form marcia results from low temperature (40°F was best) acting on the pupa (cold acting 1-9 hrs. after pupation had a much greater effect than cold applied within an hour after pupation, which usually had no effect). Oliver (1976) found that short-day (long night) photoperiod produced marcia, while long-day photoperiod produced morpheus; he stated that temperature exposure on larvae and pupae had no effect on adult phenotype, but in view of Edwards' findings, low temperature does produce marcia but Oliver's temperatures were not cold enough to produce it.

**ANTENNAE** (Table 3) were examined on all taxa. The underside of the shaft is always cream, and the cream area widens as it extends onto the basal half of the club. The dorsal 2/3 of the shaft is always dark-brown, with a narrow white ring on the base of each segment, and the dark-brown extends onto the laterodorsal part of the club. The nudum is a scaleless area covering most of the medial portion of the distal 2/3 of the club, and it extends to the tip where it wraps around onto the distal end of the lateral side of the club. The nudum can be orange (even yellow-orange centrally) or dark-orange or brown or black, but except on the darkest nudums the outer border is darker than the center, while the central portion is paler with a lattice of lines as dark or a bit darker than the border: a central darker line parallel to the shaft is perpendicular to many transverse dark lines (one at the edge of each segment), thus the dark lattice makes the central area look like pale steps of two ladders placed side-by-side. The nudum is described below using the terms border, lattice, and steps. Thus the club always has some white at base and always has brown, while some clubs have a lot of orange and others are mostly brown or black.

Interestingly, the nudum color varies from brown to orange in different ssp. of three species (all but cocyta, which shows only slight individual variation of its orange nudum): blackish in tharos riocolorado and t. tharos but orange in t. tharos orange-antenna variety, blackish in batesii batesii and b. lakota but orange in b. apsaalooke and b. anasazi, blackish in pulchella pulchella and p. montana and p. camillus and p. shoshoni but orange in p. tutchone; thus the antenna is orange in the northern or western ssp., blackish in the southern or eastern ssp., another example of convergence.

The mylitta-group, in contrast, contains 3 western U.S.-Guatemala species all with orange antennae, while the phaon-group contains 3 southern species all with orange antennae. Thus the orange antenna club may be the primitive color in subgenus Phyciodes.

**ADULT BEHAVIOR.** Most behaviors are similar between species. Adults frequently visit flowers, and males often sip mud. Females oviposit large clusters of eggs on underside of host Aster leaves, generally near the base of the plant on succulent plants esp. seedlings. Adults bask with wings mostly spread.

**Mate-location.** Males of all tharos-group species (and several phaon-group species) patrol all day to seek females, in low areas such as meadows and gulches primarily, but males also patrol some near the hosts on hillsides etc. But in the mylitta-group, males usually perch all day to await females, also in gulches (although mylitta also patrols some, esp. in agricultural fields). Males fly rather low to the ground/vegetation, although cocyta and batesii may fly a little higher than tharos and pulchella; picta & phaon fly very low to the ground. Mate-location and mating occur all day; for instance Shull (1987) found 76 mating pairs of tharos from 09:00-17:45 (most 11:00-15:30).

**Courtship** seems identical in tharos tharos, cocyta, and pulchella camillus (Scott 1986b), and these elements occur: 1) the male wing display (done after the female moves or lands) consists of his wings spread  $\sim 50^\circ$  from vertical, the forewings often drawn forward, while he is beside and often facing her; 2) male wing fluttering is also done after she moves (every kind of intermediate occurs between male display and fluttering); 3) male bending occurs as he spreads his wings a bit and crawls under her spread wings slightly and bends his abdomen to join; 4) the posture of females receptive to joining is wings-spread, abdomen raised  $\sim 20^\circ$  above horizontal; 5) unreceptive females do vigorous wing fluttering at small to large amplitude, or she may turn away or crawl away or drop into the vegetation or fly (some [esp. mated] females may fly vertically 3 m then rapidly downward to elude the male), or she may move her abdomen upward so he cannot join. All of these elements were observed in P. batesii batesii also except the females in posture #4) flew when the male bent his abdomen. Scott (1986b) wondered whether male camillus might fly loops above the resting female as a normal part of courtship; observations since then indicate that the male does not fly ritual loops (as does Chlosyne gorgone) but merely flies one way and back again occasionally while hovering over the female before landing. P. tharos readily court and mate with cocyta in nature at least in C. Colo., whereas cocyta will not mate with pulchella in nature (Scott 1986b), and tharos will not mate with batesii in nature (based on courtship failure in lab cages, Oliver 1979a), and phaon refuse to mate with tharos (Oliver 1982 was forced to hand-pair them), so batesii and phaon had to be hand-paired with tharos (Oliver 1979 J. Lepid. Soc. 33:244 found that unresponsive lab males would court better if allowed to fly to a screened window, where females could be moved near them with tweezers). Because the movements and postures of courtship behavior are evidently the same in all these species, reproductive isolation must involve pheromones of males or females. Females always fly toting the passive male if a copulating pair is scared.

**GENITALIA** (figs. 1-45) of about 6 males 6 females of each tharos-group taxon, 3 male 3 females of each mylitta-group taxon, and several males several females of each phaon-group taxon, were prepared with hot 10% KOH, and examined in glycerin (a thick clear preservative fluid which facilitates examination from every viewpoint).

Higgins' (1981) drawings (esp. female) tend to confuse irrelevant curves of membranes with outlines of the sclerites, making comparisons difficult. I think many useful characters were lost by Higgins (in the tharos- and mylitta-groups I found many characters of the male and female genitalia that were not properly drawn on Higgins' figures), so complete examinations of tropical Phyciodes genitalia in glycerine (rather than squashed flat on slides) should uncover about three times as many characters as Higgins found. At least Higgins' figures are drawn from the same viewpoint; some recent papers (such as those of Polites in C. MacNeill 1993, J. Lepid. Soc.

47:177-198) make the most elementary sin of drawing the structures from different aspects so that comparison between taxa is very difficult; the "camera lucida" etc. should be banned and authors should be forced to draw these structures in glycerine, unfused and undistorted by being squashed and fossilized in amber on slides.

In general, in the tharos-group both male and female genitalia are a little less sclerotized in riocolorado/tharos, a bit more sclerotized on the average in cocyta, and most sclerotized in batesii/pulchella.

**MALE GENITALIA of tharos-group (Table 6) and phaon-group and P. vesta (figs. 1-22).**

The **UNCUS** (figs. 1-7) is membranous, but the **GNATHOS** just below consists of a sclerotized lateral strip (narrow in all taxa, except also broad ventrally in P. vesta) from tegumen to a **GNATHOS HOOK** (the left and right hooks aimed toward each other). These hooks are comparatively large in most taxa but usually shorter in pulchella: to compare the length of the hooks I estimated how many hook lengths (the length of the hook on its shorter inner [medial] side) are required to span the widest (in dorsal view) width of the membranous uncus behind the hooks (width of the transparent space formed by the membranous uncus between the gnathos arms); thus the membrane of uncus is 3.5 to 6 hook lengths in riocolorado, 5 to 5.5 in tharos, 3.7 to 8 in cocyta, 5 to 6 in two batesii batesii, 4.5 to 6 in batesii lakota (five 6, three 5, one 4.5), 6 to 8 in apsaalooke, 5.5 to 8 in anasazi, whereas the hooks are short in pulchella (5 to 15, average 8.9, N=20) (in contrast, the P. pallescens/picta/phaon hooks are giant, 2.5-3 pallescens, 2.5 picta, 2.7-3.5 phaon) (Scott's 1986a statements on this trait should be ignored). P. vesta has about 2-3 long (2.5 lengths) and 1-2 vestigial hooks on each side (only one in other sp.) (fig. 4). The **TEGUMEN** is similar in most taxa, with an "eye" on each side that is usually slitlike in shape (the eye is close to the medial edge only in vesta); the anterolateral base of tegumen is most often somewhat shouldered laterally but often is tapered, whereas riocolorado generally has the tegumen base more tapered (a weak trait since it varies in other taxa) (tapered in pallescens, a little shouldered in one picta, tapered phaon, and the opposite of shouldered [curving toward median] in vesta); the anterior rim of dorsal part of tegumen is rather rounded in dorsal view in most taxa, but slightly more V-shaped (pointed posteriorly) in riocolorado (rather straight with a frequent very slight V in vesta). The middorsal posterior edge of tegumen (where membranous uncus joins) forms a circular arc in all taxa, except in pallescens/picta/phaon it is incised anteriorly into a very long V (figs. 3, 7; missed by Higgins 1981 even though clearly drawn on his picta fig. 213), and in vesta it is broad (forming a broad valley which may have a low hill). The **AEDEAGUS** (figs. 8-11) is always ~50% (40-60%) longer than valva, except in pallescens/picta/phaon it is only 20-30% longer (20-30% pallescens, 35% in one picta, 30% phaon), and is membranous ventrally on the distal 30%; a ventral mound (**MORULA** of Higgins [1981]) of ~8-9 tiny spines (**CORNUTI**) on each side of tip is narrowly hinged to side of tip by a sclerotized strip, while on the dorsal side of tip is a keel-shaped **MIDDLE PROCESS** (rounded distally and pointed proximally when retracted) (called ostium-keel by Higgins, dubiously because ostium is actually farther out on vesica); when the membranous tip is everted, the two cornuti mounds swing upward and outward and the middle process turns on its hinge so that the pointed end becomes distal. The middle process looks comparatively weak in riocolorado/tharos, weak a little more often than strong in cocyta, and comparatively strong in batesii ssp./pulchella ssp./pallescens/picta/phaon; it is very small in vesta. The **VALVA** (figs. 12-16) has a large medial **INNER PRONG** which extends distomedially about as far as the concave curve (in dorsal view) at tip of valva. The valva has a small dorsal **TOOTH** on tip and usually 2 dorsal teeth just behind tip; the latter 2 teeth are comparatively large on most batesii ssp./pulchella ssp./pallescens/picta/phaon and 2/3 of tharos/cocyta valvae, but smaller on some tharos/cocyta and always smaller or tiny on 5 riocolorado; vesta has only the tooth on tip and one tooth near tip (seldom a weak second). The valva is about the same length and size in all taxa (contrary to Higgins' 1981 claim for montana) except the tip is narrower in vesta (which lacks the medial shoulder present in the others). The valva of vesta also has a little more hair lateral to prong than the others. The **JUXTA** (figs. 17-18, 21-22) is a large continuous plate extending forward from saccus (so could be called juxta-saccus), which is usually longer than square in all taxa. Just ventral to aedeagus the juxta is rounded or pointed (aimed posteriorly in ventral view); this is a weak trait because of individual variation, but in batesii batesii it is pointed or nipped, in batesii lakota it is usually pointed (some are nipped, some rounded), most apsaalooke are rather pointed (few nipped), most anasazi are rather pointed and many are nipped, while 2/3 of

*pulchella* are pointed (most of these are slightly nipped), whereas it is somewhat pointed or rounded in *tharos/riocolorado* and seldom pointed or nipped in *cocyta*; 1 of 2 *pallescens* was nipped, and *picta/phaon/vesta* were nipped. The **SACCUS** (figs. 19-22) always has an anteriorly-directed pair of finger-shaped (in ventral or dorsal view) flaps, and a flange that folds forward underneath ventral part of vinculum; the 2 flaps vary somewhat in all taxa, except were always fairly long in *riocolorado*, and were reduced to short fingers on a long flap in one of five *apsaalooke* and all 3 *vesta*.

**Male genitalia of mylitta-group (Table 11, figs. 33-38).** Genitalia show good characters for every species in both sexes (except female *arizonensis* and *pallida* can be confused). The **GNATHOS HOOKS** are large in *mylitta/arizonensis/mexicana* (ratio of width of membranous space behind tegumen, to length of inner curve of gnathos hook, varies from 5-7) like *tharos*, (*arida* may be a bit smaller as one male is 7, *thebais* may be a bit larger as two males were 4), and are also large in *orseis* (5.5) and *herlani* (5-7), but are much smaller in *pallida* (8-9) and even smaller in *barnesi* (9-12). The posterior rim of the **TEGUMEN** (anterior to the membranous space between gnathos arms) is straighter across in *mylitta*-group than in *tharos*-group (where it is more rounded), and usually has small irregularities or a wide mound or plateau. The anterior rim of the tegumen is mostly rounded but sometimes a bit V-shaped in all taxa, except only rounded in *orseis/herlani* (3 males of each seen, possibly a weak trait). The side of tegumen (in dorsal view) near vinculum is variable, thus a weak or useless trait (mostly shouldered in *mylitta* [and in all 3 *arizonensis* and *pallida*], mostly tapered but some shouldered in *barnesi/orseis/herlani*). The **AEDEAGUS** is a little shorter in *mylitta*-group than *tharos*-group (averaging ~40% longer than valva, vs. ~50% in *tharos*-group: 34%, 40, 50 *mylitta*, 30, 45, 60 *arizonensis*, 50, 55, 60 *mexicana*, 40 *arida*, 30, 40 *thebais*), 40, 40, 60 *pallida*, 30, 40, 45 *barnesi*, 40, 40, 50 *orseis*, 30, 30, 40% *herlani*). The middle process of aedeagus appears identical to *tharos*-group, and is rather strongly sclerotized in *mylitta* ssp., usually strong *pallida* & *orseis*, usually weaker *barnesi* & *herlani* (a useless character in this group). The **VALVA** has the usual 2 dorsal teeth near the toothed tip in all taxa (a little stronger on some *mylitta* & *pallida* & *barnesi*, a little weaker on some *arizonensis* & *mexicana* & *orseis*), another useless trait in this group. The valva shape differs greatly near tip: it has a wide medial shoulder (basal to the terminal dorsal teeth and just distal to the long inner prong) in *mylitta* just like the shoulder of the *tharos*-group, *arizonensis* is also shouldered but slightly narrower on 2 of 3, *mexicana* is somewhat narrow on 2 and narrow (mostly unshouldered) on 2, *arida* is narrow on 1, *thebais* mostly narrow on 1 and narrow on 1, *pallida* is like *arizonensis*, *barnesi* is shouldered like *mylitta* on 3 males but fairly narrow on 1 male; in contrast, all 3 *orseis* and all 3 *herlani* have the shoulder almost absent making the valva much narrower in dorsal view; in this trait *P. orseis* is similar to S Mex. *mylitta* ssp.. The posterior margin of **JUXTA** is somewhat variable in outline (in ventral view), most slightly nipped and some merely angled or rounded (except 2 were angled in *mylitta*, all 3 nipped *pallida*); two *herlani* were angled-rounded and 1 was very rounded; a useless trait though perhaps a bit different in *herlani*. The *juxta* is roughly square with some specimens a bit longer than wide in *mylitta/arizonensis* and most longer than wide in *mexicana/arida/thebais*, longer than wide in most *pallida/barnesi*, 2 *herlani* are a little wider than long and 1 is wider than long, while all 3 *orseis* are wider than long; the *juxta* seems narrower distally in *barnesi/herlani/orseis*. The **SACCUS** is identical to *tharos* in all taxa (but somewhat variable in *mexicana*), except in *orseis/herlani* each of the two flaps is more pointed (versus fingerlike in other taxa) and the two flaps are placed farther apart in all 3 *orseis* and several *herlani*. The overall **SIZE** of genitalia is small in *mylitta* ssp. (their wingspan is small), 30% larger in *pallida/barnesi*, and 50% larger in *orseis/herlani* (correlated with the wider *juxta* and *saccus* in *orseis/herlani*).

**FEMALE GENITALIA of tharos-group (Table 7) and phaon-group and P. vesta (figs 23-32).**

The **PAPILLA ANALIS** (figs. 23-25) is similar in all taxa: a dorsal sclerotized strip (clear middorsally) extending upward from the base of each posterior apophysis connects left with right papilla analis, and a sclerotized strip (widest ventrally) from ventral end of each also connects left with right; just posterior to the former strip is a large transparent (weakly-sclerotized) area on dorsal edge of papilla analis which is variable in shape in all taxa (usually rectangular in shape but sometimes rounded or foot-shaped). Below papilla analis is a membranous area (**SINUS CONJUNCTIONIS**, where the gnathos fits during mating), then a large elliptical or more-rounded sclerotized unscaled **DOVE OF LAMELLA POSTOSTIALIS** (figs. 26-31)(the

posterior part of **LAMELLA POSTOSTIALIS** = "scutum" of Higgins)(except vesta has the area weakly-sclerotized and not domed). The shape of this dome is a weak trait (which evidently depends partly or mostly on how the abdomen dries after death) that is most distinctive in tharos: the dome edges are elliptical (straight posteriorly and anteriorly) in 5 tharos, usually rounded posteriorly or anteriorly or both in the other taxa. The midventral axis of this dome usually has a **TRANSPARENT BAND** that is variable in expression (noticeable, limited to posterior half, weak, or sclerotized thus absent): it was clear in 4 anasazi, clear or posterior or weak in cocyta/batesii/lakota/apsaalooke, notable or absent in pulchella & tharos, and weak or very weak in all 4 riocolorado (weak or absent pallescens, weak on posterior half in picta/phaon/vesta). This dome is anteriorly continuous with a concave (curved forward then down to ostium) **SCALY PORTION OF LAMELLA POSTOSTIALIS** sclerite (figs. 26-29) that tapers (narrows) evenly anteriorly to ostium. The **OSTIUM** is a mushroom-shaped opening (the mushroom head anterior, the mushroom stem posterior)(except round in vesta) at the bottom of a conelike "volcanic cone" (which could be called the henia? but is properly termed the **OSTIAL ("VOLCANIC") CONE**, Figs. 26-32); the volcanic cone surrounds only the anterior and lateral sides of the ostium (thus is U-shaped in cross-section), and the floor inside the volcanic cone has 2 lateral flanges that border the stem of the mushroom-shaped ostium (except in vesta there is no cone but just a scoop on anterior side of ostium). The volcanic cone (fig. 32) rises to a peak on the posterior end of the U-shaped rim on each side, and the peak is usually ~30% higher than the anterior rim of the volcano in most taxa (rarely only 10%; rarely the side of the volcano is a uniform ridge instead of a peak), though the average was lower in riocolorado (5, 15, 20, 30% in 4)(evidently a weak trait)(the vesta scoop has a central concavity ~10% lower). Extending lateroposteriorly (left and right) from the volcanic cone is a **LAMELLA PARAOSTIALIS** (figs. 26-30) which touches the lamella postostialis for a considerable distance (except in vesta it extends hardly at all from ostial flap); in ventral view the lateroposterior tip of lamella paraostialis is pointed in about half the adults and rounded in the other half in all taxa, except that all 4 riocolorado were rounded or truncate, and most pulchella were pointed (pallescens/picta/phaon are unique in having a clear zone beyond the tip then an additional irregularly-sclerotized long pointed triangular extension of the lamella paraostialis that extends near the anterolateral part of the dome). Lateral to the lamella paraostialis and the concave portion of the lamella postostialis is a membranous area, and both lamellae and the membranous area is surrounded laterally and anteriorly by a membranous fold that partially covers them. The ostium leads into a **DUCTUS BURSA** (figs. 26, 30-31) which is membranous for a short distance, then sclerotized for most of its length until it is folded outward and back to form a **DUCTUS BURSA FOLD** on ventral and lateral sides, then this fold and the dorsal edge of ductus bursa connect to a membranous (signum absent) **BURSA COPULATRIX**. The ductus bursa fold varies in width but seems to average narrower in riocolorado (narrow on all 4), versus usually medium width in cocyta/batesii/lakota/apsaalooke, 2 wide 1 medium in anasazi, and wide about as often as medium in pulchella (medium or wide pallescens, wide in 1 picta, medium in 1 phaon, narrow in 1 vesta).

During **MATING** the spine-mound cornuti of the male aedeagus evidently fit against the sides of the the mushroom head, while the middle process of the male aedeagus fits against the base of the mushroom stem; probably these lock the aedeagus in place; elsewhere the male gnathos hooks evidently grasp the sinus conjunctionis posterior to the dome of lamella postostialis, the inner prong of valva evidently fits inside the membranous fold of the sternum that externally hides the lamella paraostialis and the prong tip evidently contacts the lamella paraostialis, while the main valva tip (with its terminal dorsal teeth) grasps the side of the female's abdomen lateral to the membranous fold and lamella paraostialis.

**Female genitalia of mylitta-group (Table 12, figs. 39-45).** The **PAPILLA ANALIS** is very similar to tharos-group. The **DOMES OF LAMELLA POSTOSTIALIS** is also variable in shape, most often rather rounded posteriorly and fairly straight anteriorly; the clear midventral line is generally present only posteriorly and varies from absent to strong in all taxa (except no strongly-clear lines were seen in mylitta, all were moderately- or strongly-clear in orseis and mexicana/thebais, and all 3 were very weak or weak in herlani); these are evidently useless traits. The **LAMELLA POSTOSTIALIS** anterior to the dome is always concave and scaled as in tharos-group. The **LAMELLA PARAOSTIALIS** shows good characters: it is generally pointed in mylitta-group (versus often rounded at lateroposterior end in tharos-group); it is fairly long in

*mylitta* ssp., and nearly as long in *pallida/barnesi*, but is quite short (extending very little laterally and lateroposteriorly) in *orseis/herlani*. (Fig. 45 of *herlani* lamellae shows a weakly sclerotized [labeled "very weak"] membranous area lateral to both lamellae that looks like it might be homologous to the lamella paraostialis of other taxa, but actually this weakly-sclerotized membranous area edges both lamellae on all *Phyciodes* but has not been drawn on them except for *vesta* & *frisja*, figs. 30-31.) The junction between lamella postostialis and lamella paraostialis (figs. 39-43, 45) is fused (not noticeable) in most *mylitta*, fused or paler or membranous in *arizonensis*, fused in one *mexicana*, fused or half-clear in *thebais*, slightly paler but sometimes fused in *pallida*, slightly paler (in 2 females) or clear (in 2) in *barnesi*, and always a fairly-wide clear streak in *orseis/herlani*. The OSTIAL ("VOLCANIC") CONE (figs. 39-43, 45) is identical to *tharos* (conelike with distinct peaks at the posterior ends of U-shaped rim around sides and front of cone) in *mylitta* (peaks 15-35% higher than anterior low spot on rim) and *arizonensis* (20-30% higher) and *mexicana* (20%) and *thebais* (15, 15%), and is similar in *pallida* but the cone is somewhat scooplike (less U-shaped in ventral view, because the anterior midventral lowest spot of rim has extended posteriorly, simultaneously making the shape of the ostial cone more scooplike and making the peaks at the posterior ends of the U only 15-25% higher than the anterior midventral low spot of rim that forms the bottom of the U); in *barnesi* the ostial cone is even more scooplike and the peaks are only 5-15% higher, and in *orseis/herlani* the cone is quite scooplike (in part because the cone may be wider?) and the peaks little higher (only 15-30% *orseis*, 20% *herlani*); thus in *barnesi/orseis/herlani* the U-shaped rim around the ostial cone is an even ridge (the posterior ridge not much higher when viewed laterally) on most specimens (some have little peaks). The DUCTUS BURSA FOLD (ventral attachment of bursa copulatrix) is usually medium width in all taxa (except no wide ones were seen in 3 *pallida* & 3 *barnesi*, no narrow in 3 *orseis*, no very narrow or very wide in 3 *herlani*), a useless trait in this group.

**Genitalia of subgenus *Phyciodes* conclusions.** The genitalia reinforce the conclusion from other traits and biology that the *tharos*-group taxa form a step-cline from *riocolorado* to *tharos* to *cocyta* to *batesij* ssp. to *pulchella*. The *mylitta*-group has similar genitalia (*P. mylitta* and *P. tharos* in particular are similar in both sexes, evidently the primitive type in subgenus *Phyciodes*), while much farther away is the *phaon* species-group (consisting of *pallescens/picta/phaon*), distinguished by giant gnathos hooks, a V-shaped notch in posterior rim of tegumen, a shorter aedeagus, and a triangular extension posterior to each lamella paraostialis arm)(*pallescens* is evidently closest to *pulchella* because its wing pattern resembles *camillus*).

**Genitalia of other subgenera (figs. 4-6, 10-11, 14-16, 20-22, 25, 30-31).** *P. vesta* is very distinct from the previous species and previously was grossly misplaced in subgenus *Phyciodes*. My study of the genitalia of *vesta* and *Phyciodes* (*Anthanassa*) *frisja tulcis* reveals that the long multiple gnathos hooks in *vesta* (fig. 4) can be easily derived from the short multiple gnathos hooks of *frisja* (fig. 5)(and note that Higgins' Cuba *frisja* male is drawn with only 5-6 hooks, while his *frisja* from Jamaica and his *frisja tulcis* are shown with ~9, thus there is little evidence from the genitalia that the Caribbean *frisja* is a separate sp. from the mainland *tulcis*), therefore the length of the hooks is a deceptive character which led everyone to misplace *vesta* in subgenus *Phyciodes*. Comparing *vesta* to *tharos*-group (the *mylitta*- and *phaon*-groups are the same as *tharos* except as noted) and *P. frisja*: *vesta* and *frisja* have multiple gnathos hooks (2-4 long ones *vesta*, 5-9 short ones *frisja*), *tharos* one; gnathos arm wide basal to hooks *vesta* & *frisja*, narrow *tharos*; tegumen posterior rim straight or slightly produced posteriorly *vesta*, strongly produced *frisja*, concave *tharos* (straighter *mylitta*); tegumen anterior rim fairly straight *vesta* & *frisja*, curved *tharos*; tegumen slitlike "eye" near medial rim *vesta* & *frisja*, far from it *tharos*; aedeagus 40-60-65% longer than valva *vesta*, 30% longer *frisja*, ~50% *tharos* (~40% *mylitta*); aedeagus middle process very small *vesta*, curved *frisja*, large & straight *tharos*; valva tip narrow *vesta*, slightly-shouldered thus fairly narrow *frisja*, shouldered thus wider *tharos* (wider to narrower in *mylitta* group); valva has 1 tooth near tip (occasionally a weak 2nd) *vesta* & *frisja*, 2 *tharos*; saccus a long flap with short fingers *vesta* (fig. 20), 2 long fingers with division between them cutting back nearly to posterior edge of flange *frisja* (fig. 21), 2 long fingers with division not cutting back *tharos*; dome of lamella postostialis strong *tharos*, nearly flat *vesta* & *frisja*; V of lamella postostialis well-marked *tharos*, absent (continuous with flat plate) *vesta* & *frisja*; volcano surrounding ostium strong *tharos* (and *mylitta*), intermediate between scoop & volcano *frisja* (fig. 31)(and some *mylitta*-group species), a weak scoop *vesta* (fig. 30). Thus in 7 genitalic traits *vesta* resembles *frisja* more than *tharos*, and in 2 other traits *frisja* is intermediate between *tharos*

& vesta. Further proof: vesta & frisía eat Acanthaceae, true Phyciodes eat Compositae (except Verbenaceae for phaon).

The conclusion is obvious: I hereby remove vesta from subgenus Phyciodes. Now where should it go? I do not have the specimens or time or money to look at all the Latin American variations of Phyciodes; however, vesta should go in the same subgenus as frisía, and Higgins' (1981) figures suggest that P. frisía is in the same subgenus as the type species of Eresia and Tegosa (frisía does not belong in Anthanassa where Higgins placed it)(the long forked-tip flaplike saccus of vesta is transitional to the long unforked saccus of Higgins' Eresia and Tegosa), and frisía also seems congeneric with Janatella and Mazia (M. amazonica even has wing pattern similar to vesta). Thus I will call it P. (Eresia) vesta; splitters can use Eresia vesta. Higgins (1981) is an orgy of splitting, with fully nine new genera named (of which up to eight appear to be subgenera or synonyms); I am mystified why Higgins erected most of these genera, and completely fail to understand why Higgins lumped frisía and ptolyca into one subgenus, so I will treat them as subgenera of Phyciodes (P. DeVries 1987, Butt. Costa Rica, also suggested that future revision will reaggregate Higgins' genera).

P. ptolyca (figs. 6, 16, 22) differs greatly from frisía: it lacks gnathos and lacks gnathos hooks, the middle process of aedeagus is absent or replaced by a sclerite on the vesica, the valva tip lacks a dorsal tooth and instead has a ventral tooth, the juxta is extended posterolaterally beyond the usual pointed ridge (I have not examined the female). P. ptolyca seems congeneric with the type species of Anthanassa (texana) and Dagon, and is NOT congeneric with P. frisía as Higgins placed it.

## LIST OF NAMES, TYPES, & TYPE LOCALITIES OF PHYCIODES (PHYCIODES)

### A. mylitta species-group

- 1a. mylitta mylitta (W. Edwards) 1861, neotype CAS, TL Stanyan Hill, San Francisco.
  - = ++ collina (Behr) 1863 (junior homonym fide Charles Bridges), type burned in 1906 fire?, neotype male CAS Presidio, San Francisco, Calif., designated by Emmel & Emmel & Mattoon (1995, chapter 6), TL formerly "near San Francisco, hills of Contra Costa Co.", now locality of neotype.
  - Note: Miller & Brown (1981) wrongly listed callina (Bdv.) 1869 TL Sonora as a ssp. of mylitta, and dos Passos (1964) wrongly listed it as a misspelling of collina (Behr); Brown (1965) proved it a ssp. of Chlosyne (Texola) elada from Sonora, lectotype CM.
  - = epula (Bdv.) 1869, female syntype in BMNH designated lectotype by Emmel & Emmel & Mattoon (1995, chapter 5), TL "interior of California", restricted to San Francisco, Calif., by Emmel & Emmel & Mattoon (1995, chapter 5).
- 1b. mylitta arizonensis Bauer 1975, no type or in Bauer coll., TL Colo.-Ariz.-N.Mex.-Sonora, hereby restricted to Arizona because of the name.
- 1c. mylitta mexicana Hall 1928, holotype BMNH, TL Jalapa Mex.
- 1d. mylitta arida (Skinner) 1917, holotype CM ("type" ups figured plate LIX fig. 22 of Holland's 1932 Butt. Book--probably the holotype since Holland worked at CM), TL "Cochise Co., Ariz." (presumably mislabeled). (Note: arida was synonymized to P. vesta by Higgins [1981], but to P. mylitta thebais by Miller & Brown [1981]; Holland's fig. is very similar to a male from Morelia, Michoacan in AMNH (see below), and is obviously not vesta. Possibly a syn. of thebais, or an intermediate between that & mexicana.)
- 1e. mylitta thebais Godman & Salvin 1878, holotype BMNH, TL mts. of Oaxaca Mex. (adults are mostly black on ups--see Higgins' [1981] fig. 7--so it does not occur in Ariz. as recently purported by Bailowitz & Brock 1991).
- 2a. pallida pallida (W. Edwards) 1864, neotype CM, TL Flagstaff Mtn., Boulder Co. Colo.
  - = mata (Reakirt) 1866, holotype FMNH, TL "Rocky Mts., Colorado Territory", restricted in current paper to Flagstaff Mtn., Boulder Co. Colo.
- 2b. pallida barnesi Skinner 1897, holotype CM, TL Glenwood Springs, Garfield Co. Colo.

- 3a. orseis orseis (W. Edwards) 1871, lectotype AMNH, TL Mt. St. Helena, Napa Co. Calif.  
 3b. orseis herlani Bauer 1975, no type or in Bauer coll., TL Glenbrook Creek, Douglas Co. Nev. (Higgins [1981] was not qualified to judge the conspecificity of this taxon).

#### B. tharos species-group

- 4a. tharos riocolorado Scott 1992, holotype LACM, TL Moab, Grand Co. Utah.  
 4b. tharos tharos (Drury) 1773, neotype male AMNH designated J. Scott in current paper, TL Van Cortlandt Park, New York City, NY. (locality of neotype).  
 = euclea (Bergstraesser) 1780, neotype male AMNH designated J. Scott in current paper, TL New York City and vicinity, NY. (locality of neotype).  
 = marcia (W. Edwards) 1868 (preprint issued 1868, so Higgins' [1981] date 1869 is wrong), lectotype CM (photo proves lectotype is female, not male), TL Hunter, Greene Co., N. Y. An available name for the northern orange-antenna populations.  
 = packardii (Saunders) 1869, types lost or in CNC?, TL Grimsby, Ontario (according to Edwards 1874-1884) which is just W Niagara Falls, barely in the range of P. tharos (and in the range of cocyta); the type (figured by Edwards) is an extreme cold-temperature aberration that cannot be assigned properly either to P. tharos or P. cocyta, so I will arbitrarily assign it to tharos.  
 = distincta Bauer, 1975, no type or in Bauer coll., TL Calexico, Imperial Co. Calif.  
 5. cocyta (Cramer) 1777, neotype male AMNH designated J. Scott in current paper, TL Black Rock, Cape Breton, Nova Scotia (locality of neotype).  
 = + + morpheus (Fabr.) 1775, PAPILIO, junior primary homonym of Papilio (now Heteropterus) morpheus Pallas 1771 (Hesperiidae), type lost, TL restricted to Nova Scotia by Scott (1986a).  
 = selenis (Kirby) 1837, type evidently lost, TL designated Cumberland House, 54° N Lat., Sask., in current paper.  
 = pascoensis Wright 1905, lectotype CAS, TL Pasco, Franklin Co. Wash.  
 = arctica dos Passos 1935, holotype AMNH, TL Table Mtn., Port au Port, Nfld.  
 6a. batesii batesii (Reakirt) 1865, syntype(s) FMNH, TL Winchester, Frederick Co. Va., and Gloucester, Gloucester Co. N.J., restricted to Winchester Va. in present paper (correcting Klots 1951, who merely stated "TL Gloucester, New Jersey").  
 6b. batesii lakota Scott 1994 (current paper), holotype BMNH, TL Pine Ridge, Sioux Co., Nebraska.  
 6c. batesii apsaalooke Scott 1994 (current paper), holotype BMNH, TL Hidden Basin Cgd., Bighorn Co. Wyo.  
 6d. batesii anasazi Scott 1994 (current paper), holotype BMNH, TL Gateway, Mesa Co. Colo.  
 7a. pulchella pulchella (Bdv.) 1852, lectotype male USNM designated by J. Emmel & T. Emmel & Mattoon & J. Scott (in Emmel & Emmel & Mattoon 1995), this lectotype specimen also designated neotype by J. Scott in current paper (in case lectotype was really a pseudotype that had been labeled "type" after Boisduval's publication), TL restricted to San Francisco, Calif. in current paper since lectotype/neotype has no locality label.  
 = pratensis (Behr) 1863, type destroyed in 1906 fire at CAS, neotype male CAS Old Cemetery, San Francisco, Calif., designated by Emmel & Emmel & Mattoon (1995, chapter 6), TL vic. San Francisco, now locality of neotype.  
 = campestris (Behr) 1863, type destroyed in 1906 fire at CAS, neotype female CAS Old Cemetery, San Francisco, Calif., designated by Emmel & Emmel & Mattoon (1995, chapter 6), TL vic. San Francisco, now locality of neotype (designated synonym of pratensis by first reviser Edwards 1873).  
 7b. pulchella tutchone Scott 1994 (current paper), holotype BMNH, TL Nickel Creek, 4000 feet, Yukon.  
 7c. pulchella montana (Behr) 1863, type destroyed in 1906 fire at CAS, neotype male CAS Gold Lake, Sierra Co. Calif. designated by Emmel & Emmel & Mattoon (1995, chapter 6), TL was "vic. Los Angeles, headwaters of Tuolumne River, Yosemite Valley", now is locality of neotype.

- = orsa (Bdv.) 1869, male syntype in BMNH designated lectotype by Emmel & Emmel & Mattoon (1995, chapter 5), TL "interior of California", restricted to Gold Lake, Sierra Co. Calif. by Emmel & Emmel & Mattoon (1995, chapter 5).
- 7d. pulchella shoshoni Scott 1994 (current paper), holotype BMNH, TL Battle Mtn., Elko Co. Nev.
- 7e. pulchella camillus W. Edwards 1871, lectotype CM, TL Fairplay, Park Co., Colo.  
= emissa W. Edwards 1871, lectotype CM, TL Denver, Denver Co., Colo. (based on spring form, designated synonym by first reviser Edwards 1884 Trans. Amer. Ent. Soc. 12:245-337).

### C. phaon species-group

8. pallescens (Felder) 1869, syntypes BMNH, TL Mex.: Puebla, Morelos (region of Cuernavaca).
- 9a. picta picta (W. Edwards) 1865, lectotype FMNH, TL North Platte, Lincoln Co., Neb.
- 9b. picta canace W. Edwards 1871, neotype CM, TL vic. Tucson, Pima Co., Ariz.
10. phaon (W. Edwards) 1864, neotype CM, TL St. Simons Island, Glynn Co., Georgia.  
= maya Hall 1928, holotype BM, TL Lake Amatitlan 1260 m, Guatemala.

### Phyciodes (Eresia)

11. vesta (W. Edwards) 1869.
- 12a. frisia frisia (Poey) 1832.
- 12b. frisia tulcis (Bates) 1864.

### Phyciodes (Anthanassa)

13. texana (W. Edwards) 1863.
14. ptolyca (Bates) 1864

### Seasonal Forms of Most Species

Form marcia--spring form.

Form morpheus--summer form.

## A. PHYCIODES MYLITTA SPECIES GROUP (Tables 8-12)

Males of this group perch to await females (whereas tharos-group males patrol to seek females), and the forewing of males is slightly pointed (as is typical of perching species) esp. in P. pallida & P. orseis, although males of P. mylitta often perch and patrol (they usually perch in gulches, but patrol in flat areas such as agricultural fields); larvae eat Cirsium and related genera (tribe Cynareae), rather than Aster eaten by tharos-group. The antenna club nudum is orangish on all taxa (orange males, orange or often orange-brown females). The genitalia of tharos & mylitta must be the primitive type for both species groups, because their genitalia are very similar; the only general differences from tharos-group are that the aedeagus is usually a little shorter, and middorsal rear rim of tegumen is a little straighter across. The basic larval pattern resembles the tharos-group, but older larvae are more variable (body paler and orange subdorsal areas larger in pallida, body very dark in mylitta & herlani). The basic pupal pattern is like the tharos-group, and the pupal cones are as large as those of P. tharos, but they are wider so are less pointed.

### 1 A. PHYCIODES MYLITTA MYLITTA (EDW.) 1861 (Figs. 33, 35, 39, 50-54, Tables 8-12)

**DIAGNOSIS.** The genitalia are similar to P. tharos except for several small differences on males. Adults are small like tharos, but wing pattern and wing shape and hostplant differ greatly and resemble P. pallida. Numerous traits distinguish mylitta from P. pallida & P. orseis (size, multiple generations, larvae, male and female genitalia). Ssp. mylitta is the northern end of a

cline of ssp., distinguished by orange wings and shouldered valva tip. **Range** B.C.-Mont. S to NW Colo.-Utah-Nev.-N Baja Calif.

**HOSTPLANTS.** 115 eggs in cluster found on underside of leaf of Cirsium vulgare, reared to adults in lab on Silybum marianum, Copper, Siskiyou Co. Calif., May 19, 1974. Other recorded hosts are S. marianum (Calif., B. Walsh 1975 Lepid. News #2); Cirsium occidentale (Calif., F. Williams 1910, Ent. News 21:30); Silybum marianum, Cirsium californicum, C. vulgare, Carduus pycnocephalus (Calif., A. Shapiro J. Res. Lepid. 13:119; Centaurea solstitialis was "suspected" but this is not a valid host record); Cirsium hydrophilum (Calif., A. Shapiro J. Res. Lepid. 13:196); Cirsium arvense (B.C., G. Hardy 1964, Proc. Ent. Soc. B. C. 61:31-36); C. arvense and Cirsium undulatum (Utah, ova found on plants in nature and reared, Clyde F. Gillette written commun. 1994); Cirsium breweri & C. vulgare (Calif., A. Shapiro, J. Res. Lepid. 18:100); Cirsium proteanum (Calif., R. Kelson, 1983 Lepid. News #2 p. 15); Cirsium sp. (S. Calif., J. Emmel, 1984 Lepid. News #2 P. 16); C. vulgare (Wash., J. Pelham et al., 1984 Lepid. News #2 p. 17); Cirsium andersonii (Calif., J. Emmel, 1989 Lepid. News #2 p. 17); Carduus (H. Edwards 1873, Proc. Calif. Acad. Sci. 5:167-8, larva & pupa); "thistle" Carduus & Cnicus (Calif., Mead 1875 [quotes H. Edwards, who did not mention Cnicus; furthermore "Cnicus" probably refers to Cirsium because ~10 species of it are synonyms of Cirsium and the only true Cnicus species is naturalized from Europe; thus I treat Cnicus as an ERROR]); Carduus (H. Dyar 1891, Can. Ent. 23:203-204, egg larva pupa described); Carduus (K. Coolidge 1908, Can. Ent. 40:425)(most Carduus records are old, thus most--but not Shapiro's record listed above--may refer to misidentified Cirsium); Mimulus guttatus (ova found on, reared to adults (S. Calif., J. Emmel, 1984 Lepid. News #2 P. 16). Mimulus (Scrophulariaceae) would seem to be a rare accidental host, though the close botanical relationship of it and Verbenaceae--the host of P. phaon--suggests how P. phaon changed to Verbenaceae.

**EARLY STAGES** (from eggs laid by female from Thompson Can., Yolo Co. Calif., & paintings by Charles M. Dammers in Emmel & Emmel 1973, & Mead 1875). **SILK WEB.** Mead (1875) stated larvae "spin a small web, and draw the leaves of the plant together" [dubious]. **EGG:** 50 in one lab cluster, 115 in one in nature. **1ST-STAGE LARVA** similar to P. orseis herlani, collar and suranal plate black. **3RD-STAGE LARVA** with black middorsal line, blackish on dorsal half of body, subventral & ventral parts whitish. **4TH-STAGE LARVA** dorsally deep black, grayish laterally & subventrally, BL1 scoli and band running along their bases cream. **MATURE LARVA** blackish (maroon)-brown with tiny cream dots, a blackish middorsal line, a tan line beside it (this band is slightly-orangish at ventral base of BD1 scoli), a blackish-brown line along top of BD2, a tan line running through BD2 scoli (no orange visible beside scoli), a wide blackish (maroon)-brown band from bottom of BD2 scoli to just below BSD scoli, a pale-brown (or ochre) narrow band just above black spiracles (no orange visible just below BSD scoli), a faint tan wide band from spiracles to BL1 scoli, an ochre band encloses BL1 scoli and these scoli are surrounded by an orangish-tan ring, a weak light-brown band just below BL1 scoli, a faint tan band just above BL3 scoli, underside pale-brown (or ochre), BD1-2 & BSD scoli dark-brown (the tips blacker)(the mylitta-group has dark-tipped scoli, unlike P. tharos/coccyta), BL1 scoli pale ochre-tan (or "dull ash"), BL3 scoli ochre-tan on most but sclerotized brown on some larvae, legs blackish, anterior proleg plates black posteroventrally with a black extension running anterodorsally, A10 proleg plate all black or tan with black ventral and anterior rims and black streak extending across middle, suranal plate black (with some cream circles around setae) on narrowed anterior part and tan with tiny black seta bases on wide posterior part, collar black with three hills and a posterior ochre dash connected to rear margin and a cream middorsal ecdysial line, ventral neck gland present; head black with a cream stripe on vertex (rarely a cream satellite spot at its anterior end), and sometimes a small cream crescent above eyes.

**PUPA** finely-mottled brown, wood-brown varying to ashy-gray and may have a slight golden reflective sheen, with fairly-weak wing streaks; the usual abdominal rows of small brown spots (supraspiracular [one anterior & one posterior spot per segment], lateroventral, supraventral, midventral bands), a weak paler subspiracular band (esp. on young pupae) derives from the pale lateral larval band, spiracles brown, head has usual brown U-shaped edge around front rim (except dorsally) which is edged posteriorly (on side and bottom edges of head) by cream, a creamy lateral patch on T1, a creamy spot between antenna bases, an anteriorly-directed creamy middorsal V-shaped mark (with a tan middorsal line though it) on top of T2, wing has ~5-6

postmedian and as many marginal cream dots, the usual browner streaks on wing (anterior & dorsal sides of wing base ridges brown, anal margin somewhat brown, weak brownish wing streaks run from end of discal cell to margin between  $\sim R_5-M_3$  and a streak near tornus [or streak from end of discal cell to tornus]), proboscis tip darker, each antenna segment has a browner spot edged distally by a tan dash, each leg has a similar brown-then-tan mark; the usual cones (middorsal A1-8 [biggest A4, weak or absent A1, very weak or absent A8]; subdorsal T2-3-A1-7 [small A1, biggest A4]; supraspiracular A4) have an anterior brown or orangish crescent on front of bump and a creamy rear slope (all mylitta-group pupae have these cones as large as those of P. tharos, but they are wider so are less pointed); the usual transverse crests (the largest on A4 runs from near tornus dorsally to other side, weaker similar crests are on A5-7 and subdorsally on T2, sometimes very weak crests occur on A2-3) have front slope brown & rear slope cream; cremaster shouldered, very rugose.

### 1B. PHYCIODES MYLITTA ARIZONENSIS BAUER 1975

(Figs. 40, 55-58, Tables 9-12)

**NOMENCLATURE.** As noted in the above checklist, the names thebais and callina are inappropriate for Ariz.-N.M.-S Colo. populations (thebais is much blacker, mexicana is somewhat blacker, and callina is a syn. of Chlosyne elada). **DIAGNOSIS.** Shares the almost-as-small size and unf wing pattern and multiple generations and most genitalic traits of mylitta. The valval teeth are perhaps a little smaller than mylitta, and the valva end may average a little narrower. On females the junction between lamella postostialis and lamella paraostialis is generally fused in mylitta but usually paler or membranous in arizonensis, the only definite apparent difference. The ups has more black mottling than mylitta, in particular the median dark-brown ups areas are larger (medial to the postmedian ochre band) and the submarginal dark-brown ups areas are larger thus the enclosed orange spots are smaller; on unf the black tornal spot is larger. Wingspan is often larger. The latter traits and the valva width and paler lamella junction trend toward P. pallida, which suggests that character displacement has occurred (arizonensis is not sympatric with either mylitta or pallida, so some of its traits are a bit of an average of theirs). Or--obviously in the case of wing pattern--P. mylitta merely shows a cline from north to south (palest mylitta, darker arizonensis, blacker mexicana, even blacker thebais), and P. pallida shows parallel variation (palest in ssp. barnesi which mostly occurs in the range of ssp. mylitta, darker in ssp. pallida). **RANGE** S Colo., N.M., Ariz. S to Sonora and perhaps as far as Durango Mex. It colonized SE Colo. in 1993.

**HOSTPLANTS.** Larvae found Cirsium (Ariz., Bailowitz & Brock 1991). Adults associated with Carduus nutans & Cirsium ochrocentrum & C. arvense, SW Greenwood, Custer Co. Colo., July 16, 1993. Early stages unknown to me.

### 1C. PHYCIODES MYLITTA MEXICANA HALL 1928

(Figs. 59-61, Tables 9-12)

**DIAGNOSIS.** Similar to arizonensis in size, but much blacker on ups, esp. the wing bases and around the submarginal ups orange spots. The median ochre ups bands are still fairly wide, much wider than P. m. thebais. The unh--like thebais--is much more mottled than mylitta/arizonensis, with silvery basal spots, brown postbasal areas, a band of silvery median spots, a brown postmedian patch near costa, several silvery spots near apex, and a very large brown marginal patch enclosing a silver crescent. Antenna club orange (male border orange or sometimes yellow-orange, lattice orange-brown or dark-orange, steps yellow-orange; female border and lattice orange-brown, steps orange). The gnathos hooks are large like tharos (5.5, 6, 6, 7 in four males), the rear rim of tegumen is roughly straight with small jagged places or low mounds like all mylitta ssp., the anterior rim of tegumen is broadly rounded or sometimes slightly V-shaped, the side of tegumen is slightly shouldered to tapered, the aedeagus is 40-60% longer than valva (longer than other mylitta ssp., perhaps not a significant difference), the middle process moderately to strongly sclerotized, the valva is shouldered but somewhat narrow in 2 males and narrow in 2 males, the valva has 2 fairly-small teeth present near tip, the saccus is like

mylitta or sometimes shorter or wider, the juxta a little longer than square or roughly square, its posterior rim pointed or nipped; overall genitalia size like mylitta. The genitalia of one female is like mylitta, a clear band on rear of dome, the lamella paraostialis fused to the blunt lamella postostialis, the ostium cone like mylitta with peaks 20% higher than anterior rim, the ductus fold medium/wide. **RANGE** E Mex. (Veracruz and Hidalgo [C. Hoffman's checklist listed "orseis" from Veracruz and Durango, so mexicana may also occur in Durango]).

#### 1D. PHYCIODES MYLITTA ARIDA (SKIN.) 1917

(Figs. 62-63, Tables 9-11)

TL "Cochise Co. Ariz.", coll. F. Haimbach, the types were evidently mislabeled because nothing similar has been found in Ariz. since, although perhaps a few of the 3 vague records of "campestris" from Cochise Co. that Ray Stanford knows about could be arida. The "type" ups figured in Holland's 1932 Butterfly Book (plate LIX fig. 22)--evidently the true type because the type is in CM where Holland worked--matches a male from Morelia, Michoacan in AMNH; both are fairly small (15 mm on the Morelia male, slightly smaller than mexicana & thebais), dark (darker than mexicana, and a little darker than P. m. thebais on ups bases and postmedian ochre band), the forewing margin is not extended as much at veins  $M_{1-3}$  so the fw appears a little more triangular in shape, the wing fringes appear less scalloped than thebais (most like mexicana), and the submarginal creamy uph lunules appear slightly less convex; the uns is like both mexicana and thebais (the only black unf spot is the one near tornus [distinguishing it from other Mexican Phyciodes incl. pallescens, picta, phaon, & tharos, which all have black postmedian unf spots], unh heavily mottled with cream and brown with a marginal cream crescent); antenna nudum orange (border orange, lattice orange-brown, steps yellow-orange); the male genitalia has a narrow valva tip like mexicana/thebais, but this one male has gnathos hooks a bit smaller (7, vs. 4 in two male thebais and 5.5, 6, 6 in three male mexicana), which might or might not prove to be a significant difference (rest of genitalia like mylitta: tegumen rear straight with jagged spots, front rounded, side shouldered, aedeagus 40% longer than valva, middle process moderate, valva has 2 teeth near tip, saccus like mylitta, juxta a bit longer than square with rear rim somewhat nipped). The ups of arida (but not uns or genitalia) resembles some female P. pallescens a little. The Morelia male matches the arida type well, suggesting that arida might be a stable phenotype, so I provisionally treat arida as a valid ssp. from W-C Mex. (perhaps occupying the Mexican plateau), pending examination of more specimens. It could even be a valid species, since Morelia is not far from the D.F. locality of thebais, and species differences are not great in subgenus Phyciodes.

#### 1E. PHYCIODES MYLITTA THEBAIS GODMAN & SALVIN 1878

(Figs. 64-66, Tables 9-12)

**DIAGNOSIS.** Adults resemble mexicana, but are mostly black on ups (blackier than P. m. mexicana, and even blacker than P. orseis orseis, Higgins 1981 fig. 7), with the upf and uph median band of ochre spots much smaller, the submarginal uph orange band much larger in females, and in both sexes this band contains larger black spots that are close to or touch the brown ground color beyond the orange spots. Also, the wings look more scalloped due to the more acute white checkering in the wing fringe (brown fringe at wing veins and white fringe between veins). There is evidently a cline in ups darkness from the orange mylitta to arizonensis to E Mex. mexicana to S Mex.-Guatemala thebais/arida. Antenna club nudum orange (male border orange or dark-orange, lattice dark-orange, steps orange; female border and lattice brown, steps narrowly darkish-orange). Male genitalia is like mylitta except the gnathos hooks may be larger (4 in both males, perhaps not a significant difference) and the valva is mostly narrow or narrow near tip in two males (rest of genitalia like mylitta: tegumen rear rim straight and somewhat jagged, front rounded or V-shaped, side very shouldered or tapered, aedeagus 30-40% longer than valva, middle process fairly-strongly sclerotized, valva has 2 teeth near tip, saccus like tharos, juxta longer than square with rear rim pointed or nipped). The valva evidently shows a cline: it is shouldered near tip in mylitta, averages narrower in arizonensis and even

narrower in mexicana, and is usually narrow in thebais. Thus thebais and P. orseis orseis are similar in two characters: dark ups and narrow valva; presumably the narrow valvae are coincidence because the progenitor of mylitta-group probably had a wider valva like mylitta & tharos; but the similarity of dark ups could possibly be due to dark ups on the progenitor. Female genitalia like mylitta (a clear band on rear half of dome, lamella paraostialis mostly pointed and fused or half-clear at the junction with lamella postostialis, ostial cone like mylitta with 2 low peaks 15% higher than anterior rim, ductus fold medium in width or medium/wide). **RANGE** SW-S Mex. (Jalisco, Distrito Federal, Guerrero, Oaxaca) and Guatemala.

## 2A. PHYCIODES PALLIDA PALLIDA (EDW.) 1864

(Figs. 37, 41, 67-70, Tables 8-12)

**DIAGNOSIS.** Resembles mylitta, but adults have a fairly-large black postmedian spot on unf inner margin (absent in mylitta except small on a few females), adults are larger, and there is only one generation; older larvae are paler (esp. ssp. pallida) with a large orange subdorsal patch; the gnathos hooks are much smaller than mylitta (& orseis), and the ostial cone peaks are a little less pronounced; it is sympatric with mylitta in many states in NW U.S. **TAXONOMIC STATUS.** Interestingly, the half-grown larva more closely resembles Phyciodes orseis mature larva than the mature larva (which is much paler), so P. pallida (in particular ssp. barnesi) may be the closest relative of P. orseis. Older larvae of P. p. barnesi are darker than ssp. pallida so are closer to P. orseis orseis (which has a paler larva than P. o. herlani). P. pallida and P. orseis have other similarities: single generation (many in mylitta), large size, males perch in valley bottoms, both eat large native Cirsium (mylitta eats large and small Cirsium plus related genera); and they are allopatric. But several differences in larval color, gnathos hook length, valva shape, saccus shape, and lamella paraostialis shape, all seem to prove that P. pallida and P. orseis are not subspecies.

**HOSTPLANT RECORDS.** Larvae reared in lab (Scott 1976) on Cirsium incanum or C. arvense and Cirsium vulgare from eggs laid by a female from Red Rocks, Jefferson Co. Colo., June 29, 1973. Cluster of 114 yellow eggs found on 15-cm long leaf uns of fairly young plant of Cirsium ochrocentrum, Red Rocks, Jefferson Co. Colo., June 15, 1987. 3rd-stage larva found on top of C. ochrocentrum leaf ~15 cm long of small plant without aerial stem, upperside of leaf tissue eaten in patches 5 mm wide, larva ate Cirsium incanum in lab for several weeks but then diapaused 3rd-stage, S Indian Peak, Jefferson Co. Colo., Sept. 5, 1991. ~44 2nd- and 3rd-stage larvae found on Cirsium seedlings (the plants grow in patches, the patch # given): patch #1, ~27 larvae spread over ~100 cm on 6 Cirsium ochrocentrum seedlings; patch #2, 6 on 2 C. ochrocentrum seedlings 2.5 m apart; patch #3, 1 on 1 C. ochrocentrum seedling; patch #4, 2 larvae on one C. ochrocentrum seedling and 1 on C. ochrocentrum seedling 3 m away; patch #5, 1 on seedling 4 m below (downslope from) 4 Cirsium undulatum inflorescences and 2 m W of 2 C. undulatum and 2 C. ochrocentrum inflor.; patch #6, 2 larvae on seedling ~80 cm W of 6 C. undulatum inflor. and 2.5 m below 9 C. undulatum inflor. & 2 C. ?ochrocentrum (weakly 1-cm-decurrent leaf base on one leaf) inflor.; patch #7, 2 larvae on 2 seedlings 1 m W of 9 C. undulatum inflor. & 2 C. ?ochrocentrum (weakly 1-cm-decurrent leaf base on one leaf) inflor.; patch #8, 8 on seedling 1.5 m below 2 dead C. undulatum (but one is decurrent 5 mm) inflor. and 1.8 m E of 1 C. ochrocentrum inflor. & 3 m E of 3 C. ochrocentrum inflor.; Red Rocks, Jefferson Co. Colo., Aug. 13, 1992. 128 2nd-3rd-stage larvae found: patch #9, 9 larvae on 1 C. ochrocentrum seedling; patch #10, 6 larvae on 1 C. ochrocentrum seedling; patch #11, 11, 1, 2 larvae on 3 C. ochrocentrum seedlings spread over 60 cm; patch #12, 61 larvae on several C. ochrocentrum seedlings; patch #13, 1, 2, 1 larvae on 3 C. ochrocentrum seedlings; patch #14, 1, 12, 4 larvae on 3 C. ochrocentrum seedlings spread over 70 cm (4 C. ochrocentrum inflor. were 50-100 cm E of larvae, 2 m upslope from ~10 mostly C. undulatum inflor.); patch #15, 1, 2 larvae on 2 C. ochrocentrum seedlings; patch #16, 1, 6, 1 larvae on 3 C. prob. ochrocentrum (nearest inflor. C. ochrocentrum 10 m upslope) seedlings spread over 5.5 m (perhaps 2 ovips.); patch #17, 6 larvae on 1 C. prob. ochrocentrum (nearest inflor. C. ochrocentrum 10 m upslope); Red Rocks, Jefferson Co. Colo., Aug. 14, 1992. 45 2nd-3rd-stage larvae found: patch #18, 1, 2, 4 larvae on 3 C. prob. ochrocentrum (5-10 m W were C. ochrocentrum inflor., ~12 m E were C. undulatum & C. ochrocentrum inflor.) seedlings spread over 2 m; patch #19, 16 larvae on 1 C.

prob. undulatum (C. undulatum ~20 inflor. 1-4 m S & SE and downslope, C. ochrocentrum 2 inflor. 1 m SW and downslope) seedling; patch #20, 2, 2, 3, 1, 1 larvae on 5 C. ochrocentrum seedlings spread over 1 m; patch #21, 13 larvae on 1 C. ochrocentrum seedling; Red Rocks, Jefferson Co. Colo., Aug. 17, 1992. At Red Rocks, the hostplant seedlings were identified by inflorescences of nearby mature flowering plants (these Cirsium are biennial and generally grow in patches consisting of a few mature flowering plants and half a dozen or more seedlings that will flower the next year); C. ochrocentrum and C. undulatum are virtually identical and both have violet flowers and gray-green leaves, but on C. ochrocentrum the spiny leaf edge continues via a spiny ridge along the leaf petiole and onto the main stalk (decurent) whereas on C. undulatum the ridge does not run onto the stalk. The taxonomic problem is that the length of the decurrent ridge varies from less than 1 cm to up to 4 cm in individual C. "ochrocentrum", which makes one suspect that there is just one species varying from 0-4 cm and the 0 cm individuals are arbitrarily labeled undulatum and the others ochrocentrum (also, C. canescens is virtually identical, except it has long-decurent leaf bases and cream flowers; perhaps "ochrocentrum" merely represents hybrids or introgressed individuals of canescens X undulatum). Incompetence in systematics is as rampant in botany as in butterflies (probably more so, because plants are inherently more variable morphologically). However, I will list both as hostplants now, C. ochrocentrum as the usual host (because the two species were about equally common yet most larvae were on ochrocentrum), and C. undulatum as an occasional host based on patches 6 & 7. **HOSTPLANT SUMMARY.** C. ochrocentrum is the main host in the Front Range, where C. undulatum is an occasional host. Larvae occur on C. ochrocentrum/undulatum seedlings (very rarely on a leaf of a mature plant) with leaves 7-30 cm (usually 15-30) long, whereas P. p. barnesi larvae occurred on older flowering C. neomexicanum. At Red Rocks, larvae occurred mostly on S- and SE-facing upper slopes and the upper end of gulches, 1 on W-facing slope; the hosts grow on flats and on all slopes except N-facing.

**EARLY STAGES. LARVAL FEEDING.** Larvae mostly rest on upperside of leaves, and eat the leaf surface, leaving craters on the leaf (usually on upperside) that do not go through to the other side. When touched, the larvae usually roll into a ball and fall off the leaf into the litter. **DIAPAUSE STAGE.** Dead larvae had head widths 1.3, 1.3, 1.4 mm, the width of 4th stage, which must be the hibernation stage (mature larva width 2.3, 2.6). **EGG** yellowish-cream, in clusters of ~30-114 laid on leaf underside. **1ST-STAGE LARVA** ochre-tan, the seta base cones light-brown, setae black, suranal plate & collar brown; head black. **HALF-GROWN LARVA** black with tiny cream dots, a middorsal blackish-brown band contains BD1 scoli, BD1 scoli is blackish-brown with brown bottom and has orange beside ventral base or this orange may surround scoli except anteriorly, a broad cream band contains BD2 scoli on lower edge and has a blackish spot just dorsoposterior to BD2 and a blackish spot on front of segment anterodorsal to BD2 (these blackish spots may coalesce into a large black area crossing intersegmental junction), BD2 scoli is blackish-brown and has orange completely surrounding base (this orange patch nearly or widely touches the orange patch below BD1 scoli)(BD2 scoli on A9 light-brown, narrowly orange around base), next a broad blackish-brown band contains some tiny cream spots and BSD scoli, BSD scoli blackish-brown (or bottom light-orangish-brown or brownish-orange, which makes the wide blackish-brown band very irregular), a conspicuous cream band just above spiracles, a sinuous slightly-interrupted brown band runs between spiracles, a conspicuous cream lateral band contains ochre-tan BL1 scoli (with orange surrounding scoli base except sometimes dorsally), a blackish dash runs posteriorly from each BL1 scoli then runs upward to connect with brown spiracular band, underside brown with a few tiny cream dots, BL3 scoli tan, legs & prolegs blackish-brown, proleg shields orange-brown, suranal plate dark, collar black; head brownish-black with a cream anteroposterior-oriented dash on top of each side (on vertex), and many heads have a cream crescent above eyes.

**OLDER-MATURE LARVA** banded with black and cream (or ochre-cream) with black scoli, but overall appearance varies between larvae because the ground color varies from mostly white in some larvae to ochre-cream in the orangest larvae (1973 larvae were mostly ochre in ground color [Scott 1975], whereas 1992 larvae were mostly cream) and the orange (around bases of BD2 and BL1 scoli and below BD1 & BSD scoli) varies in extent, so that some larvae appear mostly white and some appear mostly orange, and the black bands (esp. the middorsal band and the band containing spiracles) also vary somewhat in darkness so some larvae are a little blacker than others; in details, body has a middorsal blackish-brown line containing BD1

scoli (BD1 scolus has orange or brown beside ventral base), next a wide cream or ochre-cream area contains BD2 scoli on its lower side (darkest larvae have this area consisting of a narrow gray band then a blackish band then a cream band), BD2 scolus surrounded by orange or brownish-orange (a narrow ring of brownish-orange in some larvae that is not connected to BD1 scolus, a wide splotch of orange in other larvae that is broadly connected to the orangish that touches BD1 scolus), each BD2 scolus has a small black spot touching front of orangish ring and another black spot touching back of orangish ring (in some larvae the region between successive BD2 scoli is mostly cream, whereas on other larvae some more black spots occur in the intersegmental area, and in still other larvae the black spots are connected to form a black subdorsal band running between the orange BD2 patches), all larvae have a cream subdorsal band touching bottom of BD2 scoli (which--in paler larvae--is fused with the above cream area), next a wide grayish-black dorsolateral band (containing tiny cream dots) runs from below the cream band to the lower edge of BSD scoli, a weak narrow orangish crescent or streak is just ventral to the base of each BSD scolus (usually brownish-orange, rarely narrowly orange, often absent), a cream band runs just above black spiracles, a grayish-black band contains the black spiracles and some tiny cream spots (this band varies somewhat between larvae, from sharp-edged black on some larvae to brown with diffuse edges on orange larvae), and on abdomen a blackish crescent extends down from this grayish-black band and forward to the rear of the orange ring around each BL1 scolus, a cream band encloses front and bottom of BL1 scoli (except behind scoli on abdomen as just noted), around BL1 scolus base is a ring of brownish-orange (or a bigger orange splotch on some larvae), underside dark-gray or gray-brown with tiny cream spots around the bases of the few setae; T1 has a different pattern with cream ground color and black hairy collar, a blackish patch at bottom of collar, T1 BL1 scolus resembles other BL1 scoli and has orange around base, underside dark-gray, neck dark-gray; all scoli brownish-black, except BL1 and BL3 scoli are ochre-tan on palest larvae (BL1 may be slightly-orangish on base) and black on darkest larvae and ochre-tan (some BL3 dark-gray) with black tip on others; as usual for *Phyciodes*, one BD1 scolus is on A1-7 and two are on A8, one BD2 scolus is on T2-A8, one BSD scolus is on T2-A10, one BL1 scolus is present on T1-2 & A1-8 but absent on T3, two BL3 scoli are on A3-6 but only one on T1-A2 & A7-8 (BL3 scoli are small on A1-2 & weak on A7-8); proleg shields chitin-black, suranal plate dark-brown (with large ochre spots at seta bases) on narrowed anterior part and light-brown (with tiny dark dot forming each seta base) on wide posterior part, legs chitin-black, ventral neck gland present, collar black (a tan anterior subdorsal spot on one collar); head black, with a cream vertex band (anterior end has a small satellite spot on some heads) and always a cream crescent or cream dot above eyes, the usual cream coronal cleavage line and cream membrane above labrum. Older larvae are distinguished from all other *Phyciodes* by having BD2 completely surrounded by orange (in other species the orange is only anterior and posterior to BD2 and only within the subdorsal cream band).

**PUPA** mottled light-orangish-brown (microscopically, cream with fine brown streaks & lines), with little variation between individuals (some are slightly creamier-brown, some are light-brown with heavier fine brown dorsal lines), A1-4 top is reddish-brown on some pupae; wing streaks weak (strongest near end of discal cell), anterior & dorsal sides of wing base ridges brown, anal margin has brown streak, wings have usual postmedian & marginal cream dot-bumps, spiracles dark-brown, abdomen has rows of small brown spots (near middorsal axis is often a brown spot and behind it an oblique streak, a weak supraspiracular row [one anterior one posterior on each segment], sometimes a tiny dot anteroventrad of each A4-7 spiracle and a brown dash in the same place on A8, a row of lateroventral tiny dots on A4-7 (2 per segment except only the posterior spot on A4), a supraventral row, and midventral row), young pupae have weak paler subdorsal and lateral abdomen bands (remnants of larval cream bands), a lateral creamy area on T1, a creamier area between antenna bases, the usual cream V (with brownish middorsal line through it) on top of T2, antenna shaft has pale dot-bumps, antennae legs proboscis darker brown, proboscis tip dark-brown, spiracles brown, shape like other *Phyciodes*, with the usual transverse crests (brown on front slope, cream on rear) over T2 & A4-7 (sometimes weak A2-3), the usual cones are browner on front & paler on rear (present middorsal T2-A7, subdorsal T2-A7 [weak A1], supraspiracular A4), a point is on ventral anterolateral corner of head (a transverse ridge connects these two points on ventral front of head) and a ridge extends backward from it on top edge of head, the usual brown U-shaped mark around front of

head (except dorsally) is edged behind by cream (on side and bottom edges of head), cremaster shouldered, rugose.

## 2B. PHYCIODES PALLIDA BARNESI SKIN. 1897

(Figs. 34, 42, 71-74, Tables 8-12)

**DIAGNOSIS.** Only weakly distinguished from ssp. pallida by wing pattern (figs. 71-74), the upf and uph postmedian areas are more uniformly orange with fewer black marks on half or more of adults of both sexes, the upf base is slightly paler on many adults, some adults are larger, and the fw is perhaps a bit more pointed on some. These weak differences make it a synonym of pallida. However the larvae are much blacker with light areas somewhat orange, and the female ostial cone is a little more scooplike (less conelike, the peaks less prominent), suggesting it is a ssp. Thus I list it as a valid ssp. pending greater geographic sampling of larvae (Dornfeld 1980 also describes the larva as dark, so barnesi larvae are probably darker in most or all of the range). **RELATIONSHIP WITH P. ORSEIS.** The valva is fairly narrow on some males, the male genitalia size is fairly large, the juxta is narrower distally, the ostial cone is more scooplike, and the junction between lamella postostialis and lamella paraostialis is often clear, all traits that trend toward orseis, indicating (with similarities in size and host and single generation and behavior, and slight similarities in larvae) that barnesi is the closest taxon to P. orseis. However, the gnathos hooks are much smaller and the saccus and valva and lamella paraostialis shape differ greatly, so they cannot be ssp.

**HOSTPLANT RECORDS.** 16 larvae (14 ~3rd stage, two ~4th) found on leaf tops of 3 Cirsium neomexicanum plants (1 pupated July 30 but was punctured by leaf spine & died, 1 male pupated Aug. 4 emerged Aug. 15); near Gateway, Mesa Co. Colo., July 29, 1993. Adults associated with Cirsium neomexicanum (the only Cirsium present except for a few C. vulgare and some C. incanum); W Hidden Basin Cgd., Bighorn Co. Wyo., Aug. 17, 1993. C. neomexicanum seems to be the main host in W Colo.-N Wyo. In Utah, Clyde F. Gillette reared one larva found on Cirsium arizonicum (written commun. 1994). In Wash the host is "thistle" (Cirsium, D. McCorkle & D. Carney, 1963 Lepid. News #4 p. 4). Lab larvae eat Cirsium incanum (my larvae) and C. arvense (D. McCorkle, in Christensen 1981). Larvae eat many craters on tops of leaves; they occur on N-facing slopes at least.

**EARLY STAGES.** Older larvae have the same species-identification trait as ssp. pallida, namely orange extending completely around BD2 scolus (often joining the orange at lower base of BD1 scolus)(instead of orange just anterior and posterior to BD2 scolus in tharos-group). Half-grown to mature barnesi larvae are much darker than ssp. pallida (the area beside middorsal black band is mostly black, the lateral and spiracular cream bands are darker). **DIAPAUSE STAGE.** ~4th-stage larvae diapaused and only reluctantly grew beyond that stage. **HALF-GROWN LARVA** variable, some are mostly black (area between BD1 & BD2 scoli mostly black, a wide blackish-brown band encloses spiracles, etc.), many larvae mostly orange (due to enlarged orange areas and brown--not black--scoli), none are mostly cream; similar to mature larva but the orangish patches are orange-tan or brownish-orange and the dark body areas are brown, the creamy band along BL1 scoli is much wider than mature larva; pattern is similar to mature larva, a middorsal black band, orangish below BD1 scolus, a wide orangish-cream band includes BD2 scoli, a small or large brown patch near rear of segment below middorsal black band, BD2 scoli have orange (yellow-orange in some) all around (and joined to orange below BD1 scoli) except darkest larvae have the orange only posterior & anterior & anterodorsal to BD2 scolus, a wide dark-brown band includes BSD scolus, orangish just below BSD scolus, an orangish-cream band includes spiracles, a light-brown band or area, an orangish-cream lateral band includes BL1 scoli, BL1 scoli surrounded by orangish ring, underside light-brown, scoli above spiracles usually brown (black on darkest larvae), BL1 scoli ochre-tan, BL3 scoli light-brown or ochre-tan, suranal plate mostly blackish, or tan with a brown spot in anterior end and posterior wide end blackish; head black with short cream vertex band on top of head, usually a short cream crescent above eyes, and ~2/3 of larvae have a pale light-brown spot on lower part of frontoclypeus.

**OLDER-MATURE LARVA** has banding pattern like ssp. pallida from Red Rocks but larva much darker (also, Dornfeld 1980 states "As in mylitta, the mature larvae are dull black, but

mottled with orange rather than lined with yellow."; the source of this description is unstated but presumably is ssp. barnesi from Oregon reared by David McCorkle [Christensen 1981 states that David McCorkle has reared larvae on Cirsium arvense], in which case it is probable that barnesi is dark throughout its range). In details, the area between middorsal black line and subdorsal cream band always black (except orange between BD1 and BD2 scoli); body black-brown with tiny dirty-cream dots, a middorsal black band encloses BD1 scoli, the orange below these scoli usually (sometimes brown just below BD1) extends widely all the way to and around BD2 scoli, remainder of area between middorsal black band and cream subdorsal band is black, the subdorsal cream band enclosing BD2 scoli is nearly complete but is often very interrupted (1/3 black, around intersegmental boundary), a wide black-brown band includes BSD scoli, BSD scoli have lower edge narrowly-orange-tan (or orange, or absent; orangish area usually weak) or all black, a weaker or stronger interrupted creamy line is just above spiracles, then a brown or black wide band encloses black spiracles and has more cream dots than usual (rarely a small orange-tan or orange spot behind spiracle), a cream lateral band touches ventral edge of BL1 scoli, BL1 scoli surrounded by an orange-tan (or orange, or absent) ring, underside brown with tiny dirty-cream dots, all scoli brownish-black (BL1 scoli on A8 may have brown base), suranal plate brown on narrow anterior end & ochre on wide posterior end, proleg plates black, ventral neck gland present, collar black, sometimes a vertical cream subdorsal dash just behind collar; head black with cream vertex dash on top, and ~70% of heads have a cream crescent above dorsoposterior eyes.

**PUPA** pattern essentially identical to P. tharos-group, the only real difference being the wider cones; overall color finely-mottled light-brown (a few pupae somewhat darker brown on wings) with weak wing streaks; wing has brown on anterior & dorsal sides of wing base ridges, anal margin of wing has brown area, several weak brown wing streaks (a brown streak extends from near end of discal cell to tornus, and a slightly-browner streak from discal cell to margin ~R<sub>5</sub>-M<sub>3</sub>), wings have usual brown lines parallel to veins and usual postmedian & marginal cream dot-bumps; the usual U-shaped brown rim around front of head (laterally and ventrally) is edged behind (on side and bottom of head) by cream, a cream spot on side of T1, a creamier spot between antenna bases, abdomen has several rows of small brown spots (supraspiracular [1 anterior 1 posterior spot per segment], lateroventral, supraventral, midventral), young pupae have slightly-browner band above spiracles and slightly creamier subdorsal & lateral bands (remnants of cream larval bands), cones as large as P. tharos but wider so less pointed (cones present middorsal A2-7 [largest A4], subdorsal T2-A7 [small T3, very small or absent A1, largest T2 & A4], subspiracular A4), cones have anterior side browner & rear side creamier (cones orangish on some pupae), the usual transverse crests (T2 [subdorsally only], A4-7, weaker A5-7) are browner on front and creamier on rear, top of T2 has usual anteriorly-directed creamy V (with brown middorsal line through it), the middorsal ecdysial cleavage line on T1-A1 is brownish as usual, each leg has usual brown & tan marks (black dash then 2 cream dashes, or black dash then cream dash, but one middle leg has only one black dash), tip of proboscis darker-brown, antenna has usual checkering, spiracles brown (present A2-7, vestigial A8), cremaster very shouldered, wider than pallida/orseis/mylitta, rugose.

### 3A. PHYCIODES ORSEIS ORSEIS EDW. 1871

(Figs. 36, 38, 43, 75-78, Tables 8-12)

**DIAGNOSIS.** Adults mottled on unh like P. mylitta but larger and darker, forewings more pointed, the submedian & median & submarginal ups bands are paler (ochre) than postmedian orange band (a unique trait among mylitta-group except for some P. o. herlani and some females of other taxa), males usually perch rather than patrol to contact females, only one generation; valva narrow (unshouldered distal to inner prong, vs. wide-shouldered in mylitta), juxta wider, saccus arms pointed and set farther apart, overall size of male genitalia 50% larger; lamella paraostialis very short and separated from lamella postostialis by a clear membrane, ostial cone more scooplike with the peaks lower; larvae seem most similar to half-grown mylitta/pallida. Adults darker than ssp. herlani, older larva not as dark. **IDENTIFICATION.** Sympatric only with P. mylitta and P. pulchella, the paler median ups bands and larger size immediately separate it from mylitta. From pulchella, it is distinguished by the orange antenna club nudum (esp. on

males) and extended forewing tip and mottled unh and black streak on unf tornus (the black is similarly-shaped in cells CuA<sub>1</sub> and CuA<sub>2</sub> in *orseis*, usually a black crescent in cell CuA<sub>1</sub> versus a black line in cell CuA<sub>2</sub> in *pulchella*). **TAXONOMIC STATUS.** *P. orseis* is obviously a distinct species, distinguished by numerous traits of wing pattern, behavior, and morphology. *P. orseis* is allopatric with *P. pallida*, so they could be conspecific, but they differ in older larval color, valva and saccus shape, and lamella paraostialis shape.

**RANGE.** The TL is "Mt. St. Helena", but the species currently does not range south of the Trinity Alps far to the north. Either the species has become extinct in San Francisco, Marin, Napa, & Sonoma Cos., or some or all of these records are mislabeled. Extinction is possible, because California has suffered other extinctions (*Speyeria adiate atossa*) that can be blamed on habitat change due to introduced Mediterranean grasses, fire suppression, development, etc.

**HOSTPLANTS.** Adults assoc. *Cirsium cymosum* in Trinity Co. Calif. (John Emmel pers. comm.), which is the host there (Kenneth Hansen pers. comm.). *C. breweri*, "present in the habitat" in Trinity Co. (A. Shapiro J. Res. Lepid. 18:100), is not a valid host record. Larvae from Siskiyou Co. Calif. (sent by Kenneth Hansen) ate tender flesh on top of bract bases (the part eaten by humans) of grocery-store artichoke *Cynara scolymus* in lab, and ate *C. incanum* & *C. ochrocentrum* leaves, though in nature the hostplant is *Cirsium* growing on slopes

**EARLY STAGES. DIAPAUSE STAGE.** 4th-stage larvae hibernate, based on head-capsule widths of lab larvae that died or diapaused for a month then grew (1.3, 1.5, 1.5, 1.6, 1.6, 1.6, 1.5, 1.4, 1.4 mm; several with 1.7 & 1.8 mm head width presumably were 5th-stage past diapause; mature larval width 2.3-2.6); diapause is difficult to break in the lab even with constant light. **EGG** (cluster of ~64 eggs sent by Kenneth Hansen) pale-green, later pale-greenish-yellow or pale-yellow; duration 10-11 days. **SILK WEB.** No web was seen in lab. **1ST-STAGE LARVA** ochre-yellow, after feeding dull-yellowish-cream with green innards except on rear, when full-grown cream, the subdorsal valley between bulges is darker, seta bases & setae brown, collar & suranal plate blackish; head black; duration 4-5 days. **2ND-STAGE LARVA** greenish-yellow-cream, becoming slightly-greenish-cream incl. scoli, heart-band light-orange-brown, a weaker row of orange-brown dashes runs between upper part of BD2 scoli, a wide orange-brown subdorsal band encloses BL3 scoli on lower side, a brown line below BL1 scoli, collar brown, suranal plate brown; head black; duration 5-6 days. **3RD-STAGE LARVA** when young greenish-gray-cream, heart-band brown, a greenish-gray-cream band, a light-brown band at level of upper edge of BD2, a little greenish-gray-cream, a wide brown subdorsal band from bottom of BD2 that includes BSD scoli, greenish-gray-cream, a light-brown line below BL1 scoli, scoli dark-brown except BL3 scoli have tan tips and BL1 & BL3 scoli tanish-cream; body later darker, a brown heart-band, a tan band (ochre at base of BD1 scoli), a wide brown area, a cream band at lower edge of BSD scoli, a brown band includes upper part of BL1 scoli, a cream band along lower edge of BL1, underside brown, BD1 scoli dark-brown-black with translucent tan base, BD2-BSD scoli dark-brown-black with tan base, BL1 scoli tan with orange-tan ring around base, BL3 scoli tan; legs dark-brown, prolegs greenish-gray-cream, suranal plate dark-brown, later blackish; collar blackish; head black with light-brown stripe on vertex. **4TH-STAGE LARVA** blackish like mature larva but with fewer orange areas, heart-band black, a gray line (orange-gray below BD1), a very wide black band, a narrow cream-gray band (widest anteriorly on each segment), a wide brown band containing black spiracle on its upper part, a narrow dull-cream band between BL1 scoli, upper scoli black, BL1 scoli ochre-tan with dull-orange ring around base, BL3 scoli tan, uns brown, suranal plate & collar blackish; head black with short gray vertex stripe.

**MATURE LARVA** black with tiny cream dots (overall appearance dark-brown), a middorsal black heart-line edged by a gray or creamy (orange below each BD1 scoli base on T3-A9) band (narrow thus faint on T1-2)(this band is replaced by black on some larvae except for anterior part of each seg.), an orange (with cream in front) dash in front of BD2 subdorsal abdomen scoli (a remnant of the subdorsal cream band that is prominent on *P. tharos*-group larvae), these subdorsal scoli have narrow orange-brown bases, a wide blackish dorsolateral band encloses BD2 and BSD scoli (some cream dots are in this band esp. in middle), a cream (sometimes blacker) line runs just above spiracles (this line is orange [because of tiny orange spots] at ventral base of supraspiracular BSD scoli), a wide brown area with many cream dots includes spiracles on upper edge and most of BL1 scoli, an orange ring surrounds each BL1 scoli base, a cream (less white than on *P. tharos*) lateral line touches ventral base of BL1 scoli, underside dark-brown; BD1-2 &

BSD scoli black, BL1 scoli ochre-tan with black tip (and orange ring around base) or sometimes brown with black distal 2/3, BL3 scoli ochre-tan or sometimes brown with black tip, legs black, proleg plates brown (black anteroventrally), suranal plate completely black or black with narrow posterior ochre rim, collar mostly black, but 3 small anterior peaks and one small posterior subdorsal point are tan or creamy; head usually all black, but many heads have a gray or tan or brown vertex stripe on top of head (often with a tan or brown satellite dot just anterior to it), some heads have a tan or brown small crescent or tiny spot above eyes (and some heads have a tiny brown spot on upper end of frontoclypeus and a dark-brown patch on side of frontoclypeus and a small brown spot on gena near labrum). Species traits of older larva (differences from *P. pallida*): subdorsal cream band nearly absent, no orange above BD2 scoli (much orange below BD1 scoli, an identification trait of ssp. *orseis*). Duration of all larval stages ~31-32 days in lab.

**PUPA** finely mottled with tiny brownish striations & marks esp. on upperside (underside slightly-darker-brown), varying somewhat between families, one family light-orangish-brown with some pupae dark-brown, some creamy-brown, a second family light-brown with fine blackish mottling, and one pupa heavily mottled with black and wing mottling very extensive and black; pattern details like *tharos*, the usual abdominal bands of small brown spots (a dorsolateral row of small brown spots [one anterior one posterior per segment], a small brown spot dorsoposterior to spiracle, a small brown spot anteroventral to spiracle, a lateroventral line of narrow blackish-brown dashes [several per segment] on A4-7, a row of short blackish-brown supraventral spots, a row of midventral blackish-brown dashes), young pupae have the usual weak subdorsal & subspiracular creamier-brown bands (remnants of cream bands of larvae), anterior & dorsal sides of wing base ridges brown, brown along anal margin of wing, the usual brown wing streaks (a brown streak from discal cell to end of cell to tornus [slightly interrupted near tornus], a brown subapical patch near apex or entire apex sometimes brown) on one family are weak on most pupae but are sometimes moderate and rarely strong, on another family are moderate to strong, wing has ~8 tiny creamy marginal and ~5-8 tiny postmedian creamy dots, front of head has the usual brown U-shaped mark around bottom and sides of front edge (edged posteriorly [on side and bottom edges of head] by cream), a creamy patch between antenna bases, a creamy patch on side of T1, a middorsal V-shaped creamy point on top of T2 (with a weak brown middorsal ecdysial line through it), proboscis tip darker, each antenna segment has a brown spot with cream dash posterior to it, middle of each leg has the usual mark (brown then cream), spiracles brown; the usual transverse crests on T2 & A4-7 (the largest on A4 starts above tornus and runs dorsally over abdomen, similarly-colored weaker crests are on A5-7 and subdorsally on T2) are brown on front slope (but blackish-brown on the blackish pupa) and creamy (tan on darkest pupae) on rear slope; the usual rows of small cones on T2-3-abdomen like *herlani* (middorsal A1-7 [biggest A4, weak A1], subdorsal T2-A7 [tiny or small A1], supraspiracular A4 and often rudimentary A3 & A5-6) represent rudiments of larval scoli and are brown anteriorly and orangish-tan on rear; cremaster shouldered, very rugose; female pupal duration 9 days in lab. Larva-pupa duration 39 days males 41 females in lab (emergence lag 1.6 days).

### 3B. *PHYCIODES ORSEIS HERLANI* BAUER 1975

(Figs. 44-45, 79-81, Tables 8-12)

**DIAGNOSIS.** Differs from *orseis* in oranger wing color, evidently due to Batesian mimicry of *Euphydryas chalcedona sierra*, thus the submedian & median & submarginal bands are mostly orangish (seldom paler as they are in ssp. *orseis*); the unh has lost the brown patches of ssp. *orseis*, and the only remaining unh brown patch is the brown patch on the margin which is present or weak or absent. Older larvae are darker than *orseis*. Other traits (including genitalia) are identical to *orseis*, and its appearance in flight is very similar (amazingly so considering the difference in color). Perching behavior is identical (males perch in gulch bottoms or valley bottoms beside the creek all day to await females), except Siskiyou Mts. *orseis* males usually perch on shrubs while *herlani* males often perch on or near the ground. **IDENTIFICATION.** Similar to *P. pulchella montana* but antenna club nudum orange (esp. males), unh uniform yellowish with fine russet lines and weak marginal brownish patch (not orangish with stronger

marginal patch like pulchella, not mottled like mylitta), and the black unf tornus streak is more linear. **TAXONOMIC STATUS.** Higgins (1981) listed herlani as a distinct species, but he possessed little information to judge its status. David Bauer once told me that orseis and herlani intergrade in the Mt. Shasta area, although adults just W of Mt. Shasta seem to be typical orseis orseis, and the only kind of intergradation I have seen is that ssp. orseis varies somewhat in ups color and some are as orange as the darkest herlani; wing color could intergrade more where Shasta-Lassen-Plumas Cos. meet, but I have not seen specimens from that area. The darker older larval color of herlani is not necessarily a species-level trait because older larvae of P. pallida barnesi are also darker than P. pallida pallida. Among related species, ssp. herlani is most similar to mylitta in the blackish older larva, most similar to pallida in orangish adult color and size and wing pattern and single generation and host specificity and male perching behavior. It might be considered a ssp. of the allopatric P. pallida, because the P. pallida barnesi larva is also moderately dark (Scott 1975 stated that herlani is not closely related to P. pallida with its pale larva, but he was unaware of the darker barnesi larva); hybridization studies between orseis and P. pallida barnesi could help elucidate their relationship. However, herlani (& orseis) lacks the extensive orange all around the BD2 scoli of P. pallida, and several genitalic traits of herlani (valva width, saccus shape and width, lamella paraostialis shape) are like orseis and differ from P. pallida, so herlani is obviously a ssp. of orseis and a distinct species from P. pallida.

**HOSTPLANTS.** Prediapause larval colonies were found on Cirsium andersonii near Lake Tahoe (J. Emmel, 1989 Lepid. News #2 p. 17). A female from Glenbrook, El Dorado Co. Calif., June 16, 1972, laid an egg cluster in lab on Cirsium vulgare and the larvae were reared on Cirsium arvense or incanum (not vulgare). **EARLY STAGES.** Scott (1973) reported the life history, & Scott (1986b) compared larva with ssp. orseis. Identification traits of P. orseis larvae are subdorsal cream band nearly absent, and no orange above BD2 scoli (& little or no orange below BD1 scoli in mature larva but not half-grown larva); mature herlani larvae differ from ssp. orseis by having line edging heart-line and wide lateral band both ochre-brown on herlani, orange on orseis. **EGG** yellowish-cream, with ~22 vertical ribs on upper sides. **1ST-STAGE LARVA** cream, the usual dark setae arranged like tharos-group (on Fig. 1 of Scott 1973, seta SD2 should be drawn behind SD1, and some smaller setae were missed), suranal plate weakly sclerotized (with a small dark spot), collar less sclerotized; head blackish-brown. **2ND-STAGE LARVA** similar, but scoli present. **HALF-GROWN LARVA** has black middorsal band enclosing BD1 scoli, orangish ventrally beside BD1 scoli, a creamy band beside middorsal black band, then a very wide maroon-black band (containing some tiny cream spots) encloses BD2 and BSD scoli, a pale spot occurs just in front of BD2 scoli (perhaps a slight touch of orangish anteriorly beside BD2 scoli? and ventrally below BSD scoli? that could not be seen on pickled larvae), a creamy band just above spiracles, a broad band enclosing spiracles and BL1 scoli is pale but has dingy-light-maroon areas (whitish circular areas surround spiracles), a somewhat-orangish ring around BL1 scoli, a cream band runs along lower edge of BL1 scoli, then a dark-dingy-maroon band below that cream band, underside light-dingy-maroon, scoli above spiracles blackish, BL1 & BL3 scoli ochre or ochre-tan (BL1 sometimes have brown or black tip), collar black with 4 or 5 ochre patches (3 anterior, others posterior, one beneath each primary seta site), and a black sclerite above spiracle, suranal plate mostly black but anterolateral corners ochre and rear ochre (black patch narrowest middorsally where the blackish nearly reaches posterior margin), proleg plates tan with black ventral margins; head black with short cream vertex dash (which sometimes has a small satellite spot at anterior end that is nearly connected).

**5TH-STAGE-MATURE LARVA** same as half-grown larva but darker (maroon-black widespread over dorsal half of body) and the orangish marks are not noticeable; the pale bands beside BD1 scoli and above spiracles and along lower edge of BL1 scoli are ochre-brown; as usual a tiny cream dot surrounds each tiny seta; all scoli mostly black, scoli setae dark-brown or black, dorsal scoli have ~25 setae but ventral scoli only ~10, length of A10 scoli only ~2 times basal diameter; legs blackish, proleg plates black (or black except for dorsal quarter ochre) and rectangular, suranal plate sclerotized and blackish (with large round ochre patches below setae) on anterior narrowed part and ochre with tan seta-base dots on wide posterior part; collar black with 3 anterior (on 3 raised areas) and 1 posterior creamy transverse streaks on each side, plus cream middorsal cleavage line, ventral neck gland present; head black with cream vertex dash (some have a cream satellite dot anterior to dash that is farther away than on half-grown larvae),

a slightly-paler (brownish) small spot above eyes, some larvae have 3 paler (light-brown) dots on frontoclypeus (at top and lower on sides). Older larval differences from *P. pallida*: subdorsal cream band nearly absent, and no orange above BD2 scoli (& little or no orange below BD1 on mature but not half-grown larva).

**PUPA** finely mottled with brown & cream streaks & spots, overall color light-brown (a few pupae dark-brown) with weak wing streaks; wing has as many as 7 cream postmedian and as many as 8 cream marginal dot-bumps, anterior & dorsal side of wing base ridges brown, wing has a brown streak on inner margin dorsal to  $\sim 1A$ , distal half of wing has narrow brown striations parallel to veins, weak to moderate wing streaks include a brown patch crossing wing from near end of cell to tornus and a brown patch on costa near apex (surrounding postmedian cream dots)(or a brown streak runs weakly from end of discal cell to margin  $\sim R_5-M_3$ , and a brown area at tornus); abdomen has rows of small brown spots (supraspiracular [1 anterior 1 posterior spot per segment], lateroventral, supraventral, and midventral rows), a few small brown abdomen spots near base of hindwing; head has the usual brown U-shaped mark around front rim (except dorsally) which is edged posteriorly (on ventral and lateral edges of head) by cream, a creamier lateral patch on T1, anterior edge of each side of T1 brown, a creamier area between antenna bases, an anteriorly-directed creamy V on top of T2 (with brown line through it, as in *tharos*-group), T1-A1 has rough slightly-paler middorsal cleavage line, antenna shaft checkered (a brown spot followed by a cream dash on each segment), antenna clubs darker, a tan spot on each leg (hind leg may have 2 tan spots), proboscis tip darker; spiracles brown; the usual transverse ridges extend across dorsum (A4 ridge fairly strong, A5-7 & T2 ridges smaller) and are dark on front slope and cream on rear, the usual cones are present and as large as *P. tharos* but wider so are less pointed (one pupa has smaller cones)(middorsal cones A2-8 [A4 largest, A8 smallest & weak, A1 very weak], subdorsal T2-8 [A4 largest, weak T3 A1 A8], supraspiracular [weak A4, weaker A2-3]); A8 fused to A9, with a weak dorsal intersegmental groove; cremaster shouldered & very rugose, with the usual depressed ventral area behind crochets and usual 2 hills near anterior end of sustensor ridges, often a black spot occurs near crochets, the midventral sex mark just behind A8 is a small slit bordered by 2 hemispherical raised area in males versus a very-slightly-longer slit without raised areas in females, (in contrast, the sex mark on *P. tharos* is ambiguous).

## B. PHYCIODES THAROS SPECIES GROUP

(Tables 1-7)

Males of this group have only patrolling behavior to locate females. Genitalia and wingspan of *P. tharos* is very similar to that of *P. mylitta*, and pupal cones are also large, so *tharos* would seem to be most primitive species of this group.

### 4. PHYCIODES THAROS (DRURY) 1773

(Figs. 1, 18, 23, 26, 46, 82-100,  
101-109, 222, 225, Tables 1-7)

Adults are similar to *P. cocyta*, but are mostly smaller and usually have the uph orange middle of wing divided by dark median line (which may be interrupted in a cell in some males). The uph submarginal row of cream crescents averages fairly strong. The lateral larval scoli are usually paler than other species, the brown band above BD2 scoli is usually slightly paler, and the dorsal scoli have conspicuous pale tips like *cocyta*. Pupae have rather large cones, like *cocyta*, and a slightly narrower cremaster (the pupa is smaller).

#### 4.A. PHYCIODES THAROS RIOCOLORADO SCOTT 1992

(Figs. 1, 18, 23, 26, 46, 82-85, Tables 1-7)

**DIAGNOSIS.** This ssp. has blackish antenna clubs, whereas the clubs are orange on *E. Colo. tharos*, indicating that *riocolorado* derived from lower Colorado River (W Arizona/SE Calif.)

stock rather than western Great Plains stock which has orange antennae. The antenna nudum border and lattice are black; the steps are dark-brown or black in males, black on base of club and dark-orange on distal tenth to half of club in females (nudum rarely all black except for very dark-brown tip). When I named riocolorado I described its wings as oranger, but actually the orange seems to be about the same tint as ssp. tharos but the wings appear paler because the black markings are much smaller; even on unf the black spots are smaller. Other differences from tharos: the anterior margin of tegumen is slightly more V-shaped, the valva teeth are smaller, the saccus averages longer, the fold on ductus bursa averages narrower, the pupal crests average larger (the weak middorsal crest a bit smaller), cremaster more tapered and a little narrower and averaging less rugose. Many of these traits are weak, but riocolorado in general is a "super-tharos", at the far end of the cline of tharos-group taxa. **RANGE.** Occurs on the Colorado/Gunnison River Valley bottoms in Grand Co. Utah to Mesa, Delta, and Montrose Cos. Colo., and probably occurs in S Utah river valleys, but the nearest record of ssp. tharos is from Clark Co. Nev. (Stanford & Opler 1993). **HABITAT** weedy moist pastures/meadows/irrigation ditches in valley bottoms.

**HOSTPLANT.** Adults associated with Aster hesperius (Conyza coulteri & Centaurea repens common also as noted in 1988, but are almost certainly not hosts), Austin, Delta Co. Colo., July 30, 1993. **EARLY STAGES.** Female from S Olathe, Montrose Co. Colo., July 30, 1993, laid 38 eggs in lab ~July 31-Aug. 2, hatched Aug. 6, pupated Aug. 30 onward, adults emgd. Sept. 10-18. **EGG** pale slightly-greenish yellow, ~23-24 ribs; lab duration ~5-6 days. **1ST-STAGE LARVA** orangish-tan, top of body light-brown, but front 1/2 then all of body develops green innards due to food, collar dark-brown with paler seta bases (the tan spot under D2 seta enlarged anteriorly on 1 of 2 larvae), suranal plate brown with paler seta bases, proleg plates light-brown (A10 brown), legs dark-brown, setae dark-brown, spiracles brown, ventral neck gland present; setal lengths like other Phyciodes; head unmarked blackish (Phyciodes heads look paler in alcohol, dark-chitin-brown), only primary setae present, head width .25 mm. **2ND-STAGE LARVA** tan-cream, a middorsal brown line, a dorsolateral brown band includes BSD scoli, a sublateral brown line; head blackish with a very wide subdorsal cream band and a cream spot in middle of frontoclypeus, head width ~.4 mm. **3RD-STAGE LARVA** like older larva, collar blackish with large tan bumps at sites of primary setae of 1st stage (the posterior D2 patch twice as large), BD1-2 & BSD scoli dark-brown with light-brown tips, BL1-3 scoli tan, proleg plates light-brown (A10 brown), suranal plate brown with the central third of posterior rim tan, legs dark-brown; head with complete pattern of wide cream vertex stripe, wide cream eye stripe running from behind eyes to neck and extending narrowly over eyes and down to bottom of front of head where it widens then extends to bottom third of frontoclypeus, this stripe also extends ventrally below eyes to rear mandible base, top 2/3 of frontoclypeus cream, head width .65 mm. **4TH-STAGE LARVA** like older larva, collar like 3rd stage, BSD1-2 & BSD scoli dark-brown with tan tips, BL1-3 scoli ochre-cream, proleg plates light-brown (A10 brown), suranal plate brown with a small tan spot on middle of narrowed anterior end and a tan rectangle occupying the central third of posterior rim, spiracles dark-brown, legs dark-brown; head width 1.1 mm. **5TH-STAGE LARVA** head width 1.3-1.4 mm.

**OLDER-MATURE (6TH-STAGE) LARVA** brown with typical Phyciodes pattern, heart-band brownish-black (sometimes grayish-black) and includes BD1 scoli, a narrow light-brown (sometimes mottled gray or gray-brown) band due to many cream dots (this band contains brownish-orange or orangish-brown laterad of BD1 scoli [sometimes a small orangish-brown ring circles scoli]), a wider fairly-dark-brown (or gray-black or dark-brown) band includes a few cream dots (the dark area above BD2 is as dark as the wide subdorsal dark band in some larvae, but is paler in some other larvae), a cream band includes BD2 scoli (this band orange in front of and behind scoli), a wide brownish-black (or dark-grayish-black) band includes a few cream dots (these dots appear to be smaller than other Phyciodes) and includes BSD scoli on its lower edge, a narrow gray-cream (or gray) band above black spiracles due to many cream dots (this band includes a small orange or orange-brown patch at ventral base of BSD scoli, whereas the patch is usually brown in ssp. tharos), an orangish-brown band with some cream dots, a cream band includes BL1 scoli (an orange ring surrounds scoli [this ring is paler orange than tharos tharos and other taxa]), a dark-brown (or grayish-dark-brown) band, underside (including BL3 scoli) grayish-brown with some cream dots; BD1-2 and BSD scoli grayish-black (BSD scoli slightly darker) with tan or ochre tip, BL1 scoli slightly-orangish-tan or ochre-tan or tan with

cream tip (entirely cream on T1-2), BL3 slightly-orangish-tan or grayish-tan or sometimes brown (all have creamy tip), BL3 entirely cream on T1 and sometimes gray on T2; collar blackish with cream middorsal ecdysial line and 3 small or large cream anterior patches below major setae, connected to middle anterior patch is a large posterior cream area which often spreads laterally on posterior rim; proleg plates light-brown but brown anteroventrally (A10 plate brown on lower half); suranal plate tan with middle or anterior part brown with cream seta bases; legs blackish-brown; ventral neck gland present; head black with the membranous area above labrum always cream, a cream coronal ecdysial line on top of head, a wide cream vertex band on top of head (anteroventral end rarely constricted into a satellite spot [only on one side of one larva]), a wide cream eye band behind eyes extends to neck and narrowly curves over eyes then widely covers bottom front of head (and extends below eyes rearward on postgena to rear mandible base) and extends to frontoclypeus (this cream area touches lower third of frontoclypeus on a few larvae, touches entire frontoclypeus on a few larvae [almost touches vertex band on one]), runs almost to top of frontoclypeus on most larvae), top 2/3 of frontoclypeus cream (a slight--sometime moderate--brown smudge crosses frontoclypeus just below top), the cream areas on head average a little larger than ssp. tharos though further rearing may show some variation; mature larval head width 1.7-2.1 mm. Larval duration in lab ~26 days males, 27 females.

**PUPA.** Overall appearance light-orange-brown on most pupae, but ~20% are creamier esp. on wings & thorax so are mostly-creamy-orangish-light-brown, always with fairly-moderate brown wing streaks (a darker-brown patch near end of discal cell, darker-brown distally near veins ~M<sub>1-3</sub>, darker-brown distal streak ~CuA<sub>1-2</sub>, slightly browner on anal margin, and dark-brown on dorsal & anterior slopes of the cream wing base ridges); pattern details like apsaalooke, only the darkest pupae have 2 small brown spots on middle of wing (in base of cells M<sub>3</sub> & CuA<sub>1</sub>), new pupae have the usual subdorsal & lateral pale abdominal bands which then disappear, small supraspiracular brown spots occur A1-8 or A3-8 (one on front & one on rear of each segment), some large dark-brown lateroventral patches (much below spiracles) on A4-7-8, small dark-brown supraventral spots A5-7, small midventral dark-brown spots A5-7, a cream spot between antenna bases, a cream anteriorly-pointed V on top of T2 is edged anteriorly with browner, T1-2 has a weak middorsal creamier band divided by brownish cleavage line, no middorsal crest on A2-4 and no creamier band there, T1 has no well-marked lateral cream spot, spiracles dark-brown on A2-7 (vestigial slit A8); the usual transverse ridges on wing base & from wing base to T2 cone and on A4-7 (A4 ridge ~30-50% higher than batesii); cones bigger and more pointed than batesii and much bigger than pulchella, including middorsal cones A2-7 (A1 tiny or absent), subdorsal T2-3, A1 (A1 small or tiny, versus usually absent in batesii & pulchella), A2-7 (T2 & A4 cones largest), a supraspiracular cone on A4 ridge, anterior slope of cones & ridges either orange-brown or (on darker pupae) brown; cremaster usually narrow and tapered (slightly widened then tapered then abruptly narrowed to base of cremaster tip), only 1 of 27 was somewhat winged and not tapered, cremaster averages .83 mm (much narrower than batesii ssp., with only ~10-20% overlap of measurements), cremaster only somewhat rugose (much less than pulchella/batesii); pupal duration in lab ~11 days males, ~12 females. Total duration egg-adult in lab ~44 days.

#### 4B. PHYCIODES THAROS THAROS (DRURY) 1773 (BLACK-ANTENNA VARIETY) (Figs. 86-100, 105-106, 109, Tables 1-7)

**TAXONOMY.** The original description was--strangely--in two parts over a three-year period: Drury's vol. I (1770) included a number of specimens in a verbal description (pp. 43-44) in english and french, and illustrated a male ups (Drury's pl. 21 fig. 5; my fig. 91) and a male uns (pl. 21 fig. 6; my fig. 92)(Edwards 1874-1884 thought that Drury's uns figure was a female with spring-form brown unh spots, but fig. 6 appears more like a male to me), but did NOT mention any name in description or plates; Drury's (1773) vol. II included the index to vol. I as an addendum, wherein was the first mention of the name tharos (as "Tharos - Dan. Fest.", the Dan. Fest. being the "genus", though Drury's "genera" are mostly equivalent to today's families); thus the complete original description took three years (1770-1773) to complete. The problem with the name tharos is that the description and figures may have included several species. Fig. 5

male ups is very dark, and resembles San Francisco *P. pulchella* = *pratensis* or *Phyciodes batesii*; it is darker than any *tharos* I have seen; however it is a painting so a certain degree of artist's license is to be expected, so it could be a *tharos* painted too dark. Fig. 6 male uns looks like *tharos* or *batesii* (it is not *pratensis*, which has smaller costal unf black spots and a weaker unh brown patch and crescent); the unf has large black spots typical of *tharos* and *batesii*, while the posterior medial black unf patch is larger than most *tharos* and a bit smaller than most *batesii*, and the unh marginal brown patch and silver crescent is like most *tharos* but browner and whiter than most *batesii* males (although if fig. 6 is a female, the silver crescent would match those of females of both *tharos* and *batesii*, though the two brown patches in middle of unh would match spring form *tharos* but not *batesii*). Drury's description lists the antenna knobs as brown, which fits New York City *tharos* and *batesii* (and *pratensis*); it states that ups color varies ("in some, the dark brown occupying the greater part of the wings, in others, the orange colour is predominant"), which suggests that the type series may have been a mixed series of *tharos* and *batesii* (and perhaps *cocyta*); and it states that unh has a reddish-brown marginal patch which contains a silver spot like a half-moon in some specimens, which also fits *tharos* and some female *batesii*. Thus I could choose to apply the name *tharos* to either the current *tharos* or current *batesii* (fig. 5 is more like *batesii*, fig. 6 a little more like *tharos*), but to preserve stability (*tharos* and *batesii* have been stable for 221 and 129 years) I will apply the name to current *tharos*, and designate a neotype to settle the matter completely. Drury (p. 44) stated "I received it from New York", which F. M. Brown (letter Mar. 1, 1980) wrote means the immediate vicinity of what now is New York City, which was then rural. Brown stated that "specimens in AMNH from Van Cortlandt Park, West Farms, etc. would be the pure quill *tharos*". The type was sold and lost (note 99 in Miller & Brown 1981), and a neotype is needed to fix both the type locality and the concept of the name, because of past confusion with the similar species *P. cocyta*, and because the orange-antenna variety of *tharos* may eventually be considered as a separate ssp. (for which the name *marcia* is available), requiring knowledge of the antenna color of true *tharos*. A **neotype** male (fig. 90) is therefore designated from New York City (from AMNH, deposited in AMNH): it is typical summer form *tharos* with black antenna clubs (border and lattice black, steps brown esp. at tip of club), and has three labels: 1) a handwritten label "Van Cortlandt Pk. 7-10-32 NY"; 2) a printed label "Coll. by. Albert S. Pinkus"; 3) my hand-printed label "NEOTYPE [underlined in red] *Papilio tharos* Drury 1773, designated by James A. Scott Feb. 1994". The *tharos* type locality is the location of the neotype, VanCourtland Park, New York City. The antenna clubs are mostly blackish on the series I examined from New York City and vicinity (in males the borders and lattice black or occasionally brown, the steps brown but sometimes orange at tip of club; in females borders & lattice are usually brown, sometimes brown, occasionally dark-orange, the steps are usually orange on basal half of each step but are often all orange esp. at tip of club or are occasionally brown but orange at tip).

The only other old name whose identity is not yet fixed is *Papilio euclea* Bergstraesser 1780, type locality "England" ("Der Falter selbst ist in England zu hause" = This butterfly itself is in England to home; "diesen englischen Falter" = this english butterfly). The type is presumed lost (Higgins 1981), so the colored figure must represent the name *euclea*: on the original plate 79, *euclea* figs. 1-2 (my figs. 95-96) are reasonably-accurate paintings of *P. tharos*, with the postmedian black line on male upperside (fig. 1) dividing the orange median-postmedian uph patch (except for one cell) as is typical of *tharos*, and the male underside (fig. 2) showing several black unf spots, and some brown lines on most of unh indicating a spring form male (without the cream bands of extreme form *marcia*). The antenna club on both figures is outlined in black with a whitish center, which represents artist's license rather than the black or orange clubs on real *Phyciodes*. The figures do not sufficiently specify the identity of *euclea* to preclude all future argument, and the name *euclea* is important because the two older names may apply to other species (*tharos* could be applied to either the current *tharos* or *batesii*, and *cocyta* applies to *selenis*; I have selected neotypes for both *tharos* and *cocyta* in this paper), and *euclea* is older than *marcia* which is the oldest name available for the northern orange-antenna variety which some people will call a distinct subspecies, so I selected a *euclea* **neotype** (from AMNH, deposited in AMNH) specimen of *tharos* which resembles Bergstraesser's figs. 1-2 reasonably well (fig. 97), a small male (evidently spring form but unh is not the cream-banded *marcia* form) with black antenna club (border and lattice black, basal half of each step brown) and black postmedian line dividing most of orange uph median-postmedian area (line missing in part of cell

M<sub>1</sub> and all of cell M<sub>2</sub>). The neotype has two labels: 1) "No. 31 New York City and vicinity. Coll. S. L. Elliot."; 2) my hand-printed label "NEOTYPE [underlined in red] *Papilio euclea* Bergstraesser 1780, designated by James A. Scott February 1994".

**DIAGNOSIS.** The tables give distinguishing features of wing pattern, genitalia, and immatures. Very closely related to *P. cocyta*, but generally a little smaller (except the second generation of *cocyta* is often also small), with a sinuous black line generally dividing the orange median-postmedian uph (and upf) area; the pupal cremaster is a bit narrower and more tapered, few pupae (at least in Colo.-Neb.-Minn.) are strongly-creamy, the dome of lamella postostialis is more often elliptical, and the antenna club nudum is black in south (Calif. to SE U.S.), orange in north & W (vs. orange in *cocyta*). The antenna nudum in C Kans.-Mo.-S Minn.-N.Y. City-SE U.S.-Tex.-Ariz.-Calif. has black border and black lattice, while the steps are mostly brown in males and brown or orange (usually orange on distal third of club) in females.

**GEOGRAPHIC VARIATION.** Vawter & Brussard (1975) electrophoresed samples from Texas and Ala., plus probable *tharos* from near Ithaca N.Y., and found little difference between them, perhaps because *tharos* is often a weedy species which has benefitted from clearing of the deciduous forest by man and sometimes may have been artificially spread. Crosses with *P. cocyta* are mentioned under *P. cocyta*.

The name *distincta* Bauer (1975) (figs. 86-89), type loc. Calexico, Imperial Valley Calif., is a synonym of *tharos* based on the series of adults I examined. The unf black spots appear to be a little smaller than typical *tharos*, and one female (fig. 89) has somewhat less black ups markings than typical *tharos*, and one female has the tip of lamella paraostialis a little more rounded than *tharos* and more like *riocolorado*, but *distincta* is closer to *tharos* than to *riocolorado* in wing pattern and genitalia, so I treat *distincta* as a synonym of *tharos*; at best it is a weak ssp. for splitters.

**HABITAT.** Every habitat is occupied except dense forest, including roadside ditches, railroad lines, weedy lots, fields, clearings in forest, pastures, meadows, etc. **HOSTPLANTS.** *Aster praealtus* in Tex. (R. Kendall, J. Lepid. Soc. 18:142), *A. texanus* in Texas (R. Neck, J. Res. Lepid. 15:76), *A. subulatus* var. *ligulatus* in Ariz. (Bailowitz & Brock 1991, as *A. exilis*, which is listed as a syn. of *A. s.* var. *ligulatus* in Flora Great Plains, but as a species in the older Gray Flora), *A. pilosus*, *A. ericoides*, *A. laevis* all Staten I. N.Y. (where only *tharos* occurs; A. Shapiro J. Res. Lepid. 23:85), *A. simplex* Fayette Co. Pa. (C. Oliver J. Lepid. Soc. 32:231), *A. novae-angliae*, *ericoides*, *simplex* (Oliver 1978), *A. solidagineus* (source unknown, listed by Opler & Krizek 1984); other N.Y. hosts *A. puniceus*, *dumosus*, *lateriflorus*, *simplex*, *acuminatus*, *novae-angliae* (Shapiro 1974) probably refer to *P. tharos* but possibly to *P. cocyta*; all of H. Tietz' records (1972) are errors incl. *A. novae-angliae* (a lab host of T. Mead except for A. Shapiro's record). Diapausing (did not grow in lab) 4th-stage larva (probably *tharos*) found on *A. simplex* var. *simplex*; extensive larval feeding damage typical of *tharos* (possibly *P. cocyta*) found on *A. laevis* var. *laevis* plant esp. on leaf uns; no damage on one *A. ericoides*; NE Conger, Freeborn Co. Minn., Sept. 12, 1994. Larval feeding damage (of *P. cocyta*?) found on ~3 *A. simplex* var. *simplex*, no damage seen on *Aster novaeangliae* or *A. ericoides*; NE Alden, Freeborn Co. Minn., Sept. 13, 1994. Cluster of 90 eggs (probably *tharos*, possibly *cocyta*) found on leaf uns of lush *A. simplex* var. *simplex* 15 cm seedling; NNE Conger, Freeborn Co. Minn., Sept. 13, 1994. Larval feeding damage on *A. simplex* var. *ramosissimus* leaf uns, S Aurora, Hamilton Co. Neb., Sept. 18, 1994. Adults assoc. *A. simplex* var. *simplex* S Twin Lakes, Freeborn Co. Minn., Sept. 11, 1994, assoc. *A. simplex* W Sheffield, Franklin Co. Iowa, Sept. 18, 1994. Adults assoc. *Aster ericoides* var. *ericoides* just W Des Moines, Dallas Co. Iowa, & Lincoln, Lancaster Co. Neb., Sept. 18, 1994. Cluster of ~129 pale-green eggs found on *Aster cordifolius* leaf uns in partial shade at edge of woods, reared to adults on *A. laevis*, *hesperius*, *ericoides*; Hall of Humes Lake, Freeborn Co. Minn., Sept. 16, 1994. Most of these *Aster* sp. are in subgenus *Euaster* (the largest *Aster* subgenus), although *acuminatus* is in subgenus *Orthomeris*, *exilis* is in subgenus *Oxytripolium*, *solidagineus* is in subgenus *Sericocarpus* (listed as a genus in Gray & Abrams floras, lumped in *Aster* in Kartesz & Kartesz checklist), and a few botanists place *novaeangliae* and *ericoides* (& *falcatus*) into subgenus or genus *Virgulus*. Larvae ate *Erigeron peregrinus* in lab (Oliver 1972), so *Erigeron* might be a possible host in nature. Ernest Williams (talk at 1993 annual meeting Lepidopterists' Society) studied lab feeding: larvae feed well on *A. lanceolatus*, *simplex*, and *novaeangliae* which all have the sesquiterpene germacrene D, and larvae feed well on *A. novabelgiae* which has germacrene

D and coumarins; but larvae dislike Aster umbellatus (which lacks germacrene D) and a chemical atracylone in it causes larvae to lose weight. Thus P. tharos larvae may prefer plants with germacrene D, while Chlosyne harrisii (Scud.) (whose main host is A. umbellatus) may prefer atracylone

**EARLY STAGES** (S Minn.; some of Edwards' [1874-1884] livestock may have been P. cocyta). I have reared only one family, found as eggs on Aster cordifolius in S Minn., which had very dark older larvae, much darker than any other tharos I have reared, and dark pupae. More rearing should be done to determine the variation among E U.S. larvae; it is of course premature to call this a distinct species that specializes on A. cordifolius. **SILK WEB:** Larvae do not live in a web (Oliver 1979a), and my S Minn. larvae made no conspicuous web. **DIAPAUSE STAGE.** 4th-stage larvae (Edwards 1874-1884) ("3rd stage" in Oliver 1979a is an error). One presumed tharos from S Minn. on Aster simplex diapaused as 4th-stage. **EGG** pale green, ~"15" ribs, laid in clusters of 25-225, average 246/female (Oliver 1972: 343 Fla., 218 Va., 182 Conn., 161 Tex.), duration 4-7 days. A single female may lay up to 700 eggs in her lifetime (Opler & Krizek 1984). **1ST-STAGE LARVA** ochre-cream, the front 2/3 greener, the usual wide low creamier mounds (a large one near top, small oval below, fairly large one between L1-2), the usual black setae, suranal plate & collar blackish; head blackish, with the usual setae; duration 5-6 days. **2ND-STAGE LARVA** tan when young with greenish innards, when older striped longitudinally with light- & dark-brown & cream (a strong brown heart-line, a brown line beside it, a wide brown subdorsal band, a weaker tan lateral line), the usual blackish suranal plate & collar; head black with tan or gray band on each vertex, often a tan triangle on frontoclypeus; duration 5-6 (sometimes as little as 3) days. **3RD-STAGE LARVA** very-dark-brown, with same pattern as mature larva but pattern indistinct except darker wide subdorsal band, one larva is all black except BL1 scoli gray, and other larvae very dark with subdorsal cream line faint (only the lateral cream band is strong); head black with cream vertex band, some have a pale frontoclypeus spot; duration 3 days (7-14 in fall). **4TH-STAGE LARVA** blackish in S Minn. with 3 dorsal bands hard to discern, a gray subdorsal band, an interrupted slightly-gray spiracular band, the lateral cream band moderately wide; head with usual cream vertex band and a cream frontoclypeus spot; duration overwinter. **5TH-STAGE LARVA** ground color smooth watery-blackish-brown with few cream dots, a dark heart-band, dark line near it, the subdorsal cream band is complete except only 2/3 complete on one larva, a wide subdorsal dark band (brown dorsal area is not paler than this band), the usual paler spiracular band, a brown band below that, a strong cream lateral band, the usual orangish areas (weak below BD1, beside BD2, weak below BSD, around BL1); some S Minn. larvae are quite black, with the subdorsal cream band narrow and nearly absent and no orangish on body except for brownish-orange below BL1; other larvae almost as black, with weak subdorsal cream band and orangish color limited to orange-brown by BD2 and orangish-brown around BL1; head black with cream vertex band, cream triangle on frontoclypeus (almost black in some S Minn. heads), and usual cream band over eyes extending posteroventrally then back to neck, this cream band often extending anteroventrally down from eyes to bottom of head; duration 10 days (sometimes as little as 3).

**6TH (MATURE) LARVA** (and see color photo in Pyle 1981, fig. 17 right, a tharos larva [with strong cream subdorsal band on body and cream eye stripe] misidentified as "mylitta"; Scudder 1889 Butt. New England shows mature larva head on pl. 75, though this may be of orange-antenna var.) dark-brown or blackish-brown with numerous tiny cream dots, striped with the usual subdorsal & lateral cream bands and the usual dark bands, the wide dark subdorsal stripe is often black, the usual brown or dark-brown upper scoli (described as partly white-tipped in summer, black-tipped [very dubious, probably confused with P. batesii by Edwards] in spring), the usual orange areas beside some scoli; in one S Minn. family body brownish-black, the dorsal brown area is as dark as subdorsal band (whereas it is paler in most tharos), and the orangish areas are small and quite brownish-orange (absent or a tiny brownish-orange sliver below BD1, brownish-orange beside BD2 esp. behind it, absent or tiny weak brownish-orange area below BSD, brownish-orange below BL1 but usually brown-black above BL1; one dark larva has only light-orange beside BD2 and brownish-orange below BL1), in S Minn. BD1-2 scoli blackish-brown, BSD black, BL1 light-brown or creamy-tan or orangish-tan, BL3 dark-brown or black, the tips of BD1-2 & BSD paler (creamier), tip of BL1 slightly paler; in S Minn. suranal plate black on anterior narrowed part, brown posteriorly, proleg plates all dark-brown, collar black with usual 4 tan spots; head black with the usual cream vertex stripe (often enlarged

at anterior end) and usual sickle-shaped cream mark on lower cheek extending over and down behind eyes almost to neck, frontoclypeus with cream triangular patch (reduced to two dark-brown spots side-by-side in one dark S Minn. larva and to a smaller cream spot on another); duration 4-6 days in summer (sometimes as little as 2), 8 days in spring.

**PUPA** (and see color photo in Pyle 1981, fig. 17, as "mylitta") grayish (creamier), or grayish on dorsum but abdomen & wings tinted yellow-light-brown, or dull white with brown (Edwards' creamy pupae and esp. this white type could have been P. cocyta), or wholly darker-brown speckled with gray; in W. Va. many pupae of summer broods marked with black patches on abdomen & wings but in spring the usual color is grayish [perhaps some of this variation was due to normal variation between families, or confusion with cocyta]; all pupae of one S Minn. family brown (orange-brown) except one pupa brown-orange (the wings slightly reddish), the usual brown wing mottling present but weak except for moderate brown discal cell spot; Minn. pattern details like P. tharos orange-antenna variety, young pupa has usual cream band between BD2 cones and sublateral cream band, usual rows of brown dashes on abdomen (midventral, supraventral, lateroventral, a brown dot anteroventral to spiracle, two brown dots [one anterior, one posterior] on each seg. below subdorsal cones, the usual brown ventral & lateral U-shaped mark on front of head (edged by cream on ridge at bottom & side of head), a creamier patch between antenna bases, a creamy lateral patch on T1, proboscis tip dark-brown, appendages marked like orange-antenna variety, the usual brown-edged cream V on top of T2, middorsal cones A2-7 (a brown spot in place of cone on A1), subdorsal cones T2-3, A2-7, tiny A1, supraspiracular cone A4, usual transverse ridges on T2 & A4-7, cones & ridges orangish in front & creamier behind; S Minn. cremaster moderately to strongly rugose, most winged but one tapered, width 1.05 mm; pupal duration 5-13 days (averaging 6 days in warmth of Aug., 7 in July, 11-13 in May, 29-30 days in a cold Sept.), S Minn. 9 days males 11 females in lab, Larval-pupal duration ~31 days males, ~33 females (Oliver 1978), 27-35 males and 29-39 females (Oliver 1980), 22-24 for both sexes in Fla.-Va. vs. 28-29 in Conn. (Oliver 1972), 42 days males 44 days females S Minn. in lab, male-female emergence lag 2.4 days.

#### 4B. PHYCIODES THAROS THAROS (ORANGE-ANTENNA VARIETY)

=P. tharos marcia (Edw.)

(Figs. 101-104, 107-108, Tables 1-7)

**DIAGNOSIS.** This ssp. is evidently very similar or identical to ssp. tharos, but usually has orange antenna clubs, vs. usually blackish. The antenna clubs are mostly orange from S Maine to C N.Y. (and some Penn. colonies) W to Sask.-Alta.-Dakotas-W Neb.-Wyo.-Colo.-extreme W Okla. In E Colo. the antenna nudum of males has orange borders and brownish-orange lattice with yellow-orange or orange steps, of females has mostly dark-orange or brownish borders and brown or orange-brown lattice and orange steps. The nudum is similarly orangish in N.D.-Sask. In W Neb. the nudum is a bit darker, males have dark-orange (sometimes orange) borders with brown lattice & yellow-orange (sometimes orange) steps, females have black or brown borders with black or brown lattice & dark-orange steps. I have not seen many specimens from NE U.S., but a couple from N Ohio have orange antennae, those from C Ohio black antennae. The clubs are orange in Adirondacks (Edwards), black around New York City and S Minn. The narrowness of the range of orange-club adults from Maine to Man. suggests that the orange antenna clubs derived from interbreeding with P. cocyta; but because orange is primitive in subgenus Phyciodes overall, the southern tharos may have just evolved black clubs. It seems unwise to base a ssp. only on one character the antenna club, so I list it now only as an unofficial "variety". Melitaea marcia (type loc. Hunter, Greene Co. New York) is an available name and evidently fits this ssp. because Edwards (1874-1884) described its antenna clubs as "black tipped with fulvous [orange]", so ssp. marcia can be used by splitters who consider this a valid ssp. (The name marcia was also applied by Edwards [1874-1884] to the spring and fall mottled-unh form of the species, caused by low temperature acting on the pupa [Oliver 1976 also proved short photoperiod produces marcia]; and Edwards proved form morpheus is the summer form.) The Neb. & Colo. rearings prove genetic variation in orangeness of adults and pupae and darkness of larvae.

**HABITAT** moist meadows, irrigation ditches, gulch bottoms, moist prairie, etc. **HOSTPLANT RECORDS.** 2 egg clusters and 2 other larvae found on underside of leaves of 3 Aster (Virgulus) ericoides plants (a cluster of 78 eggs produced 27 male 19 female adults, a cluster of 73 eggs produced 14 male 17 female adults, a cluster of two 1st stage larvae later died), Barr Lake, Adams Co. Colo., Aug. 17, 1985. Egg cluster of 53 eggs found on A. ericoides leaf underside, preoviposition 14:10 on A. ericoides, Barr Lake, Adams Co. Colo., Sept. 25, 1989. Adults associated with A. ericoides, Horsetooth Res., Larimer Co. Colo. May 23, 26, 28, Sept. 14-15, 1990, & N Bear Creek Res., Jefferson Co. Colo., 1990-1994. Cluster of 55 eggs found under lush basal leaf of A. ericoides var. ericoides, a strong web noted later for molting 1st stages, reared to adults on Aster laevis & hesperius; Fort Morgan, Morgan Co. Colo., Sept. 19, 1994. Adults associated with A. ericoides throughout the plains in Weld, Larimer, Adams, Jefferson, Arapahoe, Elbert, Pueblo and Crowley Cos. Colo. Adults assoc. with A. ericoides, 7 mi. N Wheatland, Platte Co. Wyo., Aug. 23, 1994. Oviposition 12:20, from 11:30-12:20 she landed on a group of ~5 small non-flowering Aster hesperius Gray within 70 cm on canal bank and mostly rested in shade, sometimes crawling over the leaves or fluttering a short distance to another A. hesperius, at 12:20 she landed on a seedling A. hesperius in sun that she had landed on once before and bent abdomen under a drooping leaf and laid 10 eggs from 12:20-12:26, larvae reared and 2 females emerged Dec. 19; Barr Lake, Adams Co. Colo., Oct. 11, 1989. Six 2nd-stage larvae (lot #M) found on ~3rd leaf above ground on flowering Aster laevis var. geyeri, several adults reared; five 1st-stage larvae (lot #N) found under 4th leaf above ground of flowering A. laevis, several adults reared; ~69 eggs/1st-stage larvae (lot #O) found under large basal leaf of flowering A. laevis, (larvae had frontoclypeus less cream than other lots, and pupae were creamy and heavily marked with bars on wing etc. versus mostly more tan with fainter bars in other lots), many adults reared; 41 2nd-stage larvae (lot #P) found on underside of leaf of seedling A. laevis, many adults reared, 1 larva diapaused as 4th-stage, a small larva found on A. laevis 200 cm away was lost; five 2nd-stage larvae (lot #R) found on small A. laevis, several adults reared; ~96 eggs (lot #S) found in one cluster under basal Aster ericoides var. falcatus leaf 5 cm long (lush cluster of basal leaves, which are in poor condition on most plants), many adults reared which had more extensive orange ups areas on average than adults of the other 5 lots; Sowbelly Can., Sioux Co. Neb., Aug. 23-24, 1993. No larvae found A. laevis, because older larvae must hide at base of plants, Pine Ridge, Sioux Co. Neb., May 16-18, 1994. Larvae found on A. laevis leaf uns: ~68 2nd-4th-stage larvae found on ~7 plants, adults reared, one diapaused as 4th-stage; 35 1st-stage larvae in two clusters on one plant, one had weaker coarse web all over (with head capsules) and second had stronger coarse web near eggshells on 2nd leaf (with head capsules), no web noted later, adults reared; 28 2nd-stage larvae found, made web only at spot where 2nds molted to 3rds, adults reared; Pine Ridge, Sioux Co. Neb., June 24-26, 1994. Adults assoc. with Aster adscendens, NE Edgerton, Johnson Co. Wyo., Aug. 17, 1994 (a few A. ericoides var. falcatus also present), and Douglas, Converse Co., Wyo., Aug. 24, 1994. Aster ericoides, A. laevis, and Aster simplex are hosts in Man. (Klassen et al. 1989). **HOSTPLANT SUMMARY.** P. tharos eats a wide variety of asters: A. ericoides (& var. falcatus) has tiny leaves and grows in open areas that are semi-moist to fairly dry, A. laevis has large leaves and grows on moist N-facing slopes and gulch bottoms, A. hesperius has fairly small leaves and grows only along creeks and ditches where larvae could be washed away, so it is probably a less-common hostplant in Colo. than the commoner A. ericoides, while A. simplex is nearly identical to hesperius but it grows in the moister E N. Amer. where it can grow in roadsides and meadows so surely be a frequent host.

**EARLY STAGES** from C Colo.-Neb. (partly described by Scott 1986b; Scudder's (1889) Butt. New England illustrates tharos on various plates, which may refer to orange-antenna var. if his material was from New England). **SILK WEB.** Oliver (1979a) stated that P. tharos/cocytia lacks a larval silk web. This is usually true. However, in Neb. I gave larval families found in nature lot numbers starting with W- if the larvae were found on a silk web, and two such families with silk webs were reared and produced adult tharos; this "blind" study proves that P. tharos does make silk webs sometimes (as does P. cocytia), and another strong web was found with molting 1st-stage tharos larvae in Morgan Co. Colo. Therefore, this character only works on an average basis (P. tharos/cocytia make less webbing on average than P. batesii/pulchella), it does not work every time. Strong webs are sometimes made by 1st-stage larvae molting to the 2nd

stage, or by 1st-stage larvae near their eaten eggshells (Phyciodes larvae always eat their eggshells when they hatch). Perhaps only a quarter or third of families make a conspicuous web.

**DIAPAUSE STAGE.** 4th-stage larvae hibernate (1993 & 1994 Neb. data). **EGG** pale yellowish-green or pale green-yellow, ~22 ribs (approximation, very difficult to count), average number of eggs per cluster 62 (range 10-96). **1ST-STAGE LARVA** ochre-tan or ochre-cream, the thorax then whole body becomes greener due to food, the usual creamier low areas (large one near top, small one beneath that, fairly large area between L1-2, small one below that), no dark pattern, just before molting the subdorsal area looks orange-brown because of the subdorsal orange-brown band of the 2nd-stage larva within; collar brown with slightly-paler seta bases, suranal plate brown with slightly-paler seta bases, proleg plates light-brown (slightly darker A10), legs dark-brown, setae dark-brown (paler laterally); setal lengths like related Phyciodes; head unmarked blackish, width ~.25-.3 mm. **2ND-STAGE LARVA** greenish-cream when young, then greenish-ochre-tan (esp. greenish on anterior 1/2), with a middorsal weak tan line and similar nearby line, a browner wide subdorsal band, a dark-green lateral line; when a few days old tan, a middorsal brown heart-band, a brown line above BD2 scoli, a wide dorsolateral brown band enclosing BSD scoli on lower edge, a weaker brown band below BL1 scoli; BD1-2 & BSD scoli fairly-light-brown (tips not noticeably paler), BL1-3 scoli tan, collar dark-brown with a light-brown mound under each of 4 primary setae, suranal plate brown, proleg plates light-brown (the ventral rim brown), legs dark-brown, ventral neck gland present; head unmarked blackish-brown, width .35-.4 mm. **3RD-STAGE LARVA** like older larva, BD1-2 & BSD scoli dark-brown with distal 25-30% tan, BL1-3 scoli tan, collar dark-brown with a pale area under each of 4 areas where primary setae were (the middle pale areas often coalesced into an oblique patch, or all 4 coalesced into a large tan patch), suranal plate brown (a small tan patch within anterior end), proleg plates light-brown (the ventral rim brown, the lower 1/5 darker on A10); head always with creamy vertex band, a creamy area always present on bottom front of head beside lower part of frontoclypeus, and always with upper 2/3 of frontoclypeus creamy, (or a creamy spot in middle, rarely a creamy dorsal tip and a tiny creamy spot on each side), a creamy area beside rear mandible joint, rarely a creamy crescent above eyes, width .6-.7 mm. **4TH-STAGE LARVA** like mature larva, but scoli relatively larger so larva looks darker, ground color dark-brown, same subdorsal cream band and lateral cream band with strongly-orange scoli bases etc., BD1-2 & BSD scoli dark-brown with tan tips, BL1-3 scoli orangish-tan, collar blackish with large anterolateral tan bump and 3 other large tan bumps in positions of primary setae on 1st-stage (these lateral tan areas often coalesced but a blackish streak edges rear of lateral 2 bumps and runs laterally then around front rim); head similar to mature larva, except the creamy eye crescent does not touch the creamy area on bottom front of head (the latter area extends below eyes to rear mandible joint), head width .8 mm. **5TH-STAGE LARVA** like mature larva, creamy eye patch narrowly connected to creamy bottom front of head in ~40% of larvae (separated in ~60%), head width 1.2-1.5 mm.

**OLDER-MATURE LARVA** with usual Phyciodes pattern, somewhat variable, most are brown but some are dark-brown and a few blackish-brown, most have the subdorsal cream band strong but a few have it moderately interrupted, a few have whiter bands (adding a solid cream band just above spiracles), a few are oranger (the area between BD1 and BD2 scoli orange-brown), the orange areas near scoli are paler-orange in a few (all these extremes were from Neb.), two families (Pueblo & Morgan Cos. Colo.) have heavy cream-dotting and appear creamier/frosted; a brownish-black or dark-brown heart-band includes BD1 scoli, a narrow light-brown band includes many cream dots (this band is rarely a cream band in larvae covered with cream dots)(a narrow area of orangish-brown or brownish-orange [orange in most-cream-dotted larva] laterad of BD1 scoli in this band), a wider dark-brown (brownish-black in darkest larva, orange-brown in orangest larva, rarely brown) band has some cream dots (the dark area above BD2 scoli is usually paler than the wide subdorsal dark band, but is as dark in a few larvae), a cream band includes BD2 scoli (this band usually complete, rarely moderately interrupted in the darkest larvae)(this band is orange [light-orange in some heavily cream-dotted larvae] in front of and behind BD2 scoli; additionally, a narrow orange-brown ring circles scoli base in the orangest larvae, while a brownish-orange ring circles scoli in the most-cream-dotted larvae), a wide brownish-black (dark-brown in the orangest larva) band with some cream dots includes BSD scoli on its lower side, a narrow band above black spiracles is tan or brown due to many cream dots (sometimes the band is a slightly-interrupted cream line)(the ventral base of BSD scoli in

this band is sometimes orangish-brown, but is usually brown like the rest of band), a wider orangish-brown (brown in darkest larva) band with some cream dots, a cream band includes BL1 scoli (a ring of brownish-orange or orange-brown, sometimes orange, [usually orange on T1-2], surrounds BL1 scoli), a dark-brown band, underside brown including BL3 scoli; BD1-2 scoli dark-brown (rarely brown) with ochre tip, BSD scoli brown-black (rarely brown) with ochre tip, BL1 scoli ochre-tan (only slightly orangish) with creamier tip (rarely light-brown)(BL1 scoli sometimes cream on T1 and orangish-cream T2), BL3 scoli slightly-orangish-ochre-tan or brown (T1-3 scoli slightly paler, sometimes cream on T1-2) with ochre tip (most scoli of P. tharos/cocyta have conspicuously paler tips, whereas they are not conspicuously paler on P. batesii/pulchella); collar mostly black with cream middorsal ecdysial line and 3 small creamy anterior spots below major setae and a posterior pale patch that continues cream subdorsal body band, proleg plates brown (blackier anteroventrally), suranal plate tan except a large brown area with pale seta bases occupies most of narrowed anterior part (except tan anterior rim), legs black, ventral neck gland present; head black with usual 5 pale areas, including a cream (sometimes orangish-cream) vertex band on top of head (the anterior end sometimes constricted into a satellite spot), a cream (sometimes orangish-tan, rarely brown) eye band extends from eyes to neck and always narrowly over eyes and always down to bottom front of head (where it always extends rearward below eyes to rear mandible joint, even on the darkest heads) then extends upward usually to bottom third (rarely bottom half, rarely to near top) of frontoclypeus, frontoclypeus usually has triangular cream (sometimes orangish-tan) area on upper 60% (sometimes 2/3, less often 1/2)(the triangle often constricted just below top by blackish) but frontoclypeus sometimes has only a moderate-sized creamy (rarely reddish-brown on a dark head of Neb. lot #O) spot or rarely a creamy band (brown band on the darkest head of lot #O, brown patch constricted in middle on a Morgan Co. head) across frontoclypeus, lower part of frontoclypeus rarely has a paler area, head width 1.8-2.2 mm.

**PUPA** light-orangish-brown with fairly-weak to moderate brown wing streaks, or creamier-light-brown (or darker-creamier-brown) with moderate or fairly-strong brown wing streaks, a few pupae darker-brown, a few slightly-reddish-orangish-light-brown, with considerable variation between families: Adams Co. Colo. light-orangish-brown with moderate wing streaks like riocolorado (sometimes only discal cell patch conspicuous) but 50% are creamier-light-brown (a few of these are a little darker); Morgan Co. Colo. about half light-orangish-brown and half creamier (grayer)-light-brown, with moderate to strong wing mottling; Neb. two 1994 families and misc. pupae similar except a pupa in each lot was slightly-redder-light-orangish-tan; Elbert Co. Colo. light-orangish-brown with fairly-weak to moderate browner wing streaks, but 30% are darker-creamier-brown with fairly-strong wing streaks; Pueblo Co. Colo. fairly-dark orangish-brown with fairly-weak wing streaks (a stronger discal cell spot); Neb. lots M & R light-orangish-brown (1-2 a bit darker) with weak wing streaks except conspicuous discal cell streak; Neb. lot N light-orangish-brown (a few creamier-light-orangish-brown) with weak (1 of 4 moderate) wing streaks; Neb. lot O a few are orangish-brown but 95% are creamy-brown, all have fairly-strong medium-gray wing streaks (this most-distinctive lot O produced ordinary tharos adults); Neb. lot P light-orangish-brown but 12 of 31 creamier-brown, all with fairly-weak to less-than-moderate wing streaks; Neb. lot S light-orangish-brown in a third but ~20 of 31 creamier-light-brown (all with more-than-moderate wing streaks); variation of pupae (cream to tan, wing mottling) is obviously genetic. Pattern details like apsalooke & riocolorado, often tiny brown spots in middle of wing (in base of cells  $M_3$  &  $CuA_1$ ), a cream spot between antenna bases, a weak creamy middorsal band on T1-2 is divided by browner cleavage line, ~5- < 10% have a weak middorsal crest on A2-cone of A4 (this crest generally somewhat creamy), young pupae have the usual creamy subdorsal & sublateral bands with darker-brown beneath, the usual dorsolateral, lateroventral, supraventral, midventral abdominal bands of small brown spots, a few tiny (rarely larger) brown spots below spiracles on abd., ridge & cones rather large like riocolorado (sometimes rather small, a bit smaller on lot O than lot S), the cones tall and pointed and supraspiracular A4 cone strong so that ridge slopes down directly to wing; cremaster with distinct shoulders (much more than riocolorado) on 95% which extend straight back (the portion that is winged in batesii/pulchella) then quickly taper to tip of cremaster, 5% are more tapered (including 2 of 4 lot R, and slightly on 2 of 4 lot N), width averages .87 mm (but 4m1f in lot M averaged 1.01), cremaster rugose all over top & bottom on most pupae (but not as rugose as batesii/pulchella) but smooth in center of top on some and mostly smooth on a few. Duration

egg-larva-pupa in lab 35 days male 38 female in a Neb. family, 38 m 40 f , 45 m 48 f , and 50 m 53 f in three Colo. families, male-female emergence lag 3 days.

### 5. PHYCIODES COCYTA (CRAMER) 1777

(= homonym morpheus [Fabr.] 1775 = selenis [Kirby] 1837 = pascoensis Wright 1905 = "tharos type B")  
(Figs. 47, 110-132, 222, 225, Tables 1-7)

**HOMONYMY: selenis vs. morpheus.** Scott 1986 used the name Phyciodes morpheus (Fabricius) 1775 for this species, and fixed the type locality of morpheus as Nova Scotia and synonymized Phyciodes selenis to morpheus. At that time such actions were completely proper and sufficient to make certain that morpheus was the correct name. However, I recently learned that P. morpheus is a homonym of morpheus Pallas 1771 (and selenis is a synonym of cocyta, see below). Miller & Brown (1981) mentioned no homonymy, nor did Ferris et al. (1989) nor dos Passos (1964), but dos Passos (1969) listed morpheus as "+ + morpheus (Fabricius, 1775 nec Pallas, 1771)", in which the double-dagger + + indicated (dos Passos 1964, p. v) "preoccupied names or those cited in error"; dos Passos (1969) evidently intended to state that Phyciodes morpheus is a homonym of morpheus Pallas. Phyciodes morpheus was originally named Papilio morpheus (Fabricius) 1775, and morpheus Pallas was originally named Papilio morpheus Pallas 1771 (Robert Robbins sent me the original description); later in 1806 the latter was placed in the HesperIIDae genus Heteropterus Dumeril 1806 (type species Papilio morpheus Pallas 1771), and in 1819 the former was placed in Phyciodes (type species Papilio cocyta Cramer 1777), thus morpheus Fabricius was a primary homonym from 1775-1806 so must be permanently rejected (1985 ICZN Code art. 52[b]). If a junior secondary homonym was never discovered and not replaced before 1961, and is no longer a homonym, it need not be replaced and is now valid {art. 59(c)}; however junior primary homonyms are invalid no matter when the homonymy was discovered. Thus Phyciodes morpheus is an unavailable homonym, which suggests that P. selenis is the correct name.

**SYNONYMY AND NEOTYPE: cocyta vs. selenis.** However, the type of selenis is lost, and the type locality is just "North America". A letter from F. M. Brown Mar. 1, 1980 states "Kirby's selenis was a misdetermination [?]. His specimens of 'tharos' are Canadian and from pretty close to the northern limits of the range."; the specific locality was perhaps "54° N. Lat." (?Cumberland House Sask.), the type locality given by Miller & Brown (1981) for Polygonia c-argenteum, which Kirby named 3 pages later in the same paper in which he named selenis. Cumberland House is at 54° N. Lat. in Sask. (just W of The Pas, Man.) within the range of selenis but several hundred miles north of the range of P. tharos. To settle this confusion and to fix the identity of selenis, I hereby restrict the type locality of selenis to Cumberland House Sask. But the proper name is still not settled; two older names formerly napping in the synonymy of tharos still lurk in the bushes waiting to strike selenis dead: Papilio cocyta (Cramer) 1777 (the type species of Phyciodes), type locality "Surinam" (Higgins 1981), and Papilio euclea (Bergstraesser) 1780, type locality "England" (Higgins 1981). The types of both are lost, and either would replace selenis if they were found to be this species. Therefore I investigated both names. Because the types are lost, the colored illustrations must represent the types; Dr. Frederick Rindge of AMNH kindly sent nice color reproductions of the original plates of both names. The color figure of Papilio euclea Bergstraesser 1780 (plate 79, figs. 1-2; my figs. 95-96) represents P. tharos, and a euclea neotype specimen of tharos (my fig. 97) has been designated from New York City to fix its concept, as noted above under P. tharos. However Papilio cocyta Cramer 1777 was a surprise. The original description of cocyta translated from french: "Plate 101. Fig. A. B. Cocyta. This small butterfly shows a strong resemblance on the upperside to liriope, which [liriope] is represented on the first plate, Fig. C. D; but it differs greatly on the underside. The next [fig. C] is perhaps the female. [New paragraph.] Fig. C. Cocyta. On upperside this small butterfly entirely resembles Figure A. It belongs to the four-leggeds [Nymphalidae], is found in Surinam, and is from the collection of Mr. M. Houttuin, Doctor of Medicine." P. cocyta is a surprise because the color figure of the male upperside (fig. A on plate 101; my fig. 112) very clearly shows the very large unbroken orange median-postmedian uph and upf areas that are diagnostic of selenis. Indeed, these orange areas are even

larger on fig A than on the usual selenis; the scalloped black line that bisects these orange areas on P. tharos is absent on the cocyta hindwing, and limited to the posterior part of the forewing, clearly assigning it to selenis. Therefore, regardless of the undesirability of resurrecting a name that has received almost no use for several centuries, I am FORCED to declare that cocyta and selenis are the same species, and selenis must be sunk as a synonym. This action does not cause instability anyway, because this species has had no stable name: it has been known by FIVE different names--tharos "type B", pascoensis, morpheus, selenis, and now cocyta--during the short time it has been separated from P. tharos! Cramer's fig. B (my fig. 113) is the male underside of cocyta and represents males of selenis well. Cramer's fig. C (my fig. 114)--stated to be cocyta female underside--is drawn with some markings exaggerated, but evidently is the underside of a selenis female with spring form marcia-type unh (a creamy median unh band and a marginal unh crescent); marcia-type females are uncommon in selenis but do occur (among my eastern North American females, I have one from Passadumkeag Maine and three from Doyles Nfld. that have this cream median unh band and cream marginal crescent); thus I conclude that fig. C does not contradict the assignment of cocyta to the species formerly called selenis=morpheus, and suggests that cocyta may have come from Nfld.-N.S.-Maine (the area where I have selected the neotype). The antenna is drawn (in black) too linearly on figs. B & C and esp. on A for any club color to be visible. Because the best distinguishing feature between tharos/selenis is the large unbroken orange patches on uph of selenis, I hereby state that Cramer's fig. A is the syntype figure which shall represent the concept of the name. However this figure still does not fix the identity of this species sufficiently to preclude all future argument, and stability of nomenclature is long overdue in the P. tharos-group, therefore I have selected a NEOTYPE male cocyta from Nova Scotia (fig. 111; deposited in AMNH) that matches the peculiarities of cocyta fig. A very well, with very large orange areas on upf and uph and a strong submarginal uph pale line (except the unh marginal crescent is cream on fig. B, light-brown on neotype, a variable trait). This neotype (fig. 111) has orange antenna club, left hindwing smaller than right, and its pin has two labels: 1) Black Rock, Cape Breton, Nova Scotia June 23, 1983 L. P. Grey; 2) NEOTYPE [underlined with red] Papilio cocyta Cramer 1777, designated by James A. Scott Feb. 1994. (A second male from Black Rock in my coll., fig. 110, is rather ordinary selenis with orange antenna club and postmedian black line present only on rear of large orange area on each wing.) P. cocyta is therefore the proper name, and the type locality is the locality of the neotype in Nova Scotia. I realize that historically there may be little or no evidence that the original lost type of cocyta came from Nova Scotia (it certainly did not come from "Surinam" the erroneous locality of the female syntype fig. C), but Nova Scotia is on the coast where commerce with Europe was frequent, and the neotype designation and its type locality are valid regardless of history; Nova Scotia is also a good place for the neotype because P. tharos is absent there.

**DIAGNOSIS.** In males, the antenna nudum border is orange (sometimes orange-brown, rarely brown), the lattice is orange-brown (rarely dark-brown), the steps orange (sometimes yellow-orange), in females the border is orange (often brown, rarely black), the lattice orange-brown to blackish, the steps orange (rarely brown). Similar to tharos in nearly all traits of early stages and adults (Tables 1-7), as cocyta is little evolved from tharos. The uph generally has a large orange central area where the postmedian black line is absent, and this is the best identification feature, together with the orange antenna club in males and most females.

Wingspan is generally 1-2 mm longer than tharos. However, in S Minn. (Freeborn Co.), Sept. cocyta (the 2nd or 3rd generation) are SMALL like tharos. These small adults flew in M Sept. (in moist hayfields, roadside ditches, along roadsides, mostly assoc. Aster simplex) and I first wondered if they were odd tharos, but all these cocyta males have a large uph orange area (and the uph submarginal cream line is less frequent) and all have a very orange antenna club, whereas all the sympatric synchronic tharos males have a black line through the uph orange area and all have black clubs. Furthermore, I reared an egg cluster found there on A. simplex to adults, and every male had the diagnostic large orange uph area and orange club (male nudum has steps orange & border brownish-orange, female steps orange or orangish or orange-brown or [in 2 females] brown and border brown or dark-brown or [in 3] black). (In comparison, reared tharos from there had black clubs on all males, and on females the club was almost entirely black on two females [except steps brown on distal 1 or 2 segments], black with the last 2-3 segments with orangish steps on three, black with the distal 4-5 segments with orangish steps on four, and

entirely orange [steps orange, border darker-orange] on one.) Thus in S Minn. the antenna club identifies all males and most females (females with mostly-orange nudum are probably cocyta, females with mostly-black nudum are probably tharos); the uph identifies most females because 2 reared S Minn. cocyta females had a large uph orange space, 1 had a very thin postmedian black line dividing the space, and only 2 had a thicker line like that on tharos females). In Freeborn Co. Minn., wingspan of wild Sept. cocyta averaged 15.8 mm males (vs. 15.9 tharos); reared Sept. eggs produced 17.8 mm males, 19.4 females, wild June cocyta 17.1 males 18.7 females.

**GEOGRAPHIC VARIATION.** Ferris (1989) claimed that pascoensis is a ssp. of tharos, based on Jonathan P. Pelham's supposed findings near the TL (SE Wash.) that pascoensis occurs in typical tharos habitats and has two generations. Ferris' argument is erroneous, because I found that in Freeborn Co. S Minn., cocyta has two or three generations and occurs in typical tharos habitats, and adults of the second generation are the same size as tharos. I have not seen SE Wash. adults (I have seen adults from S B.C.), but I treat pascoensis as a syn. of cocyta because the figs. of a nearby Ore. male (Dornfeld 1980) are ordinary cocyta, and the recent checklists of Ore. and Wash. butterflies compiled by John Hincliff (and based on "taxonomic determinations by Jonathan P. Pelham and Paul C. Hammond") both list it as P. selenis pascoensis. In the past, pascoensis and arctica were treated as valid subspecies, but that was when they were joined to P. tharos, so authors were comparing them with a separate species tharos rather than with other populations of cocyta; with their removal from tharos to P. cocyta, their validity as ssp. is yet to be demonstrated.

Nfld.-N.S. adults are smaller, evidently average a little darker orange on uns, and have more brown & white unh mottling; size alone is not enough for ssp. status (because the second generation is smaller and reared adults are larger), and the unh mottling could result from colder temperatures there (the mottled-unh form marcia occurs in all Phyciodes). Ssp. cocyta (= arctica) could be treated as a weak ssp. from Nova Scotia-Nfld. and perhaps westward somewhat, and then ssp. selenis could be used in the rest of the range.

George Austin is naming a new ssp. from E Nev. (1995, Chapter 46 in Emmel & Emmel & Mattoon 1995) based on a two-toned appearance of ups described as slight in male and strong in female (but some males everywhere are a little two-toned, such as figs. 124 & 128, and females are usually two-toned), and based on more extensive black (but black-ups females are frequent everywhere, such as figs. 117, 125, 126), pale unh with narrow marginal brown patch (typical of all cocyta), and large size (but not significantly larger). I have not seen it, but based on the slight differences cited, and the many recent synonyms of Nev. butterflies, I consider this a synonym.

**SPECIES STATUS.** P. cocyta has recently been treated as a distinct species from tharos, because they are sympatric and evidently seldom interbreed in the Appalachians, S Minn., NW Neb., etc., even in N Colo. in Larimer Co. But in central Colorado I reared many adults from a foothills site and released females in front of P. tharos males at a plains site; courtship occurred readily and hundreds of F1 hybrids were reared (Scott 1986b); reproductive isolation--both pre-mating and post-mating--was ABSENT. This suggested that the two are one species. C. Oliver (1972-1983) hybridized them extensively (P. cocyta usually not recognized as such and called by other names: "tharos" from Mont.-Alta. in Oliver 1972 and Oliver 1979b, "tharos type B" from Syracuse N.Y. and Vt. and Shawville Pa. in Oliver 1980, "pascoensis" in Oliver 1983) and bred thousands of F1 and backcross offspring. Oliver claimed to find reproductive isolation, but his data show little or none: in Oliver (1980) the lowest survival was within a cocyta X cocyta control mating (.878 fertile/laid, .826 hatched/fertile); nearly all hybrid eggs hatched of F1 and backcrosses (only 1 of 6 F1 broods and only 3 of 7 backcross broods showed any loss of egg fertility). Oliver (1979b; who repeated the data of Oliver 1972 but with some numbers slightly altered) also found low viability within some pure tharos X tharos crosses (.764 fertile/laid of a SE Va. X Fla. F1, .172, .550, .599, .646, .763, .774 hatched/fertile in pure tharos backcrosses) as well as low viability within a few cocyta X tharos crosses (.594, .766 fertile/laid, .696 hatched/fertile in F1 crosses, .680, .842 fertile/laid, .531 & .711 hatched/fertile in backcrosses); backcrosses had lower fertility than F1 even when the backcrosses were between separate populations of one species; in that paper also the lowest viability number (.172) was within one species (SE Va. tharos male X tharos female [daughter of SE Va. tharos female X Fla. tharos male]) so it can hardly be concluded that there was any reproductive isolation between tharos and cocyta. Oliver (1980) even stated that there was incompatibility between cocyta from N.Y. and cocyta from Vt., although again the numbers showed little decrease in hybrid viability. Oliver

(1972) even found hybrid vigor in egg production: F1 females (Conn. tharos X Mont. cocyta and Conn. tharos X Alta. cocyta) produced 482 eggs/female on average, versus only 182 for Conn. pure tharos and 204 for Mont.-Alta. pure cocyta, while some pure tharos matings produced as few as 66 eggs/female. Oliver (1980) found sex ratios of hybrids to be mostly normal, except several rearings of cocyta X tharos produced few females (90% and 61% males) and one cocyta rearing produced only 34% males (one of my P. batesii lakota families had 73% males); Oliver's (1979b) controls and hybrids rarely had a 50:50 sex ratio (some within-tharos broods had only a 1.00:.61 and 1.00:.52 sex ratios), though the most skewed sex ratios were among F1 tharos X cocyta hybrids (several broods had equal sex ratios but most had fewer females, as low as 1.00:.17, although one brood had a 1.00:1.31 ratio with fewer males). The two species remain distinct in part because they have different diapause strategies and thus a different number of generations so the flight periods overlap only partially, therefore the species have less opportunity to meet and mate. Oliver found that the probability of larval diapause of an individual is similar to the probability of diapause of the mother's population, evidently demonstrating some kind of maternal cytoplasmic inheritance of diapause threshold. Oliver (1972, 1979b, 1980, 1983) also found that male hybrids emerge after females on the average if the mother was cocyta and the father tharos, but males emerge much prior to females if the mother was tharos and the father cocyta. Male butterflies normally emerge prior to females by a day or two (longer if lifespan is longer; Scott 1977), a lag time which is carefully adjusted by natural selection to benefit both males and females: males benefit by placing their lifespan around the time when most virgin females emerge; females benefit by emerging when males are most common to minimize the time required to find a mate; (thus the peak of abundance of males coincides with the peak of emergence of females, while the peak of abundance of females comes later-roughly half the female lifespan later) and the whole population produces more eggs when the male-female emergence lag is the proper amount (Scott 1977). Thus this finely-adjusted emergence lag is disrupted when one-generation-gene adults mate with several-generation-gene adults and the diapause inheritance is maternal. Scott (1986b) showed that this disturbance of the normal male-female emergence lag is an outcrossing mechanism that helps to spread genes between species, because the males and females emerge when the opposite sex is absent and thus are forced to outcross to whatever species they can find to mate with. Oliver found that cocyta and tharos would hybridize in lab cages (because courtship barriers are absent; Scott 1986b demonstrated normal courtship between cocyta and tharos in nature), whereas tharos X batesii and tharos X pulchella montana would not mate in lab cages and had to be forcibly hand-paired (because prezygotic reproductive isolation is present). The two taxa are allopatric in most of Colo. (in 30 years I have caught 2 tharos and ~2 cocyta on Green Mtn., Jefferson Co. Colo., 1 1/2 months apart, but this hardly qualifies as sympatry because populations do not exist there and the latter's hostplant does not even grow there) except in the foothills of Larimer Co., tharos occupying the plains and cocyta the mountains. Even in Larimer Co., they may remain distinct where sympatric evidently because their different flight times and number of generations seldom allow them to interbreed, and many hybrids suffer reproductive failure because the peculiar maternally-influenced mode of diapause inheritance causes hybrids to emerge at the wrong time to find a mate. (And as a practical matter, the similarity of their adults [esp. females] makes identification of hybrids rather difficult.) The antennae of cocyta and tharos are the same color (orange) in Colo. and in the rest of the western and northern (Sask., etc.) edge of the range of tharos, either because past hybridization resulted in introgression of antenna color into tharos, or because orange is the primitive color in Phyciodes (Phyciodes), whereas antennae differ in W.Va.-Va.-Penn.-S Minn. where the two behave as separate species. Thus the lab evidence from throughout the range and successful courtship and mating in nature in Colorado do not show any reproductive isolation, and the two appear to be merely subspecies in central Colorado. But based on field evidence of reported sympatry at numerous locations outside of Colorado, including S Minn. where I found both species common (and in similar wing condition) in the same moist hayfield on the same day in M Sept.--suggesting that reproductive isolation may have developed there--and based on moderate differences in some characters of adults and immatures (Tables 1-7), it is best to list them as separate species, barely more than subspecies (see Scott 1986b), rather than listing cocyta as "P. tharos/morpheus morpheus" as Scott (1986b) listed it. But one must wonder how they can coexist together in some areas; evidently real courtship

isolation has developed in areas other than central Colo., as the disturbance of diapause and emergence time is doubtfully enough to maintain these taxa as distinct species.

**RANGE.** Mapped by Scott 1986a; also found in Pine Ridge NW Neb. (uncommon), most of N.D., S Minn. (Freeborn & Renville Cos.), and (Stanford & Opler 1993) Warner Mts. NE Calif.; but absent from Ohio (the 2 specimens in Iftner et al. 1992 are obviously misidentified tharos); the range in S Wyo.-W Colo.-Utah-Ariz.-NW N.M. is uncertain due to confusion with P. batesii anasazi.

**NUMBER OF GENERATIONS.** In the Rocky Mts. S to N.M. there is only one generation (L May-E Aug, mostly June-July). In boreal Canada there is presumably just one flight (L June-L Aug. in Nfld.). Only one is reported (with few data) in C Appalachians (M June-M July in W. Va.), but in Penn. the main flight is in M June-E July and a partial flight occurs in Aug. Near Ottawa also the main flight is June-E July, with partial flight(s) from then until L Sept. (Layberry et al. 1982, as tharos; true tharos is evidently limited to extreme S Ont.). In N.D. the main flight is June, and a partial second flight occurs in Aug. some years (R. Royer). However in Sask. one flight is mostly in June, and another perhaps-partial flight extends to Sept. 4; and S Man. has at least 2 flights from May 30-Sept. 5 (Klassen et al. 1989). And there are 2 or 3 flights in S. Minn. (L-May-M June, one male July 13, and Sept.) as noted above, where the first flight flies after the first tharos flight but Sept. adults are synchronized with the probable third tharos flight. Two flights are also reported from E Wash. Thus the extra generation is frequent except in the coldest areas, and may be usual in Minn.-Man.-Sask. Small wingspan in the second flight in S Minn. means that this flight often may have been confused with tharos, so careful attention to the uph patch and antenna color will be needed to determine the exact extent of the second flight. Reports of a second partial generation of batesii in Mich. (M. Nielsen, in Oliver 1979a) could be cocyta.

**HABITAT.** In Colo., mountain canyons, mostly gulch bottoms and open N-facing slopes, not in dry areas; in Pa.-N.Y.-Vt. moist open areas and brushy old fields on slopes near streams, or brushy ledges or gravelly areas; in Va.-W. Va. shale barrens; in SW Que. moist fields (Oliver 1980); in Sask. woodlands, meadows and fields; in Man. forest openings, meadows, roadsides and stream banks (Klassen et al. 1989); in S Minn. roadsides, roadside ditches beside corn/soybean fields, moist hayed meadows, and remnant wooded areas. **HOSTPLANT RECORDS.** Six egg clusters (28, 53, 20, 25, 40, 56 eggs) and ten clusters of young larvae found on leaf undersides of Aster laevis var. geyeri, Tucker Gulch, Jefferson Co. Colo., July 8 to Aug. 7, 1978, Aug. 5, 1983, and July 18, 1984. 7 clusters of 1st-2nd-stage larvae found under A. l. var. geyeri leaves of plants about to flower, Tucker Gulch, Jefferson Co. Colo., July 27, 1989. 1 cluster of 1st-stage larvae found on A. l. var. geyeri leaf underside, Tucker Gulch, Jefferson Co. Colo., July 31, 1989. 2 clusters of ~2nd-stage larvae found on A. l. var. geyeri leaf undersides, Tucker Gulch, Jefferson Co. Colo., Aug. 1, 1989. 2nd-stage larvae on A. l. var. geyeri (clusters of 8 & 13 larvae on one plant, ~30 on 2nd plant), Tucker Gulch, Jefferson Co. Colo., Aug. 3, 1992. Larvae on A. l. var. geyeri, Tinytown, Jefferson Co. Colo., July 30, 1978. Preoviposition 11:28 A. l. var. geyeri, Tinytown, Jefferson Co. Colo., July 14, 1992. ~30 2nd-stage larvae found on A. l. var. geyeri leaf underside ~25 cm above ground, Tinytown, Jefferson Co. Colo., July 27, 1993. Cluster of 39 eggs on underside of A. l. var. geyeri leaf, Coal Creek Can., Jefferson Co. Colo., July 7, 1985. Larval feeding damage on A. l. var. geyeri leaves, Ralston Butte, Jefferson Co. Colo., June 10, 1994. Some web noted for 1st-stage larvae in lab; mother Indian Gulch, Jefferson Co. Colo., June 18, 1994. Elongate cluster of 31 pale-green eggs on A. l. var. geyeri leaf uns, no web noted later, adults reared; Tinytown, Jefferson Co. Colo., July 5, 1994. 44 1st-stage larvae found leaf uns, with extensive silk mat over egg area and near eggs, no web noted later, adults reared; 34 1st-stage larvae found on leaf top where leaf had twisted so larvae were on ventral side, strong silk web was near eggshells on leaf uns and a second web was beneath larvae on top of leaf, no web noted later (except once very little web for 3rd-stage), adults reared; 27 1st-stage larvae on leaf uns, moderate silk web was on uns of leaf base, and a very strong silk web with 5 larvae beneath it was on top of leaf (over eggshells) where leaf curled back on itself, no web noted later, adults reared; all on A. l. var. geyeri; Tucker Gulch, Jefferson Co. Colo., July 6, 1994. 8 clusters of larvae found on A. l. var. geyeri leaf uns: 12 2nd-stage larvae; 6 1st-stage larvae; 60 1st-stage larvae had strong web near eggs and elsewhere on leaf, 2nd stages later had moderate web then no web, adults reared; 30 2nd-stage larvae; ~45 1st-stage larvae had strong silvery-looking web over eggs & nearby; 38 1st-

stage larvae had strong web near eggs but not noticeable with naked eye; 55 1st-stage larvae had strong web over egg area but close to leaf & not noticeable; 36 1st-stage larvae had strong web near leaf surface near eggs but web not noticeable except whiter; Tucker Gulch, Jefferson Co. Colo., July 16, 1994. 5 clusters of larvae found on A. l. var. geyeri (2 under shade of Salix exigua/Populus angustifolia): two 2nd-stage larvae under leaf curled & dried with strong silk web over 1 cm<sup>2</sup> area of eaten leaf & lots of 1st-stage head capsules on web, mature larva & pupa reared; three 2nd-stage larvae under green leaf with one 1st-stage head capsule on web, adults reared; Tucker Gulch, Jefferson Co. Colo., July 23, 1994. Three clusters of larvae found A. l. var. geyeri leaf uns: 12 2nd-stage larvae on leaf uns with much silk web near eggshells and 4 cm from eggshells, adults reared; 95 1st-stage larvae on leaf uns near eggshells with no silk web noted yet (they had green innards so had fed); one cluster had all larvae missing; Tynytown, Jefferson Co. Colo., July 25, 1994. Four 3rd-stage larvae found on A. l. var. geyeri leaf uns, a strong silk web on spot that included a few 1st-stage head capsules, ~10 other plants had larval feeding damage, two diapaused as 4th stage (head width 1.1 mm), male reared; Wetmore, Custer Co. Colo., Aug. 8, 1994. Cluster of 4 ~2nd-stage larvae found on A. l. var. geyeri leaf underside, Stove Mtn., El Paso Co. Colo., Aug. 19, 1989. Hostplant must be A. l. var. geyeri by association, Sowbelly Can., Sioux Co., Neb., Aug. 1993, May-June 1994 (no adults seen but earlier found June 21, 1986). Egg cluster found 60 cm above ground on lush Aster simplex var. ramosissimus leaf uns, adults reared; no feeding damage seen on one A. ericoides; NE Conger, Freeborn Co. Minn., Sept. 12, 1994. A. simplex common where adults common (Aster cordifolius common only in woods, whereas cocyta was found in more open areas); Albert Lea Lake, Freeborn Co. Minn., June 24, 1985, June 16 & 19, 1986. Adults and A. simplex var. simplex found, S Twin Lakes, Freeborn Co. Minn., June 12, 1986. Adults associated with A. laevis (Syracuse N.Y.), A. simplex & Aster prenanthoides (all Charles Oliver letter to J. Scott Dec. 10, 1981), with A. simplex in Man. (Klassen et al. 1989). Some host records of "tharos" in N.Y. may refer to cocyta. Larvae on Aster umbellatus in Nova Scotia (D. Ferguson, USDA Tech. Bull. 1521, and Ferguson, 1954)(chemicals in this sp. repel P. tharos larvae--see tharos--so these larvae possibly were Chlosyne harrisii?). **HOSTPLANT SUMMARY.** A. laevis is evidently the only host in Colo. (and NW Neb.), where its hosts are totally different from those of P. pulchella camillus, and is probably the main host in the Rocky Mts. and a frequent host over most of the range, because laevis ranges over nearly the entire range of P. cocyta (everywhere except N.S.-Nfld.). A. simplex is probably the main host in Minn.-Man. and perhaps E to Penn., and A. umbellatus is reported in N.S.

**EARLY STAGES. SILK WEB.** Oliver (1979a) stated that P. cocyta does not have silk webs. This is often true. However, about half the families of 1st- and 2nd-stage larvae that I have found had a moderate or strong silk web. This web is most frequent over the eggshells, or may be nearby. 1st- and 2nd-stage larvae make webs, but little was noticed by 3rd-stage or older larvae. Most larvae rest on top of the web, but 5 larvae of a family of 27 1st-stage larvae were resting beneath part of the web. Thus I conclude that P. cocyta often does make silk webs, but less often than P. batesii/pulchella.

**DIAPAUSE STAGE.** 4th-stage larvae hibernate in Custer Co. Colo. (head width 1.1 mm in two larvae). Oliver (1972, as Mont.-Alta. "tharos") stated "3rd-stage" (undoubtedly an error for 4th-stage). **EGG** pale green, with ~19-20 ribs (fairly accurate count), averaging 41 eggs per cluster (36 for eggs, 44 for 1st-stage clusters, range 6-95); averaging (Oliver 1972, Mont.-Alta.) 204 eggs/female). Duration 6 days (Oliver 1979a, based on N.Y. "tharos"), probably averaging longer (8-9 days?). **FIRST-STAGE LARVA** yellowish-cream or pale-yellowish or ochre when young (thorax sometimes ochre-tan), after feeding greenish on anterior 2/3 of body, with some low weakly-creamier mounds (a small mound in front of D1 seta, large between D1 & D2, small near SD1, long lateral mound, smaller long sublateral), many or most families have a pattern of darker bands and lines including a weak greener heart-band, a weak tan band enclosing D1 setae, a wide tan or orangish-tan or brown subdorsal area includes D2 setae, a weak slightly-darker greenish lateral line (this pattern of bands & lines was not noticed on some families incl. the S Minn. family, and was darkest on one Colo. family; larvae about to molt into 2nd-stage no doubt usually have a brown subdorsal band because the band of 2nd-stage can be seen through integument of 1st-stage), legs dark-brown, proleg plates light-brown (A10 a bit darker), suranal plate dark-brown with pale seta bases, collar dark-brown with 4 pale seta bases, ventral neck gland present; setae blackish, setal lengths like other Phyciodes; head unmarked black, head

width .27-.28 mm; a silk web is spun on leaf but larvae rest on it. **2ND-STAGE LARVA** greenish-tan when young, with middorsal darker-green or slightly-tan heart-band, a darker green line below it, a light-brown wide subdorsal band, a darker-green sublateral line; body later becomes darker (cream-tan or ochre-tan or light-brown) and the pattern becomes browner, including a brown heart-line (or row of brown dashes), next a light-brown band (or dashes), the dorsal area slightly bluish-green due to food, a cream band encloses BD2 scoli, a wide brown or red-brown dorsolateral band encloses BSD scoli, then a wide slightly-brown band, a cream or pale-tan band includes BL1 scoli, underside tan with slight brown mottling esp. on A1-2; upper scoli light-brown (the tips perhaps slightly but not noticeably paler), BL1-BL3 scoli orangish-tan; collar dark-brown near middorsal axis where the brown usually surrounds pale bump enclosing D1 primary seta, collar tan elsewhere except around dark-brown rim (sometimes tan only on a curved patch enclosing lateral 3 primary setae), suranal plate dark-brown with pale seta bases, proleg plates light-brown, legs dark-brown, ventral neck gland present; head unmarked blackish (but frontoclypeus slightly paler on one), head width .38-.45 mm. **3RD-STAGE LARVA** with pattern of older larva including brown band below BL1 scoli, BD1-2 scoli fairly-light-brown with tips not much paler, BSD scoli darker brown with paler tips, BL1-3 scoli tan, collar black with anteromedial bump cream and a cream patch connecting 2 lateral bumps with posterior bump (each of the 4 bumps carries a primary seta), suranal plate brown, proleg plates light-brown (A10 darker); head like older larva (except one head is entirely blackish except for slightly paler frontoclypeus and faint vertex band) except cream eye patch absent or small and not connected to orangish-cream gena patch beside base of frontoclypeus, head width .55-.75 mm. **4TH-STAGE LARVA** like older larva, BD1-2 & BSD scoli dark-brown with ochre tips, BL1-3 scoli orangish-tan, collar black with cream bumps corresponding to the 4 primary setae, the cream areas on lateral 2 bumps often connected and the cream area on middle anterior bump usually connected to the cream posterior area where D2 primary seta resides; head width .9-1.4 mm. **5TH-STAGE LARVA** like older larva, collar black with 4 cream areas on 4 bumps and all areas except anteromedial cream area often connected, suranal plate dark-brown, often with 2 pale wedges on rear; head width 1.4-1.7 mm.

**OLDER-MATURE LARVA** brown with usual *Phyciodes* pattern, very similar to *P. tharos*, and considering individual variation (the orange areas and overall orangeness of body are somewhat variable and seem to differ little) there are no traits that will always distinguish the two, but the lateral BL1 scoli is usually a little oranger in *cocyta* and creamier in *tharos* (Table 1), *cocyta* often has fewer tiny cream dots than *tharos*, and *cocyta* generally has the dark dorsal area above the subdorsal cream band almost as dark as the wide dark subdorsal band (in part because of fewer tiny cream dots)(but this difference failed in two *tharos* families from S Minn. and W Neb. which were just as dark above as below the cream band, and two *cocyta* families from Custer Co. Colo. & S Minn. had the dorsal area a bit paler than subdorsal dark band); body has brownish-black heart-band enclosing BD1 scoli (a very narrow light-brown ring usually around scoli base), next a narrow orangish-brown or dark-orangish-brown band with many cream dots (a narrow sliver of orange-brown--sometimes brownish-orange--just lateral to BD1 scoli in this band), a wider dark-brown band with some cream dots, a cream band (slightly interrupted on many larvae) includes BD2 scoli (this band is orange or slightly-brownish orange just before and just after scoli), a wide brownish-black band has some cream dots (esp. in middle of band) and band encloses BSD scoli on its lower side (a very narrow light-brown ring usually surrounds scoli base), a mostly-cream band due to many cream dots (band mostly continuous but with many tiny gaps)(in this band just beneath BSD scoli is a small or absent orange-brown or weak brownish-orange dash), a wide fairly-dark orangish-brown band includes black spiracles in its upper part and mostly includes BL1 scoli on its lower edge, a cream band touches BL1 scoli (this scoli surrounded by a ring of orange or brownish-orange or sometimes orange-brown), a dark-brown band, underside fairly-dark grayish-brown or brown; BD1-2 scoli dark-brown with ochre tip, BSD scoli dark-brown (slightly darker than BD1-2) with ochre tip, BL1 scoli orangish-tan (often orangish, seldom orangish-brown) with ochre tip (BL1 most often cream on T1-2 or cream on T1 & orangish-cream on T2), BL3 scoli orangish-tan or brown with paler tip (but often cream on T1); proleg plates light-brown with paler seta bases, but brown on ventral third or half (A3-6 plates mostly or all brown in S Minn.), A10 plate brown on lower half or on anteroventral third; suranal plate light-brown, with an irregular brown patch covering most of narrow anterior end (anterior rim light-brown), the wider posterior end is covered with tiny

black dots and is tan along posterior rim; legs blackish; collar black with cream middorsal ecdysial line and 3 small or large anterior bumps corresponding to positions of primary setae of young larvae, and a small or large cream spot on rear half is at level of cream subdorsal body band; ventral neck gland present; head black with usual cream areas (always a cream membrane above labrum, always a cream middorsal ecdysial line on top of head), the cream (rarely orange-cream) vertex stripe usually extends to neck (rarely it stops somewhat before neck, and rarely its anterior end is constricted to form a satellite spot), cream (or orange-cream) eye crescent almost always extends rearward (wide not narrow) to neck and almost always extends (fairly wide) over eyes, then it widens in front of eyes and covers bottom front of head (where it always extends beneath eyes rearward on postgena to rear mandible joint) then a sliver angles up alongside frontoclypeus (usually touching bottom third of frontoclypeus, sometimes bottom half, rarely extending to near top), frontoclypeus usually has upper 2/3 cream (sometimes orange-cream) but this pale area is sometimes constricted to a moderate spot (rarely a small spot; the darkest frontoclypeus in S Minn. has only two brown spots side-by-side) or a bar across frontoclypeus (in which case the extreme upper tip of frontoclypeus may be pale), the lower third of frontoclypeus frequently has a pale transverse area (frequently lens-shaped) across it (rarely a pale spot at middle bottom)(this pale area is uncommon in tharos); mature larva head width 1.9-2.3 mm; an Ont. larva (photo Jim Troubridge) is similar except ring around BL1 scoli is brown, vertex stripe is orange-cream, and eye crescent is orange-tan, head width 1.9-2.3 mm.

**PUPA** (Colo., Minn.) variable in color, averaging more cream suffusion than tharos, about a quarter of the pupae are quite creamy (with orangish-brown areas on wing base and on front of cones & ridges & head ridge) with moderate darker wing streaks (near end of discal cell,  $\sim R_3-M_3$ ,  $\sim CuA_1$ , below 1A, wing base), about a quarter are orangish-light-brown (the wing mottling moderate to weak), more than a quarter are variously intermediate between those types with varying degrees of creamy coloration, a few are orangish-cream with blackish & cream stripes, a few are light-brownish, a few brownish-gray, and a few are black-&-cream with heavily mottled wings (cream with large blackish streaks on wing and large cream areas on body but  $\sim 50\%$  of body surface appears dark), a few pupae are dark-brown with moderate wing streaks that are not very noticeable because of the dark ground color; in S Minn. most are creamy-light-brown but one is tan-gray, with somewhat weak wing mottling (the small brown discal cell spot most conspicuous); many pupae are unique in lacking orangish-brown (Edwards described some E U.S. tharos as light-gray or dull white, so some may be similar--or these may have been misidentified cocyta); pupae differ between families (some families have mostly creamy pupae, some have pupae mostly orangish-light-brown with some brownish-tan or creamy or brownish-gray pupae, some families have many individuals with strong black & white stripes), the wings are usually moderately or strongly mottled with brownish patches, and few pupae have weakly mottled wings; the pupal color variation is not correlated with adult variation (in width of orange areas on wing, etc.); pattern details like apsaalooke, the usual cream postmedian & marginal dots on wing, often 2 small brown spots on middle of wing (in bases of cells  $M_3$  &  $CuA_1$ ), young pupae have the usual subdorsal & subspiracular creamier bands (edged below with darker-brown) which later disappear, several brown dorsolateral spots A2-8 (one anterior one posterior per segment), a small brown spot anteroventral to spiracle A4-8, lateroventral brown spots on abd. (large on many pupae esp. a highly-mottled-wing pupa), small supraventral brown spots on abd., midventral small brown dots on abd., a cream lateral spot on T1, often a cream spot between antenna bases, the usual cream V aimed forward on top of T2 (edged anteriorly by brown), a weak middorsal cream band on T1-2 is divided by brownish cleavage line, a weak middorsal crest is noticeable on  $\sim 25\%$  of pupae on A2-cone of A4 and includes the cones (this crest generally creamier, and sometimes a creamier middorsal band is also on A1); legs with usual middle spot and sometimes a similar anterior spot, mouthparts with usual pattern and proboscis tip dark-brown; cones & ridges edged anteriorly by orange-brown on the paler pupae or by dark-brown on darker pupae, edged posteriorly with cream, cones rather large & pointed like tharos (quite large on some, somewhat smaller on many, fairly small on some)(cone distribution: middorsal cones A2-7, subdorsal T2, small T3, A2-7, absent or tiny [rarely small] A1, supraspiracular A4); the usual transverse ridges present (largest A4, the A4 ridge may extend to wing but usually has a slightly-flatter space before wing) are quite large on some pupae but smaller on many & fairly small on some pupae, averaging about the same size as tharos; cremaster usually like tharos (extending straight back from abdomen to shoulders then quickly

narrowed to base of tip), but ~30-40% are quite tapered with only slight shoulders like riocolorado, width averaging .94 mm (.99 S Minn.), cremaster moderately rugose but much less so than batesii/pulchella. Pupal duration 10-11 days male, ~11 female. Larval-pupal duration averaged 35 days male (32-53), 39 female (32-70)(Oliver 1979a, as N.Y. "tharos"), 27-28 males and 30-32 females in Pa. vs. 38-41 males and 41-45 females in Vt. (Oliver 1980), 27-36 (34-48 in "field conditions") Alta., and 46-100 Mont. (both sexes, Oliver 1972), 35 days male and 36.5 days female for one family, and about 46 days male 50 female for a second family (my 1994 Colo. data), 37 days male 38 female S Minn.; male-female emergence lag 1-4 days.

## 6. PHYCIODES BATESII (REAKIRT) 1865

(common name Dark Crescent)

(Figs. 8, 12, 19, 29, 48, 133-177,  
222-227, Tables 1-7)

With four ssp. (three new), this species displays considerable geographic variation. Nevertheless the entire species is united by many traits. The unf always has a large posterior black median spot. The upf generally has the median band paler than the postmedian (oranger) band. The upf is dark (the former common name "Tawny Crescent" is ludicrous), except in one oranger southwestern ssp. The species is always univoltine (reports of a second gen. from Mich. are no doubt misidentifications). The hosts are large-leaved rather succulent species (glaucous for three ssp., and "pale or hoary" for the fourth) that all have the leaf bases clasping the stem (this may reduce the whipping of wind-blown leaves and enable the caterpillars to move more easily between leaves and survive better on the host). Thus the species specializes on the best asters at the best time of year, as does P. cocyta, and populations are localized at the best sites (throughout the range, the species tends to be local, occurring in fewer sites than P. cocyta). In contrast, P. tharos and P. pulchella are basically multivoltine and are more polyphagous: their hosts vary from lush asters (but not in pulchella) to small-leaved rough and hairy asters; the hosts of P. tharos overlap those of P. batesii a little, but the hosts of P. pulchella never or rarely overlap. The dorsal scoli tips are dark (only microscopically paler) like P. pulchella, not conspicuously pale like P. tharos/cocyta. The pupal cones & transverse ridges are moderate in size, versus larger for P. tharos/cocyta and small for P. pulchella. The three western ssp. have several traits in common: a brown unh marginal patch, a darker larval head (the frontoclypeus most often black), darker larval cream bands (sometimes nearly--rarely completely--absent), oranger (less reddish) lateral scoli, wider cremaster, lower transverse ridge on A4 of pupa where it meets wing, and glaucous larval hosts that are rather similar in appearance. The geographic variation is clinal or step-clinal from the S Appalachians to Canada and westward to the Black Hills area then southward in the Rockies: the unh marginal brown patch changes from absent to moderate to large, the unf black patches near wing margin grow larger, the larval frontoclypeus cream patch becomes mostly absent, the lateral scoli color becomes less red and more orange then a little oranger, in the Rockies the antenna nudum becomes orange and the larva becomes a little more orangish below BD1 & BSD scoli.

### 6A. PHYCIODES BATESII BATESII (REAKIRT) 1865

(S Appalachians, common name Dark Crescent)

(Figs. 133-136, 222, Tables 1-7)

**DIAGNOSIS.** In S Appalachians the unh of males (fig. 133) always lacks a marginal brown patch and pale crescent, and the unh of females (fig. 136) generally lacks a marginal brown patch (or it is very weak) and usually lacks the crescent (I have examined some adults, and Ronald Gattelle [pers. comm.] has examined many). The pale unh, together with the paler yellower unf apex and subapical unf areas (both on costa and margin), make all adults readily distinguishable from P. batesii lakota. However, the unh marginal patch trait seems to be roughly clinal or step-clinal (the patch and crescent increasing in frequency north to Ontario, then increasing W to Man.-Neb.-Alta.) as detailed below under the N variety of ssp. batesii. The question arises as to how many names to apply to this cline. Some people would use only one name for a cline, but I will use two in this case because 100% of adults from the ends of the

cline can be identified correctly (see type locality restriction below). The larval frontoclypeus always has a cream spot, as in ssp. batesii in Que. and evidently in N.Y., and the hostplant is the non-glaucous Aster undulatus as it probably is in N.Y. and perhaps Que. **IDENTIFICATION.** The unf black spots are large as in P. tharos, but the posterior median black spot is as large or larger than the subapical black spot, the unh is quite uniform yellowish with the marginal patch absent or nearly absent, and the unf is paler (yellowish) on apex and near apex on both costa and margin. The upf median band is usually paler than the postmedian band. The uph submarginal pale band is usually weak. The antenna club is dark to the naked eye; but microscopically, the nudum of males has the border and lattice black, the steps dark-brown or sometimes orange-brown; in females the border and lattice are black, the steps orange (usually narrowly) to dark-brown.

**TYPE LOCALITY.** Reakirt's original description in 1865, based on at least several males and one female, does not describe the ups well enough to distinguish it from dark tharos, but his description of the large posterior median black unf spot and the "ochrey-yellow" unh with no brown patch, make it clear that he was describing C or S Appalachians batesii. The taxonomic problem is that the type locality of batesii is not quite at the S Appalachians end of the cline, so the extant N.C. populations may differ a little from those from the type locality in Va./New Jersey. The batesii syntypes were from Winchester, Frederick Co. Va., and Gloucester, Gloucester Co. N.J. Klots (1951) stated "TL Gloucester, New Jersey", and Miller & Brown (1981) treated this as a TL restriction to N.J. However, I hereby restrict the TL to Winchester Va., for the following reasons: 1) Klots did not mention that he was intentionally restricting the type locality, so his action may have been inadvertent--merely one locality he found in the original description--and thus could be disputed; 2) I agree with what Dr. Frederick Rindge wrote to me: "I do not believe that Klots validly restricted the type locality in his Field Guide, as this was not done in a revisionary study."; 3) Reakirt listed Winchester, Va. first, prior to Gloucester, N.J.; 4) the Gloucester specimen no longer exists according to Ronald Gatrell; 5) most importantly, Va. is closer to the S Appalachians end of the cline as noted above, and because I wish to use only two names in this cline, I want to have the TLs as near as possible to the ends of the cline. Therefore, even if Klots (1951) intentionally restricted the TL to New Jersey, I am hereby correcting it to Va. to place the TL near the end of the cline. My goal is to force the nomenclature as much as possible into obeying natural trends that are shown by the insects themselves, and my perusal of the ICZN Code suggests that the correction of the TL to better match the actual insects' geographic variation does not violate the Code (1985 ICZN Code recommendation 72H(b): "A statement of a type locality that is found to be erroneous should be corrected."). Anyone looking to split and name a new ssp. of batesii in the S Appalachians should realize that the western end of the cline in Man.-Sask.-Neb.--not the SE end in N.C.--is the most distinct from the batesii types (the C and S Appalachians populations differ very little, and not at all in immatures and hostplant), and in fact Reakirt's description of unh fits all specimens from the S Appalachians but only fits some or most of the specimens from the C Appalachians-N.J. Another consideration is that naming the N.C. population as a ssp. would increase collecting of it in almost the only place it still occurs in E U.S. (it is reportedly extinct elsewhere from N.Y. to Ga., though some colonies may still remain undetected, and it may still occur in New England)(but collecting cannot be blamed for the simultaneous disappearance of batesii throughout the Appalachian area, which would seem to involve some general habitat degradation--including fire suppression and reforestation leading to overgrowth of shrubs and trees--that ruined the habitat for batesii, or insecticide spraying/foreign parasitoids released to kill Gypsy Moths). Localities from N.Y. to Va. should be burned to create batesii habitat, and repopulated with Aster undulatus and N.C. batesii. I will therefore use taxonomists' license here, and conservatively use the name batesii for the S Appalachians end of the cline.

**HOSTPLANT.** Ronald Gatrell (pers. comm.) found several clusters of eggs on Aster undulatus in N.C., which he and I reared to adults on various Aster incl. undulatus and laevis. Aster laevis also occurs in this area of N.C., so it could also be a host.

**EARLY STAGES** (N.C., sent by Ronald Gatrell). **EGG** pale green. **MATURE LARVA** dark-brown, overall the spines lend a slightly-red-brown tint to larva (Oliver 1979a states that body color in N.Y. is "brown with pinkish tinge", though "pinkish" undoubtedly refers to the orangish color at the base of some scoli and not to the color of the basic banding pattern), in details heart-band very-dark-brown (BD1 scolus in this band is very-dark-reddish-brown and is brown around base, narrowly tan [not orangish] below ventral base), next a wider dark-brown

band (the upper part includes some tiny tan dots)(the dark dorsal area above BD2 scoli is as dark as the wide dark subdorsal band), a creamy band between BD2 scoli is strong & cream on some larvae but tan-cream and narrower on others, and tan-cream and only 2/3 complete on others (this is the second-most-conspicuous band on body; Oliver 1979a stated that the "dorsal light stripes"--this subdorsal stripe?--are comparatively heavy and even in batesii compared to tharos, which is not true in N.C.), this creamy band is brownish-orange in front of and behind BD2 scolus (BD2 scolus dark-reddish-brown), a wide very-dark-brown subdorsal band (which is blackish just below BD2 scolus) has a row of a few creamy dots just above BSD scoli and is blackish-brown below that as it encloses BSD scoli (BSD scolus blackish-brown, with no orangish color below it), a band of some irregular cream patches just above spiracles, a wide reddish-dark-brown band includes spiracles and area below them, a larger tiny cream dot anterodorsal to BL1 scolus, a cream lateral band (narrow at segment joints)(the most conspicuous light band on body) encloses bottom part of BL1 scolus, BL1 scolus dull-red (orangish-red with brown base)(slightly redder than the reddest of batesii lakota), around BL1 a ring of reddish-brown to brown (on different larvae), underside dark-brown, BL3 scoli brownish-red-orange, on T1 BL1 and BL3 are orange-cream, all scoli have paler (tan) tips but the paler color is not noticeable except under the microscope, legs black, prolegs dark-brown; collar blackish-brown (blackish behind upper bump) with creamier middorsal cleavage line on rear half, three anterior ochre oval bumps with setae (corresponding to 3 primary setae of 1st-stage), a cream patch on rear half (posteroventral to upper oval bump) (these 4 pale areas on collar are small on some larvae and very large on some others); head black, with usual cream stripe on vertex, and cream check mark on lower face (narrow where it extends laterally down from frontoclypeus then wider to above eyes, where it narrows and extends rearward and downward behind eyes then may be interrupted and then widens and becomes sinuous as it extends to near rear of head), dorsal 2/3 of frontoclypeus has a cream patch (which is very large and triangular in one larva like fig. 222, slightly smaller with a dorsal cream fingerlike extension in three larvae, smaller with a dorsal tiny cream satellite in one larva, small and round in one larva like fig. 225), the usual gray intersegmental area above labrum and usual creamier middorsal coronal cleavage line; duration of (nondiapause) larval stages roughly about 34 days in lab.

**PUPA** overall color somewhat creamy orangish-light-brown mottled with dark-brown (one is slightly-oranger), with strong brown wing mottling, 2 of 6 pupae have slightly darker wings and distal 1/3 of proboscis, no correlation between size of larval cream frontoclypeus patch and color of pupa; in details, very young pupa has the usual two creamy bands (a dorsolateral creamy band along BD2 cones, and a weak creamy band below spiracles [above the sublateral brown abdomen band]) which disappear after a day or two, wing highly mottled with dark-brown (a brown streak fills outer part of discal cell, which is weakly connected to a brown patch on outer part of cells R<sub>5</sub>-M<sub>3</sub>, brown outer part of wing from vein CuA<sub>1</sub> to middle of A<sub>1</sub>+A<sub>2</sub>, the usual brown streak along anal margin on outer half of wing, anterior & dorsal sides of wing base ridges brown as usual), the usual row of cream (brown-edged) postmedian dots in cells R<sub>5</sub>-CuA<sub>2</sub> (the posterior dots often missing), a brown median-postmedian dot in cells M<sub>3</sub>-CuA<sub>1</sub> or CuA<sub>2</sub>, a cream marginal dash at ends of most veins, head has usual brown staple-shaped mark along lateral & ventral edges of front (edged posteriorly on lateral and bottom edges by a cream line), the usual cream middorsal spot between antenna bases on rear of head, T1 has usual cream lateral spot, T2 top has usual middorsal cream V-shaped mark (pointed anteriorly) laterally edged by brown (a brown middorsal ecdysial line runs all along T1-2), smaller narrower V's on T3-A1 represent vestiges of a middorsal cone there, leg has usual brown then cream spot (rear leg may have second similar pattern near tip), proboscis dark-brown at tip, the usual brown-then cream spots on antenna segments, the usual abdominal rows of brown brown spots (sublateral, supraventral, midventral), two brown dots near spiracle on A4-8 or A5-7 (one anteroventral to spiracle, the other lower down below spiracle), much below subdorsal row of cones are two brown spots on each abd. segment (one near front of segment, another near rear), transverse ridges moderate in size (T2 cone decreases in height then increases to wing base, largest ridge across A4, smaller across A5-7) and edged by dark-brown anteriorly and by cream posteriorly, the A4 ridge is still fairly high beside wing (the A4 ridge is high near wing in P. tharos/cocytia, but mostly flattens near wing in lakota/apsaalooke/anasazi), a weak (quite weak in about half the pupae) middorsal crest from A2 (very weak on front of A1) to cone of A4, cones moderate in size (middorsal A2 small, A3 fairly large, A4 largest, A5-7 fairly large; subdorsal T2 moderate,

T3 small, A1 tiny, A2-3 & A5-7 larger, A4 moderate [largest]; supraspiracular A4 fairly small), the cones are cream on rear, brown on front and have a touch of orangish-brown near summit of anterior side, cremaster shouldered (usually expanded laterally then tapering to cremaster), billowy beneath, width 0.8-1.1 mm (mean .95); duration 9 days male, 10 female in lab.

**6A. PHYCIODES BATESII BATESII,**  
(variety C Appalachians to extreme E Ont. with  
occasional to frequent small brown unh  
marginal patch)(common name Dark Crescent)

**DIAGNOSIS.** Distinguished from other ssp. by relatively paler unh with marginal patch absent or present, older larval frontoclypeus has a cream patch, and host is the non-glaucous Aster undulatus rather than the glaucous A. laevis/A. glaucodes of the three western ssp.

**IDENTIFICATION:** Resembles P. tharos, and the unf black spots are large, but the posterior median black spot is as large or larger than the subapical black spot. The upf median band is usually paler than the postmedian band. The uph submarginal band is usually weak. The antenna club is dark with the naked eye: microscopically, the nudum of males has the border black (occasionally brown) with black (rarely brown) lattice, the steps orange to narrowly dark-brown; in females the border is brown to black, the lattice dark-brown to black, the steps orange (usually narrow) to dark-brown.

**CLINE OF UNH MARGINAL PATCH.** The brown unh marginal patch and pale unh marginal crescent vary esp. in males (females often have both patch and crescent) in a roughly clinal fashion involving ssp. batesii and ssp. lakota, decreasing in frequency eastward (from Alta./Neb. to Ont.) then decreasing southward in the Appalachians: In **ALTA.** the marginal brown patch is always present (3 had large brown patch with silvery crescent, 2 moderate patch with silvery crescent, 1 moderate patch with dull cream crescent, 1 fairly-small patch with dull cream crescent, 1 large patch with ochre crescent, 4 large patch with no crescent, 1 very small patch with no crescent). In **NEB./BLACK HILLS** the marginal brown patch is always present (varying from dark brown to narrower and lighter-brown) and the crescent is usually present and yellowish on males and creamy on females (the crescent is absent on some males and a few females). One **SASK.** male has a strong brown patch with no crescent. Eastward in **MAN./MICH.** all females have a marginal brown patch with a pale crescent, and most males have a strong (6) or moderate (4) patch, but a few have a weak (2) or absent (1) patch (in males the crescent is absent, or present and yellowish in color, rarely slightly-creamy). In **ONT.** on E side Lake Huron (not far from Mich.) most have a patch and no crescent (one male had the patch nearly absent, 1 male a small patch, 5 males a fairly strong patch [one with a yellowish-cream crescent], & 3 males with a rather strong patch [one with a silver crescent]); in **ONT.** near Ottawa and near Lake Ontario fewer males have the patch (Layberry et al. 1982 illustrate a male without the patch [and with pale unf tip], Tilden & Smith 1986 a male with a weak patch, a male and female from Oakville have a weak patch [the female has a cream crescent], a male from Carleton Co. has almost no patch). In **QUE.** the unh lacks the marginal patch and crescent (male fig. by Opler & Malikul 1992, male fig. by McDunnough 1920, and a Montreal female fig. by Bauer 1975 [both have pale unf tip also]) or has a moderate patch and yellow crescent (male fig. by Klots 1951) or a strong patch and pale crescent (female fig. McDunnough 1920). **From N.Y. to PENN.** evidently most or very many lack a marginal patch and often lack the crescent: I have seen a rather weak marginal patch and crescent and moderate patch and yellow crescent on two Onondaga Co. N.Y. males (figs. in Glassberg 1993 [fig. 5; but note that fig. 4 is obviously a misidentified mislabeled P. phaon male with orange antenna clubs] & Ferris & Brown 1981), a weak patch on one male one female (figs. Oliver 1979a), and two others lack a patch (R. Gardner, pers. comm.), and have seen an absent patch and weak yellowish crescent on an Albany N.Y. male. Shapiro (1966) drew a Pa.-N.J. female (near the syntype locality Gloucester N.J.) that completely lacks the patch and crescent. In **VIRGINIA** Clark & Clark (1951) figure a mostly-absent patch and weak yellowish crescent on a female. **N.C.-GA.** adults have the lowest frequency, as males never have marginal unh markings (Ronald Gatrell pers. comm.; the only marginal brown I have seen on N.C. adults was very weak brown patch on one female). I do not think that N.C.-Ga. adults should be described as a separate subspecies however, because the above specimens demonstrate that adults from N.Y.-Va. and often Que.

and rarely west to Mich. also have absent or small unh markings. Various authors specifically stated that the unh of C Appalachians adults lacks the brown marginal patch of tharos: Klots (1951) reported the unh is "comparatively unmarked yellow", a statement based on C or N Appalachians material (perhaps N.Y.-N.J.) since the species was not known from the S Appalachians then; Forbes (1960) stated "Male under side of hind wing almost solid yellow" "without the brown marginal patch in male and only traces in female, the crescent usually silver" "Northward, from Montreal to Lake Huron, at least, specimens show clearer traces of the tharos pattern below"; Bauer (1975) stated "yellow, comparatively lightly marked" unh; Pyle (1981) stated unh has "light markings" (Pyle's fig. 575 right is batesii with small marginal brown patch, but 575 left appears to be a misidentified female P. cocyta or P. tharos); Glassberg (1993) stated unh "markings are greatly reduced"; Ferris & Brown (1981) repeated this literature information that unh "dark border is obsolete to absent" (which is true of Appalachian populations, but is absolutely wrong for Rocky Mtn. pops. and for the batesii lakota populations they intended to describe). I corrected the TL of batesii above, and am using only two names for this cline, one for each end, and not three names which would result if the extant N.C. populations were named as a distinct ssp.

**RANGE.** Ssp. batesii--as I have used taxonomists' license to force the concept--occurs in pure form in the S Appalachians in Ga.-N.C., W. Va.-western Va. adults are probably very similar, while adults are less pure northward in the Appalachians, and I am still using the name for extreme E Ont.-Que. populations, because they also have many adults with unmarked unh, and their larval frontoclypeus and host are like that in N.C., thus they appear to be nearer batesii than lakota.

**SPECIES STATUS.** Oliver (1979a) hybridized ssp. batesii with P. tharos tharos (his "tharos type A") and P. cocyta (his Syracuse "tharos type B") in the lab; lab batesii males approached females of the other species but did not attempt to join evidently because of the wrong pheromone; some infertility and inviability of hybrid eggs and pupae was found (more in hybrids with tharos than with cocyta), esp. when the mother was batesii (some of these hybrids even had twisted abdomens), showing how batesii has had to develop reproductive isolation to protect itself from being swamped by abundant tharos males; the proper male-female emergence lag was disrupted in hybrids. Oliver stated that long-photoperiod non-diapausing lab larvae produced adults with heavier black pattern on ups and uns (dubious: this heavier pattern did NOT occur in the P. batesii lakota I reared).

**HABITAT AND CONSERVATION.** Ssp. batesii generally occurs in open areas, described by various authors as the site of an old abandoned sawmill (thus open due to tree-cutting) in Ga., roadsides and open fields on a forested shale mountain in N.C., borders of woods and glades in woods in Va., shale savannah ("barrens") or rocky riparian slopes in Appalachians of Penn. & W.Va., dry meadows & esp. old pastures (usually with much Andropogon grass) in Delaware Valley (Shapiro 1966), dry open hillside fields (Klots 1951), dry hillsides & rocky upland pastures (showing some preference for acid soils) in N.Y., dry limestone ledges (in brushland)(near a creek in Jamesville, Syracuse) in central N.Y., dry areas near Ottawa, the lower dry open brushy slopes of a small ridge adjacent to a wood in Que. These descriptions all have this in common: the habitat is drier open areas (essentially savannah or brushland or pastures). Thus in these relatively wet areas of the eastern deciduous forest biome, ssp. batesii in general prefers relatively dry areas in open forest or shrubland, whereas in the drier westward range of P. b. lakota, populations occur in comparatively wetter areas such as gallery forest and moist gulches within dry open woods (the Rocky Mts. ssp. occur in canyons with cool slopes and creeks). Statements about habitat can be misleading: for instance, statements that habitat is a wet meadow probably refers only to a location of mate-location by patrolling males (in Neb. batesii lakota males sometimes patrol about a wet meadow also, but no Aster grow there, and males also patrol gulches etc.); likewise, a statement that habitat is dry bluffs ignores the mate-location of males in gulch/valley bottoms often beside streams. All Phyciodes species of the tharos/pulchella group mate-locate preferably by patrolling in valley/gulch bottoms (or the nearest local representative such as roadside ditches; they also patrol some near the host), and all oviposit in valley bottoms/flats/slopes; ssp. batesii is surely no exception. Therefore the basic habitat of batesii batesii is relatively-dry savannah/brushy openings. Savannah has mostly disappeared in the U.S. (Nature Conservancy magazine Nov./Dec. 1993) due to its conversion to farms and pastures; its openness was originally maintained by fire. Perhaps the loss of savannah to agriculture, and the recent overgrowth of trees/shrubs caused by misguided fire

prevention, caused the extirpation of most of the batesii colonies from N.Y. to Ga. (we need a new forest management campaign--which should include hanging Smoky the Bear in effigy--that maximizes the diversity of life in the forest through judicious burning and logging etc., rather than the old program that extinguishes all fires and converts the forest into a choking-thick stand of a few species of lumber trees). Other causes of extinction could be spraying of insecticides and introduction of parasitoids to control gypsy moths (gypsy moth spraying is said to be making Pyrgus centaureae wyandot scarce in Md.), elimination of habitat such as the best nectaring area at the Jamesville (Syracuse) pop. being destroyed by construction of a power plant (overcollecting might have been a factor here? because the site was widely publicized when it was the last remaining N.Y. colony), crowding of asters by introduced Bromus inermis or Agropyron repens or similarly aggressively-spreading grasses (doubtful because the grass was widespread by 1900 or before), etc. A huge human population has "developed" the area: for example the type locality Winchester Va. suffered a massive automobile tire fire a decade ago that burned for more than nine months and released 690,000 gallons of oil. The extinction became apparent only recently, as the last colonies disappeared from the 1960s to 1990. Even by 1974 the only colony left in N.Y. was in Onondaga Co., but that went extinct by about 1990. A population at Cresheim, Philadelphia Co. Pa. was still present in 1980 but became extinct. By 1993 the only colonies left from N.Y./N.J. to Ga. were in W N.C. P. batesii now (1994) occurs only in the Great Smokies area--the highest part of the Appalachians--which suggests that the lower altitude Appalachians were farmed and urbanized so much that suitable areas for batesii were gradually choked out. Luckily ssp. near batesii is still common in E Ont. and nearby Que., and P. b. lakota is widespread over most of Canada, so adults can be reintroduced to E U.S. once the causes of extinction are found and habitats are rejuvenated by burning and logging.

Adults are said to be more local and sedentary than tharos.

**FLIGHT PERIOD.** From N.Y.-Ga. (various authors) (and in Neb. ssp. lakota), adults mostly fly between the first and second flights of P. tharos. Only northwestward in another ssp. lakota (S Man., Klassen et al. 1989), do adults usually fly with the first flight of tharos. Adults do fly mostly at the same time as the single flight of P. cocyta (incl. near Ottawa, where the "tharos" of Layberry et al. [1982] is actually cocyta). Adults fly L May-M June in S Appalachians, May 20-July 21 in C N.Y., M June-E July in Delaware Valley, L May-June near Ottawa.

**HOSTPLANTS.** The hosts of ssp. batesii are poorly documented. Ronald Gatrell found two clusters of eggs on A. undulatus in N.C. as noted above, the only definite host record. All the many previously-published references to Aster undulatus evidently originate from William Saunders' statement (cited in Macy & Shepard 1941) that A. undulatus is the host (presumably in E Ont. where Saunders lived); no one has published real data, and I have been unable to find a published record by Saunders himself. And that record is old (Saunders published many papers in Can. Ent. 1868-1882 and perhaps earlier in other journals) when some asters were not yet named, thus is inadequate because the host may have been misidentified. McDunnough (1920) found a cluster of 1st-stage larvae on "Aster with heart-shaped leaves", and several females laid an egg cluster on this aster in lab; but many asters with heart-shaped leaves occur in that area (Que. just N Ottawa) including A. macrophyllus, cordifolius, ciliolatus, and undulatus. A. macrophyllus seems a likely possibility for McDunnough's host record, because it has thick cordate ("heart-shaped") leaves (the upper stem leaves less cordate) and its range (N.B. & N.S. to Gaspé & Que. to Thunder Bay Distr. Ont. & Minn. Wisc., S to Penn. & Ill. & mts. S to Del. Tenn. & Ga.) fits the range of eastern batesii well; A. cordifolius occurs in Que. and has both basal and stem leaves cordate, though thin, and its range (N.S. N.B. to Que. [SW Que. & Gaspé] & Minn. S to Ga. Ala. Mo. Kans.) fits well; A. ciliolatus occurs in Que. (range Anticosti I., N.S., Me., Que. to Hudson Bay region & N B.C., Mackenzie, Great Bear Lake, S to N.Y., W to Minn., S.D., Mont., Wyo.) but not in the Appalachian range of batesii, and its basal leaves are merely shallowly-heart-shaped to rounded at base and upper leaves are almost never heart-shaped; A. undulatus may not range quite to Que. (range N.S. and Me. N.H. N.Y. to S Ont. and Minn., S to Fla., Ala., La., Miss., and Ark.) and only its basal leaves are heart-shaped (its range encompasses the P. batesii range in E U.S. but not from Que.-N.W.T.-Mont.-Neb.); A. laevis has upper stem leaves heart-shaped as they clasp the stem in the V, and it occurs in Que., but lower leaves are lanceolate (not heart-shaped)(it is the host in Neb. so could be a host in Que. also). Thus A. macrophyllus and cordifolius are the most likely hosts at McDunnough's site (A. laevis is most likely over the entire range of P. batesii lakota as shown

below). Oliver (1979a) stated that A. undulatus is common at batesii sites, but a female refused to oviposit on A. undulatus in lab (a poor sample size N=1) but did lay on Aster simplex, and 200+ adults released at a site possessing A. simplex but not A. undulatus produced a group of small larvae on A. simplex, but this colony presumably died out since nothing was later written or heard about it. Since then several other authors have repeated A. simplex as a host, notably Layberry et al. (1982) who stated "possibly A. simplex" near Ottawa (obviously they had not read McDunnough [1920] on batesii near Ottawa, since simplex has narrow leaves that are not heart-shaped). Throughout its range, P. batesii is evidently a species that occurs only locally in the areas with large-leaved lush Aster, and A. simplex does not qualify as a large-leaved Aster. Scudder (Butterflies of New England) stated only that a female refused to lay eggs on Aster novae-angliae, which proves little because N=1.

**EARLY STAGES** (Que., from McDunnough 1920; N.Y., Oliver 1979a). **DIAPAUSE STAGE** 4th-stage larva (McDunnough 1920). **LARVAL WEB.** McDunnough (1920) states that the 1st-2nd-stage larvae live on underside of leaf in a fine web, and Oliver (1979a) states that 1st-2nd-stages of both batesii and pulchella live in [actually they usually live on the web rather than in it] a loose web, although Oliver (1982) describes it as a "rudimentary communal web", whereas tharos does not live in a web [actually it sometimes does make a strong web]. **EGG:** pale green, conical with ~20 vertical ribs; duration 11 days, 7-7.5 days in lab (Oliver 1979a). **1ST-STAGE LARVA** pale-ochreous (greenish after feeding) with pale setae, collar tan; head black-brown with pale setae. **2ND-STAGE LARVA** pale-ochreous with greenish tinge (the body probably has darker bands esp. when older, as in all other Phyciodes 2nd-stage larvae), the usual collar and scoli; head black. **3RD-STAGE LARVA** green [probably slightly-greenish brown] with white scoli covered with black-brown setae, BSD scoli preceded by a lunate patch of brown at base esp. on posterior segments, in late stages dirty-brown "dorsal" (middorsal) and "lateral" (subdorsal?) lines appear and a pale subdorsal line includes BD2 scoli; head black-brown with pale frontoclypeus and usual pale vertex streak. **4TH-STAGE LARVAE** pale-greenish-brown [I doubt that larva is truly greenish] becoming deep muddy brown, with subdorsal and subspiracular creamy stripes, a dark area between subdorsal line and black spiracles, spiracular area paler, pale scoli covered with brown setae; head black-brown with the usual cream subdorsal dash on vertex, the frontoclypeus pale.

**5TH-6TH-STAGE (MATURE) LARVA** (Que., McDunnough 1920) "deep-purple-brown" ["purple" is certainly an erroneous description which must mean dark-brown with orange or reddish markings, as there is no purple color on any Phyciodes] with scattered tiny white dots, (evidently the dark dorsal area above BD2 scoli is as dark as the wide dark subdorsal band), BD2 scoli have traces of orange at base, a pale or "pale-yellow" (must be cream because there is no yellow band on any Phyciodes) subdorsal line through BD2 scoli, a broad pale or "pale-yellow" (must be tan because there is no yellow band on any Phyciodes) area ("band") encloses spiracles due to tiny white dots, a weak supraspiracular line [within the previous area] due to cream dots, a very distinct "pale-yellow" (must be cream) band edging bottom of BL1 scoli; scoli somewhat paler than deep purple-brown (except BSD scoli darker than this at times)\*\*Note: Oliver 1979a states "tubercle" [=scolus] color is "light pinkish-brown" in batesii versus "gray or dark brown" with white tips in tharos, but this statement is next to useless because he did not state which scoli he was describing; I cannot accept that real scoli are this pale, and they are doubtfully pink because no Phyciodes has the scoli this color [Table 1][the dorsal Phyciodes scoli vary only from brown to black, and the ventral BL1 and BL3 Phyciodes scoli are usually orangish-tan or even cream and vary only from ochre-tan to orangish to brown or rarely black; perhaps Oliver was attempting to describe the dull-reddish base of BL1 scoli of batesii batesii, which certainly are not "pink"], and McDunnough 1920 states that the scoli are somewhat paler or deeper than "deep-purple-brown".\*\*) with pale or white base (and "white tip" on 6th-stage)\*\*Note: the pillared tips of BD1-2 and BSD scoli are microscopically paler but are not conspicuously paler or white in N.C. batesii batesii larvae or in Neb. batesii lakota larvae, and Oliver 1979a states that scoli "tubercle" tip color is concolorous light-brown, so I conclude that the tips are not conspicuously pale on live larvae, despite the statement of McDunnough that the spines have a "white tip"; these scoli tips are conspicuously paler in P. tharos/cocyta which have cream pillared tips, and Oliver 1979a concurs by stating that tharos tubercle tip color is white.\*\*), setae black-brown (\*\*Note: Oliver 1979a stated in error that setae are chocolate-brown in batesii versus light-brown in tharos; actually batesii and tharos/cocyta and pulchella all have the same two seta colors and their same distribution on the

scoli.\*\*), spiracles black, legs black; head black with a white vertical band extending from top of head halfway down "cheeks", (extent of a lateral white area at base of gena rather variable), a white semicircular eye band extends on gena from bottom of head around and above the eyes (eyes white [dubious] on a black patch), apical 2/3 of frontoclypeus white, a white streak across bottom of frontoclypeus [actually on membrane below it](Oliver's 1979a sloppy words declared that the white patches on head are greatly restricted "dorsally and laterally" on *batesii* [versus extensive in *tharos*]; actually only the anterior frontoclypeus patch and anterior/lateral eye crescent are generally smaller and more variable in size in all three western *batesii* ssp., so perhaps Oliver's statement means that the amount of cream on the frontoclypeus is less on N.Y. *batesii* than on *tharos*); duration of all larval stages 26-40 days (but many hibernate).

**PUPA** (Que., McDunnough 1920, including photos) light-creamy-brown (the pupa is fairly creamy in Que. and N.C., as is the adult unh), mottled with brown and very-tiny brown & cream dashes & spots like all *Phyciodes*; wings have brown veins and a brown patch in end of discal cell and a weak brown area near margin in cells  $\sim R_4-M_3$  and a brown patch near tornus, and a double row of postmedian and marginal white bumps near wing tip, the usual 2 brown dots on middle of wing (in bases of cells  $M_3$  &  $CuA_1$ )(these spots are on medial edge of the 2 cream postmedian spots there on McDunnough's fig. 10); intersegmental areas show traces of subsorsal and subspiracular pale lines of larva [these fade with age], a faint paler middorsal band on abdomen, a creamier spot between antenna bases on McDunnough's fig. 8, a large cream lateral area on T1, the usual midventral, supraventral, and lateroventral rows of small brown abdomen spots on his fig. 9, proboscis tip dark-brown, antenna sheath dark with the usual cream transverse spot on each segment, antenna club darker, legs have the usual brown-then-cream marking, spiracles "pale-orange" (no doubt chitin-brown), the usual anteriorly-pointed cream V (edged anteriorly by brown) on top of T2; shape and ridges as in *P. tharos* but a little smaller, the usual ridges on wing base are brown anteriorly and dorsally, the usual transverse ridges are on T2 and A4-7 (largest A4, which has its brown-to-cream color contact connected to the brown-to-cream color contact of the tornal wing streak), these ridges are moderate in size on McDunnough's fig 10 (Oliver 1979a also noted that the dorsal projections are smaller than *tharos* and thus the pupa is more rounded in outline in *batesii*); the usual *Phyciodes* cones present (middorsal cones appear on figs. to be tiny A2, small A3, larger A4-7, subsorsal larger T2, weak T3, tiny or absent A1, small A2-3, larger A4-7, less large supraspiracular A4), (all cones except those on A2-3 are part of the transverse ridges), the anterior slope of each ridge & cone is dark, the posterior slope cream, (cones described as distinctly orange-tinged by McDunnough so anterior slopes must be orange-brown); pupal duration 8-13 days. Combined median larval-pupal duration in lab  $\sim 55$  days male (33-107), 57 days female (38-134)(Oliver 1979a), although many diapause even in continuous light.

## 6B. PHYCIODES BATESII LAKOTA SCOTT 1994,

### NEW SUBSPECIES

(common name Lakota Crescent)

(Figs. 8, 137-148, 223-225, Tables 1-7)

**DIAGNOSIS.** Distinguished from ssp. *batesii* by the usually-large unh brown marginal patch, by the usual absence of a cream patch on older larval frontoclypeus, the less-red lateral scoli of larvae, the higher A4 pupal ridge as it nears wing, and by the glaucous larval host (the latter two traits as in *P. batesii* *apsaalooke* and *P. b. anasazi*). **IDENTIFICATION:** The unf black spots are large like *P. tharos*, but the posterior median black spot is as large or larger than the subapical black spot (it is wide on all males and on nearly all females although divided into two black spots on a very few females). The upf median band is nearly always quite noticeably paler than the postmedian band. The uph submarginal cream band is usually weak. Some females are difficult to distinguish from *P. tharos* and *P. cocyta* in wing pattern, but the blackish (to the naked eye) antenna club will generally distinguish them, since the latter species--where they occur with *batesii*--usually have conspicuous orange on the club. The club is always dark to the naked eye, but microscopically, the antenna club nudum of males has the border black (occasionally brown) with black (rarely brown) lattice, the steps orange to narrowly dark-brown; in females the border is brown to black, the lattice dark-brown to black, the steps orange (usually narrow) to dark-brown). **VARIATION:** The unh brown patch is nearly always large

and brown, but one family had a pale-brown patch that was narrow in males and limited to the margin (this family also had smaller unf black spots, and in wing pattern resembles N Appalachians adults), and another family had slightly-smaller patches. Several families had larger unf black spots that approach those of western P. b. apsaalooke (the unf tornus spot often large and black, and even the marginal spot near apex often blackish); some of these adults (see fig. 141) in fact are identical to apsaalooke, except the antenna clubs are always dark (vs. always orange in apsaalooke). The amount of orange on ups varies somewhat within and between families, so most adults are blackish but many are more orangish, and some females are quite orangish even on upf. One family was very peculiar because all males had a narrow ochre band on unh margin beyond the brown patch; this trait was quite rare in other families. One family had a blacker upf median band in many females. The unh crescent varies somewhat between families: one family had the crescent present on all, whereas other families had the crescent absent on all males and even on half of females (combining all families, the crescent is strong on ~52% of males and ~80% of females, partial on ~29% males ~10% females, absent on ~19% males ~10% females; when present the crescent is nearly always yellow on males, creamy on a very few, but is creamy on most females and yellow on others).

**SUBSPECIES STATUS.** Sympatric with P. tharos & P. cocyta in Man. etc., with P. tharos, P. cocyta, and P. pulchella pulchella in Alta., with tharos, cocyta, and P. pulchella camillus in Black Hills and W Neb. (but camillus is rare there). Thus it is a distinct species from them. No intergradation with camillus or tharos or cocyta was found in reared Neb. batesii (and tharos), contrary to a statement of C. Ferris (in Ferris & Brown 1981), who obviously misidentified numerous specimens. This ssp. is not endangered, and collectors can readily obtain specimens from the vast northern range where batesii lakota occupies most of Canada.

**TYPES.** Holotype male allotype female (both deposited British Mus. Nat. History) and numerous paratypes (some in AMNH) coll. as eggs/larvae Pine Ridge, Sioux Co. Neb., June 24-26, 1994 and reared to adults. **RANGE.** Ssp. lakota occurs in Neb. (TL Sioux Co.) northward into Canada, and east to Man. and Mich. and evidently C Ont., because the unh marginal brown patch is large throughout this range. (My separation of ssp. batesii and lakota is based on this patch plus larval head and hostplant, but I have seen lakota larvae/pupae only from Neb. and ssp. batesii larvae/pupae only from N.C., though published descriptions are available from N.Y. and Que., and hostplants are known only in Neb., Que., and N.C.). Due to confusion with tharos, many batesii records are erroneous, including all records from Ind. (Shull 1987), Ohio, Ill., Iowa, and S Wis.

**NAME.** The name lakota is from the Lakota indians, which is the name the western Teton Sioux indians call themselves (versus the Nakota for the central Yankton Sioux, and Dakota for the eastern Santee Sioux). The word dakota could have been used because the butterfly also occurs in North and South Dakota, but only the eastern indians call themselves Dakota; the TL is Sioux Co. Neb., but the name Sioux is merely a mistaken popularization of a word the Chippewa indians gave to the french. The only problem here is that prior to a few hundred years ago, the Comanche indians evidently occupied W Nebraska, when the Sioux indians were in Minn.-Wis. etc.; but there is little surviving record of that time, and Minn.-Wis. occur in P. b. lakota anyway.

**HABITAT.** The habitat is described as along roads through Red & Jack Pine & poplar/birch forest in N Minn. (W. Bergman), along trails in poplar woods in Sask., and upland (less moist) Ponderosa Pine savannah in S.D. (where P. cocyta is found in wetter areas near creeks, Steven Spomer pers. comm.). In Neb. it occurs in hilly grassy open Ponderosa Pine savannah with rocky limestone gulches. In Mich. and Man. wetter habitats are described: moist areas in Mich. & Wis. (M. Nielsen, in Oliver 1979a), and in or near wet areas in forest openings, meadows, trails and roadsides in Manitoba (Klassen et al. 1989); however the Mich. description may have been confused with P. tharos/cocyta because the partial second brood they described is probably misidentified P. tharos/cocyta; and given the precipitation/evapotranspiration profile of Man., what open areas are not near wet areas? These descriptions are also of open areas. And in Alta. (Norbert Kondla pers. comm.) batesii occurs in mesic forest (not dense forest, not really dry or wet) and shrublands: specifically, cottonwood-poplar gallery forest on the S Alta. plains (aspen-poplar forest in upland hills), aspen parkland in C Alta., comparatively drier forest (such as sand dune complexes) in the boreal forest of N Alta., and shrubby S-facing slopes in the Peace River Valley. The gallery forest habitat on the dry S Alta. plains and the canyon habitat in Neb. are not unlike the habitat of the southwestern ssp. (canyon bottoms with streams lined

with cottonwood-willow trees, and steep gulches on those canyon walls [which is more like the limestone ledge habitat in E U.S.]). *P. batesii lakota* has a vast range in the Canadian taiga, where the term open woods or woods openings will suffice, rather than the savannah habitat in E U.S.

**FLIGHT PERIOD.** In Neb. and Black Hills and N.D., adults mostly fly (in June) between the first and second flights of *P. tharos*; and in Alta. (L June-July) and Sask. (M June-July) adults evidently fly after the peak of the first flight of *tharos*. But in Man. (Klassen et al. 1989) adults (June-July, extremes May 22-Aug. 16) overlap the first flight of *tharos* considerably. Adults fly mostly at the same time as or a little earlier than the peak of the single flight of *P. cocyta*. M. Nielsen (in Opler & Krizek 1984) reports a partial second flight sometimes occurs in Mich., but these are probably misidentified *P. cocyta*.

**HOSTPLANT.** Many eggs/larvae found on *Aster laevis* var. *geyeri* leaf uns, all larvae made silk web at one time or another, many reared to adults on *A. laevis*, a few diapaused as 4th-stage, last larva pickled Aug. 28 (a 5th stage, head width 1.9 mm); Pine Ridge, Sioux Co. Neb., June 24-26, 1994. No larvae found *A. l.* var. *geyeri*, because in spring older larvae must hide at base of plants, Pine Ridge, Sioux Co. Neb., May 16-18, 1994. The hostplant in Nebraska is only *Aster laevis* var. *geyeri* because: 1) numerous eggs and larvae were found on it and reared to adults for positive identification; 2) this plant is very common all over the canyons in gulch bottoms and on all slopes except S-facing slopes; 3) it is a wide-leaf tall *Aster* similar to the possible hosts of *batesii* in Que. just noted; 4) it has glaucous wide leaves like the host of western *batesii* (*Aster glaucodes*) (also, *A. undulatus* is described as "pale or hoary"); 5) other asters in the Neb. canyons are unsuitable: *Aster ericoides* var. *falcatus* is common but seems less desirable because its leaves are tiny and often tough and it ranges widely on the hot plains whereas *batesii* (and *A. laevis*) is restricted to the cooler Pine Ridge canyons; the only other *Aster* found was a couple *A. simplex* plants growing along a creek (too few plants to support a butterfly population), and this species (which is very similar to and interbreeds with *A. hesperius*) seems less suitable as noted above under ssp. *batesii*. Klassen et al. (1989) stated (without data) that the Manitoba host is "probably *A. simplex*", but there is no data for *A. simplex* as a natural host as noted above, thus *A. laevis* is the probable host in Man. and throughout the range. *A. laevis* is probably the main--perhaps only--host of ssp. *lakota*, just as it is the main host for *P. cocyta* in the west at least, because the range of *laevis* (Maine-Quebec-Sask. S to Long I.-Ga.-Ala.-La.-Mo.-E Kans.-E Neb.-N.D., west throughout Alta.-S Yukon-SE & N-C B.C.-E Wash. S to NW Neb.-Utah-N.M.) encompasses the entire range of ssp. *lakota* (*P. batesii lakota* barely creeps over the border into Mackenzie District where *A. laevis* is not yet known, but Porsild's flora states that *laevis* may occur there); *A. laevis* also occurs in the range of ssp. *batesii*, plus most of the range of the western ssp. (*A. umbellatus* is an ERROR, cited by Iftner et al. 1992.)

**EARLY STAGES. LARVAL WEB.** All families made strong silk webs on the hostplant leaf at least at certain times (one family had weaker webs and only made moderate webs several times during the young larval stages, but even in this family the eggshells were covered with a somewhat-silvery sheen due to the silk web). 1st- and 2nd-stage larvae seem to always make webs, whereas 3rd-stage larvae make less noticeable webs (web absent, some web present, or strong web present about equally often in the reared families), and 4th-stage larvae seldom make strong webs (most families made no web, some made a moderate web, only one family made a strong web). The strongest webs are made by larvae that stop feeding and are preparing to molt, because they apply silk continuously as they crawl over the molting spot, which soon becomes silvery with silk. But they make webs at the feeding area also, and one good web was noted even on the leaf edge between where larvae had been and the new feeding area on other side (they shifted sides only because leaf was turned upside down in lab; larvae rest on leaf uns). In nature, larvae frequently drop off the plants (except 1st-stage larvae seldom drop off) or are eaten by ants etc., so 1st- and 2nd-stage silk webs are the norm, but 3rd- and esp. 4th-stage larvae are much more solitary (few larvae manage to survive to the 4th stage in nature), so webs made by 3rd-stage larvae are no doubt rare in nature, and those made by 4th-stage larvae must be very rare. Nearly all larvae live on top of the web, though some get under it occasionally, and most of one family of 21 1st-stage larvae were found under a strong web, thus the webs are seldom used as nests to avoid predators. The strong webs would certainly help the tiny larvae hang onto the plant however, because falling off the plant is a strong cause of mortality (2nd-stage to mature larvae even voluntarily fall off the plant when disturbed, as a predator avoidance

device [another predator deterrent is regurgitation when grasped], and in nature most will probably not find their way back to the plant; this is of course why females generally oviposit where a number of hostplants grow near each other). One family of 20 1st-stage larvae about to molt into 2nd-stage were resting on top of a strong web with their heads facing inward (imperfectly forming the opposite of a circle of Musk Oxen, who form a circle with heads outward to defend their group against wolves).

**DIAPAUSE STAGE** 4th-stage larva. Few larvae diapaused in lab, although some larvae of one family delayed development for a few weeks. **EGG** pale-green, turning yellowish-pale-green, but still greenish 2 days before hatching, but about a day before hatching turns cream as larva develops within and a weak rosy ring marks margin of developing head, egg turns brown (due to dark larva within egg) less than a day before hatching, ~20-21 vertical ribs, average no. of eggs per cluster in nature=41.6 (range 10-80); duration 8 days in lab. **1ST-STAGE LARVA** when young pale-yellowish or pale-yellowish-cream or yellowish-cream, after feeding front half of body bluish-greener due to food (esp. at segment joints from T1-A3 or A4, and darkest T1-3), with creamier mounds (a large low cream mound below D1 seta, smaller cream mound in front of D2, a thin creamy sliver is above a large cream lateral bump between L1 & L2), the brown seta bases appear as very weak bands; body has very little color pattern of darker bands & lines in some families and more in other families (in comparison, *P. tharos* has almost no pattern, *P. cocyta* sometimes has pattern, *pulchella* has strong pattern), including a slightly-greener middorsal heart-line esp. on thorax (this heart-line varies and is absent on some larvae, most often is slightly-greener, or is green on T1-A4 & light-brown posteriorly, or tan, or brown esp. on T2-3), a slightly darker-green line near it (this line varies, absent on some, most often slightly-greener, sometimes tan), dorsolateral area somewhat greener between segments (sometimes only slightly-greener, sometimes a row of browner spots, sometimes area becomes a browner band only on thorax and sometimes is light-brown on ~A4-9), a slightly-darker-green lateral line (sometimes light-brown posteriorly on larvae that had previous bands browner posteriorly); when about to molt (the 2nd-stage head bulges out inside T1 of 1st-stage) body turns yellowish-cream with more orangish-brown pattern because the stronger pattern of the 2nd-stage can be seen through the integument (commonly a weak middorsal brownish line or row of light-brown spots, a weaker similar tan line below it, a wide subdorsal brown band, a weak lateral tan line); collar and suranal plate brown; head blackish, width ~.275 mm; duration ~3 days. **2ND-STAGE LARVA** cream when very young, after feeding body turns greenish-cream (except rear tan-cream), a darker-green middorsal heart-band, a slightly-darker-green line below BD1 scoli (but strongest near rear of segment and somewhat diagonal there [aimed posterodorsally]), a wide russet-brown subdorsal band (darker at/near segment joints), a darker-green lateral line; a little later the body becomes greenish-tan with tan lines, and when larva is roughly halfway through the stage the body becomes tan (sometimes ochre-tan; but one family remained dark-green-tan even when older, another family became brownish) and the bands become browner, including a middorsal slightly-rusty orangish-brown heart-band containing BD1 scoli, a creamier band, a slightly-rusty orangish-brown line, a creamier band containing BD2, a wide subdorsal orangish-brown band, a creamier band, a slightly-rusty faint line along BL1 scoli, a creamier band below BL1 scoli, an orangish-brown line below that; all scoli are pale (BL1-3 scoli are sometimes slightly-orange-cream-tan), but scoli BD1-2 are a little browner on distal half because setae are brown, BSD has only a few brown scoli at tip, BL1-3 have no brown setae; collar brown with ochre patch around D1 seta, and a large ochre patch enclosing D2, XD1, and XD2 setae; suranal plate brown, ventral neck gland present; head blackish, with just a weak indication of the vertex stripe on head capsule; head width ~.4 mm; duration ~5 days. **3RD-STAGE LARVA** brown (occasionally with a little green tint)(or blackish in darkest larvae), with color pattern like mature larva including orangish color in front of and behind BD2 scoli and orangish color around BL1 scoli, but no orangish below BD1 or below BSD scoli, collar similar to 2nd-stage, ventral neck gland present; head black, with cream vertex stripe (rarely totally black with no stripes), head width ~.6-.7 mm; duration ~8 days. **4TH-STAGE LARVA** dark-brown (or blackish in darkest larvae) with full pattern of older larva, orangish areas like 3rd stage, in some larvae the cream band is complete, others are very blackish with subdorsal cream band weak; collar mostly dark-brown with small ochre spot around D1 seta, a moderate-sized sinuous ochre squashed-small-r [the letter r] patch connects and encloses D2, XD1 and XD2 setae, ventral neck gland present; head black, with cream vertex stripe, and variable ventral pattern (usually a tiny orangish area on gena just above mandible and beside

adfrontal sulcus, occasionally an orangish small spot just above eyes, sometimes a small brown spot on frontoclypeus)(just-molted larvae of most families have a brown head with a light-brown frontoclypeus, but the head soon darkens), head width ~.8-.9 mm; duration ~6 days. **5TH-STAGE LARVA** like mature larva, most larvae have subdorsal cream band fairly complete, many have it continuous, a few have the band only a quarter or less complete so larva appears blackish, ventral neck gland present; head black with cream vertex stripe, and variable ventral pattern (usually a cream check on lower gena extends up and over eyes then down and back to rear of head, but this cream band may be nearly absent, limited to a ventromedial patch on lower gena on some larvae, frontoclypeus usually black but may have a brown or cream patch), head width ~1.3-1.45 mm; duration ~6 days.

**6TH-STAGE MATURE LARVA** dark-brown (brownish-black in the darkest larvae) with tiny cream dots; in details, a dark-brown middorsal band through BD1 scoli (wider around scoli), just below BD1 is usually blackish, often narrowly brown, often narrowly gray (no orangish color just below BD1 scoli except rarely a touch of orangish-tan or orangish-brown), then a narrow light-brown band containing some tiny cream dots, a dark-brown band also encloses upper part of BD2 scoli (the dark dorsal area above BD2 scoli is as dark as the wide dark subdorsal band, except rarely is slightly paler), a creamy subdorsal band touches lower part of BD2 scoli (this cream band varies greatly, and is usually fairly complete, sometimes is complete, often quite incomplete, rarely totally absent; a few families had the band usually complete, but more families had the band very incomplete and rarely absent), just in front of and behind BD2 scoli this cream band is usually orange (but pale-orange in many larvae or orangish-cream, in some orangish-brown or black, rarely reddish-orange), a wide blackish-brown band (brown in intersegmental area, band is esp. blackish just below BD2) has cream dots more frequent above BSD scoli and includes BSD scoli on its lower side (the part of this band that includes lower part of BSD scoli is slightly-blackish-dark-brown), the area below BSD is generally brown (very rarely slightly-orangish-brown or orangish-brown ventroposterior to BSD), on T2-3 a cream dash extends rearward from BSD (and includes a slightly-orange-tan tinge beside BSD), a wide dark-brown band encloses spiracles and BL1 scoli (the upper part of this band has many cream dots and patches that form a cream-tan irregular band just above black spiracles; a larger cream spot in this band anteroventral to BSD has a tinge of orangish on its side near BSD) and is wide and brown (with some darker-brown mottling and few cream dots) below spiracles, ring around BL1 scoli orange to brown (in different larvae; on some larvae brownish-orange, some brown, some orange, a few reddish-orange, rarely orangish-black, rarely brownish-black), a cream lateral stripe touches lower part of BL1 scoli (the most conspicuous stripe on body, and fairly strong even when subdorsal cream band is absent), this stripe edged below by dark-brown (a slightly-paler brown line runs above BL3 scoli [the scoli above prolegs]), underside grayish-dark-brown with cream dots; the T1 pattern is simpler, a middorsal brown area, below subdorsal pale band a wide brown area extending down past spiracle, a creamy lateral band containing BL1, underside brown; BD1 scoli blackish-brown with tan tip, BD2 scoli blackish-brown with paler base and tan tip, BSD scoli blackish-brown with tan tip (BSD and BD1 are the darkest scoli because of the paler base of BD2), BL1 scoli usually slightly-reddish-orange with a slight tan tint (rarely orangish-tan, rarely reddish, rarely brown) with tan tip (BL1 less reddish than batesii batesii, but more reddish than batesii anasazi and even more reddish than batesii apsaalooke), BL3 scoli orangish-tan with tan tip, the tips of all batesii lakota scoli are noticeably paler microscopically but not with the naked eye (in contrast to P. tharos/cocytia), the three dorsal scoli above spiracles are blackest just below the paler tip but are light-brown or tan (occasionally brown and not paler) on very tip where scoli branches into several narrow elongate pillars each topped by a seta, the scoli above spiracles have many shorter dark-brown setae and a few longer orange-brown setae (specifically ~6 longer setae near tip of scoli, more at scoli base), whereas BL1 scoli (below spiracles) have few short dark-brown setae (mostly at tip of scoli) and many longer orange-brown setae, and BL3 scoli have only orange-brown setae; proleg shields brown except blackish ventrally and sometimes anteriorly (A10 proleg plate mostly brown on one larva); suranal plate like apsaalooke (widest at rear, brown with tan dots only on rear 2/3 of rectangular anterior portion, anterior edge tan, wide posterior portion tan with blackish seta bases); T1 collar blackish, with four tan bumps corresponding to the positions of primary setae on 1st-stage (collar black medially except for cream ecdysial line and a tan anteromedial seta base, collar black on anterior and lateral rims, and sometimes black behind lateral two seta-containing-bumps, the 2 lateral and

1 posterior bumps are in a large tan patch which extends to rear of collar, rear of collar is black near middorsal cleavage line and laterally); neck gray-brown, ventral neck gland present; head black with a cream subdorsal vertical stripe on vertex ("temple"-top of head)(its anterior end a cream spot slightly-demarcated from rest of stripe by a slight constriction behind spot, posterior end extending to neck)(the anterior end may be separated into a satellite spot on dark heads, and rarely the entire vertex band is almost entirely absent), often a cream crescent dorsoposterior to eyes, or an irregular cream or brown eye stripe behind eyes jogs upward above eyes a little then narrowly extends downward in front of eyes to bottom of head (gena) then extends upward to lower edge of frontoclypeus where it widens (this eye stripe is more common than the pale frontoclypeus patch and thus may be present when the frontoclypeus patch is absent)(this dash extends posteriorly to neck in a wide tan band in some larvae, but in others is interrupted by black then extends to neck as a brown dash), sometimes frontoclypeus has a pale spot on middle (this spot brown or tan or cream, small and round or fairly large [covering dorsal 2/3 of frontoclypeus] and almost triangular [but constricted dorsally] on some)(the frontoclypeus is usually solid black, but most reared families had some individuals with a brown or cream spot, and two families had a majority of larvae with a brown or cream spot), head also has the usual cream membranous area above labrum and cream coronal ecdysial line on top of head; head width ~1.9-2.1 mm; mature larval duration ~5 days.

**PUPA** overall appearance usually light-orangish-brown (the upperside esp. thorax is always darker, being more mottled with dark-brown), but many pupae are creamy-light-brown, some are brown (not very dark), very few are creamy or slightly-reddish-tan or slightly-reddish-brown (no pupa is truly reddish, but a few pupae in some families show a slight-reddish tint to the orangish-brown), there is moderate variation between families (many palest families have only light-orangish-brown pupae, a few families have the majority creamy-light-brown, one family mostly creamy-darker-light-brown, the darkest mostly light-brown, one family had ~55% gray-tan, and one family had mostly orange-tan pupae), blackish dorsal mottling is heavy on a few pupae, wing mottling is most often fairly weak (sometimes weak, rarely absent) but is often moderate, seldom strong; details of pupal pattern like *P. batesii* *apsaalooke*, pupa mottled with brown and very-tiny brown & cream dashes & spots like all *Phyciodes*, the wing has light-brown veins and brown mottling (a brown patch in outer part of discal cell is nearly always present [and sometimes extends weakly to a weak brown streak in ~R<sub>4</sub>-M<sub>3</sub> beyond postmedian pale dots], a brown tornus streak centered on ~CuA<sub>1-2</sub> is weak to strong, wing anal margin is brown near vein 1A+2A, anterior & dorsal slopes of wing base ridges brown), the usual pale postmedian and marginal tiny dots (each on a bump) on wing, the usual 2 brown spots on middle of wing (in bases of cells M<sub>3</sub> & CuA<sub>1</sub>), young pupae have the usual subdorsal (containing cones on A4-7) and sublateral creamier abdomen bands edged beneath by a 1/2-mm-wide brown band (these pale bands disappear after a day or two, while the brown bands diminish to a few small brown spots), a dorsolateral row (much below subdorsal cones) of small brown spots (one anterior & one posterior per segment) on A2-8, a few tiny brown spots below spiracles including a brown dot anteroventral to A4-8 spiracles, a lateroventral row of some fairly large brown spots (usually one on front and one on rear of each segment) on A4-8, (the pupal body is somewhat paler above this row compared to below it), a supraventral row of small brown dots (one per segment) on A5-8, a midventral row of small brown dots on A4-8, the usual brown inverted staple-shaped mark along ventral and lateral edges of front of head (edged posteriorly by a cream line on ventral and lateral edges of head), a creamy spot between antenna bases, a low & wide lateral mound on T1 is cream with brownish in front of it (simulating the colors of subdorsal cones), T1-2 has a creamier middorsal band divided by browner cleavage line, an anteriorly-pointed V-shaped creamier area on top of T2 is anteriorly-edged by light- or darker-brown and the point of the V forms a low point on top of T2, a weak middorsal crest (noticeable on roughly ~80% of pupae) from A2 (and very weakly on front of A1) to cone of A4 includes the middorsal cones (this crest is creamier than ground color, and middorsal axis is slightly-creamy on A1 also), each leg has a brown transverse spot posteriorly-edged by cream (the rear leg has a faint second more-distal similar marking), each antenna segment has a narrow transverse cream ridge and a brown usually-square spot anteriorly beside it, antenna club slightly darker than shaft, tip of proboscis dark-brown, the usual transverse ridges are on T2 and A4-7 (largest A4, which has its brown-to-cream color contact connected to the brown-to-cream color contact of the tornal wing streak), these ridges are moderate in size (slightly smaller on many pupae and slightly larger on many others; the ridges are a little smaller than on *tharos/cocyta* but

much larger than on pulchella), the usual Phyciodes cones present but the cones are extended into points not as far as those of P. tharos/coccyta, middorsal cones absent T3-A1 (a small cream spot lies where the cone would be on these segments), tiny A2, small A3, larger A4-7, subdorsal cone larger T2, absent or small T3, absent or very small A1, larger but fairly small A2-3, A4-7 larger, supraspiracular cone less large A4, (all cones except those on A2-3 are part of the transverse ridges), the anterior slope of each ridge & cone is orange-brown or brownish-orange or brownish, the posterior slope of ridge & cone is cream; brown spiracles on A2-7 (A8 spiracle a useless vestigial slit as on all Phyciodes); cremaster winged (flaring laterally behind A9, then remaining wide for a long or short distance, then narrowing abruptly or more gradually to base of cremaster tip), winged portion 0.8-1.2 mm wide (varying somewhat between families, most averaging 1.02 mm, but lot W7 averaging only .94), cremaster very rugose beneath & laterally. Pupal duration in lab usually 8-9 days male (rarely 6, sometimes 7 or 10, so mean perhaps 8 days), 9-10 days female. Larval-pupal duration in lab averages (an average of family means) 40.2 days males, 42.6 days females (range 38-43 males and 40-45 females among different families). Duration from oviposition to adult emergence in lab ~51 days. Males emerge two days earlier than females in lab on the average (mean 1.9 days for all adults reared, 2.4 days average of family means, range 1.5-4.1, rarely 0, among families), which is no doubt lengthened to 3 or 4 days in nature.

#### 6B. PHYCIODES BATESII LAKOTA,

Alberta variety with slightly oranger ups  
and slightly smaller unlf spots  
(Figs. 173-177)

**DIAGNOSIS.** Resembles ssp. lakota, but the ups averages a little oranger (but many Neb. males are just as orange) and the unlf black spots are a little smaller on many. Only 12 males were seen, from one locality (near Edmonton), so this difference may not prove to be significant, because variation may occur (in Neb., adults vary from blackish to orangish on ups, and the unlf black spots are small in a few and large on some). At any rate, the differences do not seem great enough to name a new ssp. All 12 males had the unh marginal brown patch [weak in 2] and 6 had a cream crescent within it, 2 a weaker yellow crescent, 4 no crescent.

#### 6C. PHYCIODES BATESII APSAALOOKE SCOTT 1994,

NEW SUBSPECIES  
(common name Crow Crescent)  
(Figs. 19, 48, 149-160, 223-226, Tables 1-7)

**DIAGNOSIS.** Similarities to ssp. lakota & batesii: dark upf and oranger uph; two-toned upf (paler postmedian vs. oranger submarginal bands); large black unlf posterior median spot; all hostplants have leaf bases clasping the stem (a fairly uncommon trait among asters); frequent strong lab diapause up to 3 months or more even in 24-hour light (though lab diapause was infrequent in lakota); single yearly flight period; dark scolus tips; pupal cones & ridges smaller than tharos and larger than pulchella; cremaster winged & very rugose. Similarities to lakota but not batesii: glaucous hostplants (the host of western ssp. A. glaucodes is highly glaucous, the host of lakota A. laevis is highly glaucous, whereas the suspected host of ssp. batesii in the east A. undulatus is not glaucous, but is described as "pale or hoary"); A4 pupal ridge lower near wing in lakota, higher in batesii; frontoclypeus usually black like lakota (batesii in contrast has cream frontoclypeus like tharos, while pulchella frontoclypeus is always black); larva very variable but often blacker on body (not especially dark on batesii). Differences from ssp. lakota & batesii: antenna club orange and black (versus dark-brown and black), more precisely, on males the nudum border is darker-orange or orange-brown (rarely yellow-orange), the lattice is brownish-orange or brown, the steps are yellow-orange or sometimes orange, while on females the border is brown or black, the lattice a little darker, the steps mostly orange (rarely yellow-orange or brown); marginal unlf black patches larger, incl. a large black spot in the outer part of cells M<sub>1-2</sub> (this spot is small or absent in most lakota [large in some] and all batesii and most tharos/coccyta); unlf black tornal spot much larger (usually smaller in lakota though occasionally as

large in Neb. [fig. 141] and as large on one Iosco Co. Mich. male, always smaller in batesii, and smaller in tharos/coccyta); both these black unf marginal spots sandwich an ochre marginal crescent in cell  $M_3$  (the key diagnostic wing feature of this ssp.); the unh crescent (when present) is cream in males, not yellowish as it is in lakota (in lakota, the crescent is generally yellowish in males and creamy in females)(crescent present in all females, and in all males of lots D & E, but among males of lot F it was absent on 12, weak on 2, ochre on 1, cream on 2)(the unh marginal brown patch is present like lakota, though weaker in a few, and usually encloses a crescent); the distal edge of the median row of black unf spots from costa to cell  $M_2$  tends to form a straight line that is more horizontal and extends in a point into cell  $M_2$  in most apsaalooke and anasazi, and some lakota, but was not noticed in my fewer batesii (it extends into cell  $M_2$  in a point in some tharos & coccyta & pulchella camillus also, but the distal edge is seldom straight in them); gnathos hooks average a bit smaller (but size overlaps greatly); apsaalooke and anasazi often have orangish color below older larval scoli BD1 & BSD, whereas these areas are very rarely slightly orangish in lakota and brown on all six batesii larvae.

Comparison with P. batesii anasazi: ups darker (vs. quite orange), larvae usually darker and less orange, but larval heads often have larger pale markings. Like anasazi, the unf has large black spots including the large tornus spot and a large marginal spot near apex, unh has a marginal brown patch, and usually a cream crescent; on some adults most submarginal unh spots are slightly cream. **IDENTIFICATION.** It could be confused with sympatric P. pulchella near camillus, but adults have a large black subapical spot on the unf costa, whereas on pulchella that spot is brownish-orange or russet-brown or sometimes dark-brown, with at most only a tiny bit of blackish (the two also have different hosts and lab diapause and larvae and pupae etc.). Differs from P. tharos & coccyta by larger unf marginal black spots (the key feature being the unf marginal ochre crescent being sandwiched by black), more two-toned upf, etc. (Tables 4-5).

**SUBSPECIES STATUS:** Ssp. apsaalooke is the "missing link" between ssp. lakota and ssp. anasazi, because it has the ups wing pattern of lakota & batesii and has most larval/pupal traits of lakota and diapause strategy of batesii, yet has the larger unf black spots and antenna and host and many larval/pupal traits of anasazi. Some splitters might think that the larger unf black spots and oranger antenna make it a distinct species, but there is more difference in unf spot size between P. pulchella pulchella and P. p. camillus than there is between batesii and apsaalooke, and some lakota have equally large unf black marginal spots, and two other species (P. pulchella & P. tharos) have some ssp. with orange antennae and other ssp. with black. It is different in various ways from Appalachian batesii, but ssp. lakota bridges the gap to the extent that lakota is more similar to apsaalooke in host, larval head, larval scolus color, dark larval ground color, and weak A4 pupal ridge near wing. Thus lakota has already made many of the changes leading to apsaalooke.

**TYPES.** holotype male allotype female (both deposited British Mus. Nat. History) and numerous paratypes, all reared (see below) from W Hidden Basin Cgd., Bighorn Co. Wyo., Aug. 17, 1993 (except 3 male paratypes caught same site June 26, 1966). I first found it in 1966 and reported it to the Season Summary as P. batesii, but this identification was doubted by other persons so it ended up as a circle (meaning misidentified--but now proven correct) on R. Stanford's maps. **RANGE.** So far known from Bighorn Co. Wyoming, and probably also occurs in the other counties in the Bighorn Mts. incl. Big Horn Co. Mont. just to the north, and probably adjacent Carbon Co. Mont. because the Stanford & Opler atlas (1993) has a circle in Carbon Co. on the batesii map.

**NAME.** Aps'aalooke--pronounced uhbsahlroeg-yae--is the Crow indian word for their tribe (crow-, sparrow hawk-, or bird-people); it is evidently also the Crow indian word for a bird (but the Raven evidently, not the crow which is Pe'ritsi). A corruption of aps'aalooke--Absaroka--is the current english name of the mountain range at the western edge of what was Crow indian territory. Mr. Euna Rose He Does It (a Crow indian language teacher at Little Bighorn College, Crow Agency, Montana) and another Crow indian Ms. Ava Bellrock of Denver kindly pronounced Crow words for me. According to Euna, Aps'aalooke is the correct spelling for the Crow Tribe, and is pronounced thus: A as in up; P as in baby; S like an English s; AA as in father; L as in blue, but with a quick lateral tap of the tongue (L sounds more like r to me, see below), a quicker sound than the English L; OO as in bode; K like an English g but with a lesser sounding y following; final E as in able. Therefore, the name is pronounced uhbsahlroeg-yae; I could have spelled it more simply as ubsalrogyae, but finally decided to use the correct Crow spelling without trying to spell it in a manner that would ensure that most people pronounce it

correctly (people will always pronounce words in strange ways, for instance the late Donald Eff pronounced Phyciodes "fa-sy-adeez"; should it be "fy-see-oh-deez"??). Mrs. Ava Bellrock pronounced and spelled the name "Absarokee", as did a recent book about the indian hero Joe Medicine Crow, evidently because there has been some drift of language & pronunciation as the Crow language has become spoken by fewer and fewer indians; this word sounds better, but I will use the more authentic spelling. The Crow language has a special orthography, so if I printed the word the way the Crow print it most people would not understand the symbols, and scientific names are required to be spelled in the latin alphabet anyway, so this spelling is the simplest way that allows it to be pronounced fairly correctly, but the name is still a mouthful. The name bilitaishisha--the Crow indian word for butterfly--was considered; the l in this word sounds a little more like an R than an L to me, but Euna Rose--a teacher of language at Little Bighorn College--informed me that there is no R sound in the Crow language and this L is pronounced by making a lateral tap-tap on the top of the mouth with the tip of the tongue (similar to the double RR sound in spanish, as in the spanish word perro pronounced like pay-dro when spoken fast), thus the word could be pronounced beedr-eetaeesheeshuh. The Crow word for gully--pronounced hakoopeh--and for big canyon--pronounced hakupkasha--would have been suitable also. The Crow word for Bighorn Mts. is an unsuitable long description of nearby rivers.

**HABITAT.** Mountain canyons, where S-facing slopes are mostly scattered brush and N-facing slopes are mostly wooded, and the stream has cottonwood willow etc. **HOSTPLANT.** Cluster of 33 eggs (lot #D) on underside of Aster (Eucephalus) glaucodes (ssp. with more-elliptical leaves than in Colo.) leaf of small plant, many diapaused as 4th-stage; cluster of 8 1st-stage larvae and several eggs (lot #E) on same small A. glaucodes plant, some diapaused as 4th-stage; some 2nd-3rd-stage larvae (resulting from about 5 ovipositions)(lot #F) found 10-30 cm above ground on many A. glaucodes plants, the oldest larvae were at lowest altitude in canyon, many diapaused as 4th-stage; adults emerged Sept. 23-Nov. 16 in lab; W Hidden Basin Cgd., Bighorn Co. Wyo., Aug. 17, 1993. The only other asters found were common A. adscendens (the pulchella host here), and a few A. foliaceus growing at the creek edge (thus unsuitable for any Phyciodes because larvae would drown). Aster glaucodes is the same host eaten by P. batesii anasazi, but may be an unnamed ssp. here because the leaves are generally wider (more elliptical) than leaves of Colo. A. glaucodes. The host occurs on steep slopes (usually mostly dirt, sometimes heavily vegetated where the plants spread from a dirt slope) at the edge of a creek, and less commonly in small steep gulches on the canyon walls. The habitat of the host fits the habitat of the butterfly, and the range of A. glaucodes (Wyo.-W Colo.-Utah-N Ariz.) fits the combined range of the western P. batesii ssp., suggesting that this is the main host. Another indication that A. glaucodes is the main or sole host is that larvae were found only on it, whereas sympatric P. pulchella larvae were found only on Aster adscendens.

**ADULT BEHAVIOR.** Males evidently patrol canyon bottoms all day to seek females, perhaps a bit slower than P. pulchella near camillus, and were observed chasing others there at 13:00 and 15:00. Males visit mud and various flowers (blue A. glaucodes, yellow Grindelia squarrosa). Adults fly from mid June-mid Aug. (known dates June 26-Aug 17), the peak probably early July.

**EARLY STAGES. LARVAL STAGES AND HEAD WIDTHS.** Widths of larval heads indicate six larval stages, with these head widths: 1st-stage .27-.28 (n=2), 2nd-stage .35-.4 (mode .4), 3rd-stage .6-.8, 4th-stage .9-1.3, 5th-stage 1.4-2.0 (mode ~1.6), 6th-stage 2.0-2.4 mm (mode 2.3). **DIAPAUSE STAGE.** 4th-stage larvae hibernate, because head widths of nearly all larvae that died (mostly during diapause) were .95-1.3 mm. Lab diapause is frequent and long, resulting in much mortality. **EGG** no doubt greenish-yellow-cream when laid, shaped like other Phyciodes, ~21-22 ribs on conical upper portion of egg, laid on underside of lower leaves. **1ST-STAGE LARVA** pale-ochre when young, after feeding front half of body becomes slightly greener due to food, sometimes or usually with wide tan or brown dorsolateral band above brown spiracles (and perhaps there is sometimes a slightly-darker-green middorsal and nearby line and a slightly-darker-green sublateral line), suranal plate dark-chitin-brown, proleg shields light-brown (brown on A10), legs dark-brown, collar dark-chitin-brown with slightly-paler spot at bases of usual 3 long 1 short setae, setae dark-brown, setal lengths like other Phyciodes, ventral neck gland perhaps present; head blackish with only primary setae; a **silk web** was noted one-egg-height-high over part of hatched-eaten egg cluster, so larvae may live beneath this weak web for a time, head width ~.27-.28 mm. **2ND-STAGE LARVA** when

young probably greenish-tan (with darker middorsal and adjacent lines and wide brown dorsolateral band and darker sublateral line, as in other species)(this young larval pattern is based on other species: some pickled 2nd-stage larvae are solid pale-yellowish-cream--evidently young larvae with the weak pattern washed out--while others--evidently older larvae--show full body pattern of lines & bands that was seen on older live larvae), but the older 2nd-stage becomes browner (tan) and the lines and band become browner and start to resemble the pattern of older larvae by having a narrow brown heart-band, a tan line, a light-brown band along top of BD2 scoli, a creamier band enclosing BD2 scoli, a wide dorsolateral brown band enclosing BSD scoli, spiracles brown, a creamier band along BL1 scoli, light-brown below BL1; BD1-2 & BSD scoli brown or dark-brown, BL1-3 scoli orangish-tan, scoli tips not noticeably paler; suranal plate solid dark-brown, proleg plates light-brown (darker light-brown or brown A10), legs dark-brown; collar dark-brown with a paler bump carrying each of 4 primary setae (anteromedial bump sometimes dark), or collar has a dark-brown patch (enclosing an anterolateral tan bump) that extends laterally around anterior rim of collar then jogs medially to behind lateral 2 primary setae (where it may be dark-brown or light-brown); head unmarked blackish, ~6 secondary setae on each side, head width .35-.4 mm. **3RD-STAGE LARVA** body resembles older larvae, BD1-2 and BSD scoli dark, BL1-3 scoli pale; head usually has a cream vertex stripe (sometimes with satellite spot), and half the larvae have paler cream or orangish frontoclypeus areas, but the pale eye crescent is evidently always absent, and some heads are totally black, head width .6-.8 mm. **4TH-STAGE LARVA** head width .9-1.3 mm. **5TH-STAGE LARVA** head width 1.4-2.0 mm.

**OLDER-MATURE (6TH STAGE) LARVA** variable, some larvae brown with strong cream bands and orangish scoli bases (the lateral band even appearing orangish because of these bases), other larvae dark-brown (occasionally black) with subdorsal cream band nearly absent and orange patches tiny; body with usual *Phyciodes* pattern, a black (rarely dark-brown) middorsal band enclosing BD1 scoli, a brown (or dark-brown, or orangish-brown in palest larvae) band beside heart-line contains many cream dots in some larvae (lateral crescent at base of BD1 scoli is brown without orange or is tiny and orangish-brown or larger and brownish-orange; several unusual larvae had conspicuous orangish crescent below BD1 even though the subdorsal cream band was almost completely absent [black]), then a blackish-brown (or dark-brown or black) band contains fewer cream dots (the dark dorsal area above BD2 scoli is as dark as the wide dark subdorsal band, except is slightly paler in a few larvae), between the BD2 scoli runs a cream band (complete and cream in some larvae which have the band orange in front of and behind BD2 scoli in this band, but usually interrupted somewhat, and sometimes almost absent just a tiny creamy dash at each scoli with almost no orange)(this cream band is usually darker and more interrupted than on *batesii anasazi*), this cream band is orange (the orange almost absent sometimes, or brownish-orange) in front and rear of each BD2 scoli, a wide black (shiny jet black on blackest larvae) subdorsal band with some cream dots barely contains BSD scoli on its lower side, ventral base of BSD scoli orangish-brown (or brown without orange on darkest larvae, or brownish-orange on palest larvae), a weak slightly-cream tan or fairly strong creamy line formed by creamy dots/dashes (sometimes almost absent) runs along underside of previous band, a wide brown (or dark-brown or orangish-brown) band with many cream dots contains black spiracles and mostly encloses BL1 scoli on its lower edge, BL1 scoli orangish-tan to orangish-brown (often ochre-tan, sometimes brown or blackish), BL1 scoli surrounded by a ring of orange-brown (often brownish-orange or brown [on different larvae], rarely blackish), an uninterrupted cream (sometimes slightly-orangish-cream, rarely orange-tan) band runs along lower edge of BL1 scoli, blackish-brown narrowly edges bottom of this band, underside brown with cream & ochre dots; there is less orange at base of scoli than on *batesii anasazi* larvae; BD1-2 scoli dark-brown (sometimes black, sometimes brown), BSD scoli dark-brown (sometimes black, sometimes brown with blackish tip, rarely grayish-brown, usually slightly darker than BD1-2 scoli), (BD1-2 and BSD scoli do have slightly-paler [often brown, rarely light-brown] tips where the tip branches into several seta-base pillars, but these tips are not conspicuously paler, whereas *P. tharos/cocyta* have conspicuously pale tips), BL1 & BL3 scoli orangish-tan (or brown, rarely black on darkest larvae)(all scoli are black on one blackish larva), most scoli have setae dark-brown (including the short setae and few longer setae at tip of BD1-2 and BSD scoli) but these scoli have some longer ochre setae at base, BL1 scoli has some brown setae but most are orangish-brown, BL3 scoli has only orange-brown setae; proleg shields chitin-brown except dark-brown at ventral edge, A10 proleg plate usually mostly blackish

except at top; suranal plate flared at rear, brown (with pale dots) only on middle, tan on narrow anterior end, the wide posterior portion tan with many dark seta bases; legs black; ventral neck gland present; head black, with five actual or potential cream/orangish areas: 1) a cream stripe on "temple" (vertex) extends onto top of head and sometimes extends to neck (this stripe is usually wide, but sometimes is narrow and if narrow the anterior end is sometimes isolated into a pale satellite spot, sometimes the stripe is suffused with brownish, the stripe usually reaches almost to neck but sometimes is narrowed near neck), 2) a cream or orange-brown eye crescent (generally widest behind eyes, and may stop there or may extend rearward to neck, and generally extends narrowly forward above eyes and often then extends down beside eyes to bottom of head (from here the pale area occasionally extends rearward beneath eyes on postgena to rear mandible joint, but postgena is black except for extreme margin behind mandible in half the larvae) where it extends medially to frontoclypeus then extends upward as a narrow sliver beside lower half of frontoclypeus); 3) frontoclypeus may have a central cream or orange-brown wide band or spot and a tiny orange-brown spot at very top of frontoclypeus (these spots often absent)(a 5th-stage larva has the pale band connected narrowly to the pale dorsal tip of frontoclypeus), 4) below frontoclypeus the membranous area above dark-brown labrum is always cream, 5) cream coronal ecdysial line on top of head of last-stage (mature) larvae (areas #4-5 are on all Phycodes so are not mentioned further); head capsules have the exoskeleton transparent on the areas that are pale on live larvae (the cream interior shows through the transparent exoskeleton). The darkest heads have the frontoclypeus black and the vertex stripe brown with satellite spot brown and the eye crescent short and small and orangish (this crescent only a trace in several heads); the palest heads have the vertex stripe wide and long and cream, the eye crescent cream and wide and extends to neck and frontoclypeus (but is usually orangish-light-brown on bottom of front of head), the frontoclypeus has a wide lateral orangish-cream area across frontoclypeus and an orangish-cream tiny top of frontoclypeus; the most common head has a fairly wide vertex stripe and a narrower eye crescent that turns dark orange-brown on front of head and a moderate-sized brown frontoclypeus spot; about 50-60% of live larvae have a noticeable pale area on frontoclypeus (a much bigger frequency than lakota & anasazi). Mature larva head width 2.0-2.4 mm.

**PUPA** variable (under microscope, tan mottled with thousands of minute orangish-brown or brown or blackish irregular vallies & depressions, and the overall color varies depending on the color and amount of this mottling), overall color orange-brown or creamy-brown or blackish-brown, all a little darker-brown than ssp. lakota because of slightly more fine brown mottling, varying somewhat between families: lot D many are light-orange-brown, many are creamier-light-brown (mottling on a few rather black), a few pupae dark-brown, most have weak darker wing streaks (one has no wing streaks except along anal margin & on base); lot E orangish-brown with weak wing streaks (except a moderate brown discal cell spot) or creamy-tan with strong mottling; lot F most pupae light-orange-brown (with moderate brown markings to strong blackish markings), fewer creamy-light-orangish-brown (with weaker brown markings to strong blackish markings), a few rather dark-brown over most of body, most lot F have strong dark wing streaks (weak in a few pupae) and darker brown mottling on rest of body (the palest pupae creamy-light-orangish-brown with weak mottling); there is no correlation between color of pupa and the amount of pale color on the larval frontoclypeus; wing base entirely brown on dorsal and anterior side of the ridges there (and on flat area of wing base dorsal to longitudinal ridge), usually 4 other brown wing streaks (anal margin of wing dorsal to 1A, outer 1/3 of wing near tornus from  $\sim$ CuA<sub>1</sub>-partway to 1A, outer third of wing between  $\sim$ R<sub>4</sub>-M<sub>3</sub> [usually darkest basal to postmedian cream dots], a brown spot or streak near end of discal cell), wing has variable postmedian & submarginal cream dots (weaker or absent along costa & on rear 1/3 of wing), the postmedian band of dots corresponds to the pale postmedian spot band of adults and curves inward in middle of wing where two cream dots are usually tiny or absent but edged medially by brown crescents in cells M<sub>3</sub> & CuA<sub>1</sub>; very young pupae have subdorsal and subspiracular paler bands (edged by darker brown below) which then disappear as cuticle hardens (and the browner bands become small brown spots); supraspiracular brown spots on A4-8 & sometimes A1-3 (one anterior & one posterior on each segment), some very small brown dots below spiracles on abd., a lateroventral band or row of weak-small or strong-large brown spots on A4-8 or A4-7 (these spots form a band on darker pupae, a holdover of the brownish band of young pupae mentioned above), small brown supraventral dashes on A5-8, a midventral row of small brown dashes on A5-6 or A5-8, a lateral cream spot (shallowly convex) on T1 has a little brown in front

(simulating the color of the subdorsal cones); a narrow or wider creamy transverse band (dorsal to the cream ridge mentioned below) across front of head (each end starts just below antenna base), a cream spot between antenna bases, a middorsal weak creamier band is often present on T1 and usually on T2 but never on T3 and sometimes on A1 (this creamier band is divided by brownish middorsal cleavage line on T1-2 where the line splits to allow the adult to emerge, whereas from T3 to front of A1 the cleavage line is represented by a groove that rarely splits), a creamy middorsal anteriorly-pointed V-shaped area on top of T2 is edged in front by brown, ~2/3 of pupae have a noticeable weak (very low) middorsal creamy crest from A2 to the cone on A4 (the crest noticeable only on middle half or 2/3 of segments)(this crest would seem to be a worthless character it is so small, nevertheless it is present on most batesii/pulchella vs. absent on 3/4-all tharos/cocyta, whereas the transverse ridges show the opposite size trend), anteroventral rim of head is a transverse ridge with cream line along it (edged above by some brown or by a strong dark-brown band, and at each end of this ridge on anterolateral rim of head (in front of eye) a vertical ridge is browner medially & creamier behind, wing has a hill near wing base that is the end of a cream ridge running approx. along vein 2A for ~1/4 of wing length, the dorsal slope of this ridge is brown, a transverse ridge from wing base extends from costa of wing upward to wing base then lessens in height then rises to a subdorsal cone on T2, a transverse ridge on each A4-7 segment (higher A4, smaller A5-7) runs continuously over top of abdomen from above level of spiracles on one side to the other side and includes cones, all five transverse ridges have orangish-brown (dark-brown on darker pupae) front slope & cream rear slope, the transverse ridges are moderate in height but vary somewhat (for instance the A4 transverse ridge varies from less than moderate to fairly-large), half the pupae have almost-moderate ridges, some have larger ridges, and a few (~15%) are almost as large as those of tharos/cocyta but the cones (notably the supraspiracular A4 cone) are usually smaller; many cones occur: middorsal cone weak on T2, small (absent sometimes) A2, larger A3-7 esp. A4, subdorsal cone big T2, small or weak T3, rarely present (tiny) A1, present A2-7 (largest A4, often small A2-3) (middorsal & subdorsal cones are on a strong ridge A4, on weak ridge A5-7), supraspiracular cone fairly small on the A4 ridge; these cones vary from small to large on different pupae, averaging ~30-50% smaller than on tharos, each cone is orange-brown (on paler pupae) to dark-brown (on darker pupae) on front and cream on rear; intersegmental area between A4-8 translucent light-brown; antenna mottled light-brown with a transverse tan dash on each segment and a brown spot in front of it, antenna club a little darker than shaft, each leg has a tan spot edged by brown in front (sometimes a similar spot near base of leg), proboscis tip darker (dark-brown), brown spiracles on T1, A2-7, a vestigial slit A8; cremaster dark-brown esp. ventrally, 2 high little ventral bumps on front of A9, a supraventral sustensor ridge extends back from cremaster on A9-10, the sex mark of most butterfly pupae is useless in P. tharos-group because midventrally both sexes have a ventral smooth-bottomed cavern in front of cremaster tip then a long anal groove then a flat surface then a short unisex groove between the bumps, side of cremaster nearly always winged (flaring laterally from abdomen then extending rearward for a long or sometimes short distance then tapering to base of cremaster tip), wings vary in size, width at wings averages 1.00 mm in lot F but 1.15 in lot D, cremaster very rugose (covered with numerous short ropy ridges) on top and ventrally around cavern; duration averages 10 days males, 13 females; based on all adults reared, females emerge about 2 days later than males in lab when eggs were laid the same day.

#### 6D. PHYCIODES BATESII ANASAZI SCOTT 1994, NEW SUBSPECIES

(common name Canyon Crescent)

(Figs. 12, 29, 161-172, 223-225, Tables 1-7)

**DIAGNOSIS.** Similar to P. batesii apsaalooke in adult and immature morphology and hosts and habitat and lab diapause, but adults larvae and pupae are much oranger. Wing undersides are very similar to apsaalooke, but uppersides have more orange. Easily distinguished from tharos/cocyta by having the very large unf black patches of apsaalooke (including the large spot in the outer part of cells  $M_{1-2}$  and large tornus patch) that sandwich a pale marginal crescent, and the upf ground color is still usually two-toned (postmedian ochre band paler than submarginal orange band, though they are about the same color on some males). The antenna

club is orangish: the nudum of males has dark-orange (sometimes orange or brown) borders, orange-brown (rarely dark-orange or brown) lattice, the steps yellow-orange (sometimes orange); females have brown (rarely dark-orange or black) borders, brown (sometimes black) lattice, and orange (sometimes brown) steps. (Taxonomic declaration: I hereby declare as a first-reviser preemptive strike, that if anyone in the future elevates apsaalooke/anasazi to species status, their names shall be P. apsaalooke apsaalooke and P. apsaalooke anasazi.)

**IDENTIFICATION:** Adults have a large black subapical spot on the unf costa, whereas P. pulchella has only a small orangish or brown spot there with at most a tiny blackish-brown mark. The unh has a marginal brown patch (weaker on very few), that usually contains a cream crescent (weak in 16%, absent 12%); on some adults most submarginal unh spots are slightly cream. Larvae are easily distinguished from tharos/cocyta by having the frontoclypeus darker (the upper 2/3 is never as cream as it is in nearly all tharos, though a smaller pale patch sometimes occurs); some larvae are dark enough to be confused with P. pulchella.

**TYPES.** Holotype male allotype female (both deposited British Mus. Nat. History) and numerous paratypes near Gateway, Mesa Co. Colo., coll. as larvae July 29, 1993, reared as noted below. **RANGE.** This ssp. is evidently the butterfly informally called "tharos type C" by Charles Oliver for 10-15 years, because Oliver (unpublished) crossed it with P. tharos and found some or much reproductive isolation; the orangish upperside misled him and nearly everyone else into confusing it with P. tharos, thus labeling it "tharos type C". Oliver's stock was perhaps from mts. W of Encampment, Carbon Co., Wyo., where it occurs (Clifford Ferris pers. comm.). Garth (1950) was the first to publish its occurrence (as batesii), a specimen in AMNH from the N Rim of Grand Can., Coconino co. Ariz., collected July 18, 1934 by Frank Lutz; everyone subsequently ignored this record, but it was correct. I first collected it in the 1960s in Colorado (Grizzly Creek, Garfield Co. Colo. 6000', June 15, 1962, July 3, 1964), and Utah (Oak Creek Forest Camp., Millard Co. Utah, June 18, 1965, a male which could possibly be P. cocyta); Clyde F. Gillette has been collecting it in Utah since 1941. Many of the published/mapped records of P. cocyta from W Colo.-Utah-Ariz.-New Mex.-Nev. may actually be anasazi. It was mapped from Montezuma Co. Colo. and Washington Co. Utah and listed as Phyciodes "new sp." in Stanford & Opler (1993). Two records in 1992 Season Summary of Lepidopterists' Society as "new sp." (coll. Paul Opler and Patrick Savage) indicate that they or someone else may have been planning to name this as a distinct species eventually, but I decided to name it now because they are familiar only with adults, and they know nothing about the crucial missing link--ssp. apsaalooke--between batesii and anasazi; if this taxon was anyone's project it would be Charles Oliver's, and he has not worked on Lepidoptera for many years. A complete understanding of anasazi has required a detailed examination of not only adult wing pattern but also the genitalia and host and habitat and all larval stages and pupae and diapause strategy, of it and related species including the missing link apsaalooke; thus I have no confidence that other persons, at the present time, would be able to write a well-informed report on anasazi.

**NAME.** The Anasazi were the prehistoric indians--ancestors of the modern Pueblo Indians--who occupied the southern edge of the butterfly's range and built the cliff dwellings in Mesa Verde National Park etc.; the butterfly also frequents canyons. The Ute indians occupied most of the range, but there are already four "utahensis" butterfly names.

**INTROGRESSION?** Adults are mostly orange on the upperside, so one could hypothesize that the orangeness of anasazi derived from introgression with P. cocyta. I do not have any undoubted hybrids; one of two anasazi males from Grizzly Creek in Garfield Co. Colo. appears intermediate to a sympatric cocyta male on the ups, but I think it is anasazi because it has the diagnostic large black unf patches incl. the tornal spot. The introgression theory is doubtful because other traits show opposite trends. Larvae and pupae are also quite orange, but their orangeness doubtfully derived from cocyta because most cocyta larvae and pupae are not especially orange (cocyta pupae are notably creamy). And the older larval head is rather dark--the opposite of the cream-spotted cocyta head--so one could speculate that anasazi got its dark head from introgression with P. pulchella. Also, one could speculate that cocyta got its occasional middorsal pupal crest from introgression with anasazi. Actually the orange color of anasazi could have evolved from Batesian mimicry of Euphydryas chalcedona wheeleri (Hy. Edw.), which is quite orange and is presumably unpalatable to birds etc.; in the same area P. tharos riocolorado is also oranger than ssp. tharos so could be another mimic; and in the same region P. pallida barnesi is very orange and has a similar (but larger) range so may also be a

mimic. In the high Sierra Nevada of Calif. the orange *P. pulchella montana* and orange *P. orseis herlani* are probably mimics of the orange *E. chalcedona sierra*, while in the Calif. lowlands the dark-brown *P. pulchella pulchella* and dark-brown *P. orseis orseis* are evidently mimics of dark *E. chalcedona chalcedona* (Scott 1986); and in the tropics NUMEROUS *Phyciodes* of other subgenera are Batesian mimics of various poisonous Ithomiinae and Heliconiini. I conclude that introgression theories are just unsupported speculation, and mimicry is much more likely (*anasazi* occurs in the same habitat as *wheeleri* and follows it in emergence, so the birds are already trained to avoid it).

**HABITAT.** Semi-arid canyons, with mostly brush (sometimes oaks, sometimes some pinyon/juniper) on S-facing slopes, and brush and low trees such as pinyon/juniper on N-facing slopes, cottonwoods and willows along the creeks. **HOSTPLANT.** Many larvae (~10 2nd-stage, rest ~3rd stage, resulting from many ovipositions) and 2 clusters of empty eggshells found on *Aster glaucodes* (many reared to adults emerging Sept.2-Oct. 30 1993, many diapaused as 4th-stage); Gateway, Mesa Co. Colo., July 29, 1993. Adults probably fly M June-M July here. *A. glaucodes* is the only aster at this site, except for a few small *Machaeranthera grindelioides* plants growing near the creek that had no larvae. *A. glaucodes* must be the main or sole host of western *P. batesii* ssp., because 1) it is also eaten by N Wyo. *apsaalooke*, 2) its range (Wyo., W Colo., Utah, N Ariz.) is exactly the range of western *batesii*, and 3) it occurs in the canyon habitat of western *batesii*, occupying the steep dirt slopes that slide into a creek, steep sliding slopes below rimrock, and steep gulch bottoms leading into the main canyon. **OVIPOSITION.** Females must oviposit beneath lower leaves, because several eggshell clusters were found on underside of basal leaves of 40-cm-tall plants.

**EARLY STAGES. LARVAL HABITS.** Older larvae tend to move higher on the plants in part because the basal leaves turn brown and dry up; older larvae were on top of leaves of 20-50 cm plants, and older larvae tend to spread to other nearby plants. 1st-stage larvae skeletonize leaf underside near eggshells, while 2nd-3rd-stage larvae eat pits on leaf uppersides; 4th-mature larvae eat leaves from the edge. **DIAPAUSE STAGE.** 4th-stage larvae hibernate, because larvae that died in diapause had predominantly 1.1-1.3 mm head widths. Diapause is strong: even in 24-hour light most larvae diapause and only a few develop; each week about the same small proportion of a few larvae develop, so that by Nov. many larvae were still in diapause; in contrast, nearly all *P. cocyta*, *P. tharos*, and *P. pulchella* larvae develop in lab without diapause.

**LARVAL STAGES AND HEAD WIDTHS.** Head widths of numerous head capsules and larvae indicate six larval stages, with these head widths: (1st-stage .27-.28 mm in Bighorn Mts.), 2nd-stage .4-.55 (mode .45), 3rd-stage .6-.8 (mode .7), 4th-stage .85-1.5 (mode 1.2), 5th-stage 1.5-2.0 (mode 1.7), 6th-stage 1.9-2.65 mm (mode 2.3); this represents ~60-70% growth at each molt except only 35% at last molt. **EGG** unknown. **1ST-STAGE LARVA** unknown. **2ND-STAGE LARVA** (young 2nd-stage not seen, but based on other species no doubt greenish-tan with darker middorsal and adjacent line and wide brown dorsolateral band and darker sublateral line); when older is tan, with middorsal dark-brown band on T2-abdomen (enclosing BD1 scoli on abdomen), a tan center of middorsal brown spot on T2-3 (positioned where the absent BD1 scoli is on abdomen), a tan band, a narrow brown band above BD2 scoli (this band represented only by a brown patch on T2-3), a creamier (tan) band includes BD2 scoli, a wide dark-brown (weaker and paler on T1-3) subdorsal band includes BSD scoli, a tan band includes spiracles and most of BL1 scoli, a creamier (pale-tan) band touches bottom of BL1 scoli, brown dashes below BL1 scoli (darkest on abd.), light-brown dashes below BL3 scoli, underside light-brown (a little darker on A1-2); BSD scoli dark-brown, BD1-2 slightly paler (brown), BL1 & BL3 orangish-tan; collar dark-brown with a tan bump under each of 4 primary setae (a tan patch always encloses the lateral 2 bumps and this patch sometimes joins posterior pale bump), proleg plates light-brown (darker-brown A10), suranal plate dark-brown; head blackish with narrow orangish-cream vertex dash on top of head, head width .4-.55 mm. **3RD-STAGE LARVA** body similar to older larva, a slightly-to-moderately interrupted dark-brown heart-line, a tan band (somewhat dark due to dark BD1 scoli bases), a brown band running along top of BD2 scoli, a tan band includes BD2 scoli, a wide dark-brown subdorsal band (interrupted narrowly or broadly between thorax segments) includes BSD scoli (a dark-brown dash extends anteroventrally from this band on each segment), a light-brown band encloses black spiracles, a cream lateral band edges BL1 scoli, a narrow dark-brown sublateral line of dashes (two rows of dashes on abdomen above BL3 scoli), brown dashes below BL3 scoli (or brown around BL3 scoli), underside light-brown, a faint midventral darker band, underside of A1-2 (less on A7-8)

mottled with brown, T1-3 mottled with brown above legs, T1 has a wide middorsal brown patch and a wide subdorsal brown patch; BD1 scoli fairly dark-brown, BD2 scoli light-brown, BSD scoli dark-brown (the darkest), BL1 & BL3 scoli orangish-tan; legs dark-brown, proleg plates brown, suranal plate dark-brown; collar black, with anteromedial seta usually on pale base, and a large variable creamy patch covers most of lateral area (except blackish front rim) and extends to rear of collar at the level of creamy subdorsal body band (patch sometimes covers lateral edge also); head varies, completely black except for narrow cream vertex stripe (which sometimes has small satellite), but one larva black with extremely wide cream vertex stripe connected laterally to wide eye stripe behind eyes and upper 2/3 of frontoclypeus cream, head width .6-.8 mm. **4TH-STAGE LARVA** head width .85-1.5 mm. **5TH-STAGE LARVA** head width 1.5-2.0 mm.

**OLDER-MATURE LARVA** variable, most larvae rather brown with strong cream bands and orangish scoli bases (making the lateral band in particular look orangish), some larvae darker with interrupted subdorsal cream band and less orange; body has blackish-brown (or black) middorsal band enclosing BD1 scoli (lateral base beside BD1 scoli is sometimes orange-brown or brownish-orange and rests in next band), a brown or orangish-brown band has some cream dots (this band is ochre in palest larva which has ochre frontoclypeus, but band is slightly-orangish-brown or brown in most larvae), a dark-brown (or blackish-brown) band has some cream dots (the dark dorsal area above BD2 scoli is as dark as the wide dark subdorsal band, or is paler in the oranger larvae), a cream subdorsal band encloses BD2 scoli (this band is complete and cream in most larvae, but interrupted somewhat in others; this cream band has a small or large patch of orange at front of and rear of BD2 scoli), a wide blackish-brown (or black) band with fewer cream dots encloses BSD scoli on its lower side, ventral base of BSD scoli orange-brown (rarely brownish-orange)(rarely an orangish-brown ring around BSD scoli), a weak tan line of creamy dots runs along underside of previous band, a wide orangish-brown (or dark-brown) band includes black spiracles and some cream dots and mostly encloses BL1 scoli on its lower side, BL1 scoli orangish (commonest color) to orangish-tan to ochre-tan (in different larvae), ring around BL1 scoli brownish-orange to orange (in different larvae; a few orange-brown), a strong cream (or orange-cream) band touches lower side of BL1 scoli, underside (containing BL3 scoli) orangish-brown with cream dots; BD1 scoli dark-brown or blackish (sometimes base orange-brown and tip dark-brown), BD2 scoli blackish or brown (sometimes base orange-brown and tip blackish), BSD scoli black, (BD1-2 and BSD scoli do have slightly-paler [often brown, rarely light-brown] tips where the tip branches into several seta-base pillars, but these tips are not conspicuously paler, whereas *P. tharos/cocyta* have conspicuously pale tips), BL3 scoli orangish-tan, setae on scoli mostly brown on BD1-2 and BSD (few orangish setae on these), mostly orange-brown on BL1 (few brown), all orange-brown on BL3; collar blackish with middorsal ecdysial line cream, a creamy or orange-brown base of anteromedial seta, a large creamy or orange-brown patch around 3 lateral long setae and a narrow creamy dash or wide irregular creamy area edging rear of the patch, remainder of T1 like other segments (BL1 scoli orange-tan on cream band); proleg shields chitin-brown except dark-brown at ventral edge, and A10 proleg plate often browner throughout; suranal plate like *apsaalooke*, or entirely brown in younger larvae; ventral neck gland present; head black, with five actual or potential cream/orangish areas: 1) a cream or orangish-brown stripe (sometimes suffused with brownish) on "temple" (vertex) extends onto top of head and sometimes extends rearward to neck (the stripe usually reaches almost to neck but sometimes is narrowed near neck)(this stripe is usually wide, but sometimes is narrow and if narrow the anterior end is sometimes isolated into a pale satellite spot); 2) a cream or orange-brown eye crescent (generally widest behind eyes) that may stop there or may extend rearward to neck, and generally extends narrowly forward above eyes and then often extends down beside eyes to bottom of head (from here the pale area often extends rearward beneath eyes on postgena to rear mandible joint, but postgena is black except for extreme margin behind mandible in some larvae) where it extends medially to frontoclypeus and extends upward as a narrow cream or orangish sliver beside lower half of frontoclypeus; 3) frontoclypeus is usually black or very dark but may have a central cream or whitish-tan or ochre or orange-brown wide band or spot and a tiny orange-brown spot at very top of frontoclypeus (these spots are most often absent, rarely connected--a 5th-stage larva has the pale band connected narrowly to the pale dorsal tip of frontoclypeus) or sides of frontoclypeus may be pale above the basal third, or the ventral quarter of frontoclypeus may be pale; 4) below frontoclypeus the membranous area above the dark-brown labrum is always

cream; 5) cream ecdysial line on top of head (#4-5 are present on all Phyciodes so not mentioned further); the darkest heads have the frontoclypeus black and the vertex stripe very small and orangish-brown and limited to very top of head and the eye crescent very short and very small and orangish (centered on top of eyes); the palest heads have the vertex stripe wide and long and cream, the eye crescent cream and wide and extending to neck and frontoclypeus (but is usually orangish-light-brown on bottom of front of head), the frontoclypeus with a wide orangish-cream area across frontoclypeus and even an orangish bottom of frontoclypeus (very rarely most of frontoclypeus orangish except two brown spots at bottom)(the palest head is a 4th-stage which has every band and spot wide and even has the vertex band narrowly connected to eye crescent along frontoclypeus); the most common head has a fairly wide vertex stripe and a narrower eye crescent that is small and rests above eyes and a frontoclypeus with only a faint trace of brown in the center; about 20% of live larvae have a noticeable pale area on frontoclypeus; head width 1.9-2.65 mm.

**PUPA.** In overall appearance most are light-orange-brown although many are creamy-light-orangish-brown, some have more melanic mottling so are dark-orange-brown or darker-creamy-brown, but the main difference from apsaalooke is the lack of large brown streaks (no pupa had a strongly-streaked wing; the wing usually has only a weak browner spot near end of discal cell, the area along anal margin dorsal to 1A is only slightly brown, and the streaks near apex and near tornus were absent or very weak), these pupae were from many mothers so this difference from apsaalooke seems real; pupa exactly like apsaalooke in details, darker pupae have a small brown spot near base of each of cells  $M_3$  &  $CuA_1$ , with transverse rather small ridges on A4-7 that vary in height (quite small on some, moderate on many, somewhat large on some, and a few pupae have the ridges about as large as tharos/cocytia but the cones are nearly always smaller esp. the supraspiracular A4 cone--the tharos cones are higher with points on top that correspond to the pale tips of their larval scoli), in lakota/apsaalooke/anasazi the A4 ridge slopes down to a flat above wing, whereas on batesii & riocolorado the ridge is higher as it reaches wing; the anterior edge of cones & ridges usually show some orangish-brown (brownish-orange on the creamier pupae, mostly dark-brown on the darkest pupae) like apsaalooke (except the blackest apsaalooke pupae have the anterior rim only narrowly orangish near top then mostly blackish-brown); ~80% of pupae have a weak middorsal crest on A2-cone of A4 that includes the cones (this crest is generally somewhat creamy); T1-A1 has a slightly-creamier middorsal stripe also; each leg has usual transverse cream ridge with a brown spot in front, and T2 leg sometimes has trace of a similar spot near base); cremaster winged like apsaalooke (widened beyond abdomen or extending straight back, then narrowing to base of tip), width at wings averaging 1.03 mm, cremaster very rugose.

## 7. PHYCIODES PULCHELLA

(Figs. 2, 13, 17, 24, 27, 32, 178-208, 223, Tables 1-7)

**DIAGNOSIS.** This species has several distinctive features: the uph center is usually divided by a black postmedian line; the unf subapical costal patch is orangish or brownish, not black; the gnathos hooks are usually small; the older larval frontoclypeus is always black and the head has only a creamy vertex stripe; the pupal ridges and cones are quite small. The unf has a yellow bar across the discal cell, except in two ssp. The antenna club is black, except in ssp. tutchone. The ssp. cluster into the pulchella group including montana & tutchone which have very small unf black markings, and the camillus group including shoshoni with large unf black markings; these groups are rather different, and might even be distinct species.

### 7A. PHYCIODES PULCHELLA PULCHELLA (BDV.) 1852

(= pratensis [Behr] 1863, = campestris [Behr] 1863)

(Figs. 2, 13, 17, 24, 27, 32, 178-184, Tables 1-7)

**NOMENCLATURE. PRATENSIS VS. CAMPESTRIS.** Phyciodes campestris was the name used by most living persons until recently, when P. pratensis was resurrected by Miller & Brown (1981). Miller & Brown argued that pratensis should be used rather than campestris because, although Melitaea campestris has line priority over Melitaea pratensis in the same

paper by Behr, they argued that Strecker (1876, Syn. Cat. N. Amer. Macrolepid.: 121) was the first reviser (Strecker's transfer of these names from Melitaea to Phyciodes was an action they claimed constituted revision, and Strecker placed P. campestris as a synonym of his species #233 P. pratensis), and Miller & Brown stated that all workers prior to Barnes & McDunnough in 1917 (including W. J. Holland's Butterfly Book, 1898) considered pratensis to be the species name with campestris a synonym of it. Miller & Brown's argument is plausible, because line priority and page priority are not formally recognized in the code (they are recommendations but not requirements, a fact never comprehended by Ferris [1989 etc.]), and the first reviser rule gives a subsequent author the responsibility to place both names in one species and choose which of the two names will forever represent the species and which will be the synonym. However Miller & Brown erred in stating that all authors prior to 1917 treated campestris as a synonym of pratensis, because Reakirt (1866; cited by Higgins 1981, who used campestris rather than pratensis) used the name Eresia campestris only 3 years after the description of campestris and pratensis, and fully 10 years before Strecker, and a mere checklist such as Strecker's does not necessarily constitute "revision". The first reviser principle {1985 art. 24(b) and 1961 art. 24(a)(i)} states that the first author who subsequently cites together both names published on the same date and chooses one of them to have precedence over the other, has determined the precedence of the chosen name. Earlier rules were not as stringent: the 1905 Re'gles (art. 28) stated if two species are of the same date, that selected by the first reviser who unites them to form a single species shall stand; the 1878 Dall Code (LIV) merely stated "if both names are of the same date, the reviser may select the one to be retained"; but no formal rules applied when Reakirt wrote in 1866. Even so, Reakirt did not mention pratensis, so his paper cannot be first reviser. Dredging up all the old papers to completely settle this problem would require great effort. However John F. Emmel (pers. comm.) informs me that William Henry Edwards (1872, presumably his Synopsis of N. Amer. Butt. 52 p., an appendix to his Butt. N. Amer., Vol. I, Philadelphia Pa., actually published Jan. 1873) was actually first reviser because he transferred both names to Phyciodes and made campestris a syn. of pratensis; Strecker merely copied Edwards.

**PULCHELLA VS. BOTH NAMES.** But actually it does not matter that pratensis takes command over campestris, because my reexamination of this mess proves that a third name pulchella (Boisduval) 1852 validly represents this species and is older than both campestris and pratensis, which are synonyms of pulchella. The two syntypes of pulchella are campestris campestris specimens in the USNM. The original description of pulchella Bdv. 1852 verbatim: "49. Melitaea pulchella. Pap. Tharos. Drury, Ins. I. pl. 21, f.5,6. Elle se trouve dans une grande parties de la Californie. Il ne faut pas confondre cette espe'ce avec la Tharos de Cramer, qui habite e'galemente les Etats-Unis, Il es bon noter aussi que la Morpheus de Cramer, figure'e pl. 101, est tout a' fait identique avec celle qu'il avait figure'e pre'ce'demment sous le nom de Tharos." The translation: "49. Melitaea pulchella. Pap. Tharos. Drury, Ins. I. pl. 21, f. 5,6. It is found in a large part of California. One should not confuse this species with tharos of Cramer which also occurs in U.S. It is well to note also that morpheus of Cramer figured as pl. 101 is entirely identical with that which was previously figured under the name tharos."

Tilden (1974) claimed that Boisduval intended pulchella as a replacement name for tharos Drury, which Tilden claimed Boisduval thought was a homonym of tharos Cramer. Ferris' (1989) supplement to Miller & Brown (1981) repeated this claim. A "replacement name" is a name that replaces a name that is invalid because it is a homonym. So for Tilden's theory to be valid, Boisduval would have had to believe all four of the following suppositions, that 1) tharos Drury was a different species from tharos Cramer, 2) a species named tharos was named by Cramer, 3) tharos Drury was named later than tharos Cramer, and 4) tharos Drury was thus a homonym of tharos Cramer so that tharos Drury needed a replacement name pulchella. Boisduval may have believed supposition #1 because of his statement in his original description of pulchella that pulchella should not be confused with tharos Cramer (Boisduval would have believed #1 only if he believed that pulchella was like Drury's figure of tharos, and below I note that Drury's unnamed fig. 5 does resemble San Francisco pratensis but unnamed fig. 6 does not, while Cramer's figures do resemble female tharos). But Boisduval very doubtfully believed suppositions #2 and #3, because Cramer's tharos text cited "Drury, Ins.[ects] Tom.[Vol.] I. Tab.[plate] 21. Fig.5.6.", and Cramer's paper concerning tharos (Cramer 1777) was published later than Drury's original description of tharos in 1770-1773. Tilden put words into

Boisduval's mouth that Boisduval never wrote. Boisduval did not mention anything concerning homonymy or replacement name. Boisduval must have had Cramer's work since he cites plate 101 of it, and Cramer's paper cites Drury's paper as the origin of the name tharos, so how could Boisduval have believed supposition #2 that Cramer named a taxon called tharos, and how could Boisduval have believed supposition #3 that Drury's paper was older than Cramer's since Boisduval had both papers (he must have had Drury's paper because he cited it in the original description of pulchella)??!! Surely Boisduval read the contents of Drury's work, because Drury was printed in both english and french (Boisduval's language) side-by-side. And surely Boisduval must have also read the french and dutch text of Cramer. Boisduval may have been a provincial frenchman who spoke and wrote french but did not read english well (his letters to William Henry Edwards were in french) and he may have been so busy naming hordes of species that he did not have time to translate english papers, but Boisduval surely must have read these works in his own language. Boisduval referred to tharos of Cramer and morpheus of Cramer, but Cramer did NOT name either (Cramer did figure tharos and cocyta in 1777--the latter the original description of cocyta--and did compare both to Phyciodes liriopae), thus there is little reason to believe supposition #2 that Boisduval thought that Cramer named tharos. Drury's original description of tharos stated that tharos is found in New York (and Cramer repeated the New York range for tharos), whereas Boisduval gave only California as the range of pulchella, so how could Boisduval believe that pulchella was identical to Drury's tharos? The simplest explanation is that Boisduval gave the name pulchella to what was later named P. pratensis=campestris, which is common in California.

Tilden (1970) stated that "Boisduval persisted in thinking that pulchella was different from tharos"; thus by Tilden's own statement, how could Boisduval have named pulchella as a replacement name for tharos? Boisduval himself wrote in a letter June 15 1874 to William Henry Edwards (Brown 1965, p. 205): "You tell me that your Myliitta is the same as my epula. Kirby, about which anyway, the work is full of errors, unites my Epula with pratensis of Behr, on another page he makes two distinct species of Montana and of Orsa. What I find amazing in the work we are talking about is that he puts together my Pulchella and Tharos which are two very different species. I really believe that this man, who went to all kinds of trouble to compile a catalogue for the people who work, has never seen in nature [alive or dead] the species he is talking about."; thus Boisduval himself declared Tilden's theory to be 100% bogus.

But why would Boisduval cite "Pap. Tharos. Drury, Ins. I. pl.21, f.5,6.", the original description of tharos, in his original description of pulchella? Was it just a **SLOPPY MISTAKE**? Surely Boisduval would not be so stupid as to intentionally name a species that he knew was already described, so it seems logical that he had some reason for citing it, or that he was just sloppy and made a mistake. Tilden wrongly assumed that Boisduval's reason for citing the reference was because Boisduval thought tharos Drury was a homonym. But the sloppy mistake theory has much support, because Boisduval was so careless that he cited almost nothing in a proper manner: in the original description of pulchella translated above he referred to "tharos of Cramer" when tharos was actually named by Drury (he evidently meant the figures of tharos by Cramer [1777, vol. II p. 112, & pl. CLXIX figs. E, F]), and he cited "morpheus Cramer, figured on plate 101" even though morpheus was named by Fabricius, and plate 101 of Cramer figured cocyta, not morpheus; and then he failed to state who previously figured tharos (he probably meant Cramer's plate CLXIX); counting these mistakes, Boisduval made FOUR citation mistakes in ONE short paragraph, so why not five mistakes including the citation of Drury's paper? Boisduval (1869, Ann. Soc. Ent. Belg. 12:53, no. 37) later cited "Melitaea tharos Boisd. et Leconte" (in that paper he stated that tharos "occurs also in certain localities in California."); surely Boisduval would not have been so stupid as to have claimed authorship of the name for himself and LeConte after forgetting that he did not name tharos; this certainly illustrates his carelessness in citations and possibly indicates that he did not think Drury was the author of tharos; this citation has no period or comma between tharos and Boisd. et Leconte, whereas Boisduval's other writings placed a period or a comma between the word "tharos" and the words "Drury. Ins. I. pl. 21. f. 5,6", which possibly??? indicates that he did not think that Drury was the author of tharos but merely an author of a paper illustrating some species labeled tharos. By today's standards Boisduval was quite sloppy with citations and authors. It seems clear that Boisduval believed that the citation of a scientific name, followed by an author, merely referred to a work by that person on that species, and did not necessarily mean that that person

named that species. What we see today as sloppy mistakes, mostly just represent a lack of standards during Boisduval's time.

After investigating this case thoroughly, I am now convinced that Boisduval had true San Francisco pratensis in front of him when he described pulchella, and he merely cited Drury's work as a convenient picture book whose figure of tharos was similar to Boisduval's pulchella, in order to avoid having to publish an original illustration of pulchella. The proof involves a total reconstruction of everything Boisduval had in front of him when he wrote the original description: Drury's (1770-1773) color figures and text, Cramer's (1777) color figures and text, the USNM types, and the labels on the types:

1) **The Drury text and figures that Boisduval cited lacked the name tharos.** A perusal of the original description of tharos Drury 1770-1773 reveals this important clue: tharos was described in 1770 on pp. 43-44 and figured in 1770 on pl. 21 figs. 5-6, all in Drury's volume I, but the name tharos did NOT appear in the text or plate of that 1770 volume I, and instead appeared first in 1773! in volume II on the first page of the index to both volumes; thus Boisduval cited just nameless paintings; he did NOT cite the text or name of the original description of tharos. Boisduval could have thought that Drury's figure and text was not part of an original description of anything; but that thought is extremely doubtful, since Boisduval cited "...Tharos. Drury..." and must have had both volumes of Drury including the index, and 82 years had passed since Drury's work so the idiosyncrasies of Drury's work must have been well known to Boisduval. Because tharos was not made available until 1773 in Drury's index, and Boisduval cited only the nameless 1770 paintings, Boisduval did not cite the complete original description of tharos, so his citation cannot be a statement that pulchella is a synonym of tharos.

2) **Drury's fig. 5 does resemble pulchella = pratensis.** Because Drury's 1770 description and figures were nameless, Boisduval could easily have thought that the nameless figures and description were similar enough to the San Francisco pulchella specimens in front of him and convenient enough to cite to allow Boisduval to not bother with a redundant description. My excellent color copy of Drury's color figure 5 (my fig. 91) shows the male upperside is very dark (darker than tharos) and the male DOES RESEMBLE PULCHELLA! (in fact, it shows an amazing similarity in nearly every feature to Scott's 1986a campestris color figure 230a on plate 26 [and is almost as dark as Scott's figure], a specimen from San Francisco!). True, Drury's male underside figure 6 (my fig. 92) resembles tharos or P. batesii (as already noted above under P. tharos) and not San Francisco pulchella (the two costal unf black patches and the large tornal unf black patch and the completely orange unf discal cell resemble tharos or batesii and not pulchella). But the striking similarity of Drury's fig. 5 to true Calif. pulchella seems to confirm that Boisduval was attempting to describe Calif. pratensis = campestris, and not New York tharos. Drury's text described considerable variation "in some, the dark brown occupying the greater part of the wings, in others, the orange colour is predominant" which--together with Drury's figures 5 & 6 which could represent any of three species--means that Boisduval's mention of Drury's work cannot be an unambiguous declaration that pulchella resembles tharos (it could resemble pratensis or batesii). To repeat, Tilden (1970) claimed that Boisduval made Drury's figure (of tharos) the type of pulchella, but Boisduval said no such thing, and when there is an actual type specimen, obviously the type specimen must be considered the actual type rather than some figure which the author lists for unstated reasons. Even if Boisduval had intended to state that Drury's fig. 5 is typical of pulchella, he was still describing Calif. pratensis!, and because fig. 5 was nameless the mere citation of the figure does not synonymize pulchella to tharos. Drury's blackish figure 5 of tharos could be confused with three species (pulchella = pratensis, batesii, and [least similar] tharos), and his fig. 6 could be confused with two (tharos, batesii), so I have had to designate neotypes or lectotypes for all (except batesii which has a relatively unambiguous existing type).

3) **A label on a pulchella syntype compares pulchella only to Drury's fig. 5.** But why would Boisduval's (1852) original description of pulchella also cite Drury's fig. 6, which resembles tharos rather than pratensis? Probably he was sloppy and did not carefully look at the fig. 6 underside, because even today almost all lepidopterists (but not myself) mount all their specimens only on the upperside, so they find it inconvenient to compare undersides of specimens that must be picked up and turned over and studied one-by-one rather than looked at en masse in a cabinet drawer as the uppersides can be. However, the USNM pulchella "type" has a label (my fig. 178) with this line "Tharos.Dr.1.pl.21.f.5.", a citation only of Drury's fig. 5 that closely resembles the type. Thus Boisduval apparently cited Drury because he thought

that Drury's fig. 5 resembled his pulchella, and evidently was careless in the original description to also cite fig. 6. Based on this type label, Boisduval may have thought that Drury's figure 6 was true tharos and resembled Cramer's figures of tharos; but the truth is probably that Boisduval never thought very much about the underside fig. 6.

4) **Cramer's figures resemble true tharos.** A careful look at Cramer's (1777) color figures also helps interpret what Boisduval must have been thinking. Boisduval wrote that "One should not confuse this species with tharos of Cramer"; he evidently meant that Cramer's figures of tharos on plate 169 figs. E, F. are not like pulchella=pratensis or Drury's fig. 5; sure enough, Cramer's figures (my figs. 93-94) are orange like tharos (not pratensis) and are clearly tharos because of the black line dividing the postmedian orange uph area. Boisduval then wrote "morpheus of Cramer figured as pl. 101 is entirely identical with that which was previously figured under the name tharos."; he evidently meant that Cramer's figures of cocyta on plate 101 (my figs 112-114) are like Fabricius' morpheus and resemble Cramer's figure of tharos; sure enough again, Cramer's cocyta figures are orange like tharos and morpheus, not blackish like Drury's fig. 5 and pratensis and the syntypes of pulchella (more than 100 years would pass before people realized that Drury's tharos and Cramer's cocyta were separate species, distinguished by the black postmedian uph line present on tharos but absent on cocyta, so it is understandable that Boisduval thought that these two were the same species; Boisduval was correct that cocyta and morpheus are the same species, even today).

5) **Boisduval had numerous Calif. species at that time.** The paper describing pulchella (Boisduval 1852) also described numerous other Calif. butterflies, which Boisduval got from Pierre Lorquin.

6) **A documented trail exists from Boisduval to the Smithsonian.** But why would two syntype pulchella end up in the Smithsonian? Brown (1965) published letters proving that Boisduval often loaned types to Americans who sometimes did not return them; these Americans were either thoughtless clods, or merely honest procrastinators and Boisduval may have died before they could be returned, and then the Americans kept them and later gave them to American museums. Herman Strecker, for instance, never returned any loans. But the USNM lectotype has a label "EX MUSAEO DRIS BOISDUVAL" and a label "Oberthur Collection" and a label "Type pulchella Bdv. a/c Hofer." (my fig. 178), which evidently means that Oberthur acquired the specimen from Boisduval and then it was accessioned by Hofer (who evidently wrote the label with Hofer on it) to the Smithsonian. Essig (1931) wrote that Boisduval's collection was sold (presumably after his death in 1879) to Charles Oberthuer of Rennes France; some of Boisduval's collection was purchased by William Barnes of Detroit Mich. and later Decatur Ill. Kudrna & Wiemers (1990, p. 35) wrote that Boisduval's collection went to C. Oberthuer and was partly sold by Oberthuer; duplicates sold partly by A. Depuiset of Paris. After Barnes' death in 1930 his collection was purchased by the U.S. National Museum (now part of the Smithsonian). Thus the pulchella type evidently journeyed from San Francisco--where Lorquin probably collected it--to Boisduval to name, to Oberthur, to Barnes (perhaps via Depuiset), and finally to the Smithsonian where Hofer accessioned it after 1930.

7) **The USNM pulchella "type" (my figs. 179-180) is pratensis=campestris.**

What conclusion can be drawn from this mess? Obviously Boisduval's work was not up to today's standards, as his citations of names and authors did not distinguish between a work about a species and the author of that species' name, and Boisduval may have sometimes forgotten what he had written earlier, and Tilden's homonym theory has much proof against it, including Boisduval's own adamant statements that pulchella is NOT tharos. Thus Tilden's theory must be absolutely rejected. Tilden's attempt to decipher Boisduval's thinking was of course commendable; an unsuccessful attempt to read the mind of someone dead nearly 150 years could be called voodoo taxonomy, but a successful attempt could be called brilliant deduction.

To summarize, the only real facts are these: the only apparent existing syntypes of pulchella (in the USNM) are two P. pratensis pratensis=campestris campestris specimens; Boisduval wrote in the original description and vehemently in 1874 that pulchella is NOT tharos; Boisduval wrote that pulchella occurs in a large part of California which fits campestris well but does not fit tharos at all (tharos never occurred in Calif. except on the SE border along the bank of the Colorado River, until recent irrigation brought it a bit farther into extreme S Calif., 400 miles from any specimens Boisduval might have seen); and a look at the figures Boisduval cited reveals that a dark nameless Drury color figure that Boisduval mentioned in the original description and specifically mentioned on a label on the "type" actually resembles pratensis

(more than the real tharos), while Cramer's figures (of tharos and cocyta, which Boisduval stated were not like pulchella) are all orange like true tharos (and do not resemble pratensis), so Boisduval was evidently intentionally describing the dark San Francisco pratensis, and contrasting it with Cramer's orangish figures of true tharos. And Boisduval's citation merely of Drury's nameless figure could not possibly have synonymized pulchella to tharos because the figures were nameless (the name tharos was not in the cited volume) and the figures could apply to several different Phyciodes species. Thus the obvious conclusion is that pulchella is the correct name and both pratensis and campestris are synonyms.

The USNM "type" has a locality of only "Calif." and "Californie." (my fig. 178). At the time Boisduval wrote the description of pulchella he had material from San Francisco and environs and from the Tuolumne gold field (F. M. Brown letter Mar. 1, 1980; Tilden [1970] speculated--on the basis of lack of lowland campestris in material Boisduval received--that Lorquin sent Sierra Nevada gold field material but no lowland material to be described by Boisduval 1852, but the fact that the two syntypes of pulchella are lowland campestris shows that Lorquin did send lowland material to Boisduval by 1852), so the TL has to be fixed as one of these. Five persons by now have examined the USNM pulchella "type" and declared it to be P. pratensis pratensis: Tilden (1974) stated that both he and W. D. Field examined the type of pulchella in USNM and found it to be P. c. campestris (the taxon near San Francisco) and not P. campestris montana (the taxon near the Tuolumne gold field); John Emmel and Thomas C. Emmel state (pers. comm.) that both syntypes are ordinary San Francisco P. c. campestris; and my slides of the "type" (figs. 179-180) prove it to be like San Francisco P. c. campestris. Therefore the TL must be San Francisco and environs, so I hereby restrict the type locality to San Francisco (where it still occurs on Baker's Beach, and on San Bruno Mtn. just S of the city limit).

I sent a prior account of this problem to Dr. John F. Emmel, who wrote the following reply: "Regarding the name pulchella: Miller and Brown considered this a nomen nudum, and with good reason; there is no written description of it, only the reference to the Drury plate. In the way that Boisduval proposed the name, the only thing that can be done with confidence is to consider it a synonym of whatever Drury illustrated as tharos (whatever that was). And Drury could not have had any pratensis material in 1773. It does not matter that Boisduval stated that it was found in a large part of California; he was mistaken on many matters of distribution. E.g., he states that P. smintheus is found in northern Calif. (1852), even though the first Calif. phoebus were taken in the 1860's; or, Polyommatus hypophlaeas (a typical NE U.S. phlaeas) is said to be in northern Calif., as well as in "all the northern U.S." Boisduval also added type labels to specimens he received after his initial descriptions (e.g. Thecla grunus) so the pulchella labels could have been added to the USNM pratensis specimens years after his publication of the name pulchella. Also, some Boisduval type labels have somehow ended up on other species (e.g., the type label for Hesperia ruricola ended up on a specimen of Euphyes vestris, even though the description of ruricola cannot possibly apply to vestris). If Boisduval had simply put in one or two lines describing what he was proposing as pulchella, there would be no problem--we could simply compare San Francisco pratensis to the description and if it was reasonably close, the name would stick. In our paper treating the Boisduval types, we are mentioning the USNM specimens but [are] essentially treating the name as a nomen nudum." These comments need to be considered one by one. Miller & Brown (1981) actually did not mention pulchella at all, so evidently missed it, and did not call it a nomen nudum. No published paper has ever called pulchella a nomen nudum. And pulchella is not a nomen nudum, which has a very specific meaning in the ICZN Code. A nomen nudum (ICZN 1985 glossary) is "A name that, if published before 1931, fails to conform to article 12"; Art. 12 states that to be available every name published before 1931 must satisfy the provisions of Art. 11 [which a careful reading of Art. 11 provisions show that pulchella did satisfy] and must have been accompanied by a description or a definition of the taxon that it denotes, or by an indication."; an indication is "a bibliographic reference to a previously published description or definition." As Tilden (1970) thought, Boisduval's citation of tharos Drury is an indication, so pulchella is NOT a nomen nudum. If there were no description/definition, one of the nameless figures of Drury 1770 would have to be considered representative of pulchella as an indication (Drury's fig. 5 could be used to assign the name pulchella to pratensis=campestris, or fig. 6 to assign it to tharos) (and then one might deduce that Drury's probable lack of Calif. pratensis specimens would mean that pulchella could not represent pratensis). But Boisduval's description of the range and his

negative comparison of pulchella with Cramer's orange figures of tharos & cocyta technically constitutes a description/definition--bad it is true, but still a description, so that pulchella need not be based solely on the "indication" of Drury's nameless figures. Considering together Boisduval's citations of Drury and Cramer, Boisduval was evidently describing pulchella as dark like Drury's nameless fig. 5 and not orange like Cramer's tharos & cocyta, which together with the mention of the Calif. range, is an adequate description of pratensis, certainly not a nomen nudum. Concerning John Emmel's other comments, Boisduval's uricola type label probably ended up on the wrong species because of some other person's mistake if the uricola description is so different from vestris. The fact that Boisduval erred in his range descriptions for other species may just show that pioneer collectors and biologists cared much less about carefully recording localities back then than they do now, and need not mean that his range description for pulchella was wrong; anyone who has spent time in major museums realizes that at least 20% of the oldest specimens have erroneous locality labels. If Boisduval added type labels to specimens he received after describing a name, that would be deplorable and would put him in the same group as William J. Holland, who did the same on some Carnegie Museum specimens of taxa described by William Henry Edwards. But the "type" label on pulchella evidently was written by Hofer when it was accessioned into the Smithsonian, because this label contains "a/c Hofer", thus there is no reason to believe that Boisduval labeled this specimen "type" after it was named. In the absence of proof that the pulchella "type" is not a syntype, we must assume that it is a syntype, because a documented route from Boisduval to the Smithsonian has been proven as noted above.

**SOLUTION: LECTOTYPE AND NEOTYPE.** One can ignore pulchella totally as Miller & Brown (1981) did, but that is futile because ICZN rules prove it was not a nomen nudum and thus cannot be ignored; one can try to get rid of it by claiming it is a synonym of tharos as Tilden attempted and failed to do. The name pulchella is like an Egyptian mummy suffering from a curse in a bad Hollywood movie: one can whack it and shoot it and burn it but it still comes back again and again to kill off living names; the only solution is to remove the curse. If the current name was long stable it would be a shame to dredge up some old name like pulchella to replace it, but the name all living lepidopterists know (campestris) was replaced by pratensis recently, so there is no stability to overturn; Miller & Brown (1981) dredged deep to overturn the stable campestris with the long-dead pratensis, and once taxonomists start dredging up old names, why should they stop until they scrape the very bottom of the old name sewer? ICZN rules clearly favor priority over stability: in all other fields of science old incompetent work is simply happily ignored, but in taxonomy it lurks in the forefront forever; the "50-year rule" that attempted to promote stability has been junked; by ICZN decree a totally inappropriate or misleading name must be used if it has priority over a good appropriate name; and ICZN rules require changing the endings of species/subspecies names in order to make them all either male-homosexual or lesbian (but not heterosexual) genus/species/subspecies combinations, another indication that stability of nomenclature is not the primary goal of the ICZN. And let's not forget that pulchella's rival pratensis also has a sorry history: its author Behr described the same subspecies twice (campestris and pratensis; these and another pulchella ssp. montana were all described as "species" in the same paper), with campestris having line priority but no clearly-stated locality, leaving pratensis as a disputed name. Standards were very lax in Boisduval's and Behr's time: descriptions were bad, localities were vague or wrong, types were selected poorly or never designated or lost, publication dates were unstated or vague, paintings were surrealistic, etc. etc. As Douglas C. Ferguson wrote to me, "Entomologists of 150 years ago had no concept of the problems of taxonomy and nomenclature, or of the complexity of nature as we know it today, because most of this knowledge developed later. They had no standardized rules of nomenclature. They were all amateurs with no real basis for deciding what was the right thing to do." Very true: the first widely-accepted rules did not even come about until the Re'gles in 1905, 53 years after Boisduval named pulchella (some people think that the current highly-complex 339-page ICZN Code is dubious progress, because half the Code consists of obscure grammatical details on the latinization of names). We must admit that thousands of butterfly names are now accepted that are based on incompetent original descriptions. It is standard practice to read the vague poor original description of a taxon, and then ignore it and use only the type on which to base the name; that is why the type concept arose, because verbal descriptions are often bad and even excellent descriptions cannot come close to the information stored in an actual specimen. Now let's consider stability. If I ignored pulchella now, some

future person could still resurrect it to replace pratensis, and I cannot ignore it because only nomen nuda can be ignored and the ICZN rules prove it is NOT a nomen nudum; so true stability will only occur if the problem is settled now, once and for all. Accepting pulchella as valid and restricting its type locality is not enough. Obviously there are so many questions regarding the name (careless describer, bad original description consisting only of locality and designation of a species it is not, controversial mention or indication, possibly controversial type) that a lectotype/neotype designation is required. I cannot create a neotype pulchella of species tharos, because that would violate the stated locality and the USNM syntypes and would violate Boisduval's own vehement multiple statements that pulchella is not tharos and would violate Boisduval's evident intention of stating that pulchella was like Drury's pratensis-like fig. 5. I sent a revised writeup to John Emmel a second time, and he agreed that pulchella has enough of an original description to avoid being considered a nomen nudum, and agreed that the presence of two pulchella syntypes in the USNM strengthens the case that these are bonafide syntypes, not specimens that were later relabelled, and he agreed that the best decision to achieve stability in this situation is to designate one of the two Boisduval USNM syntypes a **LECTOTYPE** of pulchella. Since John Emmel and Thomas Emmel were already working on a paper concerning all Calif. butterfly types named by Boisduval, they and I agreed to designate one of the two USNM syntypes as lectotype pulchella in the work by Emmel & Emmel & Mattoon (1995, in press). Therefore, the USNM "type" specimen was selected (my figs. 179-180), which is identical to San Francisco pratensis, lacks abdomen and one antenna, and has these four labels (my fig. 178) (\ means new line): 1) "Pulchella.Boisd.Calif. \ Tharos.Dr.1.pl.21.f.5. \ Californie."; 2) "Type \ pulchella \ Bdv. \ a/c Hofer."; 3) (label on orange paper with red type and red border) "Oberthur \ Collection"; 4) (label in black type with black border) "EX MUSAEO \ Dris Boisduval". A hand-printed lectotype label has been attached to this USNM specimen, label 5): "LECTOTYPE [in red] \ pulchella, designated \ April 1994 by John Emmel, \ Thomas Emmel, Sterling \ Mattoon, and James Scott, \ [reverse of label] lectotype designation \ to appear in Emmel, \ Emmel, & Mattoon work \ on "Systematics of \ Western U.S. Butterflies" [all in black]" (a sixth label was also added, see below). This lectotype designation will satisfy all persons who accept that the two USNM syntypes are valid syntypes. However, as John Emmel's letter cited above demonstrates, there may be lingering doubts that the syntypes may be pseudotypes. My opinion is that they are probably syntypes, but that Hofer--not Boisduval--probably wrote the pulchella "type" label when the collection was accessioned by USNM. The USNM pulchella lectotype designation unfortunately will not satisfy those persons who think the USNM syntypes are pseudotypes, labeled "type" after the original description. Creating a neotype pulchella of species pratensis would create stability, because pulchella is the oldest name--the dredge can scrape no lower to find older names. But a review of ICZN rules regarding neotypes is in order. A neotype is (ICZN glossary): "The single specimen designated as the name-bearing type of a nominal species or subspecies for which no holotype, or lectotype, or syntype(s), or prior neotype, is believed to exist [Art. 75]"; this rule precludes the designation of a neotype if a valid lectotype has already been designated. However, any skeptics who believe that the two USNM "types" are pseudotypes labeled after the original description, obviously believe that no types exist, in which case a neotype can be designated. Therefore, the proper procedure is this: I hereby declare that the USNM lectotype of pulchella designated by Emmel & Emmel & Mattoon & Scott is also the **NEOTYPE** of pulchella (my figs. 179-180), and a label has been attached to the lectotype, label 6): "NEOTYPE [in red] \ pulchella, designated \ May 1994 by James \ A. Scott, designation \ to appear Papilio #7 [all in black]". (I hereby state--to clarify any future questions regarding the application of the ICZN rules on lectotypes and neotypes to this situation--that this specimen was declared a lectotype by Emmel & Emmel & Mattoon & Scott in a separate action in April 1994, prior to its designation as a neotype by J. Scott in May 1994, and I hereby state that the specimen was officially designated lectotype prior to it being designated neotype, regardless of whether the Emmel & Emmel & Mattoon paper or the present Scott paper is published first.) If the lectotype is a true syntype and not a pseudotype then of course this neotype designation is unnecessary, and technically violates the Code since a neotype cannot be designated if syntypes exist; but if the USNM specimens are pseudotypes then the neotype designation is valid. I am making this extraordinary and perhaps unprecedented action--designating the lectotype to also be the neotype--to ensure that stability is guaranteed, because my action forces both the believers (people who believe the two USNM types are valid syntypes) and nonbelievers (who question the

deficiencies of Boisduval's description and types) to permanently use the name pulchella; there are no more old names to dredge up so no more names can come forth to destroy stability. I do not care whether anyone questions or criticizes my action in designating this neotype, because stability of nomenclature in this case is more important than any criticism I may attract because of my neotype designation. The proponents of lectotype can eternally chase the proponents of neotype around in a circle, while everyone else can ignore the spectacle and simply be grateful that at last there is a stable name for the species: pulchella. (The ICZN Code needs a rule that states that a neotype becomes a lectotype if the neotype is found to be a syntype; and a lectotype becomes a neotype if it is found that the specimen is not a syntype.) The two USNM pulchella syntypes--of pratensis pratensis--have no exact locality or date labels (my fig. 178), so in order to fix the concept of pulchella properly I have restricted the type locality to San Francisco, Calif. as noted above.

**DIAGNOSIS.** Near San Francisco, adults are large, the forewing tip is not extended as it is in camillus, the uns is almost uniformly orange mottled with yellowish, the black spots are small on unf (only two present, on inner margin), the marginal unh patch & crescent are weak, the unf discal cell bar is yellow, and the spot at base of upf cell  $M_3$  is large. This spp. is quite distinctive there. Ssp. pulchella is generally easy to identify because of the unspotted unf. The antenna is dark: males have the antenna nudum border dark-brown (less often black), the lattice dark-brown to black, the steps dark-orange to less often brown; females have borders black (sometimes dark-orange), the lattice brown to black, the steps yellow-orange to dark-orange. The cremaster is very narrow on the only family reared (high altitude 10000' in Inyo Co. Calif.), but is probably larger in lowlands.

**HOSTPLANTS.** Aster hesperius in S. Calif. (reported as A. foliaceus v. hesperius by Comstock 1930; many other authors cited this record merely as A. foliaceus, an ERROR because foliaceus is a separate species), A. greatai in S. Calif. (John Emmel pers. comm.), A. chilensis at Davis, Calif. (oranger-ups pop., A. Shapiro J. Res. Lepid. 13:118 & 14:101 & Wasmann J. Biol. 32:267), A. conspicuum in Wash. (R. Pyle, Watching Wash. Butt.); a record of A. praealtus cited by Tietz (1972) is an ERROR because it is absent in the 3 references Tietz cites; a record of Aster californicus from C & N Calif. (J. Garth & J. Tilden 1986 Calif. Butterflies) is an ERROR because J. Tilden (letter to J. Scott June 1, 1988) was not sure of the source of this record and Aster californicus is a syn. of Solidago californicus in Abrams' flora.

**EARLY STAGES** (one family Coyote Creek, 10000', Inyo Co. Calif., and Comstock 1930, figs.). **SILK WEB.** 1st-3rd-stage larvae spun only a small amount of web in lab, though the web was moderate at one point for 2nd-stage larvae. **EGG** light-green, later becomes pale-yellow-green, then turns brown before hatching, ~20 (~20-25, Comstock 1930) vertical ribs. **1ST-STAGE LARVA** light-ochre-yellow, after feeding innards green in anterior 2/3 of body due to food, a creamier wide low mound between D1 & D2 setae, a smaller supralateral creamier mound, a wide lateral creamy mound with L1-2 setae; later in stage the larva ochre with innards green on anterior 2/3 due to food, a weak darker green or tan middorsal line, a wide brown subdorsal band, a weak tan lateral line, the same creamier low mounds, seta bases brown, suranal plate & collar blackish-brown; head black; duration about 5 days. **2ND-STAGE LARVA** greenish-cream, a dark-green middorsal line, a dark-green line above BD2 scoli, a wide brownish-green subdorsal band, a dark-green lateral line, with the same low creamy mounds as before (one subdorsal, two smaller on side, one sublateral); later the pattern turns browner, as both dorsal lines and lateral line are light-brown and subdorsal wide band is dark-brown; collar & suranal plate brown; head brown; duration about 6 days. **3RD-STAGE LARVA** has pattern of mature larva, middorsal band blackish-brown (no orangish coloration below BD1), then light-brown, a brown band above BD2, a cream subdorsal band encloses BD2 and is orange beside BD2, a wide dark-brown subdorsal band (a little orangish color is below BSD), a creamy area includes spiracles, a brown band, a cream lateral band touches BL1 scoli (an orange ring around BL1), underside brown. **4TH-STAGE LARVA** like mature larva, blackish-brown heart line (brownish-orange below BD1), many cream dots on the top edge of a wide dark-brown band, a cream band contains BD2 and is brownish-orange by BD2, a wide blackish-brown subdorsal band encloses BSD (brownish-orange posteroventral to BSD), a creamy band of many cream dots includes spiracles, a wider brown band has many cream dots, a cream lateral band touches BL1 (brownish-orange around BL1), underside lighter-brown, suranal plate black with brown spots on the side of anterior narrowed part, collar black with 4

tan spots corresponding to positions of 4 primary setae of 1st-stage; head black with cream vertex stripe.

**MATURE (6TH-STAGE) LARVA** (Inyo Co.) dark-brown, a blackish-brown heart-band encloses BD1 (a brownish-orange sliver below BD1), a brown band contains many cream dots, a blackish-brown band (dark-brownish-orange just above BD2)(the dark dorsal area above row of BD2 scoli is as dark as the wide dark subdorsal band, except paler in some larvae), a cream band encloses BD2 scoli and is light-orange beside BD2, a wide blackish-brown (black just below BD2) subdorsal band encloses BSD on its lower side (brownish-orange just posteroventral to BSD), a creamy band formed of cream dots at level of spiracles, an orange-brown wide band with many cream dots, a cream band touches bottom of BL1 where it narrows (a ring of brownish-orange around BL1), underside brown with some cream dots; BD1 & BSD scoli dark-brown except for tan tip, BD2 scoli brown all over, BL1 scoli orange-tan or brownish-orange, BL3 scoli orangish-tan; proleg shields light-brown with blackish-brown (blackish A10) ventral margins; collar black with 4 tan areas corresponding to positions of 4 primary setae of 1st-stage (the posterior area extends to rear margin); suranal plate blackish on wrinkled middle of narrowed anterior part and cream on margins, tan on widened posterior part which has many tiny black seta bases except on rear margin, lateral part of rear margin cream-tan; head black, with short cream vertex band; larval duration 35-40 (extremes 31-42) days in lab. **MATURE LARVA** (Comstock 1930, no locality stated but presumably S Calif.) similar to *camillus* and Inyo Co. *pulchella* but the head and dorsal body area darker: a broad middorsal grayish-black area with numerous cream dots (the middorsal blackish line and blackish line above BD2 scoli of those larvae not noticeable), a strong cream subdorsal band (slightly interrupted on thorax) contains BD2 scoli, a wide black band with fewer cream dots, a mottled yellowish-brown band (a little creamier dorsally) encloses black spiracles and BL1 scoli, then a cream lateral band touches bottom of BL1 scoli, underside brown with some cream dots, legs black, prolegs yellow-brown or straw, scoli blackish, the setae of BD2 scoli a bit paler than those of BD1 & BSD, but BL1 scoli yellowish-brown, BL3 scoli yellow-brown, (orangish areas near some scoli bases not mentioned but must be present), collar apparently has pale ridge and blackish margins; head black, with white vertex stripe reduced to a white spot on top of head beside neck, setae black or grayish.

**PUPA** (Inyo Co.) mostly light-brown, a few medium-brown, with fairly-weak wing mottling (discal cell spot is the only conspicuous spot, tornus spot weaker); in details, wing has usual brown areas (brown on anterior & dorsal sides of wing base ridges, anal margin brown dorsal to A<sub>1</sub> + A<sub>2</sub>, a brown discal cell spot, a small brown spot near tornus, a brown small spot near end of M veins), the usual postmedian & marginal cream dot-mounds (some tipped with a tiny black point) on wing, the usual brown staple-shaped mark around side & bottom of front of head (edged by a cream line on ventral and lateral edge of head), a cream patch on rear of head between antenna bases, antenna bases creamy, a creamier patch on each side of T1, a brown middorsal cleavage line T1-2, a slightly-creamier middorsal band on T & A includes a middorsal creamy anteriorly-directed triangle on top of T2 (the point of triangle is on slight point on top of T2) that is edged laterally (and weakly medially) by brown, a subdorsal creamier band on abd. (esp. when young, later almost disappears), a slightly-creamier band below spiracles esp. when young (later this area is no paler than area above spiracles), abdomen has midventral, supraventral, & lateroventral rows of small brown dots, a brown dot anteroventral to spiracle, the usual tiny brown abdominal spots (one on front & one on rear of segment) below level of subdorsal cones, proboscis tip dark brown, antenna has usual checkering, middle of each leg has usual cream-then-brown transverse bar (and rear leg may have a second similar more distal mark); the cones are quite small (middorsal weak A1-2, small A3-7, subdorsal small T2-A7 [tiny A1], suprspiracular tiny A5-6), transverse ridges are quite small (on T2, A4-7), cones and transverse ridges are brown on front & creamy on rear and the cones on A3-4 ridges have a tiny black tip, middorsal crest very weak (present on only 1/3 of pupae) on A2-3, cremaster usually highly shouldered, tapered in several, very rugose, width .78 mm (much smaller than *camillus* and the smallest average in *tharos*-group; more families should be reared, as this family may be unusual because of individual variation or high altitude); duration about 7 days males, 8 females, duration larva-pupa 43.5 days males, 46 females (an emergence lag of 1.5 days in lab). **PUPA** (Comstock 1930, S Calif.?) soft wood brown with fine darker-brown reticulations, like *camillus* but rather uniform with very little dark pattern except anterior edge of transverse ridges on A4-7 dark-brown (and T2 ridge slightly-brown anteriorly), no abdomen bands [probably missed] or

wing streaks visible on drawings, wings have usual cream dots and slightly-darker veins, proboscis tip darker, the usual dash on each antenna shaft segment, cones & crests small.

**7A. PHYCIODES PULCHELLA PULCHELLA,  
oranger variety**

In the Sacramento River delta area of Calif. the ups is often oranger/yellow, and is sometimes mostly orange. I will leave this problem to Calif. experts.

**7A. PHYCIODES PULCHELLA NEAR PULCHELLA**

Northward to Ore.-Wash.-Ida.-Mont.-Alta., adults are smaller than typical pulchella and the forewings seem a little more extended; these populations can be called near-pulchella.

**7B. PHYCIODES PULCHELLA TUTCHONE SCOTT 1994,  
NEW SUBSPECIES  
(common name Tutchone Crescent)  
(Figs. 189-192, Tables 1-7)**

**DIAGNOSIS.** Fairly small in size like camillus, fw tip extended about half as much as camillus, ups has neat rows of spots and appears more uniformly mottled than other ssp. (but less neatly-mottled in specimens other than topotypes), the postmedian upf band consists of very uniform-sized orange spots, the upf median band rather orangish (not as pale as other ssp.), the submarginal upf & uph band very dark, unf like pulchella/montana (mostly orange, with black spots nearly absent, being small on tornus and median inner margin), the unf discal cell bar yellow or orange, unh orange with fairly-strong marginal brown patch containing a usually-whitish crescent. Only one female was seen, which has the upf submarginal orange band very large. The antenna club nudum is orange, vs. blackish in all other ssp.: in males the nudum border is orange or dark-orange, the lattice orange or brownish-orange (rarely orange-brown), the steps yellow-orange or orange; in the female the borders and steps are orange, the lattice orange-brown. **NAME.** The Tutchone were American Indians who lived in SW Yukon.

**TYPES.** Holotype male (in British Mus. Nat. Hist.) and 3 male paratypes Nickel Creek, 4000 feet, SW Yukon, June 29, 1983; 6 male paratypes same data June 28, 1983; 2 male paratypes Rock Island Lake, Klondike Loop Hwy., Yukon, June 20, 1994; 4 male paratypes N White River, Alaska Hwy., Yukon, June 22, 1994; 8 male paratypes, N Gulkana, Richardson Hwy., Alaska, June 23, 1994; 1 female paratype Mile 129, Haines Road, 2400 ft., Yukon, June 26, 1970. **RANGE** Yukon-Alaska, perhaps N Alta.-N B.C.

**7C. PHYCIODES PULCHELLA MONTANA (BEHR) 1863,  
NEW COMBINATION  
(Figs. 185-188, Tables 1-7)**

**DIAGNOSIS.** Examination of the wing pattern of montana clearly shows that it is closely related to pulchella: the underside of montana is also mostly orangish with the black spots on unf nearly absent (limited to small spots on inner margin) and the unh marginal patch & crescent absent (orange), and the forewings usually somewhat stubby (but not as stubby as pulchella); the main difference from pulchella is the ups is mostly orange, and the unf discal cell bar is orange. A. Shapiro (Wasmann J. Biol. 32:267) stated that montana reared in lowland Calif. produced darker adults, but John Emmel (pers. comm.) did a similar rearing and his adults still resembled montana. The antenna club is dark: in males the antenna club nudum border is dark-brown (rarely dark-orange or black), the lattice black, the steps dark-orange (sometimes orange); in females the border is dark-orange or brown, the lattice dark-brown, the steps orange. Oliver (1978) hybridized montana with P. tharos using hand-pairing and found some infertility and inviability, esp. among female hybrids (~50-100%).

**SUBSPECIES STATUS.** Higgins (1981) gave this species status because he stated the valva tip was more robust. However Higgins may have misidentified many or all of his montana, because his Fig. 3 is pulchella X montana rather than montana. Furthermore, I examined KOH-prepared valvae in glycerin (five males) and tilted them at all angles and did not find them any different than valvae of all the other tharos-group taxa; the tip always looks narrowest in dorsal view and widest in lateral view. I then compared the length of the valva prong to the length of the valva, and found that in topotype (San Francisco) pulchella the prong tip extends beyond tip in 1, to tip in 1, less than tip in 2; in montana these numbers are 1, 1, 2 (plus 1 male had prong beyond tip on left valva and to tip on right); in near-pulchella (Mont.-Wyo.) 2, 2, 1; in camillus 0, 0, 3; in tutchone 1, 1, 1; the valva varies somewhat in shape in all tharos-group taxa and I do not think that it is any different in montana (whereas in the mylitta species group, P. orseis and several Mexican P. mylitta ssp. DO have narrower valvae). Garth & Tilden (1963) treated montana as a higher-altitude ssp. of pulchella because pulchella occurs at lower altitudes in Yosemite Nat. Park and at higher altitudes intergrades imperceptibly into montana; specimens from lower altitude on E side of Sierras (Mono Lake and vic., Bridgeport, June Lake) were stated to be clearly intermediate. I also found intermediate adults on E side of Sierras at 5 mi W. Sonora Jct., Mono Co. Calif. Forbes (1944, p. 155) stated that a Mr. Bradley found both normal pulchella and transitional montana at Sugar Pine, Madera Co., Calif. Actually, the only taxon that should be looked at for species distinction from pulchella is camillus (see it).

**HOSTPLANTS.** Aster occidentalis (T. & J. Emmel, J. Lepid. Soc. 28:345, previously misidentified as A. integrifolius by Emmel & Emmel, J. Lepid. Soc. 16:32), A. occidentalis, A. foliaceus var. parryi, A. integrifolius (all A. Shapiro, Wasmann. J. Biol. 32:267); A. chilensis (A. Shapiro, in Oliver 1978, perhaps an error for Sacramento Valley pulchella?). **EARLY STAGES.** **DIAPAUSE STAGE** part-grown larva (A. Shapiro Wasmann J. Biol. 32:267). **SILK WEB.** A silk web is made by 1st-2nd-stage larvae and larvae may [occasionally] live inside (Oliver 1979a, which evidently referred to ssp. montana of Oliver 1978). **MATURE LARVA.** Oliver (1978) stated body color is dark-reddish-brown with "pinkish" scoli (no doubt an error of color description referring to some shade of orangish only at base of some scoli) (versus chocolate-brown with white-tipped dark-brown scoli in P. tharos). **PUPA** has weak cones & crests (Oliver 1978). Duration larva-pupa 28-29 days males, 30-31 females (53-55 males, 54-55 females in late summer when some larvae evidently tried to diapause).

## 7. PHYCIODES PULCHELLA MONTANA-PULCHELLA

**DIAGNOSIS.** In lower mts. of the east side of the Sierras at least, adults resemble montana except the upperside is somewhat darker. These populations look like intergrades with pulchella as noted above (shoshoni occurs eastward in Nev., but the unf shows no influence of it).

### 7D. PHYCIODES PULCHELLA SHOSHONI SCOTT 1994,

#### NEW SUBSPECIES

(common name Shoshoni Crescent)

(Figs. 193-196, Tables 4-5)

**DIAGNOSIS.** Adults resemble camillus, but the unh has the marginal brown patch absent or almost completely absent and the marginal crescent weak, the unh is paler, and on females the black median posterior unf spot is smaller. They do not seem to represent intergrades between ordinary Utah camillus to the east and montana to the west (montana also has an unmarked unh) because the unh is pale-ochre, paler than both camillus and montana. Many Nev. butterfly ssp. have been named recently, many of which are unfortunate synonyms, but this ssp. is easily distinguishable with the naked eye. **NAME.** The Shoshoni Indians occupied SW Idaho and N Nevada, including Battle Mountain. **TYPES.** Holotype male (deposited British Mus. Nat. History) and allotype female and 2 male 3 female paratypes from willow-thistle area along Humboldt River near Battle Mtn., Elko Co., Nev. Aug. 5, 1974; 1 paratype female Reese River, Lander Co. Nev. Aug 6, 1974. George Austin (pers. comm.) has also found this phenotype in N Nev. **RANGE** perhaps limited to NC and NE Nev. because 2 males Ely, White Pine Co., Nev., Aug. 24, 1974 are closer to camillus.

## 7E. PHYCIODES PULCHELLA NEAR CAMILLUS

(Bighorn Mts.)

(Figs. 49, 202-203, 205-208, Tables 1-3)

**DIAGNOSIS.** Adults in lower Bighorn Mts. Wyo. are like camillus on underside etc., but are a little darker on the ups, and larvae are a little darker. They are not distinct enough to name as a separate ssp., and are treated in a separate section partly to afford more careful comparison with sympatric P. batesii apsaalooke.

**HOSTPLANT.** Cluster of 26 2nd-stage larvae (lot #A) found on leaf bases of seedling Aster (chilensis) adscendens, a few larvae diapaused as ~4th stage, many adults reared; cluster of 29 1st/2nd-stage larvae (lot #B) found on leaf underside of mature A. adscendens, a few larvae diapaused as ~4th stage, many adults reared; cluster of 33 2nd-stage larvae (lot #C) found on seedling A. adscendens, many adults reared; W Hidden Basin Cgd., Bighorn Co. Wyo., Aug. 17, 1993. (Other asters here produced only P. batesii apsaalooke and many Chlosyne acastus on Aster glaucodes, and nothing on Aster foliaceus.)

**EARLY STAGES. DIAPAUSE STAGE.** 4th-stage. **1ST-STAGE LARVA** ochre (greener on front of body), with sinuous brown dorsolateral band (perhaps weak middorsal and adjacent tan lines and weak sublateral tan line also present?), collar brown with tan seta bases (tan spot enlarged in front of D2 in 1 of 5 larvae), suranal plate brown with paler seta bases, proleg plates light-brown or brown A3-6, brown A10, legs dark-brown, setae dark-brown (L1-2 orangish-tan), spiracles brown, bottom of neck has 2 folds typical of neck gland in older larvae so true neck gland evidently present, setal lengths like other Phyciodes; head blackish, width .3 mm. **2ND-STAGE LARVA** ochre (greener on front 1/3 of body), later becoming tan, with heart-band brown, a narrow light-brown band above BD2 scoli, a wide irregular dorsolateral brown band, a narrow brown line at lower edge of BL1 scoli, underside light-brown; BD1-2 & BSD scoli brown or dark-brown (the tips not paler), BL1-3 scoli tan, collar dark-brown (the middorsal area sometimes darker) with 4 brown or light-brown mounds under each of 4 primary setae, suranal plate dark-brown (sometimes with darker small spot in anterior narrowed part, proleg plates light-brown or brown (sometimes brown A10), legs dark-brown; head unmarked blackish, except a faint or stronger brown or tan vertex stripe on some larvae, head width .4-.55 mm. **3RD-STAGE LARVA** like older larva, sometimes slightly reddish tinted, collar blackish with 4 tan bumps (the latter 3 often on a large creamy patch covering most of collar), suranal plate brown with a small dark-rimmed tan spot in anterior part, and a transverse tan area on middle of posterior rim, proleg plates light-brown, legs brown; head black with cream vertex stripe (sometimes weak or with anterior end a satellite spot), seldom a small brown crescent above eyes and on pickled larvae rarely a brown patch across frontoclypeus and on adjacent gena (these brown areas probably black on live larvae), head width .55-.8 mm. **4TH-STAGE LARVA** like older larvae but appear darker than mature larvae because scoli are comparatively larger, BD1-2 & BSD scoli dark-brown (tips microscopically slightly paler but not noticeably so), BL1-3 scoli orangish-brownish, collar blackish with 3 large anterior tan bumps and large posterior subdorsal tan patch angled posteroventrally to posterior rim (sometimes collar blackish with anteromedial tan bump and a large lateral patch that includes the areas of 3 other primary setae of 1st-stage), suranal plate brown or dark-brown (a tan rectangular area on rear rim, or a small tan spot on each side of rear rim), spiracles dark-brown; head like 3rd stage, width .9-1.45 mm. **5TH-STAGE LARVA** like mature larva; head width 1.5-1.6 mm.

**MATURE (6TH-STAGE) LARVAE** vary somewhat, most rather dark-brown, some larvae are quite like camillus but most are somewhat darker on body and head, some dark-brown larvae have strong cream bands and an orangish lateral area, other very dark larvae have reduced cream bands (subdorsal cream band sometimes nearly absent, the lateral cream band sometimes partially interrupted) and have little orange, some larvae are moderately-orange-brown but have reduced cream bands, lot A had the darkest heads and the most-interrupted subdorsal cream band, lot B had this band partly interrupted, while lot C had this band nearly complete and most resembled camillus; pattern details like other Phyciodes, a middorsal black heart-band encloses BD1 scoli, a narrow orangish-brown or brown (rarely orange-brown or light-brown or nearly black) band with many cream dots (on some larvae tiny areas of orange-brown are beside BD1 scoli in this band), a blackish-brown (often brownish-black or black) band has some cream dots

(the dark dorsal area above BD2 scoli is as dark as the wide dark subdorsal band, except is slightly paler in a few larvae), a cream band (interrupted slightly or moderately or mostly absent) runs between BD2 scoli (this band is orange [sometimes brownish-orange] just in front of and behind BD2 scoli), a wide black or blackish-brown dorsolateral band with some cream dots (esp. in middle of band) encloses BSD scoli on its lower edge, above spiracles a narrow orangish-brown (sometimes orangish-tan; sometimes gray between segments) band caused by many cream dots (on some larvae tiny areas of orange-brown are below BSD scoli in this band), a dark-orangish-brown (sometimes dark-brown) band with some cream dots encloses most of BL1 scoli on its lower edge (BL1 scoli usually have a very narrow brown ring around base, then a wider ring of brownish-orange or sometimes orangish-brown or rarely brown around scoli), an orangish-cream or cream (orangish-tan in the orangest larva) band (sometimes interrupted) touches bottom of BL1 scoli, a dark-brown band, underside brown (slightly grayish-brown beneath) with some cream dots; BD1-2 & BSD scoli are black (BSD sometimes brown)(the tips a bit browner but this is rarely very noticeable), BL1 scoli orangish-brown (varying from orangish to slightly-reddish-orange-brown to brown)(often orangish-cream T1-2), BL3 scoli orangish-tan; collar blackish with 3 small or larger anterior tan bumps, and a larger posterior tan area (corresponding to position of primary seta D2 on 1st stage) that angles posterolaterally to rear edge, suranal plate dark-brown with pale seta bases on narrowed anterior half (sometimes the dark-brown anterior patch is surrounded by a tan rim) but light-brown with minute black dots on widened posterior half, proleg plates light-brown with ventral quarter or third dark-brown (A10 plate may be dark-brown only on ventral fifth but is usually dark on ventral half or anteroventral 2/3 or on all but dorsoposterior corner)(on one larva, anterior plates mostly dark-brown except dorsoposterior corner and A10 plate mostly dark-brown except anteroventral corner), ventral neck gland present; head black, with a narrow and long or short (sometimes tiny, rarely wide and long, rarely with an anterior satellite spot) cream or tan (often gray, sometimes orange-tan or brown) vertex stripe, sometimes with a tiny (rarely wider and extending to neck) brown (or orange-brown or tan) dash above eyes, rarely a dark-brown (probably black on live larva) spot or horizontal stripe on frontoclypeus, head width 2.0-2.3 mm.

**PUPA** overall appearance light-orangish-brown on most pupae (most of lot A, ~2/3 lot B, > 1/2 lot C), many are medium-dark-orangish-brown (one lot C is dark-orangish-brown, one lot B is dark-brown), several lot B pupae are a creamier-light-orangish-brown, nearly all have weak wing streaks (one lot C has moderate wing streaks); pattern details like apsaalooke, new young pupae have the usual subdorsal & subspiracular creamier band with darker brown below (these bands nearly disappear later), wing has the usual brown streaks though they are usually weak beyond base (brown on wing base incl. anterior & dorsal slopes of wing base ridges, brownish on anal margin dorsal to 1A, near end of discal cell, distally between R<sub>4</sub>-M<sub>3</sub>, distally between CuA<sub>1</sub>-nearing 1A), wing has the usual postmedian & marginal cream dots, the usual 2 tiny brown spots on middle of wing (in base of cells M<sub>3</sub> & CuA<sub>1</sub>), small dorsolateral brown spots on A1-8 (1 anterior 1 posterior on each segment), a few tiny brown spots below spiracles on abd., the usual lateroventral, supraventral & midventral rows of small brown spots on abd., usually a cream spot between antenna bases, the usual creamy lateral spot on T1, usual creamy V-triangle on top of T2 edged anteriorly by brown, usually a weak creamier middorsal band T1-A1 (seldom on T3) which is divided by the brownish cleavage line on T1-T2 and by browner middorsal groove T3-A1, ~2/3 of pupae have a noticeable weak middorsal crest (generally creamier) on A2-cone of A4, proboscis tip dark-brown, usual spot on each leg & antenna segment, spiracles brown, the usual brown mark around the transverse-ventral and vertical-lateral ridge on front of head, the usual wing base ridges (short transverse ridge joined to longer lateral ridge roughly along vein 2A) are large as in other Phyciodes, the usual transverse ridges are present but quite small (somewhat larger on a few pupae)(ridges much smaller than tharos/cocyta and averaging smaller than batesii ssp.)(ridges present T2 from wing base to subdorsal cone, larger but rather small A4, almost absent A5-7 or very small); anterior slopes of ridges & cones orange-brown on paler pupae and dark-brown on darker pupae, posterior slopes cream; the usual cones are small (smaller than other sp.)(middorsal cone rare and weak A1, absent or weak A2, present A3-7 [largest A4], subdorsal T2, small or sometimes absent T3, absent or tiny A1, A2 very small, A3-7 [largest A4], supraspiracular A4), cremaster winged (flared laterally, most often widening a bit behind abdomen (on many pupae merely extending straight back) then extending straight back [but sometimes widening further or tapering a little] a

variable distance, then tapering more-or-less abruptly to base of cremaster tip, width at wings averaging 1.05 mm, cremaster very rugose on top & bottom.

**7E. PHYCIODES PULCHELLA CAMILLUS EDW. 1871,  
NEW COMBINATION  
(Figs. 201, 204, Tables 1-7)**

**DIAGNOSIS.** Ssp. camillus differs greatly in wing pattern from pulchella/montana. The forewing tip is extended more than the stubby-winged pulchella, and the unf has large yellow areas and large black unf spots. The unf tip is mostly yellow except for outer part of cell  $M_1$ , the 2 black spots on rear of unf are large, the median unf black spot on front of wing (edging the postmedian cream patch) is fairly large, the unh marginal brown patch is large and has a cream crescent (sometimes pearly), and the spot at base of upf cell  $M_3$  is tiny or absent. The unf discal cell has a strong yellow bar across the cell, which is absent in some other ssp. Antenna club nudum (Colo.-Wyo.-Utah) black with grayish-black steps (the gray due to very minute whitish objects, evidently olfactory sensillae). **SUBSPECIES STATUS.** If any Phyciodes ssp. is to be looked at for species status it is camillus, because the unf is quite different. I found a male close to pulchella and one close to camillus at Falls Creek Cgd., Sweetgrass Co. Mont., July 2, 1966, which could possibly indicate sympatry of separate species, but is probably just polymorphism in an intergrade area. Both have similar genitalia, but genitalia are not useful for distinguishing these taxa, so investigation of their relationship should be based on wing pattern/number of yearly flights/hosts etc. **RANGE.** Ssp. camillus occurs at least in most of Wyo. (at least the lowlands and lower mts. N to Bighorn Mts.)(uncommon in adjacent S.D.-Neb.) to N.M., west to N Utah & E-C Nev. Evidently absent in Mex., or possibly confused with P. pallescens which has nearly identical wing pattern; Stanford & Opler (1993) show no records from Mex., and their southernmost dots are Cochise Co. Ariz. (doubtful, based on 3 rather dubious records, and Bailowitz & Brock 1991 do not list it) and Hidalgo Co. N.M.

**HABITAT.** Occurs in open areas such as prairie, moist meadows, roadsides, gulches, meadows, canals, sagebrush, open pine woodland, etc.; everywhere except dense forest. Often occurs in drier areas than P. tharos and P. cocyta, which also occupy both the plains and mountains, but generally in moist meadows and creeksides and moist gulches. Males patrol all day in low spots such as gulch and valley bottoms for mate-location.

**HOSTPLANT RECORDS.** Cluster of 27 live green eggs & 24 dead eaten eggshells found on leaf uns of low 5 cm plant; cluster of 50 eggs found on leaf uns of 20-40 cm plant, in lab 1st-stage larvae made some to much web (even more in jar between leaves & jar); all on Aster (chilensis) adscendens (reared on Aster laevis, simplex, hesperius), adults reared; S Baggs, Moffat Co. Colo., Aug. 18, 1994. Oviposition 13:45-13:50 100 eggs on underside of A. adscendens leaf, 7 mi. W Hayden, Routt Co. Colo., Sept. 2, 1978. Oviposition 11:30 88 eggs on A. adscendens, E Portal Moffat Tunnel, Gilpin Co. Colo., July 30, 1977. Adults associated with A. adscendens, Bear Creek, Chaffee Co. Colo., Sept. 5, 1990. Adults associated with A. adscendens, S side and in Casper, Natrona Co., Wyo., Aug. 25, 1993, Aug. 24, 1994. Oviposition 13:45 27 eggs (more would have been laid had I not disturbed her) on underside of Aster porteri leaf, Green Mtn., Jefferson Co. Colo., June 19, 1985. Female flushed out of A. porteri clump at 12:10, where a cluster of 57 eggs was found on underside of leaf, Red Rocks, Jefferson Co. Colo., Sept. 22, 1987. 2 females preovipositing 11:40 and one landed on a lush A. porteri seedling for a second then flew (perhaps she detected the eggs already there and then departed), inspection of this seedling revealed 85 eggs on underside of large leaf 8 cm long; Mt. Lindo, Jefferson Co. Colo., Sept. 9, 1993. Oviposition 12:47, female flew out from plant and cluster of 10 eggs found under leaf, cluster of 85 eggs found on nearby plant, all on A. porteri (fairly raunchy seedlings, not lush); Ralston Butte, Jefferson Co. Colo., June 10, 1994. Cluster of 78 eggs found on leaf uns of large lush A. porteri seedling 10 cm wide, hatched Sept. 6, larvae made good silk web above leaf surface (at leaf curl) by Sept. 8; Foxton, Jefferson Co. Colo., Aug. 29, 1994. Oviposition 10:19-10:36, she landed & fluttered 5 min. on several nearby lush seedlings then laid 18 eggs on uns of 2-cm-long leaf of lush seedling; cluster of 14 pale-green eggs found under seedling leaf; cluster of several 1st-stage larvae (near cluster of ~30 eggshells) found on small leaf at base of seedling with silk web on & above leaf; one 1st-stage larva (& cluster of ~30 eggshells under leaf) found on seedling; all on A. porteri; Indian Gulch,

Jefferson Co. Colo., Sept. 7, 1994. Preoviposition 11:05 A. porteri, cluster of 43 eggs found on underside of A. porteri leaf, near Mt. Falcon, Jefferson Co. Colo., Sept. 18, 1988. Preoviposition A. porteri, Lone Rock Cgd., Jefferson Co. Colo., Aug. 27, 1986. Adults associated with A. porteri, Van Bibber Creek, Jefferson Co. Colo., Sept. 23, 1987, & Tinytown, Jefferson Co. Colo., May 21, 1994. Oviposition 45 eggs 11:45-11:55 on underside of 4 mm wide leaf of young plant of Aster (Virgulus) ericoides where young plants were thick, 3 mi. E Vineland, Pueblo Co. Colo., Aug. 28, 1983. Oviposition 11:40 31 eggs on underside of leaf of juvenile A. ericoides, Green Mtn., Jefferson Co. Colo., Sept. 4, 1984. 31 eggs in cluster on underside of leaf of young A. ericoides plant, Green Mtn., Sept. 12, 1985. Oviposition, female fluttered about plants 10:45-10:58 then laid 12 eggs 10:58-11:00 under big leaf of seedling A. ericoides var. falcatus (stem hairs spreading), 2 egg clusters of 102 & 150 eggs found 1 m away in middle of A. ericoides var. ericoides (stem hairs appressed), N Bear Creek Res., Jefferson Co. Colo., Sept. 9, 1991. Most of my records for A. ericoides involve var. falcatus. (Vars. falcatus and ericoides are treated as separate species in William A. Weber's latest floras and some other floras, and some floras even divide ericoides into four species. I have examined hundreds of these Aster and it is my opinion that there is genetic polymorphism for spreading vs. appressed hairs [other characters of head size and petal number seem very weak] so that different types grow in the same meadow and some plants are intermediate. Whatever the case, the butterflies cannot tell the difference between them.) Egg clusters and larval clusters found on A. ericoides var. falcatus (10 clusters of 33, 74, 52, 48, 98, 33, 64, 80, 88, 57 eggs plus ~50 1st-2nd-stage larvae found on one seedling; eight clusters of 38, 58, 76, 28, 89, 74, 235, 55 eggs on another seedling; two clusters of 135, 81 eggs found on another seedling; other clusters of 36, 19, 57, 32, 18, 57, 26, 14, 47, 118, 46 eggs found on other individual seedlings); all the eggs were on leaf undersides of lush seedlings near the ground, the most eggs being on a large 1st-year basal rosette; several Aster hesperius searched had no eggs; Green Mtn., Jefferson Co. Colo., Sept. 17, 1991. Preoviposition 11:55 A. ericoides var. ericoides; Cherry Creek Res., Arapahoe Co. Colo., Sept. 9, 1992. Adults associated with A. ericoides, Horsetooth Res., Larimer Co. Colo. May 23, 26, 28, 1990. Preoviposition 11:00 A. ericoides, Green Mtn., Jefferson Co. Colo., Sept. 1, 1990. Adults associated with A. ericoides, N Bear Creek Res., Jefferson Co. Colo., Sept. 24, 1990. Cluster of ~60 eggs found on underside of leaf of seedling Aster hesperius along canal, some reared to adults emerged Dec. 17-31; A. hesperius grows only along creeks and ditches, where larvae could be washed away, so it is probably a less-common natural hostplant than A. ericoides which occurs in moist meadows and roadsides and is more common; Barr Lake, Adams Co. Colo., Oct. 11, 1989. Oviposition 12:17-12:41 77 eggs on leaf uns of lush A. hesperius seedling in shade below mature plant after preovip. 5 min.; oviposition 12:25-12:50 109 eggs on leaf uns of lush A. hesperius seedling after preovip 12 min.; both females were disturbed from plants before oviposition, so may have laid eggs before disturbance; clusters of 46 & 51 eggs found 3-5 cm from last cluster (of 109 eggs); preovip. A. hesperius 11:50; Barr Lake, Adams Co. Colo., Sept. 24, 1994. Eggs/larvae (most probably P. p. camillus, some probably P. tharos) found on A. hesperius lush seedlings (often in shade of mature aster): nine clusters of eggs (81, 64, 66, 94, 96, 38, 17, 55, 53 eggs) on one very lush seedling, 21 eggs, one 3rd-stage larva, 52 eggs, 31 eggs, 59 & 75 eggs on one seedling, 84 & ~60 eggs on one seedling, 27 & 27 & 61 on one seedling, 46 & 51 eggs on one seedling, 101 eggs, 108 eggs, 92 eggs, 35 eggs, 99 eggs, 26 eggs; average 60 eggs/cluster; Barr Lake, Adams Co. Colo., Sept. 24, 28, Oct. 8, 1994. 2 preovipositions on Aster (Eucephalus) glaucodes and adults common near it (but in 1994 feeding damage on leaves seemed due to a beetle sp.), Green Mtn. Res., Summit Co. Colo., July 15, 1985. In Utah, Clyde F. Gillette found a cluster of eggs on Aster eatonii and reared them (written commun. 1994). Oviposition 99 eggs 11:30, and 15 large larvae found, on Machaeranthera pattersoni, Golden Gate Can., Jefferson Co. Colo., Aug. 7, 1978. Oviposition 38 eggs 12:04-12:19 on underside of leaf of seedling (4 cm tall) M. pattersoni, Genesee Mtn., Jefferson Co. Colo., Aug. 22, 1988. 16 eggs found on M. pattersoni leaf underside of seedling plant; Tinytown, Jefferson Co. Colo., Sept. 6, 1990. Oviposition 9:51-10:20, she flew slowly over plants 9:50 and landed once on host, then landed 10 cm away and laid 67 eggs on uns of ~4 cm M. pattersoni leaf; oviposition, she was scared up from M. pattersoni but returned and preovip 9:45-10:00 then landed and laid ~73 eggs ~10:05-10:25 on underside of 4 cm M. pattersoni seedling leaf of same plant the previous female laid eggs on (this female landed several times on this seedling and saw other female flutter wings there so perhaps laid eggs on

this plant to deliberately add to the egg load there); 1st-stages later made good silk web over eggs that they rested on; W Mt. Falcon, Jefferson Co. Colo., May 27, 1994. Oviposition 11:54, a female flew out from M. pattersoni clumps and I found cluster of 4 eggs she was probably laying, other clusters of 34 and 65 found on leaf uns of same clump, in lab 1st-stages made good web above leaf; Tinytown, Jefferson Co. Colo., June 4, 1994. Adults associated with Machaeranthera canescens var. rubrotinctus (previously misidentified as M. pattersoni) growing abundantly near Prairie Dog mounds (M. canescens is evidently inedible to prairie dogs), plains Barr Lake, Adams Co. Colo., Sept.-Oct. 1989-1992. Clusters of 23, 30, 46 eggs, and clusters of 2, 2, and ~40 2nd-stage larvae, all found on M. canescens lush seedlings 6 cm tall X 7 cm wide (always where several lush seedlings were clustered); preoviposition, female landed on M. canescens often 10:35-10:40 then landed on succulent seedling and basked and bent abdomen to leaf underside every minute or so from 10:40-12:20 but NO eggs were found! (an old female evidently going through the motions); Barr Lake, Adams Co. Colo., Aug. 31, 1993. 18 1st-stage larvae found in silk webs on 2 leaves of M. canescens lush seedling; 12 1st-stage larvae found on 2 large basal leaves of Aster ericoides var. falcatus; Barr Lake, Adams Co. Colo., Sept. 3, 1993. Clusters of 26 & 64 eggs found on same lush M. canescens seedling; 26 3rd-stage larvae found on lush long leaves at base and two 3rd-stage larvae on upper inflorescence leaves of same M. canescens plant, adults reared; Barr Lake, Adams Co. Colo., Sept. 21, 1993. Cluster of 1st-stage larvae found, much web between leaf bases 1 cm below mass of eggshells on uns of a leaf base, and a 3rd-stage larva found on other seedling plant, both on M. canescens; common near A. ericoides; Barr Lake, Adams Co. Colo., Sept. 5, 1994. Adults assoc. Aster fendleri Questa, Taos Co. New Mex. Sept. 10, 1977 (though A. fendleri near Morrison, Jefferson Co. Colo., may not be a host). 2 females assoc. Aster pauciflorus, 12 mi. E Savery, Carbon Co. Wyo., Aug. 18, 1994. **HOSTPLANT SUMMARY.** Occupies both the Colo. plains where the host is mainly A. ericoides, sometimes A. hesperius & the aster Machaeranthera canescens, and the mountains where several Aster (adscendens, porteri, eatonii) & Machaeranthera pattersoni are hosts. I have reared enough eggs/larvae from the large succulent glaucous Aster laevis & glaucodes in Colo.-Wyo.-Neb. to be confident that P. pulchella seldom if ever eats them (A. laevis produced P. cocyta and P. batesii, A. glaucodes only batesii); thus camillus specializes on the rough small-leaved asters that grow in semi-dry areas as well as moist areas, which explains why it is widespread in both mountains and plains and why it can have two generations rather than one.

**EARLY STAGES** (C, S, & NW Colo.; durations from Edwards 1884a). **SILK WEB.** Young larvae (esp. 1st-2nd stages) usually produce a rather strong silk web over the eggs or where they are molting or living; they usually rest on top of the web, but a few may rest under a web formed on a single leaf, and 1st-stages may live within a moderate silk web that encloses several adjacent narrow leaf bases of a seedling aster; I noted silk webs made by Jefferson & Adams & Moffat Cos. Colo. larvae. **EGG** yellowish-greenish-cream, 18-23 ribs (difficult to count, best counts were 21, 21, 23); duration ~7 days. Average number of eggs per cluster in nature 60. **1ST-STAGE LARVA** tan, greenish-creamy-tan after feeding, with middorsal narrow light-brown line or row of brown dashes, sometimes a row of weak light-brown dashes between D1 setae, a narrow light-brown line or row of dashes near them, a broad brown subdorsal band includes SD1 setae, sometimes a very weak tan line below spiracles, a brown or tan line under L1-2 setae, underside tan or very-light-brown mottled with light-brown esp. on A1-2 and A7-9, the usual creamier broad low mounds (large above subdorsal band, smaller in lower part of subdorsal band, large and dorsoventrally-narrowed at L setae), (Phyciodes tharos lacks a brown body pattern on 1st stage, P. cocyta has a weak pattern, and P. batesii batesii lacks it also [McDunnough 1920] or it is weak, while the western batesii ssp. have a weak pattern)(Edwards 1884a mentioned no pattern in camillus either, merely stating the body is "green", but perhaps he looked only at just-hatched larva), setae black, collar and suranal plates dark brown with slightly-paler seta bases, proleg plates dark brown, ventral neck gland present; head solid blackish, head width .29-.3 mm; duration 4-5 days. **2ND-STAGE LARVA** greenish-tanish-cream when young, with weak middorsal tan line and tan line near it, a wide slightly-brown subdorsal band, a weak tan sublateral line; older larva becomes darker with body pattern similar to older larvae, heart-band dark-brown enclosing BD1 scoli, a tan or cream-tan band, a brown line, a cream band encloses BD2 scoli, a wide dark-brown or mottled-blackish-brown band encloses BSD scoli on its lower edge, a mottled brown band contains cream areas (the upper part of this band encloses pale spiracles and large cream spots), a cream band encloses BL1

scoli, a brown band, underside light-brown (esp. dark T1-3 A1-2 A7-9) with brown specks & cream dots; BD1-2 and BSD scoli light-brown or brown, BL1-3 scoli cream; collar dark-brown with a tan bump under each of 4 primary setae, suranal plate brown on most or all of anterior narrowed part and light-brown or grayer-brown on wider rear, legs dark-brown, proleg plates brown, ventral neck gland present (present on all Phyciodes evidently from 1st-stage to mature); head usually unmarked blackish, but some have an orangish-tan vertex stripe, head width .38-.45 mm; duration 3-4 days. **3RD-STAGE LARVA** body like older larva, band beside heart-band evidently cream-tan, the cream BD2 & cream BL1 bands are mostly quite interrupted, upper scoli brown, BL1 & BL3 scoli cream, suranal plate brown (lighter-brown on wider rear), collar like 2nd stage; head black, with a cream or orangish-cream vertex stripe (sometimes large, sometimes narrow, sometimes with anterior end absent or constricted into satellite spot), rarely a small dark-brown spot over eyes and/or a brown lower part of gena (but these brown areas are probably blackish on live larvae), head width .55-.7 mm; duration 3-4 days. **4TH-STAGE LARVA** like older larva, band beside heart-band sometimes tan, collar dark-brown with a tan bump under anteromedial primary seta site (primary setae are obvious only on stages 1-2), the lateral 2 primary seta sites are tan bumps and a tan patch is on rear of collar where D2 primary seta resides, or all 3 latter seta sites are on a large tan patch covering lateral half of collar; head black with cream vertex band, sometimes a cream eye stripe running to neck and sometimes a brownish bottom of gena and brownish lower 2/3 of frontoclypeus (these brownish areas probably black on live larvae), head width .85-1.4 mm; duration 5-6 days. **5TH-STAGE LARVA** like mature larva; head black with creamy vertex band, rarely a creamy eye band behind eyes to neck but usually only a small tan or brown patch above eyes (rarely brown also behind eyes and on lower part of gena, these brown areas probably blackish on live larvae), head width 1.4-1.7 mm; duration 4 days.

**6TH-STAGE (MATURE) LARVA** fairly dark-brown (overall appearance a little darker than P. tharos/cocytia) with tiny cream dots and the usual Phyciodes pattern, a middorsal brownish-black band through BD1 scoli (bottom of BD1 scoli tan or brown then ventrally beside it on body a sliver of brownish-orange or brown), a narrow orangish-brown band with some creamy or tan dots, a blackish-brown band (the dark band above BD2 scoli is as dark as the wide dark subdorsal band, except is paler on some larvae), a subdorsal cream band runs between BD2 scoli (this band is very-slightly interrupted or interrupted on rear 1/6-1/3 of segment and between segments, and some have the band only 60% complete, unlike the continuous band of P. tharos/cocytia)(the band is dull-orange or light-dull-orange just before and just after scoli), a wide brownish-black (often quite black) or blackish-brown band with some cream dots in middle of it includes BSD scoli on its lower side, a weak or strong cream-tan line (caused by many cream dots) at lower edge of BSD scoli above spiracles (below BSD scoli in this band are often small areas of orange-brown or brown-orange), a wide orangish-brown band with many creamy or orangish-cream or cream-tan dots includes spiracles and BL1 scoli (BL1 scoli narrowly ringed by brown-orange or brownish-orange, and small spots of brownish-orange are below BL1), a continuous orangish-cream or creamy lateral stripe touches lower edge of BL1 scoli, this stripe sharply-outlined beneath by dark-brown in the middle of each segment, underside brown with somewhat fewer creamy or tan dots; BD1-2 scoli brownish-black or dark-gray (BSD scoli slightly darker or black)(these scoli all have slightly browner pillared tip but this is seldom noticeable even microscopically except on the longest scoli [the longest Phyciodes scoli are on A10, the next longest on A9]; all have mostly dark-brown setae), BL1 scoli orangish-tan or ochre-tan (sometimes cream on T1) with mostly dark-brown but some orangish setae, BL3 scoli orangish-tan or ochre-tan with setae all orangish; collar black with cream or tan middorsal ecdysial line, a tan anteromedial bump, 2 lateral tan bumps (a tan patch sometimes or often surrounds both), a tan patch on rear of collar (sometimes joined to tan patch on middle anterior bump); suranal plate tan with a large black patch with pale seta bases occupying most or all of narrowed anterior part, and tiny blackish dots on posterior widened part (except no dots on lateral part of rear rim); proleg plates brown or tan with pale seta bases (black on lower quarter or half or sixth; A10 plate black on lower quarter or all but dorsoposterior corner or rarely all but anteroventral corner, or brown on basal 40% and blackish on lower rim); legs black; ventral neck gland present; head black, a subdorsal cream (sometimes orangish-tan or light-brown esp. at front and rear ends) vertex stripe on top of head (sometimes wide and extending back to neck, most often narrow, the anterior end often constricted into a small cream satellite dot, the vertex stripe often short as well as narrow and only on top of head (it is a tiny gray dash on some

Moffat Co. heads), sometimes a cream or tan or brown eye stripe on side of head from neck to above eyes (the stripe sometimes absent, often very small [present only above eyes] and brown and rarely extending to neck), rarely a brown area on bottom of gena (between eyes and frontoclypeus), frontoclypeus nearly always black but on several pickled larvae is a slightly-paler triangle with black center on upper 60% of frontoclypeus [probably black on live larva] and one pickled larva has a brown spot on middle of frontoclypeus which was probably nearly black on live larva (the black--rarely almost black--frontoclypeus distinguishes pulchella from all P. tharos/cocyta which have a creamy area on frontoclypeus, and from most/many P. batesii), postgena rarely has a brown area beside rear mandible joint (very rarely connected to brown ventral edge of gena), head width 2.1-2.35 mm; duration ~6 days.

**PUPA** usually medium (slightly-darker than light)-orangish-brown (overall appearance slightly darker at least in some pupae than P. tharos/cocyta), specifically in Jefferson Co. medium-orangish-brown with lighter wings, many are somewhat-creamy-brown (creamier on wing), with weak or sometimes moderate wing streaks, in Adams Co. medium-orangish-brown (many are slightly-creamier orange-brown, some somewhat dark-brown and less orangish, some light-brown), with rather weak wing streaks (the discal cell spot and near-tornus patch somewhat noticeable), in Moffat Co. medium-brown, but about a third orangish-light-brown, wings weakly mottled (almost no mottling on light pupae, a weak discal spot on brown pupae, moderately mottled on the two darkest pupae); details like Bighorns near-camillus, with creamy postmedian & marginal wing bumps, the wing veins slightly darker, usually 2 tiny brown spots on middle of wing (in base of cells  $M_3$  and  $CuA_1$ ), the usual rows of brown spots and usual cream bands, 2/3 of pupae have a weak middorsal crest on A2-cone of A4 (but this crest absent on most Moffat Co. pupae and partial on a few), cones and ridges quite small like Bighorns near-camillus (ridges somewhat larger on a few pupae), only the anterior slope of subdorsal cones orangish on most pupae (middorsal cones orangish on some)(Moffat Co. cones have very little orangish on any cone), antenna segments have the usual tan bump with brown spot in front of it, each leg has a creamy transverse bump with brown in front (hind leg may have trace of 2nd similar spot near base), spiracles brown; cremaster rugose & winged & brown like Bighorns near-camillus, average width at wings 1.01 mm; pupal duration as short as 5-7 or as long as 11-14 days. Larval-pupal duration (Moffat Co., in lab) 31 days male, 32 female, male-female emergence lag 1.2 days.

## 7E. PHYCIODES PULCHELLA CAMILLUS,

oranger-ups variety  
(Figs. 197-200)

**DIAGNOSIS.** In the Sacramento Mts. of S New Mex., adults resemble camillus, but the ups is somewhat oranger. The antenna club nudum is black with dark-gray or brown steps.

## C. THE PHAON SPECIES-GROUP

This group consists of pallescens, picta, and phaon, and is well-distinguished from the tharos-group by four genitalic characters (gnathos hooks much longer, incised V on posterior edge of tegumen, aedeagus shorter, separate triangular posterolateral extension of lamella paraostialis), by much paler colors on larval body, by cream adfrontal areas on older larval head and complete cream ring around older larval eye patch, by taller larval head, and by very weak pupal cones & crests. Wing pattern is basically like camillus and batesii, wing size is small, and the antenna club is always orange.

## 8. PHYCIODES PALLESCENS (FELDER) 1869

(Figs. 7, 209-213)

**DIAGNOSIS.** Higgins (1981) listed this as a ssp. of P. picta, evidently because the male/female genitalia resemble picta, but they resemble phaon just as much, and the wing pattern is unlike picta and resembles P. pulchella camillus (the forewing underside is identical to

camillus with the same two-toned yellowish-tan unf with the same-sized black spots, thus postmedian unf black spots are present, unlike the sympatric P. mylitta ssp.). P. pallescens and picta are evidently sympatric (Balcazar L. 1993 found both pallescens and picta at Pedernales, Michoacan, if properly identified) so must be reproductively isolated distinct species. The only wing differences from camillus are that adults are quite small, and the upf postmedian spots and discal cell bar seem a bit paler. But four genitalic traits differ greatly from camillus: gnathos hooks (Higgins 1981 fig. 214) are three times as long as camillus, the posterior edge of tegumen has an incised V, the aedeagus is shorter (only 20-30% longer than valva), and the lamella paraostialis has a separate triangular posterolateral extension; these traits are like picta/phaon. Unlike camillus, the antenna club is mostly orange as in picta/phaon: male nudum border orange to dark-orange, lattice brownish-orange or orange-brown, steps yellow-orange or orange; female border orange-brown or brown, lattice brown, steps orange or dark-orange. Thus P. pallescens is a distinct species that resembles picta & phaon in genitalia & size & antenna, but resembles camillus in wing pattern, perhaps because the camillus wing pattern is ancestral. **RANGE.** P. pallescens occurs in Nayarit, Jalisco, Colima, Queretaro, Michoacan, Tamaulipas, San Luis Potosi, Veracruz, Morelos, Puebla, Oaxaca, Guerrero, and (C. Hoffman's Mex. checklist) Sinaloa. Because P. pallescens resembles camillus, it possibly occurs as a stray in SE Ariz. and could be responsible for some of the three "campestris" records from Chiricahua Mts. known to R. Stanford.

### 9A. PHYCIODES PICTA PICTA (EDW.) 1865

(Figs. 3, 9, 28, 214-215, 218)

**DIAGNOSIS.** Wing pattern similar to camillus & phaon, but unh and tip of unf almost unmarked (yellow in male, creamy in female). Spring form marcia is weakly-expressed, having a few slight unh marks. **RANGE.** Occurs in W Neb.-W Kans.-Colo.-SE Utah-N Ariz.-N New Mex. W Texas adults are a little oranger than typical picta: males are more similar to ssp. picta than to ssp. canace, but females are much oranger and are approximately intermediate between these ssp.

**HOSTPLANT RECORDS.** Ovipositions 10:00-10:15 (~105 eggs), 10:37 (66 eggs), 11:02 (10 eggs before I interrupted her), 11:16 (2 eggs before I interrupted her), 12:30 (7 eggs before I interrupted her), preovipositions 10:10, 11:30, 12:00, 13:00, all on Convolvulus arvensis; ten egg clusters (6, 12, 15, 30, 40, 40, 52, 61, 92, 140 eggs per cluster) and one 1st-stage larva found on underside of C. arvensis leaves; 7 older larvae and 1 pupa found under boards and dried horse pies near C. arvensis, 1 pupal shell found on C. arvensis; 10 eggs found on underside of leaf of Cardaria draba (Brassicaceae); lab larvae ate C. arvensis well and Aster laevis var. geyeri well, ate a little of Aster porteri and Machaeranthera canescens but did not prefer these, and refused Erigeron divergens and Aster ericoides var. falcatus and Tragopogon dubius and Podospermum laciniatum (the latter four were the only Asteraceae found in same field); all Toll Creek, Highline Canal, Arapahoe Co. Colo., Aug. 12 & 16, 1978. Adults assoc. only with C. arvensis along railroad tracks, near Howard, Fremont Co Colo., Aug. 3, 1973 (eggs laid on this plant in lab from this site). Adults assoc. only with C. arvensis, E Canon City, Fremont Co. Colo., July 7, 1970, Aug. 17, 1970, July 1, 1971, July 19, 1972. Adults assoc. with C. arvensis, McElmo Creek, 10 mi. E Utah line, Montezuma Co. Colo., Aug. 25, 1977. Four adults found, but the only eggs found on Aster ericoides proved to be tharos when reared, no Convolvulus seen but only a small area searched so it was probably present in adjacent cow pasture; Fort Morgan, Morgan Co. Colo., Sept. 19, 1994. **HOSTPLANT SUMMARY.** Convolvulus arvensis is now a natural host, a remarkable case of host switching because it was introduced from Europe. The ancestor of P. picta may have fed on Aster (Compositae), because my larvae ate one succulent Aster sp. in lab, and Edwards (1884b) reared larvae on "various species of Aster" (from eggs obtained by H. Nash "by confining females on Aster and also on Alfalfa"). But the myth that Aster is the main host (Ferris & Brown 1981, etc.) was based on the erroneous belief that picta belongs to the tharos-group; the truth is that picta is closely related to P. phaon, which eats Verbenaceae (Lippia). And my larvae refused to eat Aster ericoides and ate little Machaeranthera canescens, which are probably the main asters found with P. picta in Colo., which makes it hard to believe that asters were the original host. Bailowitz & Brock (1991) stated that Aster exilis is a suspected hostplant in SE Ariz. But

Kendall (1964) found that Aster was absent at his Texas site in nature and lab females oviposited on Siphonoglossa pilosella (Acanthaceae) and larvae matured on it and produced adults. Lippia might have been the original host before Convolvulus was introduced, because P. phaon eats it, L. cuneifolia occurs north to E Colo. and C S.D., and L. lanceolata occurs north to E S.D., fitting the range of picta, whereas Acanthaceae do not occur in E Colo.-W Neb.-W Kans., and aster is doubtful. Because C. arvensis is a weed, P. picta would be a good biological control agent, but unfortunately picta is too limited in its choice of habitat, and refuses to populate gardens and cultivated fields.

**EARLY STAGES. DIAPAUSE STAGE.** 2nd-4th-stage larva (4th-stage Edwards 1884b; 3rd-stage Edwards 1879 Can. Ent. 11:131; 2nd-4th stage Edwards 1885 Can. Ent. 17:108); 4th stage seems probable based on other Phyciodes. **EGG** yellow-green, ~26 vertical ribs on upper half, average 51 eggs/cluster (range 6-140); duration 5 days (Edwards, W. H. 1884b). **1ST-STAGE LARVA** yellow-green, setae black, collar brown, suranal plate brown; head black; duration 5 days. **2ND-STAGE LARVA** yellow-green, with a dorsolateral band, the usual collar; head black; duration 3 days. **3RD-STAGE LARVA** yellow-green, a weak brown middorsal line, then tan, a brown line just above BD2 scoli, the usual dark-brown dorsolateral band that has brown scoli, all other scoli greenish-yellow; head black; duration 5-6 days. **4TH-STAGE LARVA** same, but dorsal brown lines more distinct; duration 5 days. **5TH-STAGE LARVA** duration 9-13 days.

**MATURE 6TH-STAGE LARVA** (Edwards 1884b) similar, but much whiter on top and sides in Oct. than in June (the June larva more brown than white, the Oct. larva more white than brown), underside "greenish-brown" in June, yellow-green in Oct, spines in June light-brown or yellow-brown (BL scoli yellowish), in Oct. spines "yellow-green" from yellow bases [I doubt that there is any true green color anywhere on a Phyciodes older larva]; duration 9 days.

**MATURE LARVA** (Toll Creek Colo., Aug.) pale-yellowish-orangish brown with numerous tiny cream dots, a middorsal brown line, a crescent of orangish-brown around lower edges of BD1 scoli, a tan band, a dark-brown line (mottled with cream dots) along upper edge of BD2 scoli (darkest where it clasps dorsal base of BD2 scoli)(the dorsal area above BD2 scoli is much paler than the wide dark subdorsal band), a subdorsal cream band includes BD2 scoli except for dorsal base of scoli (band is ochre beside BD2 scoli), a wide blackish-brown band includes BSD scoli on its lower edge (this band has cream dots frequent just above BSD, few elsewhere in band), brownish-orange clasps ventral base of BSD scoli, a cream band just below BSD scoli and just above black spiracles, a band of light-red-brown spots in cream surroundings just below spiracles, a lateral cream ridge contains BL1 scoli (this area on T2-3 has a brown longitudinal dash), a brownish-orange ring surrounds base of BL1 scoli, a dark-orangish-brown line edges it ventrally, underside ochre-tan on middle of segments and grayish-tan near junctions; BD1-2 & BSD scoli light-brown (BSD scoli a bit darker)(none have black tips), except BL1 and BL3 scoli ochre-tan, all scoli have some black-tipped orangish-based setae and some longer orangish setae, except BL3 scoli have only orangish setae; legs light-brown, prolegs tan, proleg plates orangish-tan (on A10 light-brown with brown ventral rim and a light-brown longitudinal band near top), suranal plate tan with a small blackish spot on narrow anterior part, and many tiny black seta bases on middle of posterior widened part, collar mostly cream with a cream ridge (with 3 higher parts) that is narrowly edged by black esp. posteriorly near top, ventral neck gland present; head blackish-brown, taller than tharos-group, a long cream vertex stripe (not constricted to form satellite spot) on top of head extends to neck, frontoclypeus cream (except for brown across bottom and lower corners on the "clypeus"), adfrontal areas and cranium narrowly beside adfrontal areas are all cream, cream extends from bottom of frontoclypeus on lower face (gena) to cream ring all around eyes (eyes rest on a brown patch) and extends posteroventrally to rear mandible articulation (head narrowly brown just above front and rear mand. artic.), a small cream spike angles upward from top of cream eye ring, a cream area mottled with brown extends rearward from cream eye ring to rear of head, coronal cleavage line cream, membranous area above labrum cream, labrum brown; the head pattern has several unique elements different from the tharos-group (the cream adfrontal areas, the complete cream eye ring, the mottled cream band extending rearward to neck).

**PUPA** (Edwards 1884b) uniform yellowish-brown; or head-thorax-wings yellowish-brown, a dark-brown anterolateral patch on T2, abdomen dark-brown mottled a little with yellowish-brown. **PUPA** (Toll Creek Colo., Aug.) fairly-light mottled brown (as usual finely striated with brown) with darker-brown abdomen mottling and fairly weak wing streaks: wing has usual ~7

postmedian & ~7 marginal cream dot bumps, wing has anterior & dorsal sides of wing base ridges brown (wing base ridges weaker than on tharos), a darker-brown anal margin, a dark brown patch near end of discal cell and a slightly-browner area between ~R<sub>5</sub>-M<sub>3</sub>, a slightly-browner area at tornus, wing a bit darker on outer 2/3 of wing between veins; the usual cream edge around ventral & lateral rim of head (front of head mostly brown but a bit creamier on middle and between antenna bases), the usual anteriorly-directed cream V-shaped mark (with brownish middorsal line through it) on top of T<sub>2</sub>, a weak double-cream middorsal band from rear of T<sub>2</sub>-A<sub>1</sub>, a weak slightly-creamy middorsal crest A<sub>2</sub>-4, very young pupa has creamier subdorsal & sublateral abdomen stripes (remnants of cream larval bands), abdomen has the usual bands of small brown spots (supraspiracular [one anterior one posterior spot per segment], lateroventral, supraventral, midventral bands), a dark-brown oblique U (the opening dorsoposterior) encloses brown spiracles on A<sub>4</sub>-6, proboscis tip a bit darker, each antenna segment has usual dark-brown-then-tan mark, the usual brown-then-creamier mark on middle of each leg; cones nearly absent (just very broad low mounds, just a slight angle to body contour, not real cones)(mounds present middorsal A<sub>2</sub>-7, subdorsal T<sub>2</sub>, A<sub>2</sub>-7, supraspiracular A<sub>4</sub>); transverse crests weak (just wide low ridges: A<sub>4</sub> highest, A<sub>5</sub>-7 weak, T<sub>2</sub> moderate subdorsally) and are browner on anterior slope and have creamy blotches on posterior slope (most noticeably on A<sub>4</sub> ridge); cremaster winged, fairly rugose, with usual tall bump on anterior end of each sustensor ridge; duration ~7 days.

### 9B. PHYCIODES PICTA CANACE (EDW.) 1871

(Figs. 216-217)

**DIAGNOSIS.** Resembles ssp. picta, but is somewhat more orange on ups in both sexes.

**RANGE.** S Ariz. S to Michoacan Mex. **HOSTPLANTS.** Bailowitz & Brock (1991) stated that Aster exilis is a suspected hostplant in SE Ariz., although asters are somewhat doubtful hosts as noted above.

### 10. PHYCIODES PHAON (EDW.) 1864

(Figs. 219-221)

**DIAGNOSIS.** The male and female genitalia are essentially identical to P. pallescens/picta with the same 4 unique traits, and antenna clubs are orange like theirs, thus the usual treatment of separating phaon & picta at opposite ends of the checklist (Miller & Brown 1981) is wrong (Bauer 1975 erred in placing phaon with the tharos-group, and in placing picta into a bogus campestris-group). P. phaon is distinguished by its exaggerated fw markings (median upf band whitish [yellowish in E part of range, orangish S Fla.] instead of orange or orange-cream, upf postmedian band red instead of orange, unf red instead of orange) which are more extreme than either batesii or pulchella, and by the Verbenaceae (Lippia) hosts. **SPRING FORM.** Short photoperiod produces the spring form marcia (Oliver 1982). **SPECIES STATUS.** Oliver (1982) crossed phaon with P. tharos by hand-pairing, since females generally refused to accept courting males of the other species; hybrid and backcross eggs from tharos mothers were mostly infertile; hybrids ate both Aster and Lippia. **RANGE.** S U.S., S to Guatemala, Cuba, and Cayman Is. Males patrol most of the day near the hosts (Opler & Krizek 1984).

**HOSTPLANTS.** Lippia lanceolata and L. nodiflora are the only known hosts (Calif., C. Dammers, in J. Comstock 1929 Bull. So. Calif. Acad. Sci. 28:22; Tex., R. Kendall 1964 J. Lepid. Soc. 18:143; Fla., D. Leston et al. 1982 J. Lepid. Soc. 36:247). In Cayman Is. G. Carpenter & C. Lewis (1943, Ann. Carnegie Mus. 29:371) stated it was associated with and apparently breeds on Wedelia trilobata "marigold", but no larvae were found, and this plant belongs to Nyctaginaceae so is very doubtfully a host. **EARLY STAGES** (Comstock 1929, figs.; Charles Dammers paintings in Emmel & Emmel 1973; Oliver 1982). **LARVAL NEST.** Oliver (1982) stated that young larvae lack a communal web. **EGG** "whitish" (pale green). **MATURE LARVA** similar to tharos-group but paler ("olivaceous") with the dorsal dark bands paler (50% white dots, 50% brown), the dorsal area paler (almost as pale as the cream subdorsal band running between BD<sub>2</sub> scoli) with wider pale stripes (the dorsal area above BD<sub>2</sub> scoli is much paler than the wide dark subdorsal band), but with the same bands of tharos-group: a fine

middorsal dark-brown line, olive-brown mottling (darkest just above BD2 scoli), a wide pale-olive (creamy?) band encloses BD2 scoli, a wide dark-brown stripe (lighter and more irregular on A8-10) encloses BSD scoli on its lower edge, a wide pale mottled band encloses black spiracles, then a darker narrow band just above a cream lateral band that touches ventral part of BL1 scoli, this band is edged below by brownish-black, underside dark-olivaceous, the scoli whitish with slightly-darkened tips (the setae dark-brownish-black with slightly lighter bases [BL1 & BL3 scoli probably have only pale setae]), prolegs white (prolegs & legs dark olivaceous in Calif.); collar a pale tripartite ridge, edged behind by brownish, suranal plate small & brown; head evidently taller than tharos-group, blackish-brown with all the pale markings of tharos but those are enlarged so much that head is mostly ivory and the whole front of head is ivory, the usual cream vertex band connects to white area beside and on adfrontal areas and the white frontoclypeus which connects to cream coronal ecdysial line (all these surround a blackish-brown kidney-shaped dorsal area near middorsal axis), lateral to white vertex band is a wider blackish-brown patch, a complete cream eye ring surrounds eyes, the eyes are in a black eye patch, and a small blackish-brown spot occurs beside neck behind eyes, mandibles dark, setae brownish-black; larva duration in lab ~14 days.

**PUPA** similar to tharos-group but pale, light-cream or light tan, with a fine reticulation of light-brown, with usual abdominal rows of small brown spots like tharos-group (weak lateral, strong lateroventral, and narrow subventral and midventral abdominal rows), wings with just one dark spot (in discal cell on some pupae) but with the usual white dots and darker veins, anterior & dorsal slopes of wing base ridges brown as usual, spiracles dark-brown, antenna shaft has usual dark dash on each segment, tip of proboscis darker, cones fairly weak or stronger (weak on Dammers' painting, stronger in Comstock 1929)(whitish, tipped anteriorly with brown), transverse crests weak (the A4 crest and subdorsal part of T2 crest has brown on front and cream behind, but A5-7 crests weakly-marked), cremaster not noticeably winged on drawing; duration ~4 days in lab. Larva + pupa duration 23-26 days in lab.

## 10. PHYCIODES PHAON (ORANGE-BAND VARIETY)

**DIAGNOSIS.** The pale upf median band is oranger (orange male, orangish-yellow female) in the few adults I have seen from S Fla. Study of more specimens may prove this to be a distinct subspecies. This band is whitish in Mex.-Ariz., and perhaps becomes yellowish in SE U.S. then orangish in S Fla. Riley's (1975) fig. of a Cayman Is. male had a pale-yellow upf band.

## DISCUSSION

**Variable characters and evolution.** Most characters in Phyciodes are somewhat variable. Some genitalic traits are variable and useless for determining relationships, while others are useful constant traits. A few of the immature-stage characters are quite obvious--at least in some taxa--but many of them vary as much as some adult traits. A strong family effect was seen in many character, with the offspring of one female differing from the offspring of another female of the same population to a sometimes surprising degree: adult color pattern, larval color, larval head pattern, pupal color and cremaster width, etc. were all found to vary somewhat between families. Thus there are few totally present/absent characters in Phyciodes, so one wonders how one could validly apply such systematic tools as cladistics, which depend on real change of characters rather than the mere alteration of frequencies and sizes and shades that is the general rule in Phyciodes. Even the three species groups--well-founded groups separated by numerous traits--are linked by similarity of a few major characters: the founders of both the mylitta and tharos groups have nearly identical genitalia, and two species in the tharos and phaon groups have nearly identical wing pattern. Thus some characters remain constant for a while as others change, then different characters change.

It appears that evolution in Phyciodes has occurred through random sampling of genes from ancestors, and simultaneous gradual change of frequency of many traits in some populations; evolution does not proceed by changing one character to a separate character state, one character at a time (the ideal cladistics picture that we see when looking at evolution of higher taxa like subfamilies and families, a picture that may result mostly from extinction of all the confusing

intermediate taxa). Similar trends of evolution occur in related species: for example, *batesii* from S Appalachians and *pulchella* from N Nev. and *orseis* from the Sierras have lost the unh brown patch; some populations in three *tharos*-group species have orange antenna clubs, while others have black clubs; *orseis* and *mylitta thebais* evolved a narrower valva tip; and *pulchella* and *pallida* convergently evolved smaller gnathos hooks. And Batesian mimicry has evidently caused the evolution of oranger wing color in two unrelated species (*orseis herlani* and *batesii anasazi*).

In *Phyciodes*, most of the "missing links" are still living. Thus step-clines are still apparent, both among the geographic varieties and subspecies, and among the species. In *Phyciodes* (esp. *P. batesii*) as in most tough groups, the "Paul Grey method" proved its worth; Paul Grey made sense of *Speyeria* by accumulating series from hundreds of localities, and carefully tracking the change of characters from one meadow or mountain range to the next, then tracking them to the next spot, slowly proceeding across the continent charting how the insects themselves treated each local phenotype as a ssp. or distinct species.

**Evolutionary Scenario.** Since the genitalia of *P. mylitta* and *P. tharos* are so similar, it would seem that a small multivoltine species like them must have been the progenitor of subgenus *Phyciodes*. This progenitor evidently had orange antenna clubs and dark larval scoli tips and a dark larval head with small cream vertex dash and eye crescent. It evidently had a wing pattern and small pupal cones similar to *P. batesii* and *P. pulchella camillus* and *P. pallescens*, because the first offshoot from this group (the *phaon*-group) has adults that resemble those species (in particular *P. pallescens* and *P. p. camillus* have almost identical wing pattern) and has small pupal cones. The *phaon*-group ancestor then split off and developed various peculiarities of genitalia; *P. picta* evolved with yellower uns, and *P. phaon* evolved with its extreme wing colors. Finally, a member of the *tharos*-group that had *tharos*-type genitalia and orange antenna clubs split off to form the *mylitta*-group. This species was no doubt small like *P. mylitta*, and probably was oranger like northern *mylitta* ssp. and *P. pallida* (it doubtfully had a dark ups like S Mex. *P. mylitta thebais* and *P. orseis*), and then the ancestor of *P. pallida* diverged and *P. orseis* evolved from that ancestor. The *tharos*-group ancestor evidently split into three species, *pulchella* in the west, *batesii* in the northeast, and *tharos* in the southeast and south, then very recently *cocyta* split from *tharos*.

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### ***The Crisis in Entomology***

Recent actions by the federal government threaten to destroy the science of entomology. The threat is especially serious in W U.S., where much of the natural area is federal land. The threat to entomologists is greatest among Lepidopterists, because nearly all research on Lepidoptera is done by amateurs, and amateurs have suffered the most from federal actions. The current editors of both the *Lepidopterists' Journal* and *Lepid. News* work for the federal government and have refused to publish letters criticizing federal policies, so the present comments are unfortunately necessary.

The basic problem is that all existing conservation laws are written using deer as a model. Deer numbers are successfully managed by controlling the location and level of hunting, but legislators are too ignorant to realize that insects and plants cannot be so managed; insects lay 100-1000 eggs/female so can explode 500-fold in one generation; they can also crash in one generation due to weather etc. Thus numbers of insects cannot be "managed", and endangered insects are stay-at-homes that do not travel as far as deer, so habitat loss is the overwhelming cause of insect (and plant) extinction. Idiotic deer laws blame collectors for all insect extinctions; sensible laws would prevent habitat loss. Thus ignorant Mexican legislators have banned collecting, while their teeming millions of peasants slash and burn their fauna to death; they passed a law that foreigners have to have a permit to collect in Mexico, but when U.S. citizens apply for permits and send the requested exorbitant \$800. fee, their checks are cashed and pocketed in Panama and no permit is sent. A nearly-100-year-old U.S. law--the primitive Lacey Act--makes the U.S. enforce foreign laws, regardless of how idiotic, so U.S. Fish & Wildlife agents have raided dozens of U.S. collectors and seized all Mexican specimens. Thus the Mexicans have hoodwinked the gullible U.S. government into enforcing Mexican graft. Mexico needs a proper conservation law that would preserve the habitats of insects/plants, rather than blaming gringo collectors. Mexican lepidopterists are few in number and low in quality, and are so insecure and paranoid about being overshadowed by the U.S. that they would rather have their fauna remain unstudied than have gringos study it. U.S. lepidopterists were in the process of detailed mapping of the fauna of the northern half of Mexico, but the U.S. government has now killed that work: probably more than 50000 specimens have already been burned, and millions more are now lost to science due to refusal of collectors to allow anyone to study their collections.

Here in the U.S., U.S. government intimidation of lepidopterists has put a halt to normal scientific study of insects. With 100,000 species of U.S. insects and 10000 of lepidoptera, exchanges between workers are absolutely necessary for proper identification and study, but now

the U.S. government has demanded that everyone obtain a "special use permit" for ~\$100 for collecting specimens for commercial purposes on each parcel of federal land, and they define even non-monetary specimen exchanges as a "commercial purpose." This amounts to petty extortion, and has put a stop to all exchanges of specimens for scientific study, because there are hundreds of federal agencies and national forests and BLM properties etc. and applying for permits is time-consuming and expensive and the amateurs who do nearly all lepidoptera study cannot afford either. Under the old system, there were conservation laws, but everyone assumed they only applied to vertebrates as that was the legislators' original intent (for example no entomologist has ever been hired for a "wildlife biology" job), so lepidopterists went about their business of studying insects in comparative isolation (shunning was more often the correct word) and happily gave their findings to governments if asked--and governments rarely asked. Now, in addition to the normal discrimination that lepidopterists endure--being called weird or gay or laughed at by the ignorant public who think butterflies are a frivolous joke (causing most lepidopterists to conduct their studies rather furtively with a minimum of public display)--governments are suddenly claiming that their deer laws apply to butterflies and are harassing lepidopterists at every turn. Lepidopterists can fight back. We can be just as petty as the federal government; we can and should burn all specimens collected on federal land, and refuse to permit anyone connected with a government to study our specimens without payment, and when the government comes to us and asks what lepidoptera species live on their lands--they have zero competence to study their own faunas--we must demand that they pay us for the long hard years of study that we went through to develop the expertise to study those insects. We must demand decent real wages--Ph.D.-level wages of \$3000/month or \$10000 per summer--to study the butterfly fauna of federal lands. No more free study of federal faunas!

Unfortunately, federal competence in lepidopterology is near zero (other than a couple persons at the Smithsonian who spend their time studying genitalia mostly of tropical species, and one lepidopterist who got his Ph.D. studying micro-moths and is now assigned to editorial duties, it IS zero), as they hire unqualified persons based on political correctness (they discriminate by preferentially hiring affirmative action minorities and women, even though 95%+ of U.S. entomologists are white males) rather than merit hiring of competent lepidopterists. Then, insolent micromanagement from Washington D.C. prevents these bureaucrats from exercising any competence they might possess. As an example of federal incompetence, they have budgeted \$210000 for a "recovery plan" for the butterfly Boloria improba acrocneema which is full of various useless studies, but not one cent is allocated to transfer adults from a booming colony to the only colony/cohort of the 10 known colonies that needs recovering (the odd-year Uncompahgre Peak colony); they have rerouted hiking trails away from the two best colonies with the result that ptarmigans--formerly scared away by hikers--can now occupy each colony and peck peck peck the butterfly larvae to death all summer long; they have failed to mount a proper helicopter survey for new colonies using qualified lepidopterists; they failed for nearly 8 years to believe my finding that the butterfly flies earlier than late July; they still fail to believe that the butterfly flies lower than 13000'; they claim the butterfly was seriously declining and went extinct at one site, and now they claim it has staged a recovery there; the incompetent lepidopterists they hired to do survey work have found in over 10 years of poor effort only one of the 5 new colonies that I found in 1980; and those incompetents have published a ridiculous paper stating that the butterfly has become inbred since the last Ice Age and is doomed to extinction and should be permitted to do so (not one cent for transplanting adults, even though a transplant from the Wind River Mts. would completely cure that kind of inbreeding); they ludicrously claim that only two colonies exist--there are actually 10--and still amazingly believe that specimens found 80 miles from those two colonies are not from a colony despite the fact that the butterfly does not disperse more than a few hundred meters; they persist in claiming acrocneema is a distinct species despite predominant scientific opinion that it is a ssp. The federal Endangered Species people have administered their programs like ghouls--watching over dying animals without trying to save them (as they placed the last three Dusky Seaside Sparrows into a cage to die rather than release them at the nearest ssp.)--because they refuse to transplant adults to repopulate colonies, and their laws enforce the prohibition of transplanting for restoration by jailing any private person or conservation organization who attempts a transplant (they would be prosecuted for catching and "harassing" the animals). The federal government must actively try to restore these populations, or at least must permit private individuals/organizations to do so; there are many people who would

volunteer. Governments believe that a million past transplants of alien fish--at the cost of the decimation or near-extinction of most native fish--are not enough, while they hypocritically believe that one simple transplant of B. improba from one colony to another--that would simultaneously recover the butterfly and eliminate the inbreeding that they claim is driving it extinct--should not be attempted. The U.S. Fish & Wildlife people act like ghouls watching insects go extinct, not because of ethics, but because fishermen pay money to governments, lepidopterists do not.

Federal incompetence is everywhere. The Endangered Species Act is a ludicrous joke, because it gives very weak ssp. the same status as very distinct species; ignorant legislators fail to realize that subspecies are not species, that some subspecies are barely more than synonyms, and that hundreds of names originally proposed as "species" and "subspecies" names are now considered synonyms. Thus we have the "endangered" Euphydryas editha bayensis which is so weakly differentiated from E. e. luestherae that for 100 years 50 lepidopterists never saw any difference and still cannot see any; G. lydamus palosverdes which is only a slight intergrade between australis & incognitus; etc. etc.; a coming wave of 100 new ssp. names, representing the gamut from distinct valid taxa to complete synonyms, will no doubt be swallowed hook line and sinker by our federal Uncle Sucker Endangered Species Office.

The accelerating loss of lepidopterists' ability to collect threatens scientific study. Most insects are too small to even see without a lab microscope, so must be collected and sent to some specialist, and many insects pinned in museums may not even be identified for 50 years or more. The highly-distinctive butterflies have been named, and the tough problems that remain--such as the Phyciodes in this paper--involve minor differences requiring collection of adults and immatures. Yet the idiotic deer laws require even a federal employee to fill out an identification/collection form on each moth specimen collected in a blacklighting survey of a national park when thousands can be sampled in one night. Even so-called butterfly watching--popularized through the Audubon Society etc.--has led to the belief that butterflies should no longer be collected, and some such watchers actively discourage butterfly collecting. For instance Glassberg (1993) even lied in stating that Neonympha mitchellii became extinct in N.J. because "a group of greedy, immoral individuals returned day after day, year after year to the few very small fens where it was found. They illegally collected and killed these animals for their own "amusement" and in some cases profit."; Mr. Glassberg failed to provide a single detail to me when I requested them by letter, and letters to other N.J.-area lepidopterists revealed no such nefarious plot. There is still no well-documented case of any colony becoming extinct through collecting, while there are thousands of proven cases of habitat change causing extinction. Unfortunately, butterfly watchers contribute almost nothing to science, because they do not discover new foodplants or new species/ssp.; in the past their sole contribution has been some new distribution data, but even those are suspect because of incompetent identification (such as Glassberg's 1993 photo of Phyciodes phaon as P. batesii). Butterfly watchers are not scientists, and they should stop preaching and let scientists--including the unpaid amateurs who do nearly all lepidoptera research--do their job of studying insects.

We need a **new national law** regarding all phases of the collection and study of insects and plants, a law that overrides all other laws in granting entomologists the right to collect (and exchange/sell to other scientists) insects anywhere on public lands (and private lands with permission of owner) without restriction (perhaps with rare exceptions such as those few National Parks which allow absolutely nothing living--fish or deer or mouse or fungus--to be collected), as long as the collected insects are not considered endangered and are properly labeled and made available for study by scientists. The law must be based on ethics instead of deer-saving hysteria; for example the federal government is now prosecuting two collectors for catching P. indra kaibabensis in Grand Canyon National Park. Such collecting is currently illegal, but is not unethical because the habitat of the butterfly is 2000 square miles of the most rugged and inaccessible terrain on earth; if all the lepidopterists in the world--there are only about 3000--were told to deliberately try to exterminate that butterfly through collecting they could not even dent its population without many millions of dollars of logistical help (helicopter transportation, etc.). The park should hire lepidopterists to raise the butterfly and sell it for profit, to help pay for park improvements; but this will not happen because congress forces parks to fork over--communist-style--all moneys received to the federal treasury, so parks have no incentive to collect any money, not even admission fees. Yellowstone National Park allows

no butterfly collecting, but hypocritically permits fishing, and the major mortality of grizzly bears is shootings by park rangers.

The only possible harm of collecting insects is to small colonies of highly-local colonial butterflies with restricted ranges that are desirable to collectors. To make sure that these colonies can be protected from even the remotest possibility of harm through collecting, and because federal employees lack competence in entomology (and thus generally delay appropriate action for 10 years or longer after the discovery of such local colonial butterflies by entomologists, as was the case with N.J. *mitchellii*), and because endangered species have been treated as political footballs by the federal government, insect/plant societies should be given the responsibility of making lists of those truly distinct taxa that exist in just a few locations and are highly colonial thus vulnerable to disturbance. These societies would draw up regulations for each species and each colony (for instance none could be collected from certain colonies, or no males could be collected, or only 5 males per party on Saturdays only, etc.); violations of the regulations would be a misdemeanor fine of up to several thousand dollars. The Endangered Species Office then would have to choose its species from the lists put together by those societies, so we would no longer be burdened by the incompetent blunders of that agency. Lepidopterists maintain a "grapevine" network of rapid data exchange concerning unusual findings and rare species, and governments are decades behind in their knowledge; these lists should not be created by incompetents.

This new law must replace all other laws regarding the collection and commerce and study of insects. It must recognize the difference between weak ssp. and distinct species. It must permit commerce in insects, while giving governments the right to regulate transport of those insects that are likely to escape and multiply and become pests (crop pests, termites, mosquito vectors, etc.). The law must permit seizure of foreign specimens only if they were illegally collected endangered species. This law must recognize the ease of rearing insects, and permit private individuals/organizations to breed and transplant individuals to restore colonies, and it must permit the practice of "insect farming" (and plant breeding) of endangered species for conservation benefits (either the animals reared are transplanted to establish new colonies or are sold and the money used for purchase of habitat, or--as in New Guinea birdwing farms--the farms preserve the habitat and thus the species).

## PREVIOUS ISSUES OF PAPILIO (NEW SERIES)

1. New Papilionoidea and Hesperioidea from North America. James A. Scott, 1981, 1-12, \$1.50.
2. The life history and ecology of an alpine relict, Boloria improba acrocne (Lepidoptera: Nymphalidae), illustrating a new mathematical population census method. James A. Scott, 1982, 1-12, \$1.50.
3. Distribution of Caribbean butterflies. James A. Scott, 1986, 1-26, \$1.50.
4. Larval hostplant records for butterflies and skippers (mainly from western U.S.), with notes on their natural history. James A. Scott, 1986, 1-37, \$2.00.
5. The courtship of Phyciodes, and the relationship between Phyciodes tharos tharos and Phyciodes tharos morpheus (= pascoensis) in Colorado. James A. Scott, 1986, 1-8, \$0.50.
6. Hostplant records for butterflies and skippers (mostly from Colorado) 1959-1992, with new life histories and notes on oviposition, immatures, and ecology. James A. Scott, 1992, 1-185, \$10.00.

**CORRECTIONS TO PAPILIO #6:** P. 4 there is no bizarre rule, just normal chaos; in Oeneis chryxus & Hesperinae spp., every mention of Oryzopsis exigua should be replaced by Muhlenbergia montana except for Hesperia juba where all 4 mentions should be Schedonnardus paniculatus; Phoebis sennae, sennae not phoebis; Poladryas m. minuta is 2300' lower than arachne; Phyciodes campestris camillus, Machaeranthera "pattersoni" at Barr Lake is M. canescens; Boloria frigga, Betula is recorded host in Utah & Mich.; Euptoieta, T. Mead misidentified Linum as Sedum; Celastrina lucia-type, the fossil is Jamesia caplanii; Piruna pirus egg top has sunken platelike area, unlike Poanes; Oarisma garita middle, Festuca arundinacea not F. pratensis; Hesperia comma assiniboia near end, record of larva on Bouteloua curtipendula Aug. 24 1990 should be moved to H. viridis; Polites themistocles change 1st (solitary) eye to 6th; Atrytone arogos change eye 6 to 1, 5 to 2, Anatrytone logan change eyes 3-5 to 2-4, 1 to 6; A. logan lagus & Euphyes vestris & Amblyscirtes oslari & A. phylace change eyes 3-6 to 1-4; Ochlodes snowi, Blepharoneuron tricholepis is error; Pholisora catullus, Chen. album is prob. Chen. berlandieri, pupal hairs are 1/3 mm not 1/2.

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**TABLES AND FIGURES**

Table 1. Older Larvae of *Phyciodes tharos*-group.

Taxon	Fronto-clypeus Patch	Overall Ground Color	Color Above Vs. Below Subdorsal Cream Band	Subdorsal Cream Band	Dorsal Scolus Tip Color	Lateral (BL1) Scolus Color	Color of Ring around BL1 Scolus Base
<u>riocol-orado</u>	large & cream	brown	dark to paler	strong	pale	ochre-tan or tan	orange
<u>tharos</u>	mostly large & cream, seldom small & orange-brown	brown (few blackish-brown, few orange, few creamy-frosted)	paler, few dark (dark in some S Minn. & Neb. families)	strong (seldom moderately interrupted)	pale	ochre-tan, some creamy-tan, some orangish-tan, seldom creamy, rarely light-brown	brownish-orange or orange, some orange-brown
<u>cocyta</u>	mostly large & cream, seldom small & orange-brown	brown (fewer cream dots on average)	dark, some slightly paler	strong (slightly interrupted on many)	pale	orangish or orangish-tan, some orangish-brown	brownish-orange, some orange, some orange-brown (brown in some Ont. larvae)
<u>batesii</u>	large & cream	brown	dark	strong to moderate	dark	dull orangish-red	reddish-brown to brown
<u>lakota</u>	variable: usually black, rarely large & cream	dark-brown, some brown, many black	dark (rarely slightly paler)	strong to absent	dark	usually slightly-reddish-orange, some orange-tan, rarely orange-red or brown or sl.-orangish-black	orange to brown, a few reddish-orange, rarely orangish-black or brownish-black
<u>apsaa-looke</u>	large orangish-tan, or smaller & brown, or black (40% black)	brown to blackish-brown, some black	dark (few slightly paler)	strong to nearly absent	dark	most often orangish-tan, some ochre-tan, orangish-brown, brown, or blackish	brownish-orange to orange-brown, some brown or black
<u>anasazi</u>	usually black, sometimes large & orange-tan (80% black)	brown, some dark-brown	dark to paler	strong, some mod. interrupted (often orangish)	dark	usually orangish, some orangish-tan or ochre-tan	orange to brownish-orange, few orange-brown
<u>camillus</u>	black	dark-brown	dark, some paler	complete to moderately interrupted	dark	orangish-tan, some ochre-tan	brown-orange or brownish-orange
<u>near camillus (Bighorns)</u>	black	dark-brown, some very dark, some moderately orange-brown	dark, few slightly paler	strong to often nearly absent	dark	orangish, orangish-tan, brown, or sl.-reddish-orange-brown	brownish-orange, some orange-brown, rarely brown
<u>pulchella</u>	black	dark-brown	dark, some paler	strong	dark	orange-tan or brownish-orange	brownish-orange
<u>montana</u>	----	dark-reddish-brown	----	----	dark	----	----

**Table 2.** Larvae and Pupae of *Phyciodes tharos*-group. (The 1st-stage larva always has a brownish subdorsal band when molting to 2nd stage.)

Taxon	Larva 1st-Stage Pattern	Larva Silk Nest Stages 1-2	Pupa Overall Color	Pupa Dark Wing Streaks	Pupa Cremaster Wings	Pupa Cremaster Roughness
<u>rio-colorado</u>	none	absent or weak	most orange-brown, 20% creamy-orangish-brn.	moderate	95% tapered, 5% winged	weakly to moderately rugose
<u>tharos</u>	none	absent, sometimes present	orangish-brown (rarely sl. reddish) or creamier-brn., few creamy, few brown	weak to fairly strong	95% winged, 5% tapered	moderately rugose
<u>cocytia</u>	none or weak, sometimes fairly strong	absent or present	50% quite cream, some light-orange-brown, few dark-brown	strong or moderate, few weak	~30-40% tapered, rest winged	moderately rugose
<u>batesii</u>	none (McDunnough)	present	creamy-brn, some orangish-brown	moderate to fairly strong	wide wings	very rugose
<u>lakota</u>	weak	always present	orangish-brn. (a few slightly reddish), often creamy-brown, few creamy, few brown	fairly weak, sometimes strong	wide wings	very rugose
<u>apsaalooke</u>	often brown dorsolateral band	present often at least	orange-brown, creamy-brown, or blackish-brown (all sl. darker-brown)	weak to strong	wide wings	very rugose
<u>anasazi</u>	----	----	light-orange-brown, many creamy-orangish-brown (some a bit darker)	weak	wide wings	very rugose
<u>camillus</u>	banded like older larva	present	medium-orangish-brown, many brown, some orangish-light-brown or creamy-brown	weak (some moderate)	wide wings	very rugose
near <u>camillus</u> (Bighorns)	at least dorsolateral band present	little	orangish-brown, few dark-brown, few creamy-orangish-brown	weak (rarely moderate)	wide wings	very rugose
<u>pulchella</u>	weak	weak in one family	light-brown	weak (more or less)	90% winged, 10% tapered	very rugose

**Table 3.** Pupae and Antenna Color of Phyciodes tharos-group.

Taxon	Pupa Cremaster Width	Pupa Transverse Ridges A4-7	Pupa Weak Middorsal Crest A2-4	Pupa Cones	Pupa Subspir. A4 Cone	Antenna Club Nudum Color
<u>rio-colorado</u>	.83 mm	large	absent	large	moderate	blackish (some females orangish tip)
<u>tharos</u>	.87 mm (1.0 lot #M, 1.05 S Minn.)	large (sometimes rather small)	5- < 10% present	large	moderate	orangish N & Colo., blackish S
<u>cocyta</u>	.94 mm (.99 S Minn.)	large (sometimes rather small)	25% present	large	moderate	orange (some females brown)
<u>batesii</u>	.95 mm	moderate	~75% present	smaller	smaller	brown-black
<u>lakota</u>	1.02 mm (.94 lot W7)	moderate (weak near wing)	~80% present	smaller	smaller	brown-black
<u>apsaalooke</u>	1.00 lot F 1.15 lot D	moderate, some larger, rarely large (weak near wing)	~65-70% present	smaller, rarely large	smaller	orange (females rarely black)
<u>anasazi</u>	1.03 mm	moderate, many quite small, few large (weak near wing)	~80% present	smaller, rarely large	smaller	orange (fem. seldom brown)
<u>camillus</u>	1.01 mm	quite small	~65-70% (Moffat Co. ~5%) present	quite small	quite small	blackish
<u>near camillus</u>	1.05 mm	quite small	~65-70% present	quite small	quite small	blackish
<u>pulchella</u>	.78 mm	quite small	~33% present	quite small	quite small	dark (some fem. orange-brown)
<u>montana</u>	----	quite small	----	quite small	quite small	brown (fem. dark-orange/orange-brown)
<u>tutchone</u>		----	----	----	----	orange

**Table 4.** Diapause, Forewing Length and Upperside Wing Pattern of *Phyciodes tharos*-group.

Taxon	Yearly Flights	Lab Diapause	Forewing Length (mm)	upf median band	upf base color	Dark-Upf Females	uph orange center	Uph Submarg. Band
<u>rio-colorado</u>	3	rare	m 14-16 f 15-17	orange	pale orange	absent	divided	moderate
<u>tharos</u>	2-6	rare	m 14-16 f 16-18	orange (some females paler)	orange	sometimes	divided	moderate
<u>cocytia</u>	1, often 2 esp. Minn.-Sask., Wash.	rare/weak	m 16-18 f 17-20 (2nd gen. m 15-17 f 16-19) (Nfld. m 15-16 f 16-18)	orange (many or most females paler)	orange	often	very large, not divided	weaker
<u>batesii</u>	1	absent, or 0-3 months or more	m 14-16 f 16-18	paler	dark or oranger	always	usually divided	weak (seldom moderate)
<u>lakota</u>	1	seldom	m (14) 16-18 f (16) 17-19	paler	dark or oranger	usually	usually divided	weak (rarely strong)
<u>apsaa-looke</u>	1	0-3 mo. or more	m 15-18 f 16-20	paler	dark, often oranger	usually	usually divided	weak
<u>anasazi</u>	1	0-3 mo. or more	m 16-18 f 18-20	paler	very orange	few	large, or divided	weak
<u>camillus</u>	2 (1 in Bighorn Mts.)	rare	m 15-16 f 16-19	paler	dark, few oranger	most	divided	moderate to strong
<u>shoshoni</u>	2?	----	m 14-16 f 16-18	paler	dark, some oranger	most	divided	strong, few moderate
<u>pulchella</u>	3-4	rare	m 16-19 f (18)-20	paler	dark	always	divided	weaker
<u>montana</u>	1	rare	m 16-17 f 17-18	paler or orange	orang-ish	rare	usually divided	strong
<u>tutchone</u>	1	----	m 14-16 f 17	paler (often orange)	rather orange	usual?	divided	weak or moderate

Table 5. Underside Wing Pattern of *Phyciodes tharos*-group.

Taxon	unf black subapical costal patch	unf sub-marginal spot cells M1-2	unf black tornus spot (narrower female)	unf posterior median black spot	unf yellow discal cell bar	unh brown marginal patch	male unh pale marginal crescent (in females, usually cream)
<u>rio-colorado</u>	small	russet-brown	large	small or very small	absent	fairly strong	absent (some weak)
<u>tharos</u>	large	russet-brown, some blackish	large, very rarely giant	small or large	absent	strong	absent (some yellow, seldom white)
<u>cocytia</u>	large	russet brown	large	smaller or large	absent	strong	absent (some yellow, few white)
<u>batesii</u>	small	orangish, with yellow streaks	large	very large	absent, sometimes present	absent (some females very weak)	absent or weak (lost in yellow background)
<u>lakota</u>	small, seldom large	russet-brown or orange-brown, rarely blackish	large (some larger, seldom giant)	very large, sometimes fairly small	absent, often weak or present	strong (seldom weak)	2/3 present, but usually yellow
<u>apsaa-looke</u>	large	black or blackish	giant	very large	absent, often weak or present	strong	usually white (but absent 76% of lot #F)
<u>anasazi</u>	large	black, rarely brown	giant	very large	absent, often present	strong (rarely weaker)	usually white (seldom absent)
<u>camillus</u>	orange or brown (almost no black)	orangish M1, crescent M2	large	large	mostly yellow	strong	yellow (white in spring)
<u>shoshoni</u>	orangish or tan (almost no black)	orangish or tan or yellow M1, yellowish M2	large	large (small female)	yellow	absent (or weak female)	creamy or yellowish
<u>pulchella</u>	orangish (no black)	orangish	narrow dash	small	yellow	weak	weak
<u>montana</u>	orangish (no black)	orangish	narrow dash	small	orange	weak	weak-
<u>tutchone</u>	orangish (no black)	orangish	narrow dash	small	yellow or orange	strong (some weaker)	usually white

**Table 6.** Male genitalia of Phyciodes tharos-group.

Taxon	Gnathos Hooks	Tegumen Anterior Rim	Valva 2 Teeth near Tip	Aedeagus Middle Process	Saccus Flaps
<u>riocolorado</u>	large (largest)	more V-shaped	tiny or smaller	weak	long
<u>tharos</u>	large	more rounded	usually large	weak	variable
<u>cocyta</u>	large	more rounded	usually large	weak or strong	variable
<u>batesii</u>	large	more rounded	large	strong	variable, often wide
<u>lakota</u>	large	more rounded	usually large	strong	variable, often longer
<u>apsaalooke</u>	large to sl. smaller	more rounded	large	strong	variable
<u>anasazi</u>	large to sl. smaller	more rounded	large	strong	variable
<u>pulchella</u> ssp.	usually, small, sometimes large	more rounded	large	strong	variable

**Table 7.** Female Genitalia of Phyciodes tharos-group.

Taxon	Dome of Lamella Postostialis	Dome: Clear Midventral Axis	Lamella Para-ostialis	Ductus Bursa Fold
<u>riocolorado</u>	more/less rounded	weak/very weak	rounded or truncate	narrow
<u>tharos</u>	elliptical	clear or absent	pointed, some rounded	medium or narrow
<u>cocyta</u>	more/less rounded	clear or weak	pointed or rounded	usually medium
<u>batesii</u>	more/less rounded	clear or weak	pointed or rounded	medium or somewhat narrow
<u>lakota</u>	more/less rounded	clear or weak	pointed or rounded	usually medium, few wide
<u>apsaalooke</u>	more/less rounded	clear or weak	pointed or rounded	usually medium, some wide
<u>anasazi</u>	more/less rounded	clear	pointed, some rounded	2 wide, 1 medium
<u>pulchella</u> ssp.	rounded	clear or absent	pointed, some rounded or truncate	wide or medium

**Table 8.** Larvae of *Phyciodes mylitta*-group.

Taxon	Overall Appearance	Paler Band Below BD1 Scoli	Orange Below BD1 Scoli	Orange Above BD2 Scoli	Sub-dorsal Band (Between BD2 Scoli)	Paler Band Below BL1 Scoli	Head: Pale Vertex Stripe	Head: Pale Eye Patch
<u>mylitta</u>	blackish with tan dorsal lines, orange-brown beneath	tan	slightly orangish	absent	tan	ochre	cream stripe	absent, sometimes small
<u>pallida</u>	cream or ochre-cream with black bands and orange spots	wide cream or ochre-cream area	orange	present (narrow or wide)	cream (often wide)	cream	cream stripe (some have anterior satellite spot)	always a cream crescent or dot
<u>barnesi</u>	black with orange bands and weak cream dashes	black	orange	present (wide)	cream (often interrupted)	cream	cream stripe	some absent, most have cream crescent
<u>orseis</u>	blackish with orange & cream dashes	gray or creamy or mostly black	orange	absent	black	cream	black (some tan or brown)	absent, some small (tan or brown)
<u>herlani</u>	mostly maroon-black, brown beneath	ochre-brown	little or none	absent	black	ochre-brown	cream (some have satellite)	small, brownish

**Table 9.** Size and Wing Pattern of *Phyciodes mylitta*-group. The antenna nudum is orange in all taxa.

Taxon	Fore-wing Length (mm)	Fore-wing Shape	Upperside Overall Appearance	Upf Base Color	Unf Black Median Spot Inner Margin	Upf Black Median Spot Inner Margin	Unh Mottling	Unh Marginal Crescent
<u>mylitta</u>	m 15 (14-17) f 16-18	extended less	almost entirely orange	almost entirely orange	absent	absent	usually mottled brown & white.	usually whitish
<u>arizonensis</u>	m 16-17 (15) f 18-20	extended	mostly orange	mostly orange but less so	absent, rarely small	usually present	uniform yellow to mottled	usually whitish
<u>mexicana</u>	m 16 (16.5) f 19	extended	orange and brown	mostly brown	absent	present	very mottled brown & white	whitish
<u>arida</u>	m 15	extended little	mostly brown (spots creamier)	almost entirely brown	absent	large	very mottled brown & white	whitish
<u>thebais</u>	m 16-17 f 18-21	extended	mostly brown (most spots creamier exc. post-median uph band)	almost entirely brown	absent	large	very mottled brown & white	whitish
<u>pallida</u>	m 17-20 f 19-22	extended	mostly orange	mostly orange	present (rarely small)	present	marginal brownish patch present, little white except female	whitish
<u>barnesi</u>	m 16-21 f 20-24	extended	mostly orange	mostly orange	present (rarely absent)	present	same as <u>pallida</u>	whitish
<u>orseis</u>	m 16-19 f 19-22	extended	more brown (some orange)	mostly brown	absent or trace, seldom small	large	mottled with brown, & whitish band(s)	whitish
<u>herlani</u>	m 17-19 f 18-21	extended	mostly orange	mostly orange	absent or trace	present	yellowish, fine russet lines, weak marginal patch	yellow or yellow-white

Table 10. Wing Pattern of *Phyciodes mylitta*-group.

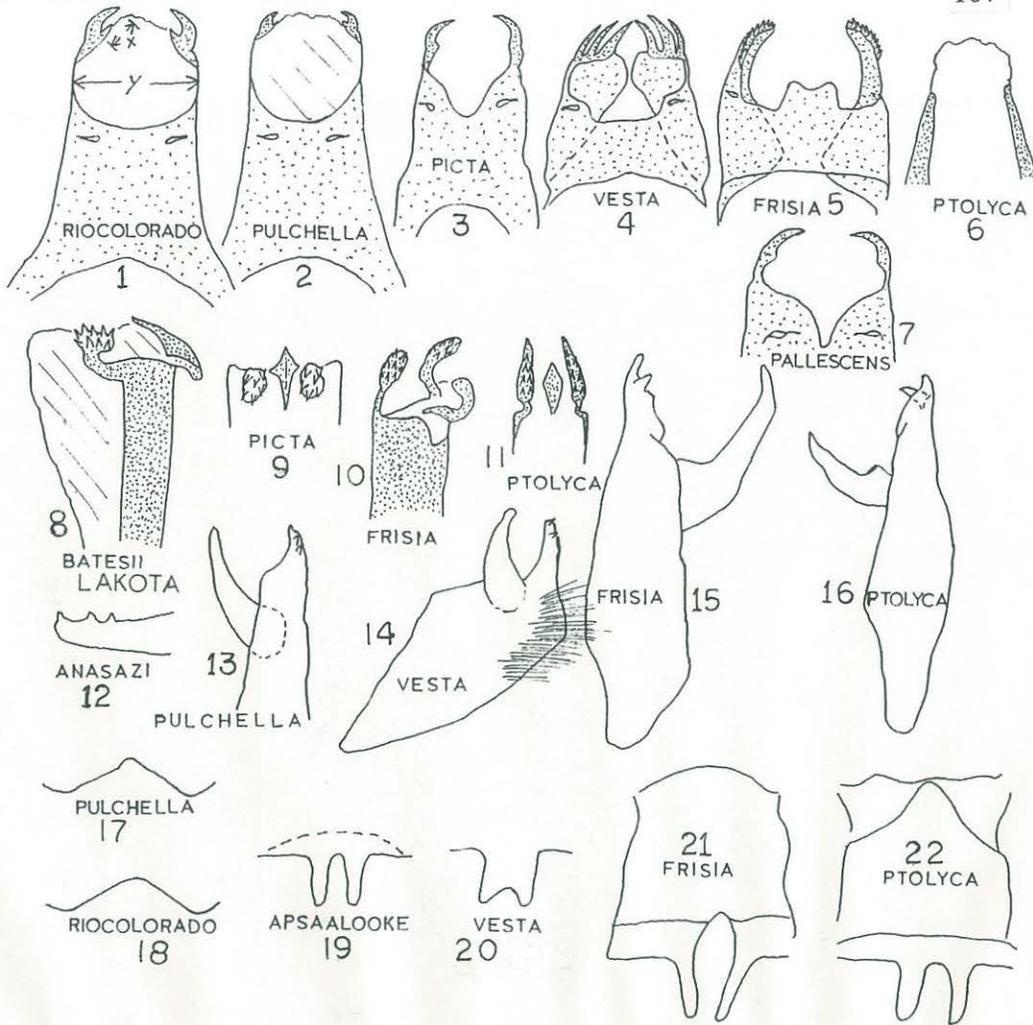
Taxon	Ups Median Band Color	Upf Median Orangish Band Width	Upf Post- median Orange Spot Size	Uph Postmedian Orange Band Width	Uph Brown Basal Edge of Sub- marginal Orange Band	Uph Marginal Lunules	Cream Spots of Wing Fringe
<u>mylitta</u>	orange male, paler female	wider (fairly wide in cell CuA2)	very wide	very wide, often joined to median orange band	narrow	fairly narrow	usual
<u>arizon- ensis</u>	orange male, paler female	wider (fairly wide in cell CuA2)	wide	wide, often joined to median orange band	wide	fairly narrow	usual
<u>mexic- ana</u>	orange male, sl. paler female	wider (narrower in cell CuA2)	narrow	narrow, not joined to median orange band	very wide	narrow	usual
<u>arida</u>	paler in male at least	narrow (narrower in cell CuA2)	narrow	very narrow, not joined (black centers large)	very wide	narrow	less crenulate
<u>thebais</u>	paler male and female	narrow (narrower in cell CuA2)	narrow	narrow male, wide female, not joined (black centers large)	very wide	narrow	more crenulate
<u>pallida</u>	orange male, paler female	wider (fairly wide in cell CuA2)	very wide	very wide, often joined to median orange band	wide	wider	usual
<u>barnesi</u>	orange male, paler female	wider (fairly wide in cell CuA2)	very wide	very wide, usually joined to median orange band	wide	wider	usual
<u>orseis</u>	paler male and female	narrow to wider (narrower cell CuA2)	wide	narrow, not joined to median orange band	very wide	narrow	more crenulate
<u>herlani</u>	orange or slightly paler male, paler female	wider (narrower in cell CuA2)	very wide	wide, seldom joined to median orange band	wide	fairly narrow	usual

**Table 11.** Male genitalia of *Phyciodes mylitta*-group. (The posterior rim of tegumen is straighter than in *tharos*-group, and the aedeagus averages shorter.)

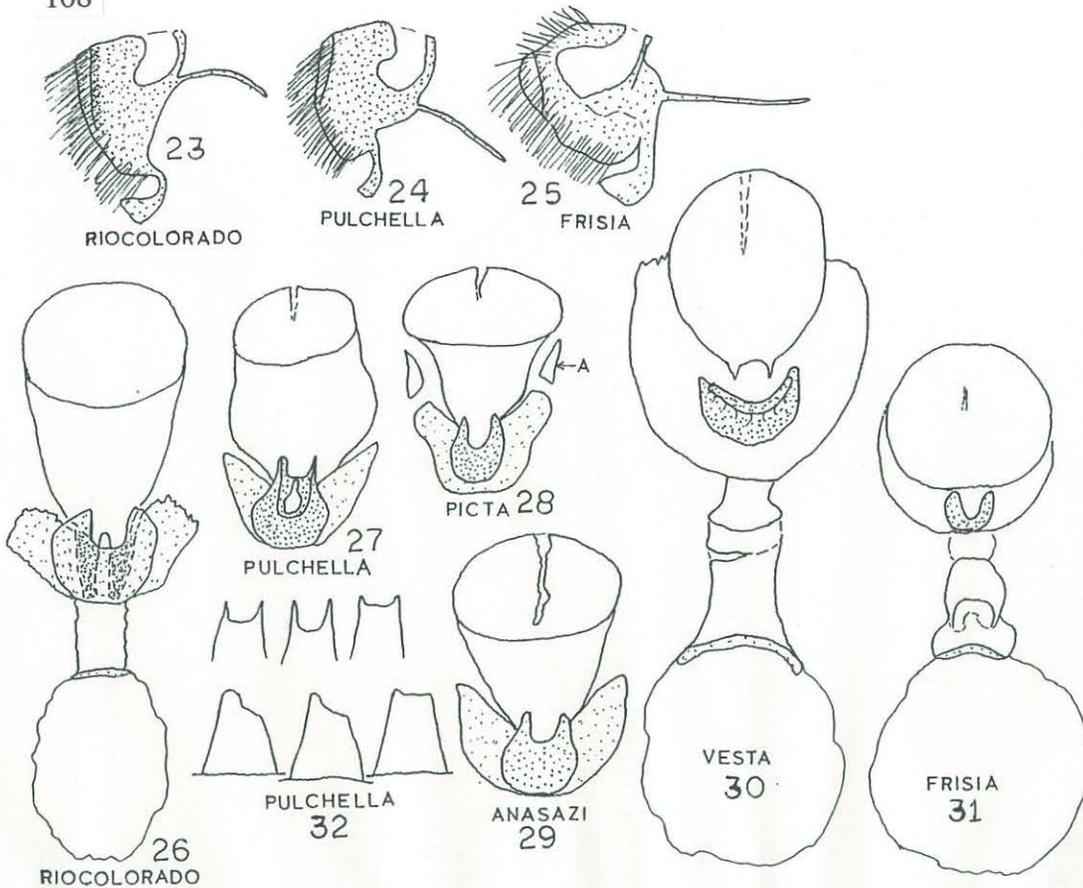
Taxon	Overall Size	Gnathos Hooks	Valva Shape near Tip	Saccus Flaps
<i>mylitta</i>	small like <i>tharos</i>	large	shouldered medially like <i>tharos</i>	like <i>tharos</i>
<i>arizonensis</i>	small like <i>tharos</i>	large	shouldered but usually a little narrower	like <i>tharos</i>
<i>mexicana</i>	small like <i>tharos</i>	large	usually narrow	like <i>tharos</i>
<i>arida</i>	small like <i>tharos</i>	a bit smaller than <i>mylitta</i>	narrow, no shoulder	like <i>tharos</i>
<i>thebais</i>	small like <i>tharos</i>	largest	narrow, no shoulder	like <i>tharos</i>
<i>pallida</i>	30% larger	small	shouldered but usually a little narrower	like <i>tharos</i>
<i>barnesi</i>	30% larger	small (smallest)	mostly shouldered	like <i>tharos</i>
<i>orseis</i>	50% larger (& juxta wider)	large	narrow, no shoulder	more pointed, wider apart
<i>herlani</i>	50% larger (& juxta usually wider)	large	narrow, no shoulder	more pointed, usually wider apart

**Table 12.** Female Genitalia of *Phyciodes mylitta*-group. (The lamella paraostialis is generally pointed in *mylitta*-group, and ductus bursa fold is usually medium in width.)

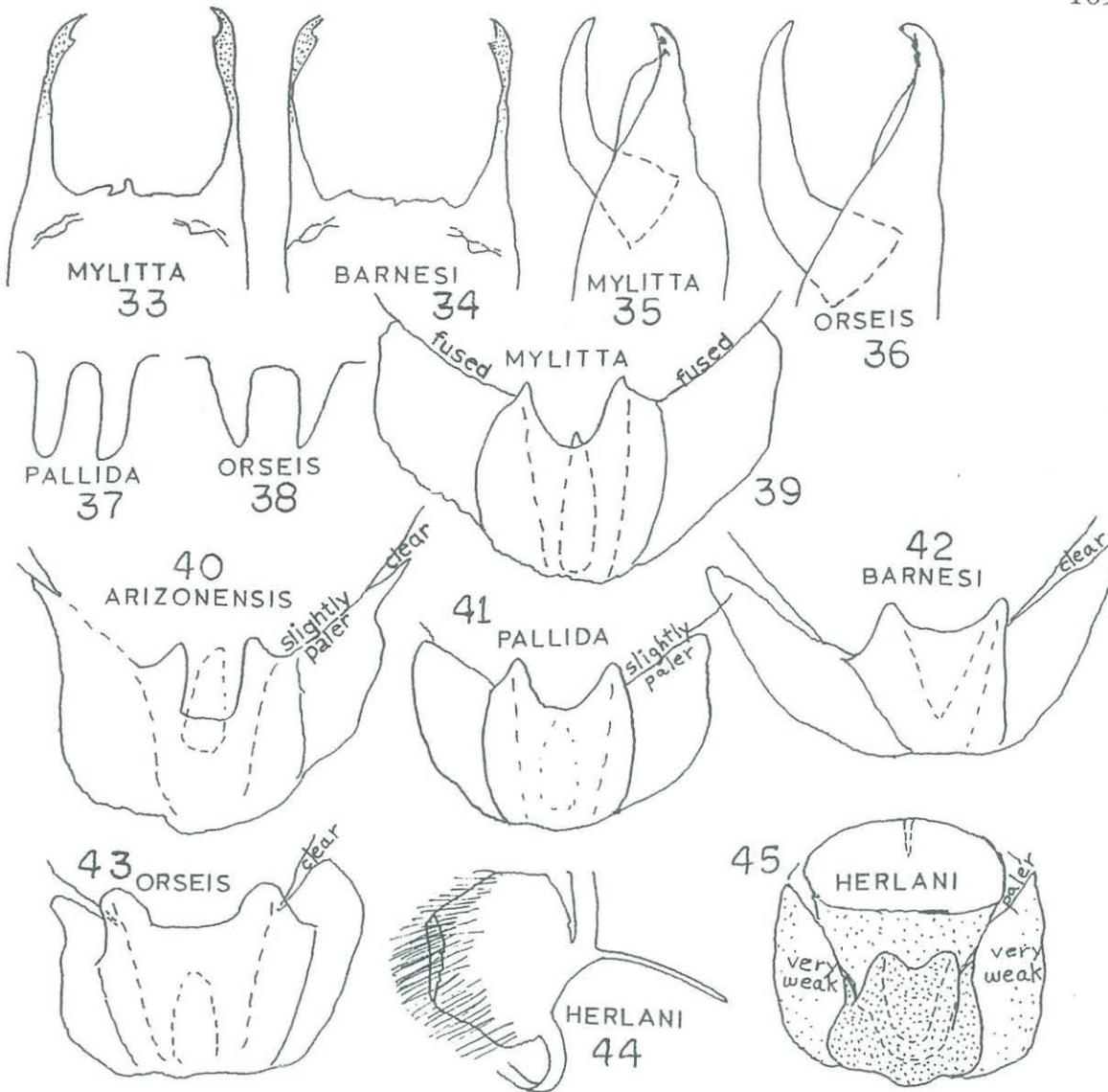
Taxon	Lamella Paraostialis (generally pointed)	Junction Lamella Postostialis and Lamella Paraostialis	Ostial "Volcanic" Cone
<i>mylitta</i>	long like <i>tharos</i>	usually fused	conelike like <i>tharos</i>
<i>arizonensis</i>	long like <i>tharos</i>	fused, slightly paler, or membranous	conelike like <i>tharos</i>
<i>mexicana</i>	long like <i>tharos</i> (sometimes blunt)	fused on one	conelike like <i>tharos</i>
<i>thebais</i>	long like <i>tharos</i>	fused or half-transparent	conelike like <i>tharos</i>
<i>pallida</i>	fairly long	slightly paler, some fused	a little more scooplike, peaks lower
<i>barnesi</i>	fairly long	slightly paler or clear	more scooplike, peaks lower
<i>orseis</i>	very short	clear	quite scooplike, peaks lower
<i>herlani</i>	very short	clear	quite scooplike, peaks lower



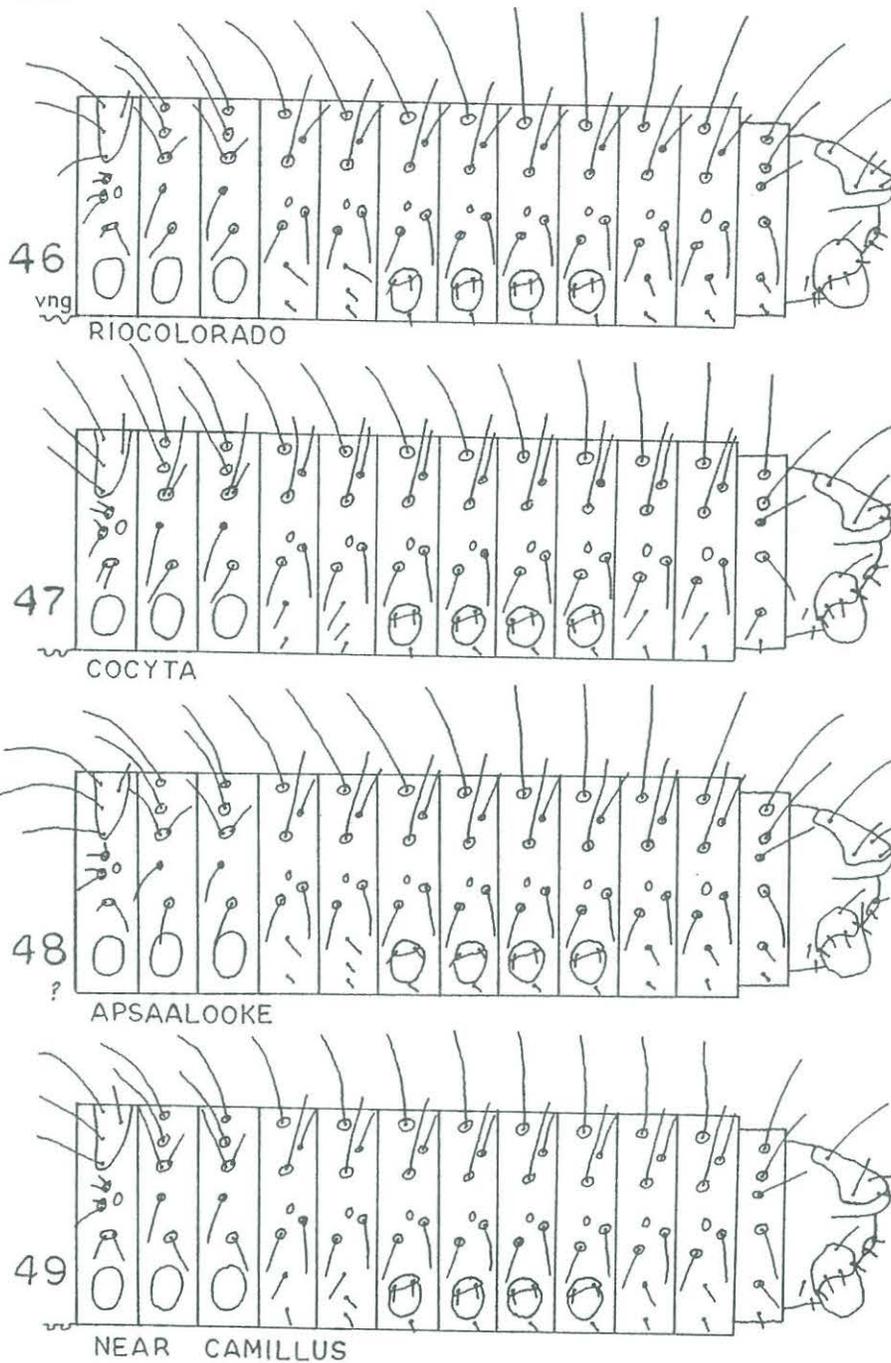
**Figs. 1-22** male genitalia, **Figs. 1-7** dorsal view of gnathos & tegumen, fig. 1 *P. tharos riocolorado*, fig. 2 *P. pulchella pulchella*, fig. 3 *P. picta picta*, fig. 4 *P. vesta*, fig. 5 *P. frisia tulcis*, fig. 6 *P. ptolyca*, fig. 7 *P. pallescens*; figs. 8-11 tip of aedeagus, fig. 8 lateral view of tip of *P. batesii lakota*, fig. 9 *P. picta picta*, fig. 10 oblique view of tip of *P. frisia tulcis*, fig. 11 *P. ptolyca*; figs. 12-16 valva, fig. 12 lateral view of tip of *P. batesii anasazi*, fig. 13 dorsal view of tip of *P. pulchella pulchella*, fig. 14 *P. vesta* lateral view, fig. 15 *P. frisia tulcis* dorsal view, fig. 16 *P. ptolyca* dorsal view; figs. 17-18 anterior edge of juxta in ventral view, fig. 17 *P. pulchella pulchella*, fig. 18 *P. tharos riocolorado*; figs. 19-20 ventral view of saccus, fig. 19 *P. batesii apsaalooke*, fig. 20 *P. vesta*; figs. 21-22 ventral view of juxta-saccus, fig. 21 *P. frisia tulcis*, fig. 22 *P. ptolyca*.



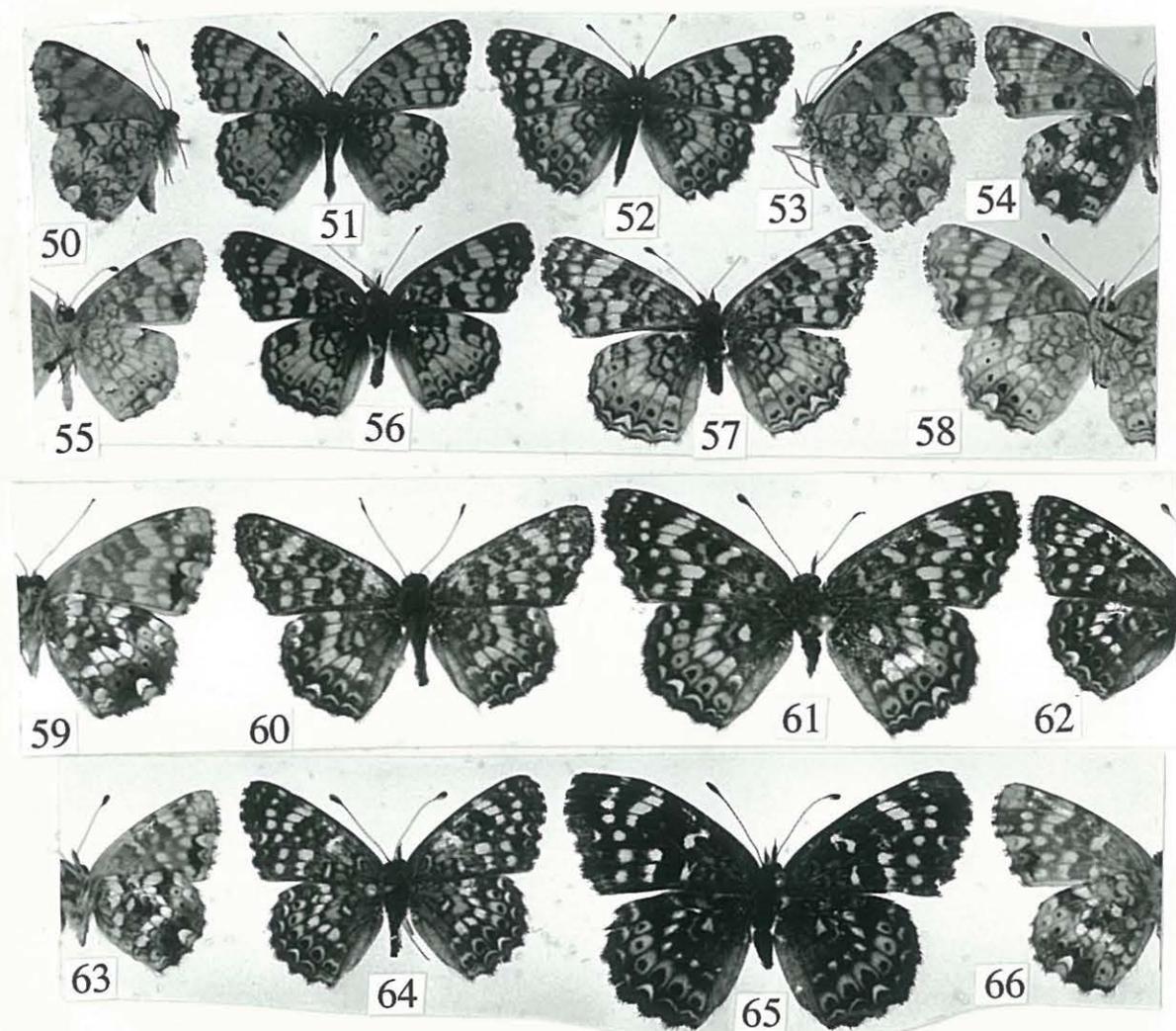
**Figs. 23-32** female genitalia: figs 23-25 papilla analis right lateral view, fig. 23 *P. tharos riocolorado*, fig. 24 *P. pulchella pulchella*, fig. 25 *P. frisia tulcis*; figs 26-31 ventral view of lamella postostialis, ostial cone, & lamella paraostialis (plus ductus bursa & bursa copulatrix of figs. 26, 30, 31), fig. 26 *P. tharos riocolorado*, fig. 27 *P. pulchella pulchella*, fig. 28 *P. picta picta*, fig. 29 *P. batesii anasazi*, fig. 30 *P. vesta*, fig. 31 *P. frisia tulcis*; fig. 32 three anterior (top) and three right-side views (bottom) of ostial cone of *P. pulchella pulchella*.



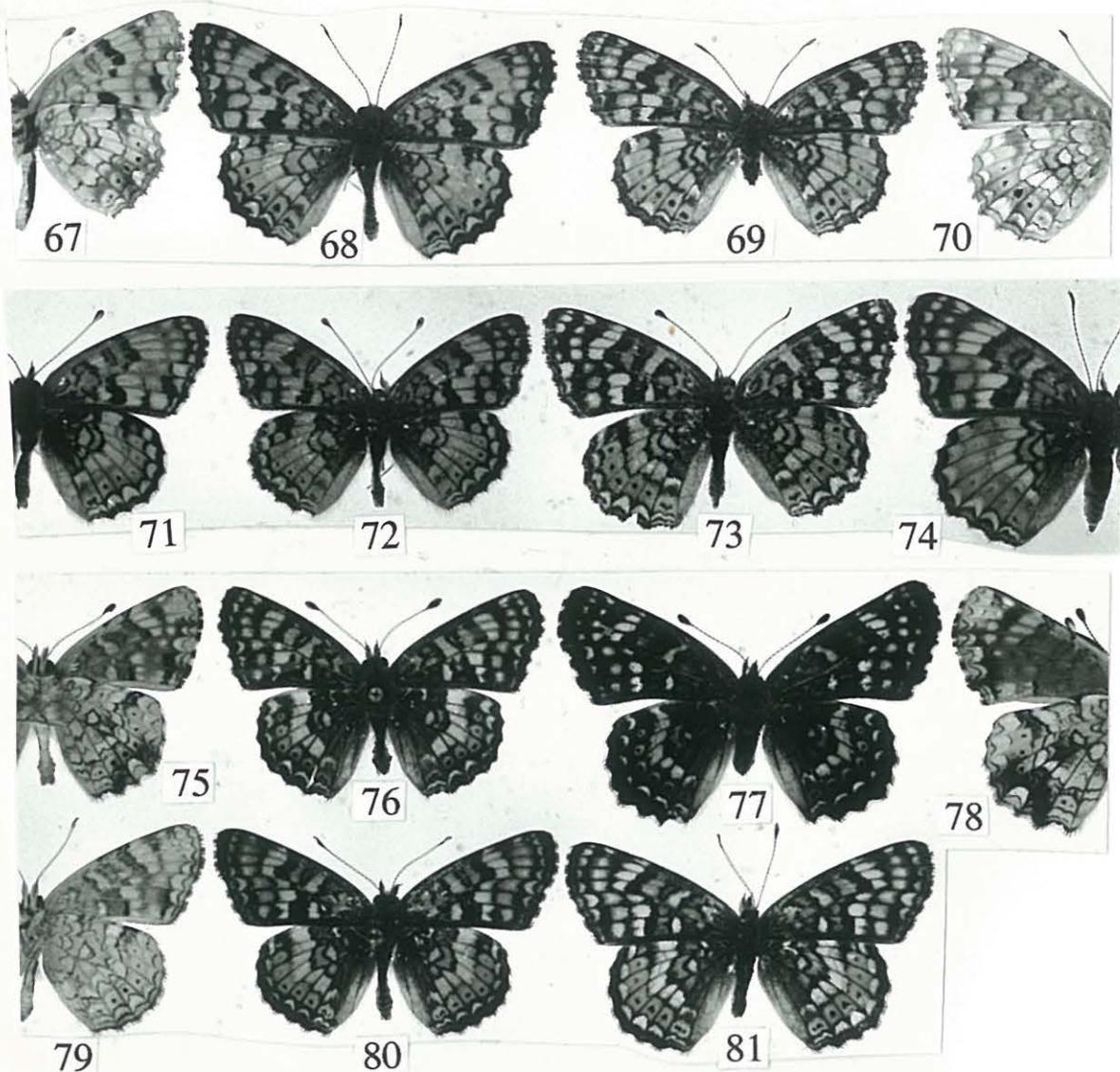
**Figs. 33-45** genitalia of *Phyciodes mylitta* group: figs. 33-34 dorsal view of gnathos & tegumen, fig. 33 *P. mylitta mylitta*, fig. 34 *P. pallida barnesi*; figs. 35-36 tip of valva in dorsal view, fig. 35 *P. mylitta mylitta*, fig. 36 *P. orseis orseis*; figs. 37-38 ventral view of saccus, fig. 37 *P. pallida pallida*, fig. 38 *P. orseis orseis*; figs. 39-43 ventral view of ostial cone & lamella paraostialis, fig. 39 *P. mylitta mylitta*, fig. 40 *P. mylitta arizonensis*, fig. 41 *P. pallida pallida*, fig. 42 *P. pallida barnesi*, fig. 43 *P. orseis orseis*; fig. 44 right lateral view of papilla analis of *P. orseis herlani*; fig. 45 ventral view of lamella postostialis, ostial cone, lamella paraostialis, & very weak lateral membrane, of *P. orseis herlani*.



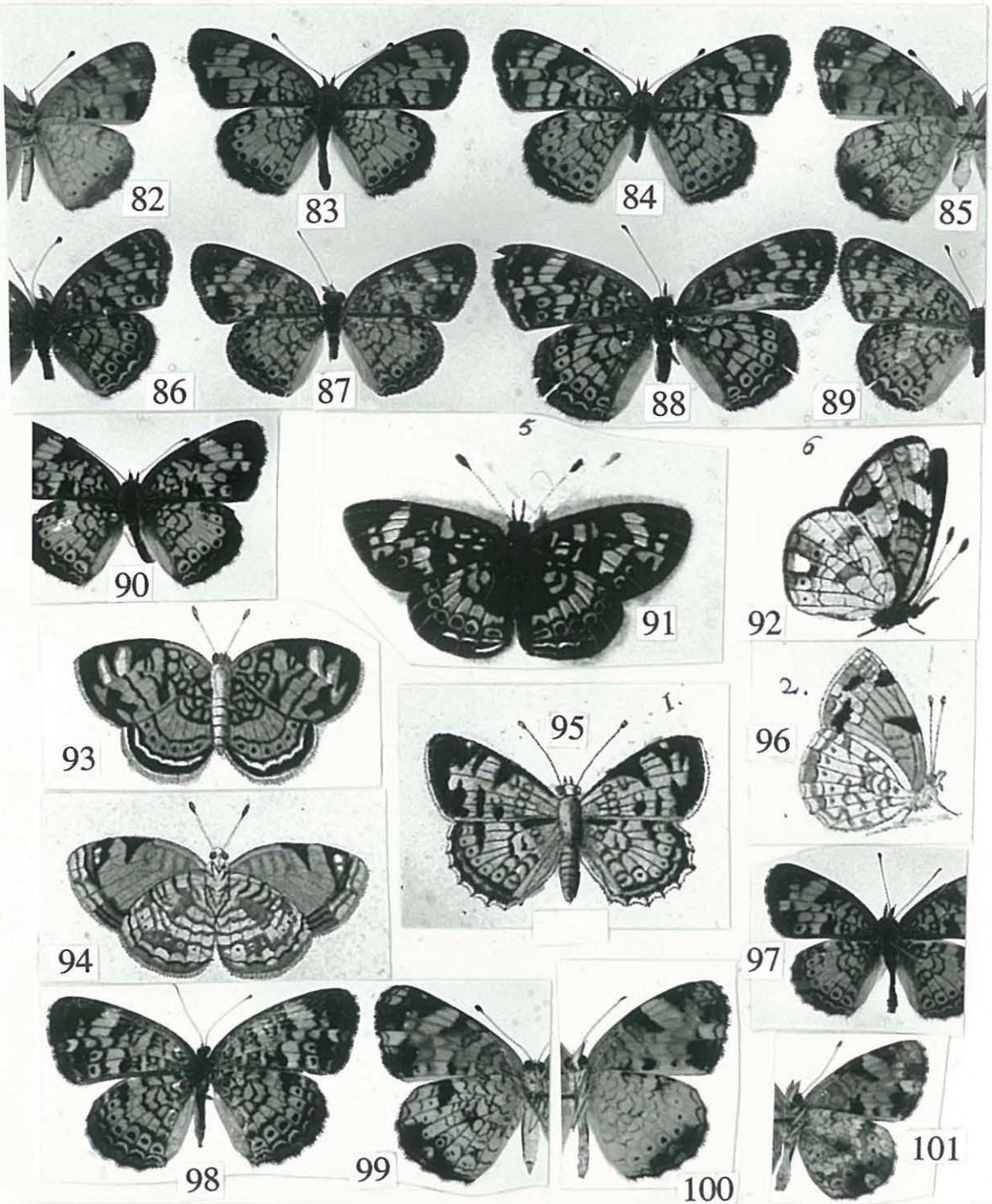
**Figs. 46-49** setal maps of first-stage larvae: fig. 46 *P. tharos riocolorado* (vng = ventral neck gland), fig. 47 *P. cocyta*, fig. 48 *P. batesii apsaalooke*, fig. 49 *P. pulchella* near camillus (Bighorn Mts.).



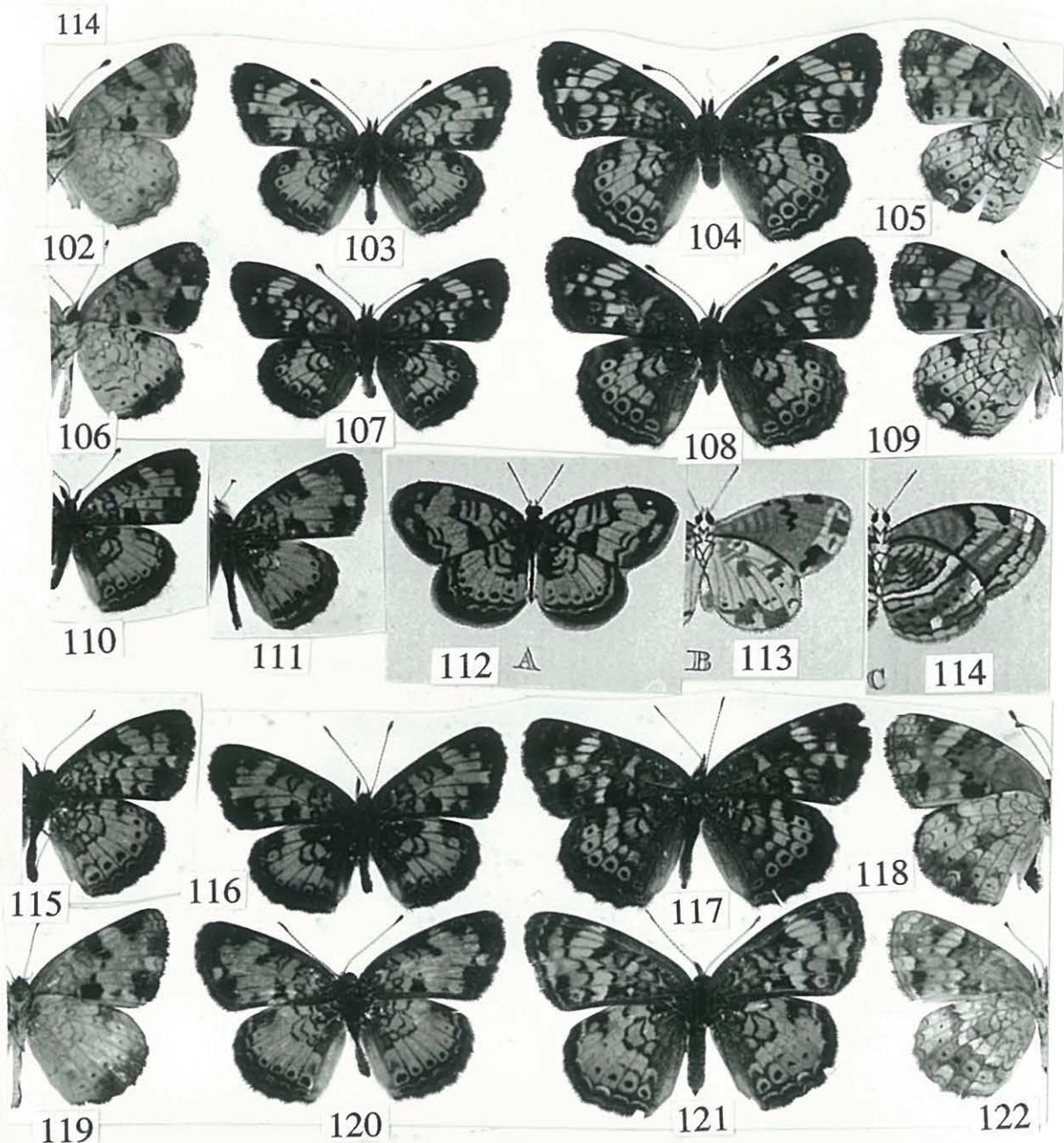
**Figs. 50-66** *P. mylitta*: figs. 50-54 *P. mylitta mylitta*, fig. 50 male uns Twin Falls Ida., fig. 51 male Twin Falls, fig. 52 female Richland Wash., fig. 53 female uns Twin Falls, Fig. 54 male uns form marcia Santa Clara Co. Cal.; figs. 55-58 *P. mylitta arizonensis*, fig. 55 male uns Custer Co. Colo., fig. 56 male La Plata Co. Colo., fig. 57 female Coconino Co. Ariz., fig. 58 female uns Cochise Co. Ariz.; figs. 59-61 *P. mylitta mexicana* Jalapa Mex. (59 male uns, 60 male, 61 female); figs. 62-63 *P. mylitta arida* Morelia Mex. (62 male, 63 male uns); figs. 64-66 *P. mylitta thebais*, fig. 64 male D.F. Mex., fig. 65 female Jalisco Mex., 66 male uns Jalisco Mex.



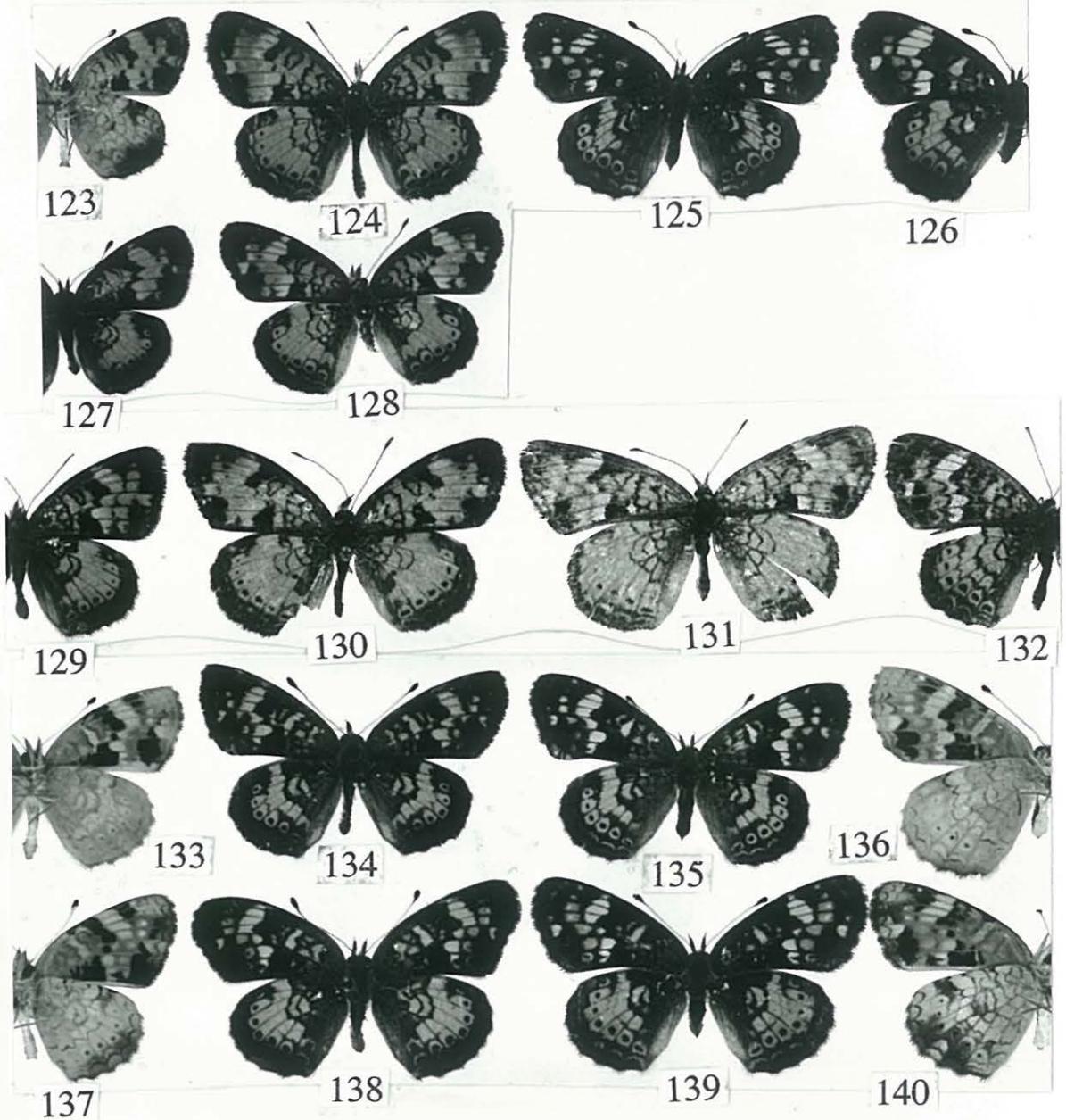
**Figs. 67-81** *P. pallida* & *P. orseis*: figs. 67-70 *P. pallida pallida*, fig. 67 male uns Boulder Co. Colo., figs. 68-70 Jefferson Co. Colo. (68 male, 69 female, 70 female uns); figs. 71-74 *P. pallida barnesi*, fig. 71 pale male Moffat Co. Colo., fig. 72 dark male Beaver Co. Utah, fig. 73 dark female Sevier Co. Utah, fig. 74 pale female Uintah Co. Utah; figs. 75-78 *P. orseis orseis* Siskiyou Co. Calif. (75 male uns, 76 male, 77 female, 78 female uns); figs. 79-81 *P. orseis herlani*, fig. 79 male uns Douglas Co. Nev., fig. 80 male Douglas Co., fig. 81 female Lassen Co. Cal.



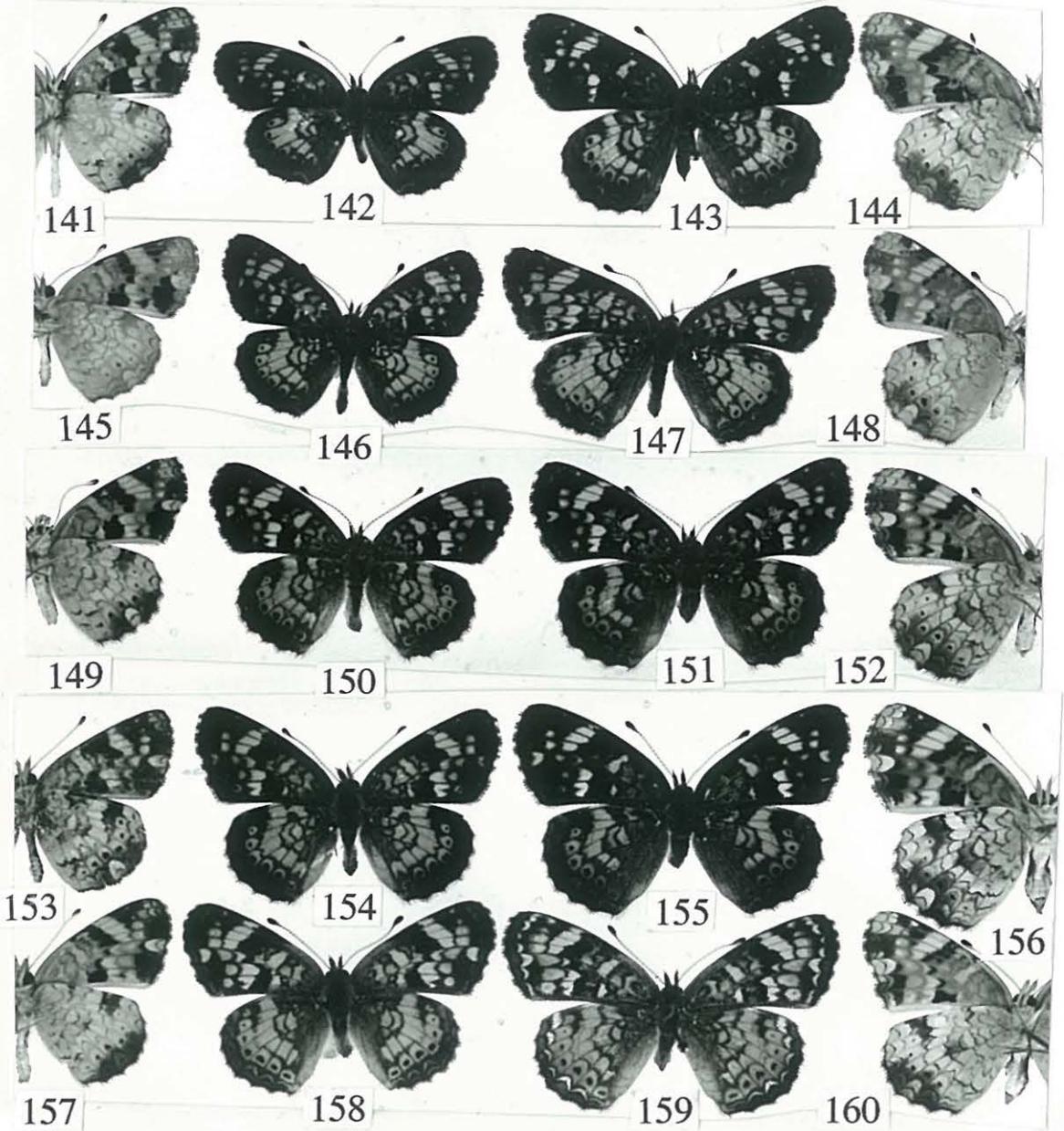
**Figs. 82-101** *P. tharos*: 82-85 ssp. *riocolorado* Montrose Co. Colo. (82 male uns, 83 male, 84 female, 85 female uns); 86-101 ssp. *tharos*, 86-89 syn. "*distincta*", 86 male Brawley Cal., 87 male Calexico Cal., 88 female Brawley, 89 female Calexico; 90 male neotype *tharos*, 91-92 Drury's 1770 unnamed O.D. figs. of male *tharos* ups/uns (BMNH), 93-94 Cramer's (1777) figs. *tharos* female ups/uns (AMNH); 95-96 Bergstraesser's 1780 O.D. figs. of *euclea* male ups/uns (AMNH); 97 male neotype *euclea*; 98 *tharos* female Abbeville Co. S.C., 99 *tharos* female uns Cecil Co. Md., 100 *tharos* male uns Sussex Co. Del., 101 *tharos tharos* orange-antenna variety form *marcia* male uns Slope Co. N.D.



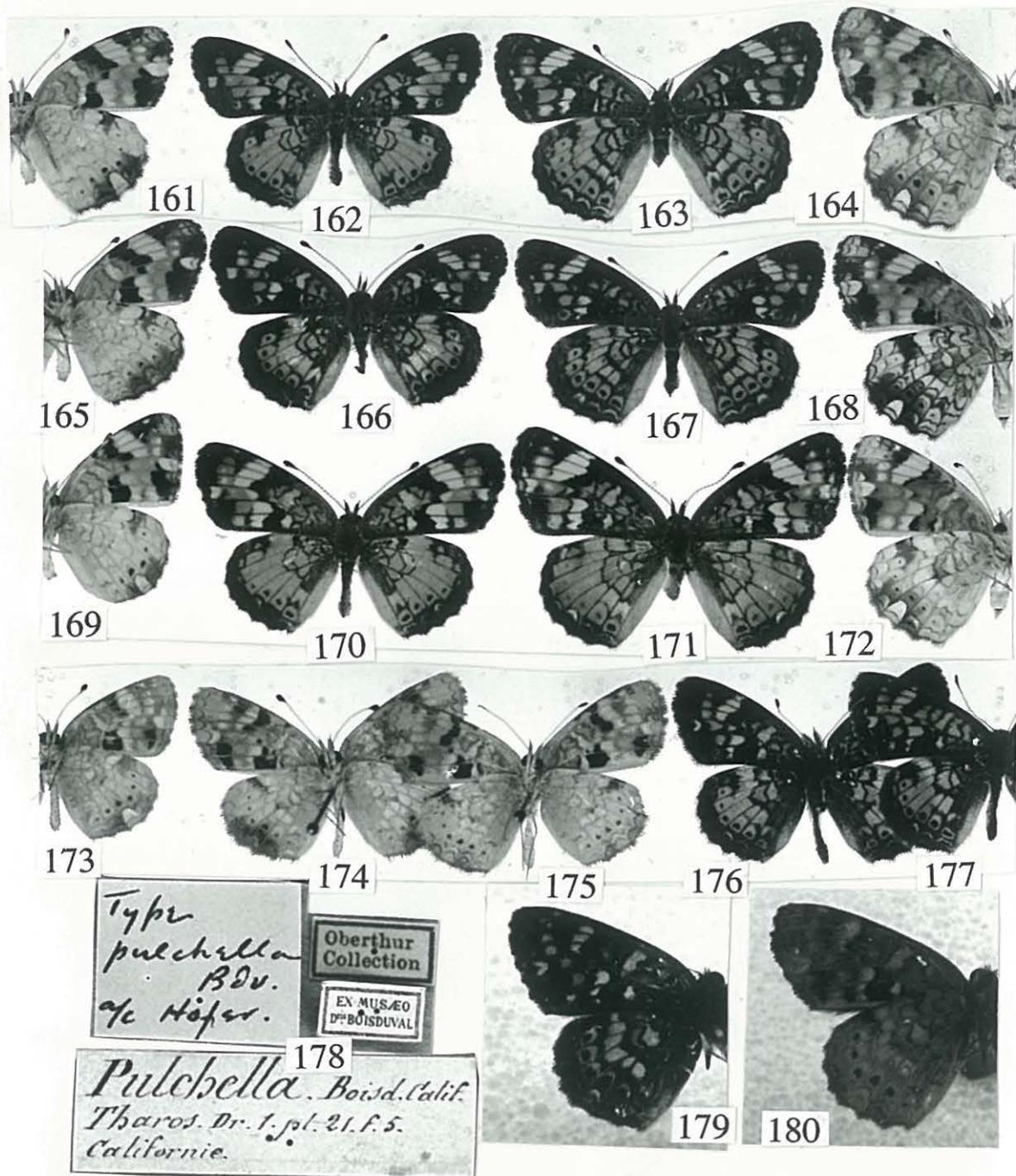
**Figs. 102-122** *P. tharos tharos* & *P. cocyta*: figs. 102-104 orange-antenna var. Sioux Co. Neb. (102 male uns, 103 male, 104 female; fig. 105 female uns Pike Co. Pa.; fig. 106 male uns Cecil Co. Md.; figs. 107-108 orange-antenna var. Sioux Co. Neb. (107 male, 108 female); fig. 109 female uns Cecil Co.; figs 110-122 *P. cocyta*, fig. 110 male same data as neotype; fig. 111 male neotype Black Rock N.S.; figs. 112-114 Cramer's 1777 O.D. figs. of *cocyta* male/male uns/form *marcia* female uns (AMNH); fig. 115 male Onondaga Co. N.Y.; fig. 116 male Missoula Co. Mont.; fig. 117 female Oakville Ont.; fig. 118 female uns Idaho Co. Ida.; fig. 119 male uns. Jefferson Co. Colo.; fig. 120 male Missoula Co.; fig. 121 female Mineral Co. Mont.; fig. 122 female uns Passadumkeag Me.



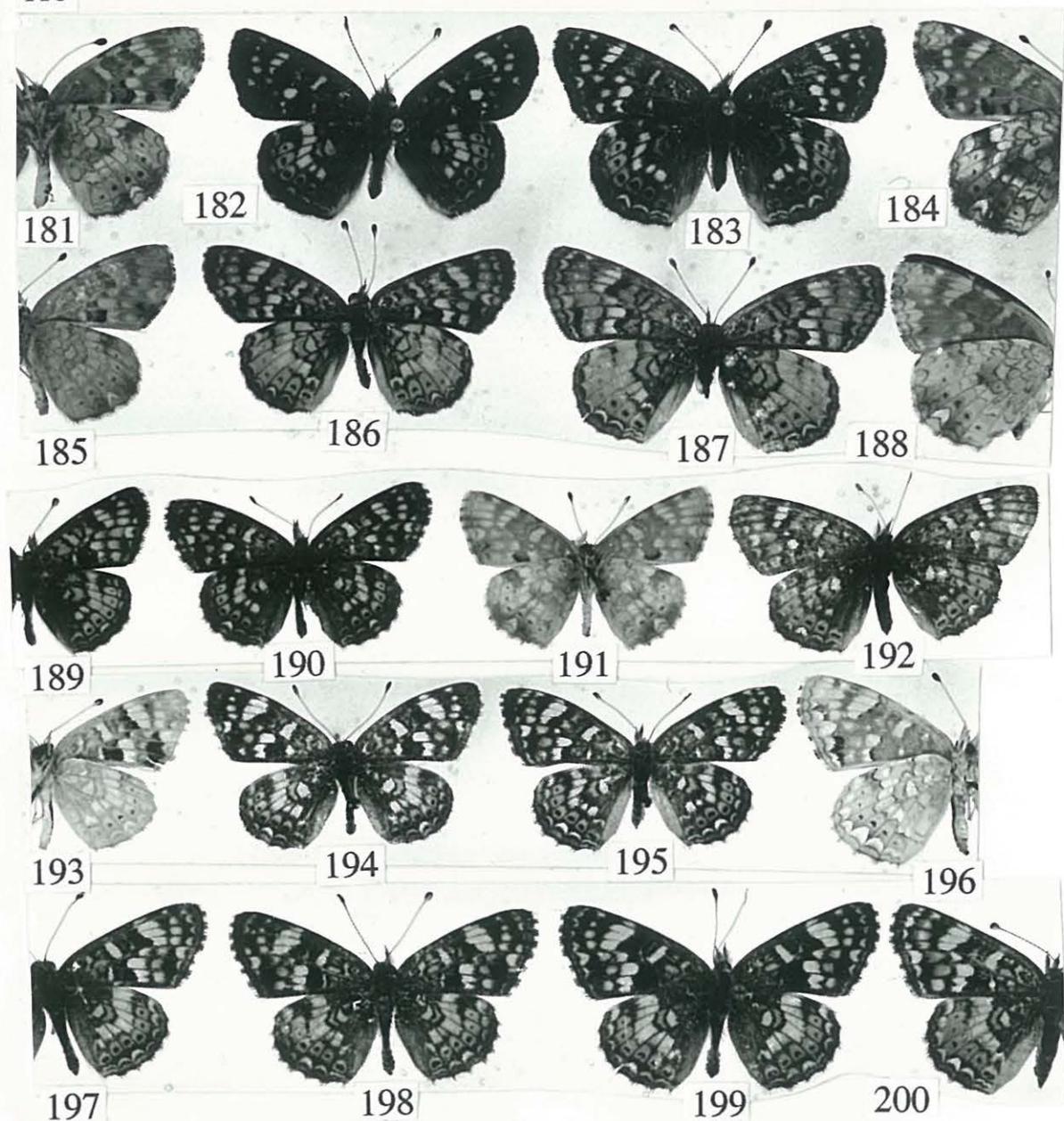
Figs. 123-140 *P. cocyta* & *P. batesii*: figs. 123-132 *P. cocyta*, figs. 123-128 Jefferson Co. Colo. (123 male uns, 124 male, 125 female, 126 female, 127 male, 128 male); fig. 129 male Eagle Co. Colo.; fig. 130 male Sandoval Co. N.M.; fig. 131 female Rio Arriba Co. N.M.; fig. 132 female Colfax Co. N.M.; figs. 133-136 *P. batesii batesii* N.C. (133 male uns, 134 male, 135 female, 136 female uns); figs. 137-140 typical *P. batesii lakota* Sioux Co. Neb. (137 male uns, 138 male, 139 female, 140 female uns).



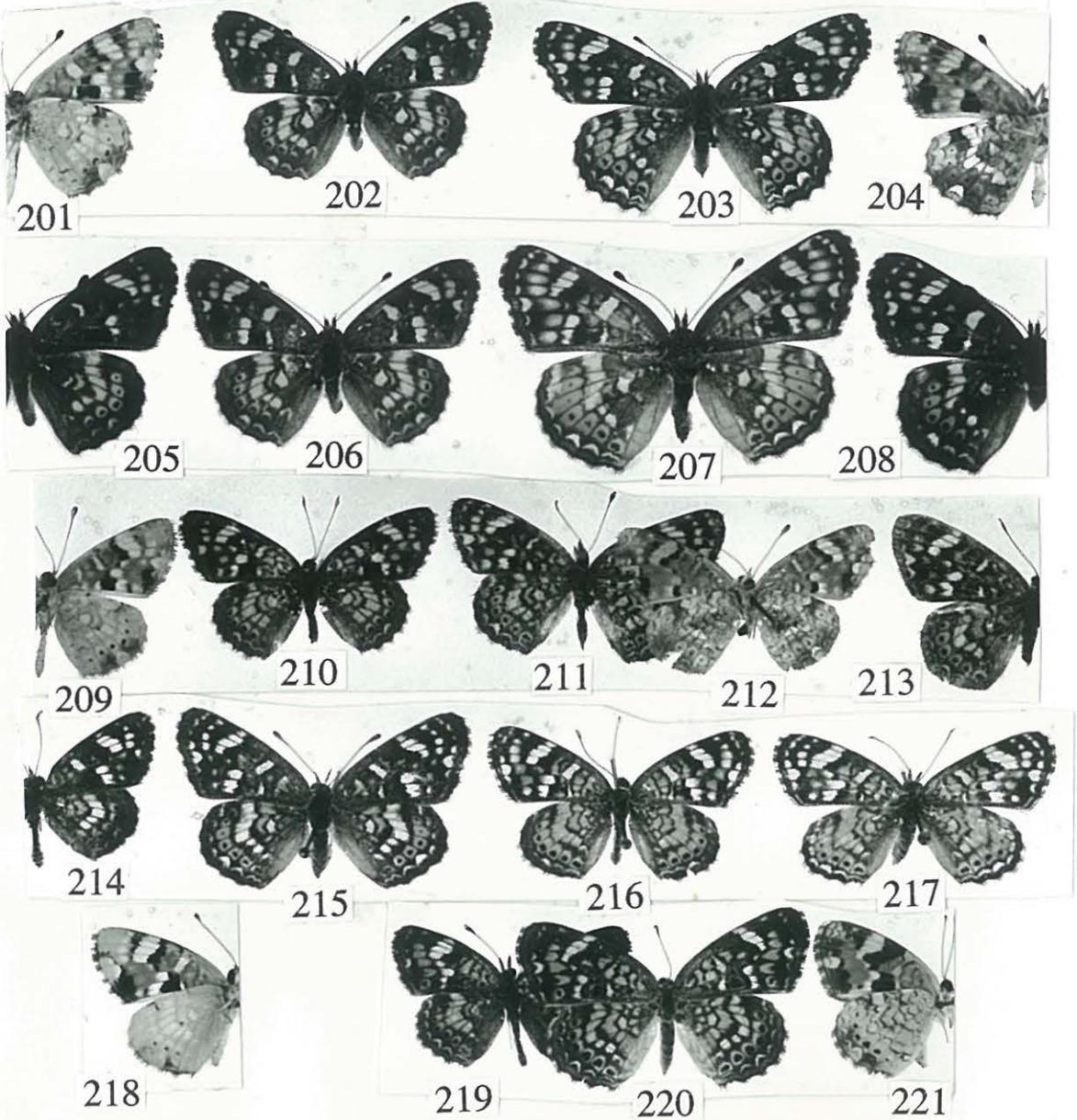
**Figs. 141-160 P. batesii lakota & P. batesii apsaalooke:** figs. 141-148 P. b. lakota Sioux Co. Neb., figs. 141-144 darkest P. b. lakota (141 male uns, 142 male, 143 female, 144 female uns); figs. 145-148 palest P. b. lakota (145 male uns, 146 male, 147 female, 148 female uns); figs. 149-160 P. b. apsaalooke Bighorn Co. Wyo., figs. 149-152 typical P. b. apsaalooke (149 male uns, 150 male, 151 female, 152 female uns); figs. 153-156 darkest P. b. apsaalooke (153 male uns, 154 male, 155 female, 156 female uns); figs. 157-160 palest P. b. apsaalooke (157 male uns, 158 male, 159 female, 160 female uns).



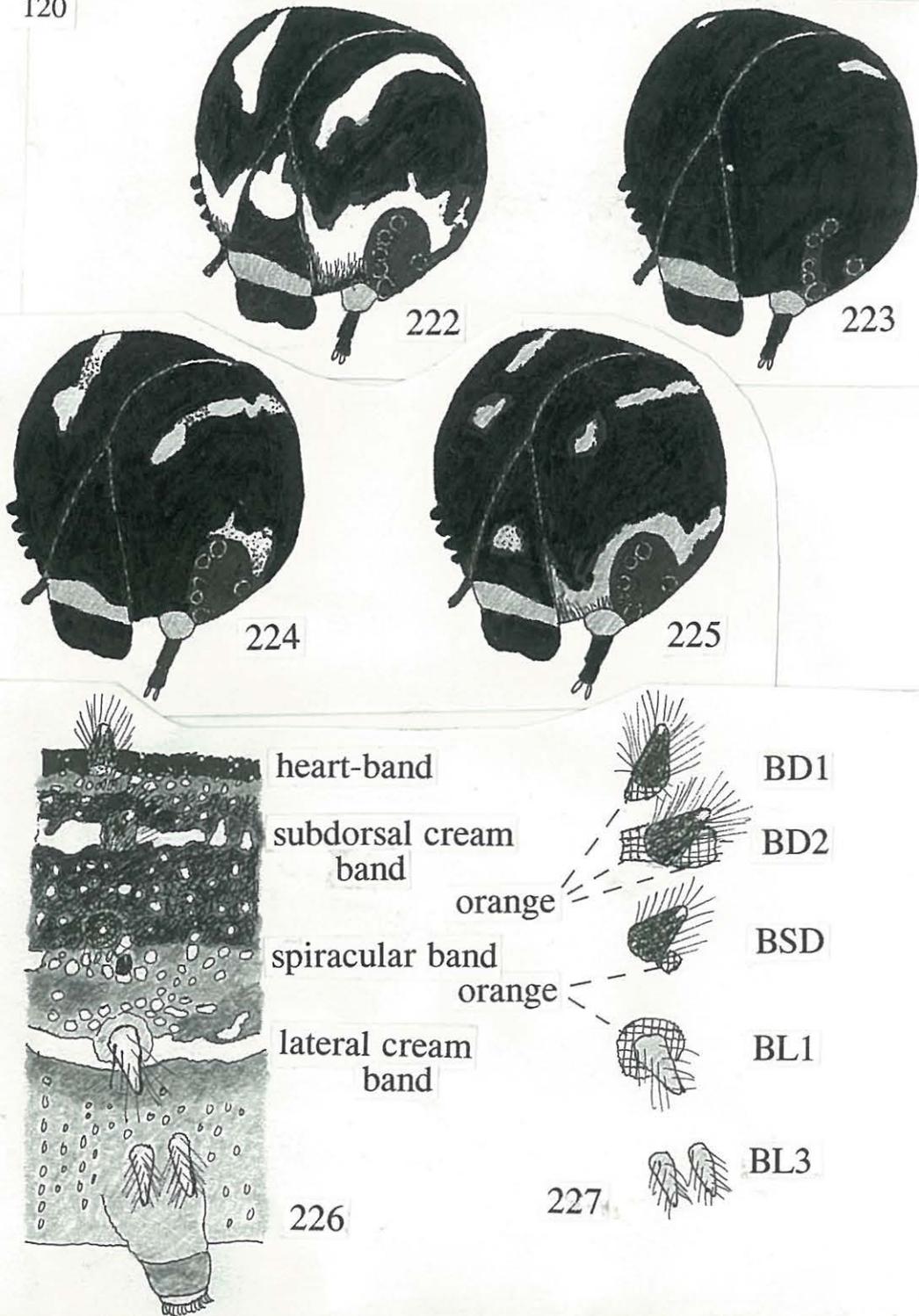
**Figs. 161-180** *P. batesii* & *P. pulchella*: figs. 161-172 *P. batesii* *anasazi* Mesa Co. Colo., figs. 161-164 typical *P. b. anasazi* (161 male uns, 162 male, 163 female, 164 female uns), figs. 165-168 darkest *P. b. anasazi* (165 male uns, 166 male, 167 female, 168 female uns), figs. 169-172 palest *P. b. anasazi* (169 male uns, 170 male, 171 female, 172 female uns); figs. 173-177 *P. batesii* *lakota* small-spotted Alta. var. males (173-175 uns); figs. 178-180 USNM *P. pulchella* lectotype = neotype male (178 labels, 180 uns).



**Figs. 181-200** *P. pulchella*: figs. 181-184 *P. p. pulchella*, fig. 181 male uns Contra Costa Co. Calif.; figs. 182-184 San Mateo Co. Calif. (182 male, 183 female, 184 female uns); figs. 185-188 *P. p. montana*, fig. 185 male uns Douglas Co. Nev.; fig. 186 male Sierra Co. Calif.; fig. 187 female Alpine Co. Calif.; fig. 188 female uns El Dorado Co. Calif.; figs. 189-192 *P. p. tutchone*, figs. 189-191 males Nickel Crk. Yukon (191 uns); fig. 192 female Haines Rd. Yukon; figs. 193-196 *P. p. shoshoni* Lander Co. Nev. (193 male uns, 194 male, 195 female, 196 female uns); figs. 197-200 *P. p. camillus* oranger-var. Otero Co. N.M. (197-199 males, 200 female).



**Figs. 201-221** *P. pulchella camillus* and *P. phaon*-group: fig. 201 *P. p. camillus* male uns Tooele Co. Utah; fig. 204 *P. p. camillus* form *marcia* male uns Jefferson Co. Colo.; figs. 202-203 & 205-208 *P. p.* near *camillus* Bighorn Co. Wyo. (202 male, 203 female, 205-206 males, 207-208 females); figs. 209-213 *P. pallescens* Mex. (209 male uns Jalisco, 210 male Oaxaca, 211 female Jalisco, 212 female uns Queretaro, 213 female Tam.); figs. 214-215 *P. picta picta* Pueblo Co. Colo. (214 male, 215 female); figs. 216-217 *P. p. canace* Santa Cruz Co. Ariz. (216 male, 217 female); fig. 218 *P. p. picta* male uns. Sierra Co. N.M.; figs. 219-221 *P. phaon*, fig. 219 male River Oaks Tex., 220-221 Maricopa Co. Ariz. (220 female, 221 female uns).



**Figs. 222-227** *Phyciodes* older larvae: figs. 222-225 head, fig. 222 has cream patch on frontoclypeus (the triangular area on front) typical of *P. batesii batesii* & *P. tharos* & *P. cocyta*; fig. 223 black head typical of *P. pulchella* and many individuals of *P. batesii* ssp. (*lakota*, *apsaalooke*, *anasazi*); fig. 224 many *lakota*, *apsaalooke*, and *anasazi*; fig. 225 small frontoclypeus patch on some *P. tharos*, *P. cocyta*, *lakota*, *apsaalooke*, *anasazi*; fig. 226 color pattern on typical abdomen segment (*P. b. apsaalooke*); fig. 227 names of scoli and location of orange areas on *tharos*-group body (hatched areas).