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A SYNOPSIS OF DECODES (LEPIDOPTERA: TORTRICIDAE), WITH DESCRIPTIONS OF NEW SPECIES AND A RELATED NEW GENUS IN MEXICO

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Abstract. The taxonomy and geographical distribution of 20 species assigned to Decodes (Lepidoptera: Tortricidae) and the related new genus Decodina are reviewed; diagnostic characters, flight periods, and biological features, where known, are given. Ten species are described as new: Decodes catherinae (USA: California), D. macswaini (Mexico: Nuevo Leon), D. stevensi (USA: Colorado), D. tonto (USA: Arizona), D. macdunnoughi (Canada: Manitoba), D. tahoense (USA: California), D. opleri (USA: California), D. asapheus (USA: California), D. zimapanus (Mexico: Hidalgo), and Decodina mazatlana (Mexico: Sinaloa). The larvae feed on Fagaceae, Ericaceae, or Saxifragaceae. Pupation occurs in the soil in a tough cocoon, enabling pupal diapause through the dry season.

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Moths of the North American genus *Decodes* are widely distributed, from the Northwest Territories at 62°N, eastward to southern Quebec and southward to Guerrero in southern Mexico. The greatest species diversity is reached in the southwestern United States, with 12 species recorded in California. Most *Decodes* have remained poorly known, having escaped the attention of collectors owing to a generally similar, nondescript, gray appearance and to the fact that nearly all fly either in early spring or late fall. Among the 20 species treated here, 16 have been described since 1960, 8 are known only from the type-localities, 1 only from males, and 3 only from females. Biologically, *Decodes* and presumably the related new genus, *Decodina*, are unique among New World Tortricinae in development of pupal diapause, which lasts through the dry season. This appears to have been the principal scheme which has

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enabled speciation in areas of seasonal drought in the southwestern United States and northern Mexico. Larval feeding occurs in spring, followed by 1 of 2 patterns: either pupal diapause through summer, with flight in fall and egg diapause in winter, or pupal diapause through summer and winter, with flight in early spring prior to host foliation. Host plants are known for only 8 species: 3 feed on *Quercus* (Fagaceae), 4 on *Ribes* (Saxifragaceae) and 1 on *Arctostaphylos* (Ericaceae). Pupation takes place in debris in ground litter or in soil, in a tough cocoon, unlike that of any other Nearctic Tortricinae (Powell 1964: fig. 52).

Subsequent to previous treatment of *Decodes* (Obraztsov & Powell 1961; Powell 1964, 1965), considerable additional biological and taxonomic data have accumulated, warranting the present review. Field efforts by personnel from the Smithsonian Institution, University of California, and elsewhere, particularly in Mexico, have revealed additional diversity, indicating a much richer fauna of these off-season moths than had been known. Besides the new taxa, additions to the knowledge of biology, geographical distribution, and taxonomic variation are presented.

Laboratory and measurement techniques were generally those outlined elsewhere (Powell 1964, 1973). The letter n designates number of observations, measurements, specimens reared, etc. Copies of complete specimen data and depositories are on file at the Essig Museum of Entomology, University of California, Berkeley. Data from material examined is given only for specimens not cited elsewhere (Obraztsov & Powell 1961; Opler 1970, 1973; Powell 1964, 1965).

Abbreviations used in the text for institutions and collections are as follows:

AB	André Blanchard, Houston, Texas
AMNH	American Museum of Natural History, New York
BMNH	British Museum (Natural History), London
CAS	California Academy of Sciences, San Francisco
CDA	California Department of Food and Agriculture, Sacramento
CNC	Canadian National Collection, Ottawa
LACM	Los Angeles County Museum of Natural History, Los Angeles
NMNH	National Museum of Natural History, Washington, D.C.
ODA	Oregon Department of Agriculture, Salem
UCB	Essig Museum of Entomology, University of California, Berkeley
UCD	University of California, Davis
UCR	University of California, Riverside
USFS(RM)	U.S. Forest Service, Rocky Mountain Forest and Range Experiment
	Station, FT. Collins, Colorado

Genus Decodes Obraztsov

Decodes Obraztsov, 1961, J. Lepid. Soc. 14: 113 ["1960"].

Type-species. Tortricodes fragariana Busck, 1919.

Small to medium-sized, gray moths with cylindrical, thin labial palpi covered by appressed scaling (Fig. 1). Costa of forewing evenly curved from base to apex. Female ovipositor "floricomous," papillae anales

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FIG. 1–3. **1.** Head of *Decodes* (*D. horarianus* complex, British Columbia), lateral aspect. **2.** Wing venation of *Decodes horarianus*, δ , Ft. Bidwell, California. **3.** Wing venation of *Decodina mazatlana*, paratype \Im .

produced in apical $\frac{1}{2}$ as broad, recessed flaps, thickly set medially with stout, nailhead-shaped setae (FIG. 33–47).

The floricomous ovipositor is used to scrape debris from the substrate and to cover the eggs with the accumulated dirt (Powell 1964: 29). This structural modification distinguishes *Decodes* from all other North American Tortricidae except *Eana* Billberg and the introduced *Cnephasia* Curtis, which have white or tan forewings.

The 2 species groups previously defined on the basis of genitalia characters, wing shape, and seasonal flight period (Obraztsov & Powell 1961, Powell 1964) become less distinctive with the discovery of intermediate forms reported here. *Decodes tonto,* a new species from Arizona, resembles *D. lundgreni* Powell in wing shape and pattern but is a spring flier with genitalic features of the *johnstoni* group. By contrast, *D. catherineae,* a new species described from California, is similar to the *johnstoni* group in wing shape and flight period, but is more like the fall-flying *lundgreni* in genitalia characteristics.

Decodes stevensi and D. macswaini are newly described as summer- and fall-flying species with male genitalia characteristics not closely allied to either of the previously defined groups.

The 4 species recorded from the mainland of Mexico all have been collected in August, and this may correspond to the end of the dry season rather than to life cycle adaptations dictated by winter conditions characteristic of more northern species.

TAXONOMIC CHARACTERS EMPLOYED IN DEFINING SPECIES GROUPS

 Forewing shape: (1) moderately broad (base-to-apex length 2.7-2.9 × width at end of discal cell); (2) moderately narrow (3.0-3.2×); (3) narrow (3.3×).

- 2. Postantennal spurs: short, straight spur of integument on crown behind each antennal socket (1) well developed (FIG. 48); (2) rudimentary (buttonlike); (3) absent.
- 3. Forewing vein R_4 termination: (1) to costa before apex; (2) to apex.
- 4. Hindwing veins $R_s + M_1$: (1) long-stalked (stem nearly 0.5 total length); (2) moderately long-stalked (0.3–0.4); (3) short-stalked (0.15–0.25).
- 5. Hindwing vein 1A: (1) strongly bowed (FIG. 2); (2) weakly bowed; (3) straight.
- 6. *Male genitalia, uncus*: (1) simple (slender, tapered through length); (2) with median, ventral enlargement.
- 7. *Male genitalia, sacculus*: (1) simple (narrow, entirely fused to valva); (2) extended beyond valva margin as inwardly directed, broad flap; (3) extended as posteriorly directed, short process; (4) extended as elongate, curved process.
- Female genitalia, signum: (1) lacking; (2) small, stellate (length 1-3 × width); (3) elongate (5-7 × width); (4) greatly elongate (ribbonlike, extending nearly the length of corpus bursae).
- 9. *Diapause*: (1) pupal in summer and egg in winter; (2) pupal through summer, fall, winter.
- 10. Larval food plant: (1) Fagaceae; (2) Ericaceae; (3) Saxifragaceae.

GROUP I. basiplaganus GROUP

Small to medium sized, forewing length 6.3-10.4 mm; forewing moderately broad to moderately narrow, length $2.7-3.1 \times$ width. Postantennal spurs lacking. Forewing with vein R₄ to costa before apex. Hindwing with R_s and M₁ long-stalked, the stem reaching nearly ½ the total length; 1st A strongly bowed (Obraztsov & Powell 1961: fig. 2). Male genitalia with uncus simple, sacculus not extended beyond valva margin. Female genitalia with signum lacking or small, stellate to 7× longer than wide. Flight in fall; egg diapause in winter, pupal diapause in summer. Food plant: Fagaceae.

Decodes basiplaganus (Walsingham)

FIG. 4, 33, 53, 57, 79-81

Sciaphila basiplagana Walsingham, 1879, Illus. Typ. Lepid. Het. Br. Mus. Part 4: 23. Decodes basiplaganus: Obraztsov & Powell, 1961, J. Lepid. Soc. 14: 116.

Forewing length: ♂, 7.9–9.1 mm (25*n*); ♀, 8.0–9.1 mm (25*n*).

This species is similar to the smaller *D. fragarianus*, differing by having the subbasal band distinctly darker than any other marking on the forewing, preceded by brownish scaling at the base of the costa, whereas the subbasal and median areas normally are concolorous gray in *fragarianus*. As noted under the latter species, the phenotypic difference is not well defined in southwestern areas of sympatry other than California.

Type data. Lectotype & (BMNH), TEXAS, Bosque County, 12.X. 1874, Belfrage.

Geographical distribution. Widespread in the Nearctic, from Massachusetts and Connecticut to South Carolina and westward to southern Ontario, Wisconsin, and Illinois; in the western ½ of the continent, scattered records are available from Texas, Colorado, Arizona, and California (FIG. 79–81).

Taxonomic discussion. The elongate signum, reported from Wisconsin specimens (Powell 1965: 67), evidently is characteristic of populations throughout the eastern

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 $\frac{1}{2}$ of the range. Additional preparations (6*n*) from Ontario, Connecticut, Virginia, and North Carolina are similar to Wisconsin material (5*n*) in this regard, while females dissected from Colorado (1*n*) and Arizona (2*n*) resemble California examples (14*n*) in having a stellate signum not more than $3 \times$ longer than wide.

Recent larval collections in California have confirmed the suspected host plant, Quercus, for D. basiplaganus, but its biology, particularly the relationship with D. fragarianus, is not well understood. Whereas basiplaganus is observed in abundance in various parts of its range (e.g., Connecticut, North Carolina, Wisconsin, Arizona), this species makes up only a small proportion of collections in California, where fragarianus is sympatric. There have been more than 100 collections of the latter species recorded from California (Powell 1964, Opler 1970, present data), but only 10 of basiplaganus, of which 5 were represented by single individuals. Moreover, basiplaganus is greatly outnumbered by fragarianus when the two fly together, ranging from 5:18 at Orinda in 1961 to 2:130 taken at light in Walnut Creek in 1961 (Powell 1964: 138). The 1961–1965 collections at Walnut Creek were made in proximity to Quercus douglasii, and in 1966-1972 samples were taken at another site, 4 airline km to the south, in association with Q. lobata. Here basiplaganus was relatively more numerous (16:108) in a black light trap, but was not obtained from 5 larval collections made between late March and early May in 1967, 1968 and 1972, from Q. lobata (15n fragarianus reared). A sample of adults by black light trap during 1968 revealed no indication of seasonal displacement in flight period, as follows (fragarianus $\partial: \varphi$ /basiplaganus &: \$\varphi\$): 16,17.IX, 16:6/1:0; 21,23.IX, 5:2/1:4; 24,27.IX, 13:6/2:0; 19,27.X, 8:2/0; and 22.XI, 0:1/0.

In collections of more than 1 individual, *D. basiplaganus* has been taken only once in California in the absence of *D. fragarianus*, namely, a series collected at black light near Stockton, San Joaquin County, in October 1974. The site has *Quercus lobata*, the dominant oak of the Central Valley, growing with an isolated stand of *Q. agrifolia* on the periphery of its range, along a slough now in an urban setting. We made a small collection of larvae there in April 1976 from *Q. lobata*, and only *basiplaganus* was reared (2n, 76D6). However, it appears that this is an isolated population of the species which has colonized in absence of *fragarianus* rather than a displacement of the latter in the Upper Sonoran zone or in austral conditions generally. A larger collection of *Decodes* larvae was made from *Q. lobata*, about 5 km to the north on the same day and only *fragarianus* was reared (22n, 76D12).

The only other host plant record for *D. basiplaganus* results from 1 individual reared along with 4 *fragarianus* from aberrant *Q. agrifolia* in Alameda County, in 1974 (74D33). At the same site *fragarianus* was reared from typical *Q. agrifolia* and *Q. douglasii* (11n; 74D34, 74D35). The tree which was the source of the *basiplaganus* is a shrubby form with more serrate, smaller leaves, both juvenile and mature, and earlier seasonal flowering and foliation than nearby typical *Q. agrifolia*. The collections were repeated in late April and mid May 1975, and *fragarianus* was reared from all 3 oaks (48n; 75D19, D26, D28, 75E16, E24), but no *basiplaganus* was obtained.

The data suggest that where the 2 *Decodes* are in sympatry, using the same larval food resource, the more widespread *basiplaganus* is at a disadvantage, and its abundance is greatly reduced or the species is eliminated, by competitive displacement. Where *basiplaganus* occurs alone, it develops abundance levels comparable to those reached by *fragarianus* in California.

Specimens examined. CANADA. ONTARIO: Leeds Co., Chaffey's Locks, 31.VII-29.VIII.1969, P. Herbert & P. Ward; Carleton Co., 3 km E of Dunrobin, 26-28.VIII. 1976, mercury vapor light, E. Munroe & Powell; Frontenac Co., Glenburnie, 9-20.VIII.1969, R. Harmsen; Hastings Co., Marmorea, 16.VIII.1952, J.F. McAlpine; Toronto, 4.VIII.1935, S.H. Parish. QUEBEC: Lac Mondor, Ste. Flore, 6-10.IX.1951, E. Munroe. USA. ARIZONA: Mohave Co., "Sept. 8-15, Sept. 16-23, Oct. 16-23"; Santa Rita Mts, Madera Canyon, 13-28.X.1959, Franclemont & Hodges. CALIFOR-NIA: Alameda Co., Patterson Reserve, Del Valle Lake, 29.IV.1974, r.f. Quercus ?agrifolia, emgd. by 13.X.1974 (JAP 74D34); Contra Costa Co., Walnut Creek (San Ramon Crk at S. Pacific RR), 9-23.X.1966, 8-10.IX.1967, 16-24.IX.1968, at light, Powell; San Joaquin Co., Stockton (5 Mi. Creek), 2.X.1974, K. Brown & M. Croce; same locality, 14.IV.1976 (larvae), r.f. Quercus lobata, emgd. 7-29.IX.1976 (JAP 76D6); Tulare Co., 9.6 km (6 mi) N of Springville, N fork Tule Riv, 550 m (1800'), 11.X.1977, R.J. Ford. COLORADO: Montezuma Co., Morfield Camp, Mesa Verde Natl. Park, 2440 m (8000'), 3.VIII.1967, Rentz; Gunnison Co., Waunita Hot Springs, N of Doyleville, 2700 m (8850'), 1.VIII.1964, H.B. Leech; Saguache Co., Valley View Spring, 11.2 km (7 mi) E of Mineral Hot Springs, 2600 m (8500'), 13.VIII.1965, Leech. CONNECTICUT: New Haven Co., Prospect, 12-22.IX.1966, black light, C.W. O'Brien. MASSACHUSETTS: Martha's Vineyard, "IX-5, IX-8" [determined as "Tortricodes fragariae" Bsk. by A.E. Brower, 1939, and recorded by Jones & Kimball (1943) as T. fragariana from this locality]. MICHIGAN: Gratiot Co., 19.VIII.1955, R.W. Hodges. MINNESOTA: St. Paul, 4.IX.1929, N. Criddle. N CAROLINA: Macon Co., Highlands, 1180 m (3865'), 30.VIII-9.IX.1958, Franclemont & Hodges. S CARO-LINA: Oconee Co., Cherry Hill Rec. Area, Rte 107, 610 m (2000'), 5.IX.1958, Franclemont. UTAH: Utah Co., Timpanogos Mt Campgr., 2140 m (7000'), 27.VII.1977, at light, J. Powell & E. Randal. VIRGINIA: Alexandria, 24.IX.1970, at light, Powell. W VIRGINIA: Pendleton Co., Smoke Hole Camp, 8.IX.1968, O.S. Flint.

Decodes fragarianus (Busck)

FIG. 5, 34, 54, 79–81

Tortricodes fragariana Busck, 1919, Proc. Entomol. Soc. Wash. 21: 52. Decodes fragarianus: Obraztsov & Powell, 1961, J. Lepid. Soc. 14: 115.

Forewing length: ♂, 6.3–8.0 mm (>200n); ♀, 6.5–8.4 mm (>200n).

This species occurs in British Columbia and the Pacific coastal and southwestern states, where it is broadly sympatric with the phenotypically and biologically similar *D. basiplaganus* (FIG. 79–81). In California the two occur in close sympatry and are distinguishable on the basis of forewing color pattern; *fragarianus* varies from nearly



FIG. 4–9. Male genitalia of *Decodes*, ventral aspect, valvae spread, aedeagus shown to right, lateral aspect. **4**, *D*. basiplaganus; **5**, *D*. fragarianus; **6**, *D*. montanus; **7**, *D*. catherineae; **8**, *D*. macswaini; **9**, *D*. stevensi.

uniform gray to gray with whitish, submedian transverse band and tornal blotch, while the larger *basiplaganus* has a brownish tinge at the base of the costa and a blackish subbasal band which is darker than the median band. In strongly marked individuals of *fragarianus*, the gray subbasal and median bands are of about the same hue. Although variation in characters has been noted (Powell 1964: 132), the differences in genitalia, especially the aedeagus (FIG. 4, 5) and ductus bursae (FIG. 33, 34), are constant at the individual level, distinguishing the 2 species.

Elsewhere in the southwest, the ranges of *D. fragarianus* and *D. basiplaganus* broadly overlap in Colorado, Utah, New Mexico, and Arizona, but generally populations appear to be mutually exclusive in a mosaic pattern (FIG. 80). The 2 *Decodes* have been collected at nearby sites in Utah (Provo in 1911–1912 and Timpanagos Mt in 1977) and in Arizona (Prescott, pre-1920 and 8 km (5 mi) N of Prescott in 1973) and both are represented in material labelled "Mohave Co." (locality or localities unknown) from the Barnes collection (Obraztsov & Powell 1961; present data). Records are too scattered spatially and temporally to document whether the 2 species occur as ecological homologues on the same oaks in these areas. In any case, the Californian phenotypic difference in color is not maintained; the forewing in both tends to be pale gray with the subbasal band conspicuously darker (FIG. 57), resembling California *basiplaganus*, as noted earlier for Utah *fragarianus* (Powell 1965: 66). By contrast, allopatric *basiplaganus* of the eastern Nearctic generally are characterized by large size, darker gray and blackish transverse bands.

Biological interrelationships between *D. fragarianus* and *D. basiplaganus* are discussed under the latter species. In California, where the 2 are in close sympatry, *basiplaganus* evidently is nearly eliminated by competitive exclusion and is always rare in population samples. This relationship in numerical density is not expressed in collections from other southwestern states where geographical ranges of the 2 *Decodes* overlap.

Type data. Lectotype ♂ (NMNH), CANADA: BRITISH COLUMBIA, Victoria.

Geographical distribution. Pacific states from southern British Columbia to southern California and the Rocky Mountain states from Utah and Colorado to northern New Mexico (FIG. 79–81).

Flight period. June to November (primarily September and October).

Host plants. Various species of Quercus (Fagaceae), including Q. agrifolia, wislizenii, kelloggii, lobata, douglasii, and turbinella (Opler 1970, 1973).

Recent data. The biology, which was described elsewhere (Powell 1964, 1965), has more recently been further investigated, particularly with regard to host range. Evergreen and deciduous oaks, exclusive of the section *Protobolanus*, are used (Opler 1973). The name *fragarianus* was based on the original series which was bred from "crowns of strawberry" in British Columbia. The misnomer can only be explained by the supposition that larvae from nearby oaks were found pupating in the soil of strawberry fields.

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Although the vast majority of *fragarianus* have been collected between late August and early November, sometimes specimens, including mated females, are active in June (Powell 1965: 66). Such records seem to indicate a short diapause, of 40–60 days. In recent material, however, there are 2 specimens from Monterey Co., Arroyo Seco, California, collected in late May. This suggests that diapause may be facultatively eliminated on rare occasions, since larvae were taken in the same area on 5 May, on *Quercus douglasii* (JAP 75E5).

Specimens examined. USA. ARIZONA: Yavapai Co., 8 km (5 mi) N of Prescott, 1670 m (5450'), 27.IX.1973, L.M. Martin. CALIFORNIA: Alameda Co.: Berkeley Hills, 430 m (1400'), 5.X.1971, 27.IX.1973, 16.X.1974, assoc. Quercus agrifolia, J. Powell; Patterson Reserve, Del Valle Lake, 19.IV.1974, r.f. Q. douglasii, emgd. by 13.X.1974 (JAP 74D33), 19.IV.1974, r.f. Q. agrifolia (atypical), emgd. 9.VI.1974, by 13.X.1974 (JAP 74D34), r.f. Q. agrifolia, emgd. 3-9.VI.1974, by 13.X.1974 (JAP 74D35), 30.IV.1975, r.f. Q. douglasii, emgd. 19.X-9.XI.1975 (JAP 75D19), 30.IV.1975, 15.V.1975, r.f. Q. agrifolia (atypical), emgd. 16.VI.1975, X.1975, 9.XI.1975 (JAP 75D26, 75E16), 30.IV.1975, 15.V.1975, r.f. Q. agrifolia, emgd. 3.VII.1975, 14.IX-25.X.1975 (JAP 75D28, 75E24); Contra Costa Co.: Walnut Creek (San Ramon Crk at S. Pacific RR), 27.III.1972, r.f. Q. lobata, emgd. VIII.1972 (JAP 72C20), 11.IV.1972, r.f. Q. lobata, emgd. 22.IX.1972 (JAP 72D7); Richmond, 8.X.1966, A.J. Slater; Lake Co., Lakeport, 20-22.X.1967, on Quercus, P.A. Rude; Los Angeles Co.: Topanga, 4.XI.1958, H. Notman; Monterey Co.: Arroyo Seco, Santa Lucia Mts 215-305 m (700-1000'), 28-31.V.1976, J.P. Donahue; Wiley Ranch, 9.6 km (6 mi) W of Greenfield, 5.V.1975, r.f. Q. douglasii, emgd. by 19.X.1975 (JAP 75E5); Riverside Co., Bundy Canyon, 27.VI, 2.IX-23.XI.1974-1977; San Bernardino Co.: Lytle Crk, 1040 m (3400'), 21–22.IX.1973, Donahue; Camp O-onogo nr Running Spring, San Bernardino Mts, VIII.1974, C.L. Hogue; San Diego Co., Vista, 22.VIII-19.X.1974-1976, 12.VI-1.VII.1977, R.J. Ford; Santa Barbara Co.: 3.2 km (2 mi) W of Los Prietos, 7.IX.1969, at light, Opler & Powell; U.C. Biol. Stn. HQ, Santa Cruz Is, 14.VIII.1968, 30.X.1972, C.L. Remington, 26-27.IX.1978, at light, Powell; Santa Clara Co., Los Gatos, 14.IX.1971, W.E. Ferguson; Sonoma Co., Monte Rio, 17.IX-16.X.1967, J.T. Doyen; Stainslaus Co., Stockton, 8 Mi. Rd., 15.IV.1976, r.f. Q. lobata, emgd. 31.VII-25.IX.1976 (JAP 76D12); Tulare Co., 9.6 km (6 mi) N of Springville, N fork Tule Riv, 550 m (1800'), 26.VII.1975, Ford. COLORADO: Douglas Co., Cherry Crk, Franktown, 1900 m (6500'), 18.IX.1970, R.L. Leuschner. NEVADA: Nye Co., Nevada Test Site, Ranier Mesa, 12-14.VIII.1964, Ferguson. NEW MEXICO: Sandoval Co., 9.6 km (6 mi) E of Jemez Spring, 17.VIII.1965, black light, J.T. Doyen. OREGON: Benton Co., McDonald Forest, 8 km (5 mi) NW of Corvallis, 150 m (500'), 9.IX.1962, UV light, N. McFarland; Josephine Co., Grants Pass, 18.VIII.1965, black light trap, K. Goeden; Polk Co., Independence, 24.VIII.1934, N.F. Larson.

Decodes montanus Powell, 1961, J. Lepid. Soc. 14: 118.

Forewing length: 3 8.7-10.1 mm (10n); 9.1-10.4 mm (20n).

This California species resembles *D. basiplaganus* but is larger and paler with a more strongly contrasting, dark subbasal band on the forewing. The female possesses large genital tufts of dark purple scales. As noted, there is variation in the latter and in distinguishing genitalia characters (Powell 1964: 132), and recent data for *montanus* indicates this species is a high elevation ecological counterpart of *basiplaganus*.

Type data. Holotype ♂ (CAS), CALIFORNIA: Los Angeles Co., Mt Lowe, 18.IX.1925, E. Piazza.

Geographical distribution. Mountains of California and western Nevada. *Flight period.* August to early October.

Food plant. Quercus vaccinifolia × chrysolepis (Fagaceae).

A rearing from the above hybrid oak at Incline Village, Nevada, led Opler (1973: 6) to suppose that both oak species are used, a notion supported by the moth's distribution, which extends beyond the range of *Q. vaccinifolia*, in the central Coast Ranges. These *Quercus* species both belong to the Section *Protobalanus*, members of which are not used by *D. fragarianus* (Opler 1973) and *basiplaganus* (present data). Thus, *montanus* appears to be ecologically allopatric.

Specimens examined. USA. CALIFORNIA: Placer Co., Ward Creek, 3.2 km (2 mi) S of Tahoe City, 1δ , 1.IX.1974, N. Westerland; Fresno Co., Grade W of Portal Forbay, 2540 m (8300'), 6.4 air km (4 mi) W of Mono Hot Springs, 1δ , 1.IX.1971, flight trap, H.B. Leech; Madera Co., SE slope Green Mt, 2320 m (7600'), 6.4 air km (4 mi) NE of Clover Mdw. Guard Stn., $1\circ$, 18.VIII.1971, flight trap, Leech; Marin Co., Mill Valley, $1\circ$, 1–15.IX.1966, T.W. Davies; Plumas Co., Spencer Lakes Rd, 12.8 km (8 mi) SW of Johnsville, $1\circ$, 11.VIII.1961, J.S. Buckett; Johnsville, $2\circ$, 2.X.1966, 10.IX.1967, H. Pini; Trinity Co.: 6.4 km (4 mi) NW of Weaverville, $1\circ$, 30.VIII.1967; Trinity Alps, $1\circ$, 30.VIII.1967, I. Baker; Tulare Co., Sequoia Natl. Park, Buckeye Flat Campgr., $1\circ$, 15.IX.1968, at light, Opler. NEVADA: Washoe Co., 6.4 km (4 mi) SE of Incline Village, $1\circ$, 30.VI.1968, r.f. Quercus vaccinifolia × chrysolepis, emgd. 22.VIII.1968, Opler (JAP 68F111).

Decodes lundgreni Powell

FIG. 63, 64

Decodes lundgreni Powell, 1965, Proc. Biol. Soc. Wash. 78: 67.

Forewing length: δ , 8.9–10.4 mm (>50*n*); \circ , 8.5–9.3 mm (15*n*).

This is a fall-flying *Decodes* with narrow forewings having a conspicuous outer costal triangle that is particularly dark in the female. The male genitalia resemble *D. montanus*, with the fultura superior narrower and proportionally smaller, the sacculus

FIG. 6, 35, 55

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with a short free tip. The female genitalia are similar to *D. macswaini*, with the antrum simple, relatively smaller, the signum elongate.

Type data. Holotype ♂ (CAS), CALIFORNIA: Tuolumne Co., Twain Harte, 4.X.1963, M. Lundgren.

Geographical distribution. Known only from the type-locality. *Flight period.* September and October.

Food plant. Unknown.

GROUP II. catherineae GROUP

Moderately large, forewing length 10.8–12.7 mm; forewing moderately narrow, length $3.1-3.2 \times$ width. Postantennal spurs rudimentary. Forewing with vein R₄ to costa before apex. Hindwing with R_s and M₁ long-stalked; 1st A moderately bowed. Male genitalia with uncus enlarged in middle, sacculus not extended beyond valva margin. Female genitalia with signum greatly elongated, nearly the length of corpus bursae. Flight in spring (diapause in summer and winter by pupa presumed). Food plant unknown.

Decodes catherineae Powell, new species

FIG. 7, 36, 65–67

This spring-flying species possesses elongate narrow forewings which are variable in gray and white patterns.

2. Length of forewing 10.8-12.4 mm (6n). Head. Crown strongly produced, postantennal spurs represented by stubs (2n). Labial palpus moderately elongate, II segment length 1.05 eye diam., III 0.5 as long as II; scaling appressed, pale whitish gray, peppered with darker scaling exteriorly, white ventrally, of crown roughened, gray, the scales broadly frosted with white. Thorax. Dorsal scaling concolorous with head, ventral shining whitish, legs speckled with gray. Forewing. Elongate, length 3.15-3.20 × width, costa more strongly curved in basal ½. Ground color gray, pattern of white and black variable, resulting in different forms: (a) (holotype, FIG. 65) a broad pale gray, transverse band from costa at 1/2 broadening to include basal ¹/₂ of dorsal margin, defined inwardly by a narrow, curved, black, subbasal line and outwardly along a sharply defined, irregular line by dark gray shading, changing to pale gray beyond cell; (b) the same pattern largely washed out, indistinct; or (c) indistinctly indicated with thin, irregular transverse striation; and (d) the same basic pattern, sharply contrasted whitish and blackish so that submedian and postmedian transverse white bands appear on a dark background (FIG. 66). Underside nonvariable, gray with a whitish patch at midbase and pale costal streaks. Hindwing. About 1.1 broader than forewing. Color whitish to gray, slightly darker towards margin. Fringe paler. Underside whitish, irregularly speckled in costal area and along veins with gray. Abdomen. Basal segment whitish dorsally, the remainder gray, paler ventrally. Genitalia as in FIG. 36 (drawn from paratype, Devils Punchbowl, JAP prep. no. 2552, 4n); sterigma narrow, bowl-shaped, unmodified; ductus bursae without sclerotization, signum elongate, broadened distally.

δ. Length of forewing 12.3–12.7 mm (4n). Essentially as described for \mathcal{Q} . In the short series available there is 1 individual of the pale form which has extensive black scaling between the veins, producing parallel longitudinal lines, especially beyond the cell. One δ is of the dark and pale-banded form; none closely resembles the holotype in forewing pattern; the allotype is a worn individual of the pale form. Genitalia as in Fig. 7 (drawn from allotype, JAP prep. no. 1761; 2n); similar to *D. lundgreni*; uncus with a median enlargement, more pronounced in lateral view; fultura superior broader, socii longer, than in the *basiplaganus* group.

Holotype \mathcal{P} , USA. CALIFORNIA: Tulare Co., 3.2 km (2 mi) E of Johnsondale, 2.V.1964, C.A. Toschi; allotype \mathcal{S} , CALIFORNIA: Tulare Co., 14.4 km (9 mi) S of Fairview, 30.IV.1964, J. Powell. Holotype and allotype deposited in CAS on indefinite loan from UCB. Paratypes (8): USA: CALIFORNIA: $1\mathcal{P}$, same data as holotype, J. Powell; Los Angeles Co., Devils Punchbowl, 2.4 air km S of Valyrmo, $2\mathcal{P}$, 1.V.1968, at light, J.A. Chemsak, P.A. Opler, & J. Powell; 4 km (2.5 mi) SSW of Valyrmo, 1470 m (4800'), 19, 16.I.1964, 23,19, 17.III.1964, 13, 13.IV.1964, N. McFarland (LACM, NMNH, UCB).

Three additional specimens were subsequently examined, but not designated as paratypes: CALIFORNIA: Riverside Co., 1δ , Bundy Canyon, 14.4 km (9 mi) S of Perris, 25.II.1975, R.J. Ford; 1δ , 1φ , Tulare Co., Scotie Meadow, 1960 m (6400'), 25.IV.1975, J.P. Donahue (LACM). The males are slightly larger (FW length 12.8 mm), and the Bundy Canyon specimen is of a different color form, having the forewing dark gray with a black subbasal band on the costal $\frac{1}{2}$, followed by a pale submedian band, so that the wing pattern resembles that of *D. basiplaganus*.

This species is peculiar in that it resembles the *johnstoni* group in size, narrow wings, and spring flight and by its polymorphism, which is paralleled only by *johnstoni* among described *Decodes*. However, the genitalia characters of *catherineae* are most similar to *lundgreni*, a fall-flying species which also occurs at intermediate elevations in the Sierra Nevada.

The species is named for Catherine A. (Toschi) Tauber of Ithaca, New York, who collected the holotype as well as many other interesting microlepidoptera when she worked with the California Insect Survey. She obtained the type while beating *Quercus*, which is a likely host plant for the species. The allotype was netted at dusk in a similar habitat, 19 air km south of the type-locality.

GROUP III. macswaini GROUP

Medium sized, forewing length 7.3–9.8 mm; forewing moderately broad to moderately narrow, length 2.7–3.1 \times width. Postantennal spurs lacking. Forewing venation with R₄ to costa before apex. Hindwing venation with M₁ slightly bent downward, M₂ slightly bent upward, 1st A nearly straight. Male genitalia with uncus simple, sacculus extended beyond valva as an inwardly directed flap. Female genitalia with signum greatly elongated, nearly the length of corpus bursae. Flight in summer; diapause unknown. Host plants unknown.

Decodes macswaini Powell, new species FIG. 8, 37, 68

This is a summer- and fall-flying species with many transverse striae on the forewings.

3. Length of forewing 8.2–9.6 mm (9n). *Head.* Labial palpus short, II segment 0.80–0.85 as long as eye diam., III about 0.55–0.60 as long as II; scaling dark gray, frosted with whitish tips. Scaling of front and crown the same. *Thorax.* Dorsal scaling dark gray, the scale tips whitish, more broadly so in 2 broad, transverse bands across the notum. Underside shining whitish, prolegs dark gray exteriorly, meso- and metalegs whitish speckled with gray. *Forewing.* Moderately broad, length 2.7–3.0 × width. Ground color gray, variably overlaid with whitish and crossed by many parallel, outwardly curved, transverse black lines; white tending to be concentrated in a broad submedian transverse band that is bordered and accented by slightly stronger black lines, the band sometimes infuscated above lower fold, forming a dorsal blotch of whitish; a dark shade usually follows the pale band, ending before distal end of cell, grayish white beyond. Underside gray. *Hindwing.* Slightly broader than forewing. Ground color pale gray, becoming darker towards margin. Fringe whitish gray. Underside pale gray heavily mottled with dark gray. *Abdomen.* Scaling dark gray, paler and shining ventrally. Genitalia as in Fig. 8 (drawn from paratype, The Basin, Texas, JAP prep. no. 3401, 4n); similar to *bicolor* Powell, socii smaller, fultura superior bluntly rounded, distal end of sacculus with broad, round flap; aedeagus elongate, strongly bent downward.

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 \bigcirc . Length of forewing 8.6–9.8 mm (8*n*). Essentially as described for \eth ; forewing slightly broader, length 2.7–2.8 × width; colors darker, especially hindwing; forewing pattern well defined owing to darkening of transverse black lines as well as whitish areas. Genitalia as in FiG. 37 (drawn from paratopotype, JAP prep. no. 3958, 2*n*); similar to *bicolor*, ductus bursae with a sclerotized patch near distal junction to corpus bursae.

Holotype \mathcal{J} and allotype \mathcal{Q} , MEXICO: Nuevo Leon, 4.8 km (3 mi) E of Galeana, 7–9.VIII.1963, Duckworth & Davis (NMNH). Paratypes (15). MEXICO: same data, 5 \mathcal{J} , 5 \mathcal{Q} ; Nuevo Leon, 6.4 km (4 mi) W of Iturbide, 1680 m (5500'); 1 \mathcal{Q} , 25.IX.1975, 1 \mathcal{Q} , 14.IX.1976, black light, Chemsak & Powell. USA: TEXAS: The Basin, Big Bend Natl. Park, 1 \mathcal{J} , 5.X.1956, J.W. MacSwain; Green Gulch, Big Bend Natl. Park, 1 \mathcal{J} , 9.X.1969, A. & M.E. Blanchard; LOUISIANA: Calcasieu Co., Sam Houston St. Park, 1 \mathcal{J} , 13–14.VIII.1963, Duckworth & Davis (AB, NMNH, UCB).

The species is dedicated to the late J. W. MacSwain, an insect biologist of diverse interests, who collected the first known specimen.

Decodes stevensi Powell, new species

FIG. 9, 58

This is a small, pale species, having whitish forewings strigulated with dark gray, and having strongly contrasting but poorly defined pre- and post-median bands.

δ. Length of forewing 7.3–7.7 mm (excluding fringes) (10*n*). *Head.* Labial palpus short, II segment length about 0.8 eye diam., III 0.55 as long as II; scaling of basal segment broadened, whitish, of II–III closely appressed, dark gray tipped with white. Scaling of crown white centrally, gray laterally, tipped with white. *Thorax.* Dorsal scaling pale gray, speckled with darker gray; underside shining pale gray. *Forewing.* Length 2.9–3.1 × width; outline similar to *D. fragarianus,* narrower, costa gently arched, termen nearly evenly rounded from apex. Whitish, strigulated with numerous transverse, incomplete striae; 2 variable, moderately well-defined bands from costa ending just beyond Cu fold before dorsal margin; the 1st at inner $\frac{1}{3}$, the 2nd at middle of costa angled outward, its inner margin either straight or sinuate, bent outward in cell, inward below middle of cell. The markings damaged in all available specimens but apparently variable in extent, distinctness, and form more so than in most *Decodes.* Fringes lost. Underside pale gray. *Hindwing.* Broader than forewing; pale gray, slightly darker towards margins. Fringes whitish gray. Underside whitish to pale gray. *Abdomen.* Dorsal and ventral scaling dark gray (probably discolored in available material). Genitalia as in Fig. 9 (drawn from paratype, JAP prep. no. 4302, 4*n*); resembling *macswaini* in general form, with a smaller inwardly-turned flap at end of sacculus, and bearing a row of 4 or 5 elongate spines of various sizes on distal, lower margin of sacculus.

♀. Unknown.

Holotype 3, USA: COLORADO: Larimer Co., Owl Canyon, 12 km NW of Ft. Collins, VI.1977, R.E. Stevens (Hopk. U.S. 3690-5 B). Paratypes: 133, same data as holotype, V. & VI.1977. The series was taken in a pheromone trap baited with Z-9 dodecenyl-ol acetate, a known attractant for *Eucosma sonomana* Kearfott. Holotype deposited in NMNH, paratypes in NMNH, UCB, and USFS(RM).

In size and general appearance this species resembles members of the *basiplaganus* group, but the genitalia appear to be most similar to *D. macswaini*. The large spines on the distal rim of the sacculus are unique within the genus. R. E. Stevens, who has produced considerable interesting data on a variety of microlepidoptera, states (in litt.) that the species was taken in large numbers (150+) during June 1–16 in traps placed in a nearly pure stand of pinyon pine (*Pinus edulis*). This appears to be the

first record of a cnephasiine tortricid responding to a sex attractant of any species of Olethreutinae.

GROUP IV. johnstoni GROUP

Moderately large, forewing length 9.8-11.9 mm; forewing moderately narrow, length $3.0-3.1 \times$ width. Postantennal spurs rudimentary, stubs or buttonlike. Forewing with vein R_4 to costa just before apex. Hindwing with veins R_s and M₁ moderately long-stalked, stem about ¹/₃ total vein length; 1st A slightly bowed. Male genitalia with uncus simple, sacculus extended beyond valva as a posteriorly directed process. Female genitalia with signum elongate, more than ¹/₂ the corpus bursae length. Flight in early spring; diapause in summer and winter by pupa. Host plant: Ericaceae (1 species).

Decodes johnstoni Powell

1980

Decodes johnstoni Powell, 1961, J. Lepid. Soc. 14: 119.

Forewing length: δ , 10.2–10.7 mm (5*n*); \Im , 9.8–11.0 mm (15*n*).

This species has gray forewings marked by variable whitish dusting, sometimes contrasting with partially developed darker transverse markings. Thus the genital characters are necessary for accurate identification.

Type data. Holotype ♂ (CNC), CALIFORNIA: Napa Co., Mt St. Helena, 7.III.1940, E.C. Johnston.

Geographical distribution. North coastal California to Baja California, Norte.

Flight period. Early March to early April.

Food plant. Unknown.

Recent data. Two worn females taken near Ensenada, Baja California, in March 1964 match typical specimens closely in genital structure. This tends to confirm the suspicion that the females from Pine Valley, San Diego County, which differ in sterigma form (Powell 1964: 141) represent an undescribed species. Moreover, 2 additional worn females from Las Arrastras, Baja California [320 km (200 mi) S of Ensenada], taken in November by D. Patterson, probably are still another species. These specimens are slightly smaller (FW 9.0 mm) and appear to possess a somewhat more mottled forewing pattern. Although the sterigma structure is similar to that of *johnstoni*, the fall flight suggests that when males in better condition become available, distinctive species characters will be shown.

Specimens examined. USA: CALIFORNIA: Marin Co., Mill Valley, 110 m (360'), 19, 19–23.IV.1966, P.H. Arnaud. Mendocino Co., N California Coast Redwood Preserve, 8 km (5 mi) N of Branscomb, 19, 17.V.1975, black light trap, J. Powell. MEX-ICO: 8.3 km (5.2 mi) NE of Ensenada, Baja Calif., 29, 24.III.1964, M.E. Irwin, J.C. Ball.

Decodes bicolor Powell

Decodes bicolor Powell, 1961, J. Lepid. Soc. 14: 122.

Forewing length: δ , 11.5–11.6 mm (3*n*); \Im , 10.1–11.9 mm (20*n*).

The forewing pattern, white on costal ¹/₂, dark gray on dorsal ¹/₂, is relatively nonvariable and distinctive from other Decodes.

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FIG. 11, 39, 70

FIG. 10, 38, 69



FIG. 10–14. Male genitalia of *Decodes*, ventral aspect, valvae spread, aedeagus shown to right, lateral aspect. **10**, *D. johnstoni*; **11**, *D. bicolor*; **12**, *D. aneuretus*; **13**, *D. tonto*; **14**, *D. asapheus* (aedeagus not shown), paratype Hastings Reserv., California.

Type data. Holotype & (NMNH), CALIFORNIA: Napa Co., Mt St. Helena, 18.IV.1939, E.C. Johnston.

Geographical distribution. Foothills of mountains from central Oregon to southern California.

Flight period. Mid March to early June. There is a record for the end of August in the central Sierra Nevada that may be a label error.

Food plant. Unknown.

Specimens examined. CALIFORNIA: Placer Co., Ward Crk, 3.2 km (2 mi) S of Tahoe City, 1844 m (6050'), 1, 1, 11.VI.1975, N. Westerland; Los Angeles Co., 4 km (2.5 mi) SSW of Valyrmo, 1462 m (4800'), 1 δ , 7.IV.1964, black light, N. McFarland; Tuolumne Co., Twain Harte, 1219 m (4000'), 1 δ , 4.IV.1964, S.M. Potter & M.R. Lundgren. OREGON: Deschutes Co., 8.0 km (5 mi) SW of Bend, 1, 2, 28.V.1964, black light trap, K. Goeden.

Decodes aneuretus Powell

Decodes aneuretus Powell, 1961, J. Lepid. Soc. 14: 121.

Forewing length: 3, 9.9-10.7 mm (2n); 9, 10.2 mm (1n).

This dark gray moth has the forewings marked by a faint, pale, antemedian, oblique band offset by rows of upraised black scales. It was known only from the type specimens collected before the turn of the century prior to the larva having been discovered on *Arctostaphylos* in Marin County, California in 1973. The Inglenook Fen Association suggested use of *Gaultheria* (Ericaceae) as a food plant.

Type data. Holotype & (AMNH), CALIFORNIA: Monterey Co., Carmel, IV.[no year], A.H. Vachell.

Geographical distribution. North and central coastal California.

Flight period. April, May.

Food plant. Arctostaphylos virgata (Ericaceae).

Specimens examined. USA: CALIFORNIA: Marin Co., Inverness Ridge, 3.2 km (2 mi) SE of Inverness, 320 m (1040'), 13, 11.V.1973, r.f. Arctostaphylos virgata, emgd. 18.I.1974 (JAP 73E10); Mendocino Co., Inglenook Fen, 8 km (5 mi) N of Ft. Bragg, 13, 7.V.1976, J. Powell.

Decodes tonto Powell, **new species**

This species resembles *D. lundgreni* in forewing pattern but is a spring flier with genitalia structure related to the *johnstoni* group.

 $\[Gamma]$. Length of forewing 9.6 mm (2n). *Head*. Crown protuberant, postantennal spurs absent (1n). Labial palpus moderately elongate, segment II 1.0 eye diam., III about 0.6 eye diam. Front smooth-scaled, crown scaling spreading; scales of palpi, antennae, and head gray frosted with white tips, palpi exteriorly and crown darker. *Thorax*. Dorsal scaling concolorous with head; metanotum with sparse, tan scale brushes. Venter shining whitish; pro- and mesolegs concolorous with dorsal scaling, metaleg whitish. *Forewing*. Narrow, length about 3.1 × width; costa flattened toward middle, apex acute, pointed. Ground color dark gray, an indistinct whitish pattern defines a large, dark costal triangle from before middle nearly to apex, extending well beyond Cu margin of cell. Underside dull brownish gray, the fringes reproducing the saltand-pepper effect of upperside. *Hindwing*. Slightly broader than forewing; costa slightly convex; apex acute, termen slightly concave. Venation as in *fragarianus* except r-m crossvein reduced to a trace and 1st A straight, not bowed upward towards Cu. Pale gray, slightly darker along veins and at margin. Fringe whitish. Underside whitish mottled with gray along costal area and on veins. *Abdomen*. Dorsal scaling gray, genital and ventral whitish. Genitalia as in Fig. 42 (drawn from allotype, JAP prep. no. 2852, 1n); similar to *johnstoni* and *bicolor*, sterigma broader, short, ductus bursae slightly sclerotized distally, signum elongate, extending onto ductus bursae.

 δ . Length of forewing 11.0 mm (1*n*). Essentially as described for Ŷ, the single known δ worn, lacking most of the whitish scaling that defines the wing pattern. Labial palpus slightly more elongate. Hindwing

FIG. 12, 41

FIG. 13, 42, 71

paler, mostly whitish. Genitalia as in FIG. 13 (drawn from holotype, JAP prep. no. 2851, 1n); similar to *johnstoni*, lateral margins of fultura superior tapered, outline more V-shaped, costa of valva and sacculus less sinuate; aedeagus evenly curved as in *fragarianus*.

Holotype δ and allotype \Im , USA: ARIZONA: Miami-Superior Hiway, Pinal-Gila Co. line, 1460 m, (4790'), 1–15.IV.1925, O.C. Poling (NMNH); paratype, 1 \Im , same data (UCB).

GROUP V. horarianus GROUP

Moderately large, forewing length 9.3–12.2 mm; forewing moderately broad to narrow, length 2.7–3.3 × width. Postantennal spurs rudimentary to well developed in \mathcal{F} (FiG. 48), lacking to rudimentary in \mathcal{P} . Forewing with vein R_4 to apex. Hindwing with $R_s + M_1$ short-stalked, stem ¹/₆ to ¹/₄ total vein length; 1st A straight (FiG. 2). Male genitalia with sacculus extended as an elongate, curved process, exceeding the valva by its width or more. Female genitalia with signum an elongate row of minute spurs or reduced to a trace. Flight in fall; diapause in winter by egg, in summer by pupa. Food plant: Saxifragaceae.

Specimens representing populations previously assigned to *Decodes horarianus* (Walsingham) represent a number of species, judging from differences in morphology. On the basis of material from scattered locations, I concluded that considerable geographical variation exists (Powell 1964), but only 1 male specimen was available from western North America. During the interim additional material has accumulated, including reared series, so that reevaluation is possible. There are differences, notably in the shape and armature of the aedeagus, between populations from nearly every locality for which I have seen males, while differentiation in female genitalia is less pronounced. External phenotypic features also differ among populations but are individually variable. Thus, the present interpretation must be regarded as provisional.

D. horariana was described from southern Oregon, based on 1 male and 1 female. The type data was erroneously cited, and it seems certain that the specimens were taken a few km SE of Ft. Klamath in September 1871. My identification of the name with present material is based on a comparison of the genitalia slide (BM 7951, δ) of the lectotype and photographs of the types from the Obraztsov file at the AMNH, with 1 male taken near Crater Lake, about 24 km NW of Ft. Klamath and a series of both sexes of the same moth reared from *Ribes* near Ft. Bidwell in northeastern California. These agree in salient features of wing pattern and male genitalia, differing in several respects from series from Ontario, Canada, and Lake Tahoe, King City, and Santa Barbara, California, which are described as new.

Several additional samples from scattered localities in Canada, Colorado, and central and southern California consist of unassociated females or include males in too poor condition to describe.

Decodes horarianus (Walsingham)

FIG. 2, 15–17, 43, 48, 72, 82

Sciaphila horariana Walsingham, 1879, Illus. Typ. Spec. Lepid. Het. Br. Mus. 4: 22. Decodes horarianus: Powell, 1964, Univ. Calif. Publ. Entomol. 32: 143 (in part).



FIG. 15–27. Male genital structures of *Decodes*. **15–17**, *D. horarianus*: **15**, aedeagus (lateral aspect), Crater Lake, Oregon; **16**, distal portion of aedeagus (lateral) and **17**, transtilla of fultura superior, Ft. Bidwell, California. **18–19**, *D. macdunnoughi*, paratype: **18**, distal portion of aedeagus (dorsolateral); **19**, transtilla of fultura superior. **20–22**, *horarianus-macdunnoughi* complex: **20**, aedeagus (lateral), Saskatchewan; **21**, distal portion of aedeagus (lateroventral), British Columbia; **22**, distal portion of aedeagus (dorsal), N.W.T. **23–25**, *D. asapheus*, paratypes: **23**, aedeagus (lateral); **24**, distal end of aedeagus (dorsal); **25**, transtilla of fultura superior. **26–27**, *D. tahoense*, paratypes: **26**, aedeagus (lateral); **27**, distal end of aedeagus (lateral); showing variation in dentation.

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Forewing length: \eth , 11.3 mm (reared) to 12.1 mm (13*n*); \heartsuit , 10.4–11.2 mm (reared) (2*n*).

This large species has 2 distinct transverse bands on the forewing, a darker, outwardly curved one near the base and a median one that is narrowed in the cell, broadened towards costal and dorsal margins, often becoming indistinct towards the dorsal margin. Male genitalia similar to *asapheus*, n. sp. (FIG. 14), aedeagus, transtilla as in FIG. 15–17 (drawn from plesiotypes, JAP prep. no. 3505, Mazama Campground, Oregon, and no. 3497, Ft. Bidwell, California, 6*n*); uncus rather short, socii broad, fultura superior narrowly sclerotized with a broad, median emargination, free end of sacculus broadly curved; aedeagus rather short, curved distally and drawn out into a single, smooth spur well beyond the vesica opening. Female genitalia as in FIG. 43 (drawn from plesiotype, JAP prep. no. 3973, Ft. Bidwell, California, 2*n*); base of ductus bursae enlarged with broad, lateral lobes; signa reduced to a row of tiny spurs.

Type data. OREGON, the type data given by Walsingham, "Crooked River near Fort Klamath, Sept. 21, 1872," is in error; (lectotype 3, bearing the date Sept. 21, 1871, BMNH). The locality actually is Crooked Creek, which extends from about 3– 9 km SE of Ft. Klamath, Klamath County. This was camp 59, September 21–23, 1871 according to the Carrier Diary at the British Museum (Copy at University of California, Berkeley) and Essig (1941). The Walsingham party was not in Oregon in September 1872. During 1871 they travelled along Crooked River in Crook County, Oregon, October 18–31, but there is no indication in the Walsingham-Carrier Diary or in the literature that any moths were collected there.

The lectotype genitalia preparation is flattened, unstained, but otherwise in good condition, with the aedeagus mounted in situ, turned laterally (BM slide 7951; prep. no. 9384, δ , J. Razowski, 1961). The specimen from Crater Lake (JAP prep. 3505) compares well, especially the aedeagus, with the following exceptions: the transtilla is more broadly sclerotized in the type, with a narrower, shallower notch; the spurs on the dorsal surface of the type are less prominent, smaller, and appear to be less extensively distributed. Differences of this magnitude occur among individuals from Ft. Bidwell, which also differ by having slightly longer free extensions of the sacculus than in the 2 Oregon examples, in which the free portion exceeds the membranous portion of the valva by a distance equal to its width.

Geographical distribution. Typical D. horarianus is known only from southern Oregon and extreme northeastern California (FIG. 82). Populations showing characteristics differing from typical horarianus are widespread to the north, according to morphological characters of scattered specimens from Canada, as discussed below under D. macdunnoughi. Records are lacking for the Pacific northwest and northern Rocky Mountain states.

Flight period. Late August, September.

Food plant. Ribes sp. (Saxifragaceae).

Specimens examined. USA: CALIFORNIA: Modoc Co., 3.2 km (2 mi) NW of Ft. Bidwell, 12.VI.1970 (larvae), 123,29, r.f. Ribes, emgd. after VIII.1970 (JAP 70F90).

OREGON: Crater Lake Natl. Park, Mazama Campground, 13, 30.VIII.1969, at light, J. Powell.

Additional material examined. The following represents populations in Colorado which appear to differ from typical horarianus but are represented by too few specimens to permit differentiation. (1) "South Park, Col." (Oslar) [location unknown], 1δ . Forewing 11.5 mm; length $3.1 \times$ width; pattern more closely resembling *D. tahoense*, n. sp. than any other phenotype discussed in the horarianus complex. Genitalia most similar to macdunnoughi, n. sp. (JAP prep. no. 4126) (NMNH). (2) Jefferson Co., 8 km (5 mi) S of Golden, 2140 m (7000'), 2δ , 17.IX.1970, R.H. Leuschner. Forewing length 11.6–12.2 mm; length $3.2–3.4 \times$ width; color pattern similar to tahoense, pale gray, with subbasal band distinct, brown margined with black, but median band paler, nearly obscured; submedian and postmedian pale areas not well defined (slightly worn). Aedeagus with lateral spur, as in Canadian atypical horarianus, but with opposing margin of aedeagus serrate (Fig. 30, 31) (JAP prep. no. 4333) (LACM).

Probably these narrow-winged specimens represent a population which is sufficiently differentiated to warrant nomenclatural recognition when adequate material becomes available for assessment.

Decodes macdunnoughi Powell, new species FIG. 18, 19, 44, 73, 82

Tortricodes horariana: McDunnough, 1933 (not Walsingham, 1879), Can. J. Res. 9: 509.—Powell, 1964 (not Walsingham, 1879), Univ. Calif. Publ. Entomol. 32: 144 (in part).

This is a Canadian species having the basal portion of the forewing pale reddish brown and the median transverse band as dark as the basal one and nearly straight on its inner margin.

3. Length of forewing 10.2-11.2 mm (17n). Head. Crown protuberant, without postantennal spurs (3n). Labial palpus short, length of II segment 0.75-0.90 eye diam.; III 0.40-0.45 as long as II; scaling gray. Scaling of front and crown slightly shaggy, pale gray with whitish tufts behind and between antennae. Thorax. Dorsal scaling gray, paler posteriorly, with a whitish band across tips of tegulae and pronotum between them. Underside shining pale gray, pro- and mesolegs dark gray exteriorly, hind leg whitish marked with dark gray. Forewing. Length $2.8-2.9 \times$ width; shape and venation as in horarianus (FIG. 2). Color pattern with pale and dark areas strongly contrasting; basal area variably pale reddish brown, preceding a dark gray subbasal transverse band, outwardly curving at middle; submedian pale band whitish containing variable transverse, dark strigulae; median band nearly straight on its inner margin, slightly recurved basally towards dorsal margin in some specimens, containing about 3 parallel rows of upraised black scales but not defined outwardly in terminal area which contains a round, pale gray spot that is often notched on its outer side. Fringe concolorous gray. Underside nearly uniform dark gray. Hindwing. Slightly broader than forewing, with broad fringe; venation similar to horarianus, basal stem of $R_s + M_1$ short (less than 0.2 the length). Color nearly uniform pale gray including fringe. Underside whitish gray with darker veins. Abdomen. Dorsal scaling pale gray, genital tufts tinged with tan, underside dark gray strongly reflecting purplish. Genitalia similar to D. asapheus, n. sp. (FIG. 14), aedeagus and transtilla as in FIG. 18, 19 (drawn from paratype, Trenton, Ontario, JAP prep. no. 4121, 4n); transtilla of fultura superior broad, strongly convoluted with a deep, narrow median emargination; free portion of sacculus abruptly bent; aedeagus elongate, extending nearly $2 \times$ the length of anellus beyond its attachment, with a free subapical, lateral projection that is variable in shape, dentate on its outer margin.

 \Im . Length of forewing 10.2–11.9 mm (3n). Essentially as described for \Im , slightly larger but measurements and color pattern within variation shown by \Im . Genitalia as in Fig. 44 (drawn from paratype, Bobcaygeon, JAP prep. no. 4123, 4n); sterigma with a narrow ventral ridge below ostium bursae, with antrum asymmetrically broadened, sclerotized; signum reduced, consisting of 8–10 spurs.

Holotype & and allotype \mathcal{P} , CANADA: ONTARIO: South March, 22–26.IX.1941, bred from gooseberry, J. McDunnough (CNC). Paratypes (19): CANADA: MANI-TOBA: Aweme, 1 \mathcal{P} , 20.IX.1927, N. Criddle; ONTARIO: 1 \mathcal{P} , same data as holotype except 1.X.1941; Bobcaygeon, bred from gooseberry, 1 \mathcal{J} , 1 \mathcal{P} , 30.IX.1931, 7 \mathcal{J} , 20– 27.IX.1932, 4 \mathcal{P} , 23.IX–4.X.1932, J. McDunnough; Trenton, 1 \mathcal{J} , 23.IX.1912, Evans; QUEBEC: 1 \mathcal{J} , "South March, Que.," bred from gooseberry, 25.IX.1945, Mc-Dunnough; Kirk's Ferry, 1 \mathcal{J} , 18.IX.1950, B.P. Bierne; Lac Mondor, Ste. Flore, 1 \mathcal{J} , 24.IX.1951, E. Munroe (CNC, UCB).

One additional male in worn condition, not designated as paratype: ONTARIO: Frontenac Co., Glenburnie, 1.X.1969, R. Harmsen. Genitalia not distinguishable from paratypes (JAP prep. no. 4108) (CNC).

This is the most distinctive species of the *horarianus* group. It can be recognized by the tan blotch at the base of the forewing and by the strongly contrasting, white submedian band defined outwardly by the nearly straight inner side of the dark median band. The aedeagus is longer than in any related species and bears a lateral, subapical, dentate process that is unique among described species.

The fragmentary nature of available material from western Canada and the complete lack of records for the northwestern United States prevent drawing conclusions on the relationships of horarianus and macdunnoughi. There are no collections showing the 2 to be closely sympatric, but morphological variation in scattered specimens from central and western Canada, particularly the aedeagus form, suggests relationships with both species. Population samples from Canada examined, as follows (FIG. 82). (1) BRITISH COLUMBIA: Victoria, 13, 15.VIII.1919, 49, 23.VII-1.IX.1917-1922, W. Downes. Forewing length \eth 9.8 mm, \Im 9.4–9.8 mm; smaller than macdunnoughi and generally paler with less strongly contrasting forewing colors but otherwise resembling typical macdunnoughi. The aedeagus bears a broader, lateral process (FIG. 21) (CNC prep. To No. 1). The female differs from macdunnoughi in having a rugose, somewhat irregularly folded, sclerotized rim on the sterigma and a shallow antrum subtended by a short, narrow sclerotization on the base of the ductus bursae, similar to tahoense. (2) NORTHWEST TERRITORIES: Ft. Simpson, 13, 27.VIII.1950, D.P. Williams. Forewing length 11.3 mm; wing pattern worn, apparently similar to macdunnoughi but with markings less strongly contrasted. Genitalia similar to macdunnoughi; aedeagus with lateral process spurlike, without dentation (FIG. 22) (JAP prep. no. 3998) (CNC). (3) SASKATCHEWAN: Saskatoon, 23, 18.XI.1975 "LU-1340." Forewing length 10.6–12.1 mm; length $3.0 \times$ width; pattern apparently similar to macdunnoughi, weakly contrasted, as in the Ft. Simpson specimen. Genitalia similar to macdunnoughi but lateral process of aedeagus spurlike, not flattened, not dentate (Mutuura prep. LU-1340) (FIG. 20) (CNC). (4) MANITOBA: Winnipeg, 19, no date,

A.W. Hanham. For ewing length 10.8 mm; length 2.7 \times width; pattern obscured, as in Saskatchewan and Northwest Territories specimens.

Decodes tahoense Powell, new species

FIG. 26, 27, 45, 74, 82

99

This species resembles typical *D. horarianus*, but the moths are smaller and have more distinctly patterned forewings, with the subbasal, transverse band narrower and more distinctly defined, margined with upraised black scales.

3. Length of forewing 9.3-11.5 mm (10n). Head. Crown protuberant, postantennal spurs short (3n). Labial palpus short, II segment length 0.80-0.85 eye diam.; III about 0.5 as long as II; scaling appressed, gray, the scales white-tipped. Scaling of front and crown hoary gray, the scales broadly white-tipped. Thorax. Dorsal scaling whitish, lightly tinged with brown anteriorly. Underside shining whitish; pro- and mesolegs peppered with gray exteriorly. Forewing. Length $2.7-3.0 \times$ width; venation and shape similar to horarianus (FIG. 2), slightly broader. Ground color pale gray, markings relatively distinct; a brown shade over base of costa; subbasal transverse band narrow (about $1.5 \times$ eye diam.), outwardly curved, chocolateto red-brown, bordered by upraised black scales; median band variable, usually narrowed and distinct in cell, brown margined with black, broadened, gray and indistinctly margined above and below cell; some scattered black scales in submedian and terminal pale areas, not forming transverse strigulae. Fringe gray with a darker basal scale row, poorly defined. Underside pale brownish gray, costa irregularly, narrowly whitish. Hindwing. Slightly broader than forewing; shape and venation as in horarianus. Ground color pale gray, slightly darker towards outer margin. Fringe concolorous, with a darker basal scale row indistinct to well defined. Underside whitish, veins gray; fringe as above. Abdomen. Scaling shining pale gray dorsally and ventrally; scaling of genitalia white. Genitalia (FIG. 26, 27 drawn from JAP preps. 2695, 3381, 4n) similar to horarianus and asapheus, n. sp. (FIG. 14), fultura superior broadly sclerotized, with a broad median notch, sparsely dentate; aedeagus enlarged subapically, slightly asymmetrical, with about 5 blunt, apical spurs.

 \mathfrak{P} . Length of forewing 9.7–11.0 mm (9n). Similar to \mathfrak{F} ; crown rather strongly protuberant, postantennal spurs represented by stubs (3n). Genitalia as in FIG. 45 (drawn from JAP prep. no. 2798, 3n); sterigma with a broad, minutely rugose, ventral rim, its posterior edge with 2 or 3 variable folds; antrum of ductus bursae broad, bowl-shaped without lateral lobes, abruptly narrowed; signa reduced to a row of minute spurs.

Holotype δ and allotype \Im , USA: CALIFORNIA: Placer Co., Ward Crk, 1850 m (6050'), 3.2 km (2 mi) S of Tahoe City, 15.IX.1965 and 15.IX.1974, N. Westerland (LACM). Paratypes (17) all from same locality as holotype: 2δ , $1\Im$, 15, 25.IX.1965; 1δ , $1\Im$, 30.IX–2.X.1966; 2δ , 25, 26.IX.1968; 1δ , 24.IX.1974; 2δ , $6\Im$, 21.IX–1.X.1975; 1δ , 27.IX.1976 (LACM, NMNH, UCB).

Superficially this species is hardly distinguishable from *D. horarianus* in Modoc County, California. Most specimens of *D. tahoense* have more distinctly contrasting forewing markings, but a few do not. In *horarianus* the pale areas of the forewing are whiter, particularly the postmedian blotch which is not defined outwardly in *tahoense*. The differences in both male and female genitalia appear to be consistent (*horarianus*, 53, 29, *tahoense*, 33, 39) and form the basis for treating this population as a separate species.

One additional specimen in too worn condition to compare its phenotype was examined: CALIFORNIA, Plumas Co., Johnsville, 13, 2.X.1966, H. Pini (M.E. Gardner prep. 1970) (CDA). The genitalia appear to be nearly indistinguishable from *tahoense*, with the apex of the aedeagus bearing short teeth, not the attenuate spur of

horarianus s. str. Additional material from this area would be useful in assessing relationships between these 2 species.

One male which resembles *tahoense* phenotypically was collected: CALIFORNIA: Shasta Co., 6.4 km (4 mi) WNW of Platina, 830 m (2700'), 29.IX.1970, D.F. Hardwick (JAP prep. no. 4119) (CNC). The aedeagus is enlarged preapically similarly to *asa-pheus*, n. sp. but is narrowed apically into a blunt spur, without the fine teeth of *asapheus* or *tahoense*.

Decodes asapheus Powell, new species

FIG. 14, 23-25, 56, 75

Decodes horarianus: Powell, 1964 (not Walsingham, 1879), Univ. Calif. Publ. Entomol. 32: 143 (in part).

This species has a more obscurely patterned forewing than any other in the *horarianus* complex, with the subbasal and median bands scarcely darker than the ground color, the pale areas only slightly contrasting and crossed by transverse strigulae.

d. Length of forewing 9.5-10.2 mm (6n). Head. Postantennal spurs well developed, as in horarianus (FIG. 48). Labial palpus short, II segment length about $0.85 \times$ eye diam.; III only 0.33 as long as II; scaling appressed, gray, scale tips whitish. Scaling of crown brownish gray, the scales white-tipped, becoming whitish on front. Thorax. Scaling as on head, whitish towards apices of tegulae, tinged with brown on notum in fresh specimens. Underside shining whitish; pro- and mesolegs gray exteriorly. Forewing. Length $2.8-2.9 \times$ width; shape and venation as in *horarianus*. Ground color pale gray (no bluish appearance); markings generally distinct but contrast with ground color variable, usually dim, weakly contrasted; basal ¼ tinged with pale brown, extending through the subbasal band which is moderately well defined with upraised black scale rows bordering inner and outer margins; pale submedian area beyond scarcely contrasted with ground and containing 4 or 5 parallel, incomplete, transverse striae of slightly upraised, black scales; submedian band moderately well defined to obsolete, not as dark as subbasal band, with fewer, weakly upraised black scales; terminal area with incomplete strigulae of black scales. Fringe gray, concolorous with ground. Underside gray, costa marked by a series of evenly spaced dark and light shades. Hindwing. Slightly narrower than forewing; shape and venation as in horarianus. Ground color entirely pale gray including fringe. Underside whitish, scaling of veins gray; fringe whitish with gray basal and median scale rows. Abdomen. Scaling shining pale gray, lightly tinged with pale brown preceding genitalia dorsally; ventral scaling paler. Genitalia similar to horarianus, as in FIG. 14, 23-25 (drawn from paratypes, [AP prep. nos. 249, 3960, 4318, 3n); fultura superior broad, shallowly notched, dorsal surface densely set with fine teeth; aedeagus expanded asymmetrically, with a broad, preapical lobe on the right side, narrowed beyond, finely dentate dorsally.

♀. Unknown.

Holotype &, USA: CALIFORNIA: Monterey Co., Salinas Riv at King City, 9.XI.1977, at UV light, J. Powell & P.A. Rude (in CAS on indefinite loan from UCB). Paratypes (6): 3& same data as holotype; 2& same locality, 3.V.1974 (larvae), reared from *Ribes aureum*, emgd. 1–7.XI.1974 (JAP 74E18); 1&, Monterey Co., Hastings Reservation [nr Jamesburg], 16.X.1949, at light, D.D. Linsdale (NMNH, UCB).

Wings of the reared specimens became worn before recovery, obliterating the forewing pattern, so the variation from moderately well-defined to nearly obscured forewing pattern is based on flown specimens. The specimen from Hastings Reservation has more distinctly marked forewings than any from the type-locality. Its aedeagus is closely similar in form to specimens from the type-locality (JAP prep. no. 249); the detail is not visible in lateral view and was not shown in my illustration (Powell 1964: FIG. 29). The 4 Salinas River males were attracted to black light between 1920–2040 h at 5–6 $^{\circ}$ C.

Three additional population samples from the Coast Range in central California (FIG. 82) are provisionally referred to *asapheus*, but not designated paratypic, because they differ slightly in morphological detail and in host plant:

(1) Santa Clara Co., New Almaden, 13, 28.III.1965 (larva), r.f. *Ribes sanguineum*, emgd. XI.1965, P.A. Opler (JAP 65D4.1); 23,19, 20.X.1963, 25–31.X.1964, at light, Opler (JAP prep. nos. 3968, 4128, 4129, 4321) (UCB).

(2) Alameda Co., Patterson Reserve, Del Valle Lake, 33, 29.IV.1974 (larvae), r.f. Ribes menziesii, emgd. 13.X-7.XI.1974 (JAP 74D42) (JAP prep. no. 3955) (UCB).

In both of these populations the forewing pattern is similar to typical *asapheus* but slightly more contrasting than the most strongly marked paratopotype. The fultura superior is less extensively dentate dorsally, and the aedeagus is less broadly enlarged, with fewer teeth. The single female has genitalia structures similar to *D. tahoense* (FIG. 45), but the inner margin of the sterigma has a median fold and the signa are completely lacking.

(3) Stanislaus Co., Frank Raines Park, Del Puerto Canyon, 13, 12.IV.1974, r.f. *Ribes quercetorum*, D.S. Green (UCB); specimen too worn to compare phenotype to other populations.

The only other specimen from the central coastal part of California is the female collected at San Leandro, Alameda Co. in 1921 (FIG. 56) (JAP prep. no. 484) (CAS). It is more heavily patterned than any discussed above. The genitalia match the New Almaden female except there is a weakly developed signum, as in *tahoense*. Thus, the signum may be variable in *asapheus*. The San Leandro population presumably has long since been destroyed by urban growth.

Ribes aureum, a deciduous shrub, is a widespread species occurring in the Salinas Valley, San Joaquin Valley, foothills of the Sierra Nevada and east of the Sierra extensively north and east to Washington and North Dakota (Munz & Keck 1959). Although the host *Ribes* species of *D. horarianus* at Ft. Bidwell, Modoc County was not determined, it was not *R. aureum*, and the 2 pairs of plant and moth species could be sympatric in that region.

The following additional records represent 6 localities in southern California (FIG. 82) from which only 9 females have been studied. Until males are available from these areas no conclusions can be formulated concerning relationships of populations in southern California to *D. asapheus*, *D. tahoense*, and *D. opleri*.

(1) Kern Co., Lebec ("L.A. Co."), $1 \, \bigcirc$, reared from *Ribes*, "emgd. March, 1938," L. Martin (JAP prep. no. 3531) (LACM). Forewing length 11.9 mm; narrow, length about 3.3 × width; pattern distinct but pale, with the dark markings not strongly contrasting; subbasal band only slightly darker than median, similar to the New Almaden *asapheus* phenotype. Genitalia similar to *tahoense*, antrum slightly broader, signa lacking.

(2) Los Angeles Co., Topanga, 460 m (1500'), 29, 7.XII.1958, 13.XII.1960, H.

1980



FIG. 28-36. Genital structures of *Decodes* and *Decodina*. **28-29**, *Decodes opleri*: **28**, aedeagus, holotype (lateral); **29**, distal end of aedeagus, paratype (dorsal). **30-31**, Colorado population of *D. horarianus* complex: **30**, distal portion of aedeagus (dorsal); **31**, transtilla of fultura superior. **32**, *Decodina mazatlana*, δ genitalia (ventral aspect), valvae spread, aedeagus (lateral) to right. **33-36**, φ genitalia of *Decodes* (ventral): **33**, *D. fragarianus*, Redwood City, California; **34**, *D. basiplaganus*, Petaluma, California; **35**, *D. montanus*, Donner Summit, California; **36**, *D. catherineae*, paratype.

Notman (JAP prep. nos. 3347, 3349) (LACM). Forewing length 11.0-11.9 mm; length $3.0-3.1 \times$ width; pattern on 1 specimen distinct with contrastingly dark bands having some brown scaling (as in *tahoense*). The second specimen is worn but apparently not so distinctly or darkly patterned. Genitalia nearly indistinguishable from *tahoense*, sterigma with a median emargination on ventral rim, not irregularly folded.

(3) Los Angeles Co., Benedict Canyon, 8 km (5 mi) N of Beverly Hills, 2° , 12.XII.1956, N. McFarland (JAP prep. no. 3956) (LACM). Forewing length 10.1–11.0 mm; length $3.1 \times$ width; ground color dark gray, markings distinctly black or brownish margined with black; pale areas scarcely distinguished from ground. Genitalia as in the Topanga examples.

(4) Los Angeles Co., Los Angeles, Mt Washington Distr, 1° , 11.I.1976, J.P. & K.E. Donahue (JAP prep. no. 4074) (LACM). Forewing length 10.5 mm; length 2.9 × width; ground color dark gray with pattern only faintly indicated, as in typical *asa-pheus*. Genitalia as in Lebec specimen, antrum slightly broadened, signa lacking.

(5) Orange Co., Laguna Beach, $2 \, \stackrel{\circ}{\downarrow}$, 15–30.XII.1924, 1–15.I.1925, O.C. Poling (JAP prep. no. 3394) (NMNH). Forewing length 11.5–11.6 mm; length $3.1-3.2 \times$ width; ground color pale gray, pattern distinct but pale, dark areas not contrasted with ground, pale areas whitish, resembling *asapheus* s. str. more so than the above examples. Genitalia as in Topanga specimens.

(6) San Bernardino Co., Upper Santa Ana Riv, 1, 1, 11.X.1947, Sperry (JAP prep. no. 483) (NMNH). Not reexamined in this study. Genitalia (FIG. 40) similar to *tahoense* and to Topanga and Benedict Canyon examples.

Decodes opleri Powell, new species

FIG. 28, 29, 76, 77

This species is large, resembling *D. johnstoni*, with bluish appearing forewings having variable, washed-out markings.

 δ . Length of forewing 11.1–12.1 mm (2n). Head. Labial palpus short, II segment length about 0.85 eve diam., III 0.33 as long as II; scaling slightly spreading, dark gray, the scales narrowly white-tipped. Crown slightly produced, with short postantennal spurs (1n). Scaling of front and crown, more conspicuously hoary-whitish, scape, base of antenna and back of vertex white. Thorax. Patagia and collar dark gray, as on head; notum posteriorly whitish. Underside shining gray, pro- and meso-legs exteriorly darker. Forewing. Narrow, length $3.1 \times$ width; shape and venation as in horarianus (FIG. 2). Ground color dark gray, basal $\frac{1}{2}$ with outwardly curved, variable, transverse, rows of slightly upraised black scales; distal $\frac{1}{2}$ indistinctly clouded with whitish. Markings poorly defined, as follows: costal area basally brown; a transverse blackish band at basal ¼, distinct only in cell; transverse, outwardly curved line before middle, white, distinct on dorsal half preceding 2 rows of black scales, indistinct on costal 1/2 where it blends into a whitish blotch which extends outward through end of cell, expanded in terminal area. Termen mostly whitish, fringe gray. Underside gray; costa whitish. Hindwing. Slightly broader than forewing. Shape and venation as in horarianus. Ground color pale gray; fringe whitish with a basal row of pale gray scales. Underside similar, fringe entirely whitish. Abdomen. Scaling pale brownish gray dorsally and ventrally. Genitalia similar to asapheus (FIG. 14); fultura superior broad with a narrow, U-shaped median notch, irregularly rugose laterally; aedeagus with a short, dentate, postmedian, lateral spur; finely dentate on spur and dorsally on aedeagus beyond the spur (FIG. 28, 29, drawn from holotype, paratype, JAP prep. nos. 2271, 4135, 2n).

♀. Length of forewing 11.0–11.1 mm (2*n*). Essentially as described for ♂; eye slightly smaller, II segment of labial palpus 0.90–0.95 eye diam. Allotype with more distinct markings than holotype, including more complete rows of upraised black scales and short rows along veins in terminal area. Genitalia very similar to *tahoense* (1*n*) (FIG. 45) and to the *asapheus* complex populations of southern California (FIG. 40).



FIG. 37-42. Female genitalia of *Decodes* (ventral aspect). **37**, *D. macswaini*, paratype; **38**, *D. johnstoni*, Mt St. Helena, California; **39**, *D. bicolor*, Mt St. Helena, California; **40**, *D. asapheus* complex, Santa Ana River, California; **41**, *D. aneuretus*, allotype; **42**, *D. tonto*, allotype.



FIG. 43–47. Female genital structures of *Decodes* and *Decodina*. **43–45**, sterigma, ductus bursae and basal portion of corpus bursae of *Decodes*: **43**, *D. horarianus*, Ft. Bidwell, California; **44**, *D. macdunnoughi*, paratype; **45**, *D. tahoense*, paratype. **46**, \Im genitalia, *D. zimapanus*, paratype. **47**, \Im genitalia, *Decodina mazatlana*, paratype.



FIG. 48–62. **48.** Crown of *Decodes horarianus*, Ft. Bidwell, California (anterior aspect) showing spurs behind antennal sockets. **49–51.** Female genitalia of *D. placitus*, holotype (ventral aspect): **49**, whole structure; **50**, detail of sterigma; **51**, detail of signum. **52.** Cocoons and pupal shell of *D. fragarianus*, Antioch, California. **53–60.** Adults of *Decodes*: **53**, *D. basiplaganus*, δ , Orinda, California, 7.X.1961, P. Opler; **54**, *D. fragarianus*, φ , Berkeley Hills, California, 16.IV.1960, r.f. *Quercus agrifolia*, J. Powell (60 D2); **55**, *D. montanus*, holotype δ ; **56**, *D. asapheus*, δ , San Leandro, California, 26.IX.1921, E. Van Duzee; **57**, *D. basiplaganus*, δ , Timpanogos Mt, Utah, 27.VII.1976, Powell & Randal; **58**, *D. stevensi*, paratype δ ; **59**, *D. australus*, holotype φ . **60**, *D. placitus*, holotype φ . **61–62.** *Decodina mazatlana*: **61**, holotype δ ; **62**, allotype φ .

Holotype δ and allotype \Diamond , USA: CALIFORNIA: Santa Barbara Co., San Marcos Pass, Santa Ynez Mts, 14.III.1967 (larvae), r.f. *Ribes malvaceum*, emgd. 17–25.X.1967 (JAP 67C1), P.A. Opler & J. Powell (in CAS on indefinite loan from UCB). Paratypes: 1δ , 1, \circ , same data as holotype (UCB).

The female is more distinctly marked, but the variation probably is not sex-related. The paratype female is worn, without forewing pattern. The host plant is endemic to the California chaparral community. The larval colony was discovered on young plants along recently graded areas. The site was reexamined March 1, 1978, but no larvae were found on mature *R. malvaceum* growing in open chaparral.

Species unplaced as to group (\bigcirc only)

Decodes zimapanus Powell, new species

A moderately large moth with uniform mouse-gray forewings having an indistinct pretornal streak of red-brown, defined inwardly by a thin, transverse dark line.

 \mathfrak{P} . Length of forewing 10.7–11.7 mm (3*n*). *Head*. Labial palpus moderately elongate, II segment length 1.05 eye diam., III 0.45 as long as II; scaling slightly spreading, dark gray exteriorly, whitish interiorly. Scaling of crown spreading, dark gray frosted with white tips. *Thorax*. Dorsal scaling gray, the scales broadly white-tipped. Ventral scaling shining whitish, pro- and meso-legs dark gray exteriorly, meta-legs pale gray. *Forewing*. Length 3.1 × width; venation as in *fragarianus*. Ground color uniform mouse gray, indistinctly streaked with reddish brown in subcostal area, near base on anal angle and more distinctly beyond a transverse black line which extends from outer $\frac{2}{3}$ of cell to dorsal margin before tornus; white scaling concentrated before the dark pretornal line and scattered with some black dots in distal area beyond cell. Underside uniform dark gray. *Hindwing*. Broader than forewing; costa moderately strongly emarginate before apex, venation differing from *fragarianus* by M₂ more strongly bowed upward, 1st A straight. Uniform gray, margin slightly darker, fringe paler. Underside pale gray, irregularly mottled. *Abdomen*. Dorsal scaling shining gray; underside paler. Genitalia as in FIG. 46 (drawn from paratype, JAP prep. no. 3961, 2*n*); sterigma with a complex plate posterior to ostium which is simple, cup-shaped; ductus bursae abruptly narrowed beyond enlarged, partially sclerotized antrum; signum rather short, narrow.

♂. Unknown.

Holotype \Im , MEXICO: Hidalgo, 3 mi E of Zimapan, 1951 m (6400'), 31.VII– 1.VIII.1963, Duckworth & Davis (NMNH). Paratypes, $2\Im$, same data as holotype (NMNH, UCB).

The unique form of the sterigma as well as the wing pattern place *zimapanus* as distinct from any described species. Discovery of the male may warrant reassessment of its assignment to *Decodes*.

Decodes australus Powell

Decodes australis Powell, 1965, Proc. Biol. Soc. Wash. 78: 70.

Forewing length: 9, 7.6 mm (1*n*).

This is a moderately small moth with subbasal dark band as in *basiplaganus* and a subtornal dark blotch on the forewing. The male is unknown. Female genitalia (Powell 1965: FIG. 4) similar to *D. placitus*, n. comb. (FIG. 49–51).

Type data. Holotype \mathcal{P} (CAS), MEXICO: Aguascalientes, ridge NW of Jocoque Dam, 19.VIII.1960, P.H. Arnaud, Jr., E.S. Ross & D.C. Rentz.

1980

FIG. 46, 78

Fig. 59



FIG. 63–70. Adults of *Decodes.* 63, *D. lundgreni*, holotype δ ; 64, *D. lundgreni*, allotype \Im ; 65, *D. catherineae*, holotype \Im ; 66, *D. catherineae*, paratype \Im , Valyrmo, California, 17.III.1964, N. Mc-Farland; 67, *D. catherineae*, paratype \Im , Valyrmo, 16.I.1964, McFarland; 68, *D. macswaini*, allotype \Im ; 69, *D. johnstoni*, paratype \Im , The Geysers, California, 19.III.1939, Johnston; 70, *D. bicolor*, \Im , Twain Harte, California, 4.IV.1964, Potter & Lundgren.



FIG. 71–78. Adults of *Decodes.* **71**, *D. tonto*, holotype \Im ; **72**, *D. horarianus*, \Im , Ft. Bidwell, California, 12.V.1970, r.f. *Ribes*, J. Powell (70F90); **73**, *D. macdunnoughi*, holotype \Im ; **74**, *D. tahoense*, paratype \Im , 16.IX.1975; **75**, *D. asapheus*, paratype King City, California, 9.XI.1977, Powell & Rude; **76**, *D. opleri*, holotype \Im ; **77**, *D. opleri*, allotype \Im ; **78**, *D. zimapanus*, holotype \Im .

Geographical distribution. Known only from the type-locality. Flight period. August. Food plant. Unknown.

Decodes placitus (Walsingham), **new combination**

tion Fig. 49–51, 60

Tortricodes placita Walsingham, 1914, Biol. Cent. Am., Lepid. Het. 4: 275.

Forewing length: \Im , ca 8.5 mm (1*n*).

This is a moderately small moth with a weakly developed subtornal dark blotch on the forewing. The illustration accompanying the original description is a misleading representation.

Type data. Holotype \mathcal{P} (BMNH), MEXICO: Guerrero, Amula, 1830 m (6000'), VIII [no year], H.H. Smith.

Geographical distribution. Known only from the type-locality.

Flight period. August.

Food plant. Unknown.

This species was described from a unique specimen, said to be a male, but the type at the British Museum is a female. Examination of it shows minor discrepancies between *placitus* and *australus* in the form of the sterigma and signum (FIG. 49–51). Possibly these are within the range of variation for 1 species, but study of material, especially males, from intervening areas between Aguascalientes and Guerrero will be necessary to determine relationships of the 2 named entities.

Decodina Powell, new genus

Type-species. Decodina mazatlana, n. sp.

Small moths superficially resembling *Decodes*, differing by having broader forewings, with R_4 to the apex, R_5 of hindwing to apex, and the transtilla with dentate lateral processes on the fultura superior.

Head. Ocellus present; labial palpus strongly ascending, short, II segment 0.9 eye diam., III 0.50–0.55 as long as II, smooth-scaled. Crown slightly protuberant behind antennae, without postantennal spurs. Forewing. Broad, length $2.5-2.6 \times$ width; venation (FIG. 3) as in Decodes fragarianus except R_s to apex or slightly below, M₁ well below apex. Hindwing. Slightly broader than forewing; costal margin slightly emarginate before the blunt apex, 1st A straight. δ genitalia. (FIG. 32) uncus, socii, gnathos similar to Decodes; valva with sacculus free on distal $\frac{1}{2}$ (similar to Decodes horarianus); fultura superior (transtilla) without median sclerotized area, laterally with prominent dentate processes; aedeagus with strong dorsal spur. φ genitalia. (FIG. 47) as in Decodes, except papillae anales subtended anteriorly by patches of spurs; sterigma broad, extended laterally nearly to anterior apophyses; signum moderately elongate, its spurs large.

Decodina mazatlana Powell, new species

FIG. 3, 32, 47, 60, 61

This is a small gray moth with transverse gray and whitish bands on the forewing.

 δ . Length of forewing 4.7–5.1 mm (4*n*). *Head.* Antenna slightly dilated, width of shaft near base about 0.25 eye diam. Scaling of labial palpus white at base becoming dark gray distally; scaling of front white, of crown gray frosted with white tips. *Thorax.* Dorsal scaling concolorous with crown. Venter shining white, pro- and mesolegs banded with dark gray, meta- mostly whitish. An elongate tuft of white scales extends posteriorly from base of tegula under base of wings. *Forewing.* Scaling gray variably overlaid with white,

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FIG. 79–81. Geographical distribution of *Decodes basiplaganus* (triangles) and *D. fragarianus* (circles). **79**, localities for *D. basiplaganus* in North America, with general distribution of *D. fragarianus* (shaded areas); **80**, localities for both species in Nevada, Utah, Colorado, Arizona, and New Mexico; **81**, localities for both species in California (detail of San Francisco Bay area shown in inset to left).

forming an incomplete basal band on costal ½, a complete, fairly well-defined submedian transverse band, and an indistinct terminal blotch extending over tornal area. Incomplete rows of upraised, blackish scales delimit the pale bands on fresh specimens. Underside gray, a pale spot near base, whitish of transverse bands reproduced on costa. *Hindwing*. Upper and undersides dark gray, fringe paler. *Abdomen*. Dorsal scaling dark gray, ventral white. Genitalia as in FIG. 32 (drawn from paratype, JAP prep. no. 3477, 3n).



FIG. 82. Geographical distribution of populations in the *Decodes horarianus* complex in North America. *D. horarianus* (closed triangles); *D. tahoense, D. asapheus, D. opleri*, and unassociated \Im specimens (open triangles); *D. macdunnoughi* (closed circles); populations with varying expressions of *horarianus-macdunnoughi* characters (half-closed circles); probable undescribed species (closed square).

 \Im . Length of forewing 4.9–6.0 mm (28*n*). Essentially as described for \Im . Antenna not dilated, width of shaft about 0.20 eye diam. Genitalia as in Fig. 47 (drawn from paratype, JAP prep. no. 1739, 3*n*).

Holotype \Im and allotype \Im , MEXICO: Sinaloa, 8 km (5 mi) N of Mazatlan, 27.VII.1964, at light, J.A. Chemsak & J. Powell (CAS on indefinite loan from UCB). Paratypes (30): $\Im\Im$, $21\Im$, same data as holotype; $4\Im$, same data except 24–28.VII.1964; $2\Im$, same data except 5.VIII.1964 (AMNH, BMNH, CAS, CNC, NMNH, UCB).

Two additional males were examined but not designated as paratypes: MEXICO, 53 km (33 mi) S of Iguala, Gro., 440 m (1450'), 5.VIII.1954, J.G. Chillcott (JAP prep. no. 3423) (CNC). These individuals are larger than the Mazatlan males (FW length 5.9 mm) and differ by having slightly narrower forewings (length 2.8 \times width) and by more distinct, darker transverse strigulae defining the markings on the forewing. The genitalia are essentially indistinguishable from the typical form of *mazatlana*, so conclusions regarding relationships of this population must await examination of further material.

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SYSTEMATIC LIST OF DECODES AND DECODINA

Decodes Obraztsov, 1961

- I. basiplaganus group
 - 1. basiplaganus (Walsingham, 1879)
 - 2. fragarianus (Busck, 1919)
 - 3. montanus Powell, 1961
 - 4. lundgreni Powell, 1965
- II. catherineae group
 - 5. catherineae, n. sp.
- III. macswaini group
 - 6. macswaini, n. sp.
 - 7. stevensi, n. sp.
- IV. johnstoni group
 - 8. johnstoni Powell, 1961
 - 9. bicolor Powell, 1961
 - 10. aneuretus Powell, 1961
 - 11. tonto, n. sp.
- V. horarianus group
 - 12. horarianus (Walsingham, 1879)
 - 13. macdunnoughi, n. sp.
 - 14. tahoense, n. sp.
 - 15. asapheus, n. sp.
 - 16. opleri, n. sp.

Incerti Sedis

- 17. zimapanus, n. sp.
- 18. placitus (Walsingham, 1914)
- 19. australus Powell, 1965

Widespread Nearctic Western Nearctic California, Nevada California

California

Texas, Nuevo Leon Colorado

California, Baja California California California Arizona

Oregon, California Manitoba, Quebec California California California

Hidalgo Guerrero Aguascalientes Decodina, n. gen.

1. mazatlana, n. sp.

Sinaloa, Guerrero

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