

REVISION OF THE NORTH
AMERICAN SPECIES OF
THE GENUS *EUPITHECIA*
(LEPIDOPTERA, GEOMETRIDAE)

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INTRODUCTION

OVER A CONSIDERABLE PERIOD OF TIME, while the author was connected with the Division of Entomology of the Canadian Department of Agriculture, endeavors were made as occasion permitted to clear up the very involved synonymy of the North American species of the genus *Eupithecia* by means of a study of the genitalia of type material. This was the subject of a number of articles appearing from time to time in the Canadian Entomologist. In the back of the author's mind there was always the hope that some day he would be enabled to publish a complete revision of the species belonging to the genus with illustrations of the genitalia, both male and female, and provide in this way a sure means of definite specific identification. This hope has finally become an actuality through the cooperation and support of the Scientific Council Fund of the American Museum of Natural History together with Mr. C. F. dos Passos of Mendham, New Jersey; to the institution and to the individual the author wishes to express his sincere appreciation for their generosity.

Material for study has been very limited in many instances, and it is largely on account of the cooperativeness of the Canadian Division of Entomology in placing virtually the entire *Eupithecia* collection accumulated in the Canadian National Collection over a long period of years at the writer's disposal that the present degree of completeness has been attained. To Dr. T. N. Freeman special thanks are due for the trouble taken in packing and forwarding this material and for furnishing much necessary information.

In the American Museum collection the author has been fortunate in being able to study the types of species described by Pearsall and Grossbeck along with considerable material collected by these two workers. Hulst's numerous types were also made available for study through a loan from the collection at Rutgers University, New Brunswick, New Jersey, which was brought about through the courtesy of the State Entomologist and Dr. J. B. Schmitt of the above institution. The large collection of Mr. John L.

Sperry of Riverside, California, particularly strong in species from the southwestern states, was made completely available, and considerable Californian material was also furnished by Mr. William Bauer of Petaluma and Mr. Frederick H. Rindge of Berkeley. Certain eastern material was secured from the collections of Mr. L. Rupert of Sardinia, New York, and Mr. A. C. Sheppard of Montreal, Quebec. Mr. V. Nabokov of the Museum of Comparative Zoölogy, Cambridge, Massachusetts, and Mr. Hahn W. Capps of the United States National Museum, Washington, D. C., have at all times been most willing to furnish information regarding type material in these institutions and clear up many difficulties that arose in the course of the investigation. To all these gentlemen and to the chairman and curators of the Department of Insects and Spiders of the American Museum of Natural History the author wishes to express his appreciation of their cooperation and of the constant interest shown in his studies. Miss Alice Gray, of the Department of Insects and Spiders of the American Museum, deserves especial commendation for the excellent way in which she has carried out the tedious task of arranging and mounting the illustrations.

As already indicated, the main purpose of the work has been to furnish as complete a set as possible of drawings of the male and female genitalia of the various indigenous species. The preparation of these drawings covers a period of years, and in consequence the scale of magnification has not always been the same. However, a recent careful check has been made for accuracy of detail, and wherever possible type material has formed the basis for illustration. In the text, together with a detailed description of genitalic characters, other structural features have been discussed. Biological notes have also been included, but our knowledge of life histories is still woefully deficient and until more work along these lines can be undertaken, the status of many so-called species remains doubtful. The sex and location of the holotype (the only really important specimen) have been added, and in this connection

the following abbreviations have been employed:

A.M.N.H., the American Museum of Natural History, New York

A.N.S.P., Academy of Natural Sciences of Philadelphia

C.N.C., Canadian National Collection, Ottawa

M.C.Z., Museum of Comparative Zoölogy, Cambridge, Massachusetts

U.S.N.M., United States National Museum, Washington, D. C.

While it is recognized that a determination from a photographic illustration must in many instances remain doubtful, it has still been thought best to supply such illustrations, wherever possible, as at least some idea of each individual species would thus be obtained. When feasible actual type

specimens have been figured. Many of Hulst's types, however, have proved to be in too poor condition for this purpose, and in such cases other material that agreed with these types in maculation and structure has been employed. In only very few cases has it been impossible to present a figure. In connection with the photography great credit is due to Mr. C. F. dos Passos who has devoted much time and care to securing accurate representations. Without his experience and his specially devised apparatus it would have been quite impossible to handle this section of the revision satisfactorily.

All the specimens illustrated in the plates are, unless otherwise indicated, in the American Museum of Natural History collection and are there labeled "photo."

REVISION OF THE GENUS

EUPITHECIA

Eupithecia CURTIS, 1825 (April 1), British Lepidoptera, vol. 2, pl. 64 (vol. 6, Lepidoptera, pt. 2, pl. 64 in systematic arrangement). Type designated by Curtis as *absinthiata* Linnaeus (Clerck). HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 265. Type designation of *linariata* Fabricius, *ultra vires*.

Tephroclystia HÜBNER, 1825, Verzeichniss bekannter Schmetterlinge, p. 323. Includes *subumbata* Schiffermüller, *residuata* Hübner, *pusillata* Schiffermüller, and seven other species. MEYRICK, 1892, Trans. Ent. Soc. London, p. 65. Misspells the genus *Tephroclystis*. HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 265. Designates the genotype as *pusillata* and follows Meyrick's spelling. REBEL in Spuler, 1910, Schmetterlinge Europas, vol. 2, p. 68.

Dyscymatoge HÜBNER, 1825, Verzeichniss bekannter Schmetterlinge, p. 324. Includes *innotata* Knoch and six other species. HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 265. Designates the genotype as *innotata*.

Tarachia HÜBNER, 1825, Verzeichniss bekannter Schmetterlinge, p. 324. Includes *castigata* Hübner, *austerata* Hübner, and *sobrinata* Hübner. HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 265. Designates the genotype as *castigata* Hübner.

Leucocora HÜBNER, 1825, Verzeichniss bekannter Schmetterlinge, p. 325. Includes *succenturiata* Linnaeus and three other species. HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 265. Designates the genotype as *succenturiata* Linnaeus.

Arcyonia HÜBNER, 1825, Verzeichniss bekannter Schmetterlinge, p. 325. Includes *venosata* Fabricius and *consignata* Hübner. HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 265. Designates the genotype as *venosata* Fabricius.

Eucymatoge HÜBNER, 1825, Verzeichniss bekannter Schmetterlinge, p. 325. Includes *togata* Hübner, *strobilata* Hübner, and *linariata* Schiffermüller. MEYRICK, 1892, Trans. Ent. Soc. London, p. 67. Employs as good genus for species with double areole on primaries. HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 272. Follows Meyrick in application and designates as genotype *togata* Hübner.

There is a certain element of doubt attached to the usage of *Eupithecia* Curtis in preference to *Tephroclystia* Hübner, but the latest work dealing with the dates of Hübner's "Verzeichniss" (Heming, 1937, "Hüb-

ner, A bibliographic and systematic account of the entomological works of Jacob Hübner," two volumes) cites the appearance of signature No. 20, containing the above Hübnerian genera, as probably 1825 (*op. cit.*, vol. 1, p. 517). Since the term *Eupithecia* is and always has been in general use by European authorities and as a definite date of publication is given for it, there seems little to be gained in upsetting a well-established usage on very doubtful premises, and consequently the current usage has been followed. While it is fully realized that the genus, as here employed, is a very unwieldy one, containing as it does nearly 150 North American species and an even greater number of Palearctic ones, it has seemed impossible to find any character or combination of characters that would justify the splitting of the group into smaller entities. European entomologists have been faced with the same problem, and when such noted workers as Petersen, Dietze, and Prout have found it impossible to subdivide the genus satisfactorily and have been content to lump the numerous Palearctic species under one heading, there has seemed little chance of finding a better solution in respect to our North American species.

It is true that a number of promising structural characters exist in the shape of the palpi, the ciliations of the male antennae, and the type of front, to say nothing of the extraordinarily complex genitalia, but it has been found that similarity of any one of such characters apparently occurs sporadically throughout the genus, and a grouping based along such lines would result on the whole in a very artificial association of species which on other characters were totally dissimilar. In a few cases it has been possible to bring together as a so-called "group" larger aggregations of species which are obviously allied. The reasons for this will be discussed later under the various subheadings, but in no case has it been considered advisable to create a generic term for any of these groups.

Formerly, following Meyrick and Hulst, the genus *Eucymatoge* Hübner was separated

from *Eupithecia* proper on the strength of a double areole in place of the normal single one in the venation of the forewing, but this character was shown by Prout to be a variable one, being either present or absent in the genotype, *togata* Hübner, and the name has since been sunk as a synonym.

The two North American genera *Nasusina* Pearsall and *Prorella* Barnes and McDunnough have also proved to possess very doubtful status and have been retained with some misgivings merely as a matter of convenience. Both contain rather incongruous elements, as will be discussed more fully later in the text.

The following definition of the genus *Tephroclystis* is given by Meyrick: "Face with short cone of scales. Palpi moderate, porrected, rough-scaled. Antennae in male ciliated. Thorax glabrous beneath. Abdomen more or less distinctly crested throughout. Posterior tibiae with all spurs present. Forewings with areole simple. Hind wings with 8 anastomosing with cell from near base to beyond middle."

Hulst's definition in his "Classification of the Geometrina of North America" is as follows: "Palpi short to long, slender to heavy, porrect or drooping; front not strongly tufted; antennae filiform, ciliate in both sexes; thorax untufted. Abdomen with tuft on each segment dorsally; fore tibiae un-

armed, hind tibiae with all spurs; forewings 12 veins, two accessory cells [*sic*]; hind wings 8 with cell to beyond middle, 6 and 7 separate or stemmed."

Meyrick's definition is very general and not entirely applicable to all our American species; it would cover fairly satisfactorily what might be termed the typical section of the genus. Hulst has noted and included in his definition various forms of palpi, but his characterization is otherwise very similar to that of Meyrick. The statement "two accessory cells" is evidently a *lapsus calami*, as in his key to the genera he includes *Tephroclystis* in his section with one accessory cell. He excuses his meager definition by the statement that "The species so gradually merge into one another in structure, and are so largely midway between the extremes that I have not attempted any closer limitations and so do not give a more exact generic diagnosis." With this statement the author is entirely in accord, bearing out as it does the argument that subdivision at the present time is impossible.

While the structural characters mentioned above may have little value from the generic standpoint, they have proved extremely useful in separating species of very similar superficial appearance as so often occurs in the genus. A detailed discussion of such characters is presented in the following section.

STRUCTURAL DETAILS OF *EUPITHECIA*

PALPI

The typical *Eupithecia* palpus, as occurs in the *satyrata* group and many other species, is of moderate length. The second joint is slightly upturned, rather roughly scaled and generally somewhat tufted apicodorsally; ventrally the tufting is largely confined to the basal section. The third joint is short and bent downward or porrected, is frequently pale in coloration, and partially concealed in the tufting of the second joint; the palpi, in consequence, continue the plane of the front, forming with it a more or less obvious, cone-shaped projection beyond the eyes. In some instances the palpi are extremely short, scarcely or barely attaining the level of the front. This is most frequently the case in those

species in which the front is roundedly bulging instead of flat and sloping (e.g., *plenoscripta* Hulst, *gilvipennata* Cassino and Swett, *nevadana* Packard), but the character is by no means confined to such species and occurs throughout the genus in such widely divergent species as *coloradensis* Hulst, *sierrae* Hulst, and *agnesata* Taylor. At the other extreme we have the long, entirely porrect, blade-like palpi so characteristic of the whole *palpata* group in which the scaling is much smoother with little of the dorsal or ventral tufting of typical species. A similar type of palpus is found in *miserulata* Grote and to a lesser extent in *misturata* Hulst which shows more scale tufting; it occurs sporadically throughout the group (e.g., *cupressata* Pearsall, *albipunctata* Packard) and links up with

the typical form with many intergradations (e.g., *rotundopuncta* Packard).

MALE ANTENNAE

The ciliation of the male antennae is of considerable importance from the specific standpoint and can frequently be used very satisfactorily to separate species that could easily be confused on account of a general similarity of wing pattern. Roughly speaking there are three main types. In the first one we find short, fine ciliae evenly and thickly distributed over the whole ventral area of each antennal segment; *misturata* Hulst is an excellent example of this type, and it also is found very generally in species occurring in the western and southwestern areas of the United States, such as *tenuata* Hulst, *agnosata* Taylor, *huachuca* Grossbeck, and the entire list of species included under *Nasusina* and *Prorella*. The members of the *satyrata* group can also be placed in this category, although a tendency is shown towards an intergradation with the second type. In this the ciliations are somewhat longer and sparser and in a lateral aspect appear to be arranged on each segment in small groups of three, each consisting of a few ciliae and more or less connected with the group of the opposite segmental edge by a transverse row of finer ciliae. This is designated as a trifasciculate or triciliate type and, while not always very distinctly defined, is quite obvious in such species as *rotundopuncta* Packard, *subapicata* Guenée and *plumasata* McDunnough. It is also found in *albipunctata* Haworth, *luteata* Packard, and a number of other species in a somewhat less distinct form which appears to be the commencement of an intergradation with type 1.

In *fletcherata* Taylor the ciliae are grouped into two clusters (bifasciculate) which arise from very minute tubercles. This leads over very nicely to the third type, in which the rather sparse ciliae are long and curled apically, arranged in two fascicles situated proximally and distally along each lateroventral edge of a segment and arising from distinct, small tubercles; the central portion of the segment shows a number of shorter ciliae arranged more or less transversely. This type of antenna is found in a number of species of the *palpata* group (e.g., *longidens* Hulst, *ornata* Hulst, *edna* Hulst) and is also

well typified in *sierrae* Hulst, the *filmata* group, *zelmira* Cassino and Swett, and *deserticola* McDunnough. It would seem to occur most frequently in species that fly in early spring and that in their larval stages (as far as our meager information goes) are associated with conifers.

In a single species, the common eastern *miserulata* Grote, we find the highest type of antennal development. In this species there are three definite fascicles on each side of a segment: a distal pair situated close together near the median line; a median pair, wide apart on the lateral edges with the addition of a single bristle dorsal of the fascicle; and a proximal pair somewhat closer together than the preceding fascicles. A well-developed conical tubercle constitutes the base of each fascicle. The central area is sparsely setose.

In the female sex the ciliae of the antennae are much shorter than in the males, and in most cases in consequence the differences are much less marked. In some instances, where the male ciliation belongs to type 3, the female ciliae are longer than usual, and this character can be of value as a primary means of separation of individual females such as those of *sierrae* Hulst.

FRONT

The typical eupitheciid front, which consists of that portion of the head ranging from the antennal base to the origin of the maxillae, is flat and sloping, scarcely raised above the level of the eyes and with a small tuft of scales on the anterior margin which merges with the tufting of the second palpal joint to form a short conical projection. There appears to be considerable difference in the length and the width between the eyes in individual species, but whether or not this would prove to have any significance from a classificatory standpoint is a matter that has not been worked out in the present revision. *Satyrata* and its close allies are good examples of this type of flat front which also occurs in such species as *castigata* Hübner and *albipunctata* Haworth. In *pygmaeata* Hübner and *undata* Freyer the front is slightly raised above the eye level and somewhat shorter than typical. In *plenoscripta* Hulst and *nimbosa* Hulst it is roundedly bulging, although in other respects these species are definitely members of the *saty-*

rata group. In fact the type of front seems to have little value as a means of establishing specific relationship. In western species such as *mystiata* Cassino, *gilvipennata* Cassino and Swett, *deserticola* McDunnough, and most particularly *nevadata* Packard, the front is very strongly bulging, leading over to the extreme type of frontal development found in most of the species included in the genus *Prorella*. Even in this group, however, it apparently cannot be used as a constant generic character. As far as can be told the bulging front is more or less associated with a shorter palpus and a reduction of the anterior tufting but, on account of the ease with which this tuft can be rubbed off, it is hard to establish its presence or absence without bred material.

THORAX

As a general rule in captured specimens the thorax is so denuded of scaling that it makes it impossible to study the squamation with any degree of satisfaction. However, in a few scattered species the presence of small lateral tufts of raised scales has been noted on each side of the mesothoracic scutellum; this has proved extremely useful as a means of separation. It occurs in all members of the *innotata* group which can thus be at once separated from similar appearing species of the *satyrata* group, such as *terminata* Taylor. It is also found in *sierrae* Hulst and its close allies and in *subapicata* Guenée and its associates.

ABDOMEN

Small mediodorsal tufting is apparently a constant feature throughout the genus. Another character which at times has considerable value is the presence of a distinct, transverse, black band on segment II. This banding is probably best marked in *affinata* Pearsall where it stands out very strongly against the light gray color of the other abdominal segments. It is more or less distinctly present in *columbiata* Dyar and its eastern race *erpata* Pearsall and is a good means of distinguishing the species from the very similarly marked *palpata* Packard. In the males the posterior segments are usually attenuated, but in a few species (e.g., *huachuca* Grossbeck) there is a distinct ventral bulge due to the type of ventral plate on segment VIII.

WING VENATION

The venation is remarkably constant throughout the group and agrees with the figure given in Spuler. The only slight variation occurs in the splitting of the normally single areole of the forewing into two unequal sections by the presence of an oblique cross vein near its base. This double areole is present in only a few species and not entirely constant in them. It occurs variably in the *albicapitata-mutata* group, is found in *tenuata* Hulst and *anticaria* Walker, and is apparently consistent in *graefii* Hulst and allied species. Using the genus *Eucymatoge* Hübner for such species has been found untenable and therefore discontinued.

HIND TIBIAL SPURS

Normally two pairs of spurs are present in *Eupithecia* species, both pairs more or less equal in length, the outer spur of each pair being from one-half to two-thirds the length of the inner one. Considerable variation exists between the various species as regards the actual length of each spur, but the relative relationship of the two pairs as to size in any one species remains fairly constant. In a few species, however, the upper pair of spurs has become much reduced in size or even obsolete. Such species were formerly included in the genus *Gymnocelis* Mabille by Hulst and other workers but later were mostly placed in *Nasusina* Pearsall and *Prorella* Barnes and McDunnough, two rather unstable genera which could easily be merged with *Eupithecia*. Apart from the species listed in these two genera there are a few others with reduced spurs which on genitalic characters must be excluded from such placement and are left, dubiously associated, in *Eupithecia*. These are *stellata* Hulst, *bowmani* Cassino and Swett, *niveifascia* Hulst, *joanata* Cassino and Swett, and *flavigutta* Hulst. A study of these species from the genitalic standpoint would seem to indicate that the reduction of the upper spurs is purely an individual feature that crops up sporadically throughout the genus but must be used with caution as a means of specific association.

MALE GENITALIA

Ever since Petersen's epoch-making work on the genitalia of Palearctic *Eupithecia*

(1909, *Iris*, vol. 22, pp. 203–313) it has been recognized that in these organs we possess the surest means of determining the species of this very involved and difficult genus. In consequence the greatest emphasis has been laid in the present study on the characters found to exist in both the male and female genitalia. The terms employed are largely those proposed by Pierce in his work on "The genitalia of the . . . Geometridae . . . of the British Islands" (1914), where the individual parts are defined and discussed in detail. Reference should also be made to Petersen's work, where an even more accurate account is given. A repetition of the findings of these two workers seems unnecessary at the present time, and the following paragraphs, therefore, merely deal briefly with the structural variations found in the parts of these organs as they occur in our North American species.

UNCUS: The typical eupitheciid uncus consists of a slender chitinous rod of variable length, attached to a broader, trigonate base; the apex is generally dorsoventrally bifid or what Pierce terms "hooded," the dorsal process resembling a short, sharply pointed hook, the ventral process being less chitinized and with its tip more rounded. Such a type, of which Pierce figures numerous examples, is general throughout the *satyrata* group. In most instances the dorsal hook projects beyond the ventral one, but at times the reverse is the case (e.g., *nevadata* group) and when this occurs it may result in the dorsal portion's becoming reduced to a very short, almost obsolete spine on a chunky base as in *affinata* Pearsall and still more so in *purpurissata* Grossbeck and *mystiata* Cassino.

In another group of species, notably *palpata* Packard and its allies, the uncus is long and simple, the apex being drawn out to a sharp point; this type is also found in the *mutata* group. Other species with simple uncus show a more normal length, the thickness varying from chunky (*bryanti* Taylor) to very thin (*huachuca* Grossbeck). *Gibsonata* Taylor and its close relation *arceuthata* Freyer are the only species in the *satyrata* group with simple uncus, which is a useful character in separating from *satyrata* and its races. In a single instance (*coloradensis* Hulst) the uncus is rudimentary, being reduced to a short, weak, membranous projection.

TEGUMEN: The tegumen, or that portion of it caudad of the claspers (valvae), is cone-shaped, the sides sloping inward from a base of variable width to a pointed or rounded apex to which the uncus is attached. While quite variable in width and height little use has been made of it as a means of separation of species. Its apparent width depends to a large degree on the extent to which the claspers have been opened out in the preparation.

VINCULUM (SACCUS): The great majority of species show a broad, short vinculum, the apical margin being slightly rounded or truncate. In a few species, however, the vinculum is considerably longer, the sides sloping inward to a narrowly rounded apex. This type occurs in *sierrae* Hulst and its allies. No particular use has been made of the character as a means of separation, but in the detailed descriptions under the specific headings it has been mentioned and at times might prove useful.

CLASPER (VALVA): The normal clasper is a simple one, generally with a variably broad base tapering gradually to a narrowly rounded or almost pointed apex. It may be quite short and chunky, as in *undata* Freyer (*scriptaria*) and *cimicifugata* Pearsall, or evenly narrow throughout, as in *alpinata* Cassino and its western allies. In a single species (*huachuca* Grossbeck) there are indications of a small harpe in the shape of a short blunt process in the median section of the angled clasper. In a goodly number of other species the ventral margin towards its middle is supplied with a very variably shaped projection ranging from the fine spines of *misturata* Hulst and *sperryi* McDunnough through the slight, rounded projections of *albipunctata* Haworth and *luteata* Packard to the long, curved, finger-like processes of *adequata* Pearsall, *subapicata* Guenée, and *cestata* Hulst.

An entirely different type of clasper exists in the *palpata* group and to a lesser extent in *miserulata* Grote and the *albicapitata-mutata* group. Here we find a long, narrow clasper, simple otherwise in the last-named group but with an incipient sacculus, a median bulge on the costal margin and an upturned apex in the *palpata* series. In *miserulata* there is no costal bulge, but a sacculus is definitely present.

Finally we meet with a few species with asymmetrical claspers and strong projections along the ventral margins. This asymmetry is only slight in *segregata* Pearsall and presumably *vitreolata* Cassino and Swett but very noticeable in *gilvipennata* Cassino and Swett and *miamata* Cassino and carried to an extreme in *gilata* Cassino and *plumasata* McDunnough which show extraordinary development along the ventral margin and possess a distinct sacculus. One other species of uniquely aberrant type is worthy of mention, viz., *woodgatata* Cassino and Swett, in which the clasper widens sharply from base to apex and then is abruptly and squarely cut off with a thin, finger-like process situated just proximad of the ventro-apical corner.

AEDEAGUS: Very few diagnostic characters are found in the aedeagus. It is generally evenly tubular, varying considerably in both length and width in the various species, occasionally slightly sinuate or with a much narrowed proximal end; a few species (*deserticola* McDunnough, *nevadata* Packard) show a rather funnel-shaped type. The greatest variation is found in several species centered around *niveifascia* Hulst, such as *agnesata* Taylor, *joanata* Cassino and Swett and *flavigutta* Hulst, which in many other respects are quite aberrant.

VESICA: The vesica itself is an eversible membrane, frequently finely spiculate. It contains numerous and very variably shaped pieces of chitin, the number and size being constant in any one species and of the utmost importance as a means of determination. Thus we have the small, toothed pieces of chitin characteristic of the *satyrata* group; the long, pointed rods found in *herefordaria* Cassino and Swett and its close associates; the short, pointed spines of the *innotata* group; and the simple twisted and semi-cylindrical piece of chitin typical of most of the *palpata* group. Many other types and combinations exist which are fully dealt with under the specific headings.

VENTRAL PLATE: This more or less chitinized plate occurs on the sternite of segment VIII and is one of the most important and most easily observed characters in specific determinations, necessitating in most cases merely the removal of a few scales from the ventral tip of the abdomen in order to ob-

serve the structure. In shape it shows all manner of variations, although in certain groups it is restricted to a more or less constant type. Thus we have the two long, often bowed rods, narrowly joined at their bases, which occur throughout the *palpata* group with merely slight variations; then in the *satyrata* group the plate consists of a single rod arising from a broad base and bluntly rounded apically. These are merely two illustrations, the matter being fully dealt with in the text and the illustrations.

FEMALE GENITALIA

OVIPOSITOR LOBES: In some instances the shape and size of these lobes have been found to be of considerable value, and several different types have been illustrated. The matter, however, has not been investigated very fully, partly owing to the delicate structure of those lobes and the difficulty in securing preparations that could be accurately compared. A more detailed study might be productive of good results

APOPHYSES (ANTERIOR AND POSTERIOR): Very little study has been made of the posterior apophyses (these arise from the inner side of the ovipositor lobes) other than to note that in the genus *Prorella* they are abnormally long, a character that has been considered as possessing generic value. The anterior apophyses arise from the cephalic end of the dorsal plate of segment VIII and are usually quite short. Most species show a short branch arising near the proximal end which has been termed the "caudal spur," curving as it does caudoventrad and ending on a thin chitinous strip that frequently bears scale tufts. Occasionally this spur is absent. No very intensive study has been made of this structure, but it is always mentioned under the detailed genitalic description of each species.

OSTIUM: In a large proportion of species the ostium is simply a broad membranous opening at the cephalic end of the eighth sternite leading into the ductus bursae. In some instances it is short, funnel shaped, and finely spiculate (e.g., *palpata* group). In others it has become strongly chitinized and lengthened and often attached caudally to the terminal ends of the caudal spurs of the anterior apophyses. When such a struc-

ture occurs it has been termed an "ostium pouch." This type is most frequently met with in species from the western and southwestern areas (e.g., *segregata* Pearsall, *huachuca* Grossbeck, *niveifascia* Hulst, *flavigutta* Hulst, *adequata* Pearsall, and the eastern *anticaria* Walker) and reaches an extraordinary development in *woodgatata* Cassino and Swett and *gilata* Cassino. Indications of this pouch are present in the *innotata* group and the *nevadata* complex, the chitinization being replaced by a heavy shagreening or fine spiculation. While very useful in separating species its presence would not appear to indicate close specific relationship except in such instances where other characters point obviously in this direction.

DUCTUS BURSÆ: Generally a short membranous tube which at times may attain a considerable length, as in *misturata* Hulst and species centering around *dichroma* McDunnough. In most instances its cephalic termination is formed by a chitinous half ring, more or less open on the ventral side, which is termed the "collar." The shape, size, or occasional entire absence of this collar is a useful character.

BURSA: Extremely variable in shape, size, and position of the spined areas in the internal armature. These differences are of the utmost importance from a specific standpoint, but considerable care should be used in evaluating them. In the first place it is very difficult in making preparations to secure a similar degree of inflation in the organ. Slides made from freshly mated females in which the bursa is well distended by the spermatophore appear superficially somewhat different from those prepared from unmated material or from older, worn specimens in which the ova have been largely deposited. In these specimens the bursa walls tend to collapse, and even with the most care-

ful treatment the bursa cannot be restored to its original shape. Such a flattened condition of the bursa can also occur when the cover glass of the slide presses too heavily on the object. This is largely owing to the use of too thin a mixture of Canada balsam or the neglect to insert thin pieces of glass beneath the cover glass to support it. The author has examined many slides that have been almost completely ruined by such careless methods. In the second place a certain amount of variability in the extent of spined areas must also be discounted. This is particularly the case with smaller areas with a limited number of spines, the actual number of spines being highly inconstant. It is impossible to discuss in the present section in full detail all the numerous variations that occur in the structure of the bursa, but these will be fully treated in the description of the organ given under each specific heading. It might be well to emphasize again that a careful study of Petersen's remarks on the bursa and its structure (*op. cit.*, pp. 220-223) might be very helpful to those unfamiliar with genitalic structure.

DUCTUS SEMINALIS: The position of the outlet of this ductus is extremely variable. It may be situated dorsally or ventrally, on the right side or the left side of the bursa. Generally speaking it is placed at or near the proximal end of the organ, but some instances occur (*pygmaeata* Hübner, *subcolorata* Hulst) where it arises from the distal end near the fundus. The actual ductus is probably a very fine, hair-like tube, but its origin from the bursa is usually an enlargement of the membranous bursa wall which may vary from a small knob to a long broad tube. In the individual descriptions this whole process is referred to as the ductus seminalis. Its size and position are of great value from the systematic standpoint.

THE *PALPATA* GROUP

This very compact group of closely related species has already been discussed in considerable detail (McDunnough, 1944, Canadian Ent., vol. 76, pp. 45-56). Since then further and more intensive studies have resulted in certain alterations connected with individual species, but in the main the value of the

group characters has been confirmed. As now differentiated the group stands out so sharply from the great bulk of the eupithecias that it seems logical to head the list with this series.

The main characters of the group are to be found in structural details of palpi and

more particularly genitalia. To this can be added a certain general similarity of wing pattern, although such pattern may occur in other non-associated eupithecias. The palpi, in all the species involved, are long, porrect, and blade-like, the scaling being thick and close, but it should be pointed out that this character alone is not sufficient for placement in the group. In the male genitalia the uncus is long, thin, and terminates in a single, well-developed spine, the whole structure being much larger than in other species of more normal character that possess the simple uncus. The claspers are quite characteristic, being long, narrow, with somewhat upcurved apex and generally a small bulge in the central region of the costa; there is a rather well-developed cluster of long hairs near the base on the inner side. Hair pencils of segment IX are absent in the majority of the species, and when this is the case the ventral margin of the clasper is furnished with long hair. A few species possess the hair pencil in various degrees of development, this evidently being a purely individual and not a group character.

The aedeagus is generally broad and chunky, and the armature of the vesica consists in the main of a single twisted and semi-cylindrical piece of chitin of various length and contour in the different species. Additions to this consist of variably arranged small clusters of spines. The ventral plate of segment VIII is also characteristic, being composed of two long, chitinous rods, narrowly connected at the base, frequently somewhat outbowed, and with their apices incurved and sharply hooked or spoon shaped when viewed laterally. In the female genitalia the ostium consists of a small funnel, finely spiculate or shagreened. The ductus bursae is membranous and without a chitinous collar and enters the bursa somewhat distad of its apex. The bursa has a long neck, at times strongly striate, its apex forming a small blind sac. It gradually broadens into the bursa proper, which may be either globular or shoe shaped. The position of the ductus seminalis is variable.

The male antennae of most of the species are distinctly bifasciculate. In a few species this fasciculation is not evident, and the rather sparse ciliae are more generally and

evenly distributed, but in such cases they are definitely longer than in those species in other groups (e.g., *misturata*) which possess a fine and evenly distributed ciliation. The most frequent and noticeable feature of the maculation of the primaries is the intensification of the t.a. and t.p. lines. These then form two dark, parallel, and inwardly oblique lines which are frequently sharply angled outwardly below the costa. This type of maculation is, as already noted, not entirely confined to the *palpata* group but taken in conjunction with the long palpi is frequently useful in placing a specimen correctly.

Eupithecia palpata Packard

Plate 26, figure 1; text figure 1A

Eupithecia palpata PACKARD, 1873, Fifth Rept. Peabody Acad. Sci., p. 58; 1876, A monograph of the geometrid moths . . . of the United States, p. 58 (*partim*). TAYLOR, 1907, Canadian Ent., vol. 39, pp. 165, 276, 278, 280. GROSSBECK, 1907, Ent. News, vol. 18, p. 196. SWETT, 1908, Ent. News, vol. 19, p. 196. TAYLOR, 1909, Canadian Ent., vol. 41, p. 425. McDUNNOUGH, 1904, Canadian Ent., vol. 72, p. 36, pl. 3, fig. 3. MCGUFFIN, 1942, Canadian Ent., vol. 74, p. 150 (biology). McDUNNOUGH, 1944, Canadian Ent., vol. 76, p. 45. MCGUFFIN, 1945, Canadian Ent., vol. 77, p. 54. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 168.

This species is one of the commoner ones in eastern North America and is often very abundant in spruce woods. It should be readily distinguished from other common eastern species, apart from its long palpi, by the deep brownish coloration of the body and primaries with the two oblique, parallel, dark cross lines enclosing the median space and showing a short blunt outward angulation in the cell. The pale s.t. line is not particularly striking but generally forms a small white spot above tornus; it is relieved to a certain extent by short blackish streaks on both sides; this gives a slight striate appearance to the terminal section of the wing. The discal dot is quite improminent. The abdomen is almost entirely deep brown dorsally, with traces of a whitish median line which originates in some pale scaling on the scutellum of the mesothorax, and black lateral streaking; ventrally prominently whitish with slight black sprinkling. There is no indication of a dark trans-

verse band on segment II which is one of the best means of separation from *columbiata erpata* Pearsall, the only eastern species with which it could easily be confused. The dark, blade-like palpi project beyond the front for a distance fully as great as the length of the head from vertex to anterior edge of front. The male antennae are rather feebly bifasciculate, another point of distinction from *erpata*. The small bunches of rather short ciliae arise from minute tubercles, but the fasciculate nature is often much obscured by the large number of secondary ciliae distributed over the entire ventral portion of each segment.

MALE GENITALIA: Segment IX without hair pencils. Tegumen broad at base, tapering conically. Uncus long, thin, well chitinized, terminating in a well-developed hook. Vinculum broad but rather short with square-cut apical margin. Clasper typical of the whole group, being long, narrow, with distinct costal bulge near middle, a bunch of long, curving hairs near base and a dorsally upcurved apex; the ventral margin in basal half folds inward, giving the appearance of an incipient sacculus. Aedeagus moderately stout, the apical section distinctly striate. Vesica with a single large piece of semi-cylindrical chitin which occupies nearly the proximal half of the organ. Ventral plate of segment VIII consisting of the two typical, stout rods, expanded and shortly connected at base, rather straight and fairly close together, incurved and hook-like in their apical fifth.

FEMALE GENITALIA: Dorsal plate of segment VIII lightly chitinized and almost square with strongly reënforced cephalic margin, from the edges of which the rather short anterior apophyses arise, sending a short spur ventrad to the lateral edges of the membranous and feebly spiculate ventral plate. Ostium consists of a short, moderately broad, spiculate funnel, continued by a short, equally broad, membranous ductus which enters the much broader bursa neck on the right side, a little below the apex of its blind, sac-like, caudal end. This neck is membranous, finely striate, and of more or less equal breadth throughout. The broad, membranous ductus seminalis arises on the right dorsal side near its distal end, bends cephalad for a

short distance, and then narrows suddenly to a fine, thread-like tube. The bursa is small, globular, and covered over its entire dorsal and ventral surfaces with moderately large spines, with the exception of a small area below the inception of the ductus seminalis.

TYPES: Holotype, male, Brunswick, Maine (M.C.Z.); allotype, female, and paratype, male, Albany, New York (State Museum, Albany, New York).

DISTRIBUTION: General throughout the eastern United States and Canada, extending southward at least as far as North Carolina (Black Mountains). A few specimens are in the Canadian National Collection, bred by the Forest Insect Survey from larvae on *Pinus contorta* and *Picea engelmanni*, from the Arrow Lake and Skeena River districts of British Columbia.

LIFE HISTORY: The species has been bred by members of the Forest Insect Survey at Ottawa from larvae beaten nearly full grown from Jack pine, white pine, and red pine. McGuffin cites as further food plants red, white, and Engelmann spruce, balsam, and tamarack (*Larix*). Strange to say, numerous attempts by the author to breed the species from the egg have failed. After hatching, the young larvae, although supplied with many of the above food plants, only nibbled occasionally and invariably died before the first moult.

***Eupithecia slossonata*, new species**

Plate 26, figure 2; text figure 1B

Of the same size, general coloration, and maculation as *palpata* and practically indistinguishable from it on superficial characters. The palpi are of the same length as in *palpata*, and the male antennae show the same weak bifasciculation. The color of primaries is a deep smoky brown with blackish cross lines of a rather upright character, the t.a. line showing a weak outward angle below the costa and the t.p. line gently rounded in this area. A more or less evident dark subterminal band precedes the s.t. line which is best evident as a white spot above the tornus. The discal spot is small. Secondaries pale smoky with a quite prominent, oblique, postmedian line which seems to show less of a bend below the costa than is the case in *palpata*; a weak subterminal dark band is present and is sepa-

rated from the darker terminal area by a paler section. There is little indication of a paler s.t. line. Beneath, the postmedian and subterminal lines are heavily marked on both wings.

The main differences from *palpata* are found in the male genitalia. The ventral plate of segment VIII shows a broad, blunt, inward projection on each rod below the terminal hooks, a feature not found in *palpata*. The piece of semicylindrical chitin in the vesica appears longer and somewhat differently shaped, and the aedeagus itself shows a slightly greater length.

HOLOTYPE: Male, Florida, collection Mrs. A. Slosson, in the American Museum of Natural History collection.

While the type locality is not definitely stated on the label, it may be surmised that the specimen was captured in the Biscayne Bay area where Mrs. Slosson did most of her collecting. It seems fitting to name the species after the collector, whose pioneer work in Florida was productive of so much interesting material.

A second male specimen taken by F. Lemmer at Lakehurst, New Jersey, on May 1 has been examined in the Buchholz collection. On the strength of similarity of the ventral plate, it would seem to belong here, but more material, especially females, is needed to decide the question. It is well known that the Lakehurst pine barrens have produced many species that are otherwise known only from localities much farther south, so that the occurrence of the species in this region would not be surprising.

***Eupithecia albimontanata* McDunnough**

Plate 26, figure 3; text figure 1C

Eupithecia albimontanata MCDUNNOUGH, 1940, Canadian Ent., vol. 72, p. 36, pl. 3, fig. 2; 1944, *ibid.*, vol. 76, p. 46.

Little can be added to what has already been noted concerning this species in the original description and the 1944 note, as the type material is not available at the present time for further study. Apart from the genitalic differences the very long palpi and the stronger and more definite bifasciculations and longer ciliae of the male antennae, together with the blacker coloration of the primaries, should distinguish the species from

palpata, to which it is closely allied. A more detailed description of the genitalia drawn up from the holotype and allotype follows.

MALE GENITALIA: Hair pencils absent. Tegumen broad at base and sharply conical towards apex. Uncus long, strong, and with a sharp terminal hook. Vinculum very broad with its apical margin almost straight. Clasper much as in *palpata* with a well-developed costal bulge but somewhat longer and slightly narrower. Aedeagus much as in *palpata*, slightly longer, armature very similar. Ventral plate of segment VIII with longer rods, rather thinner and more widely separated than in *palpata*.

FEMALE GENITALIA: Dorsal plate of segment VIII quite strongly chitinized in the cephalic two-thirds of the segment, forming a rectangle considerably broader than long and containing, above the cephalic edge centrally, an oval, pale, membranous space. Apophyses much as in *palpata*; ventral plate entirely membranous. Funnel-shaped, spiculate ostium rather narrow, continued by a membranous ductus bursae longer and narrower than in *palpata* and entering the bursa neck on the right side just below the rounded apex which projects slightly to the left. Bursa neck shorter and broader than in *palpata*, entirely membranous and very finely, but rather weakly, striate. The ductus seminalis arises broadly near the distal end of the neck definitely on the right side and not semi-dorsal as in *palpata*; it curves cephalad for a short distance before bending across the dorsal side of the bursa and narrowing. The bursa is larger and less globular than in *palpata*, being projected considerably to the right; it is largely covered with fine spines but these become obsolete on the right side above the fundus; there is also a considerable spineless area on the ventral side below the base of the neck; the spines on the right side below the exit of the ductus seminalis are the longest and strongest.

TYPES: Holotype, female, allotype, male, White Mountains, Arizona (C.N.C.).

DISTRIBUTION: Known from the White Mountain section of Arizona and will probably occur in adjacent New Mexico; a single female from Estes Park, Colorado (*ex* Sperry collection), has been examined.

LIFE HISTORY: Unknown.

***Eupithecia longidens longidens* Hulst**

Plate 26, figure 4; text figure 1D

Tephroclystis longidens HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 270.

Eupithecia longidens, PEARSALL, 1910, Proc. Ent. Soc. Washington, vol. 12, p. 140. MCDUNNOUGH, 1940, Canadian Ent., vol. 72, p. 35, pl. 3, fig. 1; 1944, *ibid.*, vol. 76, p. 46.

The species is very poorly represented in collections and it has only been possible, in consequence, to study very limited material. The type in the Hulst collection is a female, not a male as previously stated; the abdomen is lacking but a male specimen in the American Museum of Natural History with the same locality data matches it excellently. The characteristic feature of the maculation of the primaries is found in the two dark, oblique lines enclosing the median space; the inner one (t.a. line) is very sharply angled below costa, the point of the angle touching the small discal dot, the outer one shows a smaller and weaker angle. The median space and the space exterior to the t.p. line are quite pale in coloration, and the whole wing has a gray appearance with the cross lines, in consequence, showing up more sharply. The palpi are longer than in *palpata*, heavily and closely scaled; the front is pale with considerable dark sprinkling, forming more or less of a dark band across the anterior margin; the male antennae are much more strongly bifasciculate than in *palpata*; there is no indication of a dark band dorsally on segment II of the abdomen.

MALE GENITALIA: Very similar in many respects to those of *palpata*. The clasper is somewhat narrower but of the same general shape; the aedeagus is slightly thinner and the chitinous plate of the vesica smaller and differently shaped. In the ventral plate of segment VIII the two arms are shorter and irregularly thicker, more or less parallel, their apices being blunt, spoon shaped, and somewhat incurved.

FEMALE GENITALIA: Similar in general details to *palpata*. The ductus bursae enters the bursa neck on the dorsal side rather obliquely, shortly below the apex of the blind sac. The bursa neck is thinner than in *palpata*, very weakly chitinized but decidedly striate; the origin of the ductus seminalis is on the right

dorsal side, considerably more proximad than in *palpata*. The bursa itself is rather more ovate in shape than in *palpata* and is not completely covered with spines, membranous areas occurring on both sides above the fundus and the whole of the proximal section on the ventral side being free of spines.

TYPE: Holotype, female, Colorado (Rutgers University, New Brunswick, New Jersey).

DISTRIBUTION: Colorado (Glenwood Springs); New Mexico (Las Vegas; Jemez Springs, July 23); Utah (Eureka, August 18).

***Eupithecia longidens kerrvillaria* Cassino and Swett**

Plate 26, figure 5; text figure 1E

Eupithecia kerrvillaria CASSINO AND SWETT, 1924, Lepidopterist, vol. 4, p. 27. MCDUNNOUGH, 1944, Canadian Ent., vol. 76, p. 46.

Since noting the close relationship between *kerrvillaria* and *longidens*, based on the male genital structure, the study of the female genitalia has been made possible from a topotypical specimen in the collection of the American Museum of Natural History. They prove to be similar to those of *longidens* and, in consequence, it seems best to treat *kerrvillaria* as a racial form, occurring in Texas. It is characterized by its smaller size and its general light brownish tinge as compared with the smoky gray color of the type form. In other structural details it agrees with *longidens*.

Kerrvillaria is apparently known only from Kerrville, Texas, and the few specimens in the various museum collections probably all came from the original collector, Mr. R. Lacey, and were distributed by Dr. Barnes.

TYPES: Holotype, male, and allotype, female, Kerrville, Texas (M.C.Z.).

LIFE HISTORY: Unknown.

***Eupithecia ornata* Hulst**

Plate 26, figure 6; text figure 1F

Tephroclystis ornata HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 267.

Eupithecia ornata, PEARSALL, 1910, Proc. Ent. Soc. Washington, vol. 12, p. 140.

Eupithecia exornata BARNES AND MCDUNNOUGH, 1912, Contributions to the natural history of the Lepidoptera of North America, vol. 1, no. 4, p. 31, pl. 14, fig. 14.

Eupithecia ornata, MCDUNNOUGH, 1929, Ca-

nadian Ent., vol. 61, p. 63 (*partim*); 1944, *ibid.*, vol. 76, p. 51, pl. 4, fig. 8 (*partim*); 1945, *ibid.*, vol. 77, p. 63.

For a while *ornata* was erroneously considered by the author to be the female sex of *edna* Hulst, and the genitalia were figured under this name. This error was corrected, however, in 1945, and the species established as a valid one. It was originally based on material collected by Bruce in Colorado and by Dr. Barnes in Glenwood Springs, Colorado (August), and it is quite probable that the type female, figured in the "Contributions" under the name *exornata*, was one of the type lot and that the alteration in the name was a *lapsus calami* on the part of Hulst; in any case it represents the true *ornata*.

In structure of palpi and male antennae this species is very similar to *longidens*, the palpi being slightly shorter and somewhat more pointed. The wing maculation of the primaries shows considerable difference, the dark cross lines being more upright and the postmedian one almost without any outward curve below costa; there is also a small dark spot, partially outlined in pale, above tornus which does not appear in *longidens*.

MALE GENITALIA: Very close to *longidens* and scarcely separable from this species. In the light of what little material could be examined it would seem that the tegumen is longer and narrower, the aedeagus a little thinner and longer, and the chitin piece of the vesica smaller. The two rods of the ventral plate of segment VIII are closer together, rather thinner, and their slightly incurved apices are more pointed.

FEMALE GENITALIA: Show considerable difference from those of *longidens*. The ductus bursae is narrower and enters the bursa neck vertically and dorsally and not from the right side obliquely; the bursa neck is shorter and broader, its blind end broad and rounded and jutting out on the left side just below the entrance of the ductus bursae. The ductus seminalis arises on the right side near the distal end of the neck, projecting well away from the bursa and curving downward along the side of the bursa before narrowing. The proximal portion of the globular bursa bears a broad band of spines on the dorsal side which curves around to the ventral side, leaving, however, a broad, membranous space

between the two ends. There is a patch of small spines on the fundus, the remainder of the bursa being membranous with a sprinkling of very minute spines scattered over its surface.

TYPE: Holotype, female, Glenwood Springs, Colorado, August, 1892 (Rutgers University, New Brunswick, New Jersey).

DISTRIBUTION: Similar to that of *longidens*. The only definite records known are from Glenwood Springs, Colorado; Las Vegas and Jemez Springs, New Mexico, in August; and St. George, Utah. The two females from Banff, Alberta, and Ucluelet, Vancouver Island, mentioned under *edna* (1944) should probably be referred to *monacheata*.

LIFE HISTORY: Unknown.

***Eupithecia monacheata* Cassino and Swett**

Plate 26, figure 7; text figure 1G

Eupithecia monacheata CASSINO AND SWETT, 1922, *Lepidopterist*, vol. 3, p. 169. McDUNNOUGH, 1945, *Canadian Ent.*, vol. 77, p. 63.

Eupithecia carolata McDUNNOUGH, 1944, *Canadian Ent.*, vol. 76, p. 47, pl. 4, fig. 1; 1945, *ibid.*, vol. 77, p. 63.

Until more material of this little-known species is available for study, it seems best to leave it as a good species, although it has already been suggested that it may prove to be merely a race of *ornata*, inhabiting the Great Basin region. This latter viewpoint seems to be corroborated by the type of genitalic structure which, in the scanty material available for dissection, agrees very closely with that of *ornata*. The form, as based on typical material from Monache Meadows, is much larger and paler than *ornata*, and the same is true of the specimen from Inyo County, California, mentioned previously (1945), and of the male type of *carolata*. The specimens from Stockton, Utah, included as paratypes in the original description, have already been excluded, as they are smaller and may prove different when they can be more adequately studied. The female from Banff, Alberta, previously listed under *edna* (*ornata*) has again been examined; it is as large as the Inyo County specimen of *monacheata* but much darker in color, being heavily suffused with smoky gray which obscures the maculation. More material must be examined before correct

placement can be made; it could, however, on the strength of the similarity of genitalia, be placed as a northern form of this species.

TYPES: *Monacheata*, holotype, male, Monachee Meadows, Inyo County, California, July (U.S.N.M., *ex* Barnes collection); allotype, female, same data (M.C.Z.). *Carolata*, holotype, male, Charleston Mountains, Nevada, May (C.N.C.).

DISTRIBUTION: Eastern slopes of the Sierra Nevadas and adjacent areas, possibly extending northward to the Canadian border.

LIFE HISTORY: Unknown.

***Eupithecia terrestrata* McDunnough**

Plate 26, figure 8; text figure 1H

Eupithecia terrestrata MCDUNNOUGH, 1944, Canadian Ent., vol. 76, p. 48, pl. 4, figs. 3, 4.

Little further can be said of this species than was contained in the original description. A single worn male has been found in the American Museum collection from the same locality as the allotype and with similar genitalia. From this specimen it has been noted that the male antennae are much more strongly bifasciculate than in other species of the group, the ciliae being, at the same time, considerably longer. In the male genitalia the uncus is very long, thin, and sharply pointed; the clasper is also thin with little of the costal bulge evident; the aedeagus in the present specimen is scarcely as curved as in the original illustration but shows the same type of armature, the small spine cluster containing five spines, more or less welded together at their bases; in the ventral plate the two rods are subequal, rather thicker than in the illustration, and less incurved apically. Such slight differences can only, however, be considered as individual.

TYPES: Holotype, female, Globe, Arizona, July; allotype, male, Santa Catalina Mountains, Arizona; paratype, Jemez Springs, New Mexico (C.N.C.).

DISTRIBUTION: Known so far only from Arizona and New Mexico.

LIFE HISTORY: Unknown.

***Eupithecia columbiata columbiata* Dyar**

Plate 26, figure 9; text figure 1I

Tephroclystis columbiata DYAR, 1904, Proc. U. S. Natl. Mus., vol. 27, p. 891.

Eupithecia columbiata, MCDUNNOUGH, 1929,

Canadian Ent., vol. 61, p. 62; 1944, *ibid.*, vol. 76, p. 46.

This species, which is much better known by its eastern race, *erpata* Pearsall, shows a great deal of superficial resemblance to *palpata* and has been heretofore placed next to it in the lists. However, on account of certain structural details, it would seem best associated with *maestosa* Hulst. From *palpata* it can be primarily separated by the presence of a black transverse band dorsally on segment II of the abdomen, accentuated by considerable pale shading on the preceding segment. The male antennae are not bifasciculate but rather sparsely ciliate, the ciliae being fairly long and arranged more or less in transverse rows across the antennal segments but not arising from definite, raised warts; these same features occur in *maestosa* to a greater or less degree. In the maculation of primaries the s.t. line generally forms a more distinct white spot above the tornus than is found in either *palpata* or *maestosa*, especially the latter, and the black, oblique cross lines, while very similar to those of *palpata*, are scarcely so sharply angled below costa as in this species and are decidedly more defined than in *maestosa*; the palpi are slightly shorter than in *palpata*. The sharpest distinctions are, as usual, found in the genitalia.

MALE GENITALIA: Weak hair pencils indicated on segment IX. Clasper and other sections very similar to *palpata*. Aedeagus considerably thinner than that of *palpata* and vesica armed with a much smaller curved piece of chitin at base; there is some indication of striations in the apical area along with an obscure folded piece of membrane. The lyre-like ventral plate of segment VIII is most characteristic, the rods being strongly bowed in basal half, then curving sharply inward, and terminating in two more heavily chitinized and bluntly pointed sections.

FEMALE GENITALIA: Dorsal and ventral plates of segment VIII and anterior apophyses as in *palpata*. The usual funnel-like ostium is continued by a short, membranous ductus bursae which enters the bursa neck on the dorsal side below the apex. The neck of the bursa is unusually long and bowed outwardly on the left side, its apex forming a blind sac terminating on the right side; the proximal

two-thirds is lightly chitinized but the distal section is membranous; the whole is strongly striate. The ductus seminalis arises dorsally on the left side shortly before the distal end of the neck, curving cephalad and to the right across the bursa where it narrows to a fine tube. The bursa is more or less globular, at times projecting somewhat to the left side; it is entirely covered with fine spining.

TYPES: Holotype, female, Kaslo, British Columbia (U.S.N.M.); allotype, male, same locality (C.N.C., *ex* collection Cockle).

DISTRIBUTION: Known only from British Columbia but probably ranges southward through the Pacific states.

LIFE HISTORY: A female in the American Museum collection bears a label "*columbiata*" in Taylor's handwriting and on the reverse "bred from salmon berry, emerged 2.4.05." No further data are on the specimen, but it presumably occurred on Vancouver Island. No other breeding records are known.

***Eupithecia columbiata erpata* Pearsall**

Plate 26, figures 10, 11

Eupithecia erpata PEARSALL, 1908, Ent. News, vol. 19, p. 193. TAYLOR, 1909, Canadian Ent., vol. 41, p. 427. McDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 62; 1944, *ibid.*, vol. 76, p. 45. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 169.

The name *erpata* has been retained in a racial sense for the eastern form of *columbiata*, which, as a matter of fact, can be separated from the typical form only by its smaller size and possibly a slightly grayer tinge to the brown coloration of the primaries. There are no structural differences.

TYPES: Holotype, male, allotype, female, 12 paratypes, Big Indian Valley, Catskill Mountains, New York (A.M.N.H.).

DISTRIBUTION: Fairly general throughout the eastern United States and Canada but considerably rarer than *palpata*; it occurs only in early spring.

LIFE HISTORY: A Manitoba specimen, received from the Canadian National Collection, has been bred from choke cherry.

***Eupithecia maestosa maestosa* Hulst**

Plate 26, figures 12, 13; text figure 2A

Tephroclystis maestosa HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 269.

Eupithecia maestosa, PEARSALL, 1910, Proc.

Ent. Soc. Washington, vol. 12, p. 141. McDUNNOUGH, 1936, Canadian Ent., vol. 68, p. 259; 1940, *ibid.*, vol. 72, p. 37, pl. 3, fig. 5; 1944, *ibid.*, vol. 76, p. 46.

Tephroclystis multistrigata, DYAR (*nec* Hulst), 1904, Proc. U. S. Natl. Mus., vol. 27, p. 890. TAYLOR, 1906, Canadian Ent., vol. 38, p. 391.

Eupithecia dyarata TAYLOR, 1906, Canadian Ent., vol. 38, pp. 101, 390. BARNES AND McDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 271. McDUNNOUGH, 1927, Canadian Ent., vol. 59, p. 244; 1929, *ibid.*, vol. 61, p. 62; 1936, *ibid.*, vol. 68, p. 259; 1944, *ibid.*, vol. 76, p. 46.

A very widely distributed species in the western half of the continent, extending through the Rocky Mountain and Pacific coast regions from the southern border of the United States into British Columbia. Material from this latter area has been twice given names, but the form found on Vancouver Island seems the only one in which the name *harlequinaria* Dyar might be retained in a racial sense. *Dyarata* Taylor, described from the Kootenay region (Kaslo) of British Columbia, resembles so closely the typical form of *maestosa* from Colorado that it seems scarcely worth while retaining as a race, and it is consequently sunk as a synonym.

The species seems most closely related to *columbiata* Dyar. It has the same type of ciliate (not fasciculate) male antennae, the abdomen shows a dark band across segment II, although not so marked as in *columbiata*, and the general type of wing maculation and coloration is very similar. A point of distinction that might be mentioned is found in the longer palpi, especially in the female sex, although this character is not always constant, the palpal length being subject to a certain amount of variation. The general coloration tends rather towards gray than to the brown of *columbiata*, and the dark cross lines are not so prominent although possibly slightly more sharply angled below the costa. A better distinction is found in the pale s.t. line which in *columbiata* is enlarged to a more or less distinct spot above the tornus but in *maestosa* remains in this area a thin, pale line. A faint brownish tinge at the bases of veins 3 and 4 is frequently present and is a useful character, although occurring also in *columbiata*. In doubtful cases one must fall back on the genitalia which show definite characters.

MALE GENITALIA: Very similar in general structure to those of *columbiata*; hair pencils of segment IX more strongly developed than in *columbiata*; the main distinctions are to be found in the armature of the vesica and the shape of the ventral plate of segment VIII. In the former, besides the curved basal piece of chitin, there is a small series of short spines distad of same and surrounded by a band of minute spicules. In the latter the two rods, while outbowed at base, do not curve inward apically, remaining wide apart with their apices rather bluntly spoon shaped.

FEMALE GENITALIA: Similar to those of *columbiata* in general structure; the ductus bursae is more twisted and enters the bursa neck on the left side below its apex; the bursa neck, while long, is definitely shorter and less bowed than in *columbiata*, lightly chitinized and strongly striate throughout and more expanded distally. The ductus seminalis arises quite laterally on the left side near apex, projecting first outward and then cephalad before crossing the bursa on its dorsal side and narrowing to a fine tube. The bursa is globular, slightly projected to the left, rather larger than in *columbiata*, and completely spined as in this species.

TYPES: *Maestosa*, holotype, female, Colorado (Rutgers University, New Brunswick, New Jersey); *dyarata*, holotype, female, Kaslo, British Columbia (U.S.N.M., *ex* collections Taylor and Barnes).

DISTRIBUTION: General throughout the Rocky Mountain and Pacific coast states, extending north into British Columbia.

***Eupithecia maestosa harlequinaria* Dyar**

Text figure 2B

Tephroclystis harlequinaria DYAR, 1905, Proc. Ent. Soc. Washington, vol. 7, p. 29.

Eupithecia harlequinaria, TAYLOR, 1910, Canadian Ent., vol. 42, p. 80. PEARSALL, 1910, Proc. Ent. Soc. Washington, vol. 12, p. 141. BLACKMORE, 1918, Canadian Ent., vol. 50, p. 214, pl. 3, figs. 1, 2. MCDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 62; 1936, *ibid.*, vol. 68, p. 259; 1944, *ibid.*, vol. 76, p. 46.

There was considerable confusion for some time regarding the identity of *harlequinaria*, but Blackmore's article in 1918 and the subsequent restriction of the name to the female type in the United States National Museum, of which a genitalic slide was made,

satisfactorily cleared up the difficulty.

Harlequinaria can be placed as a race of *maestosa*, occurring on Vancouver Island and characterized by its much brighter and more contrasted coloration, ochreous tints being present which are lacking in the typical form. Structurally it cannot be separated from *maestosa*, although there is a tendency in some individual females in their genitalia for the bursa neck to be broader than usually is the case in mainland *maestosa*.

TYPE: Holotype, female, Victoria, British Columbia (U.S.N.M.).

DISTRIBUTION: Occurs on southern Vancouver Island but may very possibly be found on adjacent areas of the mainland.

***Eupithecia subvirens* Dietze**

Plate 26, figures 14, 15; text figure 2C

Eupithecia subvirens DIETZE, 1875, Stettiner Ent. Zeitg., vol. 36, p. 251, pl. 2, fig. 3. CASSINO AND SWETT, 1922, Lepidopterist, vol. 3, p. 179.

Eupithecia laisata STRECKER, 1899, Lepidoptera, Rhopaloceres and Heteroceres, Suppl. 2, p. 11. MCDUNNOUGH, 1944, Canadian Ent., vol. 76, pp. 46, 55.

Eupithecia diegata MCDUNNOUGH, 1940, Canadian Ent., vol. 72, p. 37, pl. 3, fig. 4; 1944, *ibid.*, vol. 76, p. 46.

The name *subvirens* has long remained unidentified and was omitted from the 1938 "Check list," but after a careful study of the original description and of the apparently quite accurate drawing of the type given by Dietze it has seemed to the author that the name can only apply to the species known as *laisata* Strecker. This species is not uncommon in the San Francisco region, and while the locality for *subvirens* is given merely as "California," there is quite a probability, taking into consideration the date of description, that Dietze's material came from the same general section. The determination of the true *laisata* has already been the subject of comment (1944). At the present time and until much more material is available there seems little value in holding the name *diegata* as a racial form from southern California. Such specimens as have been examined from this section of the state show a reduction in the light ochreous suffusion found in typical *laisata* and some (but not all) are smaller in size. As other allied species show similar color and form variability it seems in-

advisable to place too much stress on such characteristics.

Subvirens, as now determined, is very closely allied to *maestosa* but considerably paler in coloration, especially in such typical specimens as show olivaceous-ochreous or ochreous shadings over the primaries, this color not occurring in *maestosa*; the dark striations in the terminal area are generally quite prominent and the discal dot on secondaries is practically absent. The palpi are longer and paler, the ciliations of the male antennae of the same type but slightly longer, and the abdomen is strongly suffused with ochreous with the dark transverse band of segment II shading into brown rather than black, and, at times, quite prominent.

MALE GENITALIA: Scarcely distinguishable from those of *maestosa*. The oblique row of small spines in the vesica do not appear to be surrounded by a finely spiculate band, and the rods of the ventral plate of segment VIII are thinner, less outwardly bowed, and consequently somewhat closer together. Both these characters need further verification.

FEMALE GENITALIA: Of the same general type as in *maestosa*. The bursa neck is somewhat shorter and broader and the entrance of the ductus bursae more dorsal. The main distinguishing feature, however, is found in the position of the ductus seminalis which, arising on the left side as in *maestosa*, runs caudad nearly to the proximal end of the neck before bending downward to cross the upper end of the bursa on the dorsal side.

TYPE♂: *Subvirens*, California (destroyed); *laisata*, holotype, California (Chicago Natural History Museum); *diegata*, holotype, female, and allotype, male, San Diego, California (C.N.C.).

DISTRIBUTION: Coastal region of California, typical in the San Francisco Bay section; Santa Catalina Island (Avalon).

LIFE HISTORY: Unknown.

***Eupithecia castellata* McDunnough**

Plate 26, figure 16; text figure 2D

Eupithecia castellata McDUNNOUGH, 1944, Canadian Ent., vol. 76, p. 47, pl. 4, fig. 5.

Since the original description was published, three further quite perfect females from Mt. Shasta, Siskiyou County, taken in early July and kindly submitted by W.

Bauer of Petaluma, have been examined, also a female from the Charleston Mountains, Nevada, and other females from Yosemite Park and the upper Santa Ana River, San Bernardino County, California (*ex* Sperry collection). In the single specimen from Shasta of which a genitalic slide has been made, the spining of the bursa and the general shape of the neck and ducti are similar to the figure given with the original description; owing to the less inflated condition the shape of the bursa is less shoe-like, the bulge of the toe portion being reduced; the Charleston Mountains specimen matches the figure excellently. With better specimens it has been possible to check the original description, which on the whole proves fairly satisfactory. It might be noted that the median area between the two oblique lines is somewhat paler than the basal section, being less suffused with smoky. The pale subterminal area is bordered outwardly by a dark band which originates in a strong rectangular patch on costa, the terminal area being slightly paler than the aforesaid band. Too much stress has been laid on the non-crenulate nature of the s.t. line which actually is feebly dentate, slightly enlarged in the interspace between veins 3 and 4, and again above tornus.

Until the male sex has been examined the exact placement is uncertain, but judging by the shape of the bursa in the female genitalia the species must run close to *chiricahuata* McDunnough.

TYPES: Holotype, female, Castella, Shasta County, California, June, and paratype, female, Chester, California (C.N.C.).

DISTRIBUTION: Sierras of California and adjacent mountain ranges in Nevada, as far as is known.

LIFE HISTORY: Unknown.

***Eupithecia chiricahuata* McDunnough**

Plate 26, figure 17; text figure 2E

Eupithecia chiricahuata McDUNNOUGH, 1944, Canadian Ent., vol. 76, p. 51, pl. 4, fig. 6.

Represented by only the type female contained in the Canadian National Collection. The original description gives all the details known concerning the species. Among the unnamed material in the collection of the American Museum, a worn specimen from

Provo, Utah, July 21, has been unearthed with genitalia very similar to that of *chiricahuata*, the bursa being almost exactly the same and only minor differences occurring in the length of the ductus bursae and the bursa neck. In maculation this specimen is rather heavily suffused with smoky gray but appears to be closer to *castellata* than to the present species, notably in the relation between the t.p. line and the discal dot, on which possibly too much stress was laid in the original description. Until more material can be examined the specimen is placed very tentatively under *chiricahuata*.

TYPE: Holotype, female, Barfoot Park, Chiricahua Mountains, Arizona, May 23 (C.N.C.).

DISTRIBUTION: So far known only from Arizona.

LIFE HISTORY: Unknown.

***Eupithecia insolabilis* Hulst**

Plate 26, figure 18; text figure 2F

Tephroclystis insolabilis HULST, 1900, Jour. New York Ent. Soc., vol. 8, p. 215.

Eupithecia insolabilis, MCDUNNOUGH, 1944, Canadian Ent., vol. 76, p. 47.

Until quite recently the only known specimen of this species was the worn type female from Arizona in the Hulst collection from which a genitalic slide had been made a number of years ago. Among the undetermined material in the American Museum collection a female from Provo, Utah, July 26, has been discovered, the genitalia of which match excellently a drawing of the type slide. Unfortunately the specimen is in poor condition, and little trace of any maculation can be seen, although, to judge by the type, the maculation in any case is very obscure. The general coloration of the wing is a light brownish gray finely sprinkled with whitish, the secondaries somewhat paler than the primaries. On the latter are traces of a small discal spot, a t.a. line angled outwardly below costa, a postmedian line weakly outcurved below costa and somewhat accentuated by short dark dashes inwardly, some dark spotting on the cubital vein, and a broken dark terminal line. On the secondaries the dark postmedian line is visible as a straight dash above inner margin, and there is evidence of a darker terminal shade. The

palpi are fully as long as in *catalinata* and largely pale fuscous outwardly. The antennae are very finely ciliate but show, especially in the apical half, a single somewhat longer seta, laterally placed on the inner side and arising from a minute wart; this would appear, unless the character is a group one, to link the species to *catalinata* which has a similar structure. The position of the species is, however, doubtful until a male can be examined.

FEMALE GENITALIA: Ostium funnel shaped and spiculate as usual. Ductus bursae rather broad, entering the bursa neck on the dorsal side below apex. Bursa neck very broad and chunky, the proximal half broadest, with the apex strongly rounded, the distal section narrowed towards the entrance into the bursa and becoming more chitinized and heavily striate. Ductus seminalis arises broadly on the right side distally, curving first outward and then inward, narrowing as it crosses the upper dorsal section of the bursa. The globular bursa is entirely unspined on the ventral side but covered with spines dorsally with the exception of a narrow membranous band on the right side.

TYPE: Holotype, female, Arizona (Rutgers University, New Brunswick, New Jersey).

DISTRIBUTION: Known only from Arizona (no further data given) and Utah (Provo).

LIFE HISTORY: Unknown.

***Eupithecia catalinata* McDunnough**

Plate 26, figure 19; text figure 2G

Eupithecia catalinata MCDUNNOUGH, 1944, Canadian Ent., vol. 76, p. 50.

In the collection of the American Museum, among the unnamed material, two pairs of this species have been found which probably originally came from the Barnes collection through J. A. Grossbeck. They are all labeled "Redington, Arizona," and as one pair is in excellent condition a few additional notes on structure and maculation, as well as a description of the female genitalia, can now be given.

The palpi are long and thin and their coloration, along with that of the head, is largely light ochreous with only slight admixture of dark scaling. The male antennae are finely ciliate, not fasciculate, and there is, in addition, a single, short, lateral seta, best

observed in the apical half. The anterior portion of the thorax is broadly deep smoky brown, and there is considerable shading of the same color on the patagia; the scutellum of the mesothorax is similarly dark but shows a distinct pale posterior margin. The abdomen is dorsally largely light fawn color, but a certain amount of paler, light ochreous suffusion is present on segments I, III, and IV which tends to give a very slight banded appearance to segment II. The dark dorsal tufting is scarcely indicated, and there is present laterally considerable black sprinkling on the posterior segments. The ventral surface is entirely pale ochreous. The "fawn brown" color of the primaries has a distinct yellowish tinge. The t.a. line is well rounded below the costa and then strongly inwardly oblique; it is closely preceded by a parallel dark line, the intervening space being of the pale ground color; basad of these lines on the costa are two small, smoky patches which give rise to the basal and subbasal lines, running more or less parallel to the t.a. line. The median space is largely palish with a small dark discal dot and an obscure median line crossing same. The t.p. line is quite characteristic, being noticeably crenulate or dentate, owing to short, dark, inner dashes on the veins; it is very gently rounded below the costa. The maculation of the outer area is obscure, but the rather strongly dentate, pale, s.t. line can be seen, especially in the areas opposite the cell and above tornus where it is relieved inwardly by dark shading.

MALE GENITALIA: The characteristic features of these organs are the strong inward projections of the rods of the ventral plate below their apices and the structure of the aedeagus with its bilobed apex.

FEMALE GENITALIA: Dorsal and ventral plates and anterior apophyses as usual. Ostium broad, funnel shaped, spiculate. Ductus bursae very broad, membranous, with a conspicuous bulge on the right side, entering the bursa neck vertically on the dorsal side. Bursa neck very broad with its apical portion forming a rounded blind sac, resting, entirely ventrally, on the distal portion of the ductus; the distal half is lightly chitinized and strongly striate. The ductus seminalis arises about midway on the left side, jutting slightly outward and then curving downward and

across the dorsal surface of the bursa and narrowing gradually. Bursa nearly globular, projected slightly to the right, entirely covered with spines on both surfaces.

TYPE: Holotype, male, Graham Mountains, Arizona (C.N.C.).

DISTRIBUTION: Known only from southeastern Arizona.

LIFE HISTORY: Unknown.

***Eupithecia edna* Hulst**

Plate 26, figures 20, 21; text figure 2H

Tephroclystis edna HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 266.

Eupithecia edna, BARNES AND McDUNNOUGH, 1912, Contributions to the natural history of the Lepidoptera of North America, vol. 1, no. 4, p. 31, pl. 14, fig. 3. McDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 63; 1944, *ibid.*, vol. 76, p. 51 (*partim*); 1945, *ibid.*, vol. 77, p. 63.

This species with its heavy black shading in the median area of primaries (which appears to be broader in the female than in the male) and its strong, black, rather upright cross lines should give little trouble in identification. For some time it was erroneously suggested that *ornata* Hulst was merely the female sex of the species, but this mistake was later (1945) satisfactorily cleared up. The palpi are rather shorter than in the preceding group of species and heavily scaled, the scales forming more or less of a dorsal tuft at the end of the second joint. The male antennae are distinctly bifasciculate, the ciliae being quite long. The thorax and patagia are thickly covered with broad scales, quite noticeably so on the scutellum of the mesothorax.

MALE GENITALIA: Well-developed hair pencils on segment IX; tegumen moderately broad at base, narrowing rapidly and evenly towards apex. Uncus shorter and broader than usual with, however, a strong terminal hook. Vinculum with apical margin broad, almost truncate. Clasper broad and of even width to apex which, in consequence, appears broader than usual; there is little trace of a costal bulge but the basal hair tuft is prominent and extended by a row of hairs towards apex of clasper. Aedeagus long and rather narrow. Vesica with more extended armature than usual, consisting of a small basal piece, formed of two small bands connected by a

strap-like rod, and a much larger and broader chitinous band occupying the distal half of the aedeagus, rather poorly defined, but with its proximal end recurving and quite distinct. Ventral plate of segment VIII of the usual type, the two rods well separated, outbowed, with the apices bent inward and moderately sharp.

FEMALE GENITALIA: Spiculate ostium of the usual shape but rather narrow. Ductus bursae long, membranous, gradually broadening, and entering the neck of the bursa apically on the dorsal side. The bursa neck curves apically to the right, the apex being membranous and rounded, forming a ventral bulge below the entrance of the ductus; the balance of the neck is long, broad, and very strongly striate; the ductus seminalis arises from the caudal end of the striated section on the left side dorsally, juts caudad for a short distance, and bends cephalad along the edge of the neck before narrowing. The small bursa is more or less globular, slightly bulging to the left and covered entirely with spines, those on the left side being longer and more numerous than on the right side below the neck.

TYPE: Holotype, male, Colorado, Bruce (Rutgers University, New Brunswick, New Jersey).

DISTRIBUTION: Arizona (Prescott); New Mexico (Jemez Springs); Colorado.

LIFE HISTORY: Unknown.

***Eupithecia owenata* McDunnough**

Plate 26, figure 22; text figure 2I

Eupithecia owenata MCDUNNOUGH, 1944, Canadian Ent., vol. 76, p. 52, pl. 4, figs. 4, 9.

No further material of this species has been examined since the original description was prepared, and as the type specimens are not at present available for study little concerning the species can be said other than what was contained in the first characterization.

As indicated it is very closely allied to *edna* but easily separable by the much more irregular margins of the black median band and the larger size. Dr. T. N. Freeman, who has kindly examined the male holotype, writes that the antennae are not bifasciculate as in *edna* but that the rather long ciliae are evenly distributed over the whole ventral surface of each antennal segment. The male

genitalia of the two species are very similar, but as far as can be told, the rods of the ventral plate in the present species are longer and less outbowed. In the female genitalia the ductus bursae is shorter and broader, the neck is broader, shorter and less striate but somewhat more heavily chitinized; the apical section is more strongly bent to the right.

TYPE: Holotype, female, Arizona (C.N.C.).

DISTRIBUTION: Known only from the southeastern section of Arizona.

LIFE HISTORY: Unknown.

***Eupithecia longipalpata* Packard**

Plate 26, figure 23; text figure 3A

Eupithecia longipalpata PACKARD, 1876, A monograph of the geometrid moths . . . of the United States, p. 56, pl. 9, fig. 6. MCDUNNOUGH, 1944, Canadian Ent., vol. 76, p. 53, pl. 4, fig. 10.

The large size and the very long, pointed palpi should distinguish this Pacific coast species from any of the previously discussed species of the group. From the following small group it is separable by the fact that the t.a. line shows no sharp outward angle below the costa. The general color of the primaries is light brownish, frequently with considerable of an ochreous tinge. The cross lines are much as in *maestosa*, but there is generally a more strigate appearance in the terminal area owing to a series of short, dark dashes in the interspaces; the pale s.t. line is not particularly well developed but often shows as a white spot above the tornus. The male antennae are very definitely bifasciculate, the ciliae being long and plumose. The abdomen is largely brownish with fairly evident blackish lateral striping.

MALE GENITALIA: Quite normal for the group in appearance. Hair pencils on segment IX lacking. Claspers with distinct costal bulge and very long hairs along the ventral margin. Aedeagus broad, slightly curved, feebly striate apically. Vesica armed with a large piece of curved chitin, situated basally; there are also weak indications of a second, more apically situated, twisted piece. Ventral plate of segment VIII with the bars rather thick, little outbowed and more or less parallel; their apices, when viewed ventrally, appear as sharp, incurved hooks.

FEMALE GENITALIA: Dorsal and ventral

plates of segment VIII and anterior apophyses much as usual. Ostium of the usual shape, broad. Ductus bursae broad, short, membranous, entering the bursa neck slightly from the right side below apex. Neck of the bursa very broad and long with apparently a secondary bulge on the ventral side at one-third its length, heavily striate, but scarcely chitinized. Ductus seminalis arises entirely dorsally in the midsection, its point of exit being reinforced by light chitinization; it bends cephalad and to the left before narrowing. Bursa apparently rather variable in shape according to the degree of inflation, at times quite globular, hardly wider than the neck, in other cases with a distinct projection to the right; the ventral side is completely spined, the dorsal side membranous except along the right edge where the ventral spines overlap somewhat, especially in cases where the inflation is rather poor.

TYPE: Holotype, male, Mendocino, California (M.C.Z.).

DISTRIBUTION: Pacific coast states north to British Columbia, much more common on Vancouver Island than elsewhere according to the material examined. Judging by the dated specimens from Victoria the species flies from late June until early August, but farther south there may be two broods, as a single female from Seattle, Washington, in the American Museum collection is dated April 26.

LIFE HISTORY: Unknown.

REMARKS: The genitalic figures have been drawn from slides of Vancouver Island material. It is possible that when topotypical material from California is available for dissection some slight differences may occur.

***Eupithecia sabulosata* McDunnough**

Plate 26, figure 24; text figure 3B

Eupithecia sabulosata MCDUNNOUGH, 1944, Canadian Ent., vol. 76, p. 55, pl. 4, fig. 11.

Nothing much can be added to the information regarding this species other than what is contained in the original description. It is fairly easily recognized by the pale yellowish or ochreous coloration of the body and primaries. From *subvirens*, which is similarly colored, it can be separated by the much longer palpi. The dark border to the secondaries is distinctly crenulate. In the male

sex the antennal structure is hardly bifasciculate, but the rather short ciliae are evenly distributed over the ventral surface of each segment. *Sabulosata* is probably double brooded, the early spring specimens being larger than those of the summer brood. It has been considered to be an inhabitant of the San Francisco Bay region, but two large females in the American Museum from the Pearsall collection are labeled in handwriting "Plumas County," a locality that will need verification.

MALE GENITALIA: Very similar to those of *longipalpata*. The tegumen is narrower at the base and somewhat higher; the clasper is longer, thinner, and with less costal bulge, but both these differences are very slight and possibly not constant. The aedeagus is distinctly thinner and longer, but the armature of the vesica consists of the same sort of large twisted piece of chitin with a faint indication of a more apical, poorly defined piece. The rods of the ventral plate of segment VIII are thinner, more evenly bowed, and with more finely pointed apices.

FEMALE GENITALIA: Show much more distinction from those of *longipalpata* than does the male sex. Only the cephalic half of the dorsal plate of segment VIII is chitinized. The ostium and ductus bursae are narrower, and the latter enters the bursa neck more vertically. This neck is much narrower and shorter, being quite chunky; it shows considerable chitinization in the distal portion and is strongly striate; as in *palpata* the exit of ductus seminalis is dorsal but much closer to the distal end of the neck than in this species. The bursa is quite distinct, being broadly shoe shaped with the blunt toe pointed to the left; a large portion of the central area and the entire right side are membranous, the spined section consisting of a broad band below the neck, circling around the left side to the fundus where it gradually fades out. The type of bursa is much more similar to that of the following three species than to *longipalpata* and differs only in slight modifications of the spined areas and the thickness of the neck.

TYPES: Holotype, female, and paratype, female, Oakland, California, July (C.N.C.); allotype, male, Lone Mountain, San Francisco, California, September (C.N.C.).

DISTRIBUTION: Central coastal region of California, extending possibly inland into the more mountainous sections.

LIFE HISTORY: Unknown.

***Eupithecia macrocarpata* McDunnough**

Plate 26, figure 25

Eupithecia macrocarpata MCDUNNOUGH, 1944, Canadian Ent., vol. 76, p. 56.

The only specimens examined have been those of the type series, and in consequence little can be added to what has already been noted in the original description.

The brownish olivaceous coloration of the primaries separates the species from the much paler appearing *sabulosata*, and the heavier maculation, particularly in respect to the more numerous cross lines, in addition to this coloration, distinguishes the species from *placidata* and *unicolor*. To all these species *macrocarpata* is very closely allied in all structural details, including genitalia. The male antennae, when viewed laterally, appear to be feebly bifasciculate, but the fasciculation is rather obscured by the large number of ciliae thickly scattered over the entire ventral surface of each segment; the individual ciliae are scarcely as long as in *longipalpata*, but possibly a shade longer than those of *unicolor*, as far as can be judged from very limited material.

GENITALIA: In neither the male nor the female genitalia is there any marked distinction from the same organs in *sabulosata*.

TYPES: Holotype, male, allotype, female, Half Moon Bay, California, February to March (C.N.C.).

DISTRIBUTION: Known so far only from the type locality.

LIFE HISTORY: The type series was bred from larvae found feeding on *Cupressus macrocarpa*.

***Eupithecia placidata* Taylor**

Plate 26, figures 26, 27; text figure 3C

Eupithecia placidata TAYLOR, 1908, Canadian Ent., vol. 40, p. 56. BARNES AND MCDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 272. MCDUNNOUGH, 1944, Canadian Ent., vol. 76, p. 53.

A rather variable species but in general distinguished by its dark palpi as contrasted with the pale gray front, also by the general grayish ground color of the primaries with

rather obscure maculation apart from the two black cross lines, the t.a. line showing a very sharp outward angle in the cell. The median area is variably shaded with light brown, which at times is very extensive and gives the appearance of a broad band of this color crossing the wing. In a single bred male, recently received from F. Rindge, there is a distinct violaceous suffusion over the forewing as in *unicolor*, but on account of the dark palpi and the smaller size placement here is indicated. The male antennae are even less noticeably bifasciculate than in *macrocarpata*, each segment being heavily covered with moderately long ciliae.

MALE GENITALIA: Essentially the same as those of the two preceding species. The aedeagus, while still rather narrow, is somewhat longer and thicker than that of *sabulosata*, and in the armature there seems to be no trace of the obscure apical piece of chitin. The rods of the ventral plate are also somewhat thicker. These differences are slight and may not prove constant.

FEMALE GENITALIA: Extremely close to those of *sabulosata* and *macrocarpata*. The following differences have been noted in the limited material examined: the bursa neck is distinctly broader, and the entrance of the ductus bursae is slightly more from the right side; the spining on the bursa is heavier and on the dorsal side covers two-thirds of the surface, leaving only the heel and an area below the base of the neck membranous; on the ventral side the spining is more as in *sabulosata*, but the spined area does not extend across the base of the neck but commences only in the left corner, extending down the left side and across the fundus, beyond which it gradually peters out. Whether such differences are constant can only be determined when considerably more material can be studied.

TYPES: Holotype, female, Kaslo, British Columbia, July (U.S.N.M., *ex* collection Barnes); paratypes, two females, same locality (C.N.C., *ex* collection Cockle).

DISTRIBUTION: Occurs down the entire Pacific coast area from British Columbia to southern California, but is apparently rather rare in its northern limits; in Sonoma County, California, it has recently been taken in numbers from late July until October. In the

American Museum collection is a single male specimen from Glendale, Utah (June), which seems correctly placed here, and a specimen from Oak Creek Canyon, Arizona, in the Sperry collection has also been examined. There are apparently several broods of the species in the more southern localities, specimens from San Diego having been found as early as February. In the type locality the species is probably single brooded.

LIFE HISTORY: The single male mentioned above was bred at Berkeley, California, by F. Rindge from a larva taken on *Libocedrus decurrens*.

***Eupithecia unicolor* Hulst**

Plate 26, figure 28; text figure 3D

Tephroclystis unicolor HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 271.

Eupithecia unicolor, PEARSALL, 1910, Proc. Ent. Soc. Washington, vol. 12, p. 141. MCDUNNOUGH, 1944, Canadian Ent., vol. 76, p. 53, pl. 4, fig. 12.

Eupithecia cenataria CASSINO AND SWETT, 1922, Lepidopterist, vol. 3, p. 147. BLACKMORE, 1923, Rept. Prov. Mus. Nat. Hist. British Columbia, for 1922, p. 0.33, pl. 6. MCDUNNOUGH, 1944, Canadian Ent., vol. 76, p. 53.

Typical specimens of *unicolor* are characterized by the distinct violaceous coloration of the entire primaries, what Hulst in the original description characterized as "violet-red." The maculation of primaries is confined to the two black oblique cross lines, the t.a. line angled below costa but scarcely so acutely as in *placidata*, the t.p. line gently rounded below costa and scarcely angled; these lines are often quite faint. There is also a small discal dot, and in perfect specimens a white, broken s.t. line shows rather distinctly against the ground color. The palpi, head, and thorax are concolorous with the primaries, and while the former show a certain amount of dark sprinkling they are not nearly so prominently dark as in *placidata*. The male antennae are much as in *placidata*, the bifasciculate nature being feebly indicated. There is a possibility that the name *cenataria* may eventually be employed in a racial sense for specimens from Vancouver Island, but the material from this region that could be examined was not in the best of condition, and no definite distinctions could be noted, either in maculation or de-

tails of genitalia, from the typical form of the Sierra Nevadas.

MALE GENITALIA: The main distinctions from *placidata* consist in the broader aedeagus with possibly a somewhat larger chitinous piece in the armature; the rods of the ventral plate are broader, more outbowed, and there seems a tendency for the one on the right side to be shorter than that on the left.

FEMALE GENITALIA: Very close to those of *placidata*. The ductus bursae is broader and enters the upper end of the bursa neck more vertically, the blind end protruding to the left. The neck is more heavily chitinized, especially around the exit of the ductus seminalis, and the numerous striations are thicker and coarser. The spining of the bursa on the ventral side begins at a point near the lower right hand corner of the neck, extends broadly across its base, down the left side of the bursa and around its toe, crossing the fundus in a gradually narrowing band and petering out before the heel is reached; the membranous section forms a broad band descending around the heel on the right side and projecting into the median area above the fundus. On the dorsal side the spining is very similar but extends scarcely as far across the base of the bursa neck to the right as on the ventral surface.

TYPES: *Unicolor*, holotype, female, Soda Springs, California, September 1 (Rutgers University, New Brunswick, New Jersey); *cenataria*, holotype, female, Goldstream, Vancouver Island, British Columbia (M.C.Z.).

DISTRIBUTION: Much as in *placidata* but apparently more restricted in its typical form to the higher regions and occurring in late summer (July–September); no early records have been noted.

LIFE HISTORY: Unknown.

With *unicolor* the *palpata* group is concluded. The numerous species that follow, until what might be called the *satyrata* group is reached, are more or less arbitrarily placed and follow to a large extent the arrangement of the 1938 "Check list." Attempts to group them according to any individual character, such as the structure of the male ventral plate, the type of uncus, whether simple or bifid, or the ciliation of the male antennae, seem to fall down when applied to characters

of the opposite sex, and similarly a grouping based on the spining of the female bursa or the position of the ductus seminalis does not seem to be borne out by structures found in the male sex. The close morphological similarities found in the *palpata* group, which make it such a compact entity, seem to be practically entirely lacking. In consequence such grouping as has been attempted and which is based largely on male characteristics is not completely satisfactory, although indicating what seems to be a certain vague relationship between individual species. For instance the placement of *miserulata* immediately following the *palpata* group is due to similarities in the uncus and clasper, although in other details the species is highly specialized and remains quite unique. *Misurata* and its close allies or subspecies, *harveyata* and *bivittata*, are left as they stand for no other reason than the impossibility of any more satisfactory placement. The species *pygmaeata*, *bryanti*, *coloradensis*, *regina*, *undata* (*scriptaria*), and *borealis* show a certain degree of relationship based on the generally simple uncus and the two long rods found in the ventral plate, but the female genitalia are strongly variant. *Castigata*, *albipunctata*, and *luteata* with bifid uncus and two shorter prongs terminating the ventral plate are apparently distantly related, while the curious type of ventral plate in *fletcherata*, *kasloata*, and *bradorata*, along with the fact that the weak ductus seminalis arises from the right proximal section of the bursa, makes the grouping of these species fairly reasonable. *Sheppardata* is only doubtfully associated with the above three species, the real relationship being obscure, and *affinata* and *rotundopuncta* follow, although again the position seems hardly satisfactory.

Sierrae, *litoris*, and *quakerata* seem obviously related by the simple uncus, the type of antennal ciliations, and the presence of small lateral tufts on the scutellum of the mesothorax. *Bolterii* is also placed here, rather than in the position it occupies in the 1938 "Check list," on account of the presence of tufts on the scutellum and certain vague genitalic similarities with the preceding species; the uncus, however, is bifid. The section is brought to a close by a number of insufficiently known species, mostly from the

southwestern United States, in which the primaries are usually narrow and pointed, the ventral plate is composed of two parallel rods of varying length and shape, and the armature of the aedeagus is composed principally of long, apically pointed rods.

***Eupithecia miserulata miserulata* Grote**

Plate 26, figures 29–31; text figure 4A

Eupithecia miserulata GROTE, 1863, Proc. Ent. Soc. Philadelphia, vol. 2, p. 32, pl. 2, fig. 4. PACKARD, 1876, A monograph of the geometrid moths . . . of the United States, p. 52 (*partim*). TAYLOR, 1907, Canadian Ent., vol. 39, p. 168. GROSSBECK, 1907, Ent. News, vol. 18, p. 345. SWETT, 1907, Canadian Ent., vol. 39, p. 378. PEARSALL, 1908, Ent. News, vol. 19, p. 312. SWETT, 1909, Canadian Ent., vol. 41, p. 395. TAYLOR, 1909, Canadian Ent., vol. 41, p. 425. PEARSALL, 1910, Proc. Ent. Soc. Washington, vol. 12, p. 141. BARNES AND MCDUNNOUGH, 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 144. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 165.

Tephroclystis nebulosa HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 266. DYAR, 1901, Proc. U. S. Natl. Mus., vol. 23, p. 282 (biology).

Eupithecia nebulosa, GROSSBECK, 1907, Ent. News, vol. 18, p. 343. PEARSALL, 1908, Ent. News, vol. 19, p. 312. TAYLOR, 1909, Canadian Ent., vol. 41, p. 426. BARNES AND MCDUNNOUGH, 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 144.

Tephroclystis plumbaria HULST, 1900, Canadian Ent., vol. 32, p. 102. TAYLOR, 1909, Canadian Ent., vol. 41, p. 427. PEARSALL, 1910, Canadian Ent., vol. 42, p. 313.

Eupithecia plumbaria, BARNES AND MCDUNNOUGH, 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 144.

Eupithecia grossbeckiata SWETT, 1907, Canadian Ent., vol. 39, p. 378. PEARSALL, 1908, Ent. News, vol. 19, p. 313. TAYLOR, 1909, Canadian Ent., vol. 41, p. 427. BARNES AND MCDUNNOUGH, 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 144.

The identity of this species, one of the commonest in the eastern United States, was for a time very doubtful and was the subject of considerable discussion between Swett, Taylor, Grossbeck, and Pearsall. Finally an agreement was reached, and the characters of

the species were admirably summed up by Pearsall (1908), the above synonymy being definitely established. This synonymy has since been confirmed by genitalic slides of the types of both *nebulosa* and *plumbaria*.

The correct determination of the species should not cause any very great trouble, as it possesses a number of structural characters, apart from the very striking and quite unique genitalia, that can readily be noted, even in worn material. The palpi in both sexes are long, porrect, and blade-like, extending far beyond the flat, sloping front and being rather closely scaled with little indication of tufting. In the female sex there is a noticeable tendency for them to be somewhat longer than in the male, a feature frequently to be found throughout the whole genus. Their dark, smoky brown color contrasts rather strongly with the light creamy color of the front which is almost entirely devoid of dark sprinkling, showing, however, a narrow, apical, transverse band of black brown scaling. The antennae, in the male sex, are very characteristic: they are strongly fasciculate and ciliate, each segment being furnished with three pairs of fascicles, consisting of long plumed ciliae on a raised base. The anterior (distal) pair are close together near the median line. The two proximal pairs are placed obliquely as regards each other, the median pair being farthest apart and provided with the longest ciliae and, in addition, a single bristle, arising from the outer edge of the base. This bristle is also found to a modified degree in the female sex, in which the antennae are otherwise much more finely and evenly ciliate, and can often be used as a diagnostic character. A similar bristle has been noted in certain species of the *palpata* group. The abdomen dorsally is largely brownish in coloration, with segment I considerably paler; a dark transverse band on segment II is lacking. The small mediodorsal tufts are largely pale in color, and in consequence the appearance of a broken, pale, dorsal line is simulated. Considerable lateral black shading, especially on segments VI and VII, is present. The brownish coloration of the primaries serves to distinguish the species from *misturata*, with which it has been apparently frequently confused. The most prominent features of the maculation

are the large black discal dots and the distinct subterminal line, composed of a series of white spots, culminating in a larger and more prominent one above the tornus; these pale spots are repeated to a greater or lesser extent on the secondaries.

MALE GENITALIA: Strong hair pencils at the bases of the claspers, freely mixed with long feathery scales, similar scales being also present on the uncus, a feature occurring only in the widely distinct *graefii* Hulst. Tegumen narrow. Uncus well developed, single. Vinculum with the lateral edges wide apart and not joined dorso-apically in the usual manner, the ventrocephalic margin being strongly excavated. Claspers long, narrow, broader at the base, with a distinct, albeit rather weak, sacculus, merging gradually with the clasper before the middle of the ventral edge. Aedeagus rather long and narrow; vesica with long, but weak, piece of partially rolled chitin, to which the usual small end piece is more or less attached; in addition there is a single strong pointed spine with a small cluster of short spines at its base, the number showing considerable variation. Ventral plate of segment VIII very striking and characteristic, consisting of two broad, irregularly shaped, and asymmetrical rods of chitin, scarcely touching at their laterally expanded bases, the left rod produced apically to a broad, blunt point, the right rod truncated.

FEMALE GENITALIA: Dorsal plate of segment VIII rectangular, narrowing caudally. The moderately long, anterior apophyses arising from the laterocephalic edges of this plate send spurs from their bases, directed caudally, to join small, oval, chitinous plates, situated subventrally on each side, the eighth sternite being membranous and feebly spiculate. On its cephalic margin is situated the broad ostium which forms a weakly chitinized and finely striate and spiculate funnel which terminates in a very short, membranous ductus bursae. This ductus is without an apparent chitinous collar and is continued by a twisted bursa neck, the initial portion of which is well chitinized. When viewed dorsally a raised chitinous ridge is very evident, arising narrowly on the left side (right in figure) and rapidly broadening, its distal end reaching to the central section of the bursa and covering a large portion of it. The left

edge of this raised area is comparatively straight, but its right edge bends sharply to the right and terminates in a large, rounded projection from which the narrow, membranous ductus seminalis arises. This whole chitinized portion has somewhat the semblance of a Dutchman's pipe. The section of the neck to the left of the ridge is rather irregularly shaped, practically membranous, with a short, finger-like process jutting out at its distal end. The inner edges of the chitinized ridge are armed with spines of moderate length and quite variable in number and arrangement, this being apparently a purely individual characteristic. The small, oval bursa is completely covered with spines, minute and very numerous. The spined area extends considerably farther caudad on the ventral side than on the dorsal one, reaching slightly beyond the finger-like projection mentioned above.

TYPES: *Miserulata*, holotype, female, northern Virginia (apparently lost); *nebulosa*, holotype (as restricted by Grossbeck), female, New York (Rutgers University, New Brunswick, New Jersey); *plumbaria*, holotype, female, Washington, D. C. (U.S.N.M.); *grossbeckiata*, holotype, male, Framingham, Massachusetts (M.C.Z.).

DISTRIBUTION: Very general throughout the eastern half of the North American continent, extending northward into the southern portion of the province of Ontario (Pt. Pelee, Grand Bend, Simcoe) and recorded from the state of Maine by Procter (1946, Biol. Surv. Mt. Desert Region, Insecta, p. 270). Hulst's reference to the species from Popof Island, Alaska (1900, Proc. Washington Acad. Sci., vol. 2, p. 497), is incorrect.

LIFE HISTORY: The larva is apparently a very general feeder. Swett records it from *Eupatorium*, *Aster*, and other Compositae, and there are specimens in the Canadian National Collection bred from *Ptelea* and oxeye daisy.

REMARKS: There is considerable variation in the distinction of the maculation of the forewing. Specimens from the southern portion of the United States (Florida, Texas) tend to show a certain amount of brownish suffusion in the subterminal area, somewhat similar to that found in the Californian *zela*.

There is also variability in size, a few females in the American Museum collection from Texas being very large, with a wing expanse of 20 mm. compared with the usual size of 17–18 mm. Judging by the dates there are at least two broods each year in the northern portion of its range and possibly a succession of broods in the south.

***Eupithecia miserulata zela* Swett and Cassino**

Plate 26, figure 32

Eupithecia zela SWETT AND CASSINO, 1919, Lepidopterist, vol. 3, p. 109.

The name, based on material from the San Diego region of southern California, was treated at the time as that of a good species. However, a study of genitalia shows that there is nothing in the structure of these organs by which *zela* may be separated from typical eastern *miserulata*. The name is being retained in a racial sense on account of the generally greater wing expanse, the tendency for the discal dots to be reduced in size, and the browner coloration of the head, thorax, and terminal area of primaries, none of these features, however, being entirely constant. The palpi, too, appear somewhat longer than in typical *miserulata*, but this again is frequently matched in specimens from Florida and Texas. In the male genitalia the small spines in the vesica at the base of the single large spine seem to be somewhat greater in number than is usual in the typical form.

TYPE: Holotype, female, La Puerta Valley, California, March 9, 1914 (M.C.Z.).

DISTRIBUTION: From San Diego northward, extending as far as Sonoma County, at least.

LIFE HISTORY: There has been no record of the larval food plants of this western race.

***Eupithecia misturata misturata* Hulst**

Plate 26, figures 33–36, plate 27, figure 1;
text figure 4B

Tephroclystis misturata HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 266.

Eupithecia misturata, BARNES AND MCDUNNOUGH, 1916, Contributions to the natural history of the Lepidoptera of North America, vol. 3, no. 3, p. 177, pl. 14, fig. 6 (type restriction). MCDUNNOUGH, 1927, Canadian Ent., vol. 59, p. 243; 1929, *ibid.*, vol. 61, p. 60.

Eupithecia silenata, MCDUNNOUGH (*nec* Standfuss), 1929, Canadian Ent., vol. 61, p. 60.

Tephroclystis subfoveata DYAR, 1904, Proc. U. S. Natl. Mus., vol. 27, p. 892.

Eupithecia subfoveata, MCDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 60.

Eupithecia insignificata TAYLOR, 1906, Canadian Ent., vol. 38, p. 394. PEARSALL, 1910, Proc. Ent. Soc. Washington, vol. 12, p. 139. BARNES AND MCDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 270. MCDUNNOUGH, 1927, Canadian Ent., vol. 59, p. 243; 1929, *ibid.*, vol. 61, p. 60.

Eupithecia insignificata variety *sublineata* TAYLOR, 1906, Canadian Ent., vol. 38, p. 395. PEARSALL, 1910, Proc. Ent. Soc. Washington, vol. 12, p. 139. BARNES AND MCDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 270. MCDUNNOUGH, 1927, Canadian Ent., vol. 59, p. 243; 1929, *ibid.*, vol. 61, p. 60.

Eupithecia minorata TAYLOR, 1907, Trans. Roy. Soc. Canada, ser. 3, vol. 1, sect. 4, p. 201; 1908, Canadian Ent., vol. 40, p. 55. BARNES AND MCDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 271. MCDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 60.

Eupithecia scelestata TAYLOR, 1907, Trans. Roy. Soc. Canada, ser. 3, vol. 1, sect. 4, p. 202; 1908, Canadian Ent., vol. 40, p. 55. BARNES AND MCDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 271. MCDUNNOUGH, 1927, Canadian Ent., vol. 59, p. 243; 1929, *ibid.*, vol. 61, p. 60.

This rather inconspicuous little species has proved to be considerable of a stumbling block to students of the genus. The variability in the depth of coloration of the forewings as well as the distinctness of the maculation has misled earlier authors into proposing a number of new names, based on purely individual variation, and, in doing so, insufficient attention has been paid to characteristic structural details, notably those of the genitalia. With the exception of Hulst's original name, which was based on material from the upper Sacramento Valley, California, the specimens that served as types for the names included in the above synonymy all came from two sections of British Columbia. The types of *subfoveata* Dyar, *minorata* Taylor, and *scelestata* Taylor were collected at Kaslo, British Columbia, in the Kootenay region, while those of *insignificata* Taylor and *sublineata* Taylor were taken on the east coast of Vancouver Island. Notwithstanding a careful study of long series of specimens in the Canadian National Collection from these type localities, as well as other areas of

British Columbia, combined with a genitalic study of actual type material, as already indicated (McDunnough, 1929), it has been impossible to find any salient and constant character that may be used to separate northern specimens in a racial sense from typical Californian *misturata*. The typical form, as far as can be told from material examined and as figured by Barnes and McDunnough (1916), extends from the San Francisco area northward through Oregon (Corvallis) into Washington state, specimens from the Olympic Mountains linking up with Vancouver Island material. The species would appear to be at least double brooded, and the average size of specimens, notably those of the summer brood, ranges from 15 to 17 mm. Larger specimens, frequently with better defined maculation, occur sporadically throughout the range, averaging 18 to 20 mm., and on such a specimen the name *scelestata* Taylor was based. Recently a series of large, pale specimens collected by J. Sperry throughout the summer on the upper Santa Ana River, San Bernardino County, California, have been examined, and such specimens would appear to link up with *harveyata* Taylor which, owing to insufficient present data, is treated as a good species although differing genitally in no respect from *misturata*. At the other end of the variation range we have *minorata* Taylor, a much darker and smaller form with quite obscure maculation. *Insignificata* Taylor matches quite closely Californian *misturata*, with the very similar *subfoveata* Dyar and *sublineata* Taylor rather better marked and tending towards *scelestata*. The previous reference (McDunnough, 1929) of *misturata* to the European *silenata* Standfuss on account of similarity of genitalia has been abandoned for the present. As far as is known there seem to be striking differences in the larval food plants. The figure, too, of the adult given by Spuler (Schmetterlinge Europas, vol. 3, pl. 71, fig. 51) bears little resemblance in color to our North American form.

With regard to structural details *misturata* shows the same type of blade-like, porrect palpi found in *miserulata*; they are, however, shorter than in this species and paler in coloration; in the female sex they are noticeably longer than in the male. The type of

male antennae at once distinguishes the species from *miserulata*, the ciliation consisting, as in numerous other species, of fine, short ciliae evenly distributed over the ventral area. The front is flat and oblique with slight apical tufting, being light creamy in coloration with scattered smoky sprinkling which tends at times to form small dots anterior to the antennal bases but does not form a dark, transverse, anterior band as in *miserulata*. On the dorsum of the abdomen brownish scales form obscure patches on segments II and III and again to a lesser extent on segments VII and VIII, but there is no definite, blackish, transverse band. The wings are rather fragile and thinly scaled, the coloration of primaries being light to dark smoky gray, without any of the brownish tints found in *miserulata*. The maculation is rather obscure, the usual cross lines arising from small, dark blotches on the costa, a pre-apical one being most prominent. There are a small, dark, discal dot and a series of postmedian dark streaks on the veins. The pale, crenulate, s.t. line is generally obscure, but in the better-marked specimens is quite evident and relieved by the darker, terminal suffusion of the wing. From species of the *palpata* group (*maestosa*, *subvirens*) with which it might be confused on account of the long, porrect palpi, it may best be distinguished by the type of male antennae, the generally more fragile appearance with lack of any accentuation of the cross lines, the decidedly crenulate or dentate s.t. line, the lack of dark banding on segment II of the abdomen, and, of course, by the genitalia.

MALE GENITALIA: Well-developed hair pencils are situated in deep pockets of segment IX but are very easily lost in the preparation of a slide. Tegumen rather short and narrow. Uncus thin, well chitinized, dorsoventrally bifid (Pierce's term, "hooded"). Vinculum broadly rounded on its cephalic margin. Clasper moderately and evenly broad from base to middle, then narrowing to a rounded apex; a fine spine projects from middle of ventral margin. Aedeagus narrow, long, with slightly bulbous base. Vesica with single, long, twisted piece of chitin in addition to the usual small end piece. Ventral plate of segment VIII weakly chitinized, consisting of a single, narrow rod,

slightly split at apex and arising from the usual broadened base.

FEMALE GENITALIA: Dorsal plate of segment VIII weakly chitinized, rectangular, anterior apophyses arising from the thickened cephalic margin, moderately short and sending a spur ventrad and caudad to connect with small, weak, oval plates, situated semi-laterally on the membranous sternite. Ostium narrow, membranous, leading into a long, narrow, membranous ductus bursae which at its distal end is partially encircled by a chitinous collar, more than twice as long as broad. Bursa entirely membranous, large, sub-rectangular, and somewhat laterally compressed, with an area of weak spines, variable in number, situated about the center of the dorsal side. The ductus seminalis arises from the caudoventral corner, opposite the entrance of the ductus bursae, as a small membranous bulb, passing quickly into a fine tube, running caudad.

HOLOTYPE: *Misturata* Hulst, male, Soda Springs, Siskiyou County, California (Rutgers University, New Brunswick, New Jersey); *subfoveata* Dyar, male, Kaslo, British Columbia (U.S.N.M.); *insignificata* Taylor, male, Wellington, Vancouver Island, British Columbia (U.S.N.M.); *sublineata* Taylor, female, Wellington, British Columbia (U.S.N.M.); *minorata* Taylor, male, Kaslo, British Columbia (U.S.N.M.); *scelestata* Taylor, female, Kaslo, British Columbia (U.S.N.M.).

DISTRIBUTION: Pacific coast states from southern California north to British Columbia and southern Alberta (Waterton) and east to the Rocky Mountains (Colorado, Utah, New Mexico).

LIFE HISTORY: Judging by breeding records of the eastern race, *frostiata* Swett, the larva should be found on conifers, but no actual record of its occurrence on such food plants has been found. Dyar bred the larva from the egg on *Ceanothus*, but this was scarcely the natural food plant.

Eupithecia misturata delzurata Cassino and Swett

Eupithecia delzurata CASSINO AND SWETT, 1922, Lepidopterist, vol. 3, p. 184.

Described as a species, *delzurata* was based on material from San Diego, California. The

genitalia place it with *misturata*, and it may be treated as a rather doubtful race, occurring in the most southerly portion of its distributional area and characterized by the generally much paler, almost white ground color of the primaries. It quite probably extends into certain portions of southern Arizona.

TYPES: Holotype, male, San Diego, California, March (M.C.Z.), allotype and paratypes in same collection; other paratypes in the United States National Museum and the Canadian National Collection.

***Eupithecia misturata frostiata* Swett**

Plate 27, figures 2, 3

Eupithecia frostiata SWETT, 1907, Canadian Ent., vol. 39, p. 377. TAYLOR, 1909, Canadian Ent., vol. 41, p. 427. BARNES AND McDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 275. McDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 60. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 164.

Eupithecia conformata PEARSALL, 1908, Ent. News, vol. 19, p. 128. McDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 60.

A fairly well-defined race, occurring in the eastern portion of the continent and characterized by the somewhat deeper coloration of the wings, the more intensive maculation and especially the larger and quite prominent discal dot on primaries. In the female genitalia the chitinous collar of the ductus bursae is much longer than in *misturata* proper, but there seems to be no appreciable difference in the male genitalia.

TYPES: *Frostiata* Swett, holotype, male, New Windsor, New York (U.S.N.M., *ex* collections Taylor and Barnes); *conformata* Pearsall, holotype, male, Big Indian Valley, Catskill Mountains, New York: allotype, female, Bronx Park, New York City, and 11 paratypes, same localities (A.M.N.H.).

DISTRIBUTION: Eastern states west to Pennsylvania (Scranton) and south to North Carolina (Black Mountains). In Canada common in the Ottawa region in the provinces of both Ontario and Quebec, extending eastward to Nova Scotia (White Point Beach).

LIFE HISTORY: In the Ottawa region specimens have been bred from larvae beaten from larch (*Larix*). Further data on the breeding habits of the larva in the type localities are very essential.

***Eupithecia harveyata* Taylor**

Plate 27, figure 4

Eupithecia harveyata TAYLOR, 1906, Canadian Ent., vol. 38, p. 390. BARNES AND McDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 272. McDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 61.

The status of *harveyata* as a good species is extremely doubtful, the genitalia showing no tangible differences from those of *misturata*. As already indicated (McDunnough, 1929) it is supposedly distinguished by its larger size, paler coloration, and better-defined maculation, but the two latter features seem inconstant, judging by a male specimen from Duncan, Vancouver Island (March 20, 1908), in the Canadian National Collection and two very similar females in the American Museum collected at Victoria, Vancouver Island (no further data), by A. J. Croker. Apart from the larger size there is nothing in either the coloration or the maculation that would distinguish these specimens from certain *misturata* specimens of the *scelestata* type. On the other hand a male from Victoria, British Columbia (August, 1923, W. Downes), apparently of the summer brood, shows a much more distinct type of forewing maculation, notably in the very definite postmedian dark streaks on the veins and the prominently dark, terminal area through which a distinct, pale, crenulate s.t. line runs. The mere fact of the larger size would seem to have little weight as a specific character, as such variations in size are quite a common feature in many species of *Eupithecia*. However, until more material is available for study and data regarding the life history come to hand, no harm is done in considering *harveyata* as a species.

TYPES: Holotype, male, allotype, female, Vancouver, British Columbia (U.S.N.M., *ex* collections Taylor and Barnes).

DISTRIBUTION: Known only from Vancouver and Victoria, British Columbia, and adjacent regions.

LIFE HISTORY: Unknown.

REMARKS: The genitalic association with *misturata* is based on a study of the type material. The so-called paratype, labeled "Type 4," in the Blackmore collection and now the property of the University of British Columbia is spurious. Taylor distinctly stated in the original description that he

possessed only two specimens, a male and a female, both captured on April 6, 1903, by R. V. Harvey.

***Eupithecia bivittata* Hulst**

Plate 27, figure 5

Tephroclystis bivittata HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 271.

Eupithecia bivittata, PEARSALL, 1909, Proc. Ent. Soc. Washington, vol. 11, p. 132; 1910, *ibid.*, vol. 12, p. 140.

According to genitalia this species is very closely allied to *misturata* and might even prove to be a coastal race of this species. However, on account of the quite distinct and apparently constant coloration of the primaries, it seems best, at the moment, to treat *bivittata* as a good species. From *misturata* it is easily separated by the distinctly brownish color of the primaries with practically no trace of maculation except for a small black discal dot and the two variably distinct, whitish, subterminal lines which gave rise to the name; there is frequently, also, a certain amount of whitish shading in the cell and the fold, and the terminal area of the wing is lightly shaded with smoky. The light ochreous secondaries show considerable smoky shading along the inner margin, especially towards the base.

In structural details of the palpi and antennae the species is similar to *misturata*. From *zela* with which it might be confused it is at once separable on the type of antennal ciliations. Until recently material of *bivittata* has not been plentiful, but of late years collectors have secured good series in various Californian counties extending from Mendocino to Monterey. In the male genitalia the midventral spine of the clasper is much shorter than that of *misturata*, but whether or not such a character is constant cannot be decided at present. Otherwise no apparent genitalic differences exist. The female genitalia are of the same general type as those of *misturata*, the bursa consisting of a membranous sac with a weak sprinkling of spines in the middorsal area; in shape this sac appears to be less rectangular and more oval than that of *misturata*.

TYPE: Holotype, female, Mendocino, California, June 18, 1884 (Rutgers University, New Brunswick, New Jersey).

DISTRIBUTION: Apparently confined to the coastal section of central California, extending from south of the San Francisco Bay area north to Humboldt County. Specimens examined bear the following data: Oakland, March 24; Half Moon Bay, February 9, August 22; Petaluma, Sonoma County, May 10, June 3; Inverness, Marin County, May-June; Point Arena, Mendocino County, July 12; Eureka, July 6; Trinidad, Humboldt County, August 9. Several broods are indicated by the above dates.

LIFE HISTORY: Unknown.

REMARKS: A slide of the genitalia of the female holotype was made some years ago. Other slides made at a later date from some of the above material match this in all details.

***Eupithecia pygmaeata* Hübner**

Geometra pygmeata HÜBNER, [1796-1799], Sammlung Europäischer Schmetterlinge, Geometrae, fig. 234.

Eupithecia pygmeata, PETERSEN, 1909, Iris, vol. 22, p. 267, pl. 20, fig. 83. SPULER, 1910, Schmetterlinge Europas, vol. 2, p. 80, pl. 71, fig. 20. DIETZE, 1910-1913, Biologie der Eupitheciiden, p. 46, pl. 72, figs. 265, 266. MCDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 61. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 167.

The examination of the genitalia of a female specimen of this species from the province of Yakutsk, northeast Siberia, has been sufficient to confirm the reference (1929) of our North American forms to this Palearctic species. However, until longer series are available for study, it has seemed advisable to retain our American name in a racial sense.

***Eupithecia pygmaeata obumbrata* Taylor**

Plate 27, figure 6; text figure 4C

Eupithecia obumbrata TAYLOR, 1906, Canadian Ent., vol. 38, p. 393. BARNES AND MCDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 270; 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 145, pl. 22, fig. 6. MCDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 61; 1936, *ibid.*, vol. 68, p. 258.

Eupithecia fortunata PEARSALL, 1909, Proc. Ent. Soc. Washington, vol. 11, p. 123. BARNES AND MCDUNNOUGH, 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 145. MCDUNNOUGH, 1936, Canadian Ent., vol. 68, p. 258.

The species is distinctly a northern one and has a widespread distribution across the

Canadian portion of the North American continent, according to material in the Canadian National Collection. At the present time lack of sufficient material makes it inadvisable to attempt to split the species into racial forms. In any case, in a genus such as *Eupithecia* where individual variation, even in a single locality, is marked, the creation of so-called new races, based on a few specimens, seems a very hazardous procedure.

The smoky brown coloration of all wings is a characteristic feature. Along with this is a general tendency, at times quite marked, for the median and subterminal areas of the primaries to become paler, forming light bands across the wing relieved by darker borderings. The dark discal spot is small or almost absent on the primaries and practically lacking on the secondaries; there is generally a fairly distinct white spot above the tornus. The size is variable (a common occurrence in most *Eupithecia* species) but seems to have no relation to locality. The largest specimens examined are single females from Churchill, Manitoba; Cypress Hills, Sakatchewan; and Victoria, British Columbia, having a wing expanse of fully 18 mm.; small specimens from Labrador and Vancouver Island scarcely exceed 15 mm. The antennae in the male are thin and finely and evenly ciliate over the entire ventral surface; in the female the ciliations are still shorter. The palpi are very short, scarcely exceeding the front in the males, with the small third joint somewhat porrect; they are dark brown and rather roughly scaled. The front is quite short, very slightly rounded above the level of the eyes, being in this respect less flatly oblique than the front of *miserulata*; there is little trace of an apical tuft; the general coloration is dark brown, only slightly relieved by scattered white scaling. The thorax is very similar in coloration, with a considerable admixture of white on the patagia and the scutellum of the mesothorax. The abdomen is largely brown dorsally with no indication of a dark band across the second segment; there is a variable suffusion of whitish scaling, tending to form narrow bands across the proximal portion of the basal segment and the distal edges of the other segments; ventrally largely white, especially in the females.

MALE GENITALIA: Well-developed hair

pencils at base of claspers. Tegumen broad at base, narrowed and rather pointed apically. Uncus strong, long and narrow, terminating in a single hook. Vinculum broad, rounded apically. Clasper moderately broad, tapering somewhat to a rounded apex. Aedeagus broad. Vesica armed with the usual small, twisted, basal piece of chitin, a long, semicylindrical, chitinous rod, and three strong spines, two of them on long, narrow, rod-like bases, the other expanding to a broader base and partially covered by one of the other spines. Ventral plate of segment VIII consisting of two triangular pieces of chitin, slightly separated at base and tapering to long fine points.

FEMALE GENITALIA: Dorsal plate of segment VIII broadly rectangular, the caudal edge with a strong V-shaped excavation, the apex of which extends beyond the middle. From the lateral edges of the reënforced cephalic margin the anterior apophyses arise, being quite short and sending a short spur ventrad to the edge of the ventral plate which is weak, its cephalic margin with less deep and more rounded excavation than in the dorsal plate. Ostium broad, membranous. Ductus broad, consisting merely of the usual chitinous collar. Bursa broader than the collar at its proximal end and with a small blind sac attached to its left side. In shape it is long, somewhat bulb shaped, with a large, entirely membranous sac, as large almost as the bursa itself, attached broadly to its left side at the distal end. The ductus seminalis leads off from the distal end at the right side and between its inception and the collar there is on the ventral side a broad, membranous, unspined band, bordered on each side by a row of long spines, the row on the right side being frequently slightly broken near the proximal end of the bursa. The left side of the bursa proper is lightly chitinized and shows several rows of long spines, and the fundus area is also spined. The dorsal surface is less heavily spined, the spined areas being confined to the proximal end and to the fundus, the extent of the spining being rather variable.

TYPES: *Obumbrata*, holotype, female, and paratype, female, Goldstream, Vancouver Island, British Columbia (U.S.N.M., ex collection Barnes); *fortunata*, holotype, male, allotype, female, and paratype, female, Golden, Colorado (A.M.N.H.).

DISTRIBUTION: Widespread across Canada, extending southward along the Rocky Mountains into Colorado. Known localities are Hopedale, Labrador (July); Mt. Albert, Gaspé County, Quebec (July); Churchill, Manitoba (July); Cypress Hills, Saskatchewan (June); Calgary, Alberta (June); Victoria, Vancouver Island, British Columbia (May); Golden, Colorado (May).

LIFE HISTORY: Nothing is known of the life history in North America, but European authors give *Cerastium*, *Stellaria*, and *Mal-lachium* as larval food plants.

REMARKS: Genitalic slides have been made of the types of both *obumbrata* and *fortunata* as well as of other material from various localities mentioned above.

Eupithecia bryanti Taylor

Plate 27, figure 7; text figure 4D

Eupithecia bryanti TAYLOR, 1906, Canadian Ent., vol. 38, p. 392. BARNES AND MCDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 272. MCDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 61.

Eupithecia modesta TAYLOR, 1906, Canadian Ent., vol. 38, p. 393. PEARSALL, 1910, Proc. Ent. Soc. Washington, vol. 12, p. 139. BARNES AND MCDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 270. MCDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 61.

Similar to *obumbrata* Taylor in type of antennal ciliations and shape of front, but at once distinguished by the longer porrect palpi which, especially in the female, extend a considerable distance beyond the front, being rough scaled and not so blade-like as in *miserulata*. The brown coloration of both wings is much more even than in *obumbrata* and the maculation more obscure, although the t. p. line is traceable by darker dashes on the veins and the pale s. t. line is indicated by a faint series of crenulations. The thorax is similar to the wings in coloration with a darker patch on the cephalic portion of the mesothorax. The dorsum of the abdomen is almost entirely brown with traces of a pale median line. While apparently widespread in distribution, the species is rare in collections, and the only good series examined was one in the Canadian National Collection taken by the author at Waterton, Alberta, the specimens swarming at dusk around a small willow bush.

MALE GENITALIA: Hair pencils of segment IX present. Tegumen moderately broad and

rounded apically. Uncus short, broad, and hood-like, terminating in a single, short hook. Vinculum broadly rounded apically. Clasper narrow and rather pointed apically. Aedeagus narrow. Vesica armed with a single small piece of bent, hollowed-out chitin. Ventral plate of segment VIII consisting of two thin rods, narrowly joined at base and with rounded and slightly expanded apices.

FEMALE GENITALIA: Dorsal plate of segment VIII narrowly rectangular, with the centrocaudal area almost membranous; from its laterocephalic edges the long anterior apophyses arise, sending caudad very long spurs to the caudal edges of the ventral plate which is practically entirely membranous. Ostium weak, membranous, leading into a rather long, membranous ductus bursae, the distal end of which is partly encircled by a long chitinous collar; the ductus, in turn, is continued by a weakly chitinized and gradually expanding bursa neck. At the distal end of the neck, on the right side, the ductus seminalis is given off as a moderate-sized membranous tube, soon narrowing to thread-like proportions. The bursa itself is a roundish membranous sac with large patches of spines covering most of both the dorsal and ventral surfaces, leaving, however, a broad, membranous ring entirely separating the two areas.

TYPES: *Bryanti*, holotype, female, and paratypes, Stikeen River, British Columbia (U.S.N.M.); paratype, female (C.N.C.). *Modesta*, holotype, male, Stanley Park, Vancouver, British Columbia (U.S.N.M.); allotype, female, largely destroyed.

DISTRIBUTION: British Columbia (Stikeen River, July; Vancouver, June; Victoria, July; Wellington, June); Alberta (Waterton Lakes, July); Utah (Alta, August); California (Sonoma County, April, May).

LIFE HISTORY: Nothing is known of the life history, although the fact that it was found swarming around a willow bush might be indicative.

REMARKS: When more collecting is done the range of the species will probably be greatly extended, especially in the mountainous regions. So far it has not been reported from the eastern section of the continent. Genitalic slides have been made of the types and also of specimens from the above-mentioned localities.

***Eupithecia coloradensis* Hulst**

Plate 27, figures 8-10; text figure 4E

Tephroclystis coloradensis HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 268. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 167.

Eupithecia carolinensis GROSSBECK, 1907, Ent. News, vol. 18, p. 349. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 169.

Eupithecia spenceata CASSINO, 1927, Lepidopterist, vol. 4, p. 73.

Apart from the type material, the genitalia of which have been examined, forming the basis for the above synonymy, very few specimens have as yet come to hand. The species is a striking one, the ruddy subterminal area of the primaries and the numerous wavy, smoky lines in the basal half of the wing being very distinctive. There is also a smoky, terminal band with a dark spot above tornus, relieving the pale s.t. line inwardly at this point. The discal spot is weak.

The type specimens of *coloradensis* and *spenceata* were collected in Colorado and New Mexico, respectively. A few specimens from the White Mountains, Arizona, collected by J. Comstock and now in the Canadian National Collection are the only other specimens from this region examined. It is possible when more material is available for study that *carolinensis* may be given racial status, as the cross lines are much more strongly developed than in Hulst's type, which is a rather faded-out specimen without a head. Apart, however, from the unique type, the only other specimen seen has been a female taken at light at Alcove, Quebec, in the Laurentians north of Ottawa, and in the Canadian National Collection. Procter (1946, Biol. Surv. Mt. Desert Region, Insecta, p. 270) lists *carolinensis* from Maine, but the material forming the basis for the record could not be found and the determination remains doubtful. Evidently, however, the species has a wide distribution.

With regard to structural details the palpi are very short, scarcely projecting beyond the front, much as in *obumbrata*; the male antennae are finely and evenly ciliate; the front is very slightly rounded with no appreciable apical tuft. The coloration of the head and thorax is largely smoky brown with a

slight admixture of whitish scaling. Such characters, combined with the shape of the ventral plate of segment VIII in the male, seem to point to an association with the *pygmaeata-undata* group.

MALE GENITALIA: Hair pencils on segment IX present but rather weak. Tegumen broad and rather short, strongly rounded apically. Uncus very weak, almost membranous, broad basally and terminating in a single, very weak hook. Vinculum short, broad, rounded apically with slight median incision. Claspers rather evenly wide and broadly rounded at apex. Aedeagus narrow, long. Vesica practically unarmed, provided merely with a small, weak piece of chitin, corresponding more or less to the usual end piece. Ventral plate of segment VIII weak, consisting of two chitinous rods, narrowly joined at base, with rounded and somewhat expanded apices, much as in *bryanti*.

FEMALE GENITALIA: Dorsal plate of segment VIII rectangular, well chitinized; from a chitinous thickening of the laterocephalic edges the long, anterior apophyses arise, sending caudad, from this same thickened area, spurs along the lateral edges of the ventral plate as far as its caudal margin where the spurs are somewhat broadened. Ostium weak, membranous, followed by a long membranous ductus bursae, the distal end of which is half encircled by a small, chitinous collar. The bursa is an oval, membranous sac with a narrow band of spines on each side, extending to shortly before the fundus. The ductus seminalis arises at the proximal end of the bursa, more or less ventrally and in close proximity to the collar of the ductus; moderately broad at first it soon narrows to the usual thread-like tube.

TYPES: *Coloradensis*, holotype, male, Colorado (Rutgers University, New Brunswick, New Jersey); *carolinensis*, holotype, male, Black Mountains, North Carolina, August (A.M.N.H.); *spenceata*, holotype, male, and paratype, male, Jemez Springs, New Mexico, May (M.C.Z.).

DISTRIBUTION: Apparently widespread but records are very scattered, as follows: Colorado; New Mexico; Arizona (White Mountains, June); North Carolina; Quebec (Alcove, July).

***Eupithecia cretata* Hulst**

Plate 27, figure 11

Tephroclystis cretata HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 269.

Known to the author only by the type male in the Hulst collection. This specimen has been carefully studied and seems perfectly distinct specifically but, owing to lack of abdomen, no genitalic studies have been possible. It is placed tentatively next to *coloradensis* on account of the similarity of the very short palpi and the type of fine ciliation of the male antennae. The striking feature of the maculation is the broad, smoky brown, terminal band on both wings, preceded on the primaries by a distinct, gently rounded t. p. line, basad of which are numerous parallel fine, brownish hair lines; the ground color is quite pale. The holotype bears the red label "Colo. Bruce," but as Bruce collected in various regions of the state extending from Hall Valley, west of Denver, to Glenwood Springs in Garfield County, an exact locality for the type cannot be given.

TYPE: Holotype, male, Colorado (Rutgers University, New Brunswick, New Jersey).

***Eupithecia regina* Taylor**

Plate 27, figure 12; text figure 4F

Eupithecia (Tephroclystis) regina DOD, 1906, Canadian Ent., vol. 38, p. 89 (*nomen nudum*). TAYLOR, 1906, Canadian Ent., vol. 38, p. 102. BARNES AND MCDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 272.

This rather obscurely marked species shows considerable superficial resemblance to *undata*. In general the gray color of both primaries and secondaries is deeper, with a certain tendency towards a broad, darker, median band on the primaries, bordered outwardly by a narrower, pale area. The dark dashes on the veins in the postmedian area, generally quite prominent in *undata*, are only feebly indicated, and a discal dot is scarcely visible. The structural details of palpi and antennae are very similar to those of *undata*, the former being shortly upturned, scarcely exceeding the front, whilst the latter, in the male, are finely and evenly ciliate. The front is slightly longer and somewhat flatter than that of *undata*, being

scarcely raised above the level of the eyes. The abdomen is light to dark gray in coloration with no dark transverse band on segment II. The darker abdominal tufts are somewhat relieved at their bases by pale shading. In genitalia the species is so entirely different from *undata* that some doubt arises as to whether the present placement of the species is correct.

MALE GENITALIA: Well-developed hair pencils present on segment IX. Tegumen moderate in length, sharply tapering. Uncus well chitinized, bifid (or hooded) in contrast to other members of the group. Vinculum broad, short, strongly rounded apically. Clasper rather even in width, moderately broad except towards apex where it tapers considerably. Aedeagus short and broad. Vesica armed with a stout spine, its base irregularly recurved; superimposed on this spine is a broad, blade-like piece of chitin, to the base of which several short, spine-like pieces of chitin are apparently attached; there is also the usual small end piece and an obscure, semicylindrical, weakly chitinized rod. Ventral plate of segment VIII consists of two long, chitinous rods, narrowly attached at base, slightly bowed, their apices somewhat enlarged and barb-like.

FEMALE GENITALIA: Dorsal plate of segment VIII weak, long, rectangular, the anterior apophyses, attached to its laterocephalic margin, being short and sending a short branch to the same edge of the still weaker ventral plate. Ostium weak, membranous, joining immediately onto the chitinous half ring or collar of the ductus. This is followed by the long neck of the bursa which, when viewed ventrally, shows a membranous shoulder proximally on the left side and a long, well-chitinized band on the right side, the inner edge of which is armed with a row of spines; the distal end of this band projects somewhat and from it arises the thin, fine ductus seminalis. Opposite to this on the left apical side of the neck is another projection, well chitinized and with a cluster of long spines inwardly at its base. The bursa proper forms a globular sac, entirely covered with spines, of which the marginal ones are very long. On the dorsal side there is a good-sized spine patch proximally on the shoulder. From

this a narrow band crosses to the ventral side to join the row of spines bordering the chitinous band previously mentioned. There is also a small cluster of short spines ventrally at the distal end of the shoulder.

TYPES: Holotype, male, Regina, Saskatchewan, and paratypes, Calgary, Alberta (U.S.N.M.); allotype, female, Calgary, Alberta (A.M.N.H.).

DISTRIBUTION: Manitoba (Aweme, June); Saskatchewan (Regina, June; Cut Knife, August); Alberta (Calgary, June–August); British Columbia (Keremeos, May).

LIFE HISTORY: Unknown.

REMARKS: The figure of the male genitalia is based on the holotype (U.S.N.M.) and that of the female on the allotype (A.M.N.H.). The species appears to be rare, and the only records obtainable are those from the small series in the Canadian National Collection.

***Eupithecia undata* Freyer**

Plate 27, figure 13; text figure 4G

Eupithecia undata FREYER, 1842, Neuere Beiträge zur Schmetterlingskunde, vol. 4, p. 54, pl. 323. DIETZE, 1910–1913, Biologie der Eupitheciën, p. 47, fig. 259 (type). PROUT, 1914, in Seitz, Macrolepidoptera, vol. 4, p. 278, pl. 12k.

Eupithecia scriptaria HERRICH-SCHAEFFER, 1847, Systematische Bearbeitung der Schmetterlinge von Europa, vol. 3, p. 121, p. 20, fig. 123. MOESCHLER, 1883, Stettiner Ent. Zeitg., vol. 44, p. 122. PETERSEN, 1909, Iris, vol. 22, p. 262, pl. 18, fig. 75. TAYLOR, 1907, Canadian Ent., vol. 39, p. 166; 1909, *ibid.*, vol. 41, p. 125.

The first record of this European species from North America was made by Moeschler, who reported the species from Labrador. Since then it has been collected in various mountainous regions of the west and is probably quite widespread in higher altitudes of the mountains and in northern localities. The very characteristic genitalia should render the species readily recognizable. The wings are rather fragile, the coloration being of a rather light gray, turning at times, especially in older specimens, to a light smoky brown. The maculation of primaries is obscure, consisting of a number of darker cross lines which tend to give a rather banded appearance to the whole wing; a series of small, dark dashes on the veins in the postmedian area is generally quite evident; the subterminal area is paler and the terminal area shaded

by smoky and faintly cut by the usual pale, crenulate s.t. line. The discal dot is small and obscure. The palpi and antennae are much as in *obumbrata*, the former being very short and scarcely exceeding the front and the latter finely and evenly ciliate. The front is rather short, very slightly rounded, and scarcely raised above the level of the eyes, showing little sign of an apical tuft. The abdomen is largely light brown, with the basal segment more or less entirely whitish; there is no indication of a dark band across segment II.

MALE GENITALIA: Hair pencils of segment IX well developed. Tegumen short and narrow. Uncus short, stubby, simple. Vinculum broad and well rounded apically. Claspers short and rather broad, tapering apically. Aedeagus long, narrow, with slightly bulbous base. Vesica armed with the usual small, twisted end piece, an obscure, partly cylindrical piece, a long, narrow, pointed rod of chitin, and a stronger, broader, and shorter chitinous spine, placed apically and partially superimposed on the preceding piece. An obscure, rounded, and very weakly chitinized plate occurs at the extreme apex. The ventral plate of segment VIII consists of two broad rods, just touching at base, narrowing apically, being incurved and bluntly pointed.

FEMALE GENITALIA: Dorsal plate of segment VIII long, narrow, upright, the caudal end granulate. The anterior apophyses are long and attached to the laterocephalic margin of this plate with only traces of a ventrad-directed spur which does not reach the ventral plate; this plate is weak with an excavated caudal margin. Ostium forming a rectangular, chitinous pouch attached to the cephalic margin of segment IX, finely spiculate and slightly striate. Ductus bursae very short, membranous, strengthened laterally with chitinous strips, the one on the right side long and curving around to the upper edge of the bursa; a small blind sac is attached on the left side. Bursa large, rectangular, striate; on the left side, both dorsally and ventrally, a series of very long spines extends to just above the fundus; similar rows of somewhat shorter spines occur on the right side; the remainder of the surface is covered with fine spines, leaving the fundus entirely membranous. Attached to this area by a short tube is a

globular, membranous, accessory sac.

TYPES: No data are available as to the location of the original European specimens. The type specimen of *undata* is figured in Dietze.

DISTRIBUTION: As far as North America is concerned the species has been reported in the east from Labrador, but no material from this region has been studied. In the west material from the following localities is contained in the Canadian National Collection: Alberta (Laggan, July, Waterton Lakes); British Columbia (Hope Mountains, 6000 feet, July; Mt. McLean, July; Hedley, July); Washington (Hurricane Ridge, Olympic Mountains, June). The American Museum collection contains two worn males from Colorado (Ward, July; Estes Park, July) and a female from Wyoming (Moran, August).

LIFE HISTORY: European authorities state that the larva is found in the seed heads of *Silene*. There is no knowledge of any specimens having been bred on this continent.

REMARKS: The European literature on the species has not been considered in the bibliography other than the mention of a few outstanding references. The identity of the older name, *undata* Freyer, was for a long time doubtful but has apparently now been accepted by European authorities as taking priority over the much better known name, *scriptaria* Herrich-Schaeffer.

***Eupithecia borealis* Hulst**

Plate 27, figure 14; text figure 4H

Tephroclystis borealis HULST, 1898, Canadian Ent., vol. 30, p. 114.

Eupithecia borealis, DOD, 1906, Canadian Ent., vol. 38, p. 89. TAYLOR, 1906, Canadian Ent., vol. 38, p. 101. PEARSALL, 1910, Proc. Ent. Soc. Washington, vol. 12, p. 140. MCDUNNOUGH, 1927, Canadian Ent., vol. 59, p. 244. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 167.

The name of this species is rather a misnomer, as its range is decidedly less boreal than that of *undata*. It is a rather easily recognized species with its neat, distinct, blackish cross lines on the light brown ground color of the primaries. These lines arise from blackish patches on the costa, the basal and t.a. lines being irregularly outwardly bowed across the cell, the latter with slight outward

angle in the fold and darker spots on the cubitus and vein 1. The median line is geminate, strongly outcurved below the costa, the inner line passing through the distinct, upright, discal dash. It is inwardly angulated on the cubitus and vein 1, this angle being slightly accentuated by a dark dot. The t.p. line parallels the median line with a stronger inward angle on vein 2 and slight dark streaks on the veins. The s.t. line is irregularly dentate and well indicated by a contrast between brown shading in the subterminal area and a white sprinkling of scales along the outer margin. There is a considerable variation in size, some specimens from both the east and west having a wing expanse of scarcely 15 mm., while others, notably specimens from Alberta and Yellowstone Park, Wyoming, reach an expanse of fully 20 mm.

Structural details of palpi and antennae do not differ greatly from those of *undata*. The palpi are somewhat longer, reaching generally above the level of the front with a more decidedly porrect third joint and heavier scaling on the dorsal edge of the second joint; the male antennae are finely and evenly ciliate. The front is very slightly raised above the level of the eyes and is rather flat; its color is largely light buff with a distinct tendency towards a blackish line along the anterior margin. The abdomen dorsally is rather evenly light brown, segment I being paler in the median area but not so much so as in *undata*; there is a certain amount of darker shading on segment II which, however, can scarcely be defined as a dark band; the small median tufts are blackish.

MALE GENITALIA: Hair pencils of segment IX strongly developed. Tegumen rather narrow, conical, rounded apically. Uncus broad and chunky, well chitinized, terminating in a single, fine hook. Vinculum short, broadly rounded apically. Clasper moderately broad, tapering apically. Aedeagus narrow with slightly bulbous base. Vesica armed with two long, narrow, chitinous rods, slightly sinuate and bluntly pointed; in the apical section and partly superimposed on these rods are two shorter rods, one with somewhat hooked and pointed apex, the other rather obscure and weakly chitinized. The ventral plate of segment VIII is broad in its basal half, the apical half consisting of

two thick rods widely separated and with somewhat incurved apices.

FEMALE GENITALIA: Unusually small and quite unique in shape, being on this account easily recognizable. Dorsal plate of segment VIII largely membranous and feebly granulate. From its thickened laterocephalic corner the short anterior apophyses arise, sending a spur along the lateral edge of the segment to the ventral sternite which is also membranous. The ostium is situated at the cephalic edge of an irregularly shaped, chitinous pouch which is continued as an incipient half collar around the initial portion of the ductus bursae. What can be considered either as the remainder of the ductus or as the neck of the bursa consists of a broad, fleshily membranous, long tube, irregularly shaped and terminating ventrally in a small, globular, blind sac. At the proximal end of the neck is a patch of small spines, and a long band of somewhat stronger spines extends through its median area into the proximal portion of the blind sac, its upper end curving dorsad and sending a narrow spur towards the bursa proper. The ductus seminalis arises dorsally from a small membranous bulb near the proximal spine patch of the ductus. The bursa proper is a small globular sac, broadly attached to the dorsal side of the neck. Its ventral half is covered with small spines which tend to disappear or to become very minute and scattered on the dorsal surface, considerable variation in this respect being noted in the various specimens examined.

TYPE: Holotype, female, Winnipeg, Manitoba (Rutgers University, New Brunswick, New Jersey).

DISTRIBUTION: Canada: Quebec (Knowlton, June); Manitoba (Winnipeg); Alberta (Calgary, July; Waterton, July); British Columbia (Seton Lake, June; Keremeos, June-July).

United States: New York (Catskill Mountains, June-July); Colorado (Golden); Utah (Eureka, July); Montana (Richel Lodge, July); Wyoming (Mt. Washburn, Yellowstone Park, July); Arizona (Santa Rita Mountains, September); New Mexico (Las Vegas).

LIFE HISTORY: Unknown.

REMARKS: A slide of the genitalia of the holotype was made a number of years ago,

and the illustration is largely based on this preparation which showed a very fully inflated bursa; the position is semilateral. The drawing of the male genitalia is from an Aweme, Manitoba, specimen. Other slides from material of both sexes from several other localities proved similar.

***Eupithecia jejunata*, new species**

Plate 27, figure 15; text figure 5A

A small, insignificant species of 15-mm. wing expanse and a general smoky gray coloration of both wings. The palpi and front are typical eupitheciid, the former extending shortly beyond the front and the latter tufted apically, the two together forming the customary conical projection. The rather pointed primaries with the indistinct cross lines nearly upright, the t.p. line being the most evident, and with only the slightest of outward bulges below the costa, running on the whole parallel to the outer margin, with short, slight, inward dashes on the veins. Two similar lines, close together, occur in the subterminal area, being separated from the t.p. line by a somewhat paler band; the outer of these two lines is edged outwardly by an obscure, slightly dentate, pale s.t. line. The terminal area is shaded with smoky, tending to form small obscure patches opposite the cell and above the tornus. Discal dot small but distinct. The usual broken, dark terminal line is present, and the fringes are fairly obviously checkered. Secondaries light smoky with a darker discal streak and a curved postmedian line; traces of a slightly dentate subterminal line in the inner portion of the wing. Terminal area and fringes as on primaries. Beneath paler with the postmedian and subterminal dark lines more distinct than on the upper side.

FEMALE GENITALIA: Very small; dorsal plate of segment VIII chitinized, rectangular, the caudal margin rounded with a V-shaped median excavation; anterior apophyses short with the usual caudal spur leading to a finely chitinized bar on the lateroventral edge of the membranous plate. Lobes of the ovipositor rather narrow and pointed, separated by a V-shaped incision and weakly setose. Ostium and ductus bursae weak, membranous, moderately broad, the latter without any definite distal chitinous collar. The ductus leads into a long, weakly chitinized

bursa neck which narrows distally and to which is attached on the left side a fleshy membranous thickening. The distal half of this thickened area is furnished with a row of closely appressed spines extending to the bursa proper. A series of long spines occurs dorsally on the right side at the distal end of the chitinized neck. The bursa itself is small and globular and covered over its entire surface with short spines. The ductus seminalis arises on the ventral side proximally, near the right corner, as a narrow tube directed caudad.

HOLOTYPE: Female, Georgetown, Texas, April 6, 1937 (L. J. Milne) in the Canadian National Collection.

PARATYPE: Female, Georgia (collection Henry Edwards) in the American Museum of Natural History.

The position of the species is doubtful until material of the male sex is available for study. Neither of the genitalic slides shows a well-inflated bursa, but that of the holotype is the better of the two and has served for the illustration.

***Eupithecia castigata* Hübner**

Plate 27, figure 16; text figure 5B

Geometra castigata HÜBNER, [1809-1813], Sammlung Europäischer Schmetterlinge, Geometrae, pl. 89, fig. 456.

Eupithecia castigata, DOD, 1906, Canadian Ent., vol. 38, p. 90. TAYLOR, 1906, Canadian Ent., vol. 38, p. 102. PETERSEN, 1909, Iris, vol. 22, p. 246, pl. 9, fig. 42A (as *virgaureata in err.*), pl. 10, fig. 46B. DIETZE, 1910-1913, Biologie der Eupitheciën, p. 93, pl. 72, figs. 305-313. PIERCE, 1914, The genitalia of the . . . Geometridae . . . of the British Isles, pp. 50, 52, pl. 31. MCDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 61. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 167.

Tephroclystis latipennis HULST, 1898, Canadian Ent., vol. 30, p. 114 (*partim*).

Eupithecia latipennis, GROSSBECK, 1907, Ent. News, vol. 18, p. 347. TAYLOR, 1909, Canadian Ent., vol. 41, p. 427. BARNES AND MCDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 275. MCDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 61.

This species is one of the commonest of the eupithecias in the New England and Atlantic states, extending southward at least as far as North Carolina (Black Mountains). It is equally common in Quebec and Ontario and extends across the entire Dominion of

Canada to British Columbia, following what is generally termed the "spruce belt." In the west it also occurs in several of the Pacific coast states. Taylor considered this larger western form to be typical *castigata* and retained the name *latipennis* in a specific sense for the somewhat smaller eastern specimens. It is a fairly well-marked species with the usual type of *Eupithecia* maculation, and the figure given by Spuler of a European specimen (Schmetterlinge Europas, vol. 3, pl. 71, fig. 32) gives a fair idea of the species, although the color is rather too dark. The coloration of the primaries which, especially in fresh specimens, shows a distinct olivaceous tinge is one of the best means of separating *castigata* superficially from similarly marked species in which the color tones are grayer or browner. In outward structural details the species is a typical *Eupithecia*. The palpi are moderately long, the second joint upturned, the third joint porrect, the dorsal scaling forming a slight tuft at the end of the second joint which continues the scale tuft on the anterior margin of the flat, sloping front. The male antennae are finely and evenly ciliate. The general coloration of the palpi, head, and thorax is smoky gray, with, at times, traces of a darker band crossing the front, anterior to the antennae; the third joint of the palpi is pale creamy, a common occurrence in a large number of species. The abdomen is grayish with frequently a slight suffusion of brown on segments II, VI, and VII, along with traces of a pale line relieving the small, dark, dorsal tufts; there is a certain amount of lateral blackish shading, especially on the middle segments. As noted above our eastern North American specimens seem on the whole somewhat smaller in size than such European material as has been examined. This, however, would scarcely seem sufficient reason for maintaining the name *latipennis* Hulst in a racial sense, especially since the genitalia are entirely similar and large specimens do occur in British Columbia.

MALE GENITALIA: Strong hair pencils on segment IX. Tegumen rather narrow, conical. Uncus well chitinized, narrow, and somewhat longer than usual; apex bifid. Vinculum broad with well-rounded cephalic margin. Clasper broad at base, pointed apically. Aedeagus rather narrow and moderately long. Vesica

armed with a twisted, chitinous end piece and a longer, thinner, hooked piece of chitin situated distally. In the vicinity of this latter piece there is a cluster of chitinous striations. The ventral plate of segment VIII has a broad base with strong excavation of the cephalic margin; this base gives rise to two thin, parallel, chitinous rods, terminating in fine, blunt points.

FEMALE GENITALIA: Dorsal plate of segment VIII membranous, the anterior apophyses originating as usual, from its laterocephalic edges. These are moderately long and send short spurs from their point of origin to the lateral edges of the membranous ventral plate. Ostium weak, followed by a short, membranous ductus bursae which, at its distal end, is half encircled by a well-developed chitinous collar. The membranous neck of the bursa is short and broad, giving rise on its right side to the very characteristic ductus seminalis which consists of a broad tube curving downward along the side of the bursa as far as the fundus; it then bends backward to the point of origin, forming a complete convolution across the face of the bursa, and from here on narrows to the usual thread-like tube. At the base of this ductus the bursa neck is armed with a patch of moderately long spines, more numerous on the dorsal surface than on the ventral one. The bursa proper is large and globular, completely covered with spines except for a narrow membranous band on the right side, extending from the origin of the ductus seminalis almost to the fundus.

TYPES: *Castigata*, Europe (location unknown); *latipennis*, holotype, male (as restricted by Grossbeck), Quebec City, Quebec (Rutgers University, New Brunswick, New Jersey); paratype (U.S.N.M., *ex* collections Taylor and Barnes).

DISTRIBUTION: General, across the northern half of the continent, extending down the Pacific coast into Oregon and presumably California.

LIFE HISTORY: According to European authorities the larva is a very general feeder. The Canadian Forest Insect Survey records the larva on spruce, balsam, and tamarack (*Larix*).

REMARKS: No attempt has been made to give a complete bibliography of the European literature; this can easily be secured by

reference to standard catalogues and text books. The male type of *latipennis*, as restricted by Grossbeck, simply bears a red label with the number "956" in large figures, which is definitely one of Provancher's labels; the locality given as "Quebec" is probably, therefore, correct.

***Eupithecia albipunctata* Haworth**

Plate 27, figures 17, 18; text figure 5C

Phalaena albipunctata HAWORTH, 1810, Lepidoptera Britannica, p. 360.

Eupithecia albipunctata, PETERSEN, 1909, Iris, vol. 22, p. 244, pl. 9, fig. 40. DIETZE, 1913, Biologie der Eupitheciiden, p. 86, pl. 72, figs. 287, 288. PIERCE, 1914, The genitalia of the . . . Geometridae . . . of the British Islands, p. 51, pl. 30. TAYLOR, 1909, Canadian Ent., vol. 41, p. 428. McDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 61.

Tephroclystis perfusca HULST, 1900, Proc. Washington Acad. Sci., vol. 2, p. 497 (*partim*).

Eupithecia promulgata PEARSALL, 1909, Proc. Ent. Soc. Washington, vol. 11, p. 121 (*partim*, ♀ *nec* ♂). McDUNNOUGH, 1936, Canadian Ent., vol. 68, p. 258.

Eupithecia tripunctaria, FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 165.

While there is no doubt as to the occurrence of this European species in North America, it has been commonly misidentified in collections, and specimens of *castigata*, *luteata*, and even *palpata* have been substituted for it. It was first reported by Taylor from this continent on the strength of specimens bred by Lyman at North West River, Quebec, near the Labrador coast. Later (1929) specimens in the Canadian National Collection from Alberta and British Columbia were placed under this name, based on the similarity of the female genitalia. Since then a series of considerably smaller specimens has been bred by the author from larvae feeding on the young seed heads of *Viburnum* at White Point Beach, Nova Scotia, and other specimens from various localities in California have been added to the Canadian National Collection. The single female from the Catskill Mountains, New York, which Pearsall wrongly associated with *promulgata*, is the only known record from the eastern United States. The four specimens from Popof Island, Alaska, recorded by Hulst as *perfusca*, have been examined genitally. Three of them, one male and two females, belong here;

the fourth specimen, a worn female, appears to belong in the *annulata* group.

To a casual glance, the species might be considered close to *castigata* and *fletcherata* in general type of maculation. The characteristic feature is the presence on the primaries of very distinct white spots in the subterminal line in the interspaces between veins 1 and 2 and veins 3 and 4, these being repeated more or less distinctly on the secondaries. It is obviously this feature that has given rise to the specific name. From *castigata* the species is at once separated in the male sex by the antennal structure, this being definitely, although shortly, fasciculate with apparently three weak fascicles laterally on each joint (trifasciculate), whereas in *castigata* the antennae are merely evenly ciliate. The palpi in the male are obliquely upturned with porrect third joint, moderately long, and with the usual type of *Eupithecia* scaling. In the female they are noticeably longer and more inclined to be porrect, especially in western specimens. Some variation in length seems to exist in bred material. This character helps to separate the species from *fletcherata* which has a very similar type of male antenna. The general coloration of the head, thorax, and abdomen is gray brown, the mesoscutellum and the basal abdominal segment showing generally a fair amount of whitish scaling which is also sometimes present on the terminal abdominal segments. As regards the size there is a marked variation in specimens from various localities. Western specimens and the single Catskill Mountain specimen show an average wing expanse of 20–23 mm., whereas the Nova Scotian specimens, possibly owing to the colder climate but certainly not to underfeeding of the larvae, range from 15–18 mm. These specimens resemble closely Dietze's figures (289, 290) of the European summer generation, *aestiva* Dietze, although they emerged in the spring from hibernating pupae.

MALE GENITALIA: Hair pencils of segment IX strongly developed. Tegumen conical, moderately broad at base, strongly narrowed apically. Uncus stout and chunky, apex bifid, with the upper hook minute. Vinculum broad; apical margin rounded with slight median excavation. Clasper broad with a slight rounded projection arising from somewhat before the middle of the ventral edge.

Aedeagus long, broad. Vesica armed with a single strong apical spine, arising from a broadened base and slightly curved; there are a fairly large, twisted end piece and indications of a couple of other weakly chitinized and poorly defined, flat pieces distad of it. The ventral plate of segment VIII is long, the sides gradually narrowing from a broad base and terminating in two short chitinous hooks.

FEMALE GENITALIA: Dorsal plate of segment VIII weakly chitinized and rectangular. The anterior apophyses arise, as usual, from the laterocephalic edges of its thickened, cephalic margin. They are moderately long and at a point well distad of their origin and from a slight chitinous thickening send a spur caudad to the lateral edge of the membranous ventral plate. Ostium weak and membranous. Ductus bursae short, consisting virtually entirely of a well-chitinized half collar and continued by the long, gradually expanding bursa neck which is very weakly chitinized and strongly striate. On the ventral side the neck is continued by a characteristic, broad, slightly raised chitinous band which covers a greater part of the bursa nearly to the membranous fundus. The dorsal side of the globular bursa is largely covered with spines which reach around to the chitinous band of the ventral area. The striking ductus seminalis arises near the proximal end of the neck on the right side as a broad tube which becomes still further expanded into a membranous sac that reaches down the side of the bursa to beyond its middle; at the outer, upper edge of this sac a small bulb projects, from which the thread-like section continues caudad.

TYPES: *Albipunctata*, England (possibly in British Museum); *promulgata*, allotype, female, Catskill Mountains, New York (A.M. N.H.).

DISTRIBUTION: Probably widespread across the continent, but known authentic records are very scattered. The following are the definitely known ones: Eastern: Nova Scotia (White Point Beach); Quebec, Labrador, (North East River); New York (Catskill Mountains, June). Western: Alberta (Waterton, July); British Columbia (Kaslo; Revelstoke; Ucluelet, July); California (Oakland, April; Inverness, Marin County, March-April; San Bernardino Mountains, June).

With the exception of the Quebec record all the above have been substantiated by genitalic slides.

LIFE HISTORY: Larva found feeding on flower and seed heads of *Viburnum*, as far as is known the only definite record from North America. In Europe the larva is recorded on *Heracleum*, *Sambucus*, and other Umbelliferae.

REMARKS: According to Prout in Seitz' "Macrolepidoptera" the name *albipunctata* Haworth is preoccupied by *albipunctata* Hufnagel, a geometer in a different subfamily. The name *tripunctaria* Herrich-Schaeffer has been employed in its stead, but there seems little use in upsetting a well-known name on a doubtful point of nomenclature, and the generally accepted usage has, therefore, been retained.

***Eupithecia luteata luteata* Packard**

Plate 27, figures 19, 20; text figure 5D

Eupithecia luteata PACKARD, 1867, Proc. Boston Soc. Nat. Hist., vol. 11, p. 45; 1876, A monograph of the geometrid moths . . . of the United States, p. 57, pl. 8, fig. 7. TAYLOR, 1907, Canadian Ent., vol. 39, p. 276. SWETT, 1908, Ent. News, vol. 19, p. 196. MCDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 62. MCGUFFIN, 1945, Canadian Ent., vol. 77, p. 53. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 165.

Eupithecia catskillata PEARSALL, 1908, Ent. News, vol. 19, p. 192. TAYLOR, 1909, Canadian Ent., vol. 41, p. 427. MCDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 62.

Eupithecia fasciata TAYLOR, 1910, Canadian Ent., vol. 42, p. 79. BARNES AND MCDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 273; 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 145, pl. 22, fig. 7. MCDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 62.

This species is primarily recognized, as one of the names implies, by the pale band crossing the primaries just outside the discal spot and bordered outwardly by the postmedian dark band. It is generally (although in rubbed specimens hardly noticeably) feebly tinted with pale luteous or ruddy shading at the bases of veins 2 and 3, this color frequently extending outwardly to the margin of the wing as a narrow shade which partially breaks the broad dark subterminal band. Both postmedian and subterminal dark areas show a stronger outward angulation below the costa

than is found in *castigata* with which the species is frequently confused. Apart from the above details of wing maculation *luteata* is at once separable from *castigata* by the structure of the male antennae which are feebly trifasciculate, the individual ciliae being not so long as the bifasciculations of *fletcherata* but definitely longer than in the finely and evenly ciliate antennae of *castigata*.

The structure of palpi and front is much as in *castigata*, the palpi being perhaps a shade shorter. On the mesothorax there is frequently a white transverse line bordering an anterior darker area and the scutellum is prominently whitish, characters which are often of value in separating the species from its allies. There is no indication of any dark banding on segment II of the abdomen.

MALE GENITALIA: Strong hair pencils present on segment IX. Tegumen quite narrow and conical. Uncus short, chunky, hooded, terminating bifidly, the upper hook being sharp and pointed. Vinculum with the lateral edges directed obliquely inward, the apical margin straight and not rounded as usual. Clasper of moderate width, with broadly rounded apex; on the ventral edge, before middle, a small, bluntly rounded, characteristic projection arises. Aedeagus narrow, slightly expanded at apex which is feebly spiculate. Vesica furnished with the usual small, twisted end piece, a long, partially hollowed and twisted chitinous rod, and a single, small, pointed spine. The ventral plate of segment VIII is broad and chunky, the lateral edges slightly convex and tapering apically, terminating in two short blunt points.

FEMALE GENITALIA: Dorsal and ventral plates of segment VIII and the arrangement of the anterior apophyses much as in *albipunctata*. Ostium membranous. Ductus bursae short, broad, almost entirely composed of the chitinous collar; this is followed by the equally broad, long, membranous neck of the bursa from which, on the right side, the ductus seminalis branches off as a broad, membranous tube, extending for a short distance down the side of the bursa and then suddenly narrowing to the usual thread-like tube, directed caudad from its caudo-apical edge. The bursa proper is globular and entirely covered with small spines.

TYPES: *Luteata*, holotype, male, Cariboo Island, Labrador (M.C.Z.); *catskillata*, holotype, male, allotype, female, and nine paratypes, Big Indian Valley, Catskill Mountains, New York (A.M.N.H.); *fasciata*, holotype, female, Ottawa, Ontario (U.S.N.M., ex Taylor and Barnes collections).

DISTRIBUTION: General throughout the eastern section of Canada and the New England and north Atlantic states.

LIFE HISTORY: The larva feeds on hemlock, balsam, white and black spruce, and larch, according to Canadian Forest Insect Survey records.

REMARKS: Genitalic slides of the holotype of *luteata* and the holotype and allotype of *catskillata* have been examined. The very close relationship to the European *lariciata* has already been noted (McDunnough, 1929), but until Palearctic material can be studied it has seemed advisable to treat *luteata* as a separate species.

Eupithecia luteata bifasciata Dyar

Plate 27, figure 21

Tephroclystis bifasciata DYAR, 1904, Proc. U. S. Natl. Mus., vol. 27, p. 891.

Eupithecia bifasciata, TAYLOR, 1910, Canadian Ent., vol. 42, p. 80. BLACKMORE, 1918, Canadian Ent., vol. 40, p. 214, pl. 3, figs. 3, 4. MCDUNNOUGH, 1928, Canadian Ent., vol. 61, p. 62.

The name *bifasciata* is retained in a racial sense for British Columbian specimens and presumably those from adjacent regions on the Pacific coast. As so frequently occurs with western specimens when compared with eastern ones it is characterized by its larger size. The pale postmedian band is broader than in the typical form, and the projection of the luteous coloration along veins 2 and 3 to the outer margin is much more obvious. There are no essential genitalic or other structural differences.

TYPES: Holotype, female, Kaslo, British Columbia (U.S.N.M.); paratype, female, same locality (C.N.C., ex collection Cockle).

LIFE HISTORY: Western hemlock, Douglas fir, and Engelmann spruce are recorded by the Canadian Forest Insect Survey as larval food plants.

Eupithecia fletcherata Taylor

Plate 27, figures 22-24; text figure 5E

Eupithecia fletcherata TAYLOR, 1907, Ottawa

Nat., vol. 20, p. 200; 1907, Canadian Ent., vol. 39, p. 384. BARNES AND MCDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 272. MCDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 62; 1936, *ibid.*, vol. 68, p. 258. MCGUFFIN, 1945, Canadian Ent., vol. 77, p. 53 (biology). FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 168.

Eupithecia promulgata PEARSALL, 1909, Proc. Ent. Soc. Washington, vol. 11, p. 121 (*partim*, ♂ *nec* ♀). MCDUNNOUGH, 1936, Canadian Ent., vol. 68, p. 258.

Eupithecia dolorosata PEARSALL, 1910, Ent. News, vol. 21, p. 157. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 168.

The synonymy of the male holotype of *promulgata* with *fletcherata* has already been noted (1936) after a comparison of the genitalic slides of the types. It might, however, be pointed out that the specimen from New Brighton, Pennsylvania, May, on which Pearsall's name was based is very much larger than the general run of specimens of *fletcherata*. It is quite well matched by a male specimen, recently examined, from Sardinia, New York, August (Rupert) and, when more material is available for study, *promulgata* may prove to be a good race. The types of *fletcherata* and most of the other material examined were taken in August, although there are a few specimens in the Canadian National Collection, bred from overwintering pupae, which emerged in early spring, pointing at least to a partial spring brood.

With regard to *dolorosata*, the unique male type from the Catskill Mountains, New York, on which the name was based has been very carefully examined. Unfortunately the abdomen is missing, it having been removed by Cassino in 1929 (along with the abdomens of many other of Pearsall's types) in order to make a genitalic slide. This particular slide cannot now be located, although eventually it may turn up among Cassino's numerous slides in the Museum of Comparative Zoölogy at Cambridge, Massachusetts. Fortunately among the numerous specimens of *castigata* in the Pearsall collection, four specimens have been located, three from the Catskill Mountains and one from Cohasset, Massachusetts, which match the *dolorosata* type excellently, in wing coloration, type of palpi, male antennae and in date of appearance (August). The male genitalia of these specimens are similar to those of *fletcherata*, notably the structure of

the rather unique ventral plate, and details of palpal and antennal structure are also similar. The wing coloration is rather paler, being a dull gray, and the maculation is less obvious than in topotypical *fletcherata*, but such details are generally quite variable and, with our present knowledge, can scarcely be used to establish a race. The synonymization of *dolorosata* with *fletcherata* seems to be fairly satisfactorily established.

Typical *fletcherata* is a rather small species with a type of wing maculation very similar to that of *castigata*, with possibly a rather more pronounced discal dot on primaries and a coloration that is browner without the olivaceous tinge of *castigata* and more nearly approached to that of *albipunctata*. The structure of the male antennae at once separates it from *castigata*; these are distinctly bifasciculate, the weak individual bunches of ciliae being slightly longer than those of *albipunctata*. From this latter species it also differs, apart from wing maculation, in the somewhat shorter and more upturned palpi, especially in the females. The scutellum of the mesothorax and the median section of the metathorax are quite noticeably white, and the largely smoky brown abdomen is without any transverse dark band on segment II.

MALE GENITALIA: Hair pencils of segment IX well developed. Tegumen moderately broad and tapering apically. Uncus well chitinized, short, narrow, and distinctly apically bifid. Vinculum broadly rounded apically. Clasper rather short, moderately broad, and gradually tapering to a well-rounded apex. Aedeagus of normal length and somewhat tapering apically, moderately broad. Vesica armed with a poorly chitinized, irregularly twisted, long piece of chitin and a single stout spine on a broad, somewhat curved base. In certain specimens (e.g., type *fletcherata*) a second minute spine is present but, as far as can be told, this appears to be an individual variant. It is not present in the type of *promulgata* or in Catskill Mountain specimens of *dolorosata*, and other Ottawa specimens, topotypical of *fletcherata*, do not show it. Ventral plate of segment VIII very characteristic, consisting of a chitinous bar, arising from the usual broad type of base and terminating in two sharp spines which

bend to the left, the right-hand spine being longer and more curved and directed somewhat dorsad; the two spines enclose a semi-circular space.

FEMALE GENITALIA: Arrangement of anterior apophyses much as in *albipunctata*, but the dorsal plate of segment IX rather better chitinized and higher than broad; the ventral spurs terminate in distinct, oval, chitinous plates situated well apart on the lateral edges of the membranous ventral plate; the apophyses are also somewhat longer than in *albipunctata*. Ostium very weak, membranous, continued by a short membranous ductus bursae which is half encircled apically by the usual chitinous collar. Bursa neck broad and rather fleshily membranous, gradually expanding into the bursa proper, the membranous area continued farther towards the fundus on the ventral side than on the dorsal one. A large spine patch consisting of minute spines on a very weakly chitinized and striate base is situated ventrally at the proximal end of the neck, the fine ductus seminalis arising inconspicuously and semi-laterally to its right. The inner surface of the globular bursa is entirely covered with fine spines, becoming still more minute in the fundus area.

TYPES: *Fletcherata*, holotype, male, Ottawa, Ontario (U.S.N.M.), allotype, female, same locality (C.N.C.); *dolorosata*, holotype, male, Catskill Mountains, New York (A.M.N.H.); *promulgata*, holotype, male, New Brighton, Pennsylvania (A.M.N.H.).

DISTRIBUTION: Apparently widespread in the eastern portion of the continent: New York, Pennsylvania, Michigan, New Hampshire, Maine, Ontario, Quebec. As yet no definite records are known from the west.

LIFE HISTORY: In the Canadian National Collection there are specimens bred from larvae beaten from *Larix* in the Ottawa region in the fall, the adult emerging the following spring. Other records are white, red, and black spruce.

REMARKS: Judging by the ventral plate of the male the species is evidently closely allied to the European *virgaureata* Doubleday, as has already been hinted (1929). The exact relationship, however, must await examination of authentic European material.

***Eupithecia kasloata* Dyar**

Plate 27, figure 25; text figure 5F

Tephroclystis casloata DYAR, 1904, Proc. U. S. Natl. Mus., vol. 27, p. 891 (*partim*, holotype *nec* paratype).

Eupithecia kasloata, MCDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 65, fig. 1.

The generally accepted idea of this species was proved to be erroneous (McDunnough, 1929) after a slide had been made of the genitalia of the female holotype. This idea arose from the fact that numerous specimens under this name were distributed by Mr. J. Cockle of Kaslo, British Columbia, determined according to the wrongly associated paratype in his collection, now in the Canadian National Collection at Ottawa, this specimen being evidently a large form of the eastern *geminata* Packard.

The true species is evidently rare and, apart from the type and a single worn, topotypical female in the Canadian National Collection, the only other specimens examined have been a very fine pair, captured by Mr. K. Bowman of Edmonton at Nordegg, Alberta, in June and kindly donated to the Ottawa collection.

In details of palpal and male antennal structure *kasloata* is very similar to *albipunctata* and *fletcherata*. The male antennae are more feebly trifasciculate, however, and the size is considerably larger than that of eastern specimens of these species. The wing pattern is quite distinctive, the primaries being alternately banded with irregular light and dark bands; these latter consist of broad antemedian and subterminal bands and two closely approached and finely crenulate postmedian lines. There is also an upright, black, discal dash. The most characteristic feature is found in the subterminal pale line which broadens as it approaches the tornus and ends in a large, irregular patch just above. The secondaries are largely pale, with a broad smoky marginal band in which small white spots above the inner angle may be recognized.

The scaling of the head is largely pale, with scattered blackish sprinkling and a more or less obvious dark line along the anterior margin of the front. The thorax shows dark shading on the anterior portion of the mesothorax, including the patagia,

while the metathorax is quite contrastingly whitish.

MALE GENITALIA: Hair pencils of segment IX present and of moderate size. Tegumen strongly conical with rather narrow apex. Uncus well chitinized, short, narrow, and with bifid apex. Vinculum broad, with strongly rounded apical margin. Clasper moderately broad, tapering apically to a well-rounded apex. Aedeagus fairly broad, more so than in *fletcherata*, and tapering to a blunt point apically. Vesica armed with an obscure twisted rod of chitin and two pointed, partially superimposed spines, one of which is much longer than the other and more heavily chitinized. The ventral plate of segment VIII is of the *fletcherata* type but is more narrowed in the median section, and the two apical prongs are less bent to the right.

FEMALE GENITALIA: The structure of the dorsal and ventral plates of segment VIII and of the anterior apophyses is much as in *fletcherata*. The ostium is weak and membranous, being continued by a short, membranous ductus bursae which is terminated by a well-developed chitinous collar; it enters the bursa on the left side somewhat below the apex. The bursa itself is gourd shaped, with a long neck occupying the proximal half and gradually broadening into a more or less globular fundus area. The rounded apex which projects on the right side, caudad of the chitinous ductus collar, gives rise ventrally to the fine, membranous ductus seminalis. A broad, very weakly chitinized band extends down the right side of the otherwise membranous bursa sac and is provided along its inner side with several rows of very weak spines which (as far as can be told from the limited material examined) are very variable in number and distribution.

TYPE: Holotype, female, Kaslo, British Columbia (U.S.N.M.).

DISTRIBUTION: The only records known as yet for the species are Kaslo, British Columbia, July, and Nordegg, Alberta, June.

LIFE HISTORY: Nothing is known of the life history, but judging by what is known of the history of its close associates, the larva may very readily be a conifer feeder.

REMARKS: The drawings of the male and female genitalia are based on the pair from

Nordegg. The former figure of the female genitalia, published in 1929, was made from a slide of the holotype in which the bursa was not fully inflated.

***Eupithecia bradorata* McDunnough**

Plate 27, figure 26; text figure 5G

Eupithecia bradorata MCDUNNOUGH, 1930, Canadian Ent., vol. 62, p. 110, fig. 1c. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 168.

Very little is known about this species, but it seems, in the light of the scanty material available for study, as if *bradorata* might readily prove to be the eastern race of *kasloata*. The name was based on a single female from Quebec Labrador, and since then a few specimens have been added to the Canadian National Collection. These include a practically topotypical male from Natashquan, Quebec, another from Percé, Gaspé County, Quebec, and several worn females from Biscotasing, northern Ontario; also a couple of specimens from White Point Beach on the south shore of Nova Scotia near Liverpool.

In wing maculation and outward structural details no noticeable differences have been detected between *bradorata* and *kasloata*, but the former is only about half the size of the latter. The male genitalia are similar, and the female genitalia are also of the same general type. Some minor differences have been noted in the shape of the bursa and its neck and in the distribution of spines on the chitinized strip on the right side, but this latter feature is most likely quite variable in different individuals and of little use from the taxonomic standpoint. The most obvious difference consists in the presence in the Biscotasing females of small patches of minute spines above the fundus of the bursa and just below the ductus collar, and even these were apparently not present in the genitalia of the type, which, however, was based on a very poorly inflated specimen. The present illustration has been drawn from one of these Biscotasing specimens in which the bursa was well inflated and the spines on the chitinous strip rather more numerous than in other specimens from the same locality. While the close similarity between the two forms may be noted, it is considered advisable for the present to treat them as distinct species until more material and better knowledge of life histories are available.

TYPE: Holotype, female, Bradore Bay, Quebec Labrador, July (C.N.C.).

DISTRIBUTION: Known only from northern Ontario, the Gulf of St. Lawrence region of Quebec, and the south shore of Nova Scotia (White Point Beach).

LIFE HISTORY: A single male from Natashquan, Quebec, was reared from a pupa found on white spruce by members of the Forest Insect Survey of the Dominion Department of Agriculture. No other breeding records are known.

***Eupithecia sheppardata* McDunnough**

Plate 27, figure 27; text figure 5H

Eupithecia sheppardata MCDUNNOUGH, 1938, Canadian Ent., vol. 70, p. 171, figs. a-c. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 168.

Since the publication of this name only an odd specimen or two of the species has been captured in the Ottawa region; in consequence little can be added to the statements contained in the original description. The position of the species is doubtful, although its present association with the *fletcherata* group seems to be as good as any. The antennae of the male are feebly fasciculate, with shorter ciliae than in either *fletcherata* or *kasloata*. These fascicles, each consisting of a few simple ciliae, appear to be three or four in number (when viewed laterally) situated along each lateral edge of an antennal segment. There is also a series of centrally placed ciliae which tend to arrange themselves in transverse rows, connecting the lateral fascicles. The palpi are somewhat shorter than in *fletcherata* with the usual correct third joint, and the front is of the common, flatly oblique type with terminal weak scale tuft. The coloration of the head is in general a rather light brownish gray, formed by an admixture of white and brown scaling. The thoracic vestiture is a mixture of light gray and brown scaling, and the scutellum of the mesothorax bears two small, but distinct, lateral tufts, a feature rather distinctive and not mentioned in the original description. The abdomen dorsally is largely of a brownish hue but, due to the fact that segments I and III show a good deal of light shading, the appearance of a dark transverse band on segment II is somewhat simulated. The middorsal tufts are distinct, blackish, relieved basally by whitish scaling,

giving the appearance of a faint, pale, dorsal band. The apex of the abdomen is rather chunky and less attenuated than usual, resembling in this respect the abdomen of *huachuca*. The general wing maculation is very obscure, the cross lines and discal dot being feebly indicated and the coloration a rather even, light fawn gray.

MALE GENITALIA: Hair pencils on segment IX well developed. Tegumen narrow and conically tapered. Uncus short and broad, bifid, with both hooks stronger than usual. Vinculum broad, slightly tapered and well rounded apically. Clasper broad at base, tapering to a blunt point apically, with a rounded chitinous projection on the ventral margin before middle. Aedeagus broad, very slightly curved. Vesica armed with the usual small, twisted end piece, a long, curved, rod-like piece of chitin, and two large, trigonate, pointed, apically situated, and partially superimposed bars of chitin. The ventral plate of segment VIII has a broad base and tapers apically to a long fine point, from the base of which a curved hook projects outward on the right side.

FEMALE GENITALIA: Dorsal plate of segment VIII moderately chitinized, uprightly rectangular, the caudal margin with a semi-circular excavation. Anterior apophyses short, arising as usual from the laterocephalic edge of the plate and sending spurs caudad along the lateral edges of the ventral plate as far as its caudal margin, where they end in a small oval plate. The ventral plate is membranous, but the area is largely occupied by a broad, heavily shagreened, ostium pouch, the ostium itself being situated within towards its cephalic margin. Ductus bursae broad, short, membranous. Upper third of the bursa, or neck, heavily chitinized and broadening distally, very irregular, with a broad trough (when viewed dorsally) curving to the right, the right edge bent caudad and forming the base of a rounded, membranous bulge in the bursa proper from which the ductus seminalis arises; the left edge of this trough is raised and armed inwardly with long spines which connect more or less with a circular spined band, curving across the bursa to the left side and then proceeding caudad to connect with a chitinous projection extending into the bursa from the ventral side of the chitinized neck and jutting upward to touch the dorsal

membrane. The remainder of the bursa forms a membranous sac without further spining.

TYPES: Holotype, male, and allotype, female, Montreal, Quebec, June (C.N.C.).

DISTRIBUTION: Ontario (Biscotasing); Quebec (Ottawa and Montreal regions, June); New York (Sardinia, June).

LIFE HISTORY: Unknown.

***Eupithecia affinata* Pearsall**

Plate 27, figures 28, 29; text figure 5I

Eupithecia affinata PEARSALL, 1908, Jour. New York Ent. Soc., vol. 16, p. 101; 1909, Proc. Ent. Soc. Washington, vol. 11, p. 132. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 168.

This small species is best recognized by its light fawn gray coloration with prominent black discal dot on primaries and otherwise obscure maculation. A very striking black band is present on segment II of the abdomen. As suggested by Pearsall it has the superficial appearance of a small *coagulata* Guenée, but characters of the male genitalia do not indicate any close relationship, although the type of female bursa is distantly reminiscent of that of *coagulata*. Its position in the genus is rather doubtful. From the *fletcherata* group it is at once separated by the very short palpi, which project only slightly above and beyond the flat, sloping front. The male antennae, too, are finely and evenly ciliate and show no trace of the fascicles of this other group. The squamation of the head is largely pale fawn gray with a darker band of scaling along the anterior margin; the thorax is light brownish, shading into pale gray on the posterior portion of the mesothorax and the scutellum; apart from the dark transverse band of segment II and minute dark dorsal tufts the abdomen is almost entirely light gray. While probably widespread over a considerable area of the eastern United States and southern Canada the species is rare in collections, and nothing is known of its life history. Recently a few specimens from the vicinity of Prescott, Arizona, have turned up which on genitalic characters of both sexes agree very closely with eastern specimens. In the female organ no essential differences can be detected. In the male the uncus seems thinner and somewhat longer with the bifid character of the apex very weakly defined,

owing to the virtually entire elimination of the dorsal hook, which in typical specimens, in any case, is very short; the armature of the vesica is similar. It is possible that these Arizona specimens represent a distinct race, but all the material seen has been in too poor condition to characterize satisfactorily and the matter is left in abeyance.

MALE GENITALIA: Hair pencils present on segment IX. Tegumen rather short, conical. Uncus short, hooded, bifid, the upper hook very short. Vinculum broad and rounded apically, much as usual. Clasper of moderate width throughout with little narrowing towards the well-rounded apex. Aedeagus rather shorter and broader than usual, the apical membrane feebly spiculate. Vesica armed with three apically situated and partially superimposed rods of chitin; two of these are long and bluntly pointed, the third is shorter and more in the form of a spine. In addition there is a long, curved, and partially hollowed chitinous piece, adjacent to which, and basad of the pointed rods, is an irregular cluster of curved spines, arranged dorsoventrally in a curving row. The ventral plate of segment VIII is broad, narrowed somewhat in the apical half, the lateral edges becoming more strongly chitinized and projecting shortly as two bluntly rounded and slightly divergent rods.

FEMALE GENITALIA: Dorsal plate of segment VIII moderately well chitinized and broadly rectangular; the anterior apophyses originate as usual on the laterocephalic margin and are moderate in length; they send ventrad the usual spur to a small oval plate on the lateral margin of the membranous ventral sternite. Ostium broad, membranous, feebly spiculate, shortly funnel shaped. Ductus bursae entirely composed of the chitinous half collar which takes the shape of two long, parallel cylinders which merge on the ventral side into a broad trough of chitin, bending down the right side of the bursa to nearly its middle; from the apex of this trough arises the thin, membranous ductus seminalis, curving ventrad and caudad from its extreme right edge. Caudad to this ductus is a large patch of small spines, and the left edge of the trough is also provided with a series of longer spines in its proximal region. Except for a narrow membranous

area on the left proximal side the remainder of the oval bursa is covered with strong spines. On the dorsal side the initial chitinous area leading to the ductus seminalis is heavily striate.

TYPE: Holotype, male (not female as stated in the original description), New Brighton, Pennsylvania (A.M.N.H.).

DISTRIBUTION: Pennsylvania; New Jersey; New York; Michigan; North Carolina (Black Mountains); Arizona?; Ontario (Ottawa region, August); Quebec (Montreal, August).

LIFE HISTORY: Unknown.

REMARKS: The figure of the male genitalia is largely based on a slide made from a specimen from Montreal, Quebec. The slide of the holotype male is rather crushed and distorted, owing to a poor preparation by Cassino, and cannot be used for purposes of illustration. The female figure is from a Catskill Mountains specimen, one of two captured by Pearsall in August.

Eupithecia rotundopuncta Packard

Plate 27, figure 30; text figure 5J

Eupithecia rotundopuncta PACKARD, 1871, Proc. Boston Soc. Nat. Hist., vol. 13, p. 395.

Eupithecia rotundopunctata PACKARD, 1876, A monograph of the geometrid moths . . . of the United States, p. 55, pl. 8, fig. 6. PEARSALL, 1910, Proc. Ent. Soc. Washington, vol. 12, p. 141.

Eupithecia californiata VON GUMPPENBERG, 1888, Nova Acta Halle, vol. 52, p. 174. BARNES AND McDUNNOUGH, 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 146. McDUNNOUGH, 1945, Canadian Ent., vol. 77, p. 63.

The species is rather easily recognized on account of the contrasting coloration of the forewings which show considerable banding of light russet brown in the antemedian, subterminal, and terminal areas. The large black discal dot is composed of raised scales which are easily rubbed off, reducing the size of the spot considerably in worn material. The somewhat irregular, white, s.t. line borders a russet band outwardly and is further relieved, both inwardly and outwardly, by slight dark streaks which tend to give this section of the wing a somewhat strigate appearance, especially opposite the cell, where a dark blotch is at times quite prominent. The palpi are long and practi-

cally porrect, showing a very slight upturn at base; they are heavily and roughly scaled and quite dark in coloration. The male antennae are feebly trifasciulate, the individual ciliae being moderately long, as in *fletcherata*. The front is flat, largely brown scaled with slight admixture of pale, and with a small anterior tuft. The thoracic scaling is largely brown with the scutellum of the mesothorax, the metathorax, and the first abdominal segment paler. There are traces of a black band crossing abdominal segment II and some lateral black streaks on the middle abdominal segments; some russet brown shading occurs dorsally on the posterior segments.

MALE GENITALIA: Hair pencils present on segment IX. Tegumen broad at base, rounded apically. Uncus short and rather broad, distinctly bifid apically, the upper hook being short and sharp. Vinculum broad and well rounded apically. Clasper short, broad at base, and tapering rather sharply in the apical half. Aedeagus broad. Vesica armed with a long twisted piece of chitin and two short, rather pointed, auxiliary pieces in the basal section. Apically there is a sharply pointed rod of chitin which shows a few scattered teeth on its surface. Ventral plate of segment VIII broad at base, the slightly convex lateral edges tapering somewhat and terminating in two short, rounded projections each of which bears a minute recurved spine.

FEMALE GENITALIA: Ventral and dorsal plates of segment VIII and anterior apophyses much as in previous species, the rectangular dorsal plate being weakly chitinized, the ventral plate membranous and very finely shagreened, and the apophyses of moderate length with the spur branching a short distance beyond the point of origin and ending in a minute plate on the lateral edge of the ventral plate. Ostium broad, membranous, forming with the short initial section of the ductus bursae a funnel beyond which is a broad chitinous half collar. Bursa oval, the proximal half on the ventral side consisting of a broad, lightly chitinized area which forms a sharp elbow on the left side and extends from this point obliquely distad to the right side, the ductus seminalis arising at its lower edge on the right side as a fine, recurved tube. The remainder of the ventral surface,

distad of the left elbow and the ductus seminalis, is completely spined, as is also the entire dorsal surface with the exception of a narrow band proximad of the elbow on the left side. There is an oblique row of small spines on the ventral surface of the chitinous area, directed towards the mouth of the ductus seminalis. A heavier and much longer spine-band extends on the right side, semidorsally, between the mouth of the ductus seminalis and the chitinous collar, merging along the entire length with the spines of the dorsal area.

TYPES: *Rotundopuncia*, holotype, male (without abdomen), California (Edwards) (M.C.Z.); *californiata*, holotype, male, California (M.C.Z.).

DISTRIBUTION: Essentially a species of the Pacific coast states, extending northward to Vancouver Island, British Columbia.

LIFE HISTORY: Unknown.

Eupithecia sierrae Hulst

Plate 27, figures 31-34; text figure 6A

Tephroclystis sierrae HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 268.

Eupithecia sierrae, PEARSALL, 1910, Proc. Ent. Soc. Washington, vol. 12, p. 140. MCDUNNOUGH, 1936, Canadian Ent., vol. 68, p. 258; 1941, *ibid.*, vol. 73, p. 192; 1945, *ibid.*, vol. 77, p. 63.

Eupithecia conceptata PEARSALL, 1909, Proc. Ent. Soc. Washington, vol. 11, p. 124. MCDUNNOUGH, 1936, Canadian Ent., vol. 68, p. 258.

Eupithecia joymaketa CASSINO, 1925, Lepidopterist, vol. 4, p. 54. MCDUNNOUGH, 1940, Canadian Ent., vol. 72, p. 39; 1941, *ibid.*, vol. 73, p. 192; 1945, *ibid.*, vol. 77, p. 63.

The name would seem to indicate that the type material came from the Sierras, California, but as a matter of fact Hulst's type specimen was collected in Colorado by Bruce, probably in the mountains west of Denver. This type is a worn female, without abdomen or antennae but with a distinct light brown shade over the primaries and the characteristic dark, rectangular apical patch; it has been well matched by a specimen from Salida, Colorado, in the American Museum of Natural History. *Conceptata* Pearsall, from the same general locality, seems undoubtedly a synonym although with rather less brownish suffusion. The unfortunate confusion with regard to the name *joymaketa* Cassino, due to typographical and other errors on the part

of the author, has now been more or less satisfactorily eliminated. Cassino's name was based on Arizona material, but such Arizona specimens as have been examined show little difference from those taken farther north in Colorado. The types of all the three names show the brownish suffusion on primaries. This coloration is, in any case, a rather variable feature as regards its extent over the wing and, while usually present in Rocky Mountain material, can at times be virtually lacking. In consequence there seems to be little value in retaining the name *joymaketa* in a racial sense and it is therefore placed as a synonym. There would be much more excuse in giving a racial name to the form from the mountain ranges of southern California, a long series taken by J. Sperry on the upper Santa Ana River showing a much grayer tinge on the primaries. On the other hand specimens examined from the coastal region of California are characterized by a very marked brown suffusion of the primaries, darker even than in Hulst's type. The matter of races can be safely left until more material is available, as the species appears very variable, not only in size but in both coloration and intensity of maculation. Apart from the brownish or ruddy suffusion the most characteristic feature of the maculation of the primaries is the rather sharp outward angulation of the t.p. line below costa followed by a light colored band, the remaining costal area to apex being occupied by a flatly rectangular smoky patch. Other characteristic structural features are found in the very short palpi which scarcely exceed the front and are dark smoky in color. The male antennae are very noticeably bifasciculate, the rather sparse ciliae being quite long. In the female sex the ciliae are also longer than usual and much as in many males of other species. The flat front is rather short and largely dark scaled, as is also the thorax. There are definite short lateral tufts on each side of the mesoscutellum. Owing to pale dorsal shading on segment I of the abdomen the darker colored segment II presents a somewhat banded appearance, but a really definite dark band is not present.

MALE GENITALIA: Strong hair pencils present on segment IX. Tegumen quite narrow and apically pointed. Uncus broad, strong,

terminating in a long simple hook; the width and length appear somewhat variable in individual specimens. Vinculum strongly produced, tapering apically, with well-rounded terminal edge. Clasper rather narrow and pointed apically, but somewhat variable as to width. Aedeagus broad, somewhat narrowed proximally. Vesica armed with a large piece of curved chitin and a very small dentate piece immediately distad of the larger one. Ventral plate of segment VIII broad in the basal third with strongly excavated cephalic margin, produced into two strongly outbowed rods, widely separated, their apices incurved and somewhat spoon shaped when viewed laterally.

FEMALE GENITALIA: Dorsal plate of segment VIII not quite reaching caudal edge of segment, moderately well chitinized and with a slight median excavation on caudal margin; the anterior apophyses arise as usual from the lateral edges, are slightly inbent, moderately long, and quite thin; the spur to the ventral plate is well defined and terminates laterally in a triangular, weakly chitinized patch, frequently extending slightly beyond this as a short, inward projection. Ostium membranous. Ductus bursae short, membranous, terminating in the usual chitinized half collar. Bursa oval, the proximal section weakly chitinized, the ductus seminalis arising, completely ventrally, from the cephalic end of the collar and projected along the bursa for a short distance before narrowing and turning caudad. A band of moderately long spines extends along the whole dorsal area, crosses the fundus and continues halfway up the ventral side; spurs of finer spining are projected in the proximal area towards the base of the ductus; the centrolateral portions are unspined.

TYPES: *Sierrae*, holotype, female, Colorado (Rutgers University, New Brunswick, New Jersey); *conceptata*, holotype, male, Denver, Colorado; allotype, female, Golden, Colorado (A.M.N.H.); *joymaketa*, holotype, male, Pinal Mountains, Pinal County, Arizona (M.C.Z.).

DISTRIBUTION: Widespread throughout the Rocky Mountain and Pacific coast states: Colorado, New Mexico, Arizona, California.

LIFE HISTORY: Unknown.

REMARKS: The abdomen of the type of

sierrae is lacking, and no genitalic slide could, in consequence, be made. Slides of both male and female of *conceptata* are in the American Museum collection. The holotype of *joymaketa* is without abdomen and has a wrong head glued on. Other slides from the paratype series agree with those of *conceptata*. In the American Museum collection is a single very worn female from the Grossbeck collection labeled "Chester N.J. 8. 4" which seems to belong to this species on antennal and genitalic characters. While it is not impossible that *sierrae* may extend into the eastern states, as is the case with other species (e.g., *coloradensis*, *herefordaria*), the record must be treated as doubtful until further material is found.

***Eupithecia litoris* McDunnough**

Plate 27, figure 35; text figure 6B

Eupithecia litoris MCDUNNOUGH, "1945" [1946], Canadian Ent., vol. 77, p. 174, pl. 9, fig. 5.

The original description embodies virtually all that is known concerning the species. However, among the undetermined material in the American Museum collection a single rather perfect male has been found which permits the addition of certain structural details, including genitalia.

The species seems rather closely allied to *sierrae*, the palpi being similarly short and the male antennae bifasciculate. The maculation of the primaries is also quite similar, but the general ground color is much paler, being a light grayish or cream color; the s.t. line is also not so obvious. The thorax is largely concolorous with the wings, but there is a distinct brownish patch on the mesoscutellum, edged on the caudal margin with white, and with lateral tufting indicated but scarcely as strong as in *sierrae*.

MALE GENITALIA: Hair pencils on segment IX well developed. Tegumen short and broad, tapered apically with convex lateral edges. Uncus thin, short, simple. Vinculum much as in *sierrae*, being strongly produced cephalad, conical, with a narrowly rounded apex. Clasper rather short and stubby, moderately wide. Aedeagus narrow, bent to one side at base and bluntly pointed. Vesica armed with a single, rather obscure, semicylindrical piece of chitin, smaller than that of *sierrae*. Ventral plate of segment VIII consisting of two rather thick, parallel rods, narrowly joined at base;

these broaden inwardly and are more strongly chitinized in their apical third, then narrow again and terminate in rather sharp spines.

FEMALE GENITALIA: Ostium membranous. Collar of ductus bursae moderately wide, chitinized. Neck of bursa long, broad, gradually expanding along the right side with the thin, membranous ductus seminalis arising from the right distal corner. Bursa globular; on the ventral surface there is a membranous area extending obliquely across from the middle of the left side to the base of the ductus seminalis, the remainder of the bursa being finely spined; on the dorsal surface the spining extends completely up the left side and connects with a small patch of spining at the base of the ductus seminalis.

TYPE: Holotype, female, Ensenada, Baja California (C.N.C.).

DISTRIBUTION: Known only from southern California (Three Arch Beach; Gavilan; San Diego, February–April) and Lower California.

LIFE HISTORY: Unknown.

REMARKS: The male genitalia are figured from a San Diego specimen in the American Museum collection; the female organ is from the type.

***Eupithecia quakerata* Pearsall**

Plate 27, figure 36, plate 28, figure 1;
text figure 6C

Eupithecia quakerata PEARSALL, 1909, Proc. Ent. Soc. Washington, vol. 11, p. 125. MCDUNNOUGH, 1936, Canadian Ent., vol. 68, p. 258.

Eupithecia apacheata CASSINO, 1927, Lepidopterist, vol. 4, p. 60. MCDUNNOUGH, 1936, Canadian Ent., vol. 68, p. 258.

Eupithecia conglomerata MCDUNNOUGH, "1945" [1946], Canadian Ent., vol. 77, p. 168, pl. 9, fig. 1.

This species was based on a single male specimen from southern Colorado. Some time ago a slide of the genitalia from the presumable abdomen (*vide* note, 1936) was made and found similar to those of a male paratype of *apacheata* Cassino in the Canadian National Collection, both agreeing with the rather sketchy remarks concerning the genitalia made by Cassino in the original description (a figure stated to be given was never published). On the strength of these slides *apacheata* was placed in the synonymy of *quakerata*, and this will still apparently hold good. Unfortunately, a rather worn female

paratype of *apacheata*, received at the same time as the above male, was accepted as representing the other sex of the species. This female has since been more carefully studied, and the antennae have been found to agree in the length of their ciliations with those of *sierrae*, being considerably longer than those of the true male of *apacheata*, a structural feature that never occurs in the eupithecias. The genitalia, too, show remarkable similarity to those of *sierrae*, the slight variations (although at the time considered of a specific nature) being probably due to the different degree of inflation. It is very evident, in spite of Cassino's remarks on the points of separation from *sierrae* in the original description, that his type series contained specimens of both species. At the present time no data are available concerning the allotype and other female paratypes in the series, but in any case this would not affect the synonymy which is based on the male holotype.

Misled by the above female specimen, I recently described the true female of *quakerata* (*apacheata*) as *conglomerata* McDunnough. After a careful study of the type material of this latter species, together with a series of five more females from Utah and New Mexico found in the unidentified material of the American Museum, there seems little doubt that this is the correct association. The antennae show very feeble ciliations, as was to be expected from the fine ciliations of the male. The palpi, slightly longer than those of *sierrae*, coincide, and the color and maculation (or, rather, lack of maculation) of the wings point in the same direction. A careful examination of the Pearsall type of *quakerata* shows that raised scales were originally present but had been largely rubbed off, leaving the discal spot quite obscure. In *conglomerata*, as described from a perfect specimen, this spot consisted of raised black scales. The male paratype of *apacheata*, mentioned above, shows the same type of discal spot as *conglomerata*.

To sum up the characters, *quakerata* can be primarily separated from *sierrae* by the much finer and shorter ciliations of the antennae in both sexes; the palpi are slightly longer than in *sierrae* and form, with the flat front, the usual conical projection. The forewings are brownish in color (deep gray in Utah speci-

mens) with little definite maculation other than the white s.t. line which expands into a somewhat double spot above the tornus; there is a prominent, upright, black, discal streak, frequently with a fine white border line on the basal side; there is no trace of the ruddy shading frequently found at the bases of veins 2 and 3 in *sierrae*. The abdomen shows a darker segment I dorsally than in *sierrae*, this segment in the latter species being quite whitish; in consequence the dark banding of segment II is less prominent, and the remainder of the abdominal scaling shows more brown shading. As far as can be told from the generally rubbed specimens there are indications of small lateral tufts on the meso-scutellum but not so prominent as in *sierrae*.

MALE GENITALIA: Hair pencils of segment IX strongly developed. Tegumen narrow and sharply conical. Uncus thin and practically simple, the upper hook produced to a fine point and the lower one obsolescent. Vinculum of the normal short and broad type with rounded apical margin. Clasper broad, chunky. Aedeagus broad, very slightly bent. Vesica armed with a conglomerate central mass of long fine cornuti from which arise three chitinous rods, the central one long and pointed, the lateral ones shorter and more blade-like; there is also the usual small, twisted end piece. Ventral plate of segment VIII rather narrow, tapering from the usual broader base, the lateral edges produced in the apical third of the plate into two rods with bluntly incurved apices.

FEMALE GENITALIA: Dorsal plate of segment VIII large, rectangular, slightly broadening in caudal half; anterior apophyses as usual, rather short, the spur to ventral plate arising well beyond the point of origin and terminating in a thin chitinous strip on the lateral edge of the ventral plate which is membranous but which in its cephalic half shows very faint indications of a broadly rectangular ostium pouch. Ostium broad, membranous. Ductus bursae shortly membranous, terminating in a broad, strongly chitinized half collar, the lateral edges of which extend distad for a considerable distance into the gradually broadening, chitinized upper half of the bursa which might be termed the neck and is strongly striate. From the right side of this chitinized portion the ductus seminalis

arises semidorsally from a small membranous projection, and below this is a large patch of strong spines which extends around to the ventral side for about half the width of the neck. In the left lower corner of the chitinous area is a further small cluster of long spines. The balance of the bursa, a rather small section comprising the fundus area, is membranous.

TYPES: *Quakerata*, holotype, male, San Miguel, Colorado (A.M.N.H.); *apacheata*, holotype, male, McNary, White Mountains, Arizona, August 15-30 (M.C.Z.); *conglomerata*, holotype, female, near Ashfork, Arizona, July 20 (C.N.C.).

DISTRIBUTION: Probably widespread in the Rocky Mountain states. Known from Colorado, Utah, New Mexico, and Arizona.

LIFE HISTORY: Unknown.

Eupithecia bolterii Hulst

Plate 28, figure 2; text figure 6D

Tephroclystis Bolterii HULST, 1900, Canadian Ent., vol. 32, p. 102.

Eupithecia bolteri, MCDUNNOUGH, 1938, Canadian Ent., vol. 70, p. 236.

The species is rare in collections. It has a good deal of superficial similarity to *nevadata* Packard, the ground color of primaries being gray, crossed by numerous fine lines. As in *nevadata* there is a more or less evident brown, triangular patch on the costa above the large, upright, black, discal streak. Quite characteristic is a dark streak on the cubital vein, running one-third of the way to the base from a point below the discal spot. The wings are quite pointed apically. The dark-scaled palpi are long and porrect; the flat front is pale centrally with dark anterior tuft and cross line below the antennae; the vertex is largely pale ochreous. The ciliae of the male antennae are moderately long, sparse, and of the trifasciulate type. There are small lateral tufts on the scutellum of the mesothorax. The abdomen dorsally is largely gray with a certain amount of dark, median scaling but no transverse band on segment II. The species seems best placed in the *sierrae* group, showing as it does considerable similarity in various structural details with the other included species.

MALE GENITALIA: Hair pencils on segment IX present. Tegumen broad at base, conical.

Uncus broad and stubby, bifid, both hooks well developed, the dorsal one sharply pointed. Vinculum short and broadly rounded apically. Clasper moderately broad, considerably tapered apically. Aedeagus long and broad. Vesica armed with a long, straight, pointed rod, weakly chitinized and strigate. There are also a twisted piece of chitin in the median area and a small end piece. The whole is obscured by a broad, finely spiculate band. Ventral plate of segment VIII consists of two parallel rods, narrowly joined at base, their apices tapering to blunt points and more heavily chitinized.

FEMALE GENITALIA: Dorsal plate of segment VIII weakly chitinized, uprightly rectangular, caudal area finely spiculate with a faint, U-shaped membranous area at center; anterior apophyses and caudal spur normal. Ostium and short initial portion of ductus bursae membranous, the latter terminating in a long narrow collar, with raised semicylindrical edges. This is followed by a feebly chitinized, strigate, gradually widening bursa neck which twists to the right and on the left side shows an area of membranous thickening. The ductus seminalis arises dorsally on the left side at the base of this area as a raised membranous ridge, slightly strigate, curving across the neck to the right side and then proceeding caudad and ventrad as a fairly broad tube before narrowing. The globular bursa is completely covered with spines dorsally, the spined area running backward through the neck and terminating in a bunch of longer spines on the inner side of the membranous thickening. The ventral surface of the bursa proper is also spined, but the neck is largely membranous with a curved band of spines running up the left side into the thickened area and connecting with weak spining along the inner side of the ductus seminalis.

TYPE: Holotype, female, Texas (Rutgers University, New Brunswick, New Jersey).

DISTRIBUTION: Texas, Arizona (White Mountains, Palmerlee).

LIFE HISTORY: Unknown.

REMARKS: The drawing of the female genitalia is from a slide of the holotype which is in terrible condition. The male organ is based on a specimen in the Canadian National Collection from Jeff Davis County, Texas.

***Eupithecia palmata* Cassino and Swett**

Plate 28, figure 3; text figure 6E

Eupithecia palmata CASSINO AND SWETT, 1922, Lepidopterist, vol. 3, p. 171.

Very little material of this desert species had been available for examination until recently, when a series of five females was received from J. Sperry, collected at Borego, San Diego County, California, in March, 1948, by N. Crickmer. The characteristic feature of the maculation seems to be the pale yellowish brown coloration of the primaries with a broad, somewhat darker-shaded, median band which is quite upright with slight incurve at costa, resembling superficially certain *Xanthorhoe* species. The short, dark palpi contrast strongly with the pale creamy front and vertex, the former showing an apical transverse band of dark scales. The ciliations of the male antennae are of moderate length and evenly distributed, although there is a slight tendency towards a trifasciculate appearance as in a number of other species (e.g., *neomexicana*). The ciliae are distinctly longer than in those species characterized as "finely and evenly ciliate," of which *quakerata* may be cited as an example. In the Borego specimens considerable variation in coloration is evident, some of the specimens being quite heavily suffused with smoky shading, especially in the median area of the primaries. In consequence a good deal of the ochreous ground color is obliterated.

MALE GENITALIA: Hair pencils present on segment IX. Tegumen broad, conical. Uncus well developed, terminating in a single sharp hook. Vinculum much as usual, broadly rounded apically with inwardly sloping lateral edges. Clasper rather short and stubby with broadly rounded apex. Aedeagus moderately broad. Vesica armed with two long, pointed, apically placed rods of chitin. There is also the usual end piece and a good-sized, twisted, and semicylindrical piece of chitin immediately distad. A finely spiculate band traverses the apical half of the organ. Ventral plate of segment VIII weakly chitinized, consisting of two narrow, parallel rods, rounded apically and joined in the basal fourth, the base broadened as usual.

FEMALE GENITALIA: Dorsal plate of segment VIII broadly rectangular, chitinized;

the anterior apophyses curve slightly outward from their point of origin at the laterocephalic edges of the plate, then turn cephalad and at this point give rise to the spur which is strong, runs caudad to near the caudal margin of the ventral plate, ending in an elongate chitinous patch. Ostium broad, membranous, funnel shaped; it is continued by the lengthy, chitinized half collar of the ductus bursae which expands into a short, slightly broadened, and somewhat striate bursa neck. The bursa is long, oval, with the ductus seminalis arising more or less mediodorsally at its proximal end from a small membranous bulb; the left side is straight, continuing the line of the neck while the right side is strongly bulging; the dorsal surface, except for a small area around the fundus, is completely spined, the spines along the left side being the longest and continuing slightly farther into the neck than on the right side; on the ventral side the membranous fundus area is continued along the left side right up to the neck by a gradually expanding, membranous band.

TYPES: Holotype, male, Palm Springs, California, March (U. S. N. M., *ex* collection Barnes); allotype, female, same data (M.C.Z.).

DISTRIBUTION: So far known only from the desert regions of southern California.

LIFE HISTORY: Unknown.

***Eupithecia piccata* Pearsall**

Plate 28, figure 4; text figure 6F

Eupithecia piccata PEARSALL, 1910, Proc. Ent. Soc. Washington, vol. 12, p. 143.

Only the female paratype of this species in the American Museum collection and a male specimen (Jemez Mountains, New Mexico, 6600 feet, August 8, collection Buchholz) have actually been examined. Genitalic slides were made some years ago from the abdomens of the holotype male and allotype female in the United States National Museum, but the specimens themselves were not seen. Little can therefore be added to what is stated in the original description, and the description of the male genitalia has been based on a drawing made at the time of dissection of the type.

The species may be recognized by its small size and the rather strong suffusion of smoky sprinkling over both wings, presenting some-

what the appearance of a small *pygmaeata*. The sharp outward angle of the t.p. line below costa and the dark patch on costa above the apex of this angle seem characteristic. The quite bushy palpi are not very long but still project well beyond the apex of the front; the male antennae are very finely ciliate; there is no dark ring on segment II of the abdomen, which is of a light brown color; no lateral tufts exist on the mesoscutellum, which is of the same light brown color as the abdomen and smoothly scaled.

MALE GENITALIA: Uncus simple. Claspers broad and not much narrowed apically. Aedeagus broad, stout. Armature of the vesica consists, besides the end piece and a curved and partially hollowed broad band, of four long, pointed, chitinous rods, one of which is entirely obscured by the superimposing of the others. A band of fine spicules extends through the central section. Ventral plate of segment VIII broad, the lateral edges more strongly chitinized, bent outward apically and terminating in two sharp, projecting points.

FEMALE GENITALIA: Whole organ very small. Dorsal plate of segment VIII weakly chitinized, rectangular. Anterior apophyses much as in preceding species. Ostium membranous. Ductus bursae shortly membranous, terminated by a broad, rather weakly chitinized half collar, and followed by the broad, curved, neck-like portion of the bursa. This neck when viewed dorsally is fleshily membranous on the left side, weakly chitinized on the right side, bending to the right and somewhat caudad, and terminating in the membranous, dorsally situated ductus seminalis which is broad at its inception but soon narrows to the usual fine tube. The globular bursa proper is entirely covered with spines on the dorsal side, sending a broad band of similar spines caudad through the fleshy part of the neck nearly to the collar. On the ventral side there is a narrow, membranous, central section adjoining the fleshy neck that is entirely free from spines.

TYPES: Holotype, male, allotype, female, Las Vegas, New Mexico (U.S.N.M.); paratype, female, same locality (A.M.N.H.).

DISTRIBUTION: So far known only from New Mexico.

LIFE HISTORY: Unknown.

REMARKS: The drawing of the female genitalia has been made from a slide of the paratype, the organ in this specimen being in a much better inflated condition than that of the allotype.

***Eupithecia pretansata* Grossbeck**

Plate 28, figure 5

Eupithecia pretansata GROSSBECK, 1908, Jour. New York Ent. Soc., vol. 6, p. 23.

So far unrecognized by the author. Known only from the type female in the Academy of Natural Sciences of Philadelphia, of which it has not been feasible to make a genitalic slide. Judging by a photograph the species should be recognized by the darker median area of primaries, forming a broad band across the wing. The antennae are stated to be finely ciliated, the palpi moderate in length, and there is a dark band crossing segment II of the abdomen. Dr. C. Michener who has recently examined the type specimen states that he could see no trace of the subapical spurs on the single hind tibia remaining. If this character proves constant it is possible that the species should be transferred to *Prorella*, falling near *opinata*, which also differs from the typical section of this genus in lacking a protuberant front.

TYPE: Holotype, female, Carr Canyon, Huachuca Mountains, Cochize County, Arizona, August (A.N.S.P.).

***Eupithecia sinuata* McDunnough**

Plate 28, figure 6; text figure 6G

Eupithecia sinuata MCDUNNOUGH, 1946, Canadian Ent., vol. 78, p. 87, fig. 3.

Nothing can be added to the information contained in the original description, as only a single female from the type locality (*ex* collection Sperry) has since been examined. Until the male sex is known the relationship of the species is doubtful, but on account of certain similarities to the female genitalia of *neomexicana* it is temporarily placed next to this species.

TYPES: Holotype, female, Alpine, Arizona, June, and paratype, female, White Mountains, Arizona (C.N.C.).

***Eupithecia neomexicana* McDunnough**

Plate 28, figure 7; text figure 7A

Eupithecia neomexicana MCDUNNOUGH, "1945"

[1946], Canadian Ent., vol. 77, p. 175, pl. 9, figs. 6, 6a.

Since the description of this species a series of two males and seven females from various Arizona localities has been found in the undetermined material of the American Museum collection. Most of these, unfortunately, are in poor condition, and little can be added, from a study of their maculation, to the rather meager description originally offered. They have been placed under this name owing to similarity of genitalia with the original figures. They were all captured in late August or early September and occurred with specimens of a species very closely allied to *persimulata* McDunnough, from which superficially they could scarcely be separated.

The upturned palpi, of moderate length, are typically eupitheciid, rising slightly above the flat, rather short front, and showing a rather rough squamation. The male antennae show ciliae of moderate length (longer than the fine, evenly distributed ciliae of species such as *quakerata*), and when viewed laterally give the appearance of a weak trifasciculation, due to the fact that the ciliae tend to bunch into three small groups, continued across the segment in more or less parallel rows. The longer ciliae separate the species, among other things, from the *persimulata*-like form. In the maculation of primaries there seems a tendency (as far as could be determined) for a narrow dark band to arise from a small dark patch on costa, jutting outward to touch the discal dash, and then proceeding obliquely sinuate to inner margin with an outward bulge in the fold; this sinuate character does not seem to occur in allied forms.

MALE GENITALIA: Hair pencils present on segment IX. Tegumen short, narrow, sharply conical. Uncus rather short, bifid. Vinculum much as usual, broadly rounded apically. Clasper broad, sharply angled on ventral margin just beyond middle. Aedeagus moderately long and broad. Vesica armed with four pointed chitinous rods, one twice as long as the others; two others, apically situated, curved at base, one strongly recurved; one shorter rod proximad of the others. Further, the usual small end piece and a twisted, semicylindrical piece of chitin are present. Ventral plate of segment VIII consisting of

two rods, narrowly joined at the usual expanded base and slightly outcurved at their pointed apices.

FEMALE GENITALIA: Dorsal plate of segment VIII a high rectangle with convex caudal margin; anterior apophyses moderate, with short spurs to small chitinous plates on lateral edges of membranous and finely spiculate ventral plate. Ostium membranous, opening directly into the very broad, chitinized half collar of the ductus bursae which has slightly raised edges and a convex caudal margin. The ductus is directly continued by the gradually expanding and strongly chitinized bursa neck which forms a shallow trough, directed towards the right; from its lower right-hand corner the ductus bursae arises as a moderate-sized bulb, directed caudad and quickly narrowing to a fine tube. Bands of strong spines extend on both ventral and dorsal surfaces along the cephalic edge of the chitinized area, being practically conjoined at their lateral edges. The bursa proper is membranous with a small patch of long spines above the fundus.

TYPES: Holotype, male, and allotype, female, Frijoles Canyon, New Mexico (C.N.C.).

DISTRIBUTION: Apparently quite widespread throughout western New Mexico and Arizona (Prescott, Redington, Douglas) in early fall.

LIFE HISTORY: Unknown.

***Eupithecia alpinata* Cassino**

Plate 28, figure 8; text figure 7B

Eupithecia alpinata CASSINO, 1927, Lepidopterist, vol. 4, p. 65. McDUNNOUGH, 1938, Canadian Ent., vol. 70, pp. 236, 239, pl. 20, figs. 2, 2a; 1945, *ibid.*, vol. 77, p. 64.

Eupithecia prostrata McDUNNOUGH, 1938, Canadian Ent., vol. 70, p. 238, pl. 20, figs. 3a, b, c (*partim*, ♂ *nec* ♀).

The difficulties attending the correct application of this name, its separation in the male sex from the extremely similarly marked *prostrata* McDunnough, and the doubtful sex associations of the two species have already been discussed (1938, 1945). Some of these difficulties have arisen from the fact that Cassino included specimens of both species in his type series of *alpinata*. While the identity of the allotype female could be readily established by a superficial examination of the ovipositor lobes, it was impossible to as-

certain which of the two forms of males had been selected by the author as representing the holotype of *alpinata* until a genitalic slide had been made. (The genitalic figure mentioned by Cassino in the original description was never published.) This was recently done, as noted, and Cassino's sex association is for the present accepted as being the correct one, instead of the one originally given at the time of the description of *prostrata*.

The species is an obscurely marked one, the primaries being strongly suffused with smoky brown or gray with the usual cross lines vaguely indicated. The palpi are moderately long and project considerably beyond the front, forming with the flat, tufted front a rather prominent cone. The male antennae are rather weakly ciliate, the ciliae being both fewer and slightly longer than in *prostrata* males and tending feebly towards the trifasciculate type rather than the finely and evenly ciliate one. The scutellum of the mesothorax shows a central white patch and there are frequently traces of pale mediodorsal and lateral lines on the abdomen, the latter accentuated by dark shading. In the female sex the long, narrow, pointed ovipositor is a very characteristic feature.

MALE GENITALIA: Hair pencils on segment IX present and moderately well developed. Tegumen narrowly conical. Uncus short, stubby, with bifid apex, the ventral hook being strongly developed. Vinculum of normal shape. Clasper narrow and rather pointed apically. Aedeagus of moderate length and width. Vesica armed with three pointed chitinous rods, more or less in a cluster; there are also the usual small end piece and a laterally situated, fairly long, partially hollowed piece of chitin; a finely spiculate band traverses the apical half of the organ. Ventral plate of segment VIII broadly conical, the sides straight and produced in the apical half into two flat, rather broad prongs, with long, narrow, V-shaped excavation between them.

FEMALE GENITALIA: Dorsal plate of segment VIII well chitinized, rectangular, the rounded caudal margin with a prominent, narrow, V-shaped excavation; anterior apophyses strong, fairly long, the lateral spur also strong, recurved apically and termi-

nating in a small, triangular, chitinous plate, situated laterally on the membranous ventral plate. Ostium membranous. Ductus bursae largely composed of a well-chitinized collar from the distal end of which the ductus seminalis arises, entirely ventral, as a strong, bulging, membranous tube, curving down over the bursa nearly to the fundus and then turning caudad along the left side, narrowing to a fine, thread-like tube in the region of the collar. The bursa on the right side is chitinized for half its width from the proximal end nearly to the fundus; the remainder of this surface is finely spined except for a small membranous sac behind the collar; the left side of the bursa is also finely spined with the exception of a membranous band extending from above the fundus to the base of the ductus seminalis; the spines are largest around the basal area of the ductus seminalis.

TYPES: Holotype, male, and allotype, female, Alpine, Texas, April 18 (M.C.Z.).

DISTRIBUTION: Known only from Jeff Davis County, Texas, but will probably occur in adjacent regions of Arizona.

LIFE HISTORY: Unknown.

Eupithecia prostrata McDunnough

Plate 28, figure 9; text figure 7C

Eupithecia prostrata MCDUNNOUGH, 1938, Canadian Ent., vol. 70, p. 238, figs. 3d, e (*partim*, ♀ *nec* ♂); 1945, *ibid.*, vol. 77, p. 64.

The close relationship between this species and *alpinata* has already been discussed. The male antennae show slight differences from those of *alpinata* which is the only superficial character that can be satisfactorily used in separating the two forms. In *prostrata* the ciliae, while slightly shorter, are much more numerous and more evenly distributed and show no trace of the trifasciculate nature that is weakly evident in *alpinata*. The scutellum of the mesothorax does not appear to be so whitish centrally as that of *alpinata*, but most of the specimens examined were denuded of scales in this area, and this character needs checking. The broad, truncate, heavily haired ovipositor lobes in the female are an excellent means of separation from the same sex of *alpinata*.

MALE GENITALIA: Hair pencils of segment VIII moderately well developed. As compared with *alpinata*, the tegumen is somewhat

narrower. Uncus thinner and with the lower apical hook slightly less developed. Vinculum more roundedly produced. Clasper somewhat shorter and stouter. Aedeagus stouter. Vesica armed with two apically situated, superimposed pointed chitinous rods; behind this a shorter, stouter spine with broadened and recurved base; on the left side a long, pointed chitinous rod (not present in *alpinata*). The end piece, hollowed-out piece of chitin, and the spiculate band much as in *alpinata*. Ventral plate of segment VIII thinner than in *alpinata*, with longer terminal prongs which tend to curve slightly outward at apices.

FEMALE GENITALIA: Dorsal plate of segment VIII chitinized, uprightly rectangular, with a broadly V-shaped membranous and spiculate portion in the center of the caudal margin; anterior apophyses much as in *alpinata*. Ostium membranous. Ductus bursae membranous for a short distance, then with a long, rather narrow, chitinous collar, the raised edges of which project for a short distance into the bursa. Bursa subrectangular, the left side almost straight, the right side strongly bulging. Below the collar on the ventral side is a membranous space from which the ductus seminalis arises as a broad raised tube, descending downward on the right side of the bursa to near the fundus, then curving across the bursa and narrowing to a fine tube directed caudad. The remainder of the ventral surface and the entire dorsal surface are spined, with the exception of the fundus and a narrow band extending backward from the fundus along the left side to about the middle of the bursa. The spines are particularly long along the margin of the membranous area from which the ductus arises.

TYPES: Holotype, female, and paratypes, Davis Mountains, Jeff Davis County, Texas, March (C.N.C.).

DISTRIBUTION: Apparently similar to that of *alpinata*.

LIFE HISTORY: Unknown.

***Eupithecia persimulata* McDunnough**

Plate 28, figure 10; text figure 7D

Eupithecia persimulata McDUNNOUGH, 1938, Canadian Ent., vol. 70, p. 240, figs. 4a, b.

Since the description of this species, based on two females from southwestern Texas, no

topotypical males have been collected, and until this sex has been studied the position of the species is doubtful.

The maculation is very similar to that of the two preceding species, but in coloration of both wings these types are distinctly browner than either of them, although this is probably partly due to the somewhat rubbed condition of the specimens. Apart from the thin, black, discal streak on the primaries, the t.p. line is the only very evident feature of the maculation, curving strongly outward below the costa. The dark palpi extend considerably beyond the front, and the antennae are very finely and shortly ciliate. The dark band of segment II of the abdomen is quite noticeable, accentuated by the paler scaling on the preceding and following segments, and black lateral lines are fairly evident.

In the American Museum of Natural History are a series of specimens of both sexes, rather old and worn, from the Prescott region of Arizona and two further worn but fresher females from Oak Creek Canyon in the same region, collected by J. Sperry. The female genitalia of these Arizonan specimens match those of the types fairly closely, but there is some deviation in the length of the chitinized trough and the amount of spinning on the ventral surface of the bursa which makes their placement here rather doubtful. Males belonging to the series have a type of genitalia quite similar to those of *alpinata* and *prostrata*, but the vesica contains four long, pointed chitinous rods in addition to the end piece and the semicylindrical piece of chitin. It is quite possible that these specimens are correctly placed under *persimulata* but, as already stated, the placement cannot be considered certain until topotypical males have been examined. The description and drawing of the female genitalia were made from a slide of the holotype.

FEMALE GENITALIA: Dorsal plate of segment VIII upright rectangular; anterior apophyses rather thin and short, the spur triangularly broadened distally and terminating in a small, chitinous, lateral plate. There are indications of a broad, faintly shagreened ostium pouch attached to the cephalic end of the membranous ventral plate of segment VIII. Ductus bursae com-

posed principally of a broad chitinous collar which connects on the dorsal side with a short, gradually broadening, chitinized and striate, initial section of the bursa which corresponds to the neck. On the left side a trough-like, strongly chitinized band extends for a considerable distance down the bursa dorsally, and is furnished along its inner edge with a row of very long spines; at its proximal end a small membranous sac juts out to the left. Bursa long, oval, straight edged on the left side, bulging on the right, completely spined on dorsal surface with the exception of the membranous fundus. On the ventral surface a gradually expanding, median, membranous band extends from the collar to the fundus, the remainder of the surface being well spined. A small median patch of spines occurs just distad of the collar and is more or less connected with the right side spining which extends farther caudad than that of the left side. The ductus seminalis arises on the left side dorsally from a small, membranous bulb situated at the end of the chitinous band, crosses the bursa as a moderate-sized tube and narrows then to the usual thread-like one.

TYPES: Holotype, female, and paratype, female, southwest Texas, May-June (C.N.C.).

DISTRIBUTION: Southwestern Texas; Arizona (Todd's Lodge, Oak Creek Canyon).

LIFE HISTORY: Unknown.

***Eupithecia exudata* Pearsall**

Plate 28, figure 11

Eupithecia exudata PEARSALL, 1909, Proc. Ent. Soc. Washington, vol. 11, p. 120.

Misled, to a certain extent, by a very poor genitalic slide made by Cassino of the unique male type and without an actual knowledge of the specimen itself, *exudata* was associated (McDunnough, 1941, Canadian Ent., vol. 73, p. 189) with *herefordaria* Cassino as a probable eastern race. With the actual type specimen now available for study this proves to be wrong; *exudata* appears to be a good species occurring in early spring. Its much smaller size (16 mm.), the very short palpi, the much thicker antennae, and the browner coloration of the primaries with more definite maculation all serve to distinguish it from *herefordaria*, which, however, does occur in the eastern United States.

Such specimens had been previously considered to be *exudata*, but wrongly so.

In the maculation of the primaries the distinct brownish tinge, as noted above, is quite characteristic; the maculation is rather faint, consisting principally of a number of small, dark patches along the costa, a small, dark discal dot, traces of a rather upright, darker median band and a whitish dot above tornus, relieved inwardly with a dark spot and representing a portion of the otherwise obscure s.t. line. The short palpi are dark in color, the thorax is largely concolorous with the wings, with the scutellum of the mesothorax showing a paler, triangular spot; according to the original description there is a blackish band on segment II of the abdomen. The male antennae are quite characteristic, being stout and laterally compressed, alternately banded with brown and whitish dorsally. The ventral ciliation is termed by Pearsall "shortly biciliate" but would appear to be better classed as "feebly trifasciculate"; the moderately long ciliae seem to be arranged in bunches of three, when viewed laterally, much as in a number of other species with similar type of ciliation. Cassino's slide of the genitalia has been remounted and the following description drawn up from the still rather crushed and overstained preparation. Fresh material will be necessary before the organ can be described accurately.

MALE GENITALIA: No trace of hair pencils on the slide but probably present. Tegumen and uncus similar to those parts in *herefordaria*, the uncus possibly a little thinner but with both hooks of the bifid apex well developed. Vinculum as in *herefordaria*. Clasper quite narrow but less sharply constricted apically than in *herefordaria*. Aedeagus slightly thinner. Armature of vesica impossible to define accurately, owing to over-staining, but there are certainly two long, pointed, chitinous rods and possibly three; cephalad of these is a large irregularly shaped piece of chitin, the apex apparently slightly pointed; an end piece can also be detected. The ventral plate of segment IX is broken but seems somewhat shorter than that of *herefordaria* with narrower prongs, especially apically, and more as in *prostrata*.

TYPES: Holotype, male, New Brighton, Pennsylvania, April 27 (A.M.N.H.). A para-

type from the same locality should be in the United States National Museum, *ex* collections Merrick and Barnes.

DISTRIBUTION: Known only from western Pennsylvania.

LIFE HISTORY: Unknown.

Eupithecia herefordaria Cassino and Swett

Plate 28, figure 12; text figure 7E

Eupithecia herefordaria CASSINO AND SWETT, 1923, *Lepidopterist*, vol. 4, pp. 18, 56. McDUNNOUGH, 1938, *Canadian Ent.*, vol. 70, p. 236.

Eupithecia exudata FORBES (*nec* Pearsall), 1948, *Cornell Univ. Agr. Exp. Sta.*, Mem. 274, p. 166.

This long, narrow-winged, deep smoky gray species of early spring appears to be widespread in its distribution, although comparatively rare in collections. Originally described from a single male from Hereford, Arizona, it has since been reported from Jeff Davis County, Texas, and represented by a fair series of specimens from this locality in the Canadian National Collection which have been compared with the type. In the same collection are also a few specimens from Massachusetts and Pennsylvania which cannot be separated, either genitally or otherwise, from the Texan specimens.

Generally speaking the maculation of primaries is obsolescent, but in the best-marked specimens the t.a. and t.p. lines can be traced, slightly inwardly oblique with slight incurve at costa, defining a slightly darker median band which at times is somewhat relieved by narrow, paler, antemedian and postmedian bands and contains a small discal dot; the terminal area is somewhat darker. The quite long, porrect palpi are characteristic and should at once separate the species from *exudata*. The male antennae are thinner than in *exudata*, the ciliae being longer and more definitely grouped into clusters of three (trifasciculate) when viewed laterally. The ciliation is rather sparse, as is usually the case with this type of antenna. The abdomen is deep gray without any dark band across segment II.

MALE GENITALIA: Hair pencils on segment IX present, moderate. Tegumen rather narrow, conical. Uncus short but broad basally, bifid, both hooks well developed. Vinculum produced somewhat more than usual, with rounded apex. Clasper narrow and

strongly tapered at apex. Aedeagus moderately broad. Vesica armed with three long, pointed, chitinous rods and a smaller spine between them; there are also the usual end piece and an obscure piece of twisted chitin. Ventral plate of segment VIII broad at base and then continuing as two semiparallel rods, narrowing and slightly incurved apically, their apices rounded and slightly spoon shaped.

FEMALE GENITALIA: Anal lobes rather long and pointed. Dorsal plate of segment VIII rectangular, well chitinized, caudal margin slightly convex with weak median excavation. Apophyses rather short, spur short, broadening caudally and ending on the laterocephalic edge of the membranous ventral plate. Ostium and short initial portion of ductus bursae membranous, followed by a long, broad, chitinous collar, with raised, semiparallel edges when viewed ventrally. This is continued by a short, chitinized bursa neck, striate on the dorsal side and forming a trough on the ventral one; it curves to the right and the thin ductus seminalis arises from its apex on the ventral side. Bursa small, moccasin shaped, the foot jutting out to the right; both its ventral and dorsal surfaces are spined, with the exception of a small membranous area on the lower left side which extends caudad to the apex of the collar.

TYPE: Holotype, male, Hereford, Arizona (M.C.Z.).

DISTRIBUTION: Arizona, Texas (Jeff Davis County); Pennsylvania (Indiana); Massachusetts (Norwood, Newton).

LIFE HISTORY: Unknown.

Eupithecia suspiciosata Dietze

Plate 28, figure 13; text figure 7F

Eupithecia suspiciosata DIETZE, 1875, *Stettiner Ent. Zeitg.*, p. 252, pl. 2, fig. 4. CASSINO AND SWETT, 1922, *Lepidopterist*, vol. 3, p. 179.

The identity of this species has long been a puzzle. According to Cassino the type should be in the Zoological Museum, Berlin, Germany, but whether it has survived the bombing of the last war is not known. The figure given by Dietze depicts a very narrow-winged species with oblique cross lines, and the locality of "California" might easily turn out to be somewhere in the neighborhood

of San Francisco Bay, as was presumed to be the case in connection with *subvirens* Dietze. At first sight Dietze's figure is reminiscent of *acutipennis* Hulst, and his mention that in one of the specimens there is brown shading between the cell and wing apex would strengthen this idea. However, the definite statement that the palpi are pointed and at least one-quarter longer than the diameter of the eye would exclude this species from consideration, and, furthermore, it is hardly likely that such a careful observer as Dietze would omit any mention of the dark subapical streak which is quite characteristic of *acutipennis*. For some time two rather worn female specimens from Petaluma, Sonoma County, March 16, and Guerneville, Sonoma County, May 5, in the Canadian National Collection have been tentatively held under this name, as they fit in with the description as far as the palpal length, the gray color of the primaries, and the oblique cross lines are concerned. Just recently a pair of very fresh specimens from Marin County, February 22 (F. Rindge), and four females from Spring Mountain, Napa County, March 14 (W. Bauer), of this same species have been examined, and for the present it has been decided to hold the name to this series, in lack of any other known Californian species that would fit the description any better. Should it turn out that the types have been destroyed one of these specimens could be made a neotype, but at the moment such a procedure is rather premature. Based on the similarity of genitalia to these Californian specimens a male from Provo, Utah (April), and a worn female from the Charleston Mountains, Nevada (May), have been found among the unnamed material of the American Museum of Natural History.

The general coloration of the primaries is a smoky gray with a rather well-defined black discal dot composed of raised scales. The oblique dark cross lines arise from small patches on the costa, angle outwardly, and then proceed obliquely and more or less parallel to the inner margin, somewhat accentuated on the veins by dark spots. Beyond the t.p. line there is a band of somewhat paler color, the terminal area being again darker and cut by a rather obscure, pale, wavy, s.t. line which is relieved inwardly by dark streaks,

the one above the tornus largest and forming a quite prominent and rather characteristic small, dark patch. The secondaries are dirty whitish with very small discal dot and considerable blackish shading above the basal area of the inner margin. The palpi are slightly upturned, forming with the flat front a quite prominent cone. Scaling of head, thorax, and abdomen smoky gray, the posterior abdominal segments tinged somewhat with a deeper shade. The male antennae are very shortly ciliate, with a tendency towards the trifasciculate type of grouping, when viewed laterally. The type of genitalia does not entirely conform with that of preceding species, but no other placement seems any more satisfactory.

MALE GENITALIA: Hair pencils of segment IX well developed. Tegumen narrow and conical. Uncus broad at base, short, bifid, with both prongs distinct. Vinculum broad and well rounded apically. Clasper narrow, tapering somewhat apically. Aedeagus broad and long. Vesica armed with the usual small, twisted end piece, a large, semicylindrical piece of chitin occupying nearly the whole length of the aedeagus and with the proximal ends separated, and a broad band of numerous small spines, decreasing in size and becoming obsolescent towards the apex of the organ. Ventral plate of segment VIII composed of two fine, parallel, chitinous prongs arising from the usual broad base.

FEMALE GENITALIA: Dorsal plate of segment VIII weakly chitinized, rectangular, caudal margin with small, oval, median excavation; anterior apophyses and caudal spur much as usual, the latter ending in a small, narrow, chitinous strip on the lateral edge of the membranous ventral plate; anal lobes rather pointed. Ostium and short initial portion of ductus bursae membranous, followed by a moderate-sized chitinous collar. Bursa rather narrowly oval; on the ventral side, continuing the collar, a weakly chitinized but strongly striate strip extends fully half-way to the fundus, terminating in a membranous patch from which a broad ductus seminalis arises, curving caudad and reaching beyond the collar before narrowing; balance of surface spined, with particularly long spines on the left side around the base of the ductus seminalis; on the dorsal side there is a

small membranous area at the junction of the bursa and collar, containing a small patch of very minute spines.

TYPE: Holotype, California (Zoological Museum, Berlin, Germany?).

DISTRIBUTION: Based on the above specimens the species extends from the central coastal area of California into the mountains of Nevada and Utah.

LIFE HISTORY: Unknown.

***Eupithecia nabokovi* McDunnough**

Plate 28, figure 14; text figure 7G

Eupithecia nabokovi McDUNNOUGH, "1945" [1946], Canadian Ent., vol. 77, p. 169, pl. 9, figs. 2, 2a.

As only a single male specimen of this species has been seen since the original description was presented, very little can be added to what is stated therein. It might be noted that the male antennae are feebly bifasciculate or biciliate, the ciliae being grouped laterally into two more or less compact bundles from which parallel rows of ciliae extend across each segment transversely. The generally gray brown coloration of both wings, together with the fairly prominent white spots at the anal angles, is the most prominent feature of the maculation. The position of the species is doubtful. There seems to be some distant relationship to the *sierrae* group, although the thoracic scutellum is without tufting. The general type of ventral plate in the male and the character of the armature of the vesica fit in fairly well with the *alpinata* group.

To the original description of the genitalia might be added that in the male hair pencils are present and that other parts not men-

tioned are normal. In the female the dorsal plate of segment VIII is flatly rectangular, being much broader than high with a slight, oval, median excavation on caudal margin; the anterior apophyses are very stout and fairly long; the caudal spur, originating a considerable distance from the base of the apophysis, is short and forms the cephalic edge of a triangular plate on the lateroventral side, projecting inward for a short distance beyond it.

TYPES: Holotype, male, Alta, Utah (M.C.Z.); paratypes, male and female, Alta, Utah, and Jemez Springs, New Mexico (C.N.C.).

DISTRIBUTION: Utah, New Mexico, Arizona (White Mountains).

LIFE HISTORY: Unknown.

***Eupithecia biederanata* Cassino and Swett**

Eupithecia biederanata CASSINO AND SWETT, 1922, Lepidopterist, vol. 3, p. 168.

This species is entirely unknown to the author at the present time and is represented only by the two type specimens. Judging by the description the species should be easily recognized by the ferruginous color of the primaries, but its relationships are doubtful until further studies are possible.

An abdomen that had been glued on the holotype male at some time proved on dissection to be that of *miamata* Cassino and obviously, therefore, the wrong abdomen. In the female allotype the abdomen is missing. Nothing, therefore, can be stated regarding the genitalia until more material is available.

TYPES: Holotype, male, Hereford, Arizona, February (M.C.Z.); allotype, female, Palmerlee, Arizona, abdomen missing (U.S.N.M.).

THE SATYRATA GROUP

This group represents the typical section of the genus *Eupithecia* and included under this heading are a number of species of general similarity of appearance and frequently of very close relationship. Many of them are either of Holarctic distribution or extremely closely related to European forms, and, as do most of such species, show a great variability in color and maculation. Virtually all agree in possessing from one to several pieces of spined chitin in the armature of the male

vesica, and the uncus is in all but one case bifid. In general the ventral plate of segment VIII in the male consists of a single rod, arising from an expanded base, and with bluntly truncate apex. At times the apex appears bifid, owing to the thinning of the central area to almost a membranous consistency. In the female genitalia the exit of the ductus seminalis is typically on the right dorsal side near the proximal end of the bursa and bears spines around its base. The palpi are

short to moderate in length, and the ciliations of the male antennae are short and rather evenly distributed.

In the following grouping of species *cupressata* heads the list doubtfully, and until the male sex is known and studied the position is uncertain. *Albigrisata* follows on account of the presence of spined chitinous pieces in the male vesica, but the species is known only from the male type, and the relationship is problematic. Next follows the typical *satyrata* complex comprising *gibsonata* and *taylorata*, extremely closely allied to the *helveticaria* group of Europe; *satyrata* and its numerous forms, including *terminata*; then *nimbicolor* and *strattonata*. These all show considerable similarity of genitalic structure, the vesica in the male armed with several spined pieces of chitin and the rod of the ventral plate of segment VIII with broad, irregularly truncate apex. In all the species except *strattonata* the female bursa shows a narrow membranous strip on the left side extending to the fundus. *Cimicifugata* and *grata* which follow are very closely allied to each other and are possibly only forms of a single species. The male ventral plate is of the typical *satyrata* type, but the genitalia in both sexes are slightly divergent, although obviously related to the preceding group, in the female most closely to those of *strattonata*. A group of three species follows which diverges from the typical form of female genitalia in that the bursa possesses a distinct chitinous trough, descending on the right ventral side, and from the distal end of which the broad ductus seminalis projects strongly outward; the male genitalia show less variation from the normal form. This group comprises *russeliata*, *ammonata*, and *coagulata*, the latter closely allied to the European *assimilata*. *Swettii* seems best transferred here, as the female genitalia bear considerable resemblance to those of the following species, and the male aedeagus, while somewhat variant, contains spined pieces of chitin; the anal plate is broadly triangular with truncate apex, differing in this respect from the other included species. In the eight following species there is an increasing tendency towards the bifid type of apex of the male ventral plate already mentioned, and the size of the various species is greatly increased. The

spined condition of the vesica armature still is an important character, and in the female bursa the narrow membranous strip found in the *satyrata* group is present in all but the last two species. The large pear-shaped bursae are structurally very similar throughout and differ only in minor characters the one from the other. Included are *geminata*, a counterpart of the European *absynthiata*; *indistincta*; *zygadeniata*; *cretacea*, also occurring in Europe; *plenoscripta* and *nimbosa*, possibly races of a single species; and finally *multiscripta* and *behrensata*, also very closely related.

Eupithecia cupressata Pearsall

Plate 28, figure 15; text figure 8A

Eupithecia cupressata PEARSALL, 1910, Proc. Ent. Soc. Washington, vol. 12, p. 141.

The type of this species in the United States National Museum is a female, not a male as stated in the original description. A slide of the genitalia of this specimen was made some years ago. Only two other specimens are known to the author, both female, the one in the American Museum collection from Monterey County, California, and therefore topotypical, the other in the Canadian National Collection from Point Arena, Mendocino County, California, August 9.

The species should be fairly easily recognized by the long, porrect palpi and the light fawn brown color of the primaries finely peppered with white and with obscure maculation, except for a very long and prominent black discal streak. The t.a. and t.p. lines are faintly visible, both angled outwardly below the costa; the s.t. line is obsolescent. The pale, dull grayish secondaries show only a small discal spot and traces of a darker terminal band. The relationship of the species is quite doubtful, and its proper placement must await receipt of further material, including males. In any event the species has no connection with the *longipalpata* group, as claimed by Pearsall who was doubtless misled by the long, porrect palpi.

FEMALE GENITALIA: Dorsal plate of segment VIII squarely rectangular with slightly concave, lateral edges, rather feebly chitinized; anterior apophyses rather thin and short, caudal spur slightly enlarged at its inception, otherwise thin and terminating at

the laterocephalic edge of the ventral plate which is largely membranous but shows a faint, circular, finely shagreened plate at the mouth of the ostium. The broad, membranous, funnel-shaped ostium leads into a short membranous ductus bursae which is followed by a broad, chitinized collar. The bursa is extremely small for the size of the insect, largely membranous with a small patch of spines at the fundus which extends for a short distance up the ventral surface. The ductus seminalis is entirely dorsal, arising in the upper half of the bursa as a moderate-sized tube which descends over the bursa nearly to the fundus, curving to the right; it then turns caudad, narrowing to a fine thread.

TYPE: Holotype, female, Monterey, California (U.S.N.M.).

DISTRIBUTION: Central coast region of California so far as is known.

LIFE HISTORY: Larva occurs on cypress.

***Eupithecia albigrisata* Pearsall**

Plate 28, figure 16; text figure 8B

Eupithecia albigrisata PEARSALL, 1909, Proc. Ent. Soc. Washington, vol. 11, p. 122.

This species is very imperfectly understood and is known only from the holotype male in the American Museum collection. Pearsall's description is good, but the thin pale cross lines are not so distinct as one would be led to believe from the text. The two wavy, post-median lines can be traced, especially above the inner margin, and the s.t. line is moderately clear. A slide made by Cassino of the genitalia is unfortunately so imperfect and overstained that, even after being remade, it is impossible to determine definitely the number of chitinous pieces in the armature of the vesica. Then, too, the important ventral plate is lacking, which might have given a definite clue to the proper position of the species. On account of the type of spined, chitinous pieces in the vesica *albigrisata* is placed tentatively in the *satyrata* group. It resembles closely a small, feebly marked *satyrata*, but the ciliation of the antennae is much shorter and finer than in this species, being even finer than in *russeliata*. The figure of the genitalia has been drawn as accurately as was possible under the circumstances but will probably need revision when material is available.

MALE GENITALIA: Tegumen moderately broad at base, conically narrowed apically. Uncus rather chunky (broader and shorter than in *satyrata*), apex bifid, the dorsal hook sharp, the ventral one rounded. Vinculum broad and rounded as usual. Clasper moderately broad, sharply narrowed towards apex. Aedeagus moderate with finely spiculate apical section. The vesica appears to be armed with two dentate (apparently hollowed and semicircular) chitinous pieces in the distal half, with a twisted chitinous rod and a small end piece.

TYPE: Holotype, male, Atlanta, Georgia, May (A.M.N.H.).

LIFE HISTORY: Unknown.

***Eupithecia gibsonata* Taylor**

Plate 28, figure 17; text figure 8C

Eupithecia gibsonata TAYLOR, 1910, Canadian Ent., vol. 42, p. 78. BARNES AND McDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 273. McDUNNOUGH, 1941, Canadian Ent., vol. 73, p. 189. MCGUFFIN, 1942, Canadian Ent., vol. 74, p. 152, pl. 12, fig. b (biology). McDUNNOUGH, 1942, Canadian Ent., vol. 74, p. 203 (biology). MCGUFFIN, 1945, Canadian Ent., vol. 77, p. 55.

Eupithecia helveticaria, McDUNNOUGH (*nec* Boisduval), 1929, Canadian Ent., vol. 61, p. 64; 1942, *ibid.*, vol. 74, p. 203. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 169.

Eupithecia chagnoni SWETT, 1911, Canadian Ent., vol. 43, p. 255. McDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 64; 1941, *ibid.*, vol. 73, p. 159.

In spite of similarity of genitalia this species is treated as distinct from the European *helveticaria* and *arceuthata* on account of differences in the habitus of the larva, as has already been noted (McDunnough, 1942). *Gibsonata* Taylor is here restricted to the cedar-feeding species, with the name *arceuthata* Freyer employed for the scarcely to be distinguished species in which the larva feeds on juniper. In view of the fact that no mention of food plant was given in the original descriptions of both *gibsonata* and *chagnoni* and that structural features are apparently of no help in the matter, it might be queried as to whether or not the present application of names is the correct one. However, after a careful study of original descriptions, types, and topotypical material, the above synonymy appears fairly well sub-

stantiated. *Gibsonata* was based on a single female taken by C. H. Young at Ottawa in 1903. A male in the Canadian National Collection, taken by the same collector in the same year, has been compared with the type and marked as agreeing. The species is not uncommon in cedar groves in the Ottawa region in early June, notably at Aylmer, Quebec, a few miles up the Ottawa River from the city. It is characterized, as compared with the juniper feeder, by its larger size, paler brown coloration, defined by Taylor as "soft pale brown" and by Swett as "light reddish ash." The cross lines have generally a rather blurred appearance, and the pale s.t. line is normally not nearly so sharply defined nor so crenulate, although it is sometimes quite distinct in bred specimens. Superficially it is very similar to *satyrata fumata*, again differing in the paler brown coloration, the slightly longer palpi, the still finer ciliations of the male antennae, and the somewhat better defined black brown transverse band on segment II of the abdomen. Incidentally this band is still more in evidence in the juniper feeder, especially in bred specimens. On male genitalic characters it is at once distinguished from all other members of the *satyrata* group (except *arceuthata*) by the simple uncus. There are other good genitalic differences in both sexes as will be noted below.

MALE GENITALIA: Hair pencils present on segment IX. Tegumen quite narrow at base and strongly conical. Uncus well chitinized, simple, with rather short terminal point. Vinculum broad and rounded apically. Clasper moderately broad at base and tapering considerably at apex. Aedeagus moderately broad, somewhat broader than in *satyrata*. Vesica armed with a twisted end piece to which a short, semicylindrical piece is partly attached; besides these there are two apical and two median dentate pieces of chitin, as in *satyrata*, but rather smaller, differently shaped, and with the apical pair less chitinized. Ventral plate of segment VIII a broad rod rising from the usual heart-shaped base which is narrower than usual; the rod is broader than in *satyrata*, the apical margin irregularly truncate, with a notch on the left side and heavier chitinization along the edges.

FEMALE GENITALIA: Show considerable

similarity in general appearance to those of *satyrata*, but differ as follows: The dorsal plate of segment VIII does not show the small oval membranous area at the center of the caudal margin; instead this margin is generally less chitinized along its entire length with a depressed chitinous thickening, centrally and below the edge, from which numerous oblique striae branch out to each side; the fine spiculation is present as is also the ventral spiculate area anterior to the ostium. The shape of the bursa is different, the left edge being nearly straight without indication of shoulder, while the right edge is strongly bulging. The upper half of the bursa is more strongly chitinized, especially around the base of the ductus seminalis on the right side proximally. The dorsoproximal spine patch is weak, consisting often of only a couple of spines. The marginal spines to the distal spined area are shorter, stouter, and more widely spaced with little trace of a left side cluster; the membranous area descending down the left side is much broader, especially just above the fundus, and generally extends completely around, separating the dorsal and ventral spined areas entirely.

TYPES: *Gibsonata*, holotype, female, Ottawa, Ontario (U.S.N.M., ex collections Taylor and Barnes); *chagnoni*, holotype, male, Montreal, Quebec (M.C.Z.).

DISTRIBUTION: Widespread throughout the eastern section of Canada and through the New England and north Atlantic states. It apparently also occurs in the western portion of the continent, as it has been recorded from Alberta and a specimen in the American Museum collection bears the handwritten label "Cisco, Placer County, California." This needs verification, although it is not improbable.

LIFE HISTORY: The larval food plant is white cedar (*Thuja*).

Eupithecia arceuthata Freyer

Plate 28, figure 18

Larentia arceuthata FREYER, 1842, Neuere Lepidopterologische Beitrage, no. 62, p. 145, pl. 372.

Eupithecia arceuthata, PETERSEN, 1909, Iris, vol. 22, p. 251. DIETZE, 1910-1913, Biologie der Eupitheciën, p. 75, pl. 49, fig. 2, pl. 74, figs. 427, 428. SPULER, 1910, Schmetterlinge Europas, vol. 2, p.

76. McDUNNOUGH, 1942, Canadian Ent., vol. 74, p. 203.

Eupithecia taylorata SWETT, 1907, Canadian Ent., vol. 39, p. 377. McDUNNOUGH, 1945, Canadian Ent., vol. 77, p. 64.

European authorities have considered *arceuthata* as a mere form of *helveticaria*. Dietze has thus treated it but notes larval differences and seems rather uncertain as to its correct status. For reasons already stated it has seemed wise for the present to give it specific rank.

Freyer's actual type specimen is figured by Dietze (fig. 427) and appears to be much larger than our North American form but fairly similar to specimens from Holland which have been occasionally bred at Ottawa from pupae intercepted on imported *Juniperus sabina*. As a matter of fact, Dietze's figures of his new form *septentrionalis* from Finland (figs. 423, 424, 434, 435) run close in size and general appearance to American specimens, but without European material such a reference would hardly be advisable. There remains the name *taylorata* Swett which was referred to *gibsonata* in 1945. The types were in rather poor condition and have not since been examined, but a careful study of the original description leads to the belief that the type material was that of the juniper feeder rather than of the cedar one. The color of the primaries and particularly the statement regarding a distinct s.t. line point in this direction. It also seems feasible at least to imagine that Swett, with the *taylorata* types before him, would hardly describe *chagnoni* a few years later unless some fairly distinctive differences were evident. With its present placement, then, the name *taylorata* becomes available for the North American juniper-feeding species should it become necessary to separate it from European forms.

The slight differences in color and maculation from *gibsonata* have already been discussed. In the genitalia there is nothing very definite that can be used as a means of differentiation. Such slides as have been made of the males all show a much broader tegumen at the base, and the vinculum is not so produced, but the characters are slight and may not be of any great value. In the female, apart from the smaller size, differences in the organ are even less tangible.

TYPES: *Arceuthata*, location unknown; *taylorata*, holotype, male, Sherborn, Massachusetts; allotype, female, Monmouth, Maine (M.C.Z.).

LIFE HISTORY: Larva on *Juniperus*.

Eupithecia satyrata Hübner

Geometra satyrata HÜBNER, [1809-1813], Sammlung Europäischer Schmetterlinge, Geometrae, vol. 1, pl. 85, fig. 439.

Eupithecia satyrata, PETERSEN, 1909, Iris, vol. 22, p. 251, pl. 13, fig. 57. SPULER, 1910, Schmetterlinge Europas, vol. 2, p. 77, pl. 71, fig. 29. DIETZE, 1910-1913, Biologie der Eupitheciiden, p. 84, pl. 71, figs. 193-210, pl. 85, figs. 931-937. McDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 64; 1930, *ibid.*, vol. 62, p. 109. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 169.

Tephroclystis zygaenidata, HULST (*nec* Packard), 1900, Proc. Washington Acad. Sci., vol. 2, p. 297 (*partim*, ♂, Yakutat).

The presence of this very variable Palearctic species in North America was apparently not recognized by the group of workers who were so actively interested in the genus during the first decades of the century (e.g., Taylor, Pearsall, and others). Misled doubtless by the individual variability and the lack of any definite outward character that would link the specimens with the European species, the error was committed several times of proposing new specific names for what have turned out to be mere forms or, at the best, races of *satyrata*. This was conclusively shown (McDunnough, 1929) by a study of the genitalia of the type specimens and a comparison with figures given by European workers. The male specimen from Yakutat, Alaska, collected by the Harriman expedition, has been examined and proved to belong here and not under *zygaenidata* as recorded by Hulst.

Satyrata forms are among the commonest of the eupithecias in the Dominion of Canada, extending across the entire continent from Nova Scotia to British Columbia and reaching far into the north. The species is particularly plentiful in the more mountainous sections of Alberta and British Columbia. Whether the typical form occurs in North America or not is a matter that cannot be determined at the present time, but it might be noted that the Canadian specimens approach more closely to the forms from Asiatic localities, as figured by Dietze, than they do

to the apparently much darker, typical race from south Germany and Austria. In the eastern United States the species is apparently rare (except possibly in northern New England), and it is significant that, in spite of the activities of Pearsall and others, not a single specimen could be found in the American Museum collection except the two specimens from the Black Mountains, North Carolina, for which the name *intimata* was proposed. Under the circumstances it has seemed best at the present time to employ certain of the names based on North American specimens in a generalized racial sense. No apparent harm can be done by this method, and it will remain for future workers to test the values of such so-called races by breeding and by comparison of long series from individual localities.

As already noted *satyrata* shows great variation in the wing maculation. The general color of the primaries is a smoky brown (which in older specimens becomes a light wood brown) with considerable sprinkling of whitish scaling which frequently tends to give the primaries a rather grayish color. The cross lines are normally fairly distinct and typically eupitheciid, but specimens are not uncommon in which the distinctness of the lines is much reduced. The basal third of the wing, frequently slightly darker, is defined by a fairly upright t.a. line; a median line curves around the distinct black, discal dot or streak, and the t.p. line is roundedly bulging opposite the cell rather than sharply angled; all lines are somewhat accentuated on the veins by dark dots or dashes alternating with white ones. Frequently the most striking feature of the maculation is a white, dentate, s.t. line, cutting through the darker, terminal area and ending in a small white spot above the tornus. The secondaries are fairly dark, the terminal area broadly darker with dentate inner edge and traces of the white s.t. line and spot of the primaries. The palpi are moderately long, projecting a considerable distance beyond the flat front. The male antennae are finely and rather evenly ciliate; the ciliae of the female antennae are extremely minute. The head and thorax are brownish with a considerable admixture of white scaling; the abdomen is dorsally brownish, strongly peppered with white, with broken lateral black

streaks and a slight darkening of segment II, without any actual definite banding; the small middorsal tufts are scaled with white posteriorly.

MALE GENITALIA: Hair pencils of segment IX well developed. Tegumen rather narrowly conical. Uncus strong, bifid, the upper hook pointed, the lower one bluntly rounded. Vinculum broad and apically rounded as usual. Clasper rather narrow with tapered apex. Aedeagus moderate in breadth and length, slightly tapered at base. Vesica armed with six pieces of chitin as follows: the usual small, twisted end piece; a larger, semicylindrical piece in the median section towards the right; two curved, dentate pieces, the larger, rather rod-shaped piece on the right partly superimposed on the semicylindrical piece; two small, apical dentate pieces, that to the right somewhat larger and conical. The shape of the four dentate pieces varies somewhat in different individuals, partly owing to difference in position, but the general size remains much as in the illustration which is largely based on an eastern Canadian specimen. The ventral plate of segment VIII consists of a single chitinous rod with bluntly truncate and slightly irregular apex, arising from a rather narrowly expanded basal section.

FEMALE GENITALIA: Dorsal plate of segment VIII rectangular, moderately well chitinized, the caudal half finely spiculate or shagreened, leaving a small oval or V-shaped, clear, membranous area extending cephalad from the center of the caudal margin. Anterior apophyses and caudal spur much as usual, the latter terminating in a small chitinous plate situated on the laterocephalic edge of the membranous ventral plate. Ostium membranous, funnel shaped, situated at the cephalic end of a large, subtriangular, finely spiculate area of the eighth sternite. Membranous section of ductus bursae very short, terminating in the well-chitinized half collar which (as is common in the group) projects somewhat to the left. Bursa in well-inflated specimens broadly pear shaped, with a small shoulder projecting on the left and the proximal half, especially on the dorsal side, chitinous, strongly striate, and gradually broadening. The ductus seminalis arises on the right side of the dorsal surface just below

the collar, extending as a moderate-sized tube along the bursa to its median area and then curving caudad, narrowing shortly to a fine, thread-like tube; at its base is a small cluster of spines, variable as to number, extending caudad from its lower base for a short distance and occasionally extended partly across the ventral surface to the left. There is a small and numerically quite variable cluster of spines on the dorsal surface to the left of the ductus exit. The distal half of the bursa is covered with spines with the exception of a narrow membranous band extending on the left side from below the shoulder to the fundus and often slightly beyond. The marginal spines on the dorsal surface of this area are much longer on the left half than on the right section and culminate in a cluster of very long spines situated just below the shoulder on the left side. On the ventral surface the spined area extends farther proximad than on the dorsal surface. Less well-inflated bursae are more narrowly pear shaped, the shoulder is often not noticeable, and the exit of the ductus has the appearance of being farther down the right side. The small patch of spines below the collar dorsally and the patch of long spines on the left side remain as the most characteristic features. Such specimens bear great resemblance to the same organ in *geminata*. In this species, however, the dorsal marginal spines are long across the entire surface, and the proximal patch of spining on the ventral surface is much better developed, such a patch being usually not present at all in *satyrata*.

***Eupithecia satyrata fumata* Taylor**

Plate 28, figure 19; text figure 8D

Eupithecia fumata TAYLOR, 1910, Canadian Ent., vol. 42, p. 82. BARNES AND McDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 273. McDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 64.

The specific name *fumata* was based on a female specimen from Ottawa, Ontario, and the brief description compares the species with *fumosa* Hulst which Taylor claimed to have recognized (1909, Canadian Ent., vol. 41, p. 426) from material from the same region. There is some doubt, however, as to the correctness of his determination, since *fumosa* was placed by Pearsall as a synonym

of *coagulata* Guenée, a species which does not bear any very close resemblance to *satyrata*. In any case the genitalia of the holotype, when examined some time ago, distinctly placed *fumata* as identical with *satyrata* in the structure of the female organ. The name is being employed in a rather generalized racial sense for the form from the eastern section of Canada (from Manitoba to the Maritime Provinces) and the northern New England states, with possible extensions into the more mountainous sections of New York State. The wings are fairly dark in color, varying from light to dark smoky brown with moderately well-defined maculation and generally a distinct s.t. line and white spot above the tornus. The type is such a specimen, and in a long series in the Canadian National Collection from various sections of this area little marked variation could be observed, except at times a tendency towards indistinctness of maculation. The normal size shows a wing expanse of about 18 to 20 mm.

TYPE: Holotype, female, Ottawa, Ontario (U.S.N.M., ex collections Taylor and Barnes).

DISTRIBUTION: Eastern Canada, extending down into the New England and probably the north Atlantic states.

LIFE HISTORY: The larva feeds on *Aralia*, *Thalictrum*, *Viburnum*, *Scrophularia*, and probably many other plants.

***Eupithecia satyrata intimata* Pearsall**

Plate 28, figure 20

Eupithecia intimata PEARSALL, 1908, Jour. New York Ent. Soc., vol. 16, p. 100. McDUNNOUGH, 1936, Canadian Ent., vol. 68, p. 258.

The name *intimata* is being held in a rather doubtful racial sense for a form from more southerly areas of the United States. It was based on a male and female from the Black Mountains of North Carolina, the male being very much rubbed, and the female, which must be designated as the holotype, showing a rather obsolescent maculation. Apart from the types and a couple of other North Carolina specimens, two very worn specimens from Granville, Ohio, in the Canadian National Collection have been examined which may belong here, as they were captured in late July and August, as were also the Black Mountain specimens. Until, however, more

material from the region can be secured the validity of the race is open to question. It might be noted that Pearsall's name antedates Taylor's *fumata* and must be applied to the eastern North American form if no definite distinctions can be found between northern and southern specimens.

TYPES: Holotype, female, and allotype, male, Black Mountains, North Carolina (A.M.N.H.).

DISTRIBUTION: Southern Appalachian region, as far as is known.

***Eupithecia satyrata dodata* Taylor**

Plate 28, figure 21; text figure 8E

Eupithecia dodata TAYLOR, 1906, Canadian Ent., vol. 38, p. 103. BARNES AND MCDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 272. MCDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 64.

Eupithecia divinula CASSINO AND SWETT, 1924, Lepidopterist, vol. 4, p. 26. MCDUNNOUGH, 1932, Canadian Ent., vol. 64, p. 2.

Eupithecia mackieata CASSINO AND SWETT, 1925, Lepidopterist, vol. 4, p. 45. MCDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 64.

The form of *satyrata* from the Alberta foothills of the Rocky Mountains may stand as *dodata*, described from material collected by F. H. Wolley Dod in the vicinity of Calgary. A good series of topotypical specimens is contained in the Canadian National Collection. The types of Cassino and Swett's two synonyms are from the same general region, and in the case of *mackieata* a good series of paratypes is in the Ottawa collection.

In structural characters there is nothing to separate *dodata* from *satyrata*. From the eastern form, *fumata*, it is distinguished by its rather paler color, which tends towards gray rather than brown, and the possibly more definite maculation. The size is about the same as that of *fumata*. These differences of color and maculation are really very slight, and it is doubtful if in many cases the Alberta form could be distinguished from more easterly specimens without consulting the locality label. The figure of the female genitalia given is based on a slide of Taylor's type and a comparison with other specimens from the Wolley Dod collection, now incorporated in the Canadian National Collection.

TYPES: *Dodata*, holotype, female, Calgary, Alberta (U.S.N.M., ex collections Taylor and Barnes); *divinula*, holotype, male, Nordegg,

Alberta (M.C.Z.); *mackieata*, holotype, male, Edmonton, Alberta (M.C.Z.).

DISTRIBUTION: Foothills of the Canadian Rockies and adjacent regions.

LIFE HISTORY: There are no records of the species' having been bred in the west, but the larva will doubtless be found to be a fairly general feeder on flower heads.

***Eupithecia terminata* Taylor**

Plate 28, figure 22; text figure 8F

Tephroclystis satyrata, DYAR, 1904, Proc. U. S. Natl. Mus., vol. 27, p. 889.

Eupithecia terminata TAYLOR, 1908, Canadian Ent., vol. 40, p. 58. BARNES AND MCDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 292. MCDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 64.

Eupithecia slocanata TAYLOR, 1908, Canadian Ent., vol. 40, p. 59 (*partim*). BARNES AND MCDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 273. MCDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 64.

There is a very grave doubt as to whether *terminata* can be considered as anything more than a large race of *satyrata*, characterized, apart from its size, by the general brownish suffusion of the wings and the obscurity of the maculation. The material on which the name was based was collected by J. Cockle at Kaslo in the Kootenay region of British Columbia, and a long series of topotypical specimens, including a male paratype, in the Canadian National Collection has been very carefully studied. No noticeable differences in either palpal, antennal, or genitalic structure could be found.

In its type locality and surrounding regions *terminata* is fairly constant as to size and general appearance and is fairly easily separable from the smaller, paler, and better-marked *dodata*. One of the puzzling factors, however, in determining the status of the name is the fact that a number of specimens in the Ottawa collection from regions in the Alberta foothills (Waterton, Calgary, Nordegg) and even from as far north as Cameron Bay, Great Bear Lake, match excellently with the Kaslo topotypical ones. The interesting question at once arises as to whether we have two species, *dodata* and *terminata*, existing side by side, or the *terminata*-like specimens are merely individual forms of the smaller, paler *dodata*. This question, unfortunately, cannot be solved without intensive

breeding and a knowledge of the life history and food plants of the various forms involved. For this reason, and also because a similar close relationship is known to exist in other species of the group, it has seemed advisable to retain the specific status of *terminata* for the present. It is to be hoped that knowledge of the life history of the larva will eventually solve the difficulty.

TYPES: *Terminata*, holotype, male, Kaslo, British Columbia (U.S.N.M., ex collections Taylor and Barnes); *slocanata*, holotype, male, Kaslo, British Columbia (U.S.N.M.).

DISTRIBUTION: South central British Columbia and the foothills of the Canadian Rockies, extending possibly down the main range into Colorado (Durango) and also down the Coast Range into Oregon (Crater Lake) and California (Yosemite).

LIFE HISTORY: Unknown.

REMARKS: Only odd, rather poor specimens from Colorado, Oregon, and California have been examined, and while these undoubtedly belong to the *satyrata* complex, their exact status cannot be determined without additional material.

***Eupithecia nimbicolor* Hulst**

Plate 28, figures 23–28; text figure 8G

Tephroclystis nimbicolor HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 269.

Eupithecia nimbicolor, DOD, 1906, Canadian Ent., vol. 38, p. 90. TAYLOR, 1906, Canadian Ent., vol. 38, p. 101. BARNES AND McDUNNOUGH, 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 146. McDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 65; 1930, *ibid.*, vol. 62, p. 109, fig. 1a. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 171.

Tephroclystis obscurior HULST, 1896, Trans. Amer. Ent. Soc., vol. 33, p. 271.

Eupithecia obscurior, BARNES AND McDUNNOUGH, 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 146 (type designation). McDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 65.

Eupithecia adornata TAYLOR, 1906, Canadian Ent., vol. 38, p. 104; 1908, *ibid.*, vol. 40, p. 55. BARNES AND McDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 272; 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 146, pl. 22, fig. 10. McDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 65.

Eupithecia incresata PEARSALL, 1910, Ent. News, vol. 21, p. 159. BARNES AND McDUNNOUGH, 1918, Contributions to the natural history of the

Lepidoptera of North America, vol. 4, no. 2, p. 146. McDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 65; 1936, *ibid.*, vol. 68, p. 258.

Eupithecia inclarata CASSINO AND SWETT, 1924, Lepidopterist, vol. 4, p. 25. McDUNNOUGH, 1932, Canadian Ent., vol. 64, p. 2.

The variability of this species is well illustrated by the number of synonyms created on the supposition that variation in color and maculation was a specific character rather than an individual one. Three of these names, *viz.*, *nimbicolor* Hulst, *adornata* Taylor, and *inclarata* Cassino and Swett, were based on material from the same general region of the Alberta foothills. The male type of *incresata* Pearsall, which must be regarded as the holotype, was from the mountainous region of south central British Columbia (Princeton). A comparison of this type in the American Museum collection with a male paratype of *adornata* Taylor in the same collection shows absolutely nothing whereby the two specimens could be distinguished, and this similarity is confirmed by genitalic studies. The holotype male of Hulst's *obscurior*, as restricted in 1918 by Barnes and McDunnough, is labeled simply "Colo. Bruce." It is a rather obscurely marked specimen but can easily be matched from a series of Alberta material. There seems little significance in attempting to give racial value to any of these names. Strangely enough, an eastern form of the species escaped the notice of the enthusiasts of the first decade of this century. It was first recorded in 1929 from Thunder River, Quebec Labrador, and since then has been collected in early spring (May–June) in several cold bog areas of eastern Canada and Maine (Mer Bleue, Ottawa; Smoky Falls, Ontario; Chester and Southwest Harbor, Maine). These eastern specimens are considerably smaller in size, with a wing expanse of about 18 mm. as compared with one of 21–22 mm. for Alberta specimens. They are generally neatly and clearly marked, after the pattern of *adornata*, but as they offer no other salient characters a racial name seems scarcely necessary. On the other hand, several very large males (23 mm.) from the White Mountains, Arizona (Sperry), have been examined which, when more material is available, may prove to represent a good race.

The best character for superficial separa-

tion of *nimbicolor* from the other members of the *satyrata* group proper may be found in the more pointed apex of primaries and the strongly inwardly oblique nature of the outer margin, approaching in this respect the *gelidata-innotata* forms. On the primaries there is generally a considerable admixture of light brown suffusion (at times very marked) with the basic smoky brown color. The veins show an alternating dark and white strigation, and there is frequently considerable white frosting in the area beyond the cell. In specimens of the *adornata* type in which the cross lines are fairly distinct, the median line shows generally (but not always) a sharp outward angulation in the cell, passing through the small discal spot; the s.t. line may be continuously crenulate but is usually broken up into a series of small white dots. In extreme forms, notably when the specimen is worn, all maculation practically disappears. Such a specimen is the one from Calgary on which the name *nimbicolor* was based (*vide* Dod's comment, 1906). The abdomen dorsally shows a good deal of brown shading and is further frosted with white scales which are particularly heavy on segment I and also on the metathorax. As regards outward structural details the palpi are quite short, considerably less in length than those of *satyrata*; the ciliation of the male antennae is much as in *satyrata* and allied species.

MALE GENITALIA: Hair pencils of segment IX well developed. Tegumen of moderate width, conical. Uncus decidedly bifid. Vinculum short, lateral edges sloping inwardly to a broad, rounded apex. Clasper rather variable, normally narrow with tapering apex, at times rather chunky with broader basal half. Aedeagus moderately wide and long. Armature of vesica apparently more variable than usual, consisting normally of two small dentate pieces of chitin, a moderate-sized semicylindrical piece, and an end piece, more or less attached to same. At times faint indications of one or two additional small dentate pieces occur; in the case of the type of *nimbicolor* only the broader of the two dentate pieces was observed. Ventral plate of segment VIII very similar to that of *satyrata* and allies; at times the apex may appear shortly bifid, owing to a thinning of the central chitinous membrane.

FEMALE GENITALIA: Dorsal plate of segment VIII moderately chitinized, rectangular, broader than high, with the corners of the caudal margin somewhat rounded and with a small, U-shaped, central, membranous area on the caudal edge. Anterior apophyses short and thin; caudal spur thin, terminating in a triangular chitinous plate lateroventrally, larger than usual. Central area of ventral plate membranous with a large, finely shagreened patch preceding the ostium, which is broad and membranous. The fairly short, initial, membranous section of the ductus bursae ends in a narrow collar. The bursa is rather elongately oval with the proximal, membranous half very weakly chitinized. The ductus seminalis arises as a narrower tube than usual on the right dorsal side, just below the collar; at its base are a few rather stout spines, and there is a small patch of similar spines, very variable in number, situated dorsally below the collar near the left side. The fundus half of the bursa is covered with rather weak spines with the exception of a double row of marginal spines which are very stout and widely spaced; there is a narrow unspined band down the left side to the fundus as in *satyrata*.

TYPES: *Nimbicolor*, holotype, male, Calgary, Alberta (Rutgers University, New Brunswick, New Jersey); *obscurior*, holotype, male, Colorado (same collection); *adornata*, holotype, male, Calgary, Alberta (U.S.N.M., ex collections Taylor and Barnes); *incresata*, holotype, male, Princeton, British Columbia (A.M.N.H.); *inclarata*, holotype, male, Pochontas, Alberta (M.C.Z.).

DISTRIBUTION: Typically a Rocky Mountain species, occurring in June and July down the whole chain from Alberta and British Columbia to Arizona (White Mountains). However, it extends eastward through Canada, single specimens from Cypress Hills, Saskatchewan, and Riding Mountains, Manitoba, being noted in the Canadian National Collection. In eastern Ontario and Quebec it occurs in early spring in cold bog areas and along the northern coast of the Gulf of St. Lawrence and is known from two localities in Maine (Chester and Southwest Harbor). Just recently a single rather worn female from Grass Lake, Plumas County, California, has been examined which on the evidence of the genitalia certainly belongs to this species.

LIFE HISTORY: Unknown.

REMARKS: The drawing of the male genitalia is based on slides of the male types of *obscurior* and *adornata*. The female genitalia are drawn from a topotypical female from Calgary, Alberta.

***Eupithecia stratonata* Packard**

Plate 28, figure 29; text figure 8H

Eupithecia stratonata PACKARD, 1873, Fifth Rept. Peabody Acad. Sci., p. 60; 1876, A monograph of the geometrid moths . . . of the United States, p. 58, pl. 8, fig. 8. TAYLOR, 1907, Canadian Ent., vol. 39, p. 278. GROSSBECK, 1907, Ent. News, vol. 18, p. 348. SWETT, 1907, Canadian Ent., vol. 39, p. 378. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 170.

In the older lists *stratonata* was placed as a synonym of *anticaria* Walker, presumably on the authority of Hulst, but later workers arrived almost simultaneously at the correct conclusion that it had nothing to do with Walker's species and placed it as quite distinct. There should not be a great deal of difficulty in identifying the species on account of the rusty brown color of the forewings, particularly evident in fresh specimens. The rather obscure maculation is much as in *satyrata*, and the structure of palpi and male antennae is very similar. There is considerable white scaling on the posterior portion of the scutellum and the first abdominal segment and heavier brown shading on segment II gives the appearance of a faint, transverse, dark band.

MALE GENITALIA: Strong hair pencils present on segment IX. Tegumen broad at base, the sides sloping sharply inward to a narrow apex. Uncus bifid, the upper hook short and sharp, the lower one truncately rounded. Vinculum short and broad with rounded apex. Clasper rather short and broad with apex rounded and broader than usual. Aedeagus moderately long and broad. Vesica furnished with the usual end piece, a small, curved semicylindrical chitinous strip and two small, dentate pieces close together on the right side; the inner one quite narrow, the outer broader and with edges slightly curled up. Ventral plate of segment VIII of the usual rod-like form, rather short and broad with truncate apex.

FEMALE GENITALIA: Same general type of

organ as in *satyrata*. Dorsal plate of segment VIII very similar, even to the small membranous area in the center of the caudal margin, separating the two spiculate lobes; on the ventral plate the spiculate area before the ostium is larger, broadly conical, and the spicules are much stronger. The chitinous collar terminating the short, membranous ductus bursae is quite narrow. The rather small bursa is narrowly pear shaped with little indication of a shoulder, the proximal two-thirds largely free of spines, weakly chitinized and strigate. The ductus seminalis arises dorsally from a broad opening on the right proximal side and projects as a membranous tube strongly outwards, curving ventrad and caudad about the middle of the bursa; at its base a row of strong spines extends caudad, crossing on the ventral surface of the bursa to the left side and practically connected with a cluster of rather heavy spines situated on the dorsal left side. The distal third of the bursa is completely spined, the spines extending somewhat higher above the fundus on the ventral side than on the dorsal and considerably higher on the left side where the marginal spines, while few in number, are extremely large and chunky. There is no indication of a membranous strip down the left side to the fundus.

TYPE: Holotype, female, Natick, Massachusetts (M.C.Z.).

DISTRIBUTION: Widespread over the New England and north Atlantic states, extending westward to Michigan and throughout eastern Canada but never very common. Possibly double brooded in the more southern areas.

LIFE HISTORY: A single specimen was bred in the Ottawa region from a larva on *Spiraea salicifolia* by the Forest Insect Survey.

***Eupithecia cimicifugata* Pearsall**

Plate 28, figures 30, 31; text figure 8I

Eupithecia cimicifugata PEARSALL, 1908, Jour. New York Ent. Soc., vol. 16, p. 102. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 170.

Owing to inadequacy of material it has been impossible to deal completely satisfactorily with this species. There seems no doubt, based on the genitalia of type and topotypical specimens, that it and *grata* Taylor are extremely closely related, and it may very well be that the latter name must

eventually be considered as either a synonym or a northern race of *cimicifugata*. In view of the fact, however, that in such material of presumable *cimicifugata* as was available for genitalic slides some slight differences from *grata* genitalia could be noted, and as furthermore nothing is known of the life history of Taylor's species, it has seemed advisable for the present to treat both names as referring to good species.

The name *cimicifugata* was based on a single female in the United States National Museum bearing a label as follows: "Larvae bore in fruit racemes of Black Snake root (*Cimicifuga racemosa*). Cabin John, Maryland, issued June 15, 1900." This specimen must consequently be considered as the holotype. As further type material, Pearsall lists a male type (allotype) taken at New Brighton, Pennsylvania (Merrick), August 31, 1904, and now in the collection of the American Museum, unfortunately without abdomen; also three cotype females, noted simply as "captured in Pennsylvania." One of these females is in the above-mentioned collection labeled "Scranton, Pennsylvania." It also bears a small label, "3003," characteristic of material captured by Max Rothke, the well-known Scranton collector. A reference to his very meticulously kept catalogue, now in the possession of Mr. C. F. dos Passos who purchased most of the Rothke collection, shows that this number refers to a "Eupithecia" captured at light on August 14, 1902, and these complete data have now been pinned to the specimen. The whereabouts of one of the other two specimens is unknown at present, but the second female is in the Museum of Comparative Zoölogy at Cambridge, Massachusetts, *ex* collection Sweet. The main difficulties in establishing the correct sex association in *cimicifugata*, until a bred series is available, lie first in the fact that, according to the known dates on the type material, two broods seem to be indicated, the first emerging in June (holotype) and the second in late August (paratypes); and second, apart from the holotype female, only females of the August brood from Pennsylvania have been available for genitalic study. A small series of males collected by L. R. Rupert has been kindly placed at the author's disposal. This consisted of three

males taken at Ithaca, New York, on June 5, 1937, and five males from Sardinia, New York, June 24–July 8, but unfortunately no females were among the lot. While superficially the entire series appeared similar it was found, after a study of two Ithaca and three Sardinia genitalic slides, that slight differences in the shape and position of the spined pieces of the vesica occurred between the two lots. The Ithaca specimens appeared to run very close to *grata* Taylor, while the Sardinia form (note the later date of capture) showed certain other apparently constant points of differentiation, and these specimens are for the present considered as representing the male sex of *cimicifugata*. In nearly all details the male genital organ resembles that of *grata*, and the slight divergences will be discussed later under this specific head. In the female sex a slide of the holotype was made some years ago, the bursa being not fully inflated, as is usually the case with bred, unmated specimens. The Scranton paratype, also poorly inflated, agrees excellently with a drawing made from the holotype slide, and the present figure is based on these slides. Other females from New Brighton, Granville, and Delaware Water Gap (the latter figured), show better inflated bursae with similar type of spining, the main difference between these and the other two specimens being found in the fewer and larger spines in the chitinized area on the left side of the bursa. Whether this has any special significance or whether it might only be seasonal or individual variation cannot be determined until series of both sexes of both broods have been studied.

In structural details of palpi and male antennae there is little difference between the species and *satyrata*. The maculation of the wings, as far as can be judged from the almost invariably worn condition, is very obscure, the color of the primaries being of a rather olivaceous brown shade with very small discal dot and only traces of a darker t.p. line, gently rounded below the costa; a faint, pale, slightly waved s.t. line can also be traced in better specimens; the secondaries are almost as dark as the primaries.

Besides occurring rather generally in the east, *cimicifugata*, or very possibly its near ally *grata*, has been noted in a single worn specimen from such widespread western

localities as Waterton, Alberta; Olympic Mountains, Washington; Verdi, Nevada; and Provo, Utah. More material is required before such material can be properly evaluated.

MALE GENITALIA: Hair pencils of segment IX well developed. Tegumen broad at base, sides sloping strongly inward and upward to a narrow apex. Uncus stout, bifid, upper hook long and sharply pointed. Vinculum short, broad, with bulging sides and a slight invagination of the cephalic edge in the median region. Clasper very broad and chunky. Aedeagus wide, gradually and gently broadening from base to apex. Vesica heavily armed with chitinous pieces as follows: the usual small end piece; a long, semicylindrical, very obscurely defined piece, occupying a considerable section of the left side and partly superimposed on the other pieces; two thin rods, on the right side, superimposed and with dentate apices; a much broader and longer piece, situated centrally, moderately dentate apically and with a curled-up left side, the apex rounded; superimposed on this is an equally long and broad piece, less dentate, the apical edge truncate with, at times, a few teeth. Ventral plate of segment VIII consisting of the usual rod, rather narrow, with evenly sloping sides and a roundly truncate apex.

FEMALE GENITALIA: Dorsal plate of segment VIII rather high, sides sloping slightly inward towards a rounded caudal margin; apical section spiculate as usual without any appreciable central membranous area; anterior apophyses short, stout; ventral plate membranous with the usual spiculate patch before the broad, membranous ostium. Ductus bursae with a very short membranous section terminated by a broad chitinous collar. Bursa rather square-cut, the weakly chitinized proximal half largely free of spines which are confined to the distal portion, covering the entire area, without any membranous strip. On the right side, immediately below the collar the ductus seminalis juts out strongly as a broad membranous tube, curving cephalad for a short distance and then bending back on itself on the ventral side and narrowing; from its basal edge on the ventral side a band of small spines, composed of several rows, crosses the bursa to the left side and then curves around to the dorsal surface,

running along the edge of the collar to the caudal edge of the ductus. The spined distal area reaches on the right side to the cephalic edge of the ductus and is terminated, especially dorsally, by long, stout, marginal spines. On the left side, above the spined area, a more strongly chitinized section is provided with a patch of very long, strong spines, quite numerous in the holotype and paratype, but much more scattered and reduced in number in other specimens.

TYPE: Holotype, female, Cabin John, Maryland (U.S.N.M.).

DISTRIBUTION: Widespread throughout the northern and middle Atlantic states but uncommon; probably extends into the western states.

LIFE HISTORY: The larva feeds on the fruit of *Cimicifuga racemosa* (snakeroot).

Eupithecia grata Taylor

Plate 28, figure 32; text figure 9A

Eupithecia grata TAYLOR, 1910, Canadian Ent., vol. 42, p. 78. BARNES AND McDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 271. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 170.

The specific name was based on a single male specimen taken in the Ottawa region by C. H. Young on June 5. From a genitalic slide of this type a drawing was made some time ago. Since then a long series of both sexes has been secured, over a period of years, by Mr. A. C. Sheppard in the Montreal region, June 6-27, and kindly distributed to the Canadian National Collection and the American Museum of Natural History. The male genitalia, of which a number of slides have been made, agree excellently with the type drawing. As already noted, they run extremely close in general structure to those of the males of *cimicifugata*. They possess the same very chunky clasper, and the vinculum shows the same slight median excavation of the apical margin. The tegumen appears to be somewhat narrower basally, but this may not mean much. The aedeagus is very similar and of the same expanding type from base to apex. The vesica possesses the same number of chitinous pieces, but the size and distribution are different, there being three thin, rod-like pieces on the right side. The larger, central piece is rather broader and more strongly dentate, especially along the

apical margin; the other superimposed piece does not appear to be present. The ventral plate is much the same, but the apical section seems more drawn out, although this is probably an unstable character. In the female the well-inflated bursa is somewhat smaller than that of *cimicifugata* but in general structure remarkably similar. The outward projection of the ductus seminalis to the right below the collar seems less pronounced, but this may simply be owing to the better inflation in all specimens of *grata* examined. The spining on the chitinous patch on the left side varies considerably in the number of spines in individual specimens, and this feature is probably of little value specifically in either *grata* or *cimicifugata*, although in *grata* it appears to be less extended proximally and more feebly chitinized. Such differences as noted above appear, however, very insignificant and may possess no real specific value.

In maculation and color many specimens of the Montreal series of *grata* are so similar to *cimicifugata* as to be practically indistinguishable. However, a decided tendency has been noted, especially in the females, for the dark cross lines of the wings to be relieved outwardly by a narrow, pale ochreous banding which not only defines the maculation more sharply but gives the specimen a quite characteristic contrasted appearance, not noted in the rather unicolorous material examined of *cimicifugata*. The holotype shows a certain amount of this type of maculation, and it is very strongly developed in a single female from Baddeck Forks, Cape Breton Island, Nova Scotia, in the Canadian National Collection. From such specimens it can be noted that the median line projects very sharply outward below costa, is angled at or about the feeble discal dot, and then slightly irregularly oblique to the inner margin. The t.p. line, on the other hand, is only very gently rounded below the costa. All specimens examined have been captured in June or very early July, and it is very doubtful if a second brood exists in this more northerly region. Until details of the life history are available the status of *grata* is doubtful.

TYPE: Holotype, male, Ottawa, Ontario, June, (U.S.N.M., *ex* collections Taylor and Barnes).

DISTRIBUTION: Eastern Canada, possibly extending to the western provinces.

LIFE HISTORY: Unknown, but the larva should be sought on *Cimicifuga* or the allied *Actaea*.

Eupithecia russeliata russeliata Swett

Plate 28, figures 33, 34; text figure 9B

Eupithecia russeliata SWETT, 1908, Canadian Ent., vol. 40, p. 245. MCDUNNOUGH, 1930, Canadian Ent., vol. 62, p. 109; 1936, *ibid.*, vol. 68, p. 259. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 170.

A very common species in eastern Canada and at times occurring in large numbers in spruce groves. At South Milford, Nova Scotia, for instance, during the latter half of June, literally hundreds were flushed by the author by hitting the trunks or lower branches of spruce sharp blows.

The species bears a great similarity in general appearance to *satyrata*, although quite distinct on genitalic characters and evidently much more closely related to *coagulata* Guenée than to *satyrata*. The general color of the primaries shows a browner tinge than is found in *satyrata fumata*, the cross lines are usually stronger, the t.p. line being rather more sharply angled opposite the cell and with more prominent inner streaks on the veins; the s.t. line is enlarged above the tornus to a prominent irregular white spot, this spot being repeated on the secondaries above the anal angle to a modified degree. There is little difference either in palpal length or type of male antennal ciliation from *satyrata*, the ciliae being possibly slightly shorter in the present species. There is a somewhat more distinct, brown, transverse band on segment II of the abdomen, this being relieved by considerable pale sprinkling on the preceding and following segments. As already noted, it is in the genitalia that the most striking specific characters are to be found, and it is often necessary, especially in the case of worn specimens, to have recourse to these before the identity of a specimen can be established.

MALE GENITALIA: Hair pencils of segment IX well developed. Tegumen conical, base moderately broad. Uncus short, bifid. Vinculum short, the lateral edges sloping much more strongly inward than in *satyrata* to a

narrowly rounded apex. Clasper rather narrow and not very noticeably narrowed apically. Aedeagus shorter and broader than in *satyrata*. Vesica armed with three weakly dentate pieces of chitin, the one on the right side a very thin short rod, the other two chunkier and irregularly shaped, situated in the median area, the one distad of the other, the latter the larger and with a subtriangular apex. Superimposed on these is a large, poorly chitinized and defined plate from which apparently thin, rod-like projections jut out distally; the only distinct portion of this plate is a narrow curled-up section on the left side. There is no end piece. Ventral plate of segment VIII much as in *satyrata*.

FEMALE GENITALIA: Dorsal plate of segment VIII weakly chitinized, squarely rectangular, feebly spiculate below the caudal edge. Anterior apophyses short, rather thick, the spur thin and somewhat longer than usual. Ostium membranous, preceded by a very feebly spiculate and poorly defined area. Membranous portion of ductus bursae short, terminated by a broad, strongly chitinized collar, the lateral edges of which, on the ventral side, are produced into the well-chitinized proximal half of the bursa, forming a trough from the end of which a wide membranous ductus seminalis projects strongly to the right, curving somewhat downward and then bending back on itself and narrowing; a row of fine spines runs outward from the base along the caudal edge of this ductus. The balance of the bursa is globular and completely spined. Dorsally there is a patch of small spines immediately below the collar, more or less connected with the spined distal section which is similar to the ventral surface, leaving a small membranous shoulder on the left side, distad of the upper spine patch.

TYPES: Holotype, male, Winchendon, Massachusetts (M.C.Z., *ex* collection Swett); paratypes, male and female, Framingham and Winchendon, Massachusetts, respectively (A.M.N.H.).

DISTRIBUTION: Eastern United States and Canada, April to June.

LIFE HISTORY: The larva has been found feeding on spruce and will occur probably on other conifers.

***Eupithecia russeliata brauneata* Swett**

Plate 28, figure 35

Eupithecia brauneata SWETT, 1908, Canadian Ent., vol. 40, p. 245. McDUNNOUGH, 1936, Canadian Ent., vol. 68, p. 259; 1945, *ibid.*, vol. 77, p. 64.

The name is held at present, pending receipt of more material, to a browner-colored form from the Appalachian region of Virginia. Apart from the deeper color there is no tangible character by which *brauneata* can be distinguished from the topotypical form, and worn specimens, as typified by a "Cotype" female in the American Museum collection, could fall as well to *russeliata* as to *brauneata*.

TYPES: Holotype, male, Mountain Lake, Virginia, June 14–21 (collection Dr. A. F. Braun, Cincinnati, Ohio); allotype, female, same data (M.C.Z.); cotype, female, same data (A.M.N.H.).

DISTRIBUTION: Known so far by the type lot only but will probably occur all through the Appalachian region.

LIFE HISTORY: No records of the larval food plant have been published, but it will most likely prove to be a conifer.

***Eupithecia ammonata* McDunnough**

Plate 28, figure 36; text figure 9C

Eupithecia ammonata McDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 63, fig. 2.

Apart from the type series no further material of this species has come to hand. As indicated in the original description, the species could easily be mistaken for *coagulata*, differing in maculation apparently in the smaller discal streak of primaries and the practical lack of same on the secondaries. The color is possibly a shade grayer than that of *coagulata*. The cross lines of the primaries are extremely faint, but the dark spots along the costa and the white spot above the tornus are much as in Guenée's species. There is, too, no appreciable difference in palpal length or ciliation of male antennae. In the single male available with attached abdomen the dark band on segment II is less evident, owing to a darkening of the following segments; this, however,

may not be constant. It is in the genitalia that the main differences are to be noted.

MALE GENITALIA: Hair pencils of segment IX well developed. Tegumen conical with moderately broad base. Uncus chunky, bifid, with the usual pointed upper hook and rounded lower one. Vinculum of the same type as *russeliata* but slightly more produced apically. Clasper quite narrow, slightly tapered towards apex. Aedeagus slightly thinner than in *russeliata*, expanding feebly from base to apex and finely spiculate apically. Vesica armed with only two pieces of dentate chitin, elongate and rather large, with their apical edges showing a few teeth. A similar large, indeterminate plate of chitin to that found in *russeliata* overlies partially the dentate pieces; the left side of this is curled up and best defined as in the allied species. Ventral plate of segment VIII more broadly conical than usual with the lateral edges sloping evenly inward to a broadly truncate and slightly thickened apex.

FEMALE GENITALIA: Dorsal plate of segment VIII moderately chitinized, squarely rectangular and finely spiculate with a narrow V-shaped membranous area extending inward from the center of the cephalic edge. Anterior apophyses rather thin, the spur being also feeble and shorter than in *russeliata*. Bursa and its appendages very similar in general structure to those of *russeliata*; the chitinous trough extends somewhat farther down the right side of the bursa and its distal section shows curved transverse strigulation not present in the other species. The projection of the ductus seminalis is only slightly different and the spined band along the caudal edge somewhat stronger. The membranous shoulder on the upper left side is considerably more extended and the dorsal surface is more completely spined right up to the collar and including the proximal patch of spining which is more or less separated in *russeliata*.

TYPES: Holotype, male, Red Deer River, Alberta, July; allotype, female, Calgary, Alberta, July 1 (C.N.C.).

DISTRIBUTION: Known so far only from the Canadian prairie provinces (Manitoba, Saskatchewan, Alberta).

LIFE HISTORY: Unknown.

Eupithecia coagulata Guenée

Plate 29, figure 1; text figure 9D

Eupithecia coagulata GUENÉE, 1857, Histoire naturelle des insectes, vol. 10, p. 339. TAYLOR, 1907, Canadian Ent., vol. 39, pp. 166, 277. GROSS BECK, 1907, Ent. News, vol. 18, p. 346. PEARSALL, 1908, Ent. News, vol. 19, p. 194. MCDUNNOUGH, 1927, Canadian Ent., vol. 59, p. 243; 1929, *ibid.*, vol. 61, p. 63. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 171.

Eupithecia absynthiata, PACKARD (*nec* Linnaeus), 1876, A monograph of the geometrid moths . . . of the United States, p. 49, pl. 8, fig. 2 (*partim*, ♂ *nec* ♀).

Tephroclystis fumosa HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 269.

Eupithecia fumosa, GROSSBECK, 1907, Ent. News, vol. 18, p. 348. PEARSALL, 1909, Proc. Ent. Soc. Washington, vol. 11, p. 132. TAYLOR, 1909, Canadian Ent., vol. 41, p. 426.

The generally accepted idea of the species, as first indicated by Taylor (1907), has been adopted here. Guenée's type specimen, if it still exists, should be in the Paris Museum, but no information on the subject is available at the present time. The species, evidently closely allied to the European *assimilata* Guenée, may be fairly easily recognized by the brown color of the primaries, tinged slightly with ruddy, the prominent dark spots along the costa, the large, upright, black discal streak, and a prominent white spot above the tornus. The usual cross lines are generally obsolescent, but the t.p. line at times can be distinguished arising from a costal dark patch directly above the discal streak and angling outward rather sharply opposite the cell. The secondaries are considerably tinged with brown outwardly and show a small discal dot. A black brown band on segment II of the grayish abdomen is fairly well defined. Structural details of palpi and male antennal ciliation are much as in the two preceding species. The type of genitalia places it definitely in a group with *russeliata* and *ammonata*. It has little in common with *geminata* which it resembles superficially.

MALE GENITALIA: Hair pencils on segment IX well developed. Tegumen rather broad at base and shortly conical. Uncus chunky, bifid, much as usual. Vinculum short, rather more broadly rounded apically than in the two preceding species. Clasper short and narrow,

somewhat tapered apically. Aedeagus narrower than in *ammonata* with a more decidedly contracted proximal end. Armature of vesica difficult to visualize but consisting apparently of three feebly dentate chitinous pieces arranged transversely; of these the one on the right is a short, narrow rod; the middle piece is also rod-like but longer and better chitinized; the third piece is poorly delimited but seems to be rectangular with a truncate apical edge, either dentate or smooth, and is partially superimposed on the middle piece. Above these again is an indication of another obscure plate, much as in *russeliata*, with lateral edges produced apically into long thin rods. The ventral plate of segment VIII is intermediate in shape between that of *russeliata* and of *ammonata*.

FEMALE GENITALIA: Dorsal plate of segment VIII weakly chitinized, slightly broader than high, feebly spiculate with a rather broad, U-shaped, membranous area below the center of the caudal margin; anterior apophyses much as in the related species. Ostium membranous, weakly spiculate. Membranous section of ductus bursae longer than usual and also spiculate, terminating in the well-developed chitinous collar which sends much shorter projections into the bursa so that the chitinous trough of the two preceding species is reduced to a short area just below the collar. Proximal third of bursa lightly chitinized, forming a distinct shoulder on the left side; on the right ventral side the large tubular ductus seminalis projects strongly outward and downward, armed on both sides at the base with clusters of small spines. The shoulder on the ventral side is strigate and shows a fairly large cluster of moderate-sized spines, commencing on the left side and extending around to the dorsal surface below the collar. The remainder of the bursa is globular and thickly and completely covered with moderate-sized spines.

TYPES: *Coagulata*, holotype, male, Pennsylvania (? Paris Museum); *fumosa*, holotype, female, South Abington, Massachusetts, August 10, 1880 (Rutgers University, New Brunswick, New Jersey).

DISTRIBUTION: Widespread, extending from the eastern United States and Canada across the continent to British Columbia and Colorado (two worn females from Clear

Creek and San Miguel apparently belong here according to genitalia).

LIFE HISTORY: A single female has recently been examined which had been bred by the Canadian Forest Insect Survey from a larva on currant from Manitoba.

REMARKS: The description and drawing of the male genitalia are based on a specimen from New Brighton, Pennsylvania, which should be fairly topotypical.

***Eupithecia swettii* Grossbeck**

Plate 29, figures 2, 3; text figure 9E

Eupithecia swettii GROSSBECK, 1907, Ent. News, vol. 18, p. 346. PEARSALL, 1910, Proc. Ent. Soc. Washington, vol. 12, p. 141. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 166.

Comparatively few specimens of this early spring species have been available for study, although the range of distribution appears to be quite extended through the New England and northern Atlantic states. Possibly the early date of appearance may have been a factor in preventing the collection of good series. While the general time of appearance seems to be late April or early May a single small female in the American Museum collection from the Catskill Mountains, New York, bears the date July 1, which would indicate either a delayed emergence or possibly a partial second generation. A single male in the Canadian National Collection was taken at St. Mark's Junction, Quebec, on May 1 (A. C. Sheppard).

The primaries are rather narrow and pointed apically with long checkered fringes. The color is an even light fawn brown, tending towards gray, and the maculation is mostly quite obscure, although the allotype female, on which Grossbeck probably based his description, shows definite cross lines, the t.p. line being most evident with a strong bulge below costa and the forming of short streaks on the veins on its inner side. The palpi are moderate in length and well tufted dorsally. The male antennae are shortly ciliate, the ciliations being of the feebly trifasciculate type common in the group; there is a slight indication of a dark transverse band on segment II of the abdomen. The genitalia in both sexes would seem to indicate a placement in the *satyrata* group, the spinning of the female bursa particularly being

very similar to that found in the *geminata* section.

MALE GENITALIA: Hair pencils of segment IX present but weak. Tegumen broad at base with narrowly rounded apex. Uncus distinctly bifid, rather short. Vinculum short, broad, and almost square with strongly thickened margins. Clasper moderately trigonate, with gently tapered apex. Aedeagus broad at base, somewhat tapered. Vesica armed with two small, subapical, dentate pieces of chitin, partly overlapping, a larger, more centrally placed, dentate piece at the base of which is a cluster of small, truncate cornuti, and a smooth, apically situated piece with curled inner edge; the semicylindrical chitinous rod is rather feeble and is more or less joined to the end piece. Ventral plate of segment VIII broad, subtriangular with truncate apex.

FEMALE GENITALIA: Dorsal plate of segment VIII rectangular, a small triangular central section on caudal margin free of spicules. Anterior apophyses rather long, the caudal spur well developed and terminating in a narrow chitinous rod on the lateral margin of the membranous ventral plate. Ostium funnel shaped, finely shagreened. Ductus bursae very short, membranous, terminating in a broad, chitinized collar. Bursa somewhat pear shaped, the upper half lightly chitinized, strigate, and practically unspined; the fundus section covered with strong spines, the marginal ones being exceptionally long; this spined area extends considerably farther up the left side than on the right. Somewhat proximad of the middle of the right margin the ductus seminalis arises as a broad tube, descending for a short distance along the bursa and then narrowing and curving caudad; at its base on the ventral side is a short row of small spines and farther proximad and more dorsally placed is another small cluster of similar spines.

TYPES: Holotype, male, Sharon, Massachusetts (M.C.Z.); allotype, female, Framingham, Massachusetts (A.M.N.H.).

DISTRIBUTION: Massachusetts south to District of Columbia and west to western Pennsylvania (New Brighton); Quebec (St. Mark's Junction).

LIFE HISTORY: Unknown.

REMARKS: The drawing of the male genitalia is based on a slide from a topotypical

male and of the female on the allotype slide, both specimens in the collection of the American Museum.

***Eupithecia geminata* Packard**

Plate 29, figures 4-6; text figure 9F

Eupithecia geminata PACKARD, 1873, Fifth Rept. Peabody Acad. Sci., p. 58; 1876, A monograph of the geometrid moths . . . of the United States, p. 49, pl. 8, fig. 3 (*partim*, nec pl. 8, fig. 2). TAYLOR, 1907, Canadian Ent., vol. 39, p. 276 (type restriction). PEARSALL, 1908, Ent. News, vol. 19, p. 194. MCDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 63.

Eupithecia absynthiata, PACKARD (nec Linnaeus) 1876, A monograph of the geometrid moths . . . of the United States, p. 49. GOODSELL, 1877, Canadian Ent., vol. 9, p. 62 (biology). TAYLOR, 1907, Canadian Ent., vol. 39, p. 165. GROSSBECK, 1907, Ent. News, vol. 18, p. 347.

Tephroclystis absinthiata, DYAR, 1904, Proc. U. S. Natl. Mus., vol. 27, p. 888.

Eupithecia packardata TAYLOR, 1909, Canadian Ent., vol. 39, p. 277. BARNES AND MCDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 271; 1916, Contributions to the natural history of the Lepidoptera of North America, vol. 3, no. 3, p. 177. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 171.

Eupithecia meritata PEARSALL, 1908, Ent. News, vol. 19, p. 195. BARNES AND MCDUNNOUGH, 1916, Contributions to the natural history of the Lepidoptera of North America, vol. 3, no. 3, p. 178.

Tephroclystis casloata DYAR, 1904, Proc. U. S. Natl. Mus., vol. 27, p. 891 (*partim*, paratype). MCDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 65.

Eupithecia casloata, DOD, 1906, Canadian Ent., vol. 38, p. 89. TAYLOR, 1906, Canadian Ent., vol. 38, p. 102.

The rather involved synonymy of this species has been further established by a recent study of the genitalia of the female holotype of *geminata* as restricted by Taylor (1907). They match exactly slides made from the type series of *meritata*, and this confirms the idea that Pearsall's idea of *geminata* was based on specimens of a species which was later described by Taylor as *indistincta*, such specimens, including a female labeled by Pearsall as *geminata*, being contained in the American Museum collection. As to whether or not the species is identical with the Palearctic *absynthiata*, as listed by Packard, Hulst, and Dyar, is a matter of some doubt. Taylor was definitely of the opinion that the two species

were distinct, and it seems better at the present time to leave them as such until more details on the life history of the North American form are available.

The larger size, as compared with *coagulata* Guenée, especially noticeable in western specimens, the light chocolate brown color of the wings, the large black discal dot on the primaries only, and the dark costal patches at the inception of the t.a. and t.p. lines are characteristic of the species, these features being retained even when the cross lines have become obscure. Pearsall's description under *meritata* is good and can be used to supply further details of maculation. The palpi are moderate in length, semiporrect, projecting considerably beyond the front, and rather bushily tufted. The male antennae are finely and rather evenly ciliate, with a mild tendency towards the trifasciulate type. The black band across segment II of the abdomen is fairly well defined and accentuated by paler scaling on the preceding segment. When not rubbed off the small dorsal tufts are mixed black and white.

MALE GENITALIA: Hair pencils of segment IX well developed. Tegumen rather narrow and strongly conical. Uncus thin, bifid. Vinculum broad, short, with rounded apical margin. Clasper rather broad, only moderately narrowed towards the apex. Aedeagus long and broad. Vesica with four pieces of spined chitin, consisting of a quite narrow apical piece and three others more or less clustered in the middle region, the largest one to the right, much longer than the other two; besides these there are a partially hollowed piece and the usual small, twisted end piece. Ventral plate of segment VIII of the usual conical type, with broad, bluntly truncate apex which shows indications of a small median excavation.

FEMALE GENITALIA: Dorsal plate of segment VIII upright, higher than broad, rather weakly chitinized, and in structure much as in *satyrata*; anterior apophyses and lateral spurs much as usual; ventral plate membranous. Ostium membranous, funnel shaped, finely shagreened. Initial portion of ductus bursae short, membranous, terminated by a rather narrow, chitinized collar that inclines somewhat to the left. Bursa long, pear shaped, the proximal half, or neck, weakly chitinized

and gradually expanding, free of spines except for small clusters near base on both dorsal and ventral surfaces. The moderately broad, membranous ductus seminalis arises on the right side, distinctly nearer the distal end of the neck than the proximal one and is furnished at its base with a row of well-developed spines. The distal half of the bursa is strongly spined, the spined area extending farther proximad on the ventral side and with a narrow membranous band reaching down the left side to the fundus. The marginal spines on the dorsal surface are extremely long and tend to form a cluster on the upper left side. There is practically no indication of a shoulder on the left side as in *satyrata*.

TYPES: *Geminata*, holotype, female, Massachusetts (M.C.Z.); *packardata*, holotype, female, Ottawa, Canada (U.S.N.M., ex Taylor and Barnes collections); *meritata*, holotype, male, allotype, female, Catskill Mountains, New York (A.M.N.H.).

DISTRIBUTION: Very widespread, occurring in many states east of the prairies and extending across Canada from the Atlantic to the Pacific, particularly plentiful in interior British Columbia (Kaslo). It ranges through the Rocky Mountain states as far south as Arizona, and a few records are known from California.

LIFE HISTORY: The larva has been recorded by Goodell as feeding on cockscomb (*Celosia cristata*), but Taylor casts doubts on the authenticity of the specific determination. Specimens in the Canadian National Collection have been bred from yarrow and aster by the Forest Insect Survey, and Procter, in his "Insects of Mount Desert," records it as feeding on yarrow and goldenrod.

***Eupithecia indistincta* Taylor**

Plate 29, figure 7; text figure 9G

Eupithecia indistincta TAYLOR, 1910, Canadian Ent., vol. 42, p. 82. BARNES AND McDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 273. McDUNNOUGH, 1929, Canadian Ent., vol. 64, p. 65; 1940, *ibid.*, vol. 72, p. 37. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 171.

Eupithecia geminata, PEARSALL (*nec* Packard), 1908, Ent. News, vol. 19, p. 194.

This species is very close in general appearance to *geminata* Packard, and it has already been noted that Pearsall's conception of

Packard's species was based on specimens of *indistincta*. Taylor's holotype was a female from the Catskill Mountains, New York, received from Pearsall, and there are several topotypical specimens (placed by Pearsall under *geminata*) of both sexes in the American Museum collection. With male specimens available for genitalic study it has become evident that *indistincta* is a good species and not a race of *zygadeniata* as was formerly suggested by the author on a comparison of the female organs solely. The close similarity to the European *veratraria* Herrich Schaeffer has already been commented on (1929), but without knowledge of the life history it would be premature to synonymize the two names. As compared with *geminata*, with which it agrees in the chocolate brown color of the wings, the best distinctions, as pointed out by Taylor, are the presence of a definite discal spot on the secondaries and the greater space between the large discal spot of primaries and the dark costal patch at the inception of the t.p. line. The cross lines are more frequently obsolescent than in *geminata* but, when traceable, practically similar in direction. The palpi are shorter, but the ciliation of the male antennae shows little difference from that of *geminata*.

MALE GENITALIA: Hair pencils of segment IX well developed. Very similar in general appearance to *geminata*; uncus very slightly longer and clasper somewhat more pointed apically; aedeagus definitely stouter. The main difference occurs in the armature of the vesica which consists of the usual twisted end piece and a large, semicylindrical, chitinous piece in the proximal area; apical to this is a fair-sized, strongly dentate bar of chitin, and close to the apex itself two weakly chitinized, small and narrow, feebly dentate bars. A quite narrow, spiculate band runs through the center of the apical half, lacking entirely in *geminata*, but present in *zygadeniata*. The ventral plate consists of a long, narrow, bluntly truncate rod arising from the usual expanded base and in general with more similarity to that of *geminata* than to *zygadeniata*; in the apical half, however, the lateral edges of the rod are strongly chitinized with the central area much weaker in chitinization so that the appearance of two terminal prongs is simulated.

FEMALE GENITALIA: Rectangular plate of

segment VIII weakly chitinized with a distinct, broadly V-shaped excavation of the cephalic margin; anterior apophyses, caudal spur, and ventral plate as usual. Ostium and short initial section of the ductus bursae membranous, the latter followed by the well-chitinized half collar which, as in *geminata* and allies, inclines to the left. The bursa is similar in general structure to that of *geminata* but rather more narrowly elongate; the initial third is moderately well chitinized, the right side strongly outwardly projected, the left side straight. The ductus seminalis arises as a moderately broad tube on the right side at the end of the chitinized area; from its base, on both dorsal and ventral surfaces, clusters of spines cross to the left, but the distinct longitudinal row of *geminata* is not present, the origin of the ductus in this latter species being, in any case, farther distad. The central section of the bursa is membranous, this area extending farther towards the fundus on the dorsal surface and right side than ventrally, and on the left side connected with the fundus by a thin membranous band, as in *geminata* and allies. The balance of the bursa is completely covered with long, strong spines, this spined area extending up the left side almost to the chitinized portion; the marginal spines are, however, not so strong as in *geminata*.

TYPE: Holotype, female, Catskill Mountains, New York, August (U.S.N.M., *ex* collections Taylor and Barnes).

DISTRIBUTION: Apparently quite general throughout the northern Atlantic states, extending at least from Vermont to Maryland.

LIFE HISTORY: Unknown. The seed capsules of *Veratrum* are a possibility as food plant, owing to the close relationship to the European *veratraria*.

***Eupithecia zygadeniata* Packard**

Plate 29, figure 8; text figure 10A

Eupithecia zygadeniata PACKARD, 1876, A monograph of the geometrid moths . . . of the United States, p. 57, pl. 9, fig. 7. TAYLOR, 1907, Canadian Ent., vol. 39, p. 280.

Eupithecia zygadeniata, MCDUNNOUGH, 1940, Canadian Ent., vol. 72, p. 37.

Tephroclystis tenebrescens HULST, 1900, Canadian Ent., vol. 32, p. 102.

Eupithecia tenebrescens, TAYLOR, 1907, Ca-

nadian Ent., vol. 39, p. 280. GROSSBECK, 1907, Ent. News, vol. 18, p. 348.

This Texan species, of which unfortunately very few specimens were available for study, can at once be separated from the genitally very similar *indistincta* by the longer and more pointed primaries, the grayer ground color, the smaller discal dot, and the numerous, rather indistinct, oblique cross lines. Packard's figure is a pretty fair representation of the species. Unfortunately at the present time no males are available for examination, but as far as can be judged from the female sex there are no obvious differences in palpal and antennal structure from *indistincta*.

MALE GENITALIA: (Based on a drawing of a slide in the United States National Museum.) Very similar to those of *indistincta*, the clasper apparently more bluntly rounded apically, the aedeagus thicker, and the spined chitinous pieces somewhat different in shape, the apical piece on the left being obsolescent and the other two rather larger, especially the median one; the thin spiculate band is present in both species. The main difference is in the ventral plate of segment VIII in which the basal half is much broader and chunkier. The rod-like apical section is also broader, and the apparent median excavation, owing to the thinner chitinization of this section, is less deep.

FEMALE GENITALIA: The differences in this sex between *zygadeniata* and *indistincta* are even less obvious than in the males. The excavation of the cephalic margin of the dorsal plate is shallower; the bursa (possibly owing to the fuller inflation of the specimen under examination) is larger and considerably broader; the exit of the ductus seminalis appears to be closer to the proximal end; and the spined area is possibly slightly more extended. All these differences are very minor and may not hold when sufficient material is available for examination.

TYPES: *Zygadeniata*, holotype, female, Bosque County, Texas, March (M.C.Z.); *tenebescens*, holotype, female, Texas (Rutgers University, New Brunswick, New Jersey).

DISTRIBUTION: Known so far only from central Texas.

LIFE HISTORY: According to Packard (1876, *op. cit.*, p. 52) the larva occurs in

April and May on *Zygadenus nuttalli* Gray, forming a red brown pupa which remains without hatching until the next year.

REMARKS: Hulst's record of the species (misspelt *zygaenidata*) from Sitka and Yakutat, Alaska (1900, Proc. Washington Acad. Sci., vol. 2, p. 497) is erroneous.

***Eupithecia cretaceata* Packard**

Plate 29, figures 9-11; text figure 10B

Larentia cretaceata PACKARD, 1874 (March), Proc. Boston Soc. Nat. Hist., vol. 16, pl. 1, fig. 3; 1874, Sixth Rept. Peabody Acad. Sci., p. 40.

Eupithecia cretaceata, PACKARD, 1876, A monograph of the geometrid moths . . . of the United States, p. 63, pl. 8, fig. 15. DOD, 1906, Canadian Ent., vol. 38, p. 91. TAYLOR, 1906, Canadian Ent., vol. 38, p. 101. McDUNNOUGH, 1927, Canadian Ent., vol. 59, p. 243; 1941, *ibid.*, vol. 73, p. 189. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 171.

Glaucopteryx cretaceata, PACKARD, 1876, A monograph of the geometrid moths . . . of the United States, p. 562.

Eupithecia fenestrata MILLIÈRE, 1874 (August), Rev. et Mag. Zool., p. 243. TAYLOR, 1907, Canadian Ent., vol. 39, p. 279 (biology). PETERSEN, 1909, Iris, vol. 22, p. 249, pl. 12, fig. 53.

It has been shown (1941) that *fenestrata* will fall as a synonym of *cretaceata*, although many authors have given it priority, notably in Europe. Judging by Petersen's figures there is no difference in the genitalia of North American and European specimens. The larval food plant is also similar.

There is little chance of mistaking the species, owing to the chalky white coloration of the wings with the brownish blotches along the costa and the dotted cross lines of primaries. The size is very variable, specimens from the Lake Tahoe region of the Sierra Nevadas (the type locality) being the largest of any of our North American species. In the prairie provinces of Canada and on Vancouver Island specimens occur which are much smaller, scarcely as large as *geminata*.

The genitalia in both sexes are strikingly similar to those of *indistincta* and *zygadeniata*. In the male the vesica is armed with the same number of chitinous pieces and contains a spiculate band; the two apical dentate pieces are, however, longer and more rod-like, and the larger median piece is somewhat differently shaped. The ventral plate of segment VIII is very close to that of *zygadeniata*. In

the female the whole organ is so essentially similar to that of *zygadeniata* that it is impossible to point to any definite characters that could be used for the purpose of differentiation.

TYPES: *Cretaceata*, holotype, female, Sierra Nevadas, California (M.C.Z.); *fenestrata*, type location unknown.

DISTRIBUTION: Very generally distributed wherever the larval food plant, false helebore, grows. It occurs rather rarely in the more mountainous sections of the New England states and extends across Canada to Vancouver Island, being quite common in certain regions of British Columbia. It is found in the Sierra Nevadas of California (Plumas County, Lake Tahoe region) and will probably occur in many of the mountainous sections of the west.

LIFE HISTORY: Taylor records finding the larvae in great numbers on the flowers and seeds of *Veratrum viride* in British Columbia, and in the Mt. Washington, New Hampshire, area similar observations have been made.

***Eupithecia plenoscripta plenoscripta* Hulst**

Plate 29, figures 12, 19; text figure 10C

Tephroclystis plenoscripta HULST, 1900, Canadian Ent., vol. 32, p. 103. PEARSALL, 1910, Canadian Ent., vol. 42, p. 313.

Eupithecia plenoscripta, PEARSALL, 1910, Proc. Ent. Soc. Washington, vol. 12, p. 140. MCDUNNOUGH, 1940, Canadian Ent., vol. 72, p. 35.

The species, among other things, should be readily recognized by its large size (21–22 mm.) and the light gray coloration of the primaries in fresh specimens (in older specimens the color fades to a light ochreous brown) with prominent light and dark alternate banding. Perhaps the most characteristic feature of the maculation is found in the outer area of the primaries, a pale postmedian band sharply angled outwardly below the costa, being followed by a broad, darker band of a slightly brownish tinge which in turn is defined outwardly by the whitish s.t. line. The palpi are very short, the front is distinctly bulging, the squamation of both being an admixture of white and smoky scales; the male antennae are finely and evenly ciliate. The thorax is smooth scaled, of a gray color with a darker shade on the anterior portion. The concolorous abdomen dorsally has a fairly

distinct blackish band across segment II, and the posterior margin of segment III is shaded with the same color; the black mediodorsal small tufts are quite prominent. A fair number of topotypical females from Yellowstone Park (originally from the Barnes collection) and a single female from Senator, Arizona, have been available for study in the American Museum collection as well as fresher specimens of both sexes from Alta, Utah (Nabokov) from the Canadian National Collection. In the Rocky Mountain regions the species is apparently quite plentiful in July. The very similar type of genitalia in both sexes obviously connects the species with the *geminata-zygadeniata* group.

MALE GENITALIA: Hair pencils of segment IX well developed. Tegumen narrow, high, conical. Uncus broad at base, apex bifid, the upper hook pointed, the lower one rounded. Vinculum broad, strongly rounded apically. Clasper moderately broad, gradually narrowing to a bluntly rounded apex. Aedeagus broad and quite long. Vesica armed with two apically situated, dentate pieces of chitin, a longer, partially cylindrical bar on the left side, and the usual twisted end piece. Ventral plate of segment VIII consisting of a single long rod arising from the usual broadened base, its apical third being narrowly bifid.

FEMALE GENITALIA: Dorsal plate of segment VIII weakly chitinized, rectangular, much higher than broad, the lateral edges slightly concave; anterior apophyses rather short, stout, sending long, caudal spurs from near their point of origin to the lateral edges of the membranous ventral plate. Ostium membranous, moderately broad, forming a slight funnel from which a fairly long membranous ductus bursae leads to a short, chitinous collar. Bursa rather small, oval, with a slight bulge on the left side below the collar; proximal area and a zone down the right side nearly to the fundus membranous with a cluster of moderate spines on the dorsal surface below the collar. The ductus seminalis arises on the right side, at about the level of this spine patch, as a broad tube which bends ventrad and performs a complete convolution across the ventral surface of the bursa before narrowing and turning caudad; at its base ventrally is a single row of small spines. The left half of the bursa is occupied

on both surfaces by large patches of spines, descending to the fundus but completely separated on the left side by a narrow membranous band which curves across the fundus to join the membranous area of the right side.

TYPE: Holotype, female, Yellowstone Park, Wyoming, July (U.S.N.M., No. 4702).

DISTRIBUTION: Colorado, Utah, Wyoming, and probably others of the Rocky Mountain states.

LIFE HISTORY: Unknown.

REMARKS: The slide of a male specimen from Alta, Utah, has served for the illustration of the male genitalia. The figure of the female genitalia is based largely on a drawing from the holotype slide, supplemented by a slide of a topotypical specimen in the American Museum collection.

***Eupithecia plenoscripta bindata* Pearsall**

Plate 29, figure 13; text figure 10D

Eupithecia bindata PEARSALL, 1910, Proc. Ent. Soc. Washington, vol. 12, p. 142. MCDUNNOUGH, 1940, Canadian Ent., vol. 72, p. 35.

The name *bindata* is being held as a racial form of *plenoscripta* largely on account of the very small size of the type specimens which are scarcely half the size of normal *plenoscripta*. A male paratype is in the American Museum collection and in details of palpi, front, and antennae shows no difference from typical *plenoscripta*. The abdomen had at some time been removed by Cassino for the purpose of making a genitalic slide, but unfortunately the slide returned with the name *bindata* attached is obviously that of the type male of *segregata* (also with abdomen removed), and the correct slide has so far not been located. The matter is not very important as slides of the holotype and allotype in the United States National Museum have been made and agree with slides of *plenoscripta* as noted (1940). Apart from the types a single female from Mohawk, Plumas County, California, in the Canadian National Collection, which is even smaller than Pearsall's paratype, has been determined as belonging here.

GENITALIA: A drawing of the genitalia of the holotype shows a minute extra piece of chitin with the two spined pieces. This may be merely individual, as all other details agree with typical *plenoscripta*. In the genitalia of

the female allotype, the dorsal spine patch at base is slightly heavier, but this is probably also individual.

TYPES: Holotype, male, and allotype, female, Pullman, Washington (U.S.N.M.).

DISTRIBUTION: Washington (Pullman), California (Plumas County).

LIFE HISTORY: Unknown.

***Eupithecia nimbose* Hulst**

Plate 29, figures 14, 15, 20; text figure 10E

Tephroclystis nimbose HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 269 (*partim*).

Eupithecia nimbose, PEARSALL, 1909, Proc. Ent. Soc. Washington, vol. 11, p. 128; 1910, *ibid.*, vol. 12, p. 140. BARNES AND MCDUNNOUGH, 1912, Contributions to the natural history of the Lepidoptera of North America, vol. 1, no. 4, p. 31, pl. 14, fig. 4.

The identity of this species is still very imperfectly understood. The name was based on specimens from Arizona and California but must be restricted to the female specimen from Arizona in the Hulst collection with which the Californian specimens are not conspecific. Pearsall (1909) called attention to this and made a female type from California in the Brooklyn Institute Museum the allotype of his new species *usurpata*. A male type from the same state was figured in the "Contributions" (1912) and is certainly not conspecific with the Arizonan specimen. Pearsall's record from Fort Collins, Colorado (1910), needs checking. Some years ago a genitalic slide was made of the Arizona type, and the present figure is based on a drawing made from this slide. The type is somewhat worn but judging by its genitalia and general maculation and structure must be extremely close to *plenoscripta*. It possesses the same short palpi and bulging front, and only a few very minor differences can be seen in the genitalia, the most obvious being the larger size of the bursa and the fewer and somewhat stronger spines at the base of the ductus seminalis. The female from Senator, Arizona, mentioned under *plenoscripta*, was at first thought to belong here as its maculation matched that of the type very closely. However, the genitalia seem closer to those of Yellowstone Park *plenoscripta*, and it has been placed accordingly. A male and two females from the White Mountain re-

gion of Arizona have been available for study. The male is from the Sperry collection and the two females are now in the Canadian National Collection. As far as can be told these specimens (pl. 29, figs. 15, 20) match the type of *nimbosa* fairly closely but are smokier in general coloration, being fresher specimens, and show a more definitely defined median area, the lines bordering this section being stronger and the area itself somewhat darker in coloration, presenting the appearance of a faint broad band. The female genitalia match those of the type pretty closely, but the male genitalia show a third small, dentate piece of chitin in the vesica as compared with the two found in *plenoscripta*. Whether such differences are specific or not is a matter for doubt, and it would not be surprising if both so-called species proved to be mere forms or races of a single one. In this case the name *nimbosa* would take priority. At the present time, however, and until more male specimens are available for study it seems advisable to leave both names standing as representative of species.

TYPE: Holotype, female, Arizona (Rutgers University collection, New Brunswick, New Jersey).

DISTRIBUTION: Arizona (?White Mountains).

LIFE HISTORY: Unknown.

***Eupithecia behrensata* Packard**

Plate 29, figure 16; text figure 10F

Eupithecia behrensata PACKARD, 1876, A monograph of the geometrid moths . . . of the United States, p. 59, pl. 9, fig. 5. BARNES AND MCDUNNOUGH, 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 146, pl. 22, fig. 11.

Eupithecia perillata PEARSALL, 1912, Ent. News, vol. 23, p. 442. BARNES AND MCDUNNOUGH, 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 146.

Eupithecia behrensata monterata CASSINO AND SWETT, 1922, Lepidopterist, vol. 3, p. 186.

A large, gray brown colored species from the Pacific coast of California which should give no trouble in identification. Packard's type came from the San Francisco Bay region (Sausalito) and is possibly a little browner in color than specimens from San Diego on which Pearsall based his name *perillata*, but this is hardly sufficient to give racial status

to the latter name, especially as the type series in the American Museum collection varies considerably in depth of coloration and intensity of maculation. *Monterata* was based on a single female specimen in which the median area was suffused with a deeper color than normal, but until more material is available it is impossible to tell whether this is a racial character or not. The fact that some of the cross lines are obsolete, which was stressed by the authors, is of little value in this connection. Hulst's reference of the species to "*Tornos interruptaria* Grote" (1888, Ent. Amer., vol. 4, p. 49) is based on an obvious error of determination by Packard.

The semiporrect, rather roughly scaled palpi are moderate in length and project considerably beyond the flat front; they are slightly longer than in *geminata* and decidedly longer than in *indistincta*, *plenoscripta*, and *cretacea*. The ciliae of the male antennae are also longer than in any of the above-mentioned species and more decidedly of the trifasciculate type. There is a tendency for the upper pair of spurs on the hind tibiae to become reduced.

MALE GENITALIA: Strong hair pencils on segment IX. Tegumen short, very broad at base, the sides sloping rapidly inwards to the conical apex. Uncus strong, bifid, with both hooks well developed. Vinculum short, with broadly rounded apex. Clasper moderately broad, tapered strongly towards apex. Aedeagus broad, the size somewhat increasing from base to apex. Vesica armed with two well-chitinized and dentate, semirectangular pieces with two further, much smaller pieces partially superimposed; there are also a rather small, semicylindrical chitinous piece and the usual twisted end piece. Ventral plate on segment VIII broad at base, the sides sloping obliquely and straightly inwards to a rather broad, truncate apex. As in the other species of the group the central apical portion is very weakly chitinized, almost membranous, so that the appearance of a shortly bifid apex is simulated, owing to the stronger chitinization of the lateral portions.

FEMALE GENITALIA: Dorsal plate of segment VIII moderately well chitinized, rectangular; anterior apophyses short and stout, much as in the other species, as are also the caudal spurs and the ventral plate. Ostium

membranous, broad. Ductus bursae membranous for a short distance, then terminated by the usual chitinous half collar from the distal lateral edges of which two parallel rows of small spines descend on the dorsal side to the opening of the ductus seminalis which is somewhat more dorsally placed than in the *geminata* group and bends to the right before narrowing. The dorsal surface of the oval bursa is largely membranous except on the left side where a broad band of fine spines extends from the fundus to the base of the collar, connected, without the intervening membranous strip of *geminata*, with the spining of the ventral surface, which extends over the whole area except a narrow membranous portion down the right side.

TYPES: *Behrensata*, holotype, male, Saulzito, California (M.C.Z.); *perillata*, holotype, male, allotype, female, San Diego, California (A.M.N.H.); *monterata*, holotype, female, Monterey, California (M.C.Z.).

DISTRIBUTION: Coastal region of California.

LIFE HISTORY: Unknown.

***Eupithecia multiscripta* Hulst**

Plate 29, figure 17; text figure 10G

Tephroclystis multiscripta HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 270.

Eupithecia multiscripta, PEARSALL, 1910, Proc. Ent. Soc. Washington, vol. 12, p. 140. BARNES AND McDUNNOUGH, 1912, Contributions to the natural history of the Lepidoptera of North America, vol. 1, no. 4, p. 31, pl. 14, fig. 11.

This large species from the Rocky Mountain area is so similar in genitalia to *behrensata* that it could almost be referred here as a subspecies. However, as other species in the group appear similarly close to one another in these organs but remain distinct on other characters it seems best to let both names stand. The primaries are grayer in color than those of *behrensata*, the cross lines (as the

name implies) much more distinct, and there is a marked tendency for the outer section of the median area to lose color and form a pale band across the wing. These characters show up well in the figure of the female type given in the "Contributions." The Hulst collection contains two females labeled "Type." One bears the simple label "Col." The other and better-preserved specimen from Glenwood Springs, Colorado, May, 1895, W. Barnes, is hereby designated as the holotype.

Structural characters of palpi and male antennae show little difference from those of *behrensata*. In the male genitalia both the uncus and the clasper are rather stouter, and the latter is somewhat chunkier. The aedeagus is distinctly broader and, while the number of chitinous pieces in the vesica is the same, these appear to be slightly stronger and differently shaped, although probably too much stress should not be laid on this, in any case somewhat variable, feature. The ventral plate is stouter with a broader membranous apical area in the center. In the female genitalia the parallel rows of spines at the base of the ductus seminalis seem stronger and longer, and the exit of the ductus is somewhat farther removed from the proximal end of the bursa. The dorsal plate of segment VIII is not so squarely rectangular, being broader than high, with a very strongly bowed caudal spur to the anterior apophysis. It is probable, however, that none of these small differences has much specific worth.

TYPE: Holotype, female, Glenwood Springs, Colorado, May (Rutgers University, New Brunswick, New Jersey).

DISTRIBUTION: Colorado, Utah, Idaho, Washington (as recorded by Pearsall; needs verification).

LIFE HISTORY: Unknown.

THE *INNOTATA* GROUP

This small group, which contains a few closely allied species of the Palearctic and Nearctic fauna, seems best placed immediately following the *satyrata* group as both groups possess the same type of rod-like ventral plate on segment VIII in the male sex. Three species of the Palearctic fauna belong here, viz., *nanata* Hübner, *hyperboreata*

Staudinger, and *innotata* Hufnagel. Of these *hyperboreata* is Holarctic, and the name must be superseded by the earlier *gelidata* Moeschler, based on a Labrador specimen. *Nanata* has as yet not been discovered on the North American continent. *Innotata*, a very variable, widespread, and much-discussed species, was once considered by the author to be rep-

resented in our fauna by certain races but, after a careful study of the female genitalia of mid-European specimens, the conclusion has been reached that our forms show sufficient differences to warrant specific rank. Excellent figures have been given by Petersen (1909, *Iris*, vol. 22, figs. 89-91) of the genitalia of the above three species, and particular attention is called to the exit of the ductus seminalis from the female bursa. In *nanata* it is finger like and projects caudad from the right dorsal side. In *innotata* it is situated on the extreme left side at the base of the shoulder, crossing over the upper dorsal surface of the bursa to the right side before bending caudad. Nothing in the considerable slide material of North American specimens examined has been found to match exactly such positions of the ducti. Our North American fauna contains several (at least three and possibly four or five) species belonging to the group but at the present time, owing to our entire lack of knowledge of the life histories, some of these have been impossible to delimit satisfactorily, and the present treatment must be regarded as only a tentative one which may have to be altered considerably when biological knowledge is available. The rarest but most easily recognized species is *gelidata* Moeschler, an inhabitant of the Hudsonian zone. It shows good genitalic characters which match excellently in both sexes with Petersen's figures of the northern European *hyperboreata* Staudinger. *Multi-strigata* Hulst, occurring in the Great Basin area, resembles *innotata* in its general narrow wing shape and angular type of maculation, and, like this species, tends to develop a variety of forms and even broods which can be properly evaluated only when bred material can be obtained. A still more perplexing group of forms, which were formerly placed as races of *innotata* but are now given specific rank under the name *perfusca* Hulst, the oldest published name, is apparently an inhabitant of the Canadian zone and occurs in numerous forms across the entire Dominion of Canada, reaching southward into the New England states and down the mountain chains of the west at moderate altitudes. This so-called species is extremely closely allied to *multi-strigata* in genitalic characters but in general appears to have broader, less pointed pri-

maries with more indistinct maculation and with the cross lines less sharply angled below costa and less oblique in course. It must be confessed, however, that specimens occur, especially in the west, with the narrow pointed type of wing found in *multi-strigata*. The correct placement of such specimens, especially when rubbed, is almost impossible. Again, life history studies must be made before it can be hoped to arrive at a satisfactory evaluation of the species and its relationship to *multi-strigata*. At various times specific names have been proposed by Taylor for several of these forms from different sections of the Dominion, but, at the best, it would appear that they can be held only in a rather doubtful racial sense. Topotypical material, representing such names, has been available in the Canadian National Collection in fairly satisfactory numbers, and the present treatment is largely limited to a discussion of this material. The nymotypical form, *perfusca* Hulst, was formerly the subject of a good deal of misidentification but was finally restricted to a Utah type in the United States National Museum which unfortunately in recent years has been either lost or misplaced. According to the present application, if correct, it does not seem possible to consider it as anything more than a dull gray, rather immaculate form of the Canadian species and bearing considerable resemblance to the form from southern British Columbia known as *kootenaiata* Dyar. As the species extends eastward through Canada, the color of the wings becomes darker and the maculation better defined, but nothing in the genitalia of either sex indicates specific differentiation. In the case of *hanhami* Taylor, the name was based on very pale and strongly marked specimens with white front from Vancouver Island. Such few specimens as have been available for examination from this region certainly present a very distinctive superficial appearance but show no satisfactory genitalic differences. A couple of specimens from the same region appear to intergrade with *kootenaiata*, but until something is known of the biology it seems safer to retain the specific rank.

Apart from general similarity of genitalic structure the short, bushy palpi and the

finely ciliate male antennae link the species closely together, although such characters occur frequently in other non-related species. Another useful character and one that at once serves to differentiate the species from those of the *satyrata* group is the presence of distinct, small, lateral tufts on the scutellum of the mesothorax, a character found in only a few other species of the genus. Segment II of the abdomen is unbanded.

Eupithecia gelidata Moeschler

Plate 29, figure 18; text figure 11A

Eupithecia gelidata MOESCHLER, 1860, Wiener Ent. Monatsschr., vol. 4, p. 376; 1883, Stettiner Ent. Zeitg., vol. 44, p. 122. GROSSBECK, 1907, Ent. News, vol. 18, p. 348. DIETZE, 1910-1913, Biologie der Eupitheciën, p. 124, pl. 75, fig. 481. MCDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 66; 1930, *ibid.*, vol. 62, p. 109, fig. 1b. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 164.

Eupithecia hyperboreata STAUDINGER, 1861, Stettiner Ent. Zeitg., vol. 22, p. 400. PETERSEN, 1909, Iris, vol. 22, p. 270, pl. 22, fig. 90. DIETZE, 1910-1913, Biologie der Eupitheciën, p. 122, pl. 75, fig. 478 (typical). MCDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 66.

Tephroclystis miserulata HULST, 1900, Proc. Washington Acad. Sci., vol. 2, p. 497.

Tephroclystis flebilis HULST, 1900, Jour. New York Ent. Soc., vol. 8, p. 215; 1900, Proc. Washington Acad. Sci., vol. 2, p. 497. PEARSALL, 1910, Canadian Ent., vol. 42, p. 313.

Eupithecia flebilis BARNES AND MCDUNNOUGH, 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 145. MCDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 66.

Eupithecia lagganata TAYLOR, 1910, Canadian Ent., vol. 42, p. 57. BARNES AND MCDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 271; 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 145, pl. 22, fig. 5 (type figured). MCDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 66.

Eupithecia compactata TAYLOR, 1910, Canadian Ent., vol. 42, p. 58. BARNES AND MCDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 271. MCDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 66.

Eupithecia nordeggensis CASSINO AND SWETT, 1922, Lepidopterist, vol. 3, p. 164. MCDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 66.

The rather extensive North American synonymy of this species can be explained only by the paucity of the type material, the failure of authors to recognize one another's

species, and the lack of realization of the widespread distribution on the continent of *Eupithecia* species, especially such as occur in the Hudsonian zone. Since the above synonymy was worked out by the author (1929), on the basis of the genitalia of the majority of the type specimens, considerable material from eastern localities has been added to the Canadian National Collection. This now includes a male from Hopedale, Labrador, a locality very close to the type locality for *gelidata* (Okak), and a male and three females from the north shore of the Gulf of St. Lawrence, Quebec Labrador; further, three specimens from New Brunswick and four from Nova Scotia, all captured in cold bogs, and finally a male and four females from the Mer Bleue, a large cold bog east of Ottawa, Ontario, and a single male from Smoky Falls, Kapuskasing, Ontario, an area full of muskeg. Most of this material was captured in late June or early July, but some of the Nova Scotian specimens from White Point Beach were secured in a small bog by the author in the middle of August, 1935, which possibly only indicates delayed emergence, the locality being a very cold one on the south coast. Procter also records the species from Bar Harbor, Maine, in August. Material from the western and northwestern section of the continent is still very scanty and quite insufficient to evaluate from the standpoint of possible races. However, such specimens as have been available are easily matched by eastern material, and there seems little ground at the present time for giving any of the names racial status. Besides occurring in the Canadian Rockies and adjacent areas the species extends down the main chain of the mountains into Colorado and New Mexico, two specimens from the former state and one from the latter in the Canadian National Collection having been examined. *Lagganata* and *nordeggensis* were based on very limited material from the Alberta Rockies, and *compactata* was proposed for a single female from Windermere, a locality in the Kootenays, British Columbia, only slightly southwest of the Laggan region. These three names can scarcely have any individual racial value. *Flebilis* from Sitka, Alaska, has already been stated to match *lagganata* very closely (1918), and the specimen from Ucluelet, a locality on

the west coast of Vancouver Island, mentioned by Taylor (misspelt Euchulet) as a variety of *compactata*, has been carefully examined in the Ottawa collection. It will probably link up with *flebilis*, although it is somewhat more strongly marked than either of the two types. A female from Popof Island, Alaska, recorded by Hulst as *miserulata*, also proves on genitalic examination to be a worn *flebilis*. As regards the European *hyperboreata* Dietze figures a specimen (1910–1913, *op. cit.*, pl. 75, fig. 478) from Alten, Norway, which he apparently correctly states to be typical, Alten being very close to the type locality, Bossekop. This specimen would appear to match Mer Bleue specimens of *gelidata* extremely closely. Other specimens figured do not resemble it particularly well and can hardly be considered typical of Staudinger's species.

A study of the series of eastern specimens already noted shows a considerable range of maculation on the forewings. Occasional specimens, notably males, show an almost unicolorous deep brown coloration with the cross lines poorly defined and the white s.t. line much reduced in prominence. Such specimens are probably fairly close to the type of *gelidata* and show considerable resemblance to the form *transversa* Dietze (*op. cit.*, pl. 85, fig. 1001). Usually, however, the whitish areas bordering the somewhat darker median band are quite prominent, notably the one edging the t.p. line outwardly. Very characteristic, when present, is a pale rectangular area in the cell basad of the small discal dot, this being most frequently present in females and noted in the original descriptions of *flebilis*, *compactata*, and *nordeggensis*. The t.p. line shows a slight inward angle on the upper vein of the cell, followed by a rounded bulge which, as pointed out by Grossbeck, distinguishes the species from the closely similar *nanata* with which it has been confused by European authors. A dark streak along the base of vein 2 is often quite prominent, and finally the distinct V-shaped angle of the white s.t. line above the tornus is a good differentiating character, although present in *youngata*, from which the generally smaller size and the other characters mentioned distinguish it. The palpi are quite short and bushy; the ciliations of the male antennae are

short, sparse, but fairly evenly distributed. The lateral tufting of the scutellum is quite evident in unrubbed specimens, and the abdominal squamation is brown with considerable intermingling of white scaling.

MALE GENITALIA: Hair pencils of segment IX well developed. Tegumen conical, moderately broad at base with rounded apex. Uncus rather slender, narrower than in *satyrata*, with bifid apex. Vinculum broad, lateral edges sloping inward to a broadly rounded apex. Clasper narrow with tapered apex; basal half of ventral margin somewhat thickened with chitin and terminating in a distinct projecting tooth or spine, a distinguishing feature. Aedeagus rather long and moderately broad. Vesica armed with two long spines or cornuti, of which the more apical one is shorter, and a broad, semicylindrical piece of chitin; a finely spiculate band runs through the terminal half. Ventral plate of segment VIII a single rod much as in the *satyrata* group.

FEMALE GENITALIA: Dorsal plate of segment VIII rectangular, moderately chitinized, the caudal margin tending to become membranous, especially centrally, and with a slight median depression. Anterior apophyses thin but strongly chitinized with short lateral spur terminating in a well-defined chitinous rod, running along the lateral edge of the ventral plate almost to the caudal margin. Ostium membranous, protected ventrally by a characteristic spiculate pad with broad lateral expansions. Ventral plate of segment VIII membranous, with a central spiculate rod, gradually expanded distally, extending to the ostium. Membranous portion of ductus bursae very short, terminated by a narrow chitinous collar. Bursa more or less pear shaped, upper portion free of spines and weakly chitinized but strongly strigate, especially in an area extending down the right side dorsally, and with a prominent shoulder on the left side. The broad ductus seminalis arises centrodorsally below the shoulder from a large opening, bulges strongly upward and crosses the bursa to the right, bending ventrad and caudad before narrowing; there is a membranous area around its base. Remainder of bursa covered with fine spines with a cluster of rather longer ones extending caudad towards the shoulder on the left side to just beyond the exit of the ductus. Ventrally

similarly spined with the marginal spines on the right side somewhat stronger and sending a short spur caudad along the inner edge of the strigate area.

TYPES: *Gelidata*, female, Okak, Labrador (? collection Staudinger); *hyperboreata*, Bossekop, Norway (? collection Staudinger); *febilis*, holotype, male, Sitka, Alaska (U.S.N.M.); *lagganata*, holotype, male, Agnes Lake, near Laggan, Alberta (U.S.N.M., ex collections Taylor and Barnes); *compactata*, holotype, female, Windermere, British Columbia (U.S.N.M., ex collections Taylor and Barnes); *nordeggensis*, holotype, female, Pochontas, Alberta (M.C.Z.), paratype, female, Nordegg, Alberta (C.N.C., through K. Bowman).

DISTRIBUTION: Labrador and the north shore of the Gulf of St. Lawrence; cold bog areas of Nova Scotia, New Brunswick, Ontario, and Maine; Saskatchewan (Cypress Hills); Rocky Mountain region of Alberta, British Columbia, Colorado (two specimens in the Canadian National Collection from Hall Valley and Rocky Mountain Park), and New Mexico (one male, White Mountains); northern Pacific coastal area (Vancouver Island to Sitka, Alaska).

LIFE HISTORY: Dietze records the larva of *hyperboreata* as feeding on Labrador tea (*Ledum palustre*) but a specimen from Victoria County, Cape Breton, was bred by the Canadian Forest Insect Survey from a larva on birch (*Betula*). Other specimens were also reared in Manitoba from the same food plant. Further life history data are very essential.

REMARKS: The figure of the male genitalia is based on drawings of slides of the types of *febilis* and *lagganata*; the female on several slides of Quebec Labrador, New Brunswick, and Mer Bleue material.

***Eupithecia multistrigata* Hulst**

Plate 29, figures 21–23; text figure 11B, C

Tephroclystis multistrigata HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 270.

Eupithecia multistrigata, DOD, 1906, Canadian Ent., vol. 38, p. 90.

Eupithecia multiscripta TAYLOR, 1906, Canadian Ent., vol. 38, p. 101 (*lapsus calami*).

Eupithecia multistrigata, BARNES AND McDUNNOUGH, 1912, Contributions to the natural history of the Lepidoptera of North America, vol. 1, no. 4, p. 31, pl. 14, fig. 15. McDUNNOUGH, 1941, Canadian Ent., vol. 63, p. 89.

Eupithecia spaldingi TAYLOR, 1910, Canadian Ent., vol. 42, p. 58. BARNES AND McDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 271. McDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 67; 1941, *ibid.*, vol. 63, p. 189.

In many ways the present species shows the greatest resemblance to the European *innotata* of any of our North American species included in the group. It has the same type of long, pointed primaries, and the cross lines bordering the median space show the same sharp outward angle below the costa followed by a strongly inwardly oblique and almost straight continuation as far as the inner margin. There are, however, sufficient genitalic differences to warrant the supposition that we are dealing with a distinct species.

Until something is known of the life history of *multistrigata* it seems impossible to arrive at any very satisfactory idea of the species and its limitations, its races, and its possible broods. After a study of considerable material the author is inclined to the opinion that at least two broods occur, with a certain amount of dimorphism involved. This would follow the pattern of *innotata* which has been the subject of much discussion by European workers and concerning which those interested are referred to Dietze's summary (1913, Biologie der Eupitheciën, vol. 2, pp. 124–134). It has, fortunately, been possible to tie down the typical form which occurs roughly in the Great Basin area in late August and early September and would consequently be considered as belonging to the second brood. The female holotype was collected by Barnes at Glenwood Springs, Colorado, in August. Incidentally it might be well to note that the specimen figured in the "Contributions" cannot be considered a type, as stated, as it was not mentioned in the original description, although possibly it is toptotypical. *Spaldingi* was based on a rather worn male from Stockton, Utah, taken in early September, and a long series of toptotypical specimens collected by Spalding has been examined in the American Museum collection. A few other specimens, similar to the Utah ones, from the eastern slopes of the Sierras (Mono County, Modoc County, California; Elko County, Nevada) are in the Canadian National Collection, and the same collection contains a good series of both sexes from the Summerland region of British Columbia taken in

late August. These latter specimens are somewhat darker in color than Utah ones but agree with them in maculation and genitalia. It has frequently been noted that many species from Utah tend towards a paler coloration than those from other sections of the Rocky Mountain area, and it is possible that these Summerland specimens are closer to being topotypical than the paler ones. Unfortunately very little Colorado material (and that rather poor) has been available for study. Recently a small series collected by J. Sperry on the upper Santa Ana River, San Bernardino County, California, has been studied. They were collected in mid September and agree in coloration with the pale Utah form. The genitalia figures given are based on slides made of the holotype female and holotype male of *multistrigata* and *spaldingi*, respectively, and have been compared with numerous other slides made from the above-mentioned material and found to agree. With regard to what is here considered as the first brood, the Canadian National Collection contains a small series collected at Calgary, Alberta, in June and early July by Dod and considered by him and by Taylor to belong to *multistrigata*. There are also a few specimens from Moran, Wyoming, taken in late July by J. L. Sperry, which match these Calgary specimens excellently, and further some rather worn specimens from Medicine Lake, Siskiyou County, California, also taken by Sperry in mid July. Odd specimens, secured in southern British Columbia in mid July, appear to fit in with the other series, but this material is too scanty to be of much use. The unfortunate part of the whole matter is that there is no so-called second-brood material available from any of these localities nor is there so far any record of early specimens from Colorado and Utah which would substantiate the double-brooded theory. It is, therefore, not impossible that the early specimens may belong to another single-brooded, very closely allied species, a matter impossible of determination until the life history is worked out. These early specimens (pl. 29, fig. 23), as compared with typical *multistrigata*, are larger, more strongly marked, and with generally considerable brown suffusion mixed in with the deep smoky gray ground color of the primaries. There are also some very minor genitalic dif-

ferences that will be discussed in the proper place. In both forms the palpi are short and bushy, the male antennae are finely ciliate, and the general wing pattern is similar. The lateral tufting on the scutellum is present as in all members of this group.

MALE GENITALIA: (Typical, so-called second brood.) Hair pencils of segment IX well developed. Tegumen narrowly conical. Uncus thin, bifid. Vinculum with inwardly sloping lateral edges and broadly truncate apical margin. Clasper narrow and strongly tapering towards apex; ventral margin with faint angle towards middle but the spine, present in *gelidata*, is lacking. Aedeagus broad and moderately long, spiculate apically as usual. Vesica armed with a large, semicylindrical piece of chitin and two subapical pointed spines or cornuti, which ally it with *gelidata* and differentiate it from *innolata*. One of these spines (that on the right side) is much shorter than the other. A finely spiculate band partially covers the chitinous pieces. In the ventral plate of segment VIII the rod-like portion is long and narrow, the apex being almost pointed. The so-called first brood differs from the typical form in possessing a somewhat broader clasper, the basal half of the inner margin being rather more heavily chitinized and terminating in a slightly raised knob at the mid section where a sharper angle occurs. The apex of the rod-like ventral plate is broader. Other details similar.

FEMALE GENITALIA: Typical. Dorsal plate of segment VIII rectangular, the cephalic margin with feeble median bulge; caudal corners rounded, the margin spiculate as usual, with slight indication of a central clear space. Anterior apophyses fairly long, caudal spur short and terminating in a narrow plate much as in *gelidata*. Ventral pad of ostium appears to be broader than high with caudal margin emarginate in the median area and the spiculate area of the ventral plate shorter and broader, especially apically, than that of *gelidata*. Membranous portion of ductus bursae very short. Chitinous collar narrow, directed slightly to the left. Bursa pear shaped, the proximal section lightly chitinized, strigate, gradually expanding and extending down the right side farther than on the left one; a slight shoulder to the left of the collar. The ductus seminalis arises on the

dorsal side as a broad membranous tube from the end of a slight ridge running down from the collar close to the right side of the chitinized portion of the bursa; it juts out to the right, turns ventrad and somewhat caudad and then narrows to a thread-like tube; its position is much nearer to the right side than was the case with *gelidata*, and considerably more centrally situated than in *innotata*. The fundus half of the bursa is globular and covered with fine spines, sending a spur of rather long spines up the left side nearly to the shoulder with a scattered spine or two occurring at times near the base of the ductus seminalis. The ventral side is symmetrically spined with the dorsal side, except that the spines extend scarcely as far proximad.

First brood. Scarcely differing from the typical form. The cephalic edge of the dorsal plate is straight. The bursa shows little trace of a shoulder, and the band of spines running up the left side ventrally appears to be broader than on the dorsal side with an irregular patch of rather long spines jutting inward towards the middle of the bursa. Such difference may be more apparent that real and owing possibly to the varying degree of inflation of the bursa.

TYPES: *Multistrigata*, holotype, female, Glenwood Springs, Colorado, August, 1892 (Rutgers University, New Brunswick, New Jersey); *spaldingi*, holotype, male, Stockton, Utah (U.S.N.M., ex collections Taylor and Barnes).

DISTRIBUTION: Great Basin area extending from south central British Columbia into western Colorado, Utah, and southern California (San Bernardino Mountains).

LIFE HISTORY: Unknown. The close European ally, *innotata*, is known to feed on *Artemesia*. As there is plenty of sage brush (*Artemesia tridentata*) in the areas where *multistrigata* occurs it would be interesting to hunt for the larvae on this plant.

***Eupithecia perfusca perfusca* Hulst**

Plate 29, figures 24, 25

Tephroclystis perfusca HULST, 1898, Canadian Ent., vol. 30, p. 116. PEARSALL, 1910, Canadian Ent., vol. 42, p. 314 (type restriction).

Eupithecia perfusca, TAYLOR, 1908, Canadian Ent., vol. 40, p. 58 (*partim*). BARNES AND McDUNNOUGH, 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2,

p. 145. McDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 69; 1941, *ibid.*, vol. 73, p. 189.

Eupithecia alberta, PEARSALL (*nec* Taylor), 1910, Proc. Ent. Soc. Washington, vol. 12, p. 140.

The identity of *perfusca* is a matter of some doubt. The name was based on material from Easton, Washington, and Utah (June) and was later restricted by both Taylor and Pearsall to the Utah type, No. 3919 in the United States National Museum, which was present at least up to 1918 in this institution and was examined by Pearsall, Cassino, and the author at various times. Unfortunately in more recent years this type has been lost or misplaced, and it has been impossible to study the genitalia, the only sure way of definitely fixing the specific name. Pearsall (1910) claims to have matched the type with nine specimens taken at Provo, Utah, by Tom Spalding and states that "the wings are large and thin, with very indefinite markings, powdered with dusky atoms." Of these specimens only one female is present under the name *perfusca* in the American Museum collection; this is dated "Provo, Utah, July 16, 1909, Tom Spalding," and is in none too good condition. A slide of the genitalia has been made and these certainly agree with similar slides made from British Columbia material (*kootenaiata*), Alberta specimens (*alberta*), and others from the east (*youngata*). They also agree with a few Provo, Utah, specimens in the Canadian National Collection and with a small series of much fresher and better preserved material collected by V. Nabokov at Alta, Utah, in July and August of 1943, a locality probably close to the type locality of Hulst's original specimen. It has been decided to consider this material as correctly typifying *perfusca* and should it be ever definitely established that Hulst's type is permanently lost it would be well to name as a neotype one of these female specimens.

Based on the above material *perfusca* presents a dull, smoky gray type of wing coloration with generally rather obscure maculation of primaries, which, when evident, is of the same rather more upright type found in Canadian specimens; a small black discal streak is present and a darker subterminal area forms a smoky band across the wing, being outlined outwardly by the pale irregular s.t. line which, as in all members of the

group, tends to show a definite V-shaped inward angle above the tornus. The secondaries appear occasionally to be unicolorous smoky gray but generally are paler, dirty gray over the basal two-thirds with a darker terminal band, defined inwardly by a dentate dark line; there is considerable dark shading also above the inner margin, representing the beginning of dark cross lines; the discal dot is minute. The palpi, as usual, are short and bushy; the ciliations of the male antennae short, fairly evenly distributed but rather sparse; the front is very slightly bulging. The gray thorax shows a broad darker band across the anterior portion, and the lateral tufts of the mesothoracic scutellum are distinct. The abdomen shows considerable brownish suffusion over a gray ground color, this latter being most evident on the basal segment and along a middorsal line; there is no definite dark band across segment II, although at times there is a slight appearance of such, owing to paler shading on the adjoining segments.

MALE GENITALIA: Extremely close to those of *multistrigata*. The clasper is somewhat broader, especially apically, and shows no trace of an angle at the midsection of the ventral margin, being evenly rounded with slight crenulated edge. The aedeagus is possibly slightly thinner. In the armature of the vesica the cornutus of the left side is much as in *multistrigata*, but the other one is reduced to a mere small tooth; the large chitinous piece and the spiculate band are as in *multistrigata*, also the ventral plate of segment VIII.

FEMALE GENITALIA: Also very similar to those of *multistrigata*. The anterior apophyses seem somewhat shorter and thicker; the ostium pad generally shows a dark transverse line near its cephalic margin, which, when present, seems characteristic. The exit of the ductus seminalis from the dorsal side of the bursa appears to be narrower and more centrally placed at the end of a strong ridge running down from the collar; in consequence a chitinous band on the right side of the proximal half of the bursa is more obvious and is practically free of striations. The spinning of the ventral side of the bursa spreads more to the right and reaches farther towards the collar than is normally the case with *multi-*

strigata. These differences are, however, very slight and must be further checked to establish their constancy. The apparent differences in the figures are due to the different degrees of inflation of the bursae. In strongly inflated specimens the ductus exit appears more proximal and the ridge is less evident (e.g., illustration of *kootenaiata*); other figures represent the more general type of inflation.

TYPE: Holotype, female, Utah, June (? lost; should be in U.S.N.M.).

DISTRIBUTION: Mountain region of Utah, apparently extending southward into New Mexico (Taos) and possibly the White Mountain region of Arizona. A very few similar specimens from southeastern California have also been examined, and Pearsall records the species doubtfully as *albertaina* from Poland, Arizona, and Yellowstone Park, Wyoming. It would appear to occur in a single generation from late June to early August.

LIFE HISTORY: Unknown.

***Eupithecia perfusca kootenaiata* Dyar**

Plate 29, figure 26; text figure 11D

Tephroclystis cootenaiata DYAR, 1904, Proc. U. S. Natl. Mus., vol. 27, p. 890.

Eupithecia cootenaiata, PEARSALL, 1910, Proc. Ent. Soc. Washington, vol. 12, p. 140.

Eupithecia kootenaiata, BARNES AND MCDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 275 (cotype, ♀). MCDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 66.

Eupithecia slocanata TAYLOR, 1908, Canadian Ent., vol. 40, p. 59 (*partim*). MCDUNNOUGH, 1927, Canadian Ent., vol. 59, p. 243; 1929, *ibid.*, vol. 61, p. 66.

Scarcely separable from the nymotypical form, but the name has been retained in a racial sense on account of the wide distance between the type localities. Dyar's description of the species from Kaslo, British Columbia, calls for "Wings nearly uniform gray, the lines nearly obsolete, pale; discal spots large, black." This is evidently the obscurely marked form similar to the cotype of *slocanata* already relegated to the synonymy of *albertaina* (1927). Along with such more or less immaculate gray specimens, others are found in the topotypical series of the Canadian National Collection in which the ground color is somewhat deeper and the cross lines are better defined, such specimens being vir-

tually indistinguishable from *alberta*. There is nothing definite in the genitalia to separate *kootenaiata* from *perfusca*, but there seems to be a certain tendency towards a slight enlargement of the small cornutus of the vesica and also to a broadening of the clasper, approaching in this respect that of eastern forms.

Dyar's spelling of the name with a "c," owing to his refusal to accept the use of the letter "k" in Latin terms, has been changed to conform with the recognized spelling of the district on which the name was based.

TYPES: *Kootenaiata*, holotype, male, Kaslo, British Columbia, June (U.S.N.M.); allotype, female, same locality, July 17 (U.S.N.M., *ex* Taylor and Barnes collections).

DISTRIBUTION: Fairly general in the south central region of British Columbia (Kaslo, Seton Lake, Keremeos, Likely, 100 Mile House) in June and July.

LIFE HISTORY: Unknown.

***Eupithecia perfusca alberta* Taylor**

Plate 29, figure 27

Eupithecia alberta TAYLOR, 1906, Canadian Ent., vol. 38, p. 103. BARNES AND McDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 272. McDUNNOUGH, 1927, Canadian Ent., vol. 59, p. 243; 1929, *ibid.*, vol. 61, p. 66.

A very doubtful race, occurring along the eastern slopes of the Alberta Rockies and hardly to be separated from the better-marked forms of *kootenaiata*. In the male genitalia the small cornutus of the vesica has entirely disappeared in those specimens examined, agreeing in this respect with eastern specimens. There seems to be a considerable tendency in the primaries towards elongation, a feature noted by Taylor in his original description.

TYPE: Holotype, male, Calgary, Alberta (U.S.N.M., *ex* collections Taylor and Barnes).

DISTRIBUTION: Rocky Mountain region of Alberta (Banff, Calgary, Nordegg, Edmonton), occurring in June and July.

LIFE HISTORY: Unknown.

***Eupithecia perfusca youngata* Taylor**

Plate 29, figures 28, 29; text figure 11E

Eupithecia youngata TAYLOR, 1906, Ottawa Nat., vol. 19, p. 226; 1906, Canadian Ent., vol. 38, p. 404. BARNES AND McDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 272. McDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 66.

Eupithecia winnata TAYLOR, 1910, Canadian Ent., vol. 42, p. 77. BARNES AND McDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 271. McDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 66.

Eupithecia innotata FORBES (*nec* Hufnagel), 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 171.

At one time there was some doubt in the author's mind as to whether the holotype female from Ottawa, Ontario, now reduced to three wings pasted on cardboard, was conspecific with the two cotypes from the Catskill Mountains, New York, received from R. F. Pearsall. However, in the American Museum collection there is a good series of Catskill specimens from which undoubtedly Taylor's specimens were taken, the dates coinciding. One of these females agrees excellently with a good photograph of the Ottawa holotype, leaving no doubt that all three type specimens were conspecific. A genitalic examination of specimens from Montreal, Quebec (the type locality for *winnata*), and surrounding region, including Ottawa, shows no differences between such specimens and the Catskill one, as was already stated in 1929.

Youngata is the best defined of any of the races, the color of the wings being a rather bright brown with little of the gray shades found in western specimens. It is rather smaller in size with chunkier primaries; from *satyrata*, with which it could be confused it may be separated by the shorter palpi, the lateral tufting on the mesothoracic scutellum, and the V-shaped whitish mark above the tornus which is generally present. The maculation is rather clear, and there is considerable tendency for the median area of primaries to show a somewhat darker shading than the balance of the wing.

The male genitalia are slightly stouter than those of western forms, the clasper being broader, and the second cornutus of the vesica being entirely eliminated; the remaining one is frequently considerably broader than normally occurs in *perfusca*. The female genitalia show no tangible differences, the figure given being those of a moderately well-inflated specimen. It might be mentioned in conclusion that a male and two females in the Canadian National Collection from Hopedale, Labrador, August 9-10, 1935, have been examined genitally.

These represent the most northerly point in the distributional range of the species in the east. The specimens are rather rubbed but appear to be quite unicolorous dark in coloration and approach closer to *alberta* and *kootenaiata* than to *youngata*, a feature borne out by the male genitalia which show the reduced second spine of the vesica. It is not unusual to find Labrador specimens more closely linked up with Rocky Mountain material than with more southerly eastern forms.

TYPES: *Youngata*, holotype, female, Ottawa, Ontario (U.S.N.M., *ex* collections Taylor and Barnes; reduced to a single primary and both secondary wings pasted on cardboard); *winnata*, holotype, female, Montreal, Quebec (U.S.N.M., *ex* collections Taylor and Barnes).

DISTRIBUTION: Widespread throughout Ontario, Quebec, and the Maritime Provinces of Canada, extending southward through the New England states into New York and Pennsylvania. Flight occurs in June and July.

LIFE HISTORY: Unknown.

Eupithecia hanhami Taylor

Plate 29, figure 30; text figure 11F

Eupithecia hanhami TAYLOR, 1906, Canadian Ent., vol. 38, p. 391. BARNES AND MCDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 273. MCDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 67.

In all probability *hanhami* will prove to be a rather distinct pale form or race of *perfusca*. Owing, however, to the scarcity of material

and the quite characteristic general appearance of the insect it is treated as a species until such time as something is known of its life history. The vestiture of the front and thorax is creamy white with small dark spots anterior to the antennae and a dark band crossing the anterior portion of the thorax. The lateral tufting of the pale mesoscutellum is brown, and there is heavy brown shading on the abdomen with pale suffusion on segments I and III. The general ground color of the primaries is creamy white with a broad, brown, terminal border through which the pale s.t. line runs. There are a number of dark patches along the costa, and the discal spot is very large and black. The cross lines are fairly well defined on the pale background, and there are numerous dark streaks on the veins. The secondaries are pale with rather weak smoky terminal shading, a dentate subterminal line, and a very small discal dot. The fringes are rather strongly checkered. Structural features, including genitalia, are similar to those of *kootenaiata*. The species bears a certain superficial resemblance to *harveyata* from the same region but of course is at once separable on palpal length.

TYPES: Holotype, male, allotype, female, Victoria, British Columbia, June (U.S.N.M., *ex* collection Taylor and Barnes).

DISTRIBUTION: Known only from Vancouver Island (Victoria, Ucluelet). All specimens examined were captured in June except a single female from Victoria which is labeled "August, 1923, W. Downes."

LIFE HISTORY: Unknown.

THE *FILMATA* GROUP

The group is a very compact one, consisting of a few early spring species very closely related to one another in general appearance, type of male antennal ciliation, and genitalia. The broader relationship to other *Eupithecia* groups remains obscure, as there is little in the genitalia of either sex that would serve as a link to other species, and in consequence the present placement is merely for the sake of convenience.

In general it may be said that the wings of the species comprising the group are broad, rather delicate, and thinly scaled with fringes longer than usual. The male antennae are distinctly bifasciculate, the length of the

ciliations varying in the individual species. A useful character in an initial separation of the species into two groups is found in the male ventral plate of segment VIII. In the one case, comprising three species, the fissure between the two terminal forks is deep, descending more than half the length of the plate. In the second case this fissure is quite short and consists of a broad, apical notch; two species are listed in this section although it is quite possible that they may be merely racial forms of a single species. Other characters of the male genitalia are practically identical in all five species. The females are variable in size, being frequently consider-

ably smaller than the males. In many instances (especially when worn) they are very difficult to distinguish from one another owing to the general similarity of maculation and to the fact that in the Pacific area, from which most of the species were described, they all fly together. Another stumbling block lies in the very small nature of the bursae and the difficulty of securing the same degree of inflation in the genitalic preparations. As the specific distinctions appear to lie in the extent of the spining on the surface of the bursae it can readily be seen that poorly inflated bursae can assume a quite different aspect from fully inflated ones when it comes to delimiting the spined areas. In consequence of these difficulties, it is felt that the present treatment of the group is not altogether satisfactory and certainly not final. Fortunately a large proportion of the types are in the American Museum collection, and the genitalic figures in both sexes have been based on this type material. They can therefore be relied upon as representative of the specific name under which they are listed, but the correct interrelationships between the various names involved is a matter that can be worked out only at a future date when more is known of the early stages and larval food plants.

Turning to the primary subdivision of the group, the three species that show a deep fissure of the male ventral plate are *filmata* Pearsall, *annulata* Hulst (*limnata* Pearsall), and *usurpata* Pearsall. *Filmata*, the smallest species in the group, is the only one described from eastern North America; it is also the only species whose life history has been worked out. *Annulata* Hulst, based on a worn female now without abdomen, from a doubtful locality but "probably from California," has been regarded as having priority over *limnata* Pearsall, described from Vancouver Island material. The difficulty of accurately identifying such a type specimen is obvious, but for the present, at least, this synonymy is doubtfully accepted. *Orfordata* Cassino was based on a possibly mixed series from Port Orford in southern Oregon, consisting mostly of very poor specimens. The genitalia of the holotype male, of which a slide made by Cassino has been examined, do not differ from those of *annulata* (*limnata*),

and the name is treated as a synonym, although it may later be available in a racial sense. *Usurpata*, described at the same time as *limnata* and from material taken with the type series of this species, is of doubtful status. It was separated primarily on the much shorter ciliations of the male antennae and on a more suffused maculation of the primaries. These differences are borne out by the types and by the few further specimens it has been possible to examine. In the male genitalia, however, no specific differences have been discovered. It has been impossible so far definitely to associate the female sex. Pearsall's allotype, labeled simply with one of Hulst's "Cal." labels, is without abdomen, and while it agrees quite well in size and coloration with the male holotype there is no guarantee that the two are conspecific, taking into consideration the wide distance between the localities involved and the fact that as yet no males of *usurpata* have been recorded from California.

The two so-called species falling into the second group, with short fissure between the prongs of the male ventral plate, are *olivacea* Taylor and *cognizata* Pearsall. There seems no doubt that *olivacea*, based on Vancouver Island material, is a distinct species from the three already mentioned, but its relationship to *cognizata* is problematic as, apart from size and depth of coloration, there is nothing tangible to indicate specific distinctness. Typical *olivacea* is a large species of a decided olive brown coloration of the primaries and a very obscure maculation. *Cognizata*, described from a pair of specimens from southern California, is much smaller, deeper brown in color, with the maculation somewhat better defined. As far as can be told from a poor slide of the holotype made by Cassino there are no obvious male genitalic differences. For the present, until more topotypical material is available and until a knowledge of the life history can be obtained, there is no harm in considering *cognizata* as a good species.

***Eupithecia filmata* Pearsall**

Plate 30, figures 1, 2; text figure 11G

Eupithecia filmata PEARSALL, 1908, Ent. News, vol. 19, pp. 129, 195. McDUNNOUGH, 1929, Ca-

nadian Ent., vol. 61, p. 68; 1942, *ibid.*, vol. 74, p. 202 (biology). McGUFFIN, 1945, Canadian Ent., vol. 77, p. 54. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 172.

Filmata is one of the earliest spring species in eastern North America and can be distinguished from other early species not belonging to this group by the thin texture of the wings and the strong ciliations of the male antennae. Its normal time of flight is late April and early May, but seasonal variation in temperature may result in considerable alteration in the time of appearance.

Pearsall's type series in the American Museum collection consists of rather small specimens, averaging about 17–18 mm. wing expanse, of a light smoky gray coloration with rather obscure maculation. A bred series from the Ottawa region in the Canadian National Collection averages somewhat larger (20 mm.), and the color is deeper with more brownish tinges, the distinctness of the maculation being quite variable. Where the maculation is well defined the median and terminal areas are deeper in color than the balance of the wing, the former especially on its inner and outer edges; in consequence the paler subterminal area appears as a light band across the wing. The pale s.t. line is usually fairly distinct, rather irregular without being noticeably dentate, and mostly terminating in a small white spot above tornus. The discal streak is distinct and slightly elongate. The porrect palpi project considerably beyond the flat front, being somewhat longer in the female sex. The male antennae are distinctly bifasciculate, the ciliae forming the individual fascicles being sparse but quite long, although not so long as in *annulata* (*limnata*). The head, especially the vertex, is largely pale dull ochreous, but at times a certain amount of smoky sprinkling may occur which tends to form a slight band anterior to the antennae. The extreme posterior edge of the mesothoracic scutellum is white, and segment I of the abdomen is largely pale scaled. The balance of the abdominal segments are brown, the slightly deeper color of segment II giving the appearance of a weak, dark, transverse band. There is little trace of broken black lateral bands as in *annulata*.

There should be no trouble in distinguish-

ing eastern *filmata* from typical Vancouver Island *annulata* (*limnata*) which is fully twice the size, much more contrastingly marked, and with distinctly longer ciliations in the male antennae. Unfortunately, as *filmata* ranges westward through Canada it appears to become larger, paler in color with consequent more distinct maculation, and thus assumes the general appearance of a small *annulata*. On the other hand *annulata*, which occurs rarely in the east, becomes smaller and the ciliations of the male antennae (as far as can be judged from very limited material) average slightly shorter than those of topotypical specimens and have much the same length as those of *filmata* males. The paler coloration of the eastern *annulata* specimens partially helps to distinguish them from the darker-colored, bred specimens from the Ottawa area, but from the lighter-colored *filmata* specimens they are very difficult to separate on characters of maculation as this is virtually the same in both species. A single character might be mentioned that seems to hold fairly well and this is found in the course of the t.p. line below the costa. In *filmata* this line is rather evenly bulging or outwardly oblique between the costa and vein 6. In *annulata* there is a strong tendency to form a small but distinct inward angle on vein 7, this being quite apparent in well-marked specimens but tending to become obliterated in the more suffused ones. In the male genitalia differentiating characters are very slight, the only possible one that might be of value consisting in the somewhat greater width of the long, pointed piece of chitin in the vesica of *filmata* as compared to that of *annulata*. In the female *filmata* a better and apparently constant character is found in the spining of the bursa which, on the dorsal side, after half encircling the ductus seminalis, extends broadly to the fundus, whereas in *annulata* the dorsal spining is much more restricted and ends considerably above the fundus area. This character, as illustrated in the figures, has been largely used in the present study as the definite means of separation, based as it is on type material.

From the northern Atlantic and New England states through the eastern Canadian provinces *filmata* extends its range westward,

presumably through the spruce belt. There are no intermediate records, but there is a good series of females in the Canadian National Collection from Edmonton, Alberta. These were formerly listed as *limnata* (vide McDunnough, 1929), but the female genital characters place them as *filmata*. They are paler and more strongly marked than most eastern specimens. Unfortunately only a single male from this area is available, and this might easily be taken for a small *annulata*. Single females from Banff and Jasper Park, Alberta, the latter bred from *Picea*, are also in the collection, and a pair from Salmon Arm, British Columbia, with a single female from Barriere (bred from *Picea*) complete the western Canadian records. No occurrence of the species in the western United States has been noted.

MALE GENITALIA: Hair pencils of segment IX well developed. Tegumen rather narrowly conical. Uncus strong, bifid. Vinculum broad with well-rounded and centrally thickened cephalic margin. Clasper rather narrow, somewhat tapered apically. Aedeagus broad and rather long. Vesica armed with a short, truncate, apical piece of chitin and a long, apically pointed, semi-cylindrical piece which occupies two-thirds of the aedeagus and broadens towards base, showing in this area a number of semicircular striations; the small end piece is quite obscure. Ventral plate with the broad basal area showing a deeper excavation than usual on the cephalic margin; the apical half consists of two parallel rods, separated by a deep fissure and terminating in two sharp, curved spines.

FEMALE GENITALIA: Dorsal plate of segment VIII thinly chitinized, rectangular, slightly higher than broad; anterior apophyses thin and rather long, the caudal spur well developed and ending in a slight chitinous enlargement on the lateral edge of the membranous ventral plate. Ostium membranous. Ductus bursae very short, membranous, terminating in a broader collar which is hardly chitinized. Bursa very small; when fully inflated (a condition seldom met with) probably globular or oval; in most instances the membranous portion appears to thicken and form a hard mass which bulges outwardly above the fundus area. Ductus seminalis en-

tirely dorsal, consisting of a narrow tube arising proximally from a membranous area and projecting to the right before narrowing. This area is surrounded by a horseshoe-shaped patch of fine spines, which in the present species are broadly continued to the fundus, a distinguishing characteristic. The ventral surface is membranous with a fairly broad band of fine spines reaching from below the collar to just above the fundus and unconnected with the dorsal spining.

TYPES: Holotype, male, and allotype, female, Big Indian Valley, Catskill Mountains, New York, April (A.M.N.H.).

DISTRIBUTION: Eastern United States and Canada, extending westward to Alberta and British Columbia through the so-called spruce belt.

LIFE HISTORY: The larva is known to feed on spruce, balsam, and hemlock.

REMARKS: The illustrations of the genitalia are based on slides from the holotype and allotype and a female specimen from Montreal, Quebec.

Eupithecia annulata Hulst

Plate 30, figures 3-5; text figure 11H

Tephroclystis annulata HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 267.

Eupithecia annulata, BARNES AND McDUNNOUGH, 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 145, pl. 22, fig. 9. McDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 68. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 172.

Eupithecia lachrymosa, TAYLOR (nec Hulst), 1906, Canadian Ent., vol. 38, p. 389. PEARSALL, 1908, Ent. News, vol. 19, p. 130; 1909, Proc. Ent. Soc. Washington, vol. 11, p. 127.

Eupithecia limnata PEARSALL, 1909, Proc. Ent. Soc. Washington, vol. 11, p. 126; 1910, *ibid.*, vol. 12, p. 140. McDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 68.

Eupithecia orfordata CASSINO, 1927, Lepidopterist, vol. 4, p. 64. McDUNNOUGH, 1945, Canadian Ent., vol. 77, p. 64.

As has already been stated in the introduction to the group the definite identity of *annulata* is rather uncertain due to the fact that the type female is a poor specimen without abdomen and lacking definite locality data, these being given merely as "probably California." This specimen is smaller and darker in color than such females of *limnata*

as have been available for examination, and nothing could be definitely matched with it. For the present the reference of *limnata* as a synonym (1918) is being followed, although it is quite possible that *annulata* should be associated with *cognizata* rather than left in its present placement. As regards *orfordata* it has been included in the synonymy on the strength of the genitalia of the male holotype. Three paratypes (two males, one female) in the Canadian National Collection, in very poor condition, substantiate this reference. While the color of the *orfordata* type is deeper than that of the *limnata* types, it has been considered advisable not to list it as a race until more and better topotypical material is available for study. Some Vancouver Island specimens in the series under examination appear to be fully as dark. A small series from Napa County, California, definitely belongs here and, should *orfordata* be raised to subspecific rank, could be placed under this heading.

As can be noted from the figure in the "Contributions" the topotypical species is much larger and better marked than *filmata*, the palpi are considerably longer, and the ciliations of the bifasciculate male antennae are distinctly greater in length but still sparse, consisting of about five or six ciliae of diminishing lengths to a fascicle. The front and vertex are usually light ochreous, as in *filmata*, but at times are darkened by a sprinkling of smoky scales. The abdomen shows frequently more contrast in coloration than is found in *filmata*, the middle segments being shaded with light brown and whitish. A black lateral line, scarcely indicated in *filmata*, is generally quite prominent.

The range of the species through Canada is probably very similar to that of *filmata*, and the difficulties in connection with the separation of the two have already been discussed under the latter heading. Specimens in the Canadian National Collection from the interior of British Columbia seem smaller and duller in coloration than the typical contrastingly marked coastal form; they include a male and two females from Salmon Arm and single worn females from Kamloops and Kaslo. There are further three specimens (two males, one female) bred by the Forest Insect Survey from *Pseudotsuga taxifolia* at Co-

wichan Lake, Goldbridge, and Penticton. These are quite dark in color, and rather smaller in size, possibly owing to breeding, and are the first and only western records of the larval food plant. Records from farther east include a pair from Calgary, Alberta, fairly typical as to color but smaller in size; also single males from Shelter Bay, Quebec (bred from white spruce), and Cape Breton, Nova Scotia, with a female from Fredericton, New Brunswick. The only eastern records from the United States are two females from Mount Desert and Enfield, Maine.

In the male genitalia scarcely any appreciable difference from those of *filmata* can be noticed, apart from a slight reduction in the size of the two chitinous pieces of the vesica. The depth of the fissure between the two terminal rods of the ventral plate is similar in both species. In the female the bursa is small and globular, the main difference from *filmata* consisting in the fact that the dorsal spining is less extended, forming a similar horseshoe patch around the base of the ductus seminalis but gradually tapering to a point and ending considerably caudad of the fundus. On the ventral side the broad median band of spines extends caudad from the fundus to a point somewhat below the collar and about on a level with the exit of the ductus seminalis.

TYPES: *Annulata*, holotype, female, "probably California" (Rutgers University, New Brunswick, New Jersey); *limnata*, holotype, male, allotype, female, Victoria, British Columbia (A.M.N.H.); *orfordata*, holotype, male, Port Orford, Oregon (M.C.Z.).

DISTRIBUTION: British Columbia south to central California, extending eastward in Canada through Alberta to Quebec and the Maritime Provinces and northern Maine.

LIFE HISTORY: Larval food plants have been recorded as *Pseudotsuga taxifolia* and *Picea canadensis*.

REMARKS: The genitalic drawings in both sexes are based largely on type material of *limnata*.

***Eupithecia usurpata* Pearsall**

Plate 30, figure 6

Eupithecia usurpata PEARSALL, 1909, Proc. Ent. Soc. Washington, vol. 11, p. 127; 1910, *ibid.*, vol. 12, p. 140. MCDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 68.

Tephroclystis nimbose HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 269 (*partim*).

Eupithecia nimbose, PEARSALL, 1909, Proc. Ent. Soc. Washington, vol. 11, p. 128 (*partim*).

With *filmata* and *annulata* this species shows the same type of deep fissure between the terminal rods of the male ventral plate and cannot on other genitalic characters be distinguished from the latter species. It was primarily separated by Pearsall from his *limnata* on the strength of the shorter pectinations of the male antennae combined with a deeper color of the primaries and a general indistinctness of maculation, entailing a reduction in size of the discal dots. To this might be added the fact that the palpi appear somewhat shorter. There is, in consequence, more similarity to *olivacea* Taylor than to *limnata*, but in the males, at least, the much shorter depth of the fissure in the ventral plate of *olivacea* proves a good means of separation. In the few males examined, consisting merely of the type specimens and one other topotypical male in the Canadian National Collection, the above characters appear to hold fairly satisfactorily, but so far it has not been possible to associate any females definitely with such males. Pearsall's allotype from "California" is without abdomen and, as already noted in the introduction to the group, cannot be definitely considered to be conspecific with the holotype; it might readily belong to the *olivacea* complex. The same may be said for the so-called female *usurpata* in the Canadian National Collection (*vide* McDunnough, 1929), although this has the advantage of having been taken at the same time and place as the undoubted male and certainly looks very similar superficially. In the genitalia there is nothing tangible to separate it from female *olivacea*, and it could easily be that the specimen is merely a small faded example of this species. The fact that *annulata*, *usurpata*, and *olivacea* all fly at the same time and in the same locality is not calculated to help in determining correct sex associations. Until something is known, therefore, of the early stages of *usurpata* its status is doubtful, but for the present no harm can be done in listing it as a good species. It might be noted that one of the male paratypes of *limnata* in the American Museum collection belongs

here on antennal characters, and it is added proof of the great similarity between the two species when such a close observer as Pearsall could err in placement.

TYPES: Holotype, male, and paratype, male, Victoria, British Columbia, April (A.M.N.H.); allotype, female, California (*?hujus spec.*) (U.S.N.M.).

DISTRIBUTION: Definitely known only from Vancouver Island, British Columbia, but will probably have a range on the Pacific coast similar to that of the preceding species.

LIFE HISTORY: Unknown.

Eupithecia olivacea Taylor

Plate 30, figure 7; text figure 111

Eupithecia olivacea TAYLOR, 1906, Canadian Ent., vol. 38, p. 389. PEARSALL, 1910, Proc. Ent. Soc. Washington, vol. 12, p. 140. BARNES AND MCDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 272; MCDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 69.

The type specimens of *olivacea* were collected on Vancouver Island, and the species flies with *annulata* in the early spring. While similar in size, *olivacea*, as the name implies, may be distinguished by the decidedly uniform, olive brown coloration of the primaries, especially noticeable in fresh specimens. The maculation is quite obscure apart from a black discal spot or streak (generally smaller than in *annulata*) and a dentate, white, s.t. line, passing through the deeper shaded terminal area. There is frequently a small, light brownish, costal patch subterminally beyond the t.p. line, and similarly colored dots mark the termination of the veins on the outer margin. The palpi are somewhat shorter than in *annulata*, those of the female, as in this species, being longer than the male ones. There is little difference in the ciliations of the male antennae; they are possibly a shade shorter than those of *annulata*. The vertex of the head is generally dark scaled with a light posterior margin, a character emphasized by Pearsall as contrasting with the light ochreous vertex of *annulata* (*limnata*). This usually holds, but specimens occur at times that show little dark scaling in this area. The abdomen usually appears fairly uniformly smoky brown, but fresh specimens show pale and light brownish scaling in the mid section. There are mere

traces of the black lateral bands of *annulata* in the shape of small dark dots, and the dorsal tufting is fairly evident and black.

A fair-sized series of topotypical specimens has been examined in the Canadian National Collection which also contains a couple of males from Salmon Arm in the interior of British Columbia. In the same collection is a small series from McMinnville, Oregon; the specimens, while slightly smaller, obviously belong under *olivacea*. No records of the species occur from farther east.

With the following species, which may really prove to be merely a racial form of *olivacea*, the ventral plate in the male sex shows a very much shorter fissure between the terminal forks than is found in *annulata* and its allies. In other respects the genitalic differences are extremely slight. In the female genitalia the bursa, as far as can be judged, appears to be somewhat smaller and less globular than in *annulata*, the shape being narrowly oval. The dorsal spining is less extended towards the fundus, being confined to a horseshoe-shaped patch surrounding the exit of the ductus seminalis. On the other hand the ventral spining appears to be expanded, covering the larger portion of this surface, especially in the region of the fundus. It has also been noted that the width of the ovipositor lobes is noticeably broader in the present species than in *annulata*, but no great stress is placed on this at present, as it is very difficult to secure uniform preparations, and further checking will be necessary.

TYPES: Holotype, male, and allotype, female, Wellington, British Columbia (U.S.N.M.).

DISTRIBUTION: Vancouver Island and adjacent regions of the mainland of British Columbia; Oregon (McMinnville).

LIFE HISTORY: Unknown.

REMARKS: The figure of the female genitalia is based on a slide made from the allotype a number of years ago and checked with slides of other topotypical specimens.

***Eupithecia cognizata* Pearsall**

Plate 30, figures 8-10; text figure 11J

Eupithecia cognizata PEARSALL, 1910, Ent. News, vol. 21, p. 404.

Eupithecia nimbose BARNES AND MCDUN-

NOUGH, 1912, Contributions to the natural history of the Lepidoptera of North America, vol. 1, no. 4, p. 31, pl. 14, fig. 4 (spurious type).

This name is based on male and female specimens (not two males as stated in the description) from Witch Creek, San Diego County, California. A slide of the male genitalia has been rather mutilated by Cassino in the course of preparation but has been remounted. From a slide of the female genitalia, the present illustration has been drawn, the scale being somewhat larger than in the drawing of *olivacea*. While there appears to be nothing in the genitalic characters that can be definitely used to separate *cognizata* from *olivacea* it seems advisable, until more topotypical material is available for study, to treat the two names as applying to distinct species. The type specimens are much smaller, browner in color (Pearsall's "golden brown"), and more distinctly marked than Vancouver Island specimens of *olivacea*. However, similarly sized specimens in both the Canadian National Collection and the American Museum of Natural History, collected by W. Bauer in Napa and Sonoma counties, while showing the same deep brown coloration, possess the obscure maculation of *olivacea* and could as well be placed under this name as under *cognizata*, serving, as they seem to do, as a link between the extreme northern and southern forms. The spurious type of *nimbosa* Hulst, figured by Barnes and McDunnough in 1912 as a male but which is actually a female, matches well with males in the Canadian National Collection from Oakland, California, and also with a female in the Museum collection with Hulst's "Cal." label and the addition of "Monterey County" in Grossbeck's writing. All these specimens are very similar to those mentioned above from Napa and Sonoma counties and would seem to indicate that the small size, as compared with topotypical *olivacea*, is a natural feature in the San Francisco Bay area and farther south. As already indicated a knowledge of the early stages is essential before an adequate idea of the relationship between *cognizata* and *olivacea* can be formed.

TYPES: Holotype, male, and allotype, female, Witch Creek, San Diego County, California, February (A.M.N.H.).

DISTRIBUTION: Southern California, pos-

sibly extending northward into central portions of the state.

LIFE HISTORY: Unknown.

The conclusion of the *filmata* group leaves us with a large number of species, mostly of western and southwestern origin, that cannot apparently be arranged in any compact groups either among themselves or in connection with groups that have already been discussed. Individual species, it is true, often show close relationships to one or two other species, and these, in such cases, have been placed together in the arrangement. Thus we have *zelmira* and *vitreolata*; *segregata* and *pinata*; a few species centering around *niveifascia* in which a reduction of the upper spurs of the hind tibiae might indicate doubtful relationship; the *albicapitata-mutata* complex allied to the European *togata*; *adequata* and *acutipennis* in which the type of maculation is very similar; *gilata* and *plumasata* which may be merely races of a single species; and finally a few species in which a double areole is present in the forewing venation (including *anticaria* and *graefii*) but which are probably not all closely related on this account. The extraordinary diversity of the genitalia, both male and female, make it practically impossible to pick out any one character in these organs that could be considered as indicating group relationship. It might be noted that in the females a distinct, chitinous ostium pouch is present in the majority of the species, but it is quite uncertain whether this has any real value as a group character or not. In the males the ventral plate of the eighth segment generally terminates in two prongs of varying length, but again the character is a doubtful one. The great dissimilarities found in the shapes of the claspers, the form and armature of the aedeagus, and the simple or bifid nature of the uncus can apparently be used only in a very restricted sense to co-relate very closely allied species. The present arrangement, therefore, is more or less arbitrary and will quite likely be subject to considerable change when more is known of the early stages of the various species. The associations of individual species are discussed under the specific heading and need not be considered here.

***Eupithecia lachrymosa* Hulst**

Plate 30, figures 11, 12

Tephroclystis lachrymosa HULST, 1900, Canadian Ent., vol. 32, p. 103.

Eupithecia lachrymosa, PEARSALL, 1909, Proc. Ent. Soc. Washington, vol. 11, p. 127.

The type specimen with label "Marion County, Oregon," is without abdomen. Formerly the name was applied by Taylor and Pearsall to a species in the *filmata* group, but according to Pearsall's later statement the type in the Hulst collection is a male with simple ciliate antennae and cannot, in consequence, belong there.

Pearsall's statement is confirmed by a recent examination of the holotype. After a careful study of this specimen the writer fails to separate it from *georgii* McDunnough. As far as can be told from the worn condition, the maculation is similar except that the pale dentate s.t. line is much more prominent than is usually the case with typical British Columbian specimens of *georgii*. However, specimens do occur that show this feature, and a male from Plumas County, California, in the American Museum of Natural History, with the genitalia of *georgii*, is almost an exact counterpart in this respect. In the type, furthermore, faint indications of the characteristic brown shade at the base of vein 2 of *georgii* can apparently be traced. The ciliations of the male antennae are slightly longer than in British Columbian material but can be matched in length by specimens of *georgii* from Cisco, Placer County, California, so it is doubtful if too much stress should be laid on this character.

Georgii shows considerable variation throughout its extended range, and it is possible that the name will be available in a racial sense. However, until material from the type locality of *lachrymosa* (probably in the vicinity of Salem) is available for study, the exact relationship of the two names is rather problematic, especially in view of the fact that no genitalic slide of the type is possible. For this reason there seems no harm done for the present if *georgii* is not definitely sunk as a synonym of *lachrymosa*.

TYPE: Holotype, male, Marion County, Oregon (Rutgers University, New Brunswick, New Jersey).

LIFE HISTORY: Unknown.

***Eupithecia georgii* McDunnough**

Plate 30, figures 13, 14; text figure 12A

Eupithecia perfusca TAYLOR (*nec* Hulst), 1908, Canadian Ent., vol. 40, p. 58. MCDUNNOUGH, 1927, Canadian Ent., vol. 59, p. 243.

Eupithecia georgii MCDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 67, fig. 4a-c.

The proper position of this species is doubtful. Superficially it looks as if it should belong in the *satyrata* group, but the entirely different type of male genitalia rather precludes this association. It is left for the present in about the same position as it is given in the 1938 list, but a knowledge of the life history may lead to a different placement.

The apex of the primaries is well rounded and the outer margin convex. The color of the wings varies from smoky gray to dull brown, this latter color being the usual one in older specimens. The maculation of primaries is in general rather obscure, although the t.p. line is well indicated by a series of short, dark dashes on the veins. At times, too, the pale, crenulate, s.t. line is quite prominent, but this is not always the case. The presence of a brownish shade along the cubitus at the bases of veins 3 and 4 is diagnostic but in worn specimens difficult to observe. The secondaries show a broad, smoky, marginal border, running through which a strongly dentate, pale line can be frequently seen. The palpi are quite short and project only slightly beyond the flat front; the male antennae are shortly ciliate, the ciliae being quite thickly distributed. The base of the abdomen dorsally shows considerable pale scaling followed on segments I and II by dark shades which do not, however, form definite transverse banding; the remaining segments show an admixture of light brown, pale, and smoky scaling with indications of a black lateral line.

MALE GENITALIA: Hair pencils of segment IX strongly developed. Tegumen strongly conical. Uncus rather short, bifid, the sharp upper fork short and scarcely as long as the rounded lower one. Vinculum broad and rounded apically. Clasper very broad in basal half, narrowed considerably apically; on the ventral margin about the middle a strong, broad, apically truncate projection, curving ventrad, may be found; the width and length of this projection appear to vary

somewhat according to locality. Aedeagus moderately broad, very slightly tapered and finely strigate in apical section. Armature of vesica consists merely of a twisted end piece and an obscure chitinous bar, partly semi-cylindrical. The ventral plate of segment VIII consists of two parallel, widely separated rods, narrowly joined at base; the apices of these rods are at times slightly incurved.

FEMALE GENITALIA: Dorsal plate of segment VIII rectangular, chitinized; anterior apophyses rather short, the caudal spurs thickened and ending in chitinous bars at the lateral edges of the membranous ventral plate. Ostium a membranous funnel with broadly open caudal margin; to this is attached, with scarcely any intervening membrane, a well-chitinized collar, directed towards the left. This merges into the chitinous and gradually expanding upper third of the pear-shaped bursa which on the ventral side is limited on its cephalic edge by a broad band of spines extending around the left side to join with a similar and more extended band on the dorsal side which reaches to the base of the ductus seminalis. This ductus originates broadly as a membranous tube in the right cephalic corner of the chitinous area, descending alongside the bursa to the fundus where it curves caudad over the ventral side of the bursa and narrows gradually. The central section of the bursa on the ventral side is membranous, the fundus third being completely covered with long spines which join on the left side with a similarly spined dorsal area; the dorsal spining, however, extends broadly up the left side to join the transverse band of spines already mentioned, leaving a much reduced membranous area below the exit of the ductus seminalis.

TYPES: Holotype, male, Kaslo, British Columbia, June; allotype, female, same date (C.N.C.).

DISTRIBUTION: Very generally distributed in British Columbia and the Pacific coast states, extending eastward into the Rocky Mountain area (Utah, southwestern Colorado).

LIFE HISTORY: Unknown.

REMARKS: The genitalic figures are based on topotypical material in the American Museum collection.

***Eupithecia sobrinata sobrinata* Hübner**

Geometra sobrinata HÜBNER, [1814–1817], Sammlung Europäischer Schmetterlinge, Geometrae, vol. 4, pl. 90, fig. 465.

Eupithecia sobrinata, PETERSEN, 1909, Iris, vol. 22, p. 279, pl. 25, fig. 101. DIETZE, 1910–1913, Biologie der Eupitheciiden, p. 146, pl. 77, figs. 677–697, pl. 79, figs. 863–865. McDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 68. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 164.

While it is quite possible that there is no tangible difference between North American and European forms of this well-known, juniper-feeding species, it seems wise for the present to give our North American specimens racial status. Judging by Dietze's figures they approach quite closely to the race from Iceland, *scoriata* Staudinger. It is possible, according to Prout in Seitz, that *pusillata* Schiffermüller may have priority over *sobrinata* Hübner.

***Eupithecia sobrinata interruptofasciata* Packard**

Plate 30, figure 15; text figure 12B

Eupithecia interruptofasciata PACKARD, 1873, Fifth Rept. Peabody Acad. Sci., p. 59; 1876, A monograph of the geometrid moths . . . of the United States, p. 52 (*partim*). FLETCHER AND GIBSON, 1905, Canadian Ent., vol. 37, p. 262 (biology). TAYLOR, 1907, Canadian Ent., vol. 39, p. 278. SWETT, 1908, Canadian Ent., vol. 40, p. 246 (type restriction). BLACKMORE, 1922, Rept. Prov. Mus. Natl. Hist. British Columbia, for 1921, p. M 31, pl. 4. McDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 68.

Eupithecia quebecata TAYLOR, 1910, Canadian Ent., vol. 42, p. 81. BARNES AND McDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 273. McDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 68.

Packard's original description of this species was based on no fewer than three different species, according to Swett (1908), who restricted the types to two females from central Texas, collected in early fall. The treatment in the "Monograph" by Packard as a doubtful synonym of *miserulata* Grote was still more unsatisfactory, and neither of the figures given can be recognized as belonging to the species as it is now known. Packard, however, did record a specimen bred from a larva on juniper as probably belonging to the species, and this food plant record was later confirmed by Fletcher and Gibson, assisted by Taylor in the identifica-

tion of the adult. How Taylor came to re-describe the species as *quebecata* is a mystery, as he certainly possessed specimens of Fletcher's breeding.

Interruptofasciata is one of the latest of our eastern eupitheciids on the wing, the emergence of the adults occurring from the end of August through September and October. This fact alone renders it fairly easy to identify and when, in addition, the moth is disturbed from juniper bushes the determination is practically certain. The coloration of the primaries is a rather deep, smoky gray, turning brownish in older specimens; the median area frequently is somewhat paler. The cross lines are fairly distinct, blackish, the antemedian lines strongly angled outwardly below costa and then inwardly oblique and rather irregular; the median line passes through the black discal streak and is more upright; the postmedian line is straight below costa, strongly outwardly bulging or angled opposite the cell, and then more or less parallel to outer margin with strong, dark dashes inwardly on the veins; the white s.t. line is irregularly dentate and forms more or less of a blotch above the tornus. The secondaries are crossed by numerous dentate cross lines, most of which do not attain the costa; the outer area is darkened. The palpi are moderate in length, tufted dorsally, and dark in color; the front is very slightly bulging, somewhat paler than the palpi with an admixture of white scaling centrally; the abdomen shows a fairly distinct black brown band on segment II; the male antennae are finely ciliate, much as in the members of the *satyrata* group.

MALE GENITALIA: Hair pencils on segment IX present. Tegumen rather short, conical. Uncus bifid. Saccus short, strongly rounded. Clasper trigonate with a distinct tooth at about the middle of the ventral margin; apex much narrowed. Aedeagus long and broad. Vesica armed with two large, curved, and pointed apical spines, the inner one about twice the length of the outer and less curved; there is besides a long, straight spine on the left side extending more than half the length of the aedeagus and to the base of which the small end piece is more or less attached. A faintly chitinized piece with rounded margin is present below the curved

spine. Ventral plate of segment VIII is a simple rod arising from the usual broadened base; the apex of this rod is split into two short, outwardly directed prongs.

FEMALE GENITALIA: Dorsal plate of segment VIII of the normal type; ventral plate with a very finely spiculate area preceding the wide membranous ostium. Ductus bursae very short, terminating in a broad, chitinous collar, the ventral edges of which are only feebly turned up. This collar leads into a long, broad, chitinized neck, strongly striate on both surfaces on the right side and with a broadly blunt projection on the left side. From this bulge a more strongly chitinized band extends down the left side to the bursa proper, its inner surface being provided with very strong but sparsely distributed spines. From the base of a membranous projection at the distal end of the neck on the right side semiventally the small, narrow ductus seminalis projects caudad. The globular bursa proper is spined over its entire surface, the marginal spines being stout but rather short.

TYPES: *Interruptofasciata*, holotype, female, Texas (near Waco) (M.C.Z.); *quebecata*, holotype, female, Kamouraska, Quebec (U.S.N.M., ex Taylor and Barnes collections).

DISTRIBUTION: Apparently rather general over the eastern portion of the United States and Canada. Recorded also from Maple Bay, Vancouver Island, British Columbia, a record which needs checking as it may refer to the following species.

LIFE HISTORY: The larva feeds in the spring on juniper (*Juniperus communis*).

REMARKS: The drawing of the female genitalia is based on a slide of the type female of *quebecata*; it matches very closely a slide recently made of the holotype of *interruptofasciata* from Texas.

***Eupithecia niphadophilata* Dyar**

Plate 30, figure 16; text figure 12C

Tephroclystis niphadophilata DYAR, 1904, Proc. U. S. Natl. Mus., vol. 27, p. 890.

Eupithecia niphadophilata, BARNES AND MCDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 275; 1912, Contributions to the natural history of the Lepidoptera of North America, vol. 1, no. 4, p. 31, pl. 14, fig. 7. MCDUNNOUGH, 1929, Canadian Ent., vol. 61, p. 68.

While there is no doubt that *niphadophilata* is extremely close to *interruptofasciata*

both in maculation and genitalia, certain slight but apparently constant differences in both male and female genitalia have been noted which make it advisable (at least until the life history is known) to treat it as a good species rather than a western race of *interruptofasciata* as had been previously suggested.

Apart from the considerably paler gray coloration of the primaries no other differences in maculation have been detected nor could any characters in outward morphological features be discovered whereby the two forms could be separated. Dyar's type series consisted of 20 specimens (no sexes mentioned) collected at fairly high altitudes in the Selkirk Range extending from the Kaslo region of British Columbia to Field on the border of Alberta. Apart from one specimen, they were collected in late August and September, the exception being a specimen stated to have been taken on June 7, a very doubtful record for this species and one that needs verification.

In the male genitalia the main difference from *interruptofasciata* consists in the great reduction or entire absence of the shorter of the two curved apical spines; the apical prongs of the ventral plate also appear at times to be less outcurved and more or less parallel. In the female the broad bulge on the left side of the bursa neck is lacking, the membranous projection on the right side from which the ductus seminalis arises seems somewhat longer, and the spining on the left section of the bursa proper is reduced to very faint, small spicules.

TYPE: Holotype, male, Glacier, British Columbia (U.S.N.M.).

DISTRIBUTION: British Columbia, Montana, Wyoming, Colorado, Utah, occurring in late summer and early fall.

LIFE HISTORY: Unknown.

REMARKS: In a slide made from a paratype male from Field, British Columbia, in the United States National Museum the shorter spine is still present but considerably reduced. In other males from Wyoming and Colorado the spine has totally disappeared. The illustration has been made from a Moran, Wyoming, specimen. The female figure is based on a paratype in the American Museum collection and another specimen from Glacier Park, Montana.

***Eupithecia subcolorata* Hulst**

Plate 30, figure 17; text figure 12D

Tephroclystis subcolorata HULST, 1898, Canadian Ent., vol. 30, p. 114.*Eupithecia subcolorata*, GROSSBECK, 1907, Ent. News, vol. 18, p. 344 (type restriction).

The type of this species was limited by Grosbeck (1907) to the female from the San Francisco Mountains, Arizona, in the Hulst collection. A new and excellent description was drawn up from a male from Yavapai County, Arizona, now in the American Museum collection, and particular attention is drawn to the following characters: "ground color whitish . . . lightly suffused with blackish scales . . . series of strong and contrasting black lines," the extradiscal line "straight from costa to vein R, then describing a bold outward semicircle." The discal spots on both wings are large and black, and the under side is silvery gray with strong black post-medial line and a less strong subterminal one. The palpi project moderately beyond the front and are tufted dorsally. The male antennae are finely ciliate, much as in *interruptofasciata*. The basal segment of the abdomen is pale scaled, but there is no dark band crossing segment II, although there is a certain amount of brown subdorsal shading on this and the following segments, relieving a pale dorsal line. A black lateral line is also present. The species is apparently a rather late flyer, occurring in the southern Rocky Mountain region from late July until early September. It probably is not particularly closely related to *sobrinata*, but no better position can be found for it at present.

MALE GENITALIA: Hair pencils of segment IX well developed. Tegumen broad and quite short. Uncus quite broad and bifid. Vinculum short and broadly rounded apically. Clasper narrow, tapered considerably apically. Aedeagus short and broad. Vesica armed with two apical spines, slightly curving; a third piece of irregularly shaped, twisted chitin occurs in the basal section, more or less joined to the small end piece. A finely spiculate band covers most of the area. The ventral plate of segment VIII consists of two more or less parallel, thin rods, narrowly joined at their bases, their apices rounded.

FEMALE GENITALIA: Dorsal plate of segment VIII much broader than high; apoph-

yses short and with a very feeble caudal spur. Ventral plate membranous, with well-developed lateral hair pads. Ostium broadly funnel shaped and very finely spiculate. Ductus bursae very short with weak and feebly chitinized collar. Bursa long, subrectangular with a shoulder on the left side proximally and the ductus seminalis arising near the distal end on the right side as a broad tube which runs cephalad alongside the bursa for a short distance before recurving and narrowing. The bursa on the dorsal side is completely and irregularly spined, the spines being particularly long and heavy on the left side and extending around to the ventral surface, which is otherwise unspined but strongly strigate. Very characteristic is a small membranous accessory sac attached to the fundus.

TYPE: Holotype, male, San Francisco Mountains, Arizona, 8000 to 10,000 feet altitude, July 20, 1897 (Rutgers University, New Brunswick, New Jersey).

DISTRIBUTION: Southern Colorado (San Miguel), Utah, Arizona.

LIFE HISTORY: Unknown.

***Eupithecia appendiculata* McDunnough**

Plate 30, figure 18; text figure 12E

Eupithecia appendiculata MCDUNNOUGH, "1945" [1946], Canadian Ent., vol. 77, p. 170, pl. 9, figs. 3, 3a.

This rather inconspicuously marked, dark gray species shows considerable superficial resemblance to *undata* (*scriptaria*) and *pygmaea* and would probably be as well placed close to these species as in its present position, a certain similarity occurring in the female genitalia of all three species and the palpal and antennal structure being not dissimilar. However, characters of the male genitalia with the bifid uncus link it up more closely with *subcolorata* and, as the female genitalia show as much similarity to this species as to the others, it is tentatively placed in association with the latter species, although in size and maculation it differs considerably.

Other than the type series very little material has been available for study, and in consequence not much can be added to the statements in the original description. The short palpi, projecting only slightly beyond the flat front, and the fine and even ciliation

of the male antennae (the ciliae even shorter than in *undata*) are characteristic. The front shows slight, dark, anterior tufting, and there are traces of a dark cross line anterior to the antennae. In amplification of the original description of the genitalia it may be noted that in the male organ well-developed hair pencils are present; the tegumen is broad at the base, rapidly narrowing to a rounded apex; in the bifid uncus the dorsal hook is thin and sharp, the ventral one broader and rounded apically; the vinculum is much longer than usual, the lateral edges sloping inward and the apex narrowly and bluntly rounded much as in *litoris*. In the female the dorsal plate of segment VIII is almost membranous with a thickened, chitinous, cephalic edge, the anterior apophyses arising laterally as usual, moderately stout and slightly in-bent, with the caudal spur originating near the base and terminating laterally in a small, feebly chitinized, triangular plate. Between the lateral horns of the ostium pouch, as depicted in the original drawing, are a couple of rounded lobes, finely shagreened, which seem to flank the centrally placed, slit-like ostium, and probably originally were strongly covered with hair.

TYPES: Holotype, male, Alta, Utah, July 23 (M.C.Z.); allotype, female, and paratypes, male and female (C.N.C.).

DISTRIBUTION: The type series came from Utah and southern California. Recently a few specimens have been examined from Mohawk, Plumas County, and Napa and Lake counties, California (Bauer).

LIFE HISTORY: Unknown.

***Eupithecia emmedonia* Grossbeck**

Plate 30, figure 19

Eupithecia emmedonia GROSSBECK, 1908, Jour. New York Ent. Soc., vol. 16, p. 24.

This species is represented solely by the male type from Monterey County, California, originally in the collection of the Brooklyn Institute Museum but now in the United States National Museum. According to the original description it should be easily recognized by the pale whitish ground color of the primaries crossed by two oblique, blackish bands much as in some species of the *palpata* group. It cannot, however, belong here as the

palpi are stated to be "short" and the front "evenly rounded." The wing expanse is said to be "17 mm." According to the photograph, this species bears great similarity to *opinata* Pearsall.

TYPE: Holotype, male, Monterey County, California (U.S.N.M.).

LIFE HISTORY: Unknown.

REMARKS: A slide was made of the genitalia by Cassino in 1930 according to a note attached to the specimen. Unfortunately, this slide cannot be found at present but may eventually turn up among Cassino's slide material in the Museum of Comparative Zoölogy.

***Eupithecia zelmira* Swett and Cassino**

Plate 30, figure 20; text figure 12F

Eupithecia zelmira SWETT AND CASSINO, 1920, Lepidopterist, vol. 3, p. 113. MCDUNNOUGH, 1941, Canadian Ent., vol. 73, p. 192.

The species can very easily be confused with pale specimens of the *nevadata* group such as occur in southern California but in the male sex is at once separable by the lengthy ciliations of the antennae. These are definitely bifasciculate, the ciliae of the individual fascicles being quite long but sparse. The palpi are rather short, scarcely raised above the level of the front, strongly scale-tufted dorsally, and forming with the slightly raised and rounded front the usual short, conical projection. There are faint indications of lateral tufting to the mesothoracic scutellum, and segment II of the abdomen is crossed by a black brown band dorsally. The white coloration of the primaries is characteristic. The most prominent maculation consists of four brown patches along the costa; three of these, situated basally, antemedially, and postmedially, are flatly rectangular, the latter the longest and touching the upright black discal streak. The fourth patch is pre-apical and more upright, bordering a broad white subterminal band which is sharply angled outwardly along the lower edge of the brown patch and contains a median series of short dark dashes along the veins. The somewhat darker terminal area shows smoky brown suffusion opposite the cell and again above the tornus. The flight of the species occurs very early in the season, such specimens as have been examined

having been captured in February and early March.

MALE GENITALIA: Hair pencils of segment IX present. Tegumen very narrow and conical. Uncus bifid, the pointed dorsal hook being shorter than the rounded ventral one. Vinculum considerably longer than usual, broad, the lateral edges slightly sloping inward, the apical margin truncate. Clasper moderately broad, not much narrowed apically; the basal half of the ventral margin strongly chitinized and terminating distally in a bluntly pointed projection. Aedeagus long, narrow. Armature of the vesica very characteristic, consisting of a long, curved, strongly chitinized rod which is furnished apically with five to seven prongs, these increasing gradually in length, the four apical ones being quite long. There is a small piece of chitin with raised edges at the base, and subapically a weakly chitinized and finely spiculate small oval piece may be observed. The ventral plate of segment VIII gradually narrows from a broad base and terminates in two short, subparallel rods.

FEMALE GENITALIA: Very odd and characteristic. Dorsal plate of segment VIII rectangular, the cephalic margin slightly sinuate, the caudal edge rounded and with a narrow, deep, membranous incision centrally; anterior apophyses long and strong as are the caudal spurs which terminate in a chitinous patch laterally on the membranous ventral plate. Ostium consists of a deep, rectangular, strongly chitinized pouch, the ventral side of which projects roundedly caudad. This is separated from a narrow collar band by a short membranous ductus bursae. The bursa itself is leg shaped, chitinized, and bulging to the right; it terminates in a round membranous sac or foot. There is a band of spines on both the right and left sides, the former descending farther towards the foot and at its proximal end curving over to the ventral side of the bursa; dorsally and proximally there is a further patch of small spines. The membranous ductus seminalis arises as a narrow tube from a small bulb on the right dorsal side proximally and just below the collar.

TYPES: Holotype, male, and allotype, female, Eldridge, Sonoma County, California, March (M.C.Z.).

DISTRIBUTION: Oregon (McMinnville);

central and southern California (Sonoma and Napa counties to San Diego County).

LIFE HISTORY: Unknown.

***Eupithecia vitreotata* Cassino**

Plate 30, figure 21; text figure 12G

Eupithecia vitreotata CASSINO, 1927, Lepidopterist, vol. 4, p. 84, fig. McDUNNOUGH, 1945, Canadian Ent., vol. 77, p. 64.

Eupithecia gilata CASSINO, 1925, Lepidopterist, vol. 4, p. 50 (*partim*, ♀ *nec* ♂). McDUNNOUGH, 1941, Canadian Ent., vol. 73, p. 192, pl. 13, fig. 7.

Apart from the type male of *vitreotata* and a few females wrongly placed by Cassino under *gilata*, only a single female from the Sperry collection taken at Miami, Arizona, in March has been available for study. The species is without doubt very closely allied to *zelmira* on genitalic characters, but according to the original description the male antennae are filiform and not bifasciculate. The Miami specimen is in fair condition, and according to it the forewings are a rather even, dark smoky gray with little trace of maculation other than the very thin, upright, black discal streak. There are very faint indications of the dark costal patches of *zelmira*, and the t.p. line can just be made out running parallel to the outer margin with rather sharp angle below costa and indications of short, dark, anterior streaks on the veins. The fringes are much less checkered than those of *zelmira*. The secondaries are dull smoky, deepening outwardly, and show a minute discal dot. Details of palpi and front are much as in *zelmira*. The male genitalia, judging by Cassino's figure, can hardly be separated from those of *zelmira*. The female bursa is also essentially the same, and it is doubtful whether the minor differences in the general shape and the distribution of the spining noted in the drawings will hold when more material can be studied. It is too premature at the present time to place *vitreotata* as a race of *zelmira*, and data on life histories must be awaited before the correct relationship can be ascertained.

TYPE: Holotype, male, Colorado (M.C.Z.).

DISTRIBUTION: Colorado, Arizona.

LIFE HISTORY: Unknown.

***Eupithecia segregata* Pearsall**

Plate 30, figures 22-24; text figure 13A

Tephroclystis niveifascia HULST, 1898, Canadian Ent., vol. 30, p. 115 (*partim*, ♀ *nec* ♂).

Eupithecia segregata PEARSALL, 1910, Proc. Ent. Soc. Washington, vol. 12, p. 144; 1910, Canadian Ent., vol. 42, p. 313. MCDUNNOUGH, 1940, Canadian Ent., vol. 72, p. 37 (type restriction).

Eupithecia bonita CASSINO AND SWETT, 1925, Lepidopterist, vol. 4, p. 33.

A very variable species in maculation and at times quite difficult to determine without recourse to a genitalic slide. The typical form, which seems to be more prevalent in the Pacific coastal regions, is a pale, well-marked one. The basal half of the primaries is suffused with smoky shading, bordered outwardly by an irregular line passing through the discal streak. Beyond this is a broad, white, subterminal band, frequently jutting to the outer margin between veins 3 and 4 and crossed by a faint, median, dark hair line. The terminal area is suffused with smoky in the apical half and again above the tornus. The veins are frequently streaked with smoky and, when present, a dark streak at the base of vein 3 is quite characteristic. The secondaries are largely pale with a small, dark, basal patch and a moderately broad smoky terminal border through which a dentate, pale line runs. In another form which occurs quite frequently the primaries are entirely suffused with smoky gray of varying intensity, the maculation, in consequence, being partially or almost totally obliterated. This form may occur in both sexes but shows no genitalic differences from the nymotypical one. The palpi are rather long, porrect, and well tufted with scales on the dorsal edge. The front is very slightly bulging, being somewhat raised above the level of the eyes. The male antennae are very finely and evenly ciliate. The abdomen is largely dark scaled, but there are traces of a darker band crossing segment II, somewhat relieved by paler scaling on the preceding segment. The species might readily be confused with *niveifascia*, as was actually done by Hulst, but the much longer upper spurs on the hind tibiae offer as good a character as any by which to separate it, this pair of spurs in *niveifascia* being much reduced in size.

The male type from southern Arizona (which can be considered only as an allotype) in the American Museum collection, *ex* Pearsall collection, is smaller and browner than Californian specimens and, while fairly distinctly marked, has a less prominent pale

subterminal band with little indication of an extension to the outer margin. The abdomen had been removed by Cassino in order to make a genitalic slide, and this slide was not to be found in the Museum collection. However, later it was found that a slide labeled by Cassino "Cotype, *bindata* Pearsall" matched other slides of *segregata* material and was certainly not *bindata* according to the type slide in the United States National Museum. It has been presupposed that the wrong labeling was due to Cassino's well-known carelessness, and the slide has been relabeled accordingly. There is a possibility that with further material available the Arizonan form may constitute a good subspecies.

In the coastal region the species flies from late February until April, but at higher altitudes in the Sierras is not apparently on the wing until June.

MALE GENITALIA: Hair pencils present on segment IX. Tegumen broad at base, short, and sharply narrowed to a rounded apex. Uncus thin towards apex, bifid, both hooks rather inconspicuous. Vinculum normally broad, with rounded apical margin which shows a slight central evagination. Claspers very striking and characteristic and slightly asymmetrical, rather narrow at base, gradually expanding with broadly rounded apices; at the middle of the somewhat thickened ventral margin a broad truncate prominence juts out, preceded on the right side by a small notch and on the left side by a broader excavation with square-cut base. Aedeagus rather thin and long. Vesica armed with a long piece of chitin, curved and broadened apically, somewhat similar to a hockey stick, adjacent to its apex is a small spined piece of chitin and in the basal section is a large, broad, indistinct piece with curled-up edges, more or less conjoined to the small, twisted end piece; a slightly spiculate band runs through the apical section. Ventral plate of segment VIII short, the apical half consisting of two parallel prongs.

FEMALE GENITALIA: Dorsal plate of segment VIII rectangular with slightly convex caudal edge; anterior apophyses long, lacking a caudal spur. Ventral plate membranous with two prominent lateral scale tufts. Ostium pouch large, chitinized, and finely spiculate; its caudal section is raised, the

central portion strongly projecting with slight median sinuation of the edge, the lateral corners forming a couple of ear-like projections. The pouch narrows somewhat towards the cephalic margin and is continued by a membranous ductus bursae, longer than usually found in this group. A weak collar with minute flaps follows and is joined to the bursa by a short, broad, membranous neck. Bursa broadly oval with a wide membranous projection to the left, proximally from which the thin ductus seminalis rises. A cluster of thin, long spines surrounds the apex of the neck. The fundus half of the bursa on the dorsal side is covered with extremely thin, weak spines, reaching obliquely upward along the left side nearly to the proximal spine cluster; on the ventral side the spining is similar but more extended proximally. Membranous areas are left in the upper section of the bursa, more extended on the dorsal side than on the ventral one.

TYPES: *Segregata*, holotype, female, Oregon (U.S.N.M.); *bonita*, holotype, male, San Diego, California (M.C.Z.).

DISTRIBUTION: Oregon; California (Napa, Plumas, Placer, and San Diego counties); Arizona.

LIFE HISTORY: Unknown.

REMARKS: There is some variation in the left male clasper in the shape of the excavation preceding the truncate projection, but this appears to be merely individual, as no other differences are apparent.

***Eupithecia pinata* Cassino**

Plate 30, figure 25; text figure 13B

Eupithecia pinata CASSINO, 1925, Lepidopterist, vol. 4, p. 52 (as *sierrae* race *joymaketa* in error); 1925, *ibid.*, vol. 4, fig. p. 53 (as *gilata* in error); 1925, *ibid.*, vol. 4, p. 72 (attempted correction). McDUNNOUGH, 1940, Canadian Ent., vol. 72, p. 39 (correction); 1941, *ibid.*, vol. 73, p. 192, pl. 13, fig. 6; 1945, *ibid.*, vol. 77, p. 65.

The typical material available for study is in too poor a condition to give an accurate account of the maculation of the primaries. It consists of two male and one female paratypes from the Canadian National Collection. As far as can be told the narrow, pointed primaries are of a deep smoky color; the inner and outer edges of the median area are apparently formed by two solidly dark bands,

sharply angled outwardly below costa and then inwardly oblique, the outer one passing through the discal spot; the subterminal area is paler, followed by a dark, pre-apical costal blotch and two others on the outer margin, one opposite the cell and the other above the tornus. Two females in fair condition from the Baboquivari Mountains (Sperry), while agreeing with the paratype female in genitalia, are smaller in size and paler in coloration, the dark bands being much less pronounced and the subterminal area crossed by several wavy lines; the basal portion of vein 2 is outlined in black which forms a rather obvious dark streak as in *segregata*. The long palpi, projecting well beyond the front, are characteristic; the front is gently but not prominently bulging, and the male antennae are heavily and finely ciliate, similar to those of *segregata*. Until, however, more perfect material can be secured the only safe means of determination is through the genitalia, which, in the male especially, show great resemblance to those of *segregata*.

MALE GENITALIA: Hair pencils present on segment IX. Tegumen short, broad at base, the sides sloping rapidly inward to a rounded apex. Uncus short, sharply pointed, bifid. Vinculum square-cut apically, more so than in *segregata*. Claspers narrow at base, almost symmetrical, slight asymmetry being shown in the shape of the prominent bulges in the middle of the ventral margins; the right clasper has a broadly rounded bulge, whereas that of the left side is square-cut; both are preceded by a finger-like projection; the apices are well rounded. Aedeagus long and narrow, slightly sinuate, considerably longer than in *segregata*. Vesica with the same type of armature as in *segregata*, but the curved piece of chitin longer in the thin portion and broader in the curved apical section; on the other hand the twisted piece, proximad of same, is shorter and narrower, and there is no definite small spined apical bar; a finely spiculate band runs through the apical half of the organ. Ventral plate of segment VIII rather short and weakly chitinized, broad at base, the apical half consisting of two parallel prongs.

FEMALE GENITALIA: Dorsal plate of segment VIII rectangular, somewhat broader

than high; anterior apophyses long and without caudal spur, as in *segregata*; the membranous ventral plate is provided with two prominent scale pads situated on scobinate, chitinous strips; these are joined to the caudolateral, shortly projecting edges of the ostium pouch. The central section of the ventral plate is finely spiculate, with a narrow median ridge projecting below the raised and strongly convex caudal margin of the ostium pouch. This pouch is uprightly rectangular, the proximal two-thirds chitinized and spiculate, the cephalic third membranous and continued by a short, membranous ductus bursae, terminated by a narrow, weakly chitinized, but rather broad half collar. Bursa oval, thinly membranous, the ductus seminalis arising from the apex of a broad, bulbous projection on the right proximal side as a narrow tube that curves back over the bursa before turning caudad. Ventrally a band of fine spines crosses from the base of the bulge to the left side. Large patches of fine spines occupy the greater part of the distal half of the bursa on both surfaces, leaving the fundus itself and bands along both sides membranous; the dorsal spines are longer and more sharply pointed than the ventral ones.

TYPES: Holotype, male, allotype, female, Pinal County, Arizona, April 1-15 (M.C.Z.).

DISTRIBUTION: Southern Arizona.

LIFE HISTORY: Unknown.

Eupithecia tenuata Hulst

Plate 30, figure 26; text figure 13C

Eupithecia tenuata HULST, 1880, Bull. Brooklyn Ent. Soc., vol. 3, p. 45. MCDUNNOUGH, 1927, Canadian Ent., vol. 59, p. 244.

Eucymatoge tenuata HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 272. PEARSALL, 1910, Proc. Ent. Soc. Washington, vol. 12, p. 141.

Described as a *Eupithecia* the species was later transferred to the genus *Eucymatoge* by Hulst on account of the double areole in the venation of the forewings. This character, which occurs sporadically throughout the eupithecias, has been shown by Prout and other European workers to be worthless as a means of generic separation, and the two generic terms have been merged.

This fragile little species seems to have no very close relationship to other species but is placed in its present position on account of a

superficial resemblance to species of the following group, especially *agnesata*. It has also a vague similarity to certain specimens placed under *Prorella* (e.g., *albida*). It is readily recognized by its pale whitish color, the primaries marked with a small basal patch and a broad median band of a smoky gray shade, much heavier in the costal half of the wing where it shows a strong outward bulge. The white, porrect, well-tufted palpi project a considerable distance beyond the front which is slightly raised above the level of the eyes and gently rounded. The male antennae are very finely and evenly ciliate, scarcely to be distinguished from those of the female. The spurs of the hind tibiae are normal.

MALE GENITALIA: Hair pencils of segment IX feebly developed. Tegumen narrowly conical. Uncus normally developed, thin, with bifid apex, the upper hook pointed, the lower strongly projected and well rounded. Vinculum longer than usual, narrowed apically much as in *purpurissata*. Clasper quite narrow. Aedeagus long and thin. Vesica armed with a band of small spines and spicules, partly covering a semicylindrical chitinous bar; a small end piece is present. Ventral plate of segment VIII broad with little excavation of the cephalic edge; the parallel lateral edges are thickened and project shortly at apex as two blunt prongs.

FEMALE GENITALIA: Dorsal plate of segment VIII uprightly rectangular; anterior apophyses thin with short caudal spur which is attached to the caudolateral corners of a thinly chitinized and finely spiculate ostium pouch; this pouch is much broader than long with strongly concave caudal edge, in the center of which the rather narrow ductus originates. A short membranous ductus bursae leads to the rather narrow chitinous collar with well-developed flaps. The bursa is pear shaped, broadening rapidly to the right, the proximal half membranous and strigate with a lightly chitinized ridge extending along the right ventral side and terminating about the middle in the thin membranous ductus seminalis. This ridge is armed inwardly with an irregular row of very small spines extending from the ductus proximad to the right flap of the collar. The distal half of the bursa is completely covered with fine spines, the

marginal row consisting of very long thin ones. On the left side proximad of the marginal spines is a small group of similarly long spines, rather variable in number.

TYPE: Holotype, Colorado (Rutgers University, New Brunswick, New Jersey).

DISTRIBUTION: Southern British Columbia through the Rocky Mountain region to New Mexico.

LIFE HISTORY: Unknown.

REMARKS: Judging by the dates on British Columbian material in the Canadian National Collection, there are two broods in a season, the first occurring in June and the second in late July and August.

Eupithecia agnesata agnesata Taylor

Plate 30, figure 27; text figure 13D

Eupithecia agnesata TAYLOR, 1908, Canadian Ent., vol. 40, p. 57.

Another pale species with a certain superficial resemblance to *segregata* and *niveifascia*. The ground color is whitish with, at times, faint brown tinges in the subterminal area and along the veins. The basal third of the primaries is largely pale, and a characteristic feature is an upright, broad, median band, somewhat darker than the other areas, the outer margin of which is accentuated by dark shading in the costal half of wing and again below vein 2 where a small quadrate patch is formed. A rectangular dark patch on the costa before the apex is another prominent feature, the balance of the subterminal area and the apical half of the terminal section being of the pale ground color; there are patches of darker shading in this latter area opposite the cell and above the tornus. The black discal streak is fairly prominent. The secondaries are suffused with light smoky and show a curved postmedian line and an indistinct, crenulate, subterminal line through the still darker terminal area. On the under side the maculation is very strong, and the pre-apical costal patch of primaries as well as dark postmedian and subterminal lines on both wings is intensified. The palpi are rather short and well tufted, the front quite flat and short; the ciliations of the male antennae are extremely short and fine; the abdomen shows a moderately well-defined dark band across segment II, intensified by pale

scaling on the preceding segment and the posterior ones. In the female, two large scale pads can usually be observed on the ventral surface of segment VIII, cephalad of the anal lobes. The spurs of the hind tibiae are normal. The genitalia are quite abnormal, but the general structure of the male organ would seem to link the species to *niveifascia*. The species is on the wing from late June to early August, depending on the altitude, and seems more or less restricted to the mountainous regions of the Pacific coast and to Rocky Mountain areas.

MALE GENITALIA: Hair pencils of segment IX strongly developed. Tegumen narrow and high, broadly rounded apically. Uncus single, pointed. Vinculum broad at base, somewhat longer than normal, bowl shaped, with a slight point at middle of apical edge. Clasper moderately broad, tapered somewhat apically; ventral margin irregular in outline, and with a thin, transversely placed projection about the middle, which juts out as a blunt process beyond the clasper's edge. Aedeagus thin, tapered to a blunt point proximally. Vesica armed with a strong apical spine of the rose-thorn type and three obscure, small, chitinous pieces, the basal one of which represents the end piece. Ventral plate of segment VIII very broad, the lateral edges heavily chitinized; the apical section consists of two broad truncate projections, separated by a semicircular excavation.

FEMALE GENITALIA: Dorsal plate of segment VIII strongly chitinized, much broader than high, the caudal edge irregularly convex, the cephalic margin concave, the lateral edges thickened and connected with the chitinous base of the scale-pads of the ventral plate. Anterior apophyses short and stout, without caudal spur. There is a broadly rectangular, chitinized, and shagreened ostium pouch attached to the ventral edge of segment VIII; its caudal margin is raised, leaving an open ostium. This is separated from an equally broad and rectangular area, which probably represents the collar, by a thin membranous strip. Chitinous lateral projections extend from the collar into the broad, irregularly globular bursa, the proximal portion of which is lightly chitinized and strigate. From the center of the proximal edge ventrally the

ductus seminalis arises as a large tube, lightly chitinized and curving to the right; it narrows somewhat as it runs along the upper edge of the bursa before bending caudad, at which point it is reduced to a thread-like tube. The fundus half of the bursa is covered with spines, the marginal ones on both surfaces being long, especially so on the dorsal side.

TYPE: Holotype, female, Kaslo, British Columbia, July (C.N.C., *ex* collection Cockle).

DISTRIBUTION: British Columbia, Wyoming, northern California (Plumas County).

LIFE HISTORY: Unknown.

Eupithecia agnesata barnesi Cassino and Swett

Eupithecia barnesi CASSINO AND SWETT, 1922, Lepidopterist, vol. 3, p. 167.

Although possibly scarcely worth retaining in a racial sense, *barnesi* is left as such for the present owing to lack of material and also to the fact that the two type localities are very widely separated. It may be considered as a form from the southern Sierras and, based on the type material, seems to be somewhat paler in general coloration than the topotypical northern specimens.

TYPES: Holotype, male, Monachee Meadows, Tulare County, California, July (U.S.N.M.); allotype, female, same data (M.C.Z.).

DISTRIBUTION: Southern California.

LIFE HISTORY: Unknown.

REMARKS: The abdomen of the holotype is missing. It is possible that a genitalic slide was made by Cassino, but so far this has not been located. A slide made from the female allotype agrees with that of *agnesata*, and a male paratype in the Canadian National Collection shows the same form of the ventral plate as in this species.

Eupithecia huachuca Grossbeck

Plate 30, figure 28; text figure 13E

Eupithecia huachuca GROSSBECK, 1908, Jour. New York Ent. Soc., vol. 16, p. 22. BARNES AND MCDUNNOUGH, 1912, Contributions to the natural history of the Lepidoptera of North America, vol. 1, no. 4, p. 31, pl. 16, fig. 10. MCDUNNOUGH, 1938, Canadian Ent., vol. 70, p. 236.

This small, inconspicuous species, which in general type of color and maculation might

easily be confused with a dozen other species, has certain unique structural features in the genitalia that place it in a category by itself. Certain features of the genitalia, notably the type of male aedeagus and ventral plate of segment VIII as well as the position of the ductus seminalis in the female bursa, seem to indicate an obscure connection with the *agnesata-niveifascia* group and have caused its present placement. In other structural details *huachuca* displays the normal characters of a large group of *Eupithecia*; the male antennae are finely and evenly ciliate; the palpi are rather rough scaled, with slight ventral tufts at bases and dorsal scaling along the second joint which mingles with the small, conical scale tuft at the apex of the flat, sloping front; the second joint is upturned to about the level of the front with the third joint porrect and lying in one plane with the front, thus presenting the somewhat conical appearance so characteristic of numerous species in the genus. Dorsally the abdomen is light grayish with a certain amount of black sprinkling and the minute mediodorsal tufts tinged with black; there is a fairly distinct black band crossing segment II. The males can be at once distinguished by the prominent ventral bulge of the eighth sternite, caused by the nature of the ventral plate, to be discussed later, this feature being one of the most easily recognizable of the specific characters. Judging by the dates on the material available, the species appears to be double brooded.

MALE GENITALIA: Hair pencils of segment IX very weak, not in pockets but attached to the membrane at the bases of the claspers. Tegumen high and rounded apically. Uncus short, simple. Vinculum conical, narrowly rounded at apex. Clasper subtriangular, broadening rapidly towards the median area and then narrowing sharply to the rounded apex, the ventral margin forming a rather prominent rounded angle before its middle. An indication of a harpe in the form of a small, upright projection near the center of the clasper is a unique feature. Aedeagus long, rather narrow. Vesica with terminal, short, curved spine of the rose-thorn type; inner armature consists of an obscure piece of partially hollowed-out chitin and a narrow

chitinous bar, its outer surface moderately dentate. The ventral plate of segment VIII, to which attention has already been called, is a very striking feature; it consists of a broad, semi-rectangular piece of chitin, strongly convex ventrally and forming the base of a hollow pouch which partly conceals the rest of the genitalia; the laterocaudal corners form sharp shoulders and from the median area of this caudal margin two strong, irregularly curved hooks arise, closely approximate, somewhat asymmetrical and directed dorsad; the cephalic margin of the plate shows the usual strong median excavation.

FEMALE GENITALIA: Dorsal plate of segment VIII with a characteristic, small, oval, central depression. The anterior apophyses project only slightly beyond the laterocephalic edges of this plate, form thick lateral margins to its distal half, and then curve ventrad to join the caudal edges of an ostium pouch which is broadly rectangular and very finely spiculate. Ductus bursae broad, somewhat narrower than the pouch, short, consisting entirely of the customary open, chitinous collar. Bursa with the proximal half chitinized and gradually expanding towards the middle; a cluster of small spines on the left side of the ductus entrance and a larger patch of very minute spines on the proximal section of the ventral surface. The distal half of the bursa is hemispherical and completely covered with spines of moderate length with a row of extremely long spines forming the marginal border. The ductus seminalis arises dorsally from a membranous shoulder at the right proximal corner of the bursa, descends as a moderately broad membranous tube to the edge of the spined area, then narrows sharply and is recurved towards the caudal end of the abdomen.

TYPES: Holotype, male, Carr Canyon, Huachuca Mountains, Cochise County, Arizona, and paratype, male, same locality (A.M.N.H.); allotype, female, same locality (A.N.S.P.); paratypes, same locality (U.S.N.M.).

DISTRIBUTION: Arizona (Huachuca Mountains, August; Nogales, July; Chiricahua Mountains, August; Palmerlee, Cochise County, July); Texas (Jeff Davis County, May-June).

LIFE HISTORY: Unknown.

REMARKS: A genitalic slide has been made of the holotype male and matched with other slides from Arizonan and southwest Texan material. The female genitalia, as illustrated, are based on various slides from the same localities, including one from Palmerlee, Arizona, in the American Museum of Natural History.

Eupithecia woodgatata Cassino and Swett

Text figure 13F

Prorella woodgatata CASSINO AND SWETT, 1923, Lepidopterist, vol. 4, p. 28.

This species, described as a *Prorella* and placed next to *albida* Cassino on account of the similar type of maculation, has been transferred to the genus *Eupithecia* on the strength of the genitalic characters. The abdomen of the male holotype is missing, and as yet no slide of it made by Cassino has been found in the collection of the Museum of Comparative Zoölogy. A worn male from Frijoles Canyon, New Mexico (*ex* collection Sperry), has been examined genitically and presumed to belong to this species. The genitalia are quite unique. A slide made from the female allotype shows a type of genitalia very similar to that of *agnesata* and totally different from that of the typical species of *Prorella*. The front is only very slightly bulging, much as in *albida*. The reduced upper pair of spurs on the hind tibiae would not hinder its present placement as *niveifascia*, and several other species associated in a general way with *agnesata* show the same peculiarity, a fact that rather adds weight to the suggestion already put forward (1941) that the structural characters on which the genus *Prorella* is based are of very doubtful value.

As already indicated the type of wing maculation is similar to that of *albida*. Unfortunately lack of perfect material makes it impossible to point to any definite features in the pattern that might be used as a means of separation. From a study of a female paratype in the Canadian National Collection, it would appear that the palpi are slightly longer and the wing expanse is somewhat greater, but material is too scanty to evaluate these characters properly. For the present the character of the genitalia is all that can be relied on to separate the species.

MALE GENITALIA: Hair pencils of segment IX apparently absent. Tegumen short, conical. Uncus rather thin, bifid, the upper prong longer than usual and sharply pointed. Vinculum broad, rectangular, longer than ordinary with truncate apical margin. Clasper quite unique, short, broadening gradually from base to apex which is very broad and squarely cut off; ventral half chitinized, forming a species of sacculus which extends to the ventral corner of the apical edge and terminates roundedly, preceded by a thin, projecting, finger-like process, directed ventrad. Aedeagus long and thin, slightly expanded apically. Vesica armed with two small, superimposed apical pieces of chitin, the upper minutely dentate; farther proximad is a cluster of short, stout spines, five or six in number, and somewhat of the rose-thorn type; mingled with these are a small, semi-cylindrical, twisted bar and an obscure end piece. The ventral plate consists of a moderately broad bar with thickened lateral edges which terminate in two curved projecting prongs with inwardly directed apices.

FEMALE GENITALIA: Dorsal plate of segment VIII weakly chitinized, uprightly rectangular with the laterocaudal edges slightly rounded; anterior apophyses very short, the caudal spurs longer and terminating in small chitinous plates on the lateroventral side which bear scale tufts and are joined to the edges of the genital plate. Ostium widely open, situated at the caudal end of a long, rectangular, chitinized pouch, the caudal margin of which is rounded and strongly projecting. A very short membranous ductus bursae connects this pouch with a narrow, chitinous collar, situated near the left side of the short, broad, urn-shaped bursa. The upper half of the bursa is membranous, very weakly chitinized, except just below the collar where the chitinization is considerably stronger. The thin ductus seminalis arises ventrally from a small membranous projection on the proximal margin to the right of the collar, much as in *agnesata* but generally weaker. The distal half of the bursa is heavily spined, the marginal spines being long and pointed.

TYPES: Holotype, male, allotype, female, Jemez Springs, New Mexico, August (M.C.Z.).

DISTRIBUTION: Western New Mexico (Jemez Springs, Frijoles Canyon).

LIFE HISTORY: Unknown.

REMARKS: A single very worn female in the American Museum of Natural History from Inyo County, California, shows the same type of genitalia as the allotype except that the ostium pouch is much longer. More material is needed from this region before definite determination can be made.

***Eupithecia stellata* Hulst**

Plate 30, figure 29; text figure 13G

Tephroclystis stellata HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 270.

Very little material of this striking species is to be found in museum collections, and the male sex has yet to be studied. Hulst's type, although apparently a male, is badly glued up and molded and is lacking an abdomen. The species is quite a large one (22-mm. wing expanse), and the characteristic maculation of the primaries should render it easily recognizable. The general coloration is a light ruddy brown, overlying a pale ground color. The most striking feature is a dark triangular patch, edged with white, on costa just beyond the middle, the apex reaching to and including the large discal spot. This patch is continued by a much paler, narrowly irregular band, also edged with white, which expands above inner margin to another triangular patch, the band at times being slightly broken. The costa at base is dark, and a thin dentate dark band crosses the wing subbasally. On the hind wings there is considerable smoky suffusion along the inner margin. The palpi are extremely short, and the front is flat and dark scaled. No male characters can be given, lacking specimens of this sex. The upper pair of spurs on the hind tibiae are much reduced in size, and in this respect the species agrees with *niveifascia* and *joanata*. Otherwise there is little similarity, and the placement may be subject to change when the male sex is known.

FEMALE GENITALIA: Dorsal plate of segment VIII rectangular, higher than wide, lightly chitinized, with feebly rounded caudal margin which shows a small, central, membranous area. Anterior apophyses and caudal spur normal and well developed. Ostium and short ductus bursae membranous. Bursa

elongate, pear shaped, with rather long neck that contains a broad chitinous bar spined at its base. The ductus seminalis arises on the ventral side proximally from a short bulb and becomes thread-like almost immediately. A band of spines crosses the neck just distad of this bulb and connects on the right side with a spined area which descends to the fundus and merges with dorsal spining which covers this entire surface; the balance of the ventral surface is membranous.

TYPE: Holotype, male, Colorado (Rutgers University, New Brunswick, New Jersey).

DISTRIBUTION: Colorado and probably adjoining Rocky Mountain states; Manitoba; Alberta.

LIFE HISTORY: Unknown.

Eupithecia bowmani Cassino and Swett

Text figure 14A

Eupithecia bowmani CASSINO AND SWETT, 1923, Lepidopterist, vol. 4, p. 18.

This species resembles closely a small *stellata*. The dark costal patch followed by the irregular transverse band is present but scarcely as prominent, being duller in color. There is the same ruddy suffusion terminally, crossed by the pale, irregular, s.t. line, and the basal maculation is also much the same. The rather short, dark palpi project slightly beyond the flat front and are strongly tufted dorsally; the male antennae are very finely ciliate; the anterior portion of the thorax is dark but a whitish band appears (as far as can be judged) to border it posteriorly; the abdomen is shaded considerably with brownish on the anterior segments. As in *stellata* the upper pair of spurs on the hind tibiae are much reduced in size. The genitalia are quite distinct. Very few specimens apart from the type series have been examined. In the Canadian National Collection is a single female from Kaslo, British Columbia, July 23, considerably larger than the type series, with a wing expanse of 16 mm. but otherwise agreeing excellently with paratypes in the same collection.

MALE GENITALIA: Hair pencils on segment IX present. Tegumen short, conical. Uncus normal, bifid. Vinculum broad and rounded apically with a small central notch. Clasper short and stubby. Aedeagus long. Vesica armed with two long chitinous bars with

bent and pointed apices, crossing each other in this section. Ventral plate of segment VIII consists of two long, slender rods, narrowly joined at base; these run parallel and close together in the basal half and then curve symmetrically outward, terminating in blunt points.

FEMALE GENITALIA: Dorsal plate of segment VIII rectangular, higher than broad, with a small median notch on caudal margin. Anterior apophyses short and thin, the caudal spur thicker and terminating in a stronger chitinous bar than usual. Ostium membranous, followed by a moderately long, membranous ductus bursae which joins directly to the bursa without the usual chitinous collar. Bursa small, irregularly oval; on the left side a strong chitinous bar descends from the proximal end almost to the fundus; to the right of this ventrally a spined area covers most of the surface, curving around to the dorsal side which is almost entirely spined; the fundus on both surfaces is membranous, more so on the ventral side, and there are membranous areas to the right of the chitinous bar proximally; from this area on the ventral side the small ductus bursae takes its inception as a bulbous projection which quickly narrows to a fine tube.

TYPES: Holotype, male, Nordegg, Alberta, July 17 (M.C.Z.); paratypes, same locality (C.N.C.).

DISTRIBUTION: Rocky Mountain region of Alberta and British Columbia.

LIFE HISTORY: Unknown.

Eupithecia niveifascia niveifascia Hulst

Plate 30, figure 30; text figure 14B

Tephroclystis niveifascia HULST, 1898, Canadian Ent., vol. 30, p. 115 (*partim*). PEARSALL, 1910, Canadian Ent., vol. 42, p. 313 (*partim*).

Nasusina niveifascia, PEARSALL, 1909, Proc. Ent. Soc. Washington, vol. 11, p. 119; 1910, *ibid.*, vol. 12, p. 138.

Eupithecia niveifascia, BARNES AND McDUNNOUGH, 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 142. McDUNNOUGH, 1940, Canadian Ent., vol. 72, p. 37.

Hulst's original type series included specimens from Santa Fe, New Mexico, and Oregon. Later Pearsall restricted the type to the New Mexican specimen in the Hulst collection which bears the label "Ckll. 3907,

Sta. Fe, July" in Cockerell's handwriting. He transferred the species to his new genus, *Nasusina*, presumably on the strength of the reduced upper pair of spurs on the hind tibiae. As no other characters indicate a close association with the species now included under *Nasusina* and *Prorella*, *niveifascia* has been transferred back to *Eupithecia* and included in the present group which contains several species with reduced spurs and a somewhat similar general appearance. The wing maculation shows a certain similarity to that of *segregata* and *agnesata*, but the ground color of the primaries has a more ochreous tinge with less contrast between the light and dark areas. The discal spot is very prominent and is preceded on the costa by a brownish patch, from which a more or less upright median band, faintly darker than the surrounding area, arises. A brown, quadrate, pre-apical costal patch is continued across the wing by a narrow brownish band which is not cut opposite the cell by a pale projection of the lighter subterminal area. A pale crenulate s.t. line is fairly evident. The dark palpi project considerably beyond the flat front which is also dark in color, the vertex posterior to the antennae being much paler. The male antennae are finely and evenly ciliate; the mesothoracic scutellum bears a large patch of dark scaling; segments I and II of the abdomen show somewhat darker shading than the posterior segments, and there is a lateral row of small dark spots, one to a segment, situated near the posterior margin. Judging by two specimens in the American Museum of Natural History from the same source as Hulst's type and which match it very closely, New Mexican specimens appear somewhat smaller and paler in color than those from Colorado and Arizona which tend towards the race *perbrunneata*.

MALE GENITALIA: Hair pencils on segment IX apparently lacking. Tegumen broad, conical. Uncus rather chunky, bifid, the upper and very sharply pointed hook projecting considerably beyond the lower one. Vinculum short but very broad and square-cut. Clasper narrow, tapering gradually to a rounded apex and somewhat hollowed in the basal section. Aedeagus long, thin, the proximal end narrowed, then gradually expanding and rather twisted apically. Armature of the

vesica characteristic and somewhat reminiscent of that of *agnesata*, consisting of a strong apical spine of the rose-thorn type and two pointed, subapical spines, the smaller with a broadened base; there is also an obscure twisted piece of weak chitin farther basad. Ventral plate of segment VIII short and broad, the apical half strongly chitinized and terminating in two blunt projections, the apices of which are incurved and appear somewhat like a bird's beak.

FEMALE GENITALIA: Dorsal plate of segment VIII weakly chitinized, rectangular; anterior apophyses very short, with a long, thin caudal spur running backward to the base of large scale pads on the sides of the ventral plate. Attached to these is a long, rectangular ostium pouch with thickened edges that appear to be cylindrical. A short membranous ductus bursae leads into a similarly short and membranous bursa neck which on the dorsal side contains a broad chitinous bar of irregular shape which juts for a considerable distance into the bursa proper. The proximal half of the globular bursa is membranous, and the ductus seminalis arises in the right, proximal corner as a short, bent, membranous projection of moderate width which soon narrows to the usual fine tube. The fundus half is entirely spined, sending a branch up the left side nearly to the bursa neck; the marginal spines are extremely long.

TYPE: Holotype, male, Sante Fe, New Mexico (Rutgers University, New Brunswick, New Jersey).

DISTRIBUTION: New Mexico, Colorado, Utah, Arizona.

LIFE HISTORY: Unknown.

Eupithecia niveifascia perbrunneata Taylor

Plate 30, figure 31

Tephroclystis lariciata, DYAR (*nec* Freyer), 1904, Proc. U. S. Natl. Mus., vol. 27, p. 890.

Eupithecia perbrunneata TAYLOR, 1906, Canadian Ent., vol. 38, p. 395. PEARSALL, 1910, Proc. Ent. Soc. Washington, vol. 12, p. 140. BARNES and McDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 272. McDUNNOUGH, 1927, Canadian Ent., vol. 59, p. 244; 1940, *ibid.*, vol. 62, p. 37.

The name *perbrunneata* is retained in a racial sense for the British Columbian form, although, as a matter of fact, it shows little

difference from the more southern topotypical one. The size is somewhat larger and the maculation more intensified, owing to a greater extent of the darker scaling.

TYPE: Holotype, male, Kaslo, British Columbia (U.S.N.M., *ex* Taylor and Barnes collections).

DISTRIBUTION: Southern British Columbia (Kaslo, Seton Lake, Victoria).

LIFE HISTORY: Unknown.

***Eupithecia joanata* Cassino and Swett**

Plate 30, figure 32; text figure 14C

Eupithecia joanata CASSINO AND SWETT, 1922, *Lepidopterist*, vol. 3, p. 172. McDUNNOUGH, 1940, *Canadian Ent.*, vol. 72, p. 39; 1945, *ibid.*, vol. 77, p. 64.

Eupithecia balboata CASSINO AND SWETT, 1924, *Lepidopterist*, vol. 4, p. 34. McDUNNOUGH, 1940, *Canadian Ent.*, vol. 72, p. 39.

The synonymy of the species and the unfortunate (but, sad to say, not very unusual) confusion about the type series of *joanata* have already been discussed (1945). As indicated, the specimen marked "holotype" does not agree with the original description, either in locality data or in structural details, notably palpal length. Under the circumstances it would seem best either to consider the female "allotype" as the real holotype or to make the male paratype from which a genitalic slide had been made (No. 1770) the holotype. In either case the identity of the species would not be disturbed. As regards *balboata* the original description would seem to indicate that the name was based on a single male specimen, but numerous paratypes under this name have been distributed to various museum collections. It is possible that the omission of any mention of paratype material is another of Cassino's oversights.

While the general appearance of *joanata* is typically eupitheciid and the maculation of the primaries, as stated in the description, is rather reminiscent of *maestosa* or its race *harlequinaria*, the genitalia in both sexes are extremely aberrant. Furthermore the upper pair of spurs on the hind tibiae is much reduced in size, and for this reason and on account of a vague similarity in certain parts of the genitalia, the species is removed from its present association and placed with *niveifascia* Hulst.

The male antennae show ciliae of moderate length, arranged in what has been termed the "feebly trifasciculate" fashion. The palpi are quite short, scarcely exceeding the flat front, and both are dark scaled. The anterior portion of the mesothorax is also dark, but the middle section is crossed by a broad pale ochreous band. The primaries show, in well-marked specimens, considerable suffusion of a pale brown color, notably in a triangular patch along vein 3 between the cell and the outer margin of the wing. The species apparently flies from December until March and, if some of Cassino's dates are correct, may have a second generation in mid summer.

MALE GENITALIA: It is doubtful whether hair pencils are present; they cannot be noted in the slides available for study. Tegumen very narrow, the sides almost parallel and rounded apically. Uncus well developed, simple. Vinculum strongly produced, the lateral edges sloping inward and terminating in a bluntly pointed apex. Clasper short and chunky, the basal third of ventral margin with roundedly raised edge and a backward projection to join the vinculum. Aedeagus very long and narrow, the apical section bent slightly dorsad and striate. Vesica without definite armature, there being merely slight indications of small chitinized pieces in the subapical section. Ventral plate of segment VIII quite abnormal, consisting of two short, broad, bowed rods, slightly asymmetrical, with truncate and incurved apices; these rods are narrowly joined at their bases and are attached to a hemispherical and finely spiculate chitinous piece.

FEMALE GENITALIA: Dorsal plate of segment VIII very feebly chitinized with the caudal margin showing a slight median excavation; anterior apophyses very short and without caudal spur. Ventral plate consisting of two chitinized lobes separated by a central membranous groove leading to the small ostium which is situated on the caudal edge of a long, convex, chitinized, funnel-shaped, ostium pouch. Ductus bursae very shortly membranous at first, followed by a narrow, short, chitinous collar, from which on the left side ventrally a narrow chitinous strip, with several prominent teeth attached, projects into the initial portion of the bursa. Caudal margin of bursa truncate, projected

strongly to the right, giving the whole bursa a rather rectangular appearance. The proximal portion is membranous, with a narrow band of small spines on the dorsal side at the base of the ductus seminalis which arises at the left caudal corner as a small membranous bulb, quickly narrowed to a mere thread. The membranous portion of the bursa is bordered on the ventral surface by a row of very long spines which form a cluster on the left side below the chitinous strip and extend on the right side a considerable distance towards the fundus. The balance of the surface of the rather bulging, remaining section of the bursa is covered with fine, sparsely distributed spines which, on the dorsal surface, gradually increase in size, extending farther towards the proximal margin than on the ventral side.

TYPES: *Joanata*, allotype, female, and paratypes, San Diego, California; *balboata*, holotype, male, San Diego, California (M.C.Z.).

DISTRIBUTION: So far known only from the San Diego region of southern California.

LIFE HISTORY: Unknown.

***Eupithecia flavigutta* Hulst**

Plate 30, figure 33; text figure 14D

Tephroclystis flavigutta HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 268.

Although the species is decidedly rare, it is easily identified by the dark, smoky violaceous color of the primaries with the two ochreous, superimposed patches in the terminal area. The ochreous color of the scaling of the mesothorax and metathorax, along with the patagia, contrasts strongly with the dark band across the prothorax. Segment I of the abdomen is also light ochreous with a narrow, dark, posterior band, forming a contrast to the following abdominal segments which are dark in color. In the male the terminal segment is also largely ochreous with a bluntly truncate apex. The dark palpi are short, projecting only slightly beyond the flat front which is also largely dark scaled. The male antennae are finely ciliate. The upper pair of spurs on the hind tibiae are noticeably reduced in size as compared with the terminal pair, and for this reason the species is placed in association with the few other species showing this same character, although the genitalia in many respects are quite aberrant and show no close association.

MALE GENITALIA: Hair pencils very weak, consisting of a few hairs at the base of the clasper. Tegumen very narrow and pointed. Uncus short and rather chunky, bifid, the upper hook sharply pointed. Vinculum broad and longer than usual, apex quite pointed. Clasper rather broad and chunky, the basal half of the ventral margin chitinized and terminating in a raised rounded projection slightly before the middle. Aedeagus with tapered base, long and rather narrowly irregular in shape; vesica armed with a small apical piece of chitin and a larger twisted piece proximad of same, both very obscurely defined. Ventral plate of segment VIII quite unique, being uprightly rectangular with heavily chitinized caudal margin from which two small, finger-like projections protrude in the central section; these are directed dorsad and the area between them is roundedly excavated.

FEMALE GENITALIA: Dorsal plate of segment VIII heavily chitinized, rectangular; anterior apophyses quite unique, being reduced to mere short spines, the caudal spurs, in contrast, strong and curving ventrad and inward; from the laterocaudal edges of the ventral plate two thin chitinous rods project inward, almost meeting with the apices of the caudal spurs, another unique feature. Ostium pouch a large, heavily chitinized, finely spiculate rectangle, slightly directed towards the right; its caudal margin is convex, and the lateral edges form slight projections. An extremely short membranous ductus bursae separates this pouch from the short, chitinous, scobinate half collar, open ventrally. Bursa broadly oval, the proximal third membranous and sending on the right dorsal side a large membranous projection caudad, from the rounded end of which the fine ductus seminalis arises; small scattered spines, with chitinous bases, occur at the base of the projection and over the ventral membranous area. The remaining two-thirds of the bursa is heavily and evenly covered with quite long, thin spining.

TYPE: Holotype, male, Colorado (Rutgers University, New Brunswick, New Jersey).

DISTRIBUTION: Colorado, Arizona (White Mountains, Santa Catalina Mountains, July).

LIFE HISTORY: Unknown.

Eupithecia sperryi McDunnough

Plate 30, figure 34; text figure 14E

Eupithecia sperryi McDUNNOUGH, 1939, Canadian Ent., vol. 71, p. 250, figs. a-c.

The type series and a few other specimens from the same general region are all that have been examined. The female is still unknown. Little can be added to what is already contained in the original description. The small size, pale ground color with large discal dot, and brownish costal patches as well as terminal dark shading should distinguish the species. The male antennae present possibly the most striking structural character, being thick, laterally compressed, and provided with a series of large projecting scales on the dorsal side, giving a somewhat serrate appearance to the whole. The ventral ciliations are short and very numerous. The spurs on the hind tibiae are normal. The genitalia are unique, but the present position seems as good as any for the present.

MALE GENITALIA: Hair pencils present on segment IX but rather weak. Tegumen broad, lateral edges slightly convex, apex gently rounded. Uncus short, bifid, both hooks well defined, the upper sharply pointed, the lower rounded. Vinculum longer than usual, slightly tapered to a rounded apex. Clasper narrow, with a projecting spine about the middle of the ventral margin. Aedeagus thin, long. Vesica provided with two short, apical spines over which a longer, pointed piece of chitin is partially superimposed. Ventral plate of segment VIII weakly chitinized, the apical section consisting of two widely separated, pointed projections with a V-shaped incision between; their bases are broadened by chitinous thickening and bulge towards one another.

TYPE: Holotype, male, Greer, Arizona, June 11 (C.N.C.).

DISTRIBUTION: So far known only from the White Mountain region of Arizona.

LIFE HISTORY: Unknown.

Eupithecia johnstoni McDunnough

Plate 30, figure 35; text figure 14F

Eupithecia johnstoni McDUNNOUGH, "1945" [1946], Canadian Ent., vol. 77, p. 173, pl. 9, fig. 7.

The unique male type is as yet the only specimen known, and nothing can be added to what is already contained in the original

description except a more extended description of the genitalia. The species is evidently closely allied to *dichroma*, but males of this latter species and females of *johnstoni* are needed before the two species can be satisfactorily differentiated.

MALE GENITALIA: Hair pencils of segment IX well developed. Tegumen long, conical. Uncus much longer than usual, bifid. Vinculum normal, being short and broadly rounded apically. Clasper narrow and not much tapered apically. Aedeagus long, thin, with a bulbous apical expansion which is finely hirsute. Vesica armed with a long, hollow, chitinous cylinder, somewhat expanded and finely strigate in the apical half. Ventral plate of segment VIII consists of two parallel, pointed chitinous rods, narrowly joined at base.

TYPE: Holotype, male, Lone Pine, Inyo County, California, May (C.N.C.).

DISTRIBUTION: Known only from the type locality.

LIFE HISTORY: Unknown.

Eupithecia dichroma McDunnough

Text figure 14G

Eupithecia dichroma McDUNNOUGH, "1945" [1946], Canadian Ent., vol. 77, p. 173, pl. 9, fig. 8.

Represented so far by the unique female type. In consequence nothing can be added to what is contained in the original description. As noted under *johnstoni* males must be secured before the points of differentiation between the two species can be adequately discussed. I regret that it was impossible to obtain a photograph of the type.

TYPE: Holotype, female, Alta, Utah, June (M.C.Z.).

DISTRIBUTION: Known only from the type locality.

LIFE HISTORY: Unknown.

Eupithecia rindgei, new species

Plate 30, figure 36; text figure 14H

This belongs in the *dichroma-johnstoni* group, agreeing closely with the former species in the type of female genitalia and with the latter in the character of the male organ. Its size, however, is considerably smaller, averaging a bare 15 mm. in wing expanse from tip to tip, and the maculation and coloration of the primaries appear much less

intense than in either of these species.

Palpi fairly long, porrect, largely smoky outwardly, the second joint tufted dorsally. Front of the normal flat eupitheciid type with apical scale tuft. Male antennae with short, rather sparse ciliae arranged in the weakly trifasciculate manner. Head and thorax largely pale creamy with variably intense smoky sprinkling. Primaries pale creamy, lightly sprinkled with smoky, giving a rather grayish appearance to the whole wing; there are traces of improminent, pale flesh-colored shadings in the basal and sub-terminal areas. The palish basal area is bordered outwardly by an obscure, curved, brownish band, beyond which are traces of several oblique hair lines crossing the wing. More prominently indicated on the costa is the commencement of a median band, the inner edge of which is formed by a smoky, oblique bar reaching from the margin of the costa to the prominent, upright, black, discal streak and then fading out. The outer edge of this median area is formed by the t.p. line which arises from a smaller, dark, costal bar and bends strongly outward around the cell, continuing across the wing more or less as a series of dark spots on the veins running parallel to the outer margin of the wing. Below the costal area this median section is no darker than the rest of the wing. There is a faint, dark, rectangular, pre-apical patch on the costa, and the terminal area of the wing is shaded with smoky (at times with a faint fleshy tinge) which tends to form small obscure patches opposite the cell and above the tornus. A pale s.t. line is most improminent and scarcely traceable. Fringes smoky, slightly checkered. Secondaries similar in color to the primaries with faint discal dot and curved postmedian and subterminal smoky cross lines. Terminal area somewhat darker shaded than the remainder of the wing. Beneath paler than above with obscure indications of the maculation of the upper side, more distinct on secondaries than on primaries.

The male genitalia are essentially the same as those of *johnstoni*, but the central cylindrical rod of the vesica appears somewhat longer and less expanded apically. Unfortunately a slide had already been made of the genitalia before the material was submitted

and the important ventral plate of segment VIII discarded. The female genitalia correspond with the figure given of this organ in *dichroma*, the thin ductus bursae and the point of origin of the ductus seminalis being similar. The membranous bursa appears somewhat longer and more squarely cut but, like that of *dichroma*, is practically covered with very fine spicules. The genitalic slides, like those of the male, were made by the collector and are a little difficult to interpret.

HOLOTYPE: Male, Keddie, Plumas County, California, June 18, 1941 (F. Rindge), in the American Museum of Natural History.

ALLOTYPE: Female, same data, July 5, 1941, in same collection.

PARATYPES: Three females, same data, June 17, 20, 28, 1941, distributed in the American Museum of Natural History, Canadian National Collection, and Rindge collection.

The exact relationship to the closely allied species cannot be fixed until more material of both sexes of these species is available for study. In the meantime it seems fitting to call attention to the form by description, even if later it may prove to be merely a race of one or the other. It is a pleasure to dedicate it to Mr. Frederick H. Rindge, who has been most generous in supplying Californian material for study.

Eupithecia cocoata Pearsall

Plate 31, figure 1; text figure 141

Eupithecia cocoata PEARSALL, 1908, Jour. New York Ent. Soc., vol. 16, p. 103. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 170.

Apart from the type no other specimens of this species appear to exist in collections. In the original description this type was stated to be a male, but a genitalic slide made a number of years ago shows that it is a female. The present illustration is based on a drawing made from this slide. The correct position of the species is problematic. Provisionally it is placed close to *albicapitata* on account of a certain superficial resemblance in the bursae of the two species, but definite placement must await receipt of more material, including both sexes.

Judging by the original description, the general wing color is a chocolate brown with rather indistinct cross lines and definite black

discal dots; the s.t. line is represented only by "a cluster of pale scales at anal angle." The palpi are long and rough scaled, and the antennae are said to be "more heavily ciliate" than in *geminata* Packard with which it is compared.

The female genitalia are quite distinct, the ductus bursae terminating in a narrow chitinous collar attached more or less to the right proximal end of the sack-like bursa. This is largely membranous with a cluster of fine spines on the left dorsal half, continued by a few scattered spines nearly to the fundus; the narrow ductus seminalis originates on the right dorsal side above the middle.

TYPE: Holotype, female, Plummer's Island, Maryland (U.S.N.M.).

DISTRIBUTION: Known only from the type locality.

LIFE HISTORY: Unknown.

Eupithecia albicapitata Packard

Plate 31, figure 2; text figure 14J

Eupithecia albicapitata PACKARD, 1876, A monograph of the geometric moths . . . of the United States, p. 48, pl. 8, fig. 1. TAYLOR, 1907, Canadian Ent., vol. 39, p. 279. BLACKMORE, 1922, Rept. Prov. Mus. Nat. Hist. British Columbia, for 1921, p. M 31. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 166.

Tephroclystis laquaearia, DYAR (*nec* Herrich-Schaeffer), 1904, Proc. U. S. Natl. Mus., vol. 27, p. 889.

Judging by Petersen's figure of the female genitalia the species must be closely allied to the European *strobilata* Hübner, for which Prout (*in* Seitz) uses the name *bilunulata* Zetterstedt. However, there seem to be sufficient minor differences in the position of the spine clusters of the bursae to warrant separation, at least until more European material than is at present available can be studied.

With the following species, *mutata* Pearsall, *albicapitata* is characterized by the presence of ruddy cross bands on the primaries antemedially and subterminally. It is, however, a much smaller species (expanse 15 mm.), and while the general maculation is extremely similar it may be known by the paler, almost white, ground color and the narrower width of the light portion of the median band. The palpi are long and porrect, tufted both dorsally and ventrally and extending beyond the front about twice its

width. Unlike the European *strobilata*, in which the palpi are distinctly longer than its close relative, usually known as *togata* Hübner, the palpi of *albicapitata* are slightly shorter than those of *mutata* Pearsall, the North American counterpart of *togata*. The color is light smoky outwardly, and the third joint is long and tipped with white. The front is rather short, slightly raised above the eye level and rounded; the color is largely whitish, but the anterior margin and a section in front of the antennae are shaded with smoky. The male antennae are finely and evenly ciliate. Segment I of the abdomen is largely pale, segment II with a distinct, transverse, brown band, and the remaining segments with traces of brown banding across their posterior portions. In the specimens examined the areole of primaries was single. A study of a long series of specimens taken by the author at South Milford, Nova Scotia, in June, 1934, shows that considerable variation exists in both size and maculation of primaries. The smallest specimens have a wing expanse of 15 mm.; the largest ones, both male and female, average 18 to 19 mm. The amount of ruddy suffusion, especially in the subbasal band, is variable; the postmedian line either may be gently bulging below the costa or may show a quite sharp, outward angle, starting at the base of the dark costal patch. Occasionally the vertex of the head is suffused with smoky scaling, although generally the pale nature of this section is quite evident.

MALE GENITALIA: Hair pencils weak and attached to base of vinculum, not in pockets. Tegumen broad basally with convex sides which taper sharply to a rounded apex. Uncus long and simple. Vinculum short, broad, apical margin rounded. Brachium vestigial. Clasper long and thin. Aedeagus thin. Armature of vesica consists of a long, twisted bar of chitin occupying about two-thirds of the length of the aedeagus and bluntly rounded apically. Ventral plate of segment VIII broad, with parallel edges, terminating in two thin, pointed projections.

FEMALE GENITALIA: Ovipositor long, narrow, and generally protruding. Dorsal plate of segment VIII uprightly rectangular, lightly chitinized, caudal margin sparsely setose; anterior apophyses long and slender, the

caudal spur thin and terminating in a chitinous patch on the lateral edge of the membranous ventral plate which also bears a few setae. Ostium pouch attached laterally to these patches, large, rectangular, chitinized, leading to a short, membranous ductus bursae; this ductus is terminated by a chitinous collar, rather longer than usual and with distinct ventral flaps. Bursa a long, thinly membranous oval with the ductus seminalis leading out from a broad opening situated in the ventral, proximal area on the right side. In the central section ventrally, but not attaining the fundus, is a large patch of long, thin, weak spines which extends around to the dorsal side, crossing it as a much narrowed band. A second smaller spine patch occurs dorsally just below the collar and opposite the exit of the ductus seminalis.

TYPE: Holotype, male, Brunswick, Maine, June (M.C.Z.).

DISTRIBUTION: Northern in character, occurring in the mountainous district of New York (Catskills) and the New England states and across the Dominion of Canada from the Atlantic to the Pacific, following the spruce belt.

LIFE HISTORY: Not definitely known, but probably it will be found to feed in pine cones or *Chermes* galls on conifers as does its European relative.

Eupithecia mutata Pearsall

Plate 31, figure 3; text figure 14K

Tephroclystis latipennis HULST, 1898, Canadian Ent., vol. 30, p. 114 (*partim*).

Eupithecia togata, TAYLOR (*nec* Hübner), 1909, Canadian Ent., vol. 41, p. 428 (*partim*).

Eupithecia mutata PEARSALL, 1908, Jour. New York Ent. Soc., vol. 16, p. 98; 1910, Proc. Ent. Soc. Washington, vol. 12, p. 141 (*?hujus spec.*). MCDUNNOUGH, 1936, Canadian Ent., vol. 68, p. 257; 1940, *ibid.*, vol. 72, p. 40, pl. 3, fig. 6.

Eupithecia pini FORBES (*nec* Retzius), 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 166.

Following Taylor's reference of 1909, the European species commonly known as *togata* Hübner, but listed by Dietze as *abietaria* Götze and by Prout (*in* Seitz) as *pini* Retzius, has been included in our North American lists, and *mutata*, *spermaphaga*, and *helena* are considered in the 1938 "Check list" to be races of the same. However, while no very tangible differences in the male genitalia ap-

pear to exist, it was shown (1940) that the armature of the female bursae in the first two showed considerable differences in the spined areas and a fourth name, *columbrata* McDunnough, was added to the complex. As a study of European material has proved that Petersen's figure of *togata* (1909, Iris, vol. 22, pl. 5, fig. 20) is quite accurate and as, furthermore, nothing in our North American material could be found to match it, *togata* has been dropped, and the above-mentioned names are here considered as being worthy of specific rank.

As already noted *mutata* shows a very similar type of wing maculation to that of *albicapitata*, but the size is considerably larger (expanse 18–20 mm.) and the ground color duller, showing a pale ochreous tinge rather than white. Pearsall's lengthy description deals with other points of distinction that scarcely hold when a long series is examined. The porrect palpi are very slightly longer than in *albicapitata* but similar in coloration; the front and vertex show more dark scaling; the male antennae possess the same short, evenly distributed ciliations; the banding of segment II of the abdomen is less marked since the following segments are also largely scaled with smoky; the areole of the primaries may be either single or double as noted by Pearsall.

MALE GENITALIA: Very similar to those of *albicapitata*. Apart from the generally larger size the main differences are as follows: the uncus is longer, the aedeagus is considerably thicker, the piece of twisted chitin in the armature of the vesica is longer and more pointed apically; the terminal prongs of the ventral plate are blunter and thicker.

FEMALE GENITALIA: Astonishingly distinct from those of *albicapitata*. Ovipositor shorter and broader than in *albicapitata*. Dorsal plate of segment VIII and anterior apophyses very similar. Ostium pouch broad, lightly chitinized, with rounded cephalic margin. Membranous ductus bursae short, terminating in a high collar with broad flaps. Bursa membranous, more or less urn shaped or roughly rectangular, the rather thin ductus seminalis arising ventrally from near the center and curving caudad. The fundus area of both surfaces is covered with a large patch of long, thin, but well-chitinized spines.

Dorsally there is a smaller patch of similar spines, somewhat below the collar.

TYPES: Holotype, male, allotype, female, Big Indian Valley, Catskill Mountains, New York (A.M.N.H.).

DISTRIBUTION: Northern Atlantic and New England states. In Canada extending from Nova Scotia to northern Ontario.

LIFE HISTORY: No definite breeding records are known, but the larva will presumably be found feeding in the young cones of various conifers.

***Eupithecia helena* Taylor**

Plate 31, figure 4

Eupithecia helena TAYLOR, 1906, Ent. News, vol. 17, p. 191. BARNES AND MCDUNNOUGH, 1912, Canadian Ent., vol. 44, p. 272.

Known only from the single male type. It is a large, rather worn specimen, obviously belonging in the present group, but until more material is available for study its exact status cannot be determined. From an examination of the genitalic slide, made at some time by Cassino, it would seem, as far as could be told, to fall closest to *mutata*.

TYPE: Holotype, male, Pinal Mountains, Arizona (U.S.N.M., ex Taylor and Barnes collections).

DISTRIBUTION: Arizona.

LIFE HISTORY: Unknown.

***Eupithecia columbrata* McDunnough**

Plate 31, figure 5; text figure 15A

Eupithecia togata, TAYLOR (nec Hübner), 1909, Canadian Ent., vol. 41, p. 428 (partim).

Eupithecia mutata, BLACKMORE (nec Pearsall), 1922, Rept. Prov. Mus. Nat. Hist. British Columbia, for 1921, p. M 31, pl. 4.

Eupithecia togata var. *columbrata* MCDUNNOUGH, 1940, Canadian Ent., vol. 72, p. 40, pl. 3, fig. 7.

This is obviously the British Columbian representative of the eastern *mutata*. It is characterized by its somewhat larger size and much brighter coloration, the ruddy cross bands being at times strikingly prominent. The head is largely light creamy with a narrow dark line anterior to the antennae, the whole contrasting strongly with the dark, blackish palpi. Palpal length and male antennal ciliations much as in *mutata*. The abdomen is paler than in *mutata*, at times almost white, in other specimens lightly

shaded with pale brown with white, posterior, segmental edges; segment II is crossed by a dark band varying from ruddy brown to almost black, and there is a lateral line of black spots, usually quite distinct; the small dorsal tufts are largely blackish. The genitalic differences seem sufficient to warrant specific rank.

MALE GENITALIA: Extremely close to those of *mutata*. The most marked difference is in the armature of the vesica, the long chitinous bar being distinctly longer, narrower, and less curved apically, terminating in a quite sharp point.

FEMALE GENITALIA: The main distinction from *mutata* is found in the dorsal spine patch of the bursa. Instead of the thick cluster of long, thin spines found in *mutata*, the spines are very stout, arranged in a single row, and relatively few in number, although there is considerable variability in this respect. The collar is shorter and the shape of the bursa somewhat different, being more tapered towards the fundus.

TYPES: Holotype, female, Steelhead, British Columbia (C.N.C.); allotype and paratypes in the same collection.

DISTRIBUTION: Southern British Columbia and adjacent regions in Washington state.

LIFE HISTORY: Part of the type series was bred from larvae feeding in the cones of *Abies amabilis*.

***Eupithecia spermaphaga* Dyar**

Text figure 15B

Eucymatoge spermaphaga DYAR, 1917, Insector Inscitiae Menstruus, vol. 5, p. 68.

Eupithecia spermaphaga, BARNES AND MCDUNNOUGH, 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 147. MCDUNNOUGH, 1940, Canadian Ent., vol. 72, p. 40, pl. 3, fig. 7.

Apart from the type series the species is very imperfectly known. It is the largest of the group, the wing expanse given in the original description being 23 mm. The name was based on West Coast material bred from larvae found in the cones of *Abies concolor*, *Abies shastaensis*, and *Pseudotsuga taxifolia*. Specimens from Orono, Maine, "from larvae in cones of spruce" were also included, but these need checking as they may be referable to *mutata*.

The distinctive characters of the species, apart from its large size, appear to be the general gray tint of the ground color and the reduction in size of the discal dots. There are two male specimens in the Canadian National Collection that seem to comply with these characteristics; one, very large, from Plumas County, California (W. Bauer), and the other from the Forbidden Plateau, Vancouver Island, British Columbia, bred from cones of *Abies amabilis*. These both show considerably shorter palpi than are found in the other members of the group. As usual the male genitalic characters are not very satisfactory in providing distinctive points of differentiation, and more females must be examined to determine whether or not they check with the figure already given (1940). A slide of a male from Ashland, Oregon, one of the type lot bred from *Pseudotsuga*, was made some time ago and judging by this the genitalia are, as a whole, much larger, the clasper being longer and broader, the long rod of the vesica thin, twisted, and very long, and the prongs of the ventral plate very blunt. In the female genitalia, as already figured, the differences are more marked and consist in the more elongatedly oval shape of the bursa, the broader and more distally placed origin of the ductus seminalis, and the breaking up of the spine patches into four groups of very strong spines, situated dorsally, at the fundus, centro-ventrally and on both sides around the base of the ductus.

TYPE: Holotype, male, Kaolin Beds, Oregon, June 12, reared from larvae in cones of *Abies concolor* (U.S.N.M.).

DISTRIBUTION: Oregon, California, Vancouver Island (?).

LIFE HISTORY: Larvae in cones of *Abies* and *Pseudotsuga*.

Eupithecia purpurissata purpurissata Grossbeck
Plate 31, figure 6; text figure 15C

Eupithecia purpurissata GROSSBECK, 1908, Jour. New York Ent. Soc., vol. 16, p. 23. MCDUNNOUGH, 1936, Canadian Ent., vol. 68, p. 259; 1941, *ibid.*, vol. 73, p. 189.

An early spring flyer characterized by the deep purplish brown coloration of the quite pointed primaries, with little trace of maculation, and the deep smoky secondaries with faint purplish tinge. The palpi are short and

well tufted dorsally, scarcely exceeding the front which, while rather flat, is distinctly raised above the eye level and shortly tufted apically. The male antennae are very finely and evenly ciliate. The abdomen is deep purplish brown, the small dorsal tufting partially consisting of white scales.

With *mystiata* the relationship of the species seems to be with *gilvipennata* and *scabrogata*.

MALE GENITALIA: Hair pencils of segment IX well developed. Tegumen moderately broad, rounded apically. Uncus distinctive, narrowly triangular, the usual thin apical extension being practically lacking. Owing to the obsolescence of the upper hook the apex appears single, the lower branch being enlarged and rounded on its apical margin. Vinculum longer and more pointed than usual, the lateral edges sloping strongly inward. Claspers narrow and only slightly constricted apically. Aedeagus short and very broad. Armature of vesica obscure, consisting apparently of a large, strigate, partially hollowed and irregular piece of chitin which occupies the central section; there seems to be also a small dentate piece on the right side, but the whole is obscured by a broad, spined, and spiculate band which occupies most of the aedeagus, the basal spines being quite large, gradually becoming reduced to mere spicules apically. The ventral plate of segment VIII narrows gradually from a broad base, the apical half consisting of two thin, subparallel, pointed prongs.

FEMALE GENITALIA: Dorsal plate of segment VIII lightly chitinized, rectangular with somewhat concave cephalic margin. Anterior apophyses rather long and thin; caudal spur short; ventral plate membranous, very faintly shagreened. Ostium semicircular, with triangularly raised sides which are feebly chitinized, and gradually narrowing into a short, membranous ductus bursae which terminates in a rather narrow but well-chitinized collar with broad flaps. Bursa oval; ventrally a chitinized trough extends from the collar three-quarters of the way to the fundus, giving rise at its proximal end to a thin, membranous ductus seminalis, projecting caudad. The balance of the bursa, with the exception of a narrow membranous area adjacent to the trough, is covered with moderately long spines.

TYPES: Holotype, female, Monterey County, California (A.M.N.H.); allotype, male, same data (Rutgers University, New Brunswick, New Jersey).

DISTRIBUTION: Coastal region of northern and central California (Humboldt, Sonoma, Marin, and Monterey counties).

LIFE HISTORY: Unknown.

***Eupithecia purpurissata valariata* Pearsall**

Plate 31, figure 7

Eupithecia valariata PEARSALL, 1910, Ent. News, vol. 21, p. 404. McDUNNOUGH, 1936, Canadian Ent., vol. 68, p. 259; 1941, *ibid.*, vol. 73, p. 190, pl. 13, fig. 5.

Tephroclystia muriflua DYAR, 1923, Insector Inscitiae Menstruus, vol. 11, p. 22.

Eupithecia muriflua, McDUNNOUGH, 1941, Canadian Ent., vol. 73, p. 190.

A southern Californian race, characterized by the smaller size, paler coloration of primaries, and lighter-colored secondaries.

TYPES: *Valariata*, holotype, male, allotype, female, San Diego, California, March (A.M.N.H.); *muriflua*, holotype, female, San Diego, California (U.S.N.M.).

DISTRIBUTION: San Diego County, California.

LIFE HISTORY: Unknown.

***Eupithecia mystiata* Cassino**

Plate 31, figure 8; text figure 15D

Eupithecia mystiata CASSINO, 1925, Lepidopterist, vol. 4, p. 55. McDUNNOUGH, 1941, Canadian Ent., vol. 73, p. 193, pl. 13, figs. 3, 4; 1945, *ibid.*, vol. 77, p. 64.

Besides a few paratypes in rather indifferent condition it has been possible to examine specimens from Idyllwild, Riverside County, California, collected in May, and a small series of very perfect specimens from Sonoma County, California, taken in March and April. The narrow pointed primaries are of a deep smoky color with little trace of maculation, and the Arizona and Riverside County specimens are somewhat smaller and more unicolorous than those from Sonoma County. A fair-sized discal dot is present, there is frequently a narrow, somewhat paler band defining the t.p. line outwardly, and the s.t. line is obscurely indicated as a whitish, irregular line most evident above the tornus. The presence of a narrow ochreous shade below the discal dot along the cubital veins

is rather characteristic, and there are further indications of a similarly colored subapical dash. In well-marked specimens, notably in the Sonoma County material, these two areas may become joined to form a long ochreous streak, and this may even be extended basad much along the same lines as occur in *gilvipennata*. Vein 1 also shows considerable ochreous shading.

As has already been noted (1941) the species may readily be confused with *gilvipennata* (formerly called *scabrogata*) which shows essentially the same coloration and type of maculation. Apart from its rather larger size *gilvipennata* can apparently be distinguished as follows: the smaller discal dot is partially surrounded by a small circular ochreous patch (not the streak of *mystiata*), vein 1 is seldom tinged with ochreous, and the white portion of the s.t. line above the tornus is more prominent and V-shaped. These distinctions, however, are slight, and in some doubtful cases recourse must be had to genital slides, these organs being abundantly distinct in both sexes.

The palpi are extremely short, not attaining the level of the front; they are blackish with a slight pale tip. The front is strongly raised above the level of the eyes (more so than in *gilvipennata*) and is flatly bulging; it shows beneath a distinct hollowing out as if it were an incipient *Prorella*. The male antennae are extremely finely ciliate. A dark band across the prothorax is edged posteriorly by a white bar; the other thoracic segments and the patagia are largely dark with slight white sprinkling. The abdomen is similarly colored to the thorax, segment II being a shade deeper in color but not definitely banded. The species is placed next to *gilvipennata* on account of similarity of maculation, type of palpi and front, and the structure of the female ostium.

MALE GENITALIA: Hair pencils present on segment IX. Tegumen narrow, conical. Uncus with the terminal section short, broad, with simple rounded apex. Vinculum broad with rounded apical margin. Clasper narrow, slightly tapered apically. Aedeagus broad and long. Vesica armed with two short, feebly dentate bars and a longer twisted piece of chitin, connected with the end piece. These are all situated in the proximal area; distad is

a broad spiculate band, occupying the whole terminal half and partially concealing two further small, feebly chitinized, and dentate pieces which almost seem to be made up from an aggregation of spicules. Ventral plate consisting of two chitinous bars, converging apically and narrowly joined by an expanded base; their apices are bluntly rounded.

FEMALE GENITALIA: Dorsal plate of segment VIII lightly chitinized, rectangular, with slightly rounded laterocaudal edges; anterior apophyses moderately long, caudal spurs quite short and terminating on the laterocephalic edges of the finely shagreened ventral plate. Ostium arising in a median groove between the two lobes of the ventral plate, narrow, finely shagreened, the sides triangularly raised and extended caudally to points. Ductus bursae short, membranous, terminated by a broad, heavily chitinized collar with large flaps. This leads into a broad, chitinous trough with strong, raised edges which extends down the right ventral surface of the flatly oval bursa to approximately the middle of the right margin and terminates in a rounded membranous projection from which the narrow ductus seminalis curves caudad. The balance of the bursa is thickly spined over both surfaces.

TYPES: Holotype, male, allotype, female, near Miami, Arizona, March (M.C.Z.).

DISTRIBUTION: Arizona, California (Riverside and Sonoma counties).

LIFE HISTORY: Unknown.

***Eupithecia gilvipennata* Cassino and Swett**

Plate 31, figures 9, 10; text figure 15E

Eupithecia scabrogata PEARSALL, 1912, Canadian Ent., vol. 44, p. 28 (*partim*, ♂ *nec* ♀). BLACKMORE (*nec* Pearsall), 1922, Rept. Prov. Mus. Nat. Hist. British Columbia, for 1921, p. M 31, pl. 4.

Eupithecia scabrogata form *gilvipennata* CASSINO AND SWETT, 1922, Lepidopterist, vol. 3, p. 148. BLACKMORE, 1923, Rept. Prov. Mus. Nat. Hist. British Columbia, for 1922, p. O 33, pl. 6. MCDUNNOUGH, 1940, Canadian Ent., vol. 72, p. 39.

Eupithecia scabrogata, CASSINO (*nec* Pearsall), 1925, Lepidopterist, vol. 4, pp. 47, 48, figs. 1, 2. MCDUNNOUGH, 1940, Canadian Ent., vol. 72, p. 39; 1941, *ibid.*, vol. 73, p. 193.

In 1940 a genitalic slide was made from the supposed abdomen of the holotype female of *scabrogata* Pearsall in the collection of the

American Museum. This abdomen had become detached at some time but was contained in a small paper envelope, pinned below the specimen. When the slide showed that the genitalia did not agree with those of the species generally accepted as *scabrogata* but were actually the same as those of *vistata* Cassino, the author, not knowing the actual specimen, decided against accepting this abdomen as authentic and published a note to this effect (1940). Since then it has been possible to examine carefully the actual type, and based on this study it unfortunately becomes necessary to reverse the decision of 1940. There seems little doubt that the holotype of *scabrogata* actually represents the species known as *vistata* and that, in consequence, the abdomen and its genitalic slide must be considered as authentic. Such being the case *gilvipennata* becomes available as the correct specific name, this name being based on a color form in which a broad yellow band extends from base to apex of primaries through the otherwise black brown ground color. This form is an extreme one, found more frequently in the males. In the more usual coloration the primaries are largely black brown with indications of ochreous shading around the small discal dot and at the apex of the wing. By a union of these areas and a basad extension of the pale color all manner of variations occur, culminating in typical *gilvipennata*. The dark color of the wing obscures most of the maculation, but generally a white V-shaped mark above the tornus indicates the termination of the s.t. line. The secondaries are dirty white with broad blackish shading along the outer and inner margins. The thorax and abdomen are blackish, the former usually with a distinct, white, median, transverse band, the latter with the dorsal tufting lightly edged with whitish. The palpi are very short, scarcely projecting beyond the front, dark, with the third joint tipped with ochreous. The front is bulging, and the male antennae are very finely and evenly ciliate. Based solely on the male ventral plate *gilvipennata* would fall into the *satyrata* group, but other characters hardly warrant this association. The species occurs very early in the spring, flying in central California in late February and early March, farther north in late April and early May.

MALE GENITALIA: Hair pencils strongly developed. Tegumen narrow, sharply conical. Uncus chunky, bifid. Vinculum broad, rather squarely cut, with heavily chitinized edges. Clasper broad, asymmetrical, the right one showing a single rounded bulge on the ventral margin beyond the middle, the left one, in addition to the bulge, with a sharper projection nearer the base, the section between the two being heavily chitinized and strongly concave. Aedeagus long and rather thick. Vesica armed with a large, twisted, semi-cylindrical piece of chitin with a foot-like base and a broad, obscure, apical piece, very lightly chitinized, with rounded and fluted distal edge; between the two is a narrow spiculate band. Ventral plate of segment VIII a single, thin rod arising from a broad base and terminating in two very short forks, narrowly separated.

FEMALE GENITALIA: Very similar in general style to some of the species of the *satyrata* group. Dorsal plate of segment VIII uprightly rectangular, lightly chitinized; anterior apophyses long, thick, with short, thick, caudal spurs terminating in lateral, setose, chitinous patches at the edges of the membranous, ventral plate which shows centrally a broad, shagreened bar descending into the ostium. The raised, semicircular ostium is partly protected by a fold of the membrane of segment VII; its triangular sides are lightly chitinized; it leads into a short, membranous ductus bursae, which terminates with a broad, semicircular collar. The initial portion of the bursa, the neck, is broad, lightly chitinized, and strongly projected to the right, the membranous ductus seminalis arising ventrally from the rounded outer edge of the bulge as a rather broad, membranous tube which descends a short distance over the bursa proper before bending caudad and narrowing. Bursa broadly attached to the neck, oval; the left half of the ventral surface and nearly the whole dorsal surface are spined; the right half ventrally is membranous, this area continued around the right side to form a narrow membranous strip along the dorsal edge which reaches to the fundus.

TYPE: Holotype, male, Wellington, British Columbia (University of British Columbia, Vancouver, ex Blackmore collection).

DISTRIBUTION: Pacific coast from British

Columbia to California; Colorado (Morrison); Arizona.

LIFE HISTORY: Unknown.

***Eupithecia miamata* Cassino**

Plate 31, figure 11; text figure 16A

Eupithecia miamata CASSINO, 1925, Lepidopterist, vol. 4, pp. 47-49, fig. McDUNNOUGH, 1941, Canadian Ent., vol. 73, p. 190.

Owing to lack of material not much can be added to what has already been said of this species. Judging by the paratype male in the Canadian National Collection, the species is considerably smaller than *gilvipennata*. The primaries are narrow, pointed, and of a deep smoky coloration. The rubbed condition of the specimen has obliterated any maculation that might have been present except a small, circular, ochreous patch around the minute discal dot and a similarly colored, subapical, short streak. There are traces of a faint, white, irregular s.t. line. The palpi are short but project slightly beyond the front which is somewhat raised above the level of the eyes but in general rather flat and not so strongly bulging as in either *mystiata* or *gilvipennata*. The male antennae are very finely ciliate. A slide made from the female allotype shows that the genitalia, as was to be expected, show great similarity to those of *gilvipennata*, being intermediate between this species and *segregata*. The main difference from *gilvipennata* consists in the lesser degree of chitinization in the proximal area of the bursa and the much less prominent outward bulge at the base of the ductus seminalis. The spining on the ventral surface appears to extend farther to the right, leaving a narrower membranous space. This, however, may be individual and needs further checking. In the male genitalia the different shape and position of the projections on the ventral margin of the left clasper, as a reference to the figure will show, distinguish it from *gilvipennata*.

TYPES: Holotype, male, allotype, female, Miami, Arizona, March (M.C.Z.).

DISTRIBUTION: Known only from the type locality.

LIFE HISTORY: Unknown.

REMARKS: From a topotypical female specimen just received from Mr. J. Sperry, it has been possible to present a figure of the

adult in much better condition than the specimens originally studied.

Eupithecia scabrogata Pearsall

Plate 31, figure 12; text figure 16B

Eupithecia scabrogata PEARSALL, 1912, Canadian Ent., vol. 44, p. 28 (*partim*, ♀ *nec* ♂). MCDUNNOUGH, 1940, Canadian Ent., vol. 72, p. 39 (*partim*).

Eupithecia vistata CASSINO AND SWETT, 1922, Lepidopterist, vol. 3, p. 175.

The error in connection with the correct determination of this species has already been explained under *gilvipennata* (p. 663). The true *scabrogata* is smaller in size and more fragile in appearance but very similar in type of maculation of primaries. Its flight is apparently from December to February, but there may be a second brood, as a female from Borego, California, bears a date label May 5. The ground color is a smoky brown, rather lighter than in *gilvipennata*, and the cross lines are very obscure; the t.p. line can be faintly traced as an oblique line parallel to outer margin with a slight inbend at costa; beyond this on the outer border of the subterminal area is a faint series of short dashes on the veins; there is little indication of a paler s.t. line; typically the minute discal dot is shaded below with light yellowish and in the holotype this color also occurs in obscure apical and basal streaks; in a single female, from Napa County, there is no trace of ochreous shading. The secondaries show considerably less dark marginal suffusion, and the under side is noticeably lighter with only traces of maculation. While the palpi are much the same in length as those of *gilvipennata*, the front is decidedly more strongly bulging. The stalk of the male antenna is thinner, and the ciliations, while similar in length, seem to be less numerous.

In the original description of *vistata*, male specimens (presumably through a printer's error) have been designated as both holotype and allotype. In the Cassino collection all the labels have been changed to read "female," the male sex not being represented. The determination of the species is based on a slide made by Cassino from a female allotype (No. 5321).

MALE GENITALIA: Hair pencils of segment IX present. Tegumen narrowly conical,

rather short. Uncus short, weakly bifid. Vinculum somewhat longer than normal, produced and narrowed apically. Claspers short and chunky, tapered slightly towards apex. Aedeagus thin, apical area finely spiculate. Armature of vesica obscure, owing to very weak chitinization of the pieces in the single available slide. These seem to consist of a small, twisted end piece and a poorly defined half cylinder which extends through the apical section of the aedeagus and of which only one curled-up proximal edge is at all definitely visible; this seems to be partially covered by a narrow band of spicules. Ventral plate, as far as can be determined from the weak chitinization, consists of a single rod with bluntly rounded apex, much as in *satyrata*.

FEMALE GENITALIA: Dorsal plate of segment VIII uprightly rectangular, lightly chitinized; anterior apophyses strong and rather long, the caudal spurs thin, terminating in fair-sized, lateroventral, chitinous patches. The membranous ventral plate shows a central, finely shagreened area leading to the ostium which is much as in *gilvipennata*, being semicircular with triangularly chitinized sides. A short membranous ductus bursae follows, terminated by a narrow, chitinous half collar. Bursa oval, the proximal half membranous, showing little of the chitinization found in *gilvipennata* and *scabrogata*, continued down the right side as a gradually narrowing band reaching to the fundus; the balance of the bursa on both surfaces is equally covered with short spines. The ductus seminalis arises at the base of the collar on the right side somewhat ventrally as a broad raised tube, descending along the unspined right side of the bursa for nearly two-thirds of its length, then narrowing and turning caudad.

TYPES: *Scabrogata*, holotype, female, California (A.M.N.H.); *vistata*, holotype, female, San Diego, California, December (M.C.Z.).

DISTRIBUTION: Southern California, extending along the coast northward to Napa County; Arizona (Redington).

LIFE HISTORY: Unknown.

REMARKS: The drawing of the male genitalia is made from a specimen from Redington, Arizona, which originally came from the

Barnes collection and is now in the American Museum, *ex* collection Grossbeck, together with a female from the same locality. The female genitalia have been based on a slide of the holotype of *scabrogata* and other slides from southern Californian material.

***Eupithecia adequata* Pearsall**

Plate 31, figure 13; text figure 16C

Eupithecia adequata PEARSALL, 1910, Ent. News, vol. 21, p. 158.

The identification of this species should not cause any great difficulty. The rather narrow, pointed primaries are of a dull whitish ground color, the cross lines angled sharply outward below the costa and then strongly inwardly oblique. The area from the base to the t.p. line is more or less darkened by smoky shading and contains a light brown band of varying intensity on the basal side of the t.a. line. A broad, pale, subterminal area forms a rather sharp contrast to the darker preceding section and juts out below the apex to attain the outer margin. It is bordered outwardly across the balance of the wing by a light brown, narrow band. There is a brownish shade on costa pre-apically which contains two black streaks. The black discal spot is small and is contained in the angle of the t.p. line. The palpi are short and bushy, slightly projecting beyond the front which is somewhat raised above the eye level and flatly rounded. The ciliation of the male antennae consists of short, sparse ciliae of the trifasciulate type. The scutellum shows a patch of dark scaling. The abdomen dorsally shows a dark transverse band on segment II and frequently considerably dark shading on segments I and IV, the remaining segments being lighter, more smoky gray; a narrow white posterior border is present on all segments. The posterior segments of the female abdomen show strong scale tufts, causing a thickening at this point. The upper pair of spurs on the hind tibiae tend to be rather shorter than usual.

MALE GENITALIA: Hair pencils on segment IX lacking. Tegumen long, thinly conical. Uncus short, stubby, but with distinctly bifid apex. Vinculum more pointed than usual, much as in *purpurissata*. Clasper narrow, the ventral edge strongly chitinized for three-quarters of its length, terminating

in a blunt, raised projection. Aedeagus long, rather narrow, somewhat expanded apically. Armature of vesica consisting of two thin, spined pieces of chitin, situated apically and medially, and an obscure semicylindrical piece adjacent to the latter, the whole covered by a broad band of spicules. Ventral plate short and broad, terminating in two thin parallel prongs.

FEMALE GENITALIA: Dorsal plate of segment VIII rectangular; anterior apophyses thick and rather long with short thick caudal spurs, terminating as usual. Attached to the cephalic edge of the membranous ventral plate is a flat, broadly rectangular and finely shagreened ostium pouch, from the cephalic margin of which a very short membranous ductus bursae leads to a well-chitinized collar which inclines slightly to the left. A broadly oval bursa follows which on its ventral surface shows a broad, median band of thin spines, descending from the collar to the fundus, leaving narrow membranous areas on each side. Dorsally a strongly raised, chitinized area starts narrowly at the left hand corner of the collar and descends, rapidly broadening, to the middle of the bursa where it covers nearly the entire face. At its base is a small cluster of long spines and from its right distal end the narrow ductus seminalis has its origin, curving caudad. Below this a similarly broad band of spines to that of the ventral surface reaches to the fundus but does not join with the other spined area; the marginal spines of this band are very long and thin.

TYPES: Holotype, male, and allotype, female, Eureka, Utah, May (A.M.N.H.).

DISTRIBUTION: Utah, extending through Nevada into California east of the Sierras.

LIFE HISTORY: Unknown.

REMARKS: The genitalic figures are based on slides of type material.

***Eupithecia acutipennis* Hulst**

Plate 31, figure 14; text figure 16D

Tephroclystis acutipennis HULST, 1898, Canadian Ent., vol. 30, p. 115. PEARSALL, 1910, Canadian Ent., vol. 42, p. 314.

Very similar in general maculation to *adequata*, but the apex of primaries is even more acute, the ground color more of a light smoky ochreous, and the cross lines are more strongly incurved above the inner margin

where they are accentuated by dark shading. Segment II of the abdomen shows a definite dark band. The palpi are longer than in *adequata*, the front more roundedly bulging, and the ciliations of the male antennae, while retaining their triciliate character, are distinctly longer. The species appears to be on the wing from late November until February.

MALE GENITALIA: Hair pencils of segment IX apparently lacking. Tegumen narrowly conical. Uncus normally long and thin, with distinct bifid apex. Vinculum much as usual, broadly rounded apically. Clasper trigonate, without any chitinized thickening of the ventral margin but with a strong projection of this margin about the middle which terminates in a sharply pointed spine, curving ventrad. Aedeagus long and thin. Armature of vesica consists of a band of closely appressed small spines in the apical half which partially covers a small bar of chitin with curled edges. Ventral plate of segment VIII broad at base, gradually narrowing and terminated in the apical third by two parallel prongs.

FEMALE GENITALIA: Dorsal plate of segment VIII weakly chitinized except the cephalic margin, broadly rectangular; anterior apophyses rather long and thin with weak caudal spur. Ventral plate membranous but with strong lateral scale tufts. Ostium a broad, open, finely spiculate pouch with raised caudoventral edge. A short membranous ductus bursae connects it with a narrow, but strongly chitinized collar with large flaps. The bursa superficially bears a good deal of resemblance to that of *purpurissata*, but the chitinous trough from which the fine ductus seminalis arises has shifted to the dorsal side and is considerably shorter. The fundus third of the oval bursa is covered on both surfaces with spines, with a band of similar spines jutting up the ventral surface to just below the collar. At the base of the trough a few spines are present; the balance of the proximal section is membranous.

TYPE: Holotype, male, Los Angeles County, California (U.S.N.M.).

DISTRIBUTION: Southern California.

LIFE HISTORY: Unknown.

Eupithecia subapicata Guenée

Plate 31, figure 15; text figure 16E

Eupithecia subapicata GUENÉE, 1857, Histoire

naturelle des insectes, vol. 10, p. 331. PACKARD, 1876, A monograph of the geometrid moths . . . of the United States, p. 62, pl. 8, fig. 11.

Chesias occidentaliata PACKARD, 1870, Proc. Boston Soc. Nat. Hist., vol. 13, p. 404.

This species is distinguished by its pointed primaries, the ground color of which is wood brown. Characteristic also is the presence of a small, light ochreous brown, pre-apical, costal patch which is almost connected with an elongate, subapical patch of similar color. The basal portion of the wing frequently shows slight shading of a lighter color which at times also occurs on the outer margin of the median band. In such cases the median band appears darker than the remainder of the wing, running obliquely across and parallel to the outer margin with a strong outward angle below costa. The pale s.t. line is hardly as prominent as Packard's figure shows and is usually more or less limited to a thin, white lunule above the tornus. The black, raised, discal dot is prominent, and the veins are streaked alternately with black and white. The secondaries are pale smoky with indications of numerous cross lines, especially above the darker shaded inner margin. The palpi are rather short and bushy, projecting moderately beyond the rather flat front which is only slightly raised above the level of the eyes. The general color of head, thorax, and abdomen is wood brown, but there are traces of paler banding across the anterior portion of the thorax and a slight intermingling of paler and darker shades on the abdomen. The scutellum of the mesothorax shows distinct lateral tufting which in worn specimens, however, is easily rubbed off. The ciliae of the male antennae are moderately long, sparse, and distinctly of the trifasciculate type. The female antennae are very shortly ciliate. The species flies in the central coast region of California in February and March. Packard's type specimens of *occidentaliata* are simply recorded as from "California, Edwards." Among the specimens in the Henry Edwards' collection in the American Museum is a male from California numbered "213" and a reference to his original catalogue shows that it was collected in San Mateo County in March, Packard's name for the species having been added by Henry Edwards in a different colored ink at a later date. The specimen

could readily be one of the type lot.

MALE GENITALIA: Hair pencils of segment IX lacking. Tegumen short, conical. Uncus long, bifid. Vinculum short, broad, apical margin rather truncate. Clasper broad in the basal half and lightly chitinized; ventral margin with a strong, finger-like projection at middle; apical half narrow and of even width throughout. Aedeagus broad. Vesica armed with a long, stout rod gradually tapering to a pointed apex, strongly strigate, especially in the basal section and obscurely dentate in the apical portion; there is also a small, thin, basal piece of chitin. Ventral plate consists of two parallel, tapering prongs, broadly joined in the basal third of the plate.

FEMALE GENITALIA: Dorsal plate of segment VIII lightly chitinized, rectangular, slightly tapering caudally, the caudal edge rounded with a small, V-shaped membranous area medially; anterior apophyses long and strong; caudal spur similar, terminating in a chitinous, lateroventral patch. Ostium broad, finely spiculate. Ductus bursae composed almost entirely of the chitinous collar which is broad, with only slightly raised edges. Bursa pear shaped, the proximal half well chitinized, with strong but sparse striations on the dorsal surface and a large patch of short spines on the ventral surface shortly below the collar. At the distal end of the chitinized area a characteristic V-shaped projection juts into the fundus area on the right side. The fundus half of the bursa is covered on both surfaces with long spines, the marginal ones being particularly long; on the left ventral side this area is restricted by a membranous band jutting down from the chitinized portion and there are indications of a similar, but much narrower band on the dorsal side. The ductus seminalis arises dorsally as a small, finger-like projection from near the center of the chitinized area.

TYPES: *Subapicata*, holotype, male, California (U.S.N.M., ex Oberthur and Barnes collections); *occidentaliata*, holotype, male (without abdomen), California (M.C.Z.).

DISTRIBUTION: Central coastal region of California.

LIFE HISTORY: Unknown.

Eupithecia shirleyata Cassino and Swett

Plate 31, figure 16; text figure 16F

Eupithecia shirleyata CASSINO AND SWETT, 1922, Lepidopterist, vol. 3, p. 165, fig. on p. 162.

In spite of the differences noted in the original description as distinguishing the species from *subapicata*, the only superficial one that seems to hold is the smaller size. There are tendencies towards a duller wing coloration, especially in the males, and the pale apical areas may be somewhat reduced in size, but these features do not always hold. The genitalia in both sexes offer, however, good characters. The species, as far as is known, is confined strictly to the southern portion of California and flies during the winter months from the end of November until late March or even early April.

MALE GENITALIA: Very similar to those of *subapicata*, the projection from the ventral margin of the clasper being somewhat broader. The main distinction lies in the fact that the single rod which forms the armature of the vesica is much thinner and considerably longer; the aedeagus is also somewhat longer and narrower.

FEMALE GENITALIA: Dorsal plate, ostium, and collar much as in *subapicata*, but the latter much more lightly chitinized. The bursa, however, is entirely different and quite uniquely shaped. The left edge forms an almost straight, vertical line, while the right side bulges strongly outward. Both surfaces, except at the extreme right of the bulge, show a number of narrow vertical ridges provided with several rows of quite short spines. The most unique character is the extension of the fundus area into a long, narrow, membranous tube, terminating in a small bulb. The ductus seminalis arises as a small, membranous finger near the upper, outer margin of the bulge of the bursa on the ventral side in the afore-mentioned, membranous area.

TYPES: Holotype, male, allotype, female, San Diego, California, March (M.C.Z.).

DISTRIBUTION: Southern California (Pasadena, San Diego, and adjacent areas).

LIFE HISTORY: Unknown.

Eupithecia redingtonia, new species

Plate 31, figure 17; text figure 16G

This species is the third in the closely similar *subapicata-shirleyata* group, the general appearance being essentially the same as that of the other two species. In palpal length and type of ciliation (trifasciculate) of the male antennae it agrees with the other species. The front, however, seems to be more

distinctly bulging than in either *subapicata* or *shirleyata*. The coloration of the primaries is also very similar, varying from smoky brown in fresh specimens to wood brown in older ones. The light ochreous subapical bar which is a prominent feature in *subapicata* is much reduced and has become practically obsolete in the holotype, although present but reduced in size in the paratypes. A small but distinct, ochreous, costal spot just exterior to the t.p. line is apparently always present. The maculation of the primaries is faint but consists of a number of fine, oblique, wavy cross lines, angled outwardly below costa; of these a geminate t.p. line is fairly evident in the costal portion of the wing but tends to fade out towards the inner margin. As in *subapicata* the thin, irregular, white s.t. line is best observed as a lunate mark above the tornus. The black discal dot is quite prominent. The secondaries are a dull smoky, deepening in color along the inner and outer margins; there are vague traces of curved postmedian lines which show up more distinctly on the similarly colored under side. The size is the same as that of *shirleyata*.

The main distinctions are found in the genitalia, those of the male approaching closer to *subapicata*, while the female organ is distinctly of the *shirleyata* type.

MALE GENITALIA: Very similar to those of *subapicata*. The uncus is thinner and more sharply pointed; the vinculum slightly longer; the finger-like projection from the mid-ventral edge of the clasper, while equal in width, is noticeably longer. The main distinction is found in the aedeagus and its armature; the aedeagus is much longer and thinner; the vesica is armed with a long, broad, chitinous rod with slightly bent and pointed apex; this rod is toothed on the left side, and its basal portion appears to be recurved with the edge strongly dentate. Besides the rod there is a thin, semicylindrical, chitinous piece adjacent to the base of the rod on the left side.

FEMALE GENITALIA: Very similar to those of *shirleyata*. The collar is somewhat broader and slightly better chitinized. The bulging proximal section of the bursa is shorter, and the spined ridges are fewer in number and do not descend to the fundus except on the right side where the fine spining extends into the membranous tube for half its length. This

tube is shorter than in *shirleyata* and appears to show a better-defined terminal bulb.

HOLOTYPE: Female, Redington, Arizona, in the American Museum of Natural History (*ex* collection Grossbeck).

ALLOTYPE: Male, same data.

PARATYPES: One male, one female, same data; one female, Miami, Arizona, March 20 (Sperry collection).

The Redington material came originally from the Barnes collection and apart from the holotype is in rather poor condition. The allotype lacks the abdomen and left secondary but is otherwise less rubbed than the paratype male from which the genitalic slide has been made. This specimen is worn, and the head is missing. The paratype female also lacks an abdomen.

Eupithecia gilata Cassino

Plate 31, figures 18, 19; text figure 17A

Eupithecia gilata CASSINO, 1925, Lepidopterist, vol. 4, p. 50, fig. (*partim*, ♂ *nec* ♀). MCDUNNOUGH, 1941, Canadian Ent., vol. 73, p. 190, pl. 13, figs. 1, 2; 1945, *ibid.*, vol. 77, p. 64.

This small, dark-colored species with sharply pointed primaries can easily be confused with other similarly colored species from the same general region, and in such cases the only sure means of determination is through a genitalic slide, the organs in both sexes being extraordinarily distinct.

Recently a virtually topotypical female (pl. 31, fig. 19), taken by the Sperrys at Miami, Arizona, in March and in excellent condition, has been carefully examined and compared with a small series from Napa County, California, confirming the diagnosis given in 1941. The Arizonan specimen lacks the faint brown tinges in the ground color found in the primaries of the Californian specimens but agrees in all other respects. Maculation is practically obsolete, the small, black, discal dot and a minute, white mark above the tornus being the only characters readily observable. The palpi are quite short, project very slightly beyond the flat front, presenting with it the usual conical appearance; the male antennae are feebly trifasciculate with rather numerous ciliae.

MALE GENITALIA: Hair pencils on segment IX apparently lacking. Tegumen very narrow and long with rounded apex. Uncus with broad, bulbous base, the terminal por-

tion short, thin, sharply pointed, and bifid. Vinculum produced cephalad with apex bluntly pointed, the lateral chitinous edges enlarged to form two lobes, contiguous in their median line. Claspers asymmetrical; sacculus well developed and chitinized, strongly raised above the basal half of the dorsal surface and appearing hollow when viewed ventrally, much broader on the left clasper than on the right one; the former shows on the ventral margin a small, finger-like projection, followed distally by a rounded prominence; the latter shows only a slight rounded projection; both terminate in large, irregularly shaped, and ventrally curved prominences which are thickly covered with flat dark scales; balance of clasper membranous with chitinous costal edge extended to the broadly rounded apex. Aedeagus curved, somewhat tapered apically. Vesica armed with a basal piece of semicylindrical chitin followed distally by two long, thin bands of fine, closely appressed spines. Ventral plate short and broad, terminating in two short, parallel prongs.

FEMALE GENITALIA: Dorsal plate of segment VIII strongly chitinized, much longer than usual, being fully twice as high as broad; caudal area spiculate, with slight median notch on terminal edge; anterior apophyses short and thin, caudal spurs long, curved, arising at the extreme base of the apophyses and terminating in chitinous strips which are heavily scaled and nearly meet in the median line of the ventral plate. This plate is very finely shagreened and provided with two hollowed, oval pads, situated on the chitinized cephalic margin and strongly spiculate on their dorsal surface. A rather narrow, twisted, and semirectangular ostium pouch is attached at its base to the chitinous strips, showing raised flaps on its ventral side which may indicate the opening of the narrow ostium. Ductus bursae very short, membranous, terminated by a short, narrow, chitinous collar with broad flaps. Bursa an irregular oval, projecting to the right. The dorsal surface is chitinized and somewhat strigate on its proximal two-thirds, the ductus seminalis arising as a broad, strongly raised, chitinous ridge, commencing at the base of the collar and bending to the right; after projecting slightly beyond the edge of the bursa

it narrows to a fine membranous tube which is directed caudad; at its base on the left side is a scattering of small spines. The fundus is covered with spines, the marginal ones being long and thick. On the ventral surface, situated more or less medially, is a large patch of moderate-sized spines, the fundus, both edges, and the lightly chitinized proximal section being quite free of spining. The ventral surface of segment VII is very heavily covered with scale pads.

TYPE: Holotype, male, Gila-Pinal county line, Arizona (M.C.Z.).

DISTRIBUTION: Arizona; California (Napa County).

LIFE HISTORY: Unknown.

REMARKS: The spined areas on the bursae of Californian specimens are rather more extended than in the single Arizonan specimen studied. No other differences, however, can be noted, and as variability in the extent of spined areas in individual specimens is of frequent occurrence all through the genus, this feature is not treated as of any special significance. The drawing is based on a Californian specimen.

***Eupithecia plumasata* McDunnough**

Plate 31, figures 20, 21; text figure 17B

Eupithecia plumasata MCDUNNOUGH, 1946, Canadian Ent., vol. 78, p. 86, fig. 2 on p. 89.

Since the description of this species from a single male specimen Mr. William Bauer has been successful in securing several more specimens of both sexes in the type locality, Mohawk, Plumas County, California, and has kindly deposited a male and two females in the American Museum collection. These specimens check very well with the original description, the larger size and the deep smoky gray color of the wings, as compared with Napa County *gilata*, serving as a means of separation from this closely allied species. The male antennae are considerably more distinctly trifasciculate than those of *gilata*. The females are somewhat smaller and darker than the males but similarly obscure in maculation. It might be noted that the pale vertex of the head contrasts rather sharply with the deeper colored thorax and that a narrow black band crosses segment II of the abdomen, the segments posterior to this being unicolorous deep smoky. These fea-

tures were not mentioned in the original description. In the male genitalia the spindle-shaped bundle of cornuti in the vesica, the broader apical margin of the vinculum, and the slight differences in the irregularities along the ventral border of the left clasper serve to distinguish the species from *gilata*. The tegumen appears also to be much shorter and not so narrow, a character that will need further checking. The female genitalia, as was to be expected, are also very close to those of *gilata*. The ostium pouch is considerably broader, less twisted, and with the flaps reduced in size. The bursa is somewhat larger, with the chitinous ridge, forming the initial portion of the ductus seminalis, broader and projected farther over the right margin; the scattered basal spining found in *gilata* has been augmented to form a fair-sized patch; other details are similar in both species.

TYPE: Holotype, male, Mohawk, Plumas County, California (C.N.C.).

DISTRIBUTION: So far known only from the type locality.

LIFE HISTORY: Unknown.

REMARKS: There is a possibility that *plumasata* may eventually be considered as a mere race of *gilata*, but until life histories are known it seems better to give both names specific rank.

Eupithecia deserticola McDunnough

Plate 31, figure 22; text figure 17C

Eupithecia deserticola MCDUNNOUGH, 1946, Canadian Ent., vol. 78, p. 88, figs. 1, 4.

Since the original description the species has been collected in some numbers in the type locality, Borego, California, and Mr. John L. Sperry has kindly deposited a small series in the American Museum collection. These specimens were collected in both January and March, and it is noticeable that the January specimens show a much deeper and smokier color of the primaries than those taken later in the year in which the ground color is decidedly of a pale ochreous tinge. Whether these latter specimens belong to a second brood or not is a matter that cannot be clarified until the life history is known. The characteristic features of the maculation of this rather large but frail-appearing species have been sufficiently

dealt with in the original description. The very short palpi, the strongly rounded and bulging front, the bifasciculate nature of the male antennae with long, sparse, curved ciliae, and the dark banding on segment II of the abdomen are all helpful determinative characters; the spurs of the hind tibia are normal. The position of the species is problematic as it does not seem to show any particularly close relationship to other species, although the short palpi, bulging front, and the shape of the aedeagus in the male genitalia might indicate some obscure connection with *nevadata* Packard.

The genitalia are extremely small for the size of the insect. To the original diagnosis additions might be made as follows: in the male the tegumen is rather short and strongly conical, the uncus somewhat longer and thicker than usual with the two terminal prongs prominent and pointed; the vinculum slightly tapered and square-cut apically; the ventral margin of the clasper lightly chitinized from the base to the median projection, the apical half being much narrower with rounded apex; the broad, cone-shaped aedeagus is quite characteristic. In the female genitalia the dorsal plate of segment VIII is more or less rectangular, lightly chitinized, with the caudal section sparsely covered with blunt spicules; the lateral edges are rounded, and there is a small, median, V-shaped excavation; anterior apophyses short and somewhat outcurved, caudal spurs long and strongly outbowed, terminating in a slightly thickened strip on the caudolateral edge of the membranous ventral plate. The drawing of the bursa given with the original description does not appear to be accurate in the light of further, better inflated material from the March specimens. Viewed ventrally the bursa shows more of a bulge to the left in its proximal membranous portion, and the spined area on both surfaces consists of a band of spines extending obliquely across the distal half from the middle of the right side towards the fundus and separated by a narrow, membranous strip along the right edge; the marginal spines are quite heavy in the initial portion and rest on chitinous bases; on the dorsal side the spine band does not quite attain the fundus.

TYPES: Holotype, male, allotype, female,

Borego, San Diego County, California, December (C.N.C.).

DISTRIBUTION: Desert regions of the extreme southwestern portion of the United States.

LIFE HISTORY: Unknown.

Eupithecia anticaria Walker

Plate 31, figures 23, 24; text figure 17D

Eupithecia anticaria WALKER, 1862, Catalogue of the Lepidoptera Heterocera in the British Museum, pt. 24, p. 1241. PACKARD, 1876, A monograph of the geometrid moths . . . of the United States, p. 64. HULST, 1895, Ent. News, vol. 6, p. 70. DOD, 1906, Canadian Ent., vol. 38, p. 90. TAYLOR, 1906, Canadian Ent., vol. 38, p. 101; 1907, *ibid.*, vol. 39, pp. 167, 279. GROSSBECK, 1907, Ent. News, vol. 18, p. 348. BARNES AND McDUNNOUGH, 1914, Contributions to the natural history of the Lepidoptera of North America, vol. 2, no. 5, p. 203. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 165.

Eucymatoge anticaria, HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 272.

Eupithecia implicata WALKER, 1862, Catalogue of the Lepidoptera Heterocera in the British Museum, pt. 24, p. 1241. PACKARD, 1876, A monograph of the geometrid moths . . . of the United States, p. 64. HULST, 1887, Entomologica Americana, vol. 3, p. 114; 1895, Ent. News, vol. 6, p. 70. TAYLOR, 1906, Canadian Ent., vol. 39, p. 167; 1909, *ibid.*, vol. 41, p. 426.

Eupithecia explanata WALKER, 1862, Catalogue of the Lepidoptera Heterocera in the British Museum, pt. 24, p. 1242. PACKARD, 1876, A monograph of the geometrid moths . . . of the United States, p. 64. HULST, 1895, Ent. News, vol. 6, p. 70. TAYLOR, 1906, Canadian Ent., vol. 39, p. 167.

The above synonymy, although not checked in recent years, seems to be fairly well established. The species is one of the more common in spring in Canada, extending from Nova Scotia to Alberta and being particularly numerous in northern Saskatchewan. In the east it extends its range southward through the New England states to the higher regions of New York State (Catskills), and specimens have been examined from Arizona (pl. 31, fig. 24) which cannot be separated genitally from eastern ones.

The rather small species can generally be recognized by the presence on the primaries of ruddy suffusion on the lower portion of the moderately prominent median band, this color extending outward into the subterminal

and terminal areas. The outer margin of the median band is very gently rounded below the costa, the whole band appearing rather upright, dark shaded in the costal area, and relieved somewhat by whitish bands on both sides. There is also a fairly well-defined small black patch above the tornus on the basal side of the white s.t. line. Segment I of the abdomen shows white basal scaling followed by a narrow black band along the posterior margin. Segment II is broadly banded with ruddy brown. The remaining segments are light fawn brown, narrowly edged with white along the posterior margins, the small blackish dorsal tufts showing quite conspicuously on the lighter color of the segments. The palpi are quite short, projecting but slightly beyond the gently bulging front, the male antennae are very finely and evenly ciliate. *Anticaria* is one of the few species with a double areole in the venation of the primaries and, in consequence, was once placed in the genus *Eucymatoge*, but, as already noted, the presence of this double areole is not at all indicative of a close specific relationship between the species that show this character, and the generic name has been merged with *Eupithecia*.

MALE GENITALIA: Hair pencils of segment IX well developed. Tegumen narrow, conical. Uncus short, bifid. Vinculum normal, with broadly rounded apical margin. Clasper trigonate with strongly tapered apex and a rounded projection at middle of ventral margin. Aedeagus thin and rather short. Vesica armed with two small pieces of chitin with pointed apices and an odd spine or so on their outer surfaces; proximad of these is a small twisted piece of chitin, more or less joined to the end piece. A finely spiculate narrow band runs between these pieces; ventral plate high and narrow, the edges more heavily chitinized in the apical section and terminating in two shortly projecting prongs with rounded apices.

FEMALE GENITALIA: Dorsal plate of segment VIII lightly chitinized, rectangular, rather broader than high, the caudal edges gently rounded with a small, V-shaped, membranous area in the center of the posterior margin; anterior apophyses and caudal spur normal, the latter terminating in the pro-

duced caudolateral corners of a rectangular, chitinous ostium pouch, much broader than high, with rounded cephalic edges. The membranous ostium originates indistinctly in the lower part of this pouch and leads into a very short membranous ductus bursae which terminates in a distinct chitinous collar with raised flaps. This in turn leads into a broader, chitinized bursa neck from which on the right ventral side a strongly projecting membranous ductus seminalis arises, curving down along the edge of the bursae nearly to the fundus, then recurving over the ventral surface and narrowing as it proceeds caudad. The proximal section of the globular bursa is membranous with a membranous strip extending down the left side halfway to the fundus; the balance of both surfaces is symmetrically spined, sending projections caudad along the inner sides of the aforesaid membranous strip, the marginal spines in this area somewhat longer than the others.

TYPES: *Anticaria, implicata, explanata*, holotypes, females, Nova Scotia (B.M.).

DISTRIBUTION: Canada from Nova Scotia west to the Rocky Mountains of Alberta; New England and northern Atlantic states; Arizona.

LIFE HISTORY: The only known breeding record is found in notes sent by W. McGuffin of the Canadian Forest Insect Survey who writes, "A larva was collected by me on the shore of Waskesiu Lake, in Prince Albert National Park, Saskatchewan. It was feeding on the flowers of a plant in the family Labiatae. Inasmuch as I could not find this particular plant again I tried the flowers of a wild aster with success."

Eupithecia pertusata McDunnough

Plate 31, figure 25; text figure 17E

Eupithecia pertusata MCDUNNOUGH, 1938, Canadian Ent., vol. 70, p. 236, pl. 20, figs. 1a-d; 1941, *ibid.*, vol. 73, p. 63.

Only a single male of this species (Davis Mountains, June, collection Buchholz) has been examined since the original description was made. In consequence little can be added to what has already been stated. A careful examination of the paratype and of the above-mentioned specimen shows that the patagia and the adjacent portion of the thorax are largely pale ochreous in color and

that there is considerable whitish scaling at the base of the abdomen; the feebly rounded front is scarcely raised above the level of the eyes. It has already been noted that the upper pair of spurs on the hind tibiae are much reduced in size. A more detailed description of the genitalia has been drawn up from holotype and allotype slides. The relationship of the species is doubtful, but it seems as well placed in association with *anticaria* as anywhere.

MALE GENITALIA: Hair pencils present on segment IX. Tegumen short, broad at base with concave, lateral edges directed sharply inward to a rounded apex. Uncus strong, bifid. Vinculum very broad and short, with truncate apical margin. Clasper trigonate with ventral margin weakly chitinized in basal half and with a median rounded projection. Aedeagus broad with finely spiculate apical area. Vesica armed with two strong, pointed spines partially covered by a strigate membrane. Proximad of these is a small twisted piece with curled edges, partially attached to the small end piece. Ventral plate of segment VIII broadly triangular and weakly chitinized, terminating in two closely approximate and shortly protruding, rounded projections.

FEMALE GENITALIA: Dorsal plate of segment VIII lightly chitinized, rectangular, caudal lateral corners rounded; anterior apophyses short, caudal spurs arising towards their distal end, bowed outwardly, and ending lateroventrally in a feeble, chitinous strip; ventral plate membranous and finely spiculate. Ostium broad, membranous, weakly spiculate. Membranous section of ductus bursae very short. Collar broad, well chitinized, with rather narrow, raised flaps. Bursa broadly oval, the proximal half membranous. Just below the collar a more strongly chitinized area projects to the right, the rounded and somewhat protuberant end forming the base of the ductus seminalis which curves caudad as a narrow tube. The proximal half of the bursa is largely covered with strong spines with the exception of a broad membranous strip down the left side to fundus; the marginal spines are particularly strong. Dorsally and ventrally two heavily chitinized bars project proximad on the left side from the spined area, each

furnished on inner side with a row of large heavy spines and with their apices contiguous.

TYPES: Holotype, male, allotype, female, southwestern Texas, May-June (C.N.C.).

DISTRIBUTION: Known so far only from Jeff Davis County, Texas.

LIFE HISTORY: Unknown.

***Eupithecia tricolorata* Cassino**

Text figure 17F

Eupithecia tricolorata CASSINO, 1927, Lepidopterist, vol. 4, p. 85, fig.

The unique female type is the only known specimen of the species. It is a very striking *Eupithecia* with a large portion of the primaries and certain portions of the secondaries colored a brick red. Cassino's figure of the genitalia, made from a dorsal view, is difficult to interpret as it has been drawn from a crushed and flattened preparation. However, the slide has been remade and the genitalic description has been drawn up, as far as possible, from this slide, the figure presented showing the ventral aspect. The correct position of the species cannot be determined until more material is available. A photograph of the type was unobtainable.

FEMALE GENITALIA: Dorsal plate of segment VIII uprightly rectangular, the latero-caudal corners slightly rounded; anterior apophyses and caudal spurs quite short; ventral plate and ostium partially destroyed, but what is left is membranous and finely shagreened and appears to join immediately onto the broad chitinous collar with much reduced flaps. Bursa lengthily elongate, the upper half forming a broad, chitinized neck, at the left upper corner of which is a small patch of weak spines. Below this, on the same left side and just above the bursa proper, is a patch of very large, widely separated spines on a chitinous base. Opposite this the neck broadens somewhat and forms a slight projection on the right side from which the thin ductus seminalis arises on the ventral side, curving caudad almost immediately; at its base is a curved row of eight to nine small, thick spines. The bursa proper occupies the distal third and is quite heavily spined, the marginal spines on the dorsal surface being very long and thick and joining with the spine patch of the left side; on the ventral surface these spines are much reduced in size

except on the right side where they lengthen preparatory to joining the long spines of the dorsal surface.

TYPES: Holotype, female, southern Arizona, October (M.C.Z.).

DISTRIBUTION: Known only from the type locality.

LIFE HISTORY: Unknown.

***Eupithecia carneata* McDunnough**

Plate 31, figure 26; text figure 17G

Eupithecia carneata MCDUNNOUGH, "1945" [1946], Canadian Ent., vol. 77, p. 172, pl. 9, figs. 4, 4a.

Since the original description no further material of this species has been available for examination; in consequence not much can be added to the diagnosis. The drawing of the genitalia of the female allotype is accurate as far as it goes, but the bursa was apparently not fully inflated, and the position of the median chitinous ridge may change somewhat when better-inflated material is available. It might be added that the dorsal plate of segment VIII is thinly chitinized, rectangular, being higher than wide; the anterior apophyses are thin and considerably longer than usual, the caudal spur well developed and ending, as usual, is a thin, lateroventral, chitinized strip, beyond which it projects as a short spur. The ovipositor lobes are rather narrow, weakly chitinized, with sparse, very fine and short setae; the posterior apophyses are long.

TYPES: Holotype, female, Oak Creek Canyon, near Flagstaff, Arizona, August (C.N.C.); allotype, male, Alta, Utah, August (M.C.Z.).

DISTRIBUTION: Arizona, Utah.

LIFE HISTORY: Unknown.

***Eupithecia classicata* Pearsall**

Plate 31, figure 27; text figure 18A

Eupithecia classicata PEARSALL, 1909, Proc. Ent. Soc. Washington, vol. 11, p. 128. BARNES AND MCDUNNOUGH, 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 147.

Until recently the species has been known only from the unique male type in the American Museum of Natural History. This specimen is in very rubbed condition, and the abdomen, present when Pearsall described

the species, had at some time become detached. A second male specimen in excellent state of preservation which matches the type in size and maculation (as far as the poor condition of the type permits a comparison) has been found among some material collected by Dr. A. B. Klots at Superior, Pinal County, Arizona, in July. A genitalic slide made from this male has proved identical with that of a slide made from a loose abdomen in one of the *Eupithecia* drawers. In all probability this abdomen was that of the *classicata* type, as no other material was present with which it could possibly be associated, and it has been marked accordingly.

It was suggested in 1918 that the names *classicata* and *penumbrata* were synonymous, but after a further study of the type material it has seemed advisable to keep the two names apart as referring to distinct species. There is no doubt that they are very closely allied; both show a double areole on the forewing and the type of maculation and coloration is very similar. *Classicata*, however, is a much smaller species, the wing expanse, from tip to tip of primaries in a spread condition, being barely 17 mm. (not 20 mm. as given by Pearsall who probably used a different system of measurement). *Penumbrata* on the other hand shows a wing expanse of 20 mm. in the allotype male and 24 mm. in the female. The palpi of *classicata* appear to be somewhat shorter than those of *penumbrata*, and in the maculation of the primaries there is little indication of the broad, light ochreous brown suffusion extending from the discal streak towards the apex of the wing which is quite prominent in *penumbrata*, especially in the females. The time of flight, too, appears different, both specimens of *classicata* having been captured in July, whereas *penumbrata* flies in very early spring, according to the data available. Finally, while the male genitalia are closely similar, there is a slight difference in the shape of the ventral plate of segment VIII. Of course it is quite possible that the species is double brooded and that the differences mentioned above are merely seasonal; this matter, however, cannot be settled until the life history is known.

Based largely on the male in better condition from Superior, the following description has been drawn up: The palpi, vertex of head,

upper scaling of the collar, and the thick scaling on the mesothoracic scutellum and on the metathorax are deep smoky; the base of the collar and a band across the thorax are prominently white; the abdomen dorsally is largely brown with a smokier shade crossing segment II to form an incipient band. The general coloration of the primaries is brown with a distinct ruddy tinge and a certain amount of smoky suffusion in the basal and terminal areas. A prominent inwardly oblique blackish bar crosses the basal third of the wing, nearly touching the oblique ruddy discal streak in its costal portion. Several fine, wavy hair lines cross the lighter median area which is bordered outwardly, except in the costal area, by a narrow, diffuse, oblique, smoky bar. Beyond the ruddy-colored discal streak the brown ground color extends along the costa without interruption nearly to the apex of the wing, and the subterminal area, exterior to the dark bar, shows a narrow band of the brown color. The exterior portion of the subterminal area and most of the terminal area show a strong smoky suffusion crossed by a white, slightly irregular, s.t. line. A patch of black scaling at the base of the inner margin of the secondaries is quite distinct, and there are indications of curved postmedian and subterminal dark lines.

The male antennae are rather thicker than usual, somewhat laterally compressed, and very finely ciliate.

MALE GENITALIA: Hair pencils of segment IX very strong and composed of long, hair-like scales, a similar type appearing on the dorsal area of the uncus base. Tegumen rather short and narrow, rounded apically. Uncus short and stubby with a single apical hook. Vinculum short, broad, and square cut. Clasper rather short and stubby, very broad in the basal half, and tapered strongly apically. Aedeagus short and broad. Vesica armed with two strong, pointed, chitinous spines, of which the more apical one is bent at its distal end. Proximad of these is a weak, twisted, and semicylindrical chitinous bar more or less attached to a small end piece. A faint spiculate band partially covers the apical spines. Ventral plate of segment VIII consists of two long, parallel rods, rather close together but slightly divergent apically and terminating in sharp points; these are at-

tached proximally to a short and weakly expanded base.

TYPE: Holotype, male, Huachuca Mountains, Arizona, July (A.M.N.H.).

DISTRIBUTION: Southern Arizona.

LIFE HISTORY: Unknown.

REMARKS: Apart from its very close relationship to *penumbata*, the species is obviously related to *graeffi* on genitalic characters.

***Eupithecia penumbata* Pearsall**

Plate 31, figure 28; text figure 18B

Eucymatoge penumbata PEARSALL, 1912, Canadian Ent., vol. 44, p. 29. BARNES AND McDUNNOUGH, 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 147, pl. 22, fig. 8.

Under the preceding specific heading the reasons for holding *penumbata* as a distinct species have already been stated. The female holotype from Palmerlee, Arizona, without further data, in the American Museum collection is without abdomen. There is a second female in the same collection from Redington, Arizona, February 1-10, of which the abdomen is also lacking. This specimen came originally from the Barnes collection and is topotypical with the male cotype figured in the "Contributions." The most striking features of the maculation of the primaries of the holotype are the large, oblique, red brown, discal streak and the broad, ochreous brown suffusion extending from the streak nearly to the apex of the wing; a small patch of the same light color is indicated in the terminal area between veins 3 and 4. It should be noted that while the two above-mentioned females show three thin, oblique, black, antemedial lines, the male allotype, as figured (1918), shows a solid black bar in the same region, a difference that may be merely sexual, occurring as it does in the male of *classicata*. In this allotype male, which has been carefully examined, it might be further noted that the discal streak is more suffused with blackish than in the females, and the ochreous brown suffusion is much less obvious; the whole area beyond the dark oblique antemedian band is paler and is bounded outwardly by the dark suffusion of the subterminal region as can be seen in the figure. The male antennae are much as in *classicata*.

Apart from its larger size and slightly longer palpi the specimen runs extremely close to *classicata*. The terminal area is the darkest on the wing and in the Redington specimen is crossed by a distinct, white, crenulate, s.t. line which is obscure in the holotype. The palpi in all three specimens are quite long and porrect; the color of head and thorax is much as in *classicata*; the patagia are darker than in this species, but the white band across the thorax is present and the white collar base could probably be noted if the overlying dark scales were removed. The original description calls for a dark band across segment II of the abdomen, but in the male allotype this did not appear very obvious, the whole abdomen being more or less unicolorous deep brown. A slide of the genitalia of the allotype shows a very obvious relationship to *graeffi*. Judging by the dates on the two Redington specimens the species flies very early in the year, which is an additional reason why it must be held distinct for the present from *classicata*, the type of which was captured in July.

MALE GENITALIA: (Based on the allotype.) Hair pencils of segment IX very strong, consisting of thickened, hair-like scales. Tegumen very narrow and high. Uncus short and terminating in a single sharp point. Vinculum short and very broad with the apical margin truncate. Clasper very broad and chunky with apex strongly tapered. Aedeagus much thinner than in *graeffi* and not so expanded apically. Vesica armed with two strong, pointed spines, one of which is curved apically, both being shorter than in *graeffi*; there is also a semicylindrical, twisted bar of chitin partially joined to the small end piece; a weak, roundedly conical mass projects from the apical end of the aedeagus; through the upper half a finely spiculate band runs. Ventral plate of segment VIII is moderately wide, little expanded basally, and terminates in two long pointed prongs, of which the left-hand one is straight, the right-hand one sinuate apically and somewhat longer than the other.

TYPES: Holotype, female, Palmerlee, Arizona (A.M.N.H.); allotype, male, Redington, Arizona, January (U.S.N.M., ex Barnes collection).

DISTRIBUTION: Southeastern Arizona.

LIFE HISTORY: Unknown.

Eupithecia graefii graefii Hulst

Plate 31, figures 29-31; text figure 18C

Eucymatoge graefii HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 273.*Eupithecia graefii*, MCDUNNOUGH, 1940, Canadian Ent., vol. 72, p. 39.

Apart from the fact that the species is one of the few that show consistently a double areole in the venation of the primaries it should readily be recognized by its large size, the prominent oblique discal dash, either black or ruddy in color, the tendency for a ruddy suffusion to occur over various areas of the wing, notably subterminally, and the numerous fine wavy cross lines with a strongly dentate, white s.t. line running close to the outer margin. In coloration and general appearance the species is variable, a feature which has led to its redescription from various rather widespread localities. Most of the names proposed have been retained in a rather dubious racial sense rather than allowed to sink definitely into the synonymy but, judging by long series collected by Taylor and others on Vancouver Island, the differential characters on which the names have been based prove of a very evanescent nature.

Typical *graefii* was based on specimens from "Mount Hood, Washington" (the state, of course, should be Oregon), and a topotypical female specimen has been found in the Henry Edwards' collection which may readily have been one of the type lot. It is proposed to restrict the name to the race of the Cascade Mountains and the northern Sierras of California in which the ground color of the primaries is of a light to deep smoky gray. The discal dash in the type happens to be black, and there is no trace of ruddy suffusion visible, but in a small series of similarly colored specimens from Mohawk, Plumas County, California, it is found that this dash may be either black or reddish and that diffuse ruddy suffusion may extend outward from the dash towards the apex and the outer margin of the wing. The palpi are moderately long, porrect, and extend considerably beyond the rather flat front, the apex of which is distinctly tufted with dark scales. The male antennae are finely and evenly ciliate. A dark band across segment II of the abdomen is usually fairly well

defined but in some females appears to be quite faint.

In the coastal regions of central California a form occurs in which the wings are very much darker in color than those of typical *graefii*, being of a decidedly brown tinge; the same variation as in the type form occurs in the color of the discal streak and in the amount of ruddy suffusion present. The palpi, especially in the females, appear to be somewhat longer than in the Mohawk specimens, but the genitalia show no points of distinction. This form is as worthy of a racial name as some of the others for which names exist, but at the present time it is not considered advisable to propose one.

In a single female from Del Norte County, California, the median area of the primaries is largely whitish, forming a noticeable pale band across the wing; the discal streak is ruddy brown, and similar-colored suffusion is present to a considerable degree in the apical area.

MALE GENITALIA: Hair pencils of segment IX extremely heavy and composed of hair-like scales. Tegumen very narrow, conical. Uncus thick and stubby, terminating in a single sharp point. Vinculum short and broad, with truncate, apical margin. Clasper broad and stubby with sharply tapered apex. Aedeagus short and broad, slightly tapered at proximal end. Vesica armed with two long, sharply pointed spines and a twisted, semicylindrical piece, more or less joined to the small end piece; apically there is a large, broadly oval, and very feebly chitinized piece which is irregularly strigate and partially overlies the larger of the two spines; the whole is covered by a finely spiculate, membranous band. The ventral plate of segment VIII is rather narrow and high with little basal expansion; it terminates in two thin prongs, of which the right one is much the longer.

FEMALE GENITALIA: Dorsal plate of segment VIII rectangular, chitinized lightly, the caudal area sparsely setose with a slight median excavation of the margin; anterior apophyses rather long, caudal spurs strong, directed caudad, and terminating in narrow chitinous plates bearing strong scale pads. Ostium broad, leading into an equally broad, feebly chitinized, irregularly strigate and pleated pouch which is continued by a very

short, membranous ductus bursae and terminates in a broad chitinous collar with small lateral flaps. Bursa irregularly and broadly rectangular with rounded corners. From a rounded membranous projection in the right proximal corner the ductus seminalis arises on the ventral side as a broad membranous tube that curves back over the surface of the bursa to the center and then narrows and bends caudad; around its base is a half ring of spines, arranged in a single row. With the exception of a small, membranous area below the collar on the left side the ventral surface of the bursa is completely spined. On the dorsal surface a broad membranous band extends obliquely across the entire bursa from the upper right to the lower left corner; this is bordered by a chitinous rim which bears very strong, long spines; the left edge, outside this rim, is fleshily membranous and in poorly inflated material frequently protrudes as a small appendage; the area on the right side below the vein bears spines much as on the ventral surface.

TYPE: Holotype, male, Mt. Hood, Oregon (U.S.N.M., *ex* Graef collection).

DISTRIBUTION: Mountainous areas of Oregon and northern California.

LIFE HISTORY: Unknown.

REMARKS: The figure of the male genitalia is based on a Vancouver Island specimen; that of the female organ is from a specimen from Mohawk, Plumas County, California.

***Eupithecia graefii vancouverata* Taylor**

Plate 31, figure 32

Eucymatoge grandis, HULST (*nec* Hulst), 1900, Proc. Washington Acad. Sci., vol. 2, p. 497. DYAR, 1904, Proc. U. S. Natl. Mus., vol. 27, p. 892; 1905, Proc. Ent. Soc. Washington, vol. 6, p. 223.

Eucymatoge vancouverata TAYLOR, 1906, Canadian Ent., vol. 38, p. 397. BARNES AND McDUNOUGH, 1912, Canadian Ent., vol. 44, p. 273.

Eucymatoge vancouverensis PEARSALL, 1910, Proc. Ent. Soc. Washington, vol. 12, p. 141.

Eupithecia stikineata CASSINO AND SWETT, 1922, Lepidopterist, vol. 3, p. 146.

Eupithecia graefii var. *vancouverata*, McDUNOUGH, 1930, Canadian Ent., vol. 72, p. 39.

The name is being held for the form from British Columbia, particularly Vancouver Island, which extends northward along the coast to Alaska. It is very variable as noted by Taylor in his original description who states, "The wings have a very variegated

appearance, the ground colour and colour of the lines varying from bright chestnut, through many shades of brown to nearly black." He differentiates it from *graefii* by the color of the discal spot which is "bright brown instead of black." This, however, has been shown to be a very variable feature, the long series from Vancouver Island in the Barnes and the Canadian National Collections showing both color types. *Stikineata*, based on material from the British Columbia coastal area near the Alaskan boundary, has the spots black and can be matched with specimens from the above-mentioned series in spite of the authors' attempt to differentiate it from *vancouverata* and *graefii*; the genitalia are similar. Some of the Vancouver Island specimens examined are almost as dark as those mentioned from central California coastal counties. Others approach in their lighter type of coloration typical *graefii*. On the whole the brownish shades are more prevalent in the wing coloration than the gray ones, and for this reason the name may be permitted to stand in a racial sense. Taylor notes that there are probably two broods in a season, and this will most likely be found to apply throughout the various races.

TYPE: Holotype, female, Wellington, Vancouver Island, July (U.S.N.M., *ex* Taylor and Barnes collections).

DISTRIBUTION: British Columbia to Alaska.

LIFE HISTORY: Unknown.

***Eupithecia graefii tulareata* Cassino and Swett**

Eupithecia tulareata CASSINO AND SWETT, 1922, Lepidopterist, vol. 3, p. 170.

The name is held in a racial sense for a pale form taken in the higher altitudes of the southern Sierras of California. The color of the primaries is given as "light silver gray," and the discal spot is stated to be of "a darker red than *vancouverata*." The only specimens known are contained in the short type series, and it remains to be seen whether or not the distinctions hold when adequate material is available for study.

TYPES: Holotype, male, Monachee Meadows, Tulare County, California, July (U.S.N.M., *ex* Barnes collection); allotype, female, same data (M.C.Z.).

DISTRIBUTION: High Sierras of southern California.

LIFE HISTORY: Unknown.

THE NEVADATA GROUP

What is treated in the present revision as the final group in the genus *Eupithecia* consists of a number of so-called species ranging from the northern Atlantic coast region to the Pacific and from British Columbia to southern California, extending inland through the Great Basin area. From time to time names have been proposed based largely on color characters and the greater or less intensity of the maculation. After a careful study of a good deal of material (which includes either specimens from the type lots or those that have been compared with the types) it has been established that in outward structural features all these "species" are identical. In all instances the palpi are quite short and rather bushy, being heavily scaled ventrally; the front is distinctly roundedly bulging, leading over in this respect to the genus *Prorella*; the male antennae are very finely ciliate; the primaries are long and rather sharply pointed apically. In virtually all the "species" the head, collar, patagia, and the terminal segment of the abdomen (notably in the males) are white or creamy with the addition of a broad blackish anterior margin to the front; where these areas appear darker it is due to smoky sprinkling over the pale ground color. The dorsal tufting of the smoky-colored abdomen consists of rather bright russet brown scales, and there are lateral black markings, notably on the anterior segments; the ventral area is contrastingly whitish. The coloration of the primaries which, as noted above, has served as a basic character for differentiating the species is extremely variable, ranging from almost pure white through gray of various shades to purple brown. The maculation is essentially of the same type throughout, consisting of a series of brown costal patches of varying shades and degrees of intensity. Chief of these is a large, central, semitriangular patch, containing on its outer edge the long, upright, black, discal streak. Geminate pale lines, usually fairly evident in the costal region but tending to fade towards the center of the wing, define the brown patches; distinct black streaks occur on the veins in the subterminal area, and small diffuse brownish shadings usually are evident, inward from the outer margin, opposite the cell

and above the tornus. A consideration of the genitalia, both male and female, has shown the same existing similarity of structure in both sexes. In the males the claspers all show a strong projection from the center of the ventral margin. This projection is apparently quite variable in shape and length, making it difficult to discriminate between individual variation and specific distinctness, when using this character as a basis for separation. The armature of the vesica is also practically identical, but again minor variation is shown in the shape of the individual pieces of chitin which in any case are obscurely outlined, especially in their basal section, and appear to merge into a general conglomerate mass; the same doubt exists in evaluating these differences as was found with the ventral projection of the clasper. In the female genitalia the situation is no clearer. In the first place a large proportion of the bursae shows a poor degree of inflation which makes comparison with better-inflated preparations difficult. Then, too, the extent of the spined areas and the number of spines in each are subject to great variability, hardly any two specimens being alike. In only a couple of instances (which will be discussed later) have male and female characters been found that could be considered as definitely specific. In the most obvious cases names have been reduced to subspecific rank but, wherever a certain element of doubt existed, it has been considered expedient to leave the name standing as that of a species. It is felt that the present treatment is far from satisfactory, but until a good deal more material in certain instances is available for study and, above all, until the life history of the western forms can be worked out, the present arrangement is the best that can be offered. There are still a number of forms for which no names are available, but in the present state of our knowledge it seems most unwise to name them.

Eupithecia nevadata nevadata Packard

Plate 31, figures 33-36; text figure 18D

Eupithecia nevadata PACKARD, 1871, Proc. Boston Soc. Nat. Hist., vol. 13, p. 395; 1874, *ibid.*, vol. 16, pl. 1, fig. 2; 1876, A monograph of the geometrid moths . . . of the United States, p. 61, pl. 8, fig. 10.

The species was described from a single specimen with the locality given as "Nevada, Edwards." In the Museum of Comparative Zoölogy this specimen, a female without abdomen, is labeled "Type No. 1" and besides the locality label "Nevada" bears the Edwards' number "249." A reference to this number in Henry Edwards' original catalogue in the possession of the American Museum of Natural History gives the further information that *Eupithecia nevadata* (the name written in later by Edwards) was taken in March at Gold Hill, a locality close to Virginia City, Nevada, where Edwards frequently collected. A second so-called type, also a female without abdomen in the same collection, simply bears the label "H. Edwards" and the number "1376." This number in the Edwards catalogue refers to an entirely different species, and its origin cannot be traced. However, the specimen itself is the one figured in 1874 on plate 1 of volume 16 of the Boston Proceedings. Although probably correctly identified as *nevadata* this specimen cannot be considered to be a true type, and the name must be held to the above-mentioned "Type No. 1," which is herewith designated as holotype. In view of the marked variation in color that occurs in the species in different localities and that, as noted in the discussion of the group, has given rise to a number of specific names, the necessity of carefully determining the typical form becomes obvious. Packard's original description is rather misleading in that he refers to the color of the various patches along the costa as "black." Later, however, in his monograph, where the original description is repeated virtually word for word, he gives this color as "reddish brown" or "russet brown" which corresponds much better with the color of the patches found in the type specimen, the ground color being correctly stated to be "pale gray." The holotype specimen was carefully examined a few years ago by the writer and closely matched with a San Diego female now in the Canadian National Collection. It is realized that the two localities are rather widely divergent, but from the data that can be gathered from the material examined it would seem that the typical form should be found all through the dry, sage-brush country on the western side

of the Great Basin area. It also appears to extend westward through the counties of southern California to the San Diego region. In the American Museum of Natural History is an old Henry Edwards' male specimen from Havilah, California, taken by Stretch and labeled *nevadata* by Edwards, which matches not only Packard's figure already mentioned but also the compared specimen very closely. Other specimens from southern California agree. Along the coastal region of California the same form with only slight modifications extends northward as far as Napa and Sonoma counties. However, in these latter regions and farther inland in the higher mountainous districts (Plumas County) a good deal of color variation occurs, the general tendency being apparently towards a deepening of the ground color of the primaries to a smoky purplish, especially above the inner margin in the central area of the wing. This leads to a great deal of confusion with *cestata* Hulst, which is being treated as a good species from the San Francisco Bay area and which will be discussed later. As here delimited typical *nevadata* possesses short bushy palpi scarcely reaching the apical margin of the front; their color is deep smoky with slight admixture of white scales ventrally. The male antennae are very finely ciliate. The front is considerably raised above the level of the eyes and roundedly bulging, almost as much as in the genus *Prorella*; the entire vertex and front are evenly pale cream color with a broad black anterior margin to the front. The collar and patagia are whitish, the central portion of the prothorax largely blackish, and there are black spots at the base of the patagia below the wing level; the scutellum is creamy with indications of a median brown line. The ground color of the acute primaries is a light gray, shading somewhat into fawn (not the white of *ravocostaliata* or *morensata*) and is most evident in the basal portion of the wing and broadly in the subterminal area, a certain amount of brown sprinkling occurring in the median area and along the inner and outer margins. The most characteristic feature of the maculation is the large, median, semi-triangular, russet brown, costal patch; the inner margin of this patch is formed by an obscure, geminate, whitish, t.a. line which

runs from the costa at about two-fifths sharply outward to near the long, upright, black, discal streak from which it is separated by a short projection of the brown patch; the inner portion of the t.a. line is very obscure but can generally be traced running obliquely inwards to the inner margin. The outer margin of the brown patch is formed by a still more obscure, geminate, pale, median line which arises on costa above the discal streak and runs inward, very close to its edge, to the base of vein 2; it is continued to the inner margin as a geminate, faint, sinuate, smoky line filled with the paler ground color. On costa beyond the median line is a small brown patch, frequently appearing connected with the triangular patch when the pale median line becomes obsolete. The t.p. line is indicated in the costal region by two pale streaks, directed outward; it is very obscure and feebly crenulate across the balance of the wing, in general paralleling the outer margin, and is defined inwardly by a series of black streaks on the veins which nearly cross the pale subterminal area. The terminal area is slightly darker with a pre-apical, brown, costal rectangle and obscure dark shading opposite the cell and above tornus. The costal half of the secondaries, including the cell, is dull whitish with a dark discal dot rather prominent; the inner margin of the wing is rather heavily sprinkled with smoky, this shading extending more sparsely along the outer margin as far as vein 4. The abdomen dorsally is largely deep brown with slight black lateral spotting, notably on segment II; the posterior segment is contrastingly creamy, and there is frequently creamy sprinkling on the preceding segments leaving, however, segment II evenly brown when the appearance of a transverse band is simulated; the dorsal tufting is bright brown.

Geneura Swett and Cassino, described as a good species from Utah, and *moirata*, named by the same authors from material from the vicinity of Penticton, British Columbia, also a sage-brush area, are in general very similar to the type form and at the best can be considered only as races of the species. *Probata* in general appearance is further removed and is a much better-defined race than the two above-mentioned ones. *Morensata*, with pale white ground color, from the San Diego region

is possibly only a color form; there seem to be intergrades to typical *nevadata* in San Bernardino County. However, as it may be linked with a special larval food plant it is treated for the present as a race. The species is known to extend eastward across the Great Basin area as far as Glenwood Springs, Colorado. A specimen from this locality was figured in the Barnes and McDunnough "Contributions" (1912, vol. 1, no. 4, p. 31, pl. 14, fig. 8) as what must be considered to be a spurious type of *implorata* Hulst. In the American Museum of Natural History are three further specimens labeled as types of a manuscript name of Cassino's which it seems hardly worth while validating as the form runs pretty close to *geneura*, being merely slightly deeper brown in ground color.

MALE GENITALIA: Hair pencils of segment IX well developed. Tegumen short, broad at base, sides sloping rapidly inward to a narrowly rounded apex. Uncus strong, curved ventrad, bifid, the lower fork strongly projecting and rounded apically, the upper one a sharp, fine spine. Vinculum very short and broad, scarcely projecting beyond the level of the ventral margin of the claspers. Clasper moderately broad, only slightly tapered; ventral section in basal half chitinized and covered dorsally with fine scaling, forming a sort of sacculus which terminates somewhat beyond the middle in a broad projection curving ventrad and with a more or less truncate apex. (The length of this projection appears, as far as can be judged from the material examined, to be rather variable; the usual length is much as in the figure, but occasional specimens show a somewhat longer extension, although in other respects no differences can be noted.) Aedeagus broad and considerably expanded towards the apex. Vesica armed with two large apical pieces of chitin, heavily spined; the spines of the larger piece on the left side are long and sharply pointed, those of the smaller one to the right being blunter; basally these two pieces are not sharply defined and appear to be covered with a strigate membrane; between them in this section a small chitinous bar is more or less clearly delineated. Farther proximad the usual semicircular twisted bar can be seen, but no definite end piece occurs. Ventral plate of segment VIII broad and

stubby, terminating in two widely separated prongs.

FEMALE GENITALIA: Dorsal plate of segment VIII well chitinized and rectangular, the caudal edges gently rounded and the margin with a slight median excavation. Anterior apophyses short and outbowed, without caudal spur. Ventral plate membranous and feebly shagreened. Ostium a broad, open pouch, twice as wide as high, and quite weakly shagreened, the caudoventral edge irregularly sinuate. A very short and equally broad membranous ductus bursae connects this pouch with the broad chitinous collar which shows few traces of the usual lateral flaps. The bursa in its proximal half is even broader than the collar, projecting slightly to the left; on its ventral side it projects broadly and roundedly over the distal half of the collar, this protruding section being filled with several rows of spines which extend in varying degree of numerical intensity for a short distance down the right side. On the dorsal side the proximal half of the bursa is chitinized, with a raised ridge extending from the right corner nearly to the middle and giving rise to the ductus seminalis which bends to the right and narrows rapidly to a fine tube. On the left side is a heavily chitinized area which forms a rounded projection in the mid section. The inner edge of this projection is spined, the number and extent of these spines being apparently quite variable, as is also the strength of the projection beyond the bursa proper. (The illustration, made from an exceptionally well-inflated preparation, shows a strong bulge, but in poorly inflated specimens this bulge is less obvious and frequently quite feeble.) Along the left side, proximad of the projection, the dorsal surface shows a spine patch; these spines are fairly long and quite variable as regards number. The whole distal section of the bursa below the chitinous projection is globular when well inflated and covered with spines, the marginal spines being long and thin on the dorsal side; on the ventral side the spining extends much farther proximad, practically connecting on the right side with the spines descending from the region of the collar. It should be noted that the whole fundus section of the bursa, when poorly inflated, tends to collapse and shrivel

more or less entirely, extending in extreme cases scarcely beyond the projection of the left side; the whole bursa, in such unfortunately rather numerous preparations, presents a quite different aspect to that of the figure and renders comparisons difficult.

TYPE: Holotype, female, Gold Hill, Nevada (M.C.Z.).

DISTRIBUTION: Nevada; California (south-eastern and southern sections; coastal region from Sonoma County to San Diego County).

LIFE HISTORY: Unknown, but the larva may possibly feed on various willows.

Eupithecia nevadata geneura Swett and Cassino

Eupithecia geneura SWETT AND CASSINO, 1919, Lepidopterist, vol. 3, p. 108.

Geneura represents the form of *nevadata* from the eastern section of the Great Basin area. The name was based on material collected by Tom Spalding in the Eureka section of Utah, and since his death no further specimens have shown up. As a race it is not well defined and differs chiefly in the more evenly dark color of the secondaries; the primaries in some specimens are somewhat deeper in ground color than in the type form; other specimens, however, are almost an exact match in color and maculation. A topotypical specimen, which has been compared with the holotype, is before the writer with other specimens collected by Spalding, and the above note on variation is based on these specimens. There are no obvious genitalic differences, and the name could easily be sunk as a synonym. Until, however, more knowledge can be obtained of the life history no harm is done in treating *geneura* as a race. The somewhat darker brown form from Glenwood Springs, Colorado, already mentioned, may be included under this heading for the present.

TYPE: Holotype, female, Eureka, Utah, May 7 (M.C.Z.).

DISTRIBUTION: Utah (Eureka); Colorado (Glenwood Springs).

LIFE HISTORY: Unknown.

Eupithecia nevadata morensata Cassino and Swett

Plate 32, figure 1

Eupithecia morensata CASSINO AND SWETT, 1922, Lepidopterist, vol. 3, p. 178.

The status of *morensata* is rather doubtful

as, apart from a small topotypical series (including a female paratype) in the Canadian National Collection, little material has been available for study. It is treated for the present as a pale race of *nevadata*, occurring in the San Diego region, but it may be a mere color form, as typical, darker *nevadata* occurs in the same area and specimens have been examined from Riverside County that seem to intergrade between the two. The maculation of *morensata* is similar in every respect to that of *nevadata*, but the ground color of the primaries is white and there is considerable tendency for the central portion of the brown, triangular, costal patch to become paler than the marginal areas. The secondaries are almost entirely white, the darker shading along the inner margin being reduced. In such genitalic preparations as it has been possible to examine no striking differences have been noted. In the single male slide the ventral projection of the clasper is rather longer than is normally the case in *nevadata*, but this difference also occurs in typical specimens of *nevadata* from the same region, as has already been noted, and does not seem to have much value as a means of separation. In the female bursa the chitinous bar of the left side is not so strongly bulging, and there seems to be a slight increase in the spinning of the proximal portion of the ventral surface, but these differences appear to be of little moment. The statement in the original description that the genitalia "show it to be a very distinct species" is not borne out by the preparations examined, including a male slide made by Cassino, and some error of comparison was probably made.

The form appears to be very early on the wing, appearing in January and February.

TYPE: Holotype, male, San Diego, California (M.C.Z.).

DISTRIBUTION: Southernmost area of California.

LIFE HISTORY: Unknown.

Eupithecia nevadata moirata Swett and Cassino

Plate 32, figure 2

Eupithecia moirata SWETT AND CASSINO, 1919, Lepidopterist, vol. 3, p. 106. BLACKMORE, 1920, Rept. Prov. Mus. Nat. Hist. British Columbia, for 1919, p. R 23, pl. 2.

The name is being held for a rather poorly defined race of *nevadata* occurring in south central British Columbia in regions that represent the most northerly extension of the sage-brush areas of the Great Basin. Material has been limited, but, besides a female paratype, several topotypical specimens in the Canadian National Collection have been available for study. In general *moirata* is characterized by a deepening of the ground color and a more even suffusion of the gray brown color over the whole of the primaries, tending in consequence to lessen the distinctness of the large, brown, triangular costal patch. The secondaries are noticeably deeper in color, being light smoky over the entire area with little of the paler shades in the costal half of the wing found in the typical form. Whether the above characters hold in a long series or not is doubtful. In a small series in the Canadian National Collection taken on April 11, 1923 (Garrett), at Oliver, British Columbia, a locality about 10 miles south of the type locality, Penticton, one specimen shows the characters of *moirata* very satisfactorily. Two others are considerably paler, approaching closer to typical *nevadata* with the brown, triangular, costal patch showing quite clearly. Two others are still paler, almost whitish in ground color, and show the flatly rectangular costal spot which is supposed to be a feature of *ravocostaliata*. In the same collection is a considerable number of specimens from Kaslo, British Columbia, a locality somewhat east of the typical "dry belt" area. Most of these specimens (pl. 32, fig. 2) were found to agree with those of the second group from Oliver, but one female was distinctly of the *ravocostaliata* type. The genitalia unfortunately offer no clue, being almost identical throughout. The correct evaluation of the various forms must therefore be left in abeyance until extensive breeding experiments can be carried out, but it would almost seem as if, in these western Canadian regions, the pale eastern *ravocostaliata* merged with the darker-colored *nevadata*.

TYPE: Holotype, male, Penticton, British Columbia, April 18 (M.C.Z.).

DISTRIBUTION: South central British Columbia.

LIFE HISTORY: Unknown.

***Eupithecia nevadata probata* Swett and Cassino**

Plate 32, figure 3

Eupithecia probata SWETT AND CASSINO, 1919, *Lepidopterist*, vol. 3, p. 105. BLACKMORE, 1920, *Rept. Prov. Mus. Nat. Hist. British Columbia*, for 1919, p. R 23, pl. 2.

This is the most striking race of *nevadata* and possibly the one most worthy of specific rank, although the genitalia show no definite character that can be used as a means of separation. The small amount of material available for study is contained in the Canadian National Collection, including a male paratype from which a slide has been made.

The size of *probata* is somewhat larger than the general run of *nevadata* forms. The ground color of the primaries is a light grayish white; the costal and other patches are a lighter and brighter brown than is found in the other forms and stand out very sharply from the pale ground color; the discal dash is rather reduced in size. The secondaries are tinged with pale smoky over a whitish ground and show heavier suffusion along the inner and outer margins, a dentate subterminal line being generally quite evident; the abdomen dorsally is largely suffused with a bright brown color similar to that of the costal spots. In the genitalia the male organ is similar to that of *nevadata*; in the female the only apparent difference is that the chitinous bar of the left side of the bursa is still weaker than in *moirata* and considerably less prominent than in *nevadata*.

A rather perplexing situation arises from the fact that, with typical *probata*, a white form entirely similar to the eastern *ravocostaliata* occurs. Apparently both are on the wing at the same time (March–May) and in the same localities. Whether the conclusion could be drawn from this fact that two distinct species are involved or not is a matter of doubt. A good deal of careful field work is necessary before arriving at any definite decision. Certainly genitalic studies seem of little help.

TYPE: Holotype, male, Duncan, Vancouver Island (M.C.Z.).

DISTRIBUTION: Southern Vancouver Island and adjacent areas of the British Columbia mainland (lower Fraser Valley).

LIFE HISTORY: Unknown.

***Eupithecia implorata* Hulst**

Plate 32, figures 4–6; text figure 18E

Tephroclystis implorata HULST, 1896, *Trans. Amer. Ent. Soc.*, vol. 23, p. 272.

In spite of the fact that the genitalia and other outward structural features appear identical with those of *nevadata*, *implorata* is treated as a good species on characters of maculation of the forewing. The correctness of this action can be substantiated only when more knowledge of life histories is obtained. Hulst's type series was apparently mixed and, as already stated, the "type" figured in the Barnes and McDunnough "Contributions," (vol. 1, no. 4, pl. 14, fig. 8) is spurious and does not even represent the true species. The name must be based on the female in the Hulst collection from Havilah, California, which is hereby designated as holotype. This type, which bears the Henry Edwards' catalogue number 7651, is matched by a female (unfortunately minus an abdomen) in the American Museum of Natural History with same number and from the same locality, evidently part of a lot collected by Stretch. Besides the original genitalic slide of the type, based on a slide made by the writer a number of years ago, a good deal of material received from various sources has been carefully studied. The main point of distinction from *nevadata* is found in the course of the broadly geminate, antemedian line. This line, instead of making a prominent outward angle below the costa to form one side of the brown triangular costal patch as in *nevadata*, is gently outwardly rounded to the base of vein 2 and then proceeds more or less uprightly to the inner margin. The whole area below the costa between the antemedian and median lines extending across the cell is usually suffused with brown of varying shades, forming a quadrate patch which is sometimes narrowly extended across the whole wing; vein 2 is rather sharply outlined in black for about half its length. The other lines are more or less as in *nevadata* but typically more sharply outlined. In color of primaries *implorata* is quite variable; the ground color in typical specimens is a purplish gray, rather evenly suffused over the whole wing, and obscuring the brown shades of the median band; in other specimens, notably those from areas farther north than the type

locality, the ground color pales and the brown banding stands out quite prominently; a few female specimens from southern California counties have been examined in which the whole wing is a dark gray with very obscure maculation, even the usually prominent black discal streak becoming obsolescent. Until more is known of the species it seems scarcely advisable to create names for such forms, although some of them appear quite striking.

GENITALIA: Indistinguishable from those of *nevadata*.

TYPE: Holotype, female, Havilah, California (Rutgers University, New Brunswick, New Jersey).

DISTRIBUTION: Southern California, extending northward in the coastal region to Napa and Sonoma counties.

LIFE HISTORY: Unknown.

Eupithecia cestata Hulst

Plate 32, figures 7, 8; text figure 18F

Tephroclystis cestata HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 271.

Rather surprisingly *cestata* appears to be a good species with genitalic characters that, especially in the female sex, distinguish it fairly readily from *nevadata* and *implorata*. In the original description the type locality was most unfortunately merely designated as "California." Besides the actual holotype, material from the northern section of the San Francisco Bay area, including a specimen from Petaluma, Sonoma County, which has been marked by Dr. T. N. Freeman after a comparison with Hulst's type as a good match, has been available for study; also the original genitalic slide of the type female that was made some time ago by the writer. Such material leads to the belief that the species is indigenous to the San Francisco Bay area and that it is quite within the bounds of probability that Hulst's type was collected in this region.

The ground color of the primaries is a light whitish gray, but this color appears only in areas at the basal third of the wing and subterminally in the costal half; the balance of the wing is rather heavily suffused with a purplish brown, especially strong in the outer half above the inner margin, this color extending upward and tending to connect

with the rather obscurely defined median costal patch which is shaped much as in *nevadata* but is also largely of a purple brown shade. The maculation is essentially the same as in *nevadata*. *Cestata* shows extraordinary similarity to the suffused form of *nevadata* from Plumas County and adjacent areas which possesses the same purplish shading, and without genitalic study it is practically impossible to separate the two forms correctly. So far no authentic specimens of *cestata* have been found from the higher inland regions, but the available material has been too scanty to place it definitely as a coastal species. As the general type of genitalia is the same in both *cestata* and *nevadata* the description of these organs is confined to a statement of the distinctions; the male association is based on specimens taken at the same time and place as the females.

MALE GENITALIA: Similar to those of *nevadata* in all respects except in the shape of the ventral projection of the clasper; this, instead of being broad and truncately cut off apically, is longer, narrower, and gradually tapering to a blunt point. The structure can often be seen by removing a few scales from the end of the abdomen, which obviates the necessity of making a complete slide.

FEMALE GENITALIA: Most readily separated by the character of the ostium pouch which is considerably longer than in *nevadata* and of a much deeper color, the length being only slightly less than the breadth. In general the chitinous collar is also longer and narrower, and the overlapping proximal end of the bursa on the ventral surface does not extend nearly so far over it as is the case in *nevadata* nor does it project slightly on the left corner. However, this character is somewhat variable and some genitalic preparations show a broader collar and a greater overlap; the holotype happens to be one of these instances. This latter slide has been closely matched by a specimen from Inverness, Marin County, whereas another specimen, taken at the same place and on the same date, shows the narrower collar. The dorsal spines on the left side in the region of the projecting chitinous bar are much reduced, and the same is true of the proximal ventral spining. The drawing is based on a

preparation with well-inflated bursa made from the above-mentioned Petaluma specimen that was compared with the type. In poorly inflated specimens, of which, unfortunately, the type slide is an example, the position of the various parts appears, as usual, somewhat altered.

TYPE: Holotype, female, California (Rutgers University, New Brunswick, New Jersey).

DISTRIBUTION: Marin, Napa, and Sonoma counties, California.

LIFE HISTORY: Unknown.

To complicate matters in an already sufficiently involved group another species with genitalia in the female sex sufficiently distinct from those of *cestata* to warrant separation occurs in the southern section of the San Francisco Bay region. As no name appears available it is described as follows:

Eupithecia cestatoides, new species
Plate 32, figure 9; text figure 18G

Practically identical with *cestata* Hulst in color and maculation of primaries and in all outward structural characters. Color of head and patagia a light smoky white rather than the clear white of *nevadata*. Primaries heavily suffused with purple brown, obscuring the usual maculation and also the paler areas found in *cestata* in basal and subterminal areas (this character, while present in the holotype, is not entirely constant, and some paratypes are counterparts of *cestata*). A pale, dentate s.t. line is fairly visible, preceded by a narrow band of purplish brown, and followed along outer margin by a deeper purplish shade. Secondaries heavily suffused with smoky along inner and outer margin, leaving the cell a smoky whitish with an improminent discal dot. A dentate subterminal line is normally fairly evident. The male genitalia, judging by the single specimen available, are quite similar to those of *cestata*; it is in the female genitalia that the most characteristic structural differences occur.

FEMALE GENITALIA: Of the same general type as other members of the *nevadata* group. As compared with *cestata* the following differences are quite marked: ostium pouch still longer than in *cestata*, being higher than broad and very dark in color; collar con-

siderably narrower and followed by a long, heavily chitinized bursa neck which terminates on the left side in the usual rounded projection; on the right side dorsally a long, strongly chitinized ridge extends over the bursa to a level with this projection, bending then to the right and giving rise to the thin membranous ductus seminalis; the projection of the bursa ventrally over the collar is reduced to a small median knob; there is no dorsal spining in the proximal half of the bursa, the only spined area being a patch of spines situated ventrally below the collar and extending downward along the inner edge of the initial portion of the ductus seminalis. The fundus section is spined similarly to that of *cestata*. The drawing is based on the well-inflated holotype.

HOLOTYPE: Female, Half Moon Bay, San Mateo County, California, February 19, 1939 (W. H. Lange), in the American Museum of Natural History.

ALLOTYPE: Male, Los Gatos, Santa Clara County, April 24, 1943 (G. Pollard), in same collection.

PARATYPES: Three females, same locality and collector as the holotype, March 15, 17, 18, 1939, in Canadian National Collection; one female, same data as allotype, in the American Museum of Natural History; one female, Alma, California, April, 1946 (Pollard), in same collection; two females with similar data, respectively, to the two preceding paratypes in the collection of F. H. Rindge from whom the Santa Clara County material was obtained.

It is quite possible that the species extends into southern California, as odd specimens have been examined from Los Angeles and San Bernardino counties that seem to belong here. More material is needed, however, before a definite statement can be made.

Eupithecia ravocostaliata Packard

Plate 32, figures 10, 11; text figure 18H

Eupithecia ravocostaliata PACKARD, 1876, A monograph of the geometrid moths . . . of the United States, p. 60, pl. 8, fig. 9.

Tephroclystis ravocostaliata, DYAR, Proc. U. S. Natl. Mus., vol. 27, p. 889.

Eupithecia ravocostaliata, DOD, 1906, Canadian Ent., vol. 38, p. 90. TAYLOR, 1906, Canadian Ent., vol. 38, p. 101; 1907, *ibid.*, vol. 39, p. 280. PEAR-

SALL, 1910, Proc. Ent. Soc. Washington, vol. 12, p. 141. FORBES, 1948, Cornell Univ. Agr. Exp. Sta., Mem. 274, p. 164.

Ravocostaliata was described from a single female, taken at Norway, Maine, and in the east, at least, is not difficult to distinguish. The type of maculation is essentially that of *nevadata*, and the genitalia in both sexes are so similar that the two forms might readily be considered to be races of a single species. The pale, whitish ground color of *ravocostaliata* together with the fact that the large, triangular, median, costal patch of *nevadata* is reduced to a narrowly rectangular elongate bar in typical specimens makes it advisable to treat *ravocostaliata* as a distinct species for the present. The species occurs in the New England states, descending southward into the more mountainous districts of New York. It is, however, essentially a Canadian species and has been taken sparingly across the entire Dominion. In the western portion of its distributional area, particularly in the mountainous section of Alberta and in central British Columbia, it appears to meet the *nevadata* forms that have extended northward through the sage-brush areas into the so-called dry belt of British Columbia. In such areas it has been almost impossible to delimit correctly the two forms, and little help can be gotten from the genitalia. The males show no characters that can be used as a means of separation, and female material from these regions has been too scanty to be of much value, as a considerable amount of individual variation occurs throughout the group, and plenty of preparations are essential before salient features can be determined.

On Vancouver Island a rather larger form occurs which is essentially of the *ravocostaliata* type and which has always been classed as this species by such workers as Taylor and Pearsall. It is even paler in color than eastern specimens. The costal maculation is fairly typical, but occasional specimens occur that show indications of an intergrade between the costal bar of *ravocostaliata* and the triangular patch of *nevadata*, owing to more extended dark suffusion basad of the discal streak. This form occurs apparently with *nevadata probata* and gives rise to another of those perplexing problems that one meets

throughout the group and that can be solved only by intensive breeding experiments. In the female genitalia slight, but apparently constant, differences occur from those of eastern specimens mainly in the width of the collar and the size of the chitinous bar on the left side. The differences are not greater than those frequently found in specimens from widely divergent localities and are probably of no great significance from either a specific or a racial standpoint. They serve, however, as another illustration of the difficulties encountered in endeavoring to evaluate similar minor differences between the bursae of *nevadata* and *ravocostaliata* and to decide on just what might constitute a specific character. The Vancouver Island form appears to extend southward at least as far as the San Francisco Bay area; specimens have been examined from McMinnville, Oregon, Sonoma County and Half Moon Bay, California. These are very contrastingly marked with their white ground color and dark brown costal patches and are superficially readily separated from the *nevadata* forms found in the same areas. Unfortunately, the single slide of female genitalia examined from Half Moon Bay agrees almost exactly with that of a fairly typical *nevadata* from the same locality and diverges considerably from those of both Vancouver Island and eastern specimens. Are we dealing with mere color forms or distinct species with similar genitalia? Time alone will tell.

Ravocostaliata is the only one of the group of which the larval food plant is known; it has been bred from larvae on willow on several occasions by members of the Canadian Forest Insect Survey, but further life history details have not been published.

MALE GENITALIA: No differences of any moment have been discovered between this species and *nevadata*, the ventral projection of the clasper, the armature of the aedeagus, and the ventral plate of segment VIII being all similar.

FEMALE GENITALIA: As based on eastern specimens there are a few slight divergences from those of *nevadata*. While the ostium pouch is very similar in shape and color the collar is slightly broader and shows hardly any of the slight bulges on either side found in *nevadata*; the ventral bulge of the bursa

over the collar extends at times almost to its caudal margin across virtually its entire surface; the chitinous projecting bar of the left side seems somewhat reduced in prominence, but the spining in this area is increased on both surfaces, especially along the interior edge of the bar. Other characters are similar. In Vancouver Island specimens the width of the collar appears variable but on the whole is narrower than in eastern specimens and the ventral bulge of the bursa over it is reduced; the chitinous bar of the left side is also further reduced in prominence. All these differences are quite slight and may eventually prove to have little significance from a specific standpoint.

TYPE: Holotype, female, Norway, Maine (M.C.Z.).

DISTRIBUTION: Northern New York and New England states, extending across Canada from the Maritime Provinces to Vancouver Island and down the west coast as far as the San Francisco Bay region.

LIFE HISTORY: The larval food plant is willow.

GENUS NASUSINA PEARSALL

Nasusina PEARSALL, 1908, Canadian Ent., vol. 40, p. 345. BARNES AND MCDUNNOUGH, 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 141. MCDUNNOUGH, 1941, Canadian Ent., vol. 73, pp. 62-63.

GENOTYPE: *Gymnocelis inferior* Hulst.

The species *inferior* Hulst was designated by Pearsall as the type of his new genus, *Nasusina*. Chief distinctive characters are the reduction of the upper pair of spurs on the hind tibiae and the peculiar structure of the front which is bulging, more or less vertically truncate, and clothed with closely appressed scales. Doubt has already been expressed (1941) as to whether or not such characters are sufficient for generic separation, as in other respects, notably the genitalia, there is nothing to indicate a sharp separation from *Eupithecia*. The reduction of the upper pair of spurs has already been noted in a small group of species included in *Eupithecia* (e.g., *niveifascia*) which in maculation and genitalia show little relationship to *inferior*; a bulging front, although not so vertically truncate, is present in the *nevadata* group and several other small groups of species with normal

hind tibial spurs. Another included species, *vaporata* Pearsall, while showing a type of front very similar to that of *inferior* and being also quite similar genitally, possesses normal spurs. On the other hand in *mendicata* Barnes and McDunnough, scarcely separable from *vaporata* on genital characters and with normal type of spurs, we find the usual flat *Eupithecia* front. Finally *minuta* Hulst, in which the upper hind tibial spurs are entirely missing but in which the frontal structure is comparatively close to that of *inferior*, is quite dissimilar in genitalia. Based on this combination of characters there might appear to be a certain justification for the erection of a new generic term for this single species.

As the four species at present included in *Nasusina* are all inhabitants of the desert regions of the extreme southwest of the United States and as there is a considerable general similarity in superficial appearance, it has been decided to retain the generic term, more or less as a matter of convenience. Three of the species certainly show a very evident relationship genitally, and the fourth, *minuta*, is included, in spite of strong genitalic divergence, rather than complicate matters by proposing a new genus for it.

Nasusina inferior Hulst

Plate 32, figure 12; text figure 19A

Gymnocelis inferior HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 264. GROSSBECK, 1908, Jour. New York Ent. Soc., vol. 16, p. 21.

Nasusina inferior, PEARSALL, 1908, Canadian Ent., vol. 40, p. 345; 1909, Proc. Ent. Soc. Washington, vol. 11, p. 119; 1910, *ibid.*, vol. 12, p. 138. BARNES AND MCDUNNOUGH, 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 141, pl. 25, fig. 7. MCDUNNOUGH, 1941, Canadian Ent., vol. 73, pp. 62-63.

As already noted this species is the type of the genus *Nasusina*, and some of the main structural details have been discussed under the generic heading. The wings are rather narrow and pointed and of a light smoky brown coloration; on the primaries the black discal dot is quite prominent, and there are numerous fine cross lines, sharply angled below costa and then inwardly oblique and parallel to the outer margin, somewhat as in *longidens* and other members of the

palpata group; a fairly evident, whitish, somewhat irregular s.t. line runs through the darker marginal area. The secondaries are only slightly paler than the primaries with traces of several fine cross lines on the inner half of the wing. There is a fairly evident and rather broad, blackish, transverse band on segment II of the abdomen. The palpi are quite short and bushy and the male antennae very finely and evenly ciliate. The genitalia, in both sexes, are typically eupitheciid and, judging by this feature alone, the separation into a distinct genus is unwarranted. The species is on the wing from late March until early May.

MALE GENITALIA: Hair pencils on segment IX well developed. Tegumen sharply conical. Uncus rather short and thin; apex bifid, the upper fork short and pointed, the lower one broader and rounded. Vinculum short and broad, the apical margin gently rounded. Clasper narrow, somewhat tapered apically. Brachium normal. Aedeagus rather long and broad for the size of the insect. Vesica armed with two small, dentate, apically situated pieces of chitin and a long, twisted piece down the left side, more or less attached to an obscure end piece; a spiculate band runs through the center of the apical half. Ventral plate of segment VIII narrowly conical, produced in the apical half into two closely approximated prongs.

FEMALE GENITALIA: Dorsal plate of segment VIII uprightly rectangular with the laterocaudal corners rounded, finely spiculate over the terminal half; anterior apophyses quite long and moderately thick, caudal spur short, terminating on the laterocephalic edge of the membranous ventral plate; posterior apophyses of normal length, anal lobes normal and fairly widely separated, the posterior margin appearing truncate. Ventral plate with moderate scale tufts laterally, the central area caudad of the ostium very finely shagreened. Ostium broad, membranous, and finely shagreened, forming an irregularly shaped funnel, continued by the short, membranous ductus bursae; chitinous collar well developed and rounded. Bursa either sack shaped or almost globular, according to the degree of inflation; the ductus seminalis arises on the right side proximally as a fairly broad, membranous tube, projects down the side of

the bursa and then, curving around over its ventral surface, narrows to a fine tube which is directed caudad. At the base of the ductus a row of small spines crosses the bursa on both ventral and dorsal surfaces. The proximal third of the bursa is otherwise membranous and slightly strigate; the lower two-thirds is largely covered by large dorsal and ventral patches of spines, well separated on the right side but almost contiguous on the left; these spines are strong and well developed at first but gradually diminish in size towards the fundus, being more or less obsolescent in this latter area, although the fundus itself is weakly spined when viewed from the dorsal side.

TYPE: Holotype, California (Rutgers University, New Brunswick, New Jersey).

DISTRIBUTION: Southern California and probably Arizona.

LIFE HISTORY: Unknown.

REMARKS: The drawing of the female genitalia is based on a very fully inflated specimen in the Canadian National Collection from Phelan, California. The membranous areas separating the dorsal and ventral spine patches are not so evident in less-inflated specimens.

Nasusina vaporata Pearsall

Plate 32, figure 13; text figure 19B

Eupithecia vaporata PEARSALL, 1912, Canadian Ent., vol. 44, p. 28.

Nasusina vaporata, BARNES AND MCDUNNOUGH, 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 141, pl. 22, fig. 1. MCDUNNOUGH, 1941, Canadian Ent., vol. 73, pp. 62-63.

A considerably smaller species than *inferior* but of much the same type of coloration; the fine, slightly darker cross lines on the primaries are less sharply angled below the costa, especially in the case of the t.p. line which is quite gently rounded; in well-marked specimens a paler band edges the t.p. line outwardly, and this in turn is bordered by a dentate, darker line, being the inner edge of a somewhat darker terminal area; the s.t. line is hardly evident; discal dot very obscure, at times obsolete. The spurs on the hind tibiae are normal which at once distinguishes the species from *inferior*; the front is roundedly bulging but not so vertically truncate as in *inferior*; the palpi are slightly shorter than in

this species and the male antennae similarly finely ciliate; there is no dark banding on segment II of the abdomen. The genitalia of the two species are closely related. The time of flight appears to be the same as that of *inferior*.

MALE GENITALIA: Hair pencils of segment VIII well developed. Tegumen narrowly conical. Uncus short; apex bifid, much as in *inferior*. Vinculum short and rounded apically. Clasper narrow and somewhat tapered apically. Brachium normal. Aedeagus rather short and broad, shorter than in *inferior*. Vesica armed as in *inferior* with two small, dentate, apical pieces of chitin and a twisted piece on the left side which is shorter than that of *inferior*; a well-spiculated central band is also present. Ventral plate of segment VIII similar to that of *inferior* but smaller.

FEMALE GENITALIA: Dorsal and ventral plates of segment VIII, the rather thin apophyses and the ostium much as in *inferior*. Anal lobes narrower and more pointed than in *inferior*, approaching those of *mendicata* in this respect. Collar well developed but narrower than in *inferior*. Bursa small, sack-like, with the ductus seminalis arising as in *inferior* on the right side proximally; on the dorsal surface at its base a row of stout spines extends across the bursa just below the collar; on the ventral surface there is also a row of spines in the same position, but these are much reduced in size and do not reach the left side. On both surfaces in the median section broad patches of spines occur (less extensive, however, than in *inferior*); these are separated by membranous strips on both sides; the spines are extremely long in the proximal portions but dwindle rapidly towards the fundus end of the patches. The fundus third of the bursa is membranous and appears somewhat roughened.

TYPES: Holotype, male, allotype, female, San Diego, California, May 16 (A.M.N.H.).

DISTRIBUTION: Southern California; Nevada (Verdi); probably Arizona.

LIFE HISTORY: Unknown.

Nasusina mendicata Barnes and McDunnough
Plate 32, figure 14; text figure 19C

Eupithecia mendicata BARNES AND MCDUNNOUGH, 1916, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 143, pl. 22, fig. 2.

Nasusina mendicata, MCDUNNOUGH, 1941, Canadian Ent., vol. 73, pp. 62-63.

A species very similar to *vaporata* in size and general appearance. It may be primarily separated from this species by the flat, typically eupitheciid front; the palpi are also slightly longer. The coloration of the wings is rather paler and the maculation somewhat better defined; the discal dot on the primaries is usually quite distinct as is the t.p. line which bulges more strongly below the costa than in *vaporata*; there are distinct traces of an irregular pale s.t. line. The abdomen is unbanded, and the spurs of the hind tibia are normal. The genitalia are scarcely separable from those of *vaporata*. The species appears to fly at about the same time as *vaporata*. Its range extends apparently farther up the Californian coast.

MALE GENITALIA: Hair pencils of segment IX well developed. Tegumen narrow, uprightly conical. Uncus thin, apex bifid. Vinculum broad, short, apical margins flatly rounded. Clasper narrow, tapering considerably to a rounded apex. Aedeagus somewhat thinner and longer than in *vaporata*. Armature of vesica similar but the two apical, spined pieces of chitin much reduced in size. Ventral plate of segment VIII a simple tapering rod, slightly split at the apex, the whole much as in members of the *satyrata* group.

FEMALE GENITALIA: Very similar to those of *vaporata*. Dorsal plate of segment VIII rectangular with rounded laterocaudal corners. Both apophyses considerably thicker than in *vaporata*; the anterior ones moderately long with short caudal spurs which terminate ventrocephalically on the edges of large, weakly chitinized plates bearing scale tufts. Anal lobes long, narrow, sparsely setose, with a slight V-shaped incision separating them terminally. Ostium, ductus bursae, and collar much as in *vaporata*. Bursa somewhat larger but with the same type of armature and a similar position for the ductus seminalis. The greater extent of the spine patch of the dorsal surface on the left side towards the collar, which has previously been mentioned as a distinguishing character, is not altogether reliable, and the position varies with the greater or less degree of inflation of the bursa.

TYPES: Holotype, male, allotype, female, San Diego, California (U.S.N.M., *ex* collection Barnes); paratype, female, same data (A.M.N.H.).

DISTRIBUTION: Southern and central California, extending up the coast as far as Sonoma and Napa counties.

LIFE HISTORY: Unknown.

***Nasusina minuta* Hulst**

Plate 32, figure 15; text figure 19D

Gymnocelis minuta HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 265. GROSSBECK, 1908, Jour. New York Ent. Soc., vol. 16, p. 21. PEARSALL, 1908, Canadian Ent., vol. 40, p. 344.

Nasusina minuta, BARNES AND MCDUNNOUGH, 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 141. MCDUNNOUGH, 1941, Canadian Ent., vol. 73, pp. 62-63.

As already noted, this species shows little relationship genitally to the three preceding species, but rather than create a new genus for it (which eventually may have to be done) it has been included under *Nasusina* for the present. Placement under *Gymnocelis*, as was originally proposed, would be just as unsatisfactory, as there is little similarity between its genotype, *pumilata*, and *minuta*. The European *pumilata* has the typical flat, tufted front of *Eupithecia*, rather long, porrect palpi, and much stronger ciliations in the male antennae than those of *minuta*. The genitalia, too, show no close resemblance, and the only point of similarity is the entire absence in both species of the upper pair of spurs on the hind tibia.

In size and general appearance *minuta* shows considerable similarity to both *vaporata* and *mendicata*. The color of the wings is paler, especially that of the secondaries, and there is a slight ochreous tinge to the light gray ground color; the maculation of the primaries is obscure, but in well-marked specimens the median area is shaded with smoky and forms an oblique band across the wing, the outer edge of which shows a moderately sharp outward angle opposite the cell. The discal dot is quite minute. The secondaries are largely dull whitish with smoky shading along the inner margin. The abdomen shows an admixture of white and smoky scaling with a blackish transverse band on segment II fairly evident. The dark,

porrect palpi are fairly long for the size of the insect and project considerably beyond the front; they are bushily scaled, especially on the dorsal edge. The front is raised well above the level of the eyes and is roundedly bulging but not so vertically truncate as in *inferior*; it is largely white scaled with traces of darker sprinkling over the vertex and along the anterior margin. The male antennae are finely and evenly ciliate as in the other members of the genus. The venation appears to be quite normal. The species is on the wing from March to May.

MALE GENITALIA: Hair pencils of segment VIII strongly developed. Tegumen broad at base, sharply conical. Uncus short and broad, quite stubby; the upper fork of the bifid apex appears as a small, sharp, pre-apical spine. Vinculum longer than normal with rounded apex. Clasper rather short and narrow, apex rounded and scarcely tapered. Brachium reduced. Aedeagus narrow, slightly tapered apically. Vesica armed with an apical, semi-triangular piece of chitin, consisting of three closely appressed spines joined on a broadened base; proximad of this is a long spine, flanked by several shorter ones and with a small cluster of quite short spines at its base; an obscure, twisted, semicylindrical piece of chitin occurs proximad of the long spine. Ventral plate of segment VIII consists of two broad, widely separated rods, narrowly joined at their bases; they taper apically into two more strongly chitinized prongs.

FEMALE GENITALIA: Dorsal plate of segment VIII rectangular, feebly chitinized; anterior apophyses very thick and long, caudal spur also strong and terminating in a large, oval, strigate, chitinous plate, situated on the laterocaudal portion of the membranous ventral plate. Anal lobes quite distinctive, long, finely hirsute, and meeting together caudally at a point, the posterior apophyses attached to their laterocephalic edges, as thick as the anterior ones and somewhat longer than usual. Ostium broad, membranous. Membranous section of ductus bursae very short, terminating in a chitinous collar, of which the lateral flaps are long and semicylindrical. Bursa irregularly oval with a membranous projection on the left side extending from the collar halfway down the bursa; on the dorsal side this projection con-

tains a patch of spines which curve around below the collar to the right side of the bursa. A strong chitinous band descends from the collar on the right side, bending outward and terminating well beyond the middle area; the ductus seminalis arises as a fine, recurving tube from its ventrodorsal end, and it is preceded on the ventral side by a row of small spines. The small, globular fundus section of the bursa is nearly covered on the ventral side with spines, of which the marginal ones are very long and strong; on the dorsal side there is merely a band of heavy spining on the left side, partially separated from the ventral spining by a membranous band.

TYPE: Holotype, Argus Mountains, California, April (Rutgers University, New Brunswick, New Jersey).

DISTRIBUTION: Desert regions of southern California, western Arizona, and probably Nevada.

LIFE HISTORY: Unknown.

GENUS *PRORELLA* BARNES AND McDUNNOUGH

Prorella BARNES AND McDUNNOUGH, 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 142, pl. 25, fig. 6. McDUNNOUGH, 1941, Canadian Ent., vol. 73, pp. 62, 63.

GENOTYPE: *Eupithecia gypsata* Grote.

The main character on which this genus was based, viz., the prow-like projection of the front, has not held up well as a generic character, as has already been noted (1941). On the one hand similarity of genitalic characters has, in several cases, more or less forced the introduction of species with the typical flat eupitheciid front. On the other hand it has been found that a small group of species, centered around *remorata*, in which the frontal development is even stronger than in the genotype, shows a totally dissimilar type of genitalia. The reduction of the upper pair of spurs (even to extinction) holds throughout, but such a character is also to be noted in the *niveifascia* group of *Eupithecia* with a type of genitalia that prohibits association with *Prorella* species. In fact in a single case, *woodgatata* Cassino and Swett, genitalic studies have made the transference from *Prorella* to *Eupithecia* advisable, although maculation is almost identical with species still retained in the genus. The gen-

eral type of genitalia in all the species except the *remorata* group is essentially similar, notably the shape of the male ventral plate and the position of the outlet of the ductus seminalis in the female.

While it is fully recognized that the heterogeneous nature of the species included in the genus tends to make its validity rather questionable, it has been considered inadvisable for the present to sink it entirely, as it serves to separate off from a very cumbersome genus a small aggregation of species that in the main show a number of points of similarity.

As it now stands the genus includes several groups. The typical group, centered around the genotype, consists of *gypsata*, *discoidalis*, *leucata*, and *albida*, the latter somewhat atypical owing to the reduction of the frontal protuberance. All these species are rather pale in coloration with darker costal and terminal blotches. Closely allied to these, as far as frontal structure is concerned, is a small group of dark gray species with extremely similar maculation of the primaries which consists of fine oblique cross lines. This comprises *desperata*, *artestata*, *mellisa*, and *insipidata*. Easily connected with these is the minor group of *opinata* and *protoptata* in which the normal, flat, eupitheciid front is present. The final group, centered around *remorata*, while quite similar in color and maculation to *albida*, is the most widely divergent from the genotype, the frontal projection showing a greater prominence and the genitalia, notably the female bursa, being quite at variance with the typical form, so much so, indeed, in two of the species as to indicate almost generic separation. The finer details of structure and maculation are discussed under the various specific headings.

Prorella gypsata Grote

Plate 32, figure 16; text figure 19E

Eupithecia gypsata GROTE, 1882, Canadian Ent., vol. 14, p. 188.

Gymnocelis gypsata, HULST, 1896, Trans. Amer. Ent. Soc. vol. 23, p. 264. GROSSBECK, 1908, Jour. New York Ent. Soc., vol. 16, p. 21.

Nasusina gypsata, PEARSALL, 1908, Canadian Ent., vol. 40, p. 345.

Prorella gypsata, BARNES AND McDUNNOUGH, 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 142, pl. 25, fig. 6.

This species, the genotype of *Prorella*, possesses a flatly conical, moderately protuberant front considerably raised above the level of the eyes. The squamation consists of large, flat, closely appressed scaling with very slight indications of apical tufting, the color being almost entirely black brown. The short, thin, porrect palpi do not rise above the level of the front; they, too, show rather appressed scaling of a similar color to that of the front. The male antennae are very finely ciliate. The upper pair of spurs on the hind tibiae are much reduced. The species is a striking one and readily recognized. The patagia, thorax (with the exception of the anterior portion of the prothorax), abdominal segment I, and the greater portion of the primaries are of a creamy white coloration; in the median area there is a large, elongated, rectangular, costal patch which descends inward across the cell and contains the upright, black, discal streak; a narrow, white, outwardly angled band, representing the t.p. line, separates this rectangle from a similarly colored, subapical blotch. The subterminal area is largely but brokenly smoky brown, the terminal margin lighter brown, the two areas separated by a fairly evident, dentate, white, s.t. line. The ordinary lines are slightly indicated by dark dashes on the veins. The secondaries are white crossed by curved postmedian and subterminal lines; beyond the latter the margin is broadly tinged with smoky through which a dentate, white s.t. line runs. The abdomen, apart from the pale segment I, is smoky brown with black lateral spotting. The species appears to be double brooded, occurring in May and June and again from August to October.

MALE GENITALIA: Hair pencils of segment IX well developed. Tegumen narrow, conical. Uncus short, stubby, apex bifid with the upper fork sharply pointed. Vinculum broad, somewhat longer than normal, the sides converging inwardly to a rounded apex. Clasper moderately broad, apex well rounded, gently tapering. Aedeagus narrow proximally, gently expanded towards apex, fairly long. Vesica armed with two large, opposed, semi-cylindrical, strigate pieces of chitin, their apical margins feebly dentate; these are partially covered by a broad, curving, spiculate band. Proximad to these is a weak,

curled bar of chitin partially joined to the usual twisted end piece. Ventral plate of segment VIII a broad, chitinous bar with parallel sides, terminating in two projecting, rather heavily chitinized prongs with rounded apices.

FEMALE GENITALIA: Dorsal plate of segment VIII chitinized, high, and rather narrow with the caudal margin showing a deep V-shaped incision; anterior apophyses very long and thin; caudal spurs also long and extending caudad nearly to the caudolateral edge of the membranous ventral plate; posterior apophyses extraordinarily long, arising from rather weak anal lobes which are separated apically by a short V-shaped incision. Cephalic portion of the ventral plate finely shagreened as is the broad, funnel-shaped, membranous ostium which is attached to a broad chitinous collar without apparently any intervening membranous section. Bursa broadly oval, the proximal half largely membranous with a strong chitinous bar descending on the left side from the collar to the median area; in its distal half this bar is furnished inwardly with long strong spines. The ductus seminalis arises on the right side proximally as a rather narrow tube which descends along the bursa to the median area and then curves across its ventral surface before narrowing and turning caudad; it is furnished at its base with a cluster of spines. Another band of spines crosses the bursa below the collar. The distal half of the bursa is covered with fine spining, the margin of this area curving obliquely upward from left to right from the distal end of the chitinous bar to a point somewhat below the origin of the ductus seminalis. In the right half ventrally the marginal spines are long and strong and connect with a row of spines with chitinized bases which runs proximad through the central area of the bursa. On the dorsal side the longer marginal spines occur on the left side, projecting shortly into the membranous area parallel to the chitinous bar.

TYPE: Holotype, male (?), Arizona (U.S.N.M., *ex* collection Neumoegen).

DISTRIBUTION: Colorado (Berkeley); New Mexico (High Rolls); Arizona (Prescott, Globe); southwest Texas (Jeff Davis County).

LIFE HISTORY: Unknown.

Prorella discoidalis Grossbeck

Plate 32, figure 17; text figure 19F

Gymnocelis discoidalis GROSSBECK, 1908, Jour. New York Ent. Soc., vol. 16, p. 19.*Nasusina discoidalis*, PEARSALL, 1908, Canadian Ent., vol. 40, p. 345; 1910, Proc. Ent. Soc. Washington, vol. 12, p. 138.*Prorella discoidalis*, BARNES AND McDUNNOUGH, 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 142.

Although superficially this species does not resemble *gypsata* very closely, it agrees exactly with it in type of palpi, frontal structure, and male antennal ciliation. The genitalia are also of a very similar character. For these reasons its position would obviously seem to be next to *gypsata*.

In coloration the primaries are much grayer than those of *gypsata*, and the large median costal patch is reduced to two small blotches. Small dark patches are also present on the costa near apex and along the outer margin below apex and above tornus. The main distinctive feature is a very large black discal spot, as the name indicates. The cross lines are faint and are indicated by short streaks on the veins. A moderately distinct dark band on segment II of the abdomen is present. Like *gypsata* the species appears to be double brooded, occurring in June and again in August.

MALE GENITALIA: Hair pencils of segment IX well developed. Structure of tegumen, uncus, vinculum, and clasper essentially the same as in *gypsata*. Aedeagus rather thinner and slightly more tapered proximally. In the armature of the vesica the same two apical pieces of chitin are present but are much reduced in size and somewhat differently shaped as is shown in the illustration; other details similar. Ventral plate of segment VIII of the same type, somewhat narrower, and the prongs possibly slightly shorter.

FEMALE GENITALIA: Type of dorsal plate, apophyses, and ostium similar to those of *gypsata*. Bursa somewhat smaller than that of *gypsata* but of the same general character as concerns the position of the ductus seminalis, the presence of a broad, chitinous bar on the left side, and the location of the various spined areas. These latter (in any case rather variable individually as regards the number

of spines) differ only in minor details from those of *gypsata* and are best noted by a reference to the illustration; the most obvious difference appears to be in the greater length of the marginal spines on the right ventral area.

TYPE: Holotype, female, Carr Canyon, Huachuca Mountains, Cochise County, Arizona, August (A.N.S.P.).

DISTRIBUTION: Arizona; Utah (Alta).

LIFE HISTORY: Unknown.

REMARKS: The illustration of the female genitalia is based on a slide from a practically topotypical specimen from Palmerlee, Arizona, in the American Museum collection. The specimen serving for the male slide was from the Graham Mountains, Arizona, and is in the Canadian National Collection.

Prorella leucata Hulst

Plate 32, figure 18; text figure 19G

Tephroclystis leucata HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 267.*Nasusina leucata*, PEARSALL, 1909, Proc. Ent. Soc. Washington, vol. 11, p. 119.*Prorella leucata*, BARNES AND McDUNNOUGH, 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 142.

In structural details of palpi, front, male antennae, and upper spurs on the hind tibiae the species is very closely allied to *gypsata*. The genitalia are somewhat more divergent than those of *discoidalis* but still adhere to the same general type. This is evident in the long apophyses of the female and the origin of the ductus seminalis from the right proximal section of the bursa. In the male the ventral plate is similar, and the main differences occur in the armature of the aedeagus.

The species is an easily recognized one. The wings show a pale creamy coloration blotched along the costa with blackish; of these patches a rectangular, pre-apical one and a median one just interior to the discal spot are the most prominent; the latter generally sends a more or less evident continuation across the cell, the inner edge of which is slightly angled; the t.p. line is fairly evident, strongly and rather squarely exerted opposite the cell; the terminal area is weakly suffused with pale brown, basad of which an obscure, white, crenulate, s.t. line can be traced. The basal segment of the abdomen is whitish; the

remaining segments are shaded with light brownish and show black lateral spotting. The species appears to fly from late July to early September; no spring records have been observed.

MALE GENITALIA: Hair pencils of segment IX well developed. Tegumen sharply conical. Uncus rather short and chunky, apex bifid with the upper fork sharply pointed. Vinculum tapering slightly towards apex. Clasper narrow with rather pointed apex. Aedeagus thin with slightly tapered proximal end. Vesica armed with two small, irregularly shaped, and feebly dentate apical pieces of chitin, proximad of which is a short, stout spine, not present in the two previous species; a short, twisted, chitinous bar and a small end piece occur as in *gypsata*; the large spiculate band is also present. Ventral plate of segment VIII as in *gypsata*.

FEMALE GENITALIA: Dorsal and ventral plates of segment VIII, apophyses, and ostium much as in *gypsata*; the excavation in the central area of the caudal margin of the dorsal plate rather more U-shaped. Membranous ductus bursae very short, terminated by the usual chitinous collar. Bursa broadly oval, the proximal half membranous with the ductus seminalis arising much as in *gypsata* on the right side, somewhat distad of the collar, the intervening area being lightly chitinized. On both ventral and dorsal surfaces a row of strong spines extends caudad from the exit of the ductus towards the collar, that of the dorsal side reaching almost across the bursa below the collar; this arrangement is much as in *gypsata*. There is no chitinous bar on the left side of the bursa, but the row of large spines, occurring in *gypsata* on the inside of the bar, is present and connects with the fully but rather weakly spined distal half of the bursa. From this spined area on the ventral side a small patch of much larger spines projects proximad, being connected with the heavy spining of the left side by the aforesaid weaker spining; the marginal border is, in consequence, irregular and extends much farther up the left side than the right one. On the dorsal side, situated inward from the large spines on the left side, is a small isolated patch of large spines. It should again be emphasized that the arrangement and extent of the various

spined areas are subject to considerable variation, especially when specimens from widely separated localities are involved. At the present time there is no good reason to consider such variation as anything more than individual. Eventually, when more material is available for study, such differences may prove to have racial significance.

TYPE: Holotype, female, Montana (Rutgers University, New Brunswick, New Jersey).

DISTRIBUTION: Montana; Colorado; Utah (Eureka); southern California (upper Santa Ana River).

LIFE HISTORY: Unknown.

Prorella albida Cassino and Swett
Plate 32, figure 20; text figure 19H

Nasusina albida CASSINO AND SWETT, 1923, Lepidopterist, vol. 4, pp. 16, 29.

Prorella albida, MCDUNNOUGH, 1941, Canadian Ent., vol. 73, p. 63.

Eupithecia ruthiata CASSINO, 1927, Lepidopterist, vol. 4, p. 63.

Prorella ruthiata, MCDUNNOUGH, 1941, Canadian Ent., vol. 73, p. 63 (pr. syn.).

Errors in the designation of the type locality for the species were corrected on page 29 of the same journal, restricting the type locality to Eureka, Utah. In the American Museum is a small series of paratype females from this locality as well as other topotypical specimens of both sexes. From these, genitalic slides have been made. Other slides, including a male paratype, have been examined from the Canadian National Collection. Of *ruthiata* it has been possible to make a genitalic slide of the male holotype (Jemez Springs, New Mexico, 19. IX. 1919) and also of another male paratype (marked as a female). The synonymy suggested in 1941 has been confirmed.

Albida diverges considerably in characters of both maculation and structure from the genotype but, on account of the general similarity of genital structure, seems best placed under *Prorella*. The pale creamy ground color of the wings with light brown cross lines and costal spotting is rather reminiscent of *niveifascia* Hulst, but the type of genitalia precludes this association. The reduction of the upper spurs of the hind tibiae and the fine ciliation of the male antennae agree with these characters in *gypsata*; the

front, however, is much less conically protruding, being only slightly raised above the level of the eyes and gently rounded; the palpi, while fairly short, project farther beyond the front than in *gypsata* and are rather thin with closely appressed scaling. In the genitalia the ventral plate of segment VIII in the male is similar, and the female organ is essentially of the same pattern as in the genotype, especially as regards the ostium, the point of exit of the ductus seminalis, and the general character of the spined areas of the bursa.

MALE GENITALIA: Hair pencils of segment IX strongly developed. Tegumen narrow and sharply conical. Uncus well developed, bifid, the upper prong, as usual, forming a sharp spine. Vinculum short, broad, with very slightly pointed apex. Clasper narrow with apex quite sharply pointed. Aedeagus thin. Vesica armed with a single small, apical piece of chitin, weakly spined. Below this on the left side is a long, semicylindrical, chitinous bar followed by the small, twisted end piece. A curved, spiculate band runs through the apical half. The ventral plate is of the same type as in the preceding species but narrower, the sides feebly sinuate, the terminal prongs short, broad, and bluntly rounded apically.

FEMALE GENITALIA: Dorsal plate of segment VIII lightly chitinized, rectangular; both pairs of apophyses of normal eupitheciid size and not extremely long as in the genotype. Ostium broad, forming the usual long, shagreened funnel and attached to the narrow chitinous collar without any obvious membranous ductus bursae. Bursa oval, the proximal half largely membranous with a very broad ductus seminalis arising from the right side about midway and curving around as usual over the ventral surface of the bursa; dorsal and ventral rows of small spines run along the base of the ductus and curve, below the collar, to the left side, becoming more or less conjoined. Distal half of bursa completely spined, the marginal spines on both surfaces long and sharply pointed; to the left of the central areas on both sides patches of long spines, connected with the marginal spines, jut proximad, the patch on the dorsal side nearly reaching the transverse row of small spines below the collar.

TYPES: *Albida*, holotype, male, Eureka, Utah, August (M.C.Z., ex Cassino collection); *ruthiata*, holotype, male, Jemez Springs, New Mexico (M.C.Z.).

DISTRIBUTION: Utah, New Mexico, southwestern Texas.

LIFE HISTORY: Unknown.

***Prorella ochrocarneata*, new species**

Plate 32, figure 19; text figure 19I

Allied to *albida*, the front being only slightly raised above the level of the eyes and gently rounded, apparently somewhat shorter than that of *albida*. The upper pair of spurs on the hind tibiae much reduced in size. The palpi project moderately beyond the front and are scale tufted at the apex of the second joint, appearing slightly longer than in *albida*. The color of the palpi is a light smoky, that of the head cream colored. The thorax and primaries are a light fleshy ochreous, the color of the latter deeper than in *albida* and more evenly suffused over the entire wing surface. Maculation of the *albida* type, the cross lines quite indistinct, the median, postmedian, and pre-apical costal blotches on the contrary rather more distinct than in *albida*. The terminal area is of a deeper shade than the remainder of the wing, forming a narrow terminal band, rather even in character and without any obvious trace of an s.t. line. Dark discal streak quite prominent. On the paler secondaries there are a small smoky patch at base of wing; an irregular sinuate, postmedian line, basad of which is a good deal of smoky sprinkling; a darker terminal band indistinctly bordered inwardly by a dentate subterminal line; the discal streak is very thin. Beneath rather pale shiny, ochreous with traces of the upper side maculation visible. Expanse 17 mm.

FEMALE GENITALIA: Dorsal plate of segment VIII chitinized, rectangular, the caudal margin somewhat excavated centrally; anterior apophyses fairly long, posterior ones of normal size as in *albida*; caudal spur well developed and terminating in a thin chitinous bar running laterally along the membranous ventral plate. Ostium broad, forming the usual finely shagreened membranous funnel. Membranous ductus bursae very short, terminating in a narrow chitinous collar with well-developed flaps. Bursa narrowly oval,

largely membranous. The ductus seminalis arises as usual from a feebly chitinized strip on the right side proximally and consists of a fine tube which runs down the side of the bursa before curving caudad over its ventral surface. At the base of the ductus on both sides is a row of small spines, that of the dorsal surface continuing below the collar across the bursa to the left side. The whole distal half of the bursa is spined on both surfaces, the marginal spines being fairly long. On the left side this spined area is continued caudad by a row of long, stout, widely spaced spines, reaching two-thirds of the way to the collar and not based on any particularly heavily chitinized bar as often occurs in allied species.

HOLOTYPE: Female, Huachuca Mountains, Arizona, October 8-15, in the American Museum of Natural History, *ex* Grossbeck collection, but originally from the Barnes collection.

***Prorella irremorata* Dyar**

Plate 32, figure 21; text figure 20A

Nasusina irremorata DYAR, 1923, *Insector Insectiae Menstruus*, vol. 11, p. 22.

Through the courtesy of Mr. H. W. Capps of the United States National Museum who has made a slide of the genitalia of the male holotype it has been possible to fix the name definitely. According to Mr. Capps the females mentioned by Dyar in the original description from the Argus Mountains belong to another species. *Irremorata* belongs in a group of three species with practically similar wing maculation and a very strong frontal projection, one of the species being *remorata* Grossbeck and the other apparently undescribed. From *remorata* it can at once be separated by the fact that the upper pair of spurs on the hind tibiae are present in both sexes but much reduced in size, whereas in *remorata*, as now restricted, they are normally entirely absent, only occasionally a trace of the upper inner spur being found in a female. The undescribed species, which unfortunately appears to occur in the same desert areas and at the same time of year, can be separated easily on genitalic characters of both male and female, but the correct associations of the females with their respective males present a problem that cannot be solved definitely at the present time. The

association of sexes as now made for *irremorata* is based on a topotypical female from Palm Springs, California, in the United States National Museum and several specimens of both sexes from Borego, San Diego County, California (originally from the Sperry collection), which agree in genitalia with the Palm Springs specimens.

On account of the strong frontal projection the palpi appear very short and thin; the ciliation of the male antennae is very fine. The general wing coloration is a light ochreous with darker blotches along the costa and in the outer area opposite the cell and above the tornus, a type of maculation which is more or less general throughout the group and especially similar to that of *albida*. The most prominent blotch occurs in the central area of the costa, projecting across the cell as a rectangular or semitriangular patch which includes the well-defined discal dot on its outer edge; it sometimes can be traced faintly as a narrower irregular band across the entire wing. Between this blotch and the apex of the wing are two other smaller blotches; from the first the t.p. line arises, the other patch being pre-apical. The t.p. line generally forms a fairly sharp outward angle below the costa and is rather irregular in outline with a strong inbend at vein 2. No characters of maculation have been found (partly owing to the generally rubbed character of the material) by which the species can be definitely separated from *remorata* or from the new species to be described.

MALE GENITALIA: (Based on a topotypical specimen in the Canadian National Collection.) Hair pencils on segment IX well developed. Tegumen very short with convex sides. Uncus much broader and chunkier than usual, the upper fork of the bifid uncus projecting sharply as a short, fine spine. Vinculum longer than normal, gently rounding to a broadly chitinized apical margin. Clasper short and narrow, tapered. Aedeagus rather thin and fairly long. Vesica armed with a single, strong, pointed spine, the base of which is somewhat recurved; there are a small twisted end piece and above it a small, boat-shaped piece of chitin which is followed distally by a band of small spines or spicules. Ventral plate of segment VIII consists of two long sinuate bars, connected near their bases

by a thin cross piece; their apices are sharply pointed.

FEMALE GENITALIA: Dorsal plate of segment VIII weakly chitinized, rectangular; both apophyses long but shorter than in *remorata*, the caudal spur of the anterior pair long, thickening apically, and terminating in a narrow chitinous bar on the lateral margin of the membranous ventral plate. Ostium weak and membranous, followed by a short, membranous ductus bursae which terminates in a fairly well-chitinized collar with prominent flaps. Bursa pear shaped, the upper portion, or neck, thinly chitinized with a proximal spine patch on the dorsal surface which curves around to the ventral surface on the left side. The most prominent feature consists of two chitinous plates, situated, more or less opposed, left and right in the central area; these are armed inwardly with very strong, widely spaced spines. On the extreme right a chitinized bar extends from the collar to near the middle section, the ductus seminalis arising from its distal end as a narrow tube, recurving over the right ventral surface of the bursa. The ventral surface of the distal half of the bursa is unspined; on the dorsal surface the same section is weakly spined with slightly longer marginal spines, the spines gradually fading out towards the fundus and on the left side.

TYPE: Holotype, male, Palm Springs, California, March 9 (U.S.N.M.).

DISTRIBUTION: Desert regions of southern California (Palm Springs, Riverside County; Borego, San Diego County; Split Mountain Canyon, San Diego County; San Felipe Wash, Imperial County; 12 miles south of Cave Springs, Mojave Desert); Nevada (Valley of Fire). According to Mr. Capps a cotype of *remorata* Grossbeck in the United States National Museum belongs here, which extends the range of the species into Arizona.

LIFE HISTORY: Unknown.

***Prorella tremorata*, new species**

Plate 32, figure 22; text figure 20B

Indistinguishable from *irremorata* Dyar on outward structural features and in color and maculation of the wings. The primaries are of the same general light ochreous color with darker costal blotches arranged as in *irremorata*; the secondaries are somewhat paler in color with a prominent dark discal streak

and an irregular postmedian line, strongly bent in above the inner margin; there are traces of a darker subterminal line and a fairly evident dark blotch about the middle of the terminal area. The male genitalia are closely related to those of *irremorata*, while the female genitalia show more similarity to those of *remorata*.

MALE GENITALIA: Very similar to those of *irremorata*, differing principally in the armature of the vesica; the stout spine is longer, more sinuate, especially apically; in place of the boat-shaped piece of chitin and the band of spicules of *irremorata* there is a fine, moderately long, sharply pointed spine, at times partially superimposed on the basal portion of the larger spine; a weak end piece is present. The ventral plate of segment VIII is of the same general type as in *irremorata*, but the bars are more sinuate, more closely approached in the median section, and with their apices furnished with a sharper spine.

FEMALE GENITALIA: Of the same general type as in *remorata*, the bursa being long and leg shaped; the long, feebly chitinized leg terminates in a bulbous fundus. As in *remorata* the collar is very weakly chitinized and scarcely noticeable; there is a patch of spines on the left side below the collar but none on the right side; another patch of longer spines occurs in the central area of the leg ventrally, much more proximally placed than the corresponding patch in *remorata*. The foot is membranous and of a somewhat roughened texture; the ductus seminalis is much as in *remorata*, arising proximally and dorsally.

HOLOTYPE: Male, Tub Canyon, Borego, California (Crickmer), March, 1947, in the American Museum of Natural History, courtesy of J. Sperry.

ALLOTYPE: Female, same data, in the American Museum of Natural History.

PARATYPES: Two males, Tub Canyon, Borego, California, February, March, 1947, in the American Museum of Natural History and collection of Sperry, respectively; one male, Split Rock Tank, Mojave Desert, California, May 20, 1938, in the Canadian National Collection; four females, Split Rock Tank, Mojave Desert, California, May 20 and 21, in the American Museum of Natural History, Canadian National Collection, and the United States National Museum; one

female, Borego, California, December, 1945, in the American Museum of Natural History. One of Grossbeck's cotypes of *remorata* from Yuma, Arizona, in the American Museum of Natural History also belongs here.

***Prorella remorata* Grossbeck**

Plate 32, figure 23; text figure 20C

Gymnocelis remorata GROSSBECK, 1907, Canadian Ent., vol. 39, p. 345; 1908, Jour. New York Ent. Soc., vol. 16, p. 21. BARNES AND MCDUNNOUGH, 1912, Contributions to the natural history of the Lepidoptera of North America, vol. 1, no. 4, p. 31, pl. 14, fig. 2.

Naususina remorata, PEARSALL, 1908, Canadian Ent., vol. 40, p. 345; 1910, Proc. Ent. Soc. Washington, vol. 12, p. 138.

Prorella remorata, BARNES AND MCDUNNOUGH, 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 142.

The species was described from a number of specimens from Yuma County, Arizona. Later (1908) Grossbeck notes that of his type series seven males and two females possessed merely the lower pair of spurs on the hind tibiae and nine females showed two pairs, the upper being rudimentary. In the American Museum collection are three "Cotype" females, two entirely without the upper pair of spurs and one with the rudimentary ones. A study of these specimens shows that the genitalia of the two specimens without upper spurs are distinct from those of the one with reduced spurs and that Grossbeck's type series evidently consisted of a mixed lot of specimens. As it is obvious from Grossbeck's later note that the males all belonged to the species in which the upper spurs were entirely absent, it is proposed to restrict the name to the "male type," which has been examined, it being doubtful at the present time which species was represented by his "type female." Superficially *remorata* can scarcely be separated from *irremorata* except on the character of the hind tibial spurs (very occasionally a vestige of the upper spur is present in the female sex), the coloration and maculation being practically similar in both species. It also has the general appearance of *albida* but structurally shows a wide divergence in the size of the frontal prominence not only from *albida* but also from the genotype, *gypsata*. This same character, as already noted, is found in the two

closely allied species with reduced upper spurs present and for which the names *irremorata* and *tremorata* have been employed.

The details of palpi and male antennae are the same as in these two species.

With regard to the wing maculation it might be noted that the intensity of the brown spotting may vary considerably from pale fawn, as in the types, to a more distinct light wood brown as in a few specimens from the Tucson area; the dark discal streaks on both wings are quite long, that of the forewing situated on the outer margin of a more or less defined median band, originating in an outwardly oblique costal patch; on the hind wings beyond the streak there is considerable blackish sprinkling which extends outward to a pale subterminal band. The t.p. line of primaries, originating in a small costal blotch, bends outward at almost a right angle below same and then continues faintly and rather irregularly to the inner margin, more or less defined inwardly by short dark streaks on the veins; a pre-apical costal blotch and blotches slightly inward from the darker outer margin are fairly well defined opposite cell and above tornus. The genitalia in both sexes are totally dissimilar from those of other species included in the genus except *tremorata*, but in the female genitalia of *irremorata* there seems to be a link connecting it with the more typical members of the genus. It might be noted that the idea of the male genitalia is based on a single male from Tucson, Arizona (April), in the Canadian National Collection and another male from the Sperry collection taken at Organ Pipe Cactus National Monument. These agree with the holotype in structure of the anal plate and match females from the same localities, the genitalia of which agree with those of Grossbeck's paratypes with single pair of hind tibial spurs already mentioned. Mr. H. W. Capps furnishes the information that there are males among the specimens in the United States National Museum from Ajo and Redington, Arizona.

MALE GENITALIA: Hair pencils of segment IX strongly developed. Tegumen narrow, conical, apex rather sharply pointed. Uncus short and stubby with the ordinary bifid apex. Vinculum long, rounded, and somewhat tapered apically, the lateral edges thin, the apical section broadly chitinized. Clasper

moderately broad, apex rather truncately cut off. Aedeagus long and thin, tapered proximally. Armature of vesica consists of a long, curved, pointed spine with base somewhat recurved; an equally long, thin, twisted, chitinous bar expands apically into a broad, smooth, rounded section; a second similarly smooth and rounded piece, without, however, the long thin base, is adjacent apically to the other piece. Ventral plate of segment VIII very characteristic; it consists of two parallel rods, narrowly joined at base and expanded apically into two rounded knobs, each bearing a single sharp spine.

FEMALE GENITALIA: Dorsal plate of segment VIII very weakly chitinized. Both pairs of apophyses extraordinarily long, much longer even than those of *gypsata*. Ostium very weak and membranous, poorly defined and leading into a weak and scarcely chitinized collar of equal width with the proximal end of the bursa. A long, leg-like bursa is lightly chitinized and striate and terminates in a membranous club foot. At the proximal end of the leg small lateral spine patches occur, that on the left side being best developed; at the distal end on the ventral surface is a narrow patch of spines, the upper ones quite long, the lower ones becoming gradually smaller and obsolescent. A much smaller patch of fine spines occurs on the opposite dorsal surface. The fundus is membranous. The very fine ductus seminalis arises proximally and dorsally near the spine patch of the left side and descends over the leg of the bursa nearly to the foot before bending to the right and curving caudad.

TYPE: Holotype, male, Yuma, Arizona, April (Rutgers University, New Brunswick, New Jersey).

DISTRIBUTION: Southern Arizona (Yuma; Tucson; Organ Pipe Cactus National Monument; Baboquiveri Mountains; Ajo; Redington).

LIFE HISTORY: Unknown.

***Prorella desperata* Hulst**

Plate 32, figure 24; text figure 20D

Gymnocelis desperata HULST, 1896, Trans. Amer. Ent. Soc., vol. 23, p. 264. GROSSBECK, 1908, Jour. New York Ent. Soc., vol. 16, p. 21.

Nasusina desperata, PEARSALL, 1908, Canadian Ent., vol. 40, p. 345; 1909, Proc. Ent. Soc. Washington, vol. 11, p. 119.

Prorella desperata, BARNES AND MCDUNNOUGH, 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 142.

While the reduced upper spurs of the hind tibiae, the palpal structure, and the type of ciliation of the male antennae are similar to those of *gypsata*, the conical, protuberant front is decidedly more raised above the eye level and projects farther beyond the anterior margin of the eyes than is the case with the genotype. The type of wing maculation also differs considerably, the large costal dark blotches of the primaries being virtually lacking and replaced by inwardly oblique lines more or less on the pattern of *Nasusina inferior*. The present species is characterized by a strongly oblique, dark, antemedian band, angled outwardly below costa, the angle almost touching the well-developed black discal streak; the t.p. line bulges very strongly below the costa and then runs closer to the outer margin of the wing than in other allied species; there is a rectangular, pre-apical, costal patch and small blotches on the terminal area opposite the cell and above tornus reminiscent of similar maculation in *gypsata*. A fairly distinct blackish band crosses segment II of the abdomen, the other segments being light fawn brown. The genitalia, while adhering to a considerable extent to the pattern found in *gypsata*, show considerably greater variation from the type form than was present in *discoidalis* and *leucata*. Judging by the data on specimens examined both spring and fall broods occur.

MALE GENITALIA: Hair pencils of segment IX well developed. Tegumen narrow and sharply conical. Uncus broad at base, sharply tapered, the upper prong of the bifid uncus very acute. Vinculum rather longer than usual, broad with rounded apex. Clasper rather chunky, not much tapered apically. Aedeagus long and broad. Vesica armed with two strong, superimposed apical spines, of which the dorsal one is the longer; proximad to these on the left side is a larger, somewhat curved spine, sharply pointed; besides these there are the usual semicircular, upright piece and the small twisted end piece; a narrow band of short, blunt spines runs through the central area. The ventral plate of segment VIII is broad and terminates in two

widely separated prongs, bluntly rounded apically, and with a deep V-shaped excavation between them.

FEMALE GENITALIA: Chitinized dorsal plate of segment VIII high and narrow; apophyses and caudal spur very long, much as in *gypsata*; ostium also similarly funnel shaped and shagreened. Chitinous collar narrow. Bursa small, oval. From its lightly chitinized right side the ductus seminalis arises somewhat below the collar, runs alongside the bursa towards the fundus, and then curves across the ventral surface, turning caudad and narrowing; ventrally along its base is a row of small spines; on the dorsal side a patch of small spines, arranged in several rows, extends obliquely from its base to the left side just below the collar. Centrally on the left side is a patch of very large spines on a chitinous base; on the ventral surface somewhat inward from the right side in the central area a chitinized bar projects caudad, furnished with large scattered spines. Below these two spine patches the entire distal third of the bursa is covered with spines. On the dorsal surface a smooth, weakly chitinized area on the right side below the exit of the ductus seminalis bears short chunky spines; inwardly from this is a much weaker replica of the ventral surface.

TYPE: Holotype, male, Blanco County, Texas, October (Rutgers University, New Brunswick, New Jersey).

DISTRIBUTION: Central and southwestern Texas.

LIFE HISTORY: Unknown.

Prorella artestata Grossbeck

Plate 32, figure 25; text figure 20E

Gymnocelis artestata GROSSBECK, 1908, Jour. New York Ent. Soc., vol. 16, p. 20.

Nasusina artestata, PEARSALL, 1908, Canadian Ent., vol. 40, p. 345.

Prorella artestata, BARNES AND MCDUNNOUGH, 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 142.

The correct identity of this species is still slightly doubtful. It was described from a single female from the Huachuca Mountains, Arizona, collected in August, and it has not been possible to remove the abdomen for genitalic study. The present idea of the

species is based on a male (unfortunately without head) from the type locality and probably one of the type lot (*ex* collection Grossbeck) and a pair of specimens in the American Museum collection from the same mountain range and collected in the same month; these originally came from the Barnes collection through Grossbeck. Several other specimens from the Chiricahua Mountains, Arizona (June), the vicinity of Flagstaff, Arizona (Sperry), and from Jeff Davis County, Texas (Poling), in the Canadian National Collection appear to agree genitally with the above topotypical specimens.

Based on this material the species is very evidently closely allied to *insipidata* Pearsall and is extremely difficult to separate from it on maculation of primaries alone. The structural features of palpi, front, male antennae, and hind tibial spurs are exactly similar to those of both *desperata* and *insipidata*, and these species, with one or two others, form a compact little group, as noted under the generic heading. *Artestata* possesses much darker-colored primaries than *desperata* and lacks the prominent, oblique, dark, ante-median band on the pale background of this species, the oblique cross lines being finer and rather obscure and the t.p. line much farther inward from the outer margin. On account of the rather poor condition of the material examined it is impossible to compare accurately the very similar maculation of *artestata* and *insipidata*; both species are largely smoky brown in coloration with oblique dark cross lines (slightly tending towards bands) sharply angled below costa. It would appear that *artestata* shows possibly less pale suffusion in the median and subterminal areas and that the t.a. line (or band), which forms the inner edge of the median band, is less oblique than in *insipidata*, reaching the inner margin somewhat nearer its middle than is the case with the same line in *insipidata*. These characters are, however, very slight and possibly not constant, and recourse must be had to genitalia definitely to decide identity. Grossbeck, in his original description, laid great stress on the angulation of the postmedian line of the secondaries, but the value of this character is doubtful and must be carefully checked when more material is available. In any case Grossbeck was com-

paring the species with *Eupithecia huachuca*, an entirely different species, and not with any of the present close allies. The Flagstaff specimens were collected in August and September, the Texan specimens and a single male from the Chiricahua Mountains in May to June which would point to a double brood, as appears general in the whole group.

MALE GENITALIA: Hair pencils of segment IX strongly developed. Tegumen broad at base, narrowing sharply to a rounded apex. Uncus broad at base and rather chunky, the upper prong of the bifid apex sharply pointed as in *desperata*. Vinculum broad at base, tapered to a bluntly rounded apex. Clasper long, narrow, with gently tapered apex. Aedeagus long and broad. Vesica armed apically with a single, weakly chitinized, fan-shaped piece of chitin, the upper margin of which is slightly dentate. This is a distinguishing feature from *insipidata* which shows three apical chitinous pieces. The whole apical area appears covered with a spiculate membrane. In the central section occurs a hollowed-out piece of chitin with recurved base; it tapers to a point and has somewhat the appearance of a spine and appears to be connected with an obscure, strigate, indefinitely defined membrane that occupies the whole central area. Distad of this the usual semicircular bar and twisted end piece are present, and a narrow band of fine spicules runs through the central area. Ventral plate of segment VIII conical, terminating in two thin, shortly projecting, and closely approached prongs with rounded apices, these prongs being closer together than in *insipidata*.

FEMALE GENITALIA: Very similar to those of *desperata* and even closer to those of *insipidata*. Dorsal plate of segment VIII high with strongly excavated caudal margin; apophyses long, the anterior ones considerably longer than in *desperata*. Ostium the usual tapering, shagreened funnel. Collar narrow, well chitinized, with the raised lateral flaps well developed. Bursa elongately oval, rather more than the proximal half membranous and somewhat striate, the remaining distal section covered with small spines, the marginal ones on the right dorsal section being quite long. The ductus seminalis arises on the right side, considerably farther below the collar than in *desperata*, and

there is light chitinization around its base which is armed with a row of small spines on the ventral side much as in *desperata*; dorsally an irregular, oblique row of still finer spines, sparser than in *desperata*, descends from the collar along the basal portion of the ductus. The strongly spined chitinous bar which juts proximad in *desperata* from the spined distal portion of the bursa on the ventral side is much reduced and contains only an odd spine or two, and there is no sign of any projection on the dorsal side; the chitinous patch of the left side, while present, is also reduced, the spines being considerably smaller than those of *desperata*; there is no chitinous area with spines on the right side below the ductus.

TYPE: Holotype, female, Carr Canyon, Huachuca Mountains, Arizona, August (A.N.S.P.).

DISTRIBUTION: Arizona, southwestern Texas.

LIFE HISTORY: Unknown.

***Prorella mellisa* Grossbeck**

Plate 32, figure 26; text figure 20F

Gymnocelis mellisa GROSSBECK, 1908, Jour. New York Ent. Soc., vol. 16, p. 19.

Nasusina mellissa, PEARSALL, 1908, Canadian Ent., vol. 40, p. 345.

Prorella mellisa, BARNES AND McDUNNOUGH, 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, pp. 142-143, pl. 22, fig. 3.

The identity of this species is still rather confused. On the strength of the slight ochreous suffusion of the primaries it was suggested by Barnes and McDunnough (1918) that the species was distinct from the very similar *insipidata* Pearsall as represented by the male holotype from New Mexico in the United States National Museum. This latter specimen, with virtually identical maculation, showed none of the ochreous tinges of *mellisa*. Both forms were figured at the time by specimens from Kingman, Arizona, and Prescott, Arizona, respectively.

The unique male type of *mellisa* is in the American Museum collection, and a poor genitalic slide, made by Cassino, has been remounted. According to this slide the genitalia are exactly similar, notably in the armature of the vesica, to those of male specimens in the same collection from Pres-

cott, Yavapai County, Arizona, which seem to agree with the conception of *insipidata* given in the "Contributions."

The outer morphological characters of both forms are identical and similar to those noted for *artestata* Grossbeck, but the color differences mentioned above hold good. No other material, topotypical or otherwise, has been examined that can be definitely assigned to *mellisa*. A pair of specimens, however, in the American Museum of Natural History from Eureka, Utah, August, the female cotype of *insipidata* in the same collection, as well as a considerable series of both sexes from southwestern Texas (Jeff Davis County) May-June, from the Canadian National Collection, which show the ochreous shading of the holotype, have been carefully studied. In genitalic slides of several males the only difference noted is the reduction of the fan-shaped, apical piece (*vide* detailed description) to a small, irregular spine with broad base. As such a change might easily be due to an elimination of the left-hand portion of the fan (which in any case is very obscure) and as otherwise no difference in the color and maculation of the forewing can be observed, these specimens, although somewhat larger than the type, are being tentatively placed as *mellisa*. Other specimens, unfortunately, from the Texas series have the darker coloration of *insipidata* and, in the only male available, show a better development of the fan. In consequence, it has been impossible to decide whether *insipidata* should be considered as a mere race or form of this species or whether the two names should be kept apart as specific entities. For the present the latter course is followed.

MALE GENITALIA: Hair pencils presumably present, although destroyed in Cassino's dissection. Tegumen conical, fairly broad at base, the sides sloping sharply inward to a rounded apex. Uncus rather chunky, with the usual bifid apex. Vinculum short, broad, with rounded apical margin. Clasper narrow, only slightly tapered apically. Aedeagus moderately broad, slightly tapered proximally. Armature of vesica consists of an apical, fan-shaped, chitinous piece as in *artestata*; in addition to this (a distinctive character) are a small, feebly dentate bar and a short spine, both situated apically in conjunction

with the fan-shaped piece. Proximad of these on the left side is a long, thin spine, superimposed over the usual semicylindrical, chitinous bar at the base of which is a small, twisted end piece. A thin, curved, spiculate band runs, as usual, through the central section between the long spine and the apical pieces. The ventral plate is unfortunately missing in Cassino's slide.

FEMALE GENITALIA: The figure, drawn from a slide of one of the Texan females, shows very great similarity to that of *insipidata*, the slightly different position of the spined areas being possibly due to different inflation of the bursa.

TYPE: Holotype, male, Minnehaha, Yavapai County, Arizona, September (A.M.N.H., *ex* collection Grossbeck).

DISTRIBUTION: As yet definitely known only from the type locality.

LIFE HISTORY: Unknown.

***Prorella insipidata* Pearsall**

Plate 32, figure 27; text figure 20G

Nasusina insipidata PEARSALL, 1910, Proc. Ent. Soc. Washington, vol. 12, p. 138 (*partim*, ♂ *nec* ♀).

Prorella insipidata, BARNES AND MCDUNNOUGH, 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, pp. 142-143, pl. 22, fig. 4.

The correct application of the name must be based on the male holotype from Las Vegas, New Mexico, in the United States National Museum. The cotype female in the American Museum of Natural History from Havilah, California (Henry Edwards), would be best placed under *mellisa*, owing to its ochreous suffusion. The close relationship of this rather dubious species to *mellisa* has already been discussed. From *artestata*, to which it is also very similar in color and maculation, it may be separated fairly readily by the more strongly inwardly oblique character of the antemedian lines and band. Outward morphological details are virtually identical in both species, but in the genitalia there is an addition in the male of a small spine and a short, chitinous, weakly spined bar to the single fan-shaped piece of *artestata*. In the female bursa the ventral, spined, chitinous bar, projecting proximad from the spined fundus area, is much more strongly developed.

Other details of spining are very similar, and lack of material has made it impossible to decide whether the differences that may be noted in the figures are of specific value or merely due to different degrees of inflation of the bursa. A single slide made from a female from Frijoles Canyon, New Mexico, a locality very close to the type locality, Las Vegas, has served for the illustration. The bursa in this preparation was rather poorly inflated, and it is probable that in better-inflated material the exit of the ductus seminalis would appear closer to the collar, and the opposed, spined, chitinous bars would be located more centrally, as in the figure under *mellisa*.

MALE GENITALIA: Indistinguishable from those of *mellisa*. The ventral plate much as in *artestata* but with the apical prongs wider apart.

FEMALE GENITALIA: (Based on a New Mexico specimen.) Dorsal plate of segment VIII weakly chitinized, uprightly rectangular with the caudal margin broadly excavated; apophyses long and thin as in allied species. Ostium, ductus bursae, and collar much as in allied species. Bursa elongately oval or pear shaped, upper two-thirds largely membranous, fundus third covered with spines, of which the marginal ones on the dorsal side are long and thin. Ductus seminalis arises, as usual, from a weakly chitinized area on the right side, descends alongside the bursa, and curves caudad across the ventral face of the bursa; ventrally at its base is a row of fine spines; dorsally, in the same area, a weak spine patch, consisting of several rows of spines, runs back to the collar, extending below it to the left side. Centrally on the left side is a chitinous bar provided with strong, widely spaced spines, and somewhat inward from the right side a chitinous bar juts upward from the fundus spined area, being also strongly and sparsely spined.

TYPE: Holotype, male, Las Vegas, New Mexico, August (U.S.N.M.).

DISTRIBUTION: New Mexico, Arizona, southwestern Texas.

LIFE HISTORY: Unknown.

***Prorella opinata* Pearsall**

Plate 32, figures 28, 29; text figure 20H

Nasusina opinata PEARSALL, 1909, Proc. Ent. Soc. Washington, vol. 9, p. 119.

Nasusaria opinata, BARNES AND McDUNNOUGH, 1912, Contributions to the natural history of the Lepidoptera of North America, vol. 1, no. 4, p. 31, pl. 14, fig. 6.

Eupithecia opinata, BARNES AND McDUNNOUGH, 1918, Contributions to the natural history of the Lepidoptera of North America, vol. 4, no. 2, p. 142.

Prorella opinata, McDUNNOUGH, 1941, Canadian Ent., vol. 73, pp. 62-63.

Originally placed in *Nasusina*, presumably on account of the reduction of the upper pair of spurs on the hind tibiae, the species was later (1918) transferred to *Eupithecia*, due to the fact that the flat type of front disagreed with the conical type on which the genus *Prorella* was based. It remained in this position in the 1938 "Check list." Later, however (1941), when studies of genitalia showed the close resemblance of these organs in *opinata* to more or less typical members of the genus *Prorella*, it was retransferred, frontal structure alone being recognized as a rather poor character on which to base association of species. Along with *protoptata* the present species differs then from *gypsata*, the generic type of *Prorella*, in possessing the normal flat, eupitheciid front; the palpi, too, are more eupitheciid in character, the second segment being well tufted dorsally. On the other hand the reduced tibial spurs, the type of genitalia, and the forewing maculation point definitely to an association with the *desperata-mellisa* section of the genus *Prorella* and would seem to justify retention in this group.

Typical *opinata* is a small gray species, the primaries with fine, inwardly oblique cross lines, the antemedian lines tending at times to fuse into a faint band which runs from the fairly evident discal dot to the inner margin at about one-fourth. Besides the type specimens and other topotypical ones from Prescott, Yavapai County, Arizona, the American Museum of Natural History contains a good series from Eureka, Utah, with the same gray coloration of the wings. With these specimens are a number of others, evidently collected at the same time, that show a faint ochreous tinge over the outer area of the primaries. As no genitalic differences can be noted between the two it would seem to be inadvisable to consider such color changes as having specific value. It appears to be an

analogous case to that of *mellisa* and *insipidata*, which, although treated separately in the preceding pages, may readily prove to be mere color forms of a single species.

MALE GENITALIA: Very similar to those of *artestata* and *mellisa*, differing principally in the armature of the vesica which entirely lacks both the apical, chitinous piece and the thin, long spine; the semicylindrical bar and the small end piece, together with the spiculate band, are all that remain; the whole appears to be enclosed in a transparent membranous or gelatinous cover with roundedly projecting apical section, a similar feature being evident in other allied species. In the ventral plate the two apical prongs are close together and rather short.

FEMALE GENITALIA: Of the same general character as found in the preceding specimens. Dorsal plate of segment VIII rectangular, the laterocaudal edges gently rounded and the caudal margin with a small median excavation. The apophyses, in contradistinction to those of typical members of the genus, are scarcely longer than is usually the case in *Eupithecia*. The finely shagreened, funnel-shaped ostium, however, is much the same as in other species of the genus, the membranous ductus bursae, connecting the ostium with the moderately broad, chitinous collar, being somewhat longer than usual. The bursa, as usual, is lengthily oval with the proximal half largely membranous. Below the collar is a short neck, very weakly chitinized, the sides of which bulge slightly outwardly. The ductus seminalis follows the usual plan of taking its inception on the right side of the bursa before the middle and circling around over its ventral surface; along its base are the two dorsal and ventral rows of small spines, of which the ventral ones are the stouter. The fundus half of the bursa is completely spined, the spines extending up the left side almost to the collar; these latter spines are somewhat stronger than the others but not nearly comparable in size to those found in similar areas in the preceding species nor is any very obvious chitinous base present. In the central area on both surfaces spined projections are directed proximad, their bases being more weakly chitinized than is normally the case in allied species.

TYPES: Holotype, male, allotype, female, Prescott, Arizona, September (A.M.N.H.).

DISTRIBUTION: Arizona; New Mexico; Utah; southern California (San Bernardino County).

REMARKS: In a couple of female specimens in the American Museum of Natural History from New Mexico (Fort Wingate, Deming) there are slight variations in the armature of the bursa from the typical form as described above. The median projection of spines from the fundus area is much reduced on the ventral surface, while that of the dorsal surface tends to fuse with the projecting row of spines along the left side; the dorsal spines along the base of the ductus appear also more numerous than usual. Whether these differences have any specific significance or not cannot be determined at present, owing to the worn condition of the specimens and the paucity of material. The general maculation pattern seems entirely similar as far as can be told.

LIFE HISTORY: Unknown.

Prorella protoptata McDunnough

Text figure 20I

Eupithecia protoptata MCDUNNOUGH, 1938, Canadian Ent., vol. 70, p. 240, pl. 20, figs. 5a-d.

Prorella protoptata MCDUNNOUGH, 1941, Canadian Ent., vol. 73, p. 63.

With *opinata* this species shows the flat front of *Eupithecia*. The reduced upper pair of spurs on the hind tibiae and especially the general type of genitalia seem to indicate a relationship with the more typical group of *Prorella* rather than with *Eupithecia*; hence the present placement. The species is another example of the apparent utter futility of trying to split up the eupithecias according to any one constant group of characters.

As only the type material of the species is known and as this is unavailable for examination at the present time, nothing can be added to what was originally mentioned in the description.

TYPES: Holotype, male, allotype, female, southwestern Texas, May-June (C.N.C.).

DISTRIBUTION: Known so far only from the type locality.

LIFE HISTORY: Unknown.

LIST OF SPECIES

- Eupithecia** Curtis
- 1 palpata *Packard*
 - 2 slossonata *McDunnough*
 - 3 albimontanata *McDunnough*
 - 4 longidens *Hulst*
a kerrvillaria *Cassino and Swett*
 - 5 ornata *Hulst*
 - 6 monacheata *Cassino and Swett*
carolata *McDunnough*
 - 7 terrestrata *McDunnough*
 - 8 columbiata *Dyar*
a erpata *Dyar*
 - 9 maestosa *Hulst*
dyarata *Taylor*
a harlequinaria *Dyar*
 - 10 subvirens *Dietze*
laisata *Strecker*
diegata *McDunnough*
 - 11 castellata *McDunnough*
 - 12 chiricahuata *McDunnough*
 - 13 insolabilis *Hulst*
 - 14 catalinata *McDunnough*
 - 15 edna *Hulst*
 - 16 owenata *McDunnough*
 - 17 longipalpata *Packard*
 - 18 sabulosata *McDunnough*
 - 19 macrocarpata *McDunnough*
 - 20 placidata *Taylor*
 - 21 unicolor *Hulst*
cenataria *Cassino and Swett*
 - 22 miserulata *Grote*
nebulosa *Hulst*
plumbaria *Hulst*
grossbeckiata *Swett*
a zela *Swett and Cassino*
 - 23 misturata *Hulst*
subfoveata *Dyar*
minorata *Taylor*
insignificata *Taylor*
sublineata *Taylor*
scelestata *Taylor*
a delzurata *Swett and Cassino*
b frostiata *Swett*
conformata *Pearsall*
 - 24 harveyata *Taylor*
 - 25 bivittata *Hulst*
 - 26 pygmaeata *Hübner*
a obumbrata *Taylor*
fortunata *Pearsall*
 - 27 bryanti *Taylor*
modesta *Taylor*
 - 28 coloradensis *Hulst*
carolinensis *Grossbeck*
spenceata *Cassino*
 - 29 cretata *Hulst*
 - 30 regina *Taylor*
 - 31 undata *Freyer*
scriptaria *Herrich-Schaeffer*
 - 32 borealis *Hulst*
 - 33 jejunata *McDunnough*
 - 34 castigata *Hübner*
latipennis *Hulst*
 - 35 albipunctata *Haworth*
promulgata *Pearsall* (♀)
 - 36 luteata *Packard*
catskillata *Pearsall*
fasciata *Taylor*
a bifasciata *Dyar*
 - 37 fletcherata *Taylor*
promulgata *Pearsall* (♂)
dolorosata *Pearsall*
 - 38 kasloata *Dyar*
 - 39 bradorata *McDunnough*
 - 40 sheppardata *McDunnough*
 - 41 affinata *Pearsall*
 - 42 rotundopuncta *Packard*
californiata *Gumpfenberg*
 - 43 sierrae *Hulst*
conceptata *Pearsall*
joymaketa *Cassino*
 - 44 litoris *McDunnough*
 - 45 quakerata *Pearsall*
apacheata *Cassino*
conglomerata *McDunnough*
 - 46 bolterii *Hulst*
 - 47 palmata *Cassino and Swett*
 - 48 piccata *Pearsall*
 - 49 pretansata *Grossbeck*
 - 50 sinuata *McDunnough*
 - 51 neomexicana *McDunnough*
 - 52 alpinata *Cassino*
 - 53 prostrata *McDunnough*
 - 54 persimulata *McDunnough*
 - 55 exudata *Pearsall*
 - 56 herefordaria *Cassino and Swett*
 - 57 suspiciosata *Dietze*
 - 58 nabokovi *McDunnough*
 - 59 biedermanata *Cassino and Swett*
 - 60 cupressata *Pearsall*
 - 61 albigrisata *Pearsall*
 - 62 gibsonata *Taylor*
chagnoni *Swett*
 - 63 arceuthata *Freyer*
a taylorata *Swett*
 - 64 satyrata *Hübner*
a fumata *Taylor*
b intimata *Pearsall*
c dodata *Taylor*
divinula *Cassino and Swett*
mackieata *Cassino and Swett*
 - 65 terminata *Taylor*
slocanata *Taylor*

- 66 *nimbicolor* Hulst
obscurior Hulst
adornata Taylor
incresata Pearsall
inclarata Cassino and Swett
- 67 *strattonata* Packard
- 68 *cimicifugata* Pearsall
- 69 *grata* Taylor
- 70 *russeliata* Swett
a brauneata Swett
- 71 *ammonata* McDunnough
- 72 *coagulata* Guenée
fumosa Hulst
- 73 *swettii* Grossbeck
- 74 *geminata* Packard
packardata Taylor
meritata Pearsall
kasloata auctorum (nec Dyar)
- 75 *indistincta* Taylor
geminata Pearsall (nec Packard)
- 76 *zygadeniata* Packard
tenebescens Hulst
- 77 *cretacea* Packard
fenestrata Millière
- 78 *plenoscripta* Hulst
a bindata Pearsall
- 79 *nimbosa* Hulst
- 80 *behrensata* Packard
perillata Pearsall
monterata Cassino and Swett
- 81 *multiscripta* Hulst
- 82 *gelidata* Moeschler
hyperboreata Staudinger
flebilis Hulst
lagganata Taylor
compactata Taylor
nordeggensis Swett and Cassino
- 83 *multistrigata* Hulst
spaldingi Taylor
- 84 *perfusca* Hulst
a kootenaiata Dyar
slocanata Taylor (*partim*)
b alberta Taylor
c youngata Taylor
winnata Taylor
- 85 *hanhami* Taylor
- 86 *filmata* Pearsall
- 87 *annulata* Hulst
limnata Pearsall
orfordata Cassino
- 88 *usurpata* Pearsall
nimbosa Hulst (*partim*)
- 89 *olivacea* Taylor
- 90 *cognizata* Pearsall
- 91 *lachrymosa* Hulst
- 92 *georgii* McDunnough
- 93 *sobrinata* Hübner
- a interruptofasciata* Packard
quebecata Taylor
- 94 *niphadophilata* Dyar
- 95 *subcolorata* Hulst
- 96 *appendiculata* McDunnough
- 97 *emmedonia* Grossbeck
- 98 *zelmira* Swett and Cassino
- 99 *vitreatata* Cassino
gilata Cassino (♀)
- 100 *segregata* Pearsall
bonita Cassino and Swett
- 101 *pinata* Cassino
- 102 *tenuata* Hulst
- 103 *agnesata* Taylor
a barnesi Cassino and Swett
- 104 *huachuca* Grossbeck
- 105 *woodgatata* Cassino and Swett
- 106 *stellata* Hulst
- 107 *bowmani* Cassino and Swett
- 108 *niveifascia* Hulst
a perbrunneata Taylor
- 109 *joanata* Cassino and Swett
balboata Cassino and Swett
- 110 *flavigutta* Hulst
- 111 *sperryi* McDunnough
- 112 *johnstoni* McDunnough
- 113 *dichroma* McDunnough
- 114 *rindgei* McDunnough
- 115 *cocoata* Pearsall
- 116 *albicapitata* Packard
- 117 *mutata* Pearsall
togata auctorum (nec Hübner)
- 118 *helena* Taylor
- 119 *columbrata* McDunnough
- 120 *spermaphaga* Dyar
- 121 *purpurissata* Grossbeck
a valariata Pearsall
muriflua Dyar
- 122 *mystiata* Cassino
- 123 *gilvipennata* Cassino and Swett
scabrogata auctorum (nec Pearsall)
- 124 *miamata* Cassino
- 125 *scabrogata* Pearsall
vistata Cassino and Swett
- 126 *adequata* Pearsall
- 127 *acutipennis* Hulst
- 128 *subapicata* Guenée
occidentaliata Packard
- 129 *shirleyata* Cassino and Swett
- 130 *redingtonia* McDunnough
- 131 *gilata* Cassino
- 132 *plumasata* McDunnough
- 133 *deserticola* McDunnough
- 134 *anticaria* Walker
implicata Walker
explanata Walker
- 135 *pertusata* McDunnough
- 136 *tricolorata* Cassino

- 137 *carneata* *McDunnough*
138 *classicata* *Pearsall*
139 *penumbrata* *Pearsall*
140 *graefii* *Hulst*
 a *vancouverata* *Taylor*
 b *tulareata* *Cassino and Swett*
141 *nevadata* *Packard*
 a *geneura* *Swett and Cassino*
 b *morensata* *Cassino and Swett*
 c *moirata* *Swett and Cassino*
 d *probata* *Swett and Cassino*
142 *implorata* *Hulst*
143 *cestata* *Hulst*
144 *cestatoides* *McDunnough*
145 *ravocostaliata* *Packard*
Nasusina *Pearsall*
 1 *inferior* *Hulst*
 2 *vaporata* *Pearsall*
 3 *mendicata* *Barnes and McDunnough*
 4 *minuta* *Hulst*
Prorella *Barnes and McDunnough*
 1 *gypsata* *Grote*
 2 *discoidalis* *Grossbeck*
 3 *leucata* *Hulst*
 4 *albida* *Cassino and Swett*
 ruthiata *Cassino*
 5 *ochrocarneata* *McDunnough*
 6 *irremorata* *Dyar*
 7 *tremorata* *McDunnough*
 8 *remorata* *Grossbeck*
 9 *desperata* *Hulst*
 10 *artestata* *Grossbeck*
 11 *mellisa* *Grossbeck*
 12 *insipidata* *Pearsall*
 13 *opinata* *Pearsall*
 14 *protoptata* *McDunnough*

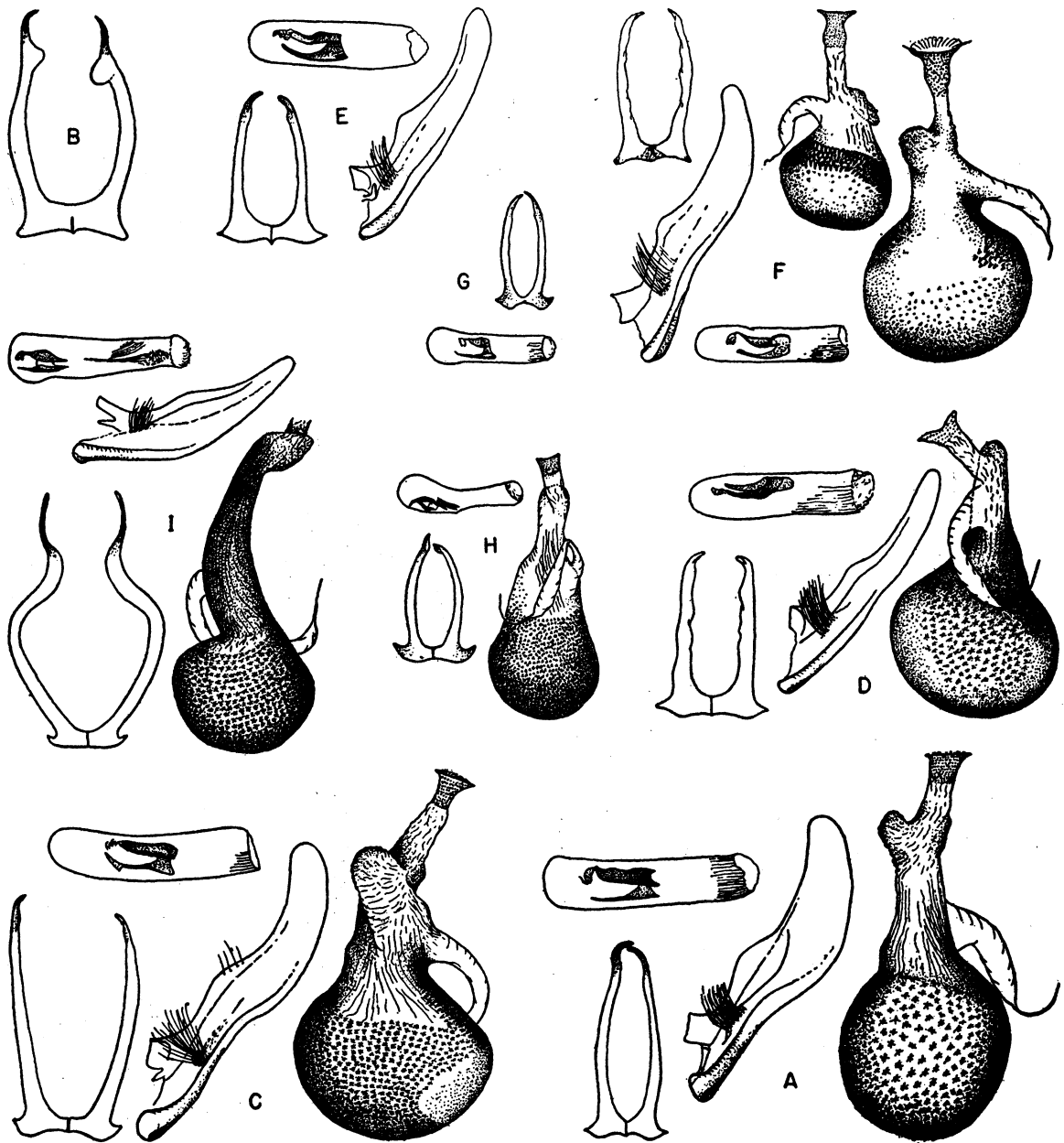


FIG. 1. A. *Eupithecia palpata* Packard, right clasper, aedeagus, ventral plate, ventral view of bursa. B. *E. slossonata* McDunnough, holotype, ventral plate. C. *E. albimontanata* McDunnough, right clasper, aedeagus, and ventral plate of holotype, ventral view of bursa of allotype. D. *E. longidens* Hulst, right clasper, aedeagus, ventral plate, and, of a paratype, dorsal view of bursa; all in United States National Museum. E. *E. longidens kerrivillaria* Cassino and Swett, right clasper, aedeagus, ventral plate of topotypical specimen. F. *E. ornata* Hulst, right clasper, aedeagus, ventral plate, dorsal and ventral views of bursa. G. *E. monacheata* Cassino and Swett, aedeagus, ventral plate of holotype of *E. carolata* McDunnough. H. *E. terrestrata* McDunnough, aedeagus, ventral plate, dorsal view of bursa; all of type material. I. *E. columbiata* Dyar, right clasper, aedeagus, ventral plate, ventral view of bursa.

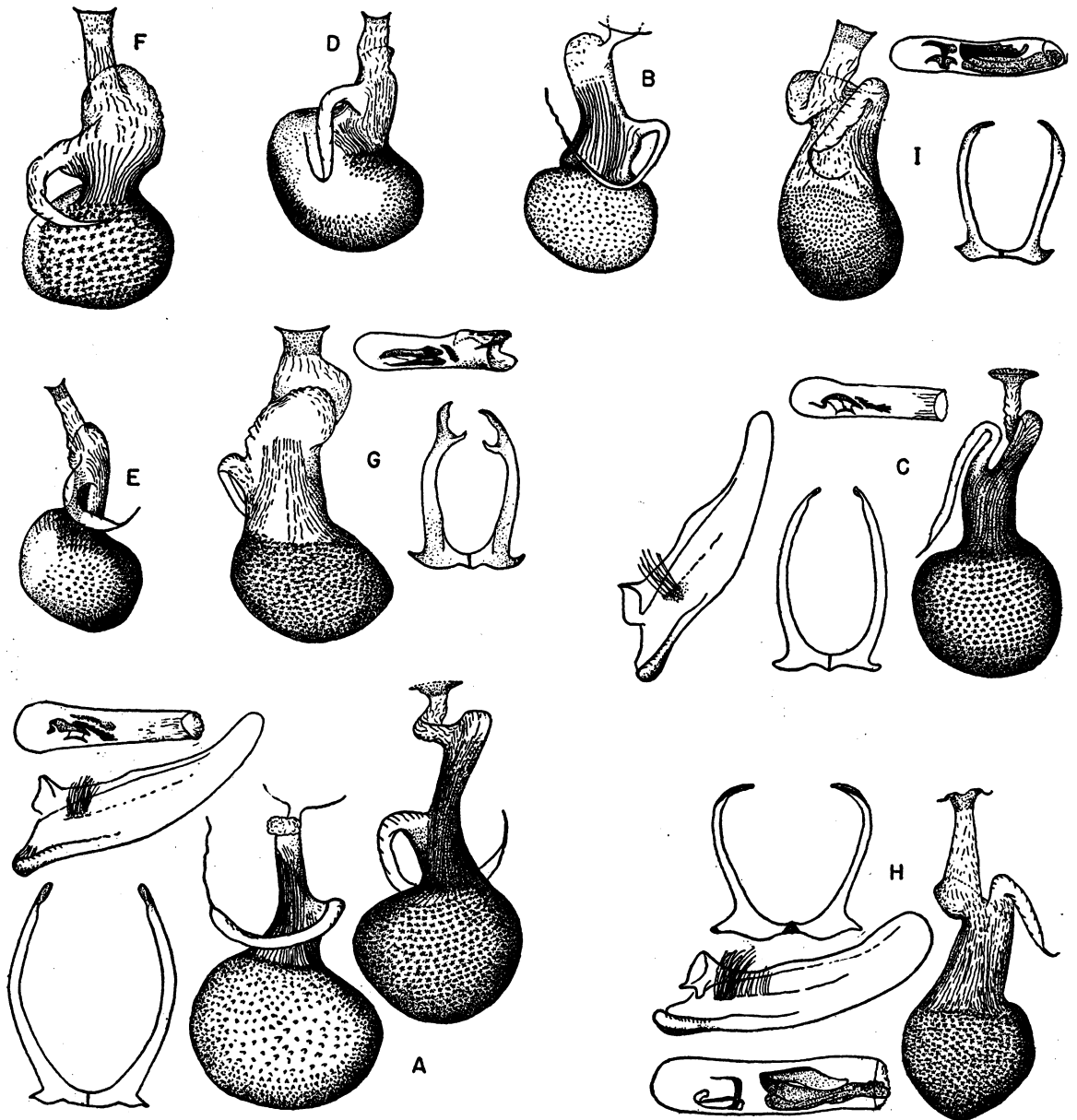


FIG. 2. A. *Eupithecia maestosus* Hulst, right clasper, aedeagus, ventral plate, and of holotype, dorsal view of bursa, ventral view of another bursa. B. *E. maestosus harlequinaria* Dyar, dorsal view of bursa of holotype. C. *E. subvirens* Dietze, right clasper, aedeagus, ventral plate, ventral view of bursa; all of type material of *E. diegata* McDunnough. D. *E. castellata* McDunnough, dorsal view of bursa of type material. E. *E. chiricahuata* McDunnough, dorsal view of bursa of holotype. F. *E. insolabilis* Hulst, dorsal view of bursa of holotype. G. *E. catalinata* McDunnough, aedeagus, ventral plate of holotype, and, of a specimen from Redington, Arizona, ventral view of bursa. H. *E. edna* Hulst, right clasper, aedeagus, ventral plate, dorsal view of bursa; all of New Mexico material. I. *E. owenata* McDunnough, aedeagus, ventral plate, dorsal view of bursa; all of type material.

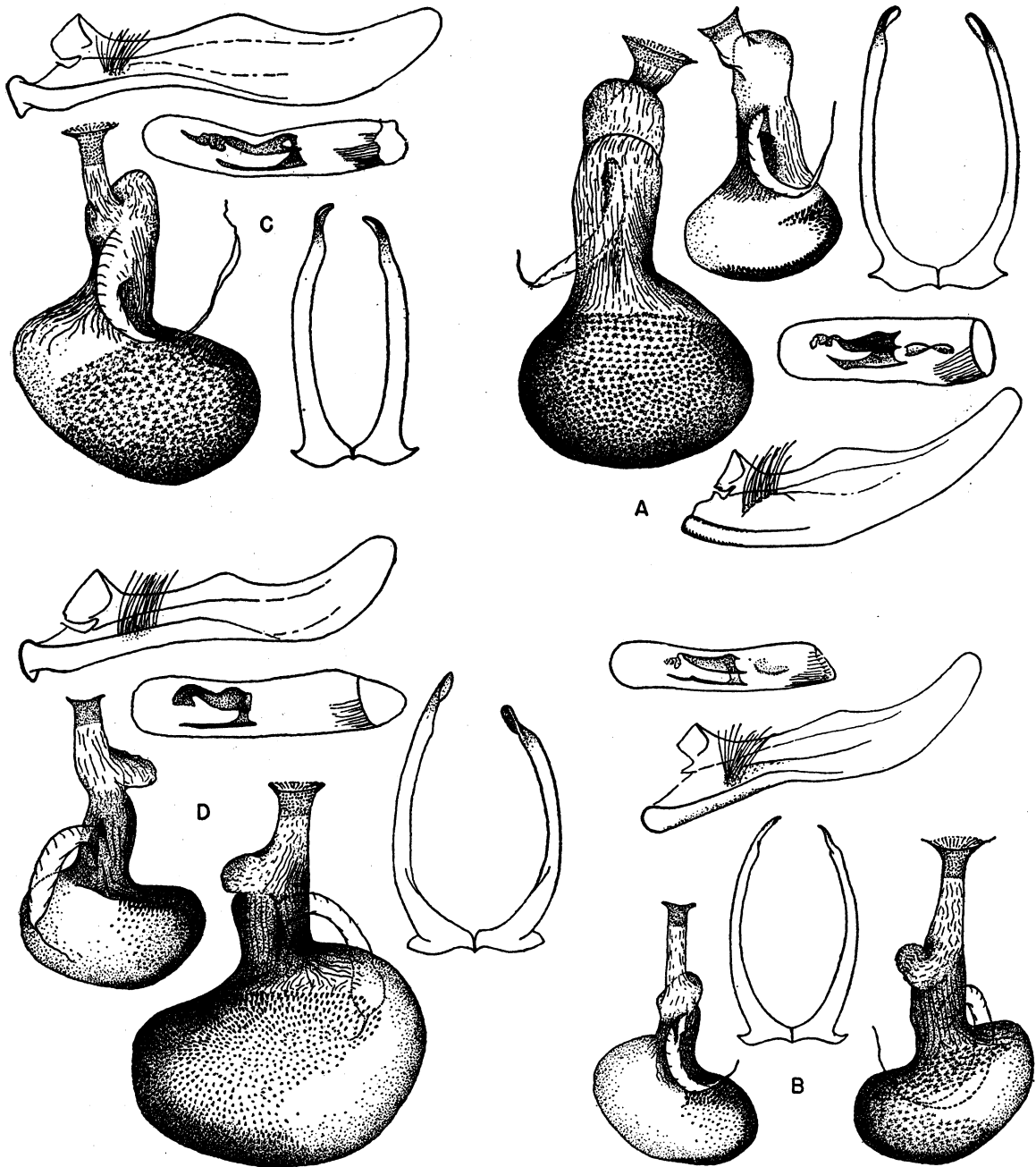


FIG. 3. A. *Eupithecia longipalpa* Packard, right clasper, aedeagus, ventral plate, dorsal and ventral views of bursa; all of Vancouver Island material. B. *E. sabulosata* McDunnough, right clasper, aedeagus, ventral plate, dorsal and ventral views of bursa; all of type material. C. *E. placidata* Taylor, right clasper, aedeagus, ventral plate and, of holotype, dorsal view of bursa. D. *E. unicolor* Hulst, right clasper, aedeagus, ventral plate, dorsal view of bursa and, of a paratype of *E. cenataria* Cassino and Swett, ventral view of bursa.

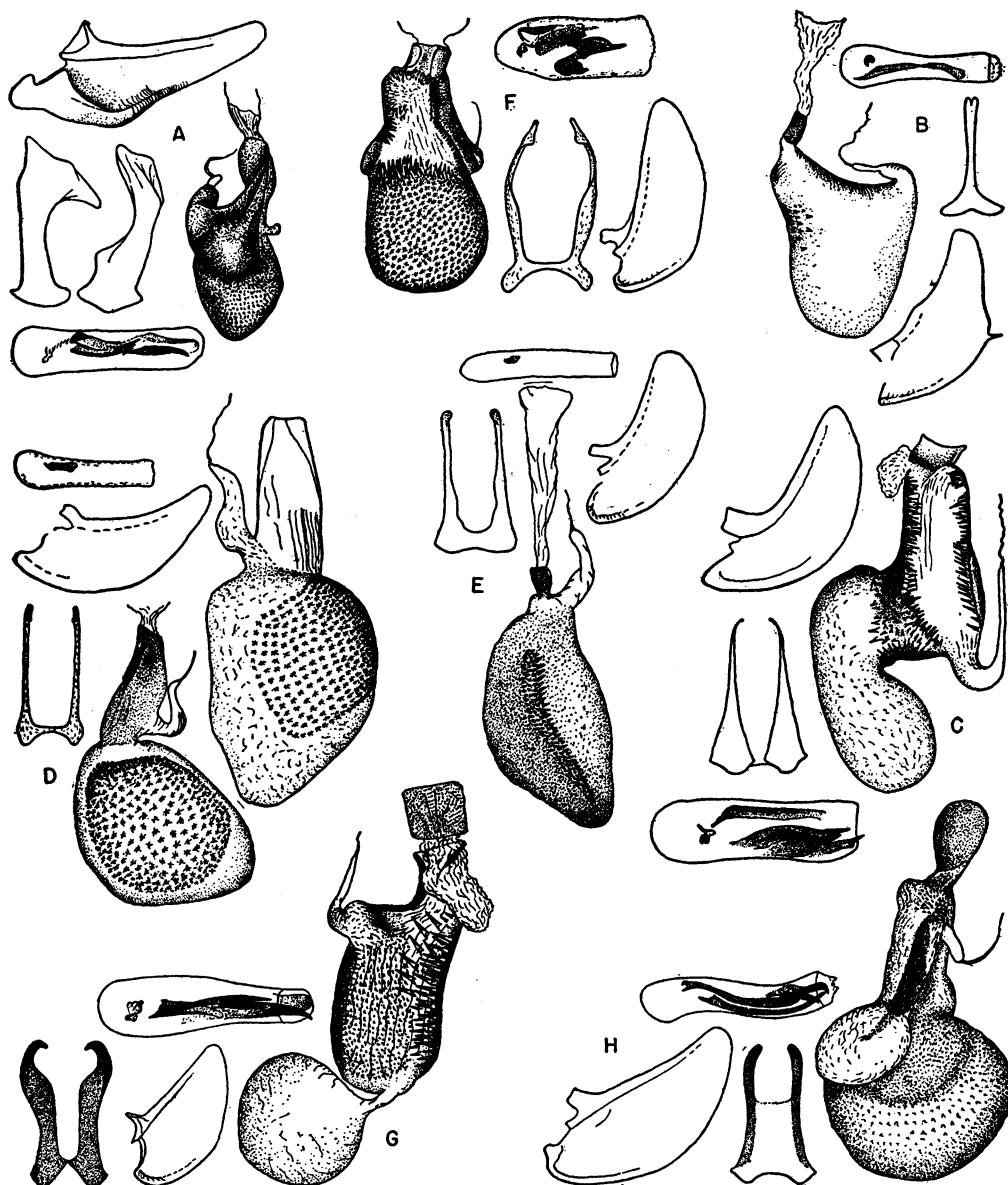


FIG. 4. A. *Eupithecia miserulata* Grote, right clasper, aedeagus, ventral plate, and, of New Jersey specimen agreeing with holotype of *E. plumbaria* Hulst, subdorsal view of bursa. B. *E. misturata* Hulst, right clasper, aedeagus, and ventral plate of holotype of *E. minorata* Taylor, and, of holotype of *E. sublineata* Taylor, lateral view of bursa. C. *E. pygmaeata obumbrata* Taylor, right clasper, aedeagus, and ventral plate of a Hopedale, Labrador, specimen, and, of holotype, ventral view of bursa. D. *E. bryanti* Taylor, right clasper, aedeagus, and ventral plate of holotype of *E. modesta* Taylor, and, of holotype, dorsal view, greatly enlarged, of bursa, ventral view of bursa of specimen from Victoria, British Columbia. E. *E. coloradensis* Hulst, right clasper, aedeagus, and ventral plate of holotype and, of specimen from Alcove, Quebec, lateral view of bursa. F. *E. regina* Hulst, right clasper, aedeagus, and ventral plate of holotype, and, of allotype, ventral view of bursa. G. *E. undata* Freyer, right clasper, aedeagus, ventral plate, and dorsal view of bursa of material from Hedley, British Columbia. H. *E. borealis* Hulst, right clasper, aedeagus, and ventral plate of topotypical male, and, of holotype, semilateral view, greatly enlarged, of bursa.

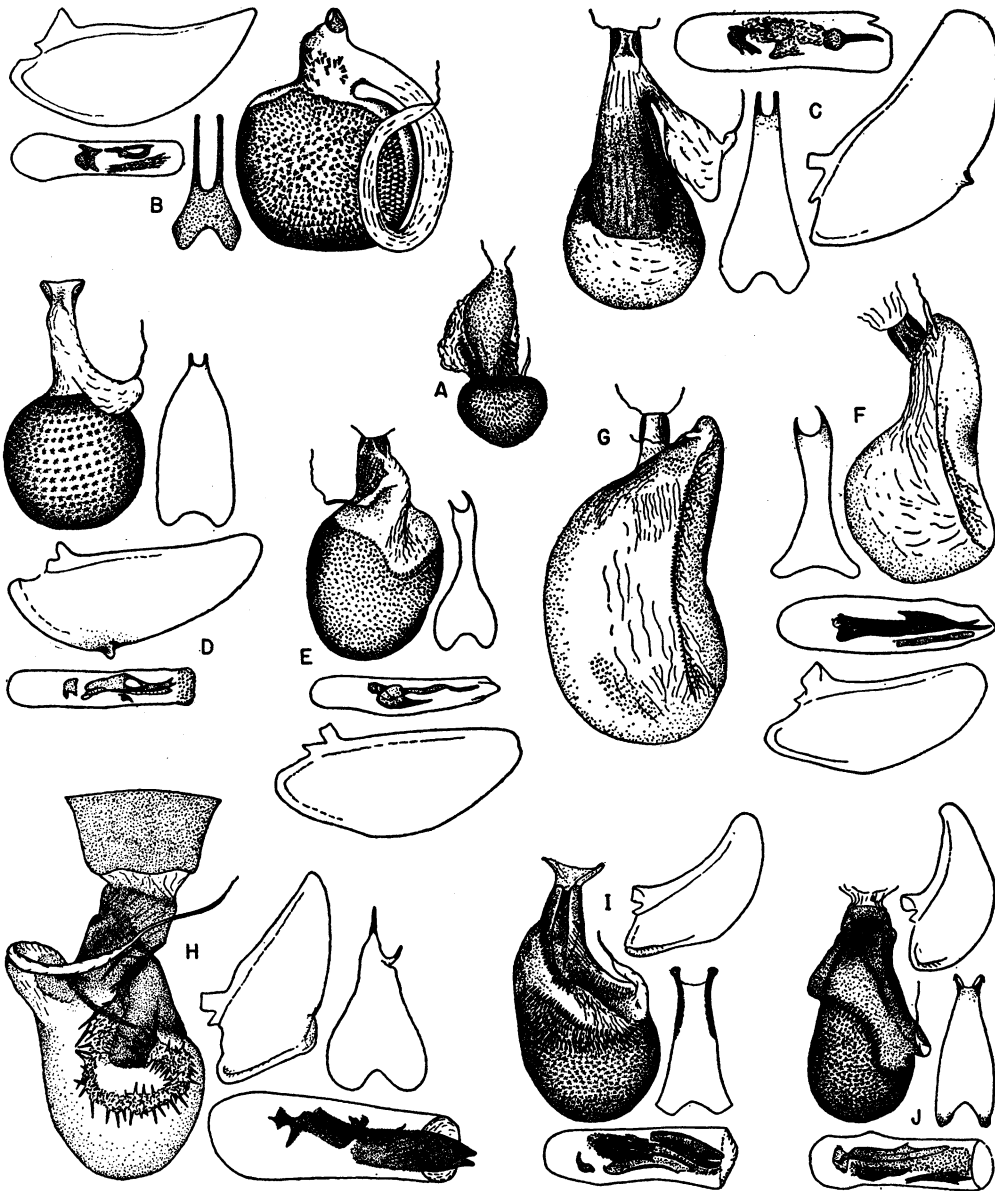


FIG. 5. A. *Eupithecia jejuna* McDunnough, bursa of holotype. B. *E. castigata* Hübner, right clasper, aedeagus, ventral plate, ventral view of bursa. C. *E. albipunctata* Haworth, right clasper, aedeagus, and ventral plate of specimen from White Point Beach, Nova Scotia, ventral view of bursa. D. *E. luteata* Packard, right clasper, aedeagus, and ventral plate of holotype and, of a paratype of *E. catskillata* Pearsall, ventral view of bursa. E. *E. fletcherata* Taylor, right clasper, aedeagus, and ventral plate of holotype of *E. promulgata* Pearsall, and, of allotype, ventral view of bursa. F. *E. kasloata* Dyar, right clasper, aedeagus, ventral plate, and, of allotype, ventral view of bursa. G. *E. bradorata* McDunnough, ventral view of bursa of specimen from Biscotasing, Ontario. H. *E. sheppardata* McDunnough, right clasper, aedeagus, ventral plate, and dorsal view of bursa; all of type material. I. *E. affinata* Pearsall, right clasper, aedeagus, and ventral plate of male from Montreal, Quebec, ventral view of bursa of female from Catskill Mountains, New York. J. *E. rotundopuncta* Packard, right clasper, aedeagus, ventral plate, ventral view of bursa.

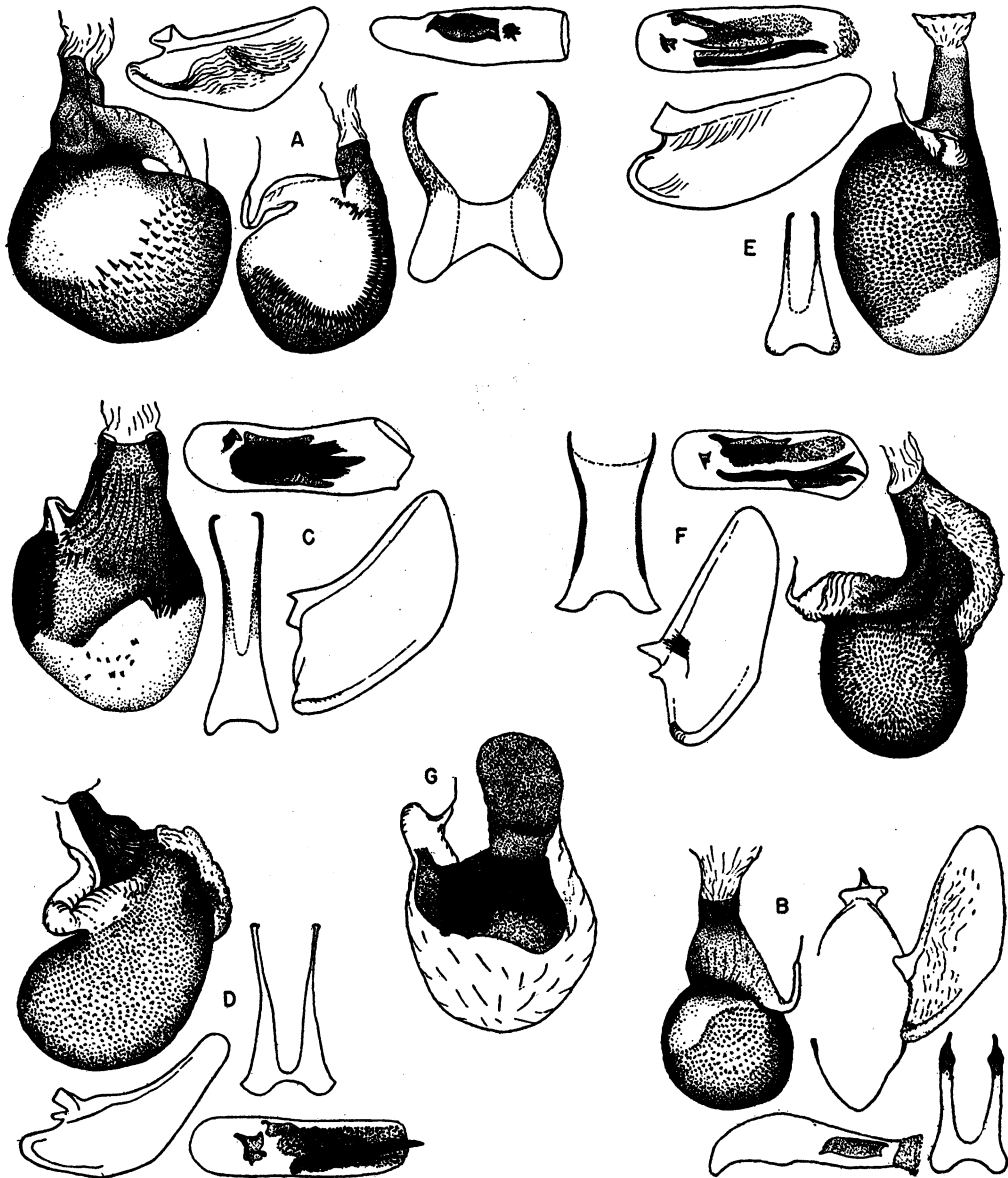


FIG. 6. A. *Eupithecia sierrae* Hulst, right clasper, aedeagus, and ventral plate of holotype of *E. conceptata* Pearsall, and, of allotype of *conceptata*, right lateral view of bursa; left lateral view of bursa of Arizona variety. B. *E. litoralis* McDunnough, right clasper with uncus and vinculum attached, aedeagus, and ventral plate of male from San Diego, California, and, of holotype, ventral view of bursa. C. *E. quakerata* Pearsall, right clasper, aedeagus, and ventral plate of holotype, and, of holotype of *E. conglomerata* McDunnough, dorsal view of bursa. D. *E. bolterii* Hulst, right clasper, aedeagus, and ventral plate of male from Texas, and, of holotype, dorsal view of bursa. E. *E. palmata* Cassino and Swett, right clasper, aedeagus, ventral plate, and, of a paratype, dorsal view of bursa. F. *E. piccata* Pearsall, right clasper, aedeagus, and ventral plate of holotype, and, of a paratype, semidorsal view of bursa. G. *E. sinuata* McDunnough, dorsal view of bursa; type material.

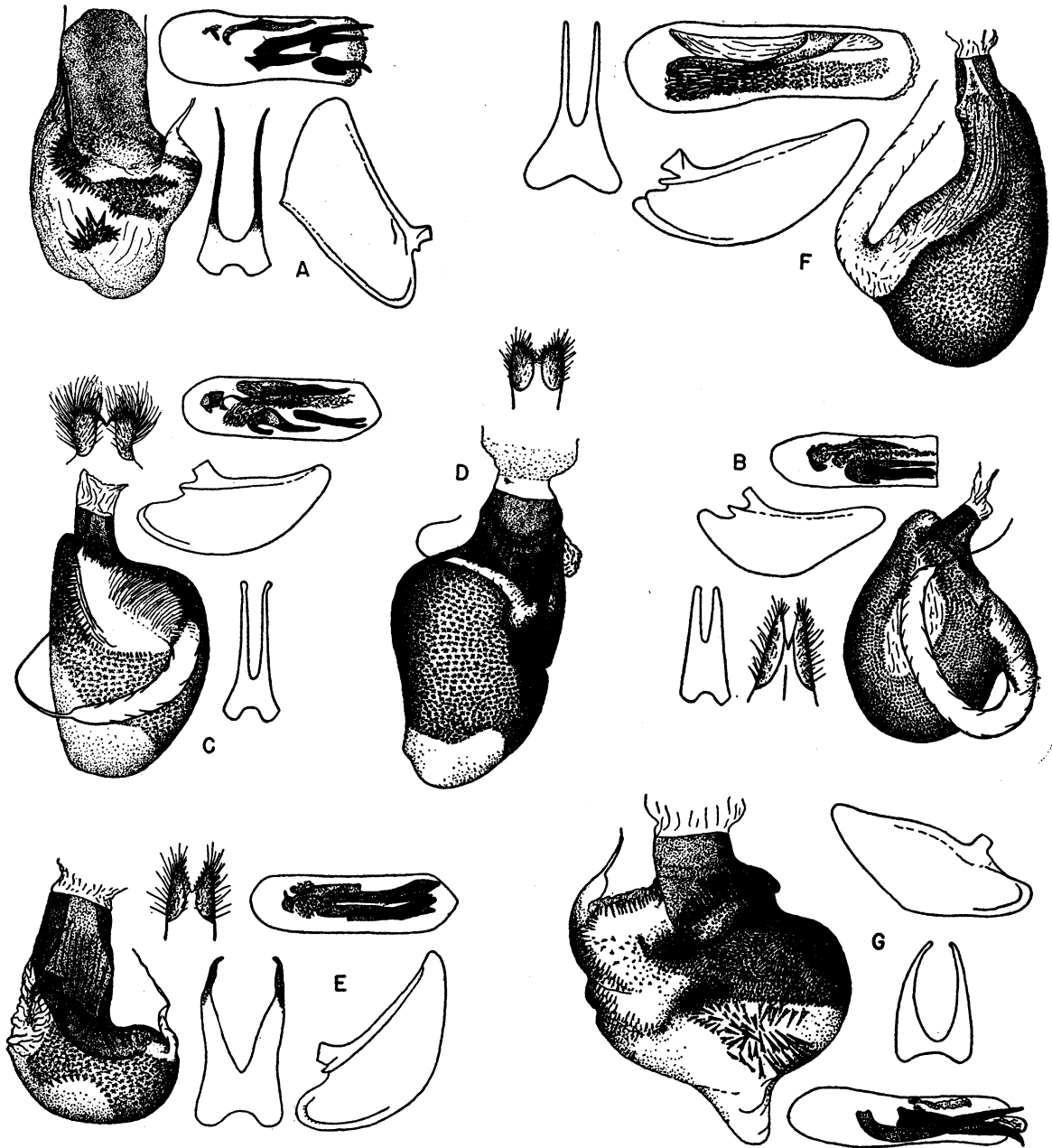


FIG. 7. A. *Eupithecia neomexicana* McDunnough, left clasper, aedeagus, ventral plate, ventral view of bursa; all of type material. B. *E. alpinata* Cassino, right clasper, aedeagus, ventral plate, ovipositor lobes, left lateral view of bursa. C. *E. prostrata* McDunnough, right clasper, aedeagus, ventral plate, ovipositor lobes, ventral view of bursa; all of type material. D. *E. persimulata* McDunnough, ovipositor lobes, dorsal view of bursa, of type material. E. *E. herefordaria* Cassino and Swett, left clasper, aedeagus, and ventral plate of an eastern specimen, and, of a specimen from Jeff Davis County, Texas, ovipositor lobes, ventral view of bursa. F. *E. suspiciosata* Dietze, right clasper, aedeagus, and ventral plate of a specimen from Marin County, California, and, of a specimen from Sonoma County, California, slightly ventrolateral view of bursa. G. *E. nabokovi* McDunnough, left clasper, aedeagus, ventral plate, dorsal view of bursa; all of type material.

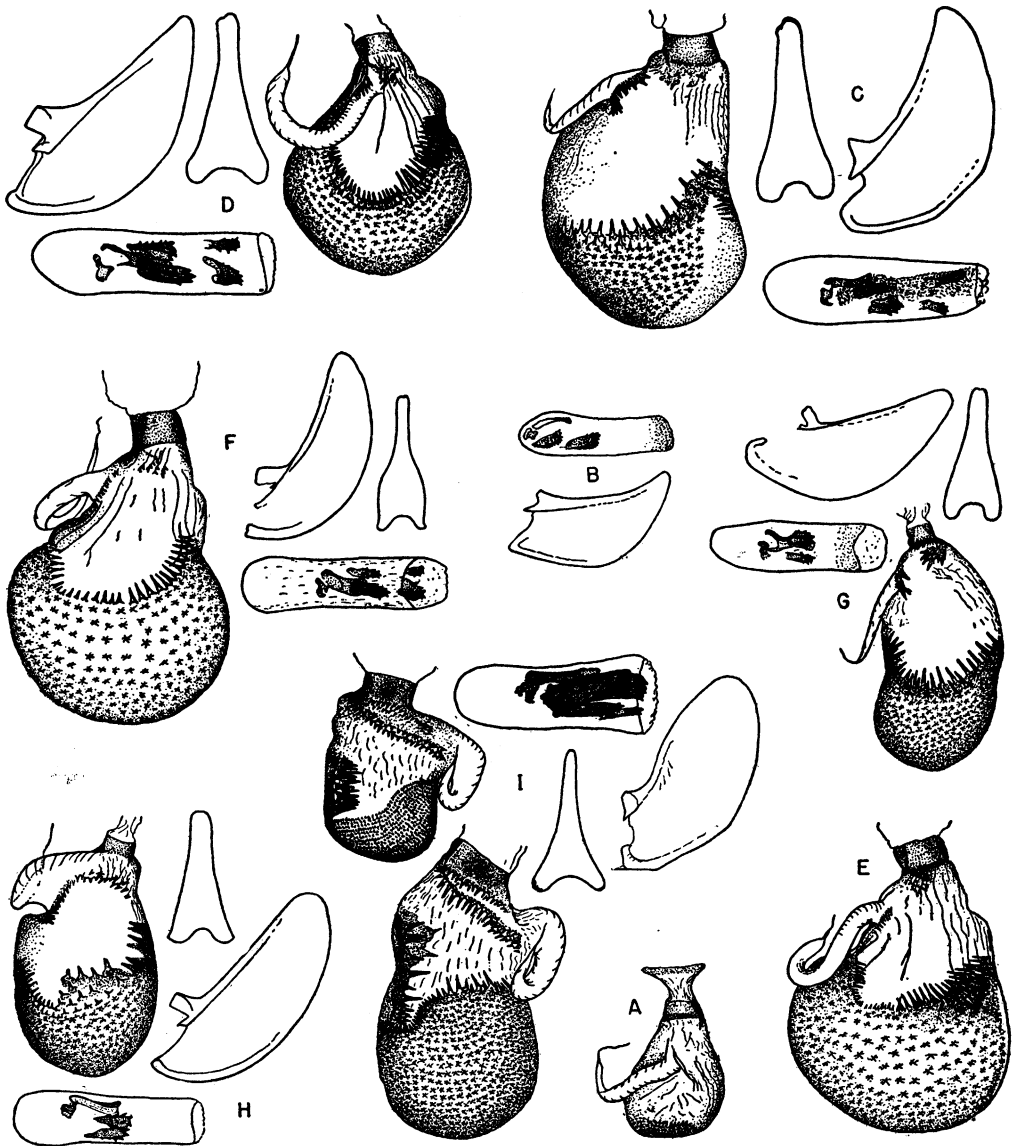


FIG. 8. A. *Eupithecia cupressata* Pearsall, dorsal view of bursa, poorly inflated, of holotype. B. *E. albigrisata* Pearsall, right clasper, aedeagus of holotype. C. *E. gibsonata* Taylor, right clasper, aedeagus, and ventral plate of holotype, dorsal view of bursa. D. *E. satyrata fumata* Taylor, right clasper, aedeagus, and ventral plate of specimen from Knowlton, Quebec, and, of specimen from Mer Bleue, Ottawa, Ontario, dorsal view of bursa. E. *E. satyrata dodata* Taylor, dorsal view of bursa of holotype. F. *E. terminata* Taylor, right clasper, aedeagus, and ventral plate of holotype, and, of a cotype of *E. slocanata* Taylor, dorsal view of bursa. G. *E. nimbicolor* Hulst, right clasper, aedeagus, and ventral plate of holotype of *E. adornata* Taylor, and, of a toptypical specimen, dorsal view of bursa. H. *E. stratonata* Packard, right clasper, aedeagus, ventral plate, dorsal view of bursa. I. *E. cimicifugata* Pearsall, right clasper, aedeagus, and ventral plate of specimen from Sardinia, New York, and, of holotype, ventral view of bursa; below, enlarged figure of bursa of specimen from Delaware Water Gap, Pennsylvania.

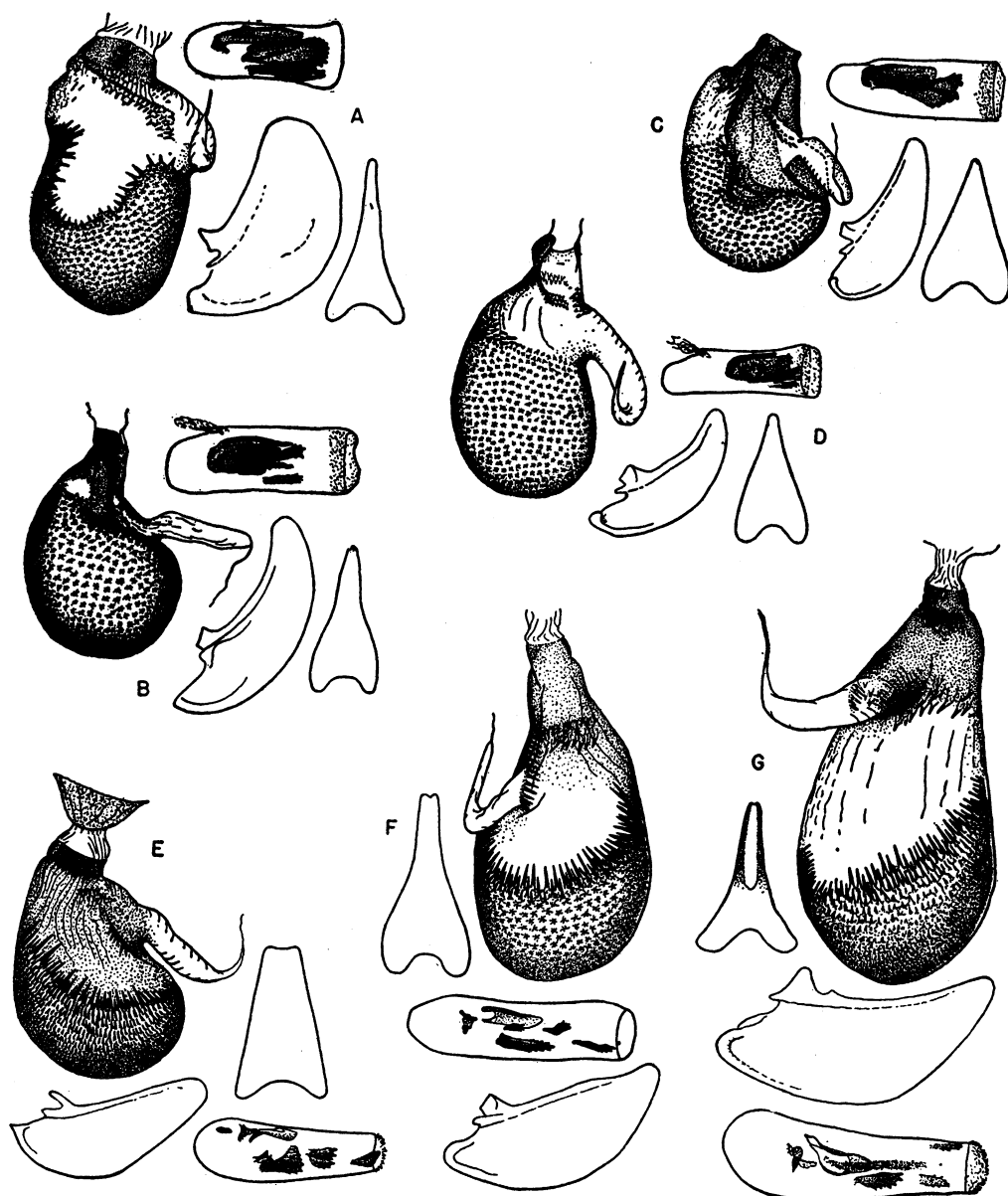


FIG. 9. A. *Eupithecia grata* Taylor, right clasper, aedeagus, and ventral plate of holotype, and, of a specimen from Montreal, Quebec, ventral view of bursa. B. *E. russeliata* Swett, right clasper, aedeagus, ventral plate, left lateral view of bursa. C. *E. ammonata* McDunnough, right clasper, aedeagus, and ventral plate of holotype, and, of type material, left lateral view of bursa. D. *E. coagulata* Guenée, right clasper, aedeagus, ventral plate, semiventral view of bursa. E. *E. swettii* Grossbeck, right clasper, aedeagus, ventral plate, and, of allotype, ventral view of bursa. F. *E. geminata* Packard, right clasper, aedeagus, ventral plate, and, of holotype, dorsal view of bursa. G. *E. indistincta* Taylor, right clasper, aedeagus, ventral plate of specimen from Stowe, Vermont, and, of a specimen from Maryland, dorsal view of bursa.

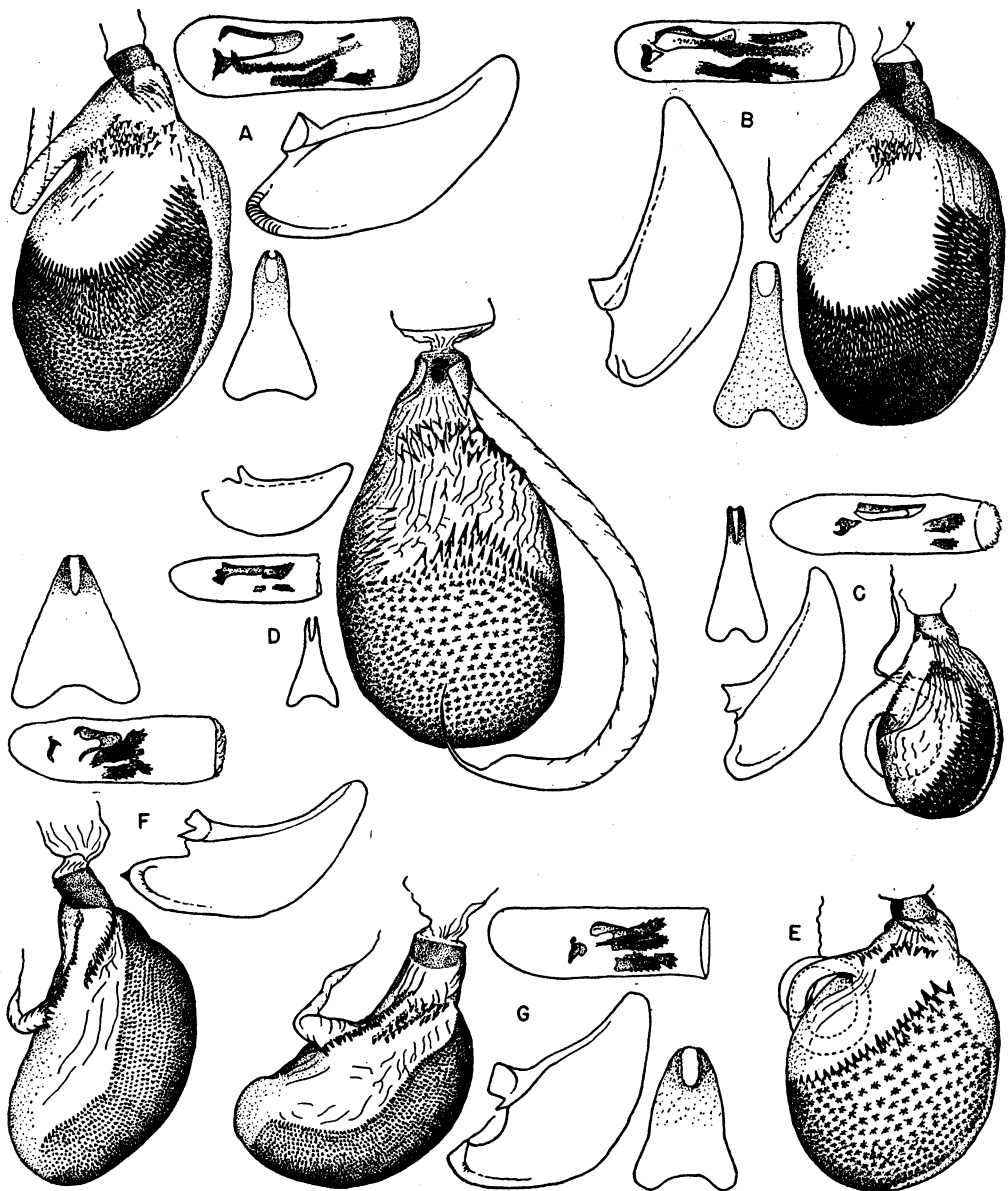


FIG. 10. A. *Eupithecia zygadeniata* Packard, right clasper, aedeagus, ventral plate, dorsal view of bursa; all of topotypical material. B. *E. cretacea* Packard, right clasper, aedeagus, ventral plate, dorsal view of bursa. C. *E. plenoscripta* Hulst, right clasper, aedeagus, ventral plate, and, of holotype, dorsal view of bursa. D. *E. plenoscripta bindata* Pearsall, right clasper, aedeagus, ventral plate of holotype, and, of allotype, ventral view of bursa, greatly enlarged. E. *E. nimbose* Hulst, dorsal view of bursa of holotype. F. *E. behrensata* Packard, right clasper, aedeagus, ventral plate of cotype of *E. perillata* Pearsall, and dorsal view of bursa. G. *E. multiscripta* Hulst, right clasper, aedeagus, ventral plate, dorsal view of bursa; all of topotypical material.

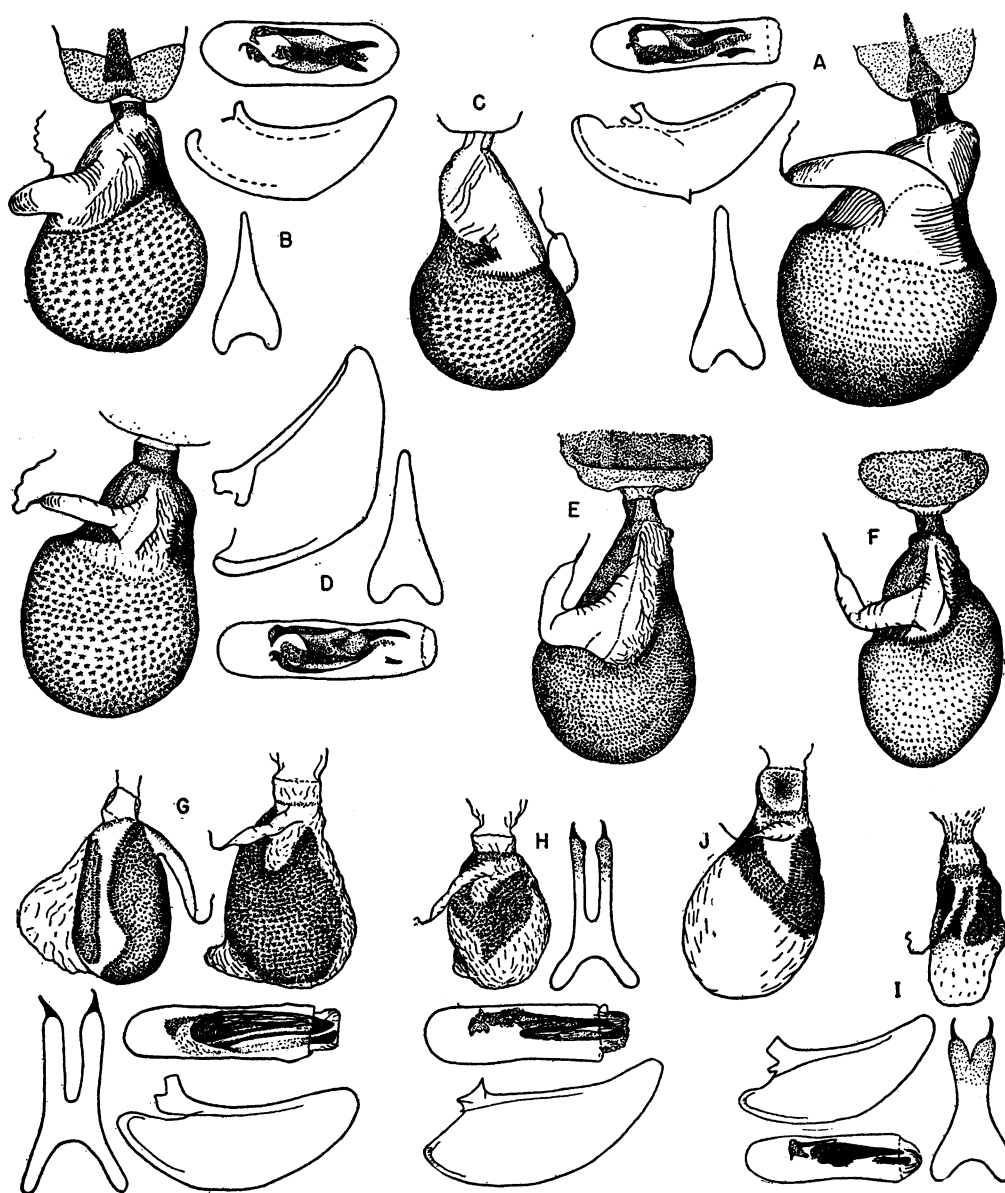


FIG. 11. A. *Eupithecia gelidata* Moeschler, right clasper, aedeagus, ventral plate of holotype of *E. lagganata* Taylor, and, of a specimen from Quebec Labrador, dorsal view of bursa. B. *E. multistrigata* Hulst, right clasper, aedeagus, ventral plate of holotype of *E. spaldingi* Taylor, and, of holotype, dorsal view of bursa. C. *E. multistrigata* Hulst, ventral view of bursa of specimen from Calgary, Alberta, so-called first brood. D. *E. perfusca kootenaiata* Dyar, right clasper, aedeagus, and ventral plate of holotype, and, of a topotypical specimen, dorsal view of bursa. E. *E. perfusca youngata* Taylor, dorsal view of bursa, moderately inflated, of a specimen from Ottawa, Ontario. F. *E. hanhami* Taylor, dorsal view of bursa of specimen from Victoria, British Columbia. G. *E. filmata* Pearsall, right clasper, aedeagus, ventral plate of holotype, and, of allotype, left lateral view of bursa; on right, dorsal view of bursa of specimen from Montreal, Quebec. H. *E. annulata* Hulst, right clasper, aedeagus, ventral plate of a paratype of *E. limnata* Pearsall, and, of a specimen from Wellington, Vancouver Island, semilateral view of bursa. I. *E. olivacea* Taylor, right clasper, aedeagus, ventral plate, and, of allotype, dorsal view of bursa. J. *E. cognizata* Pearsall, dorsal view of bursa of allotype.

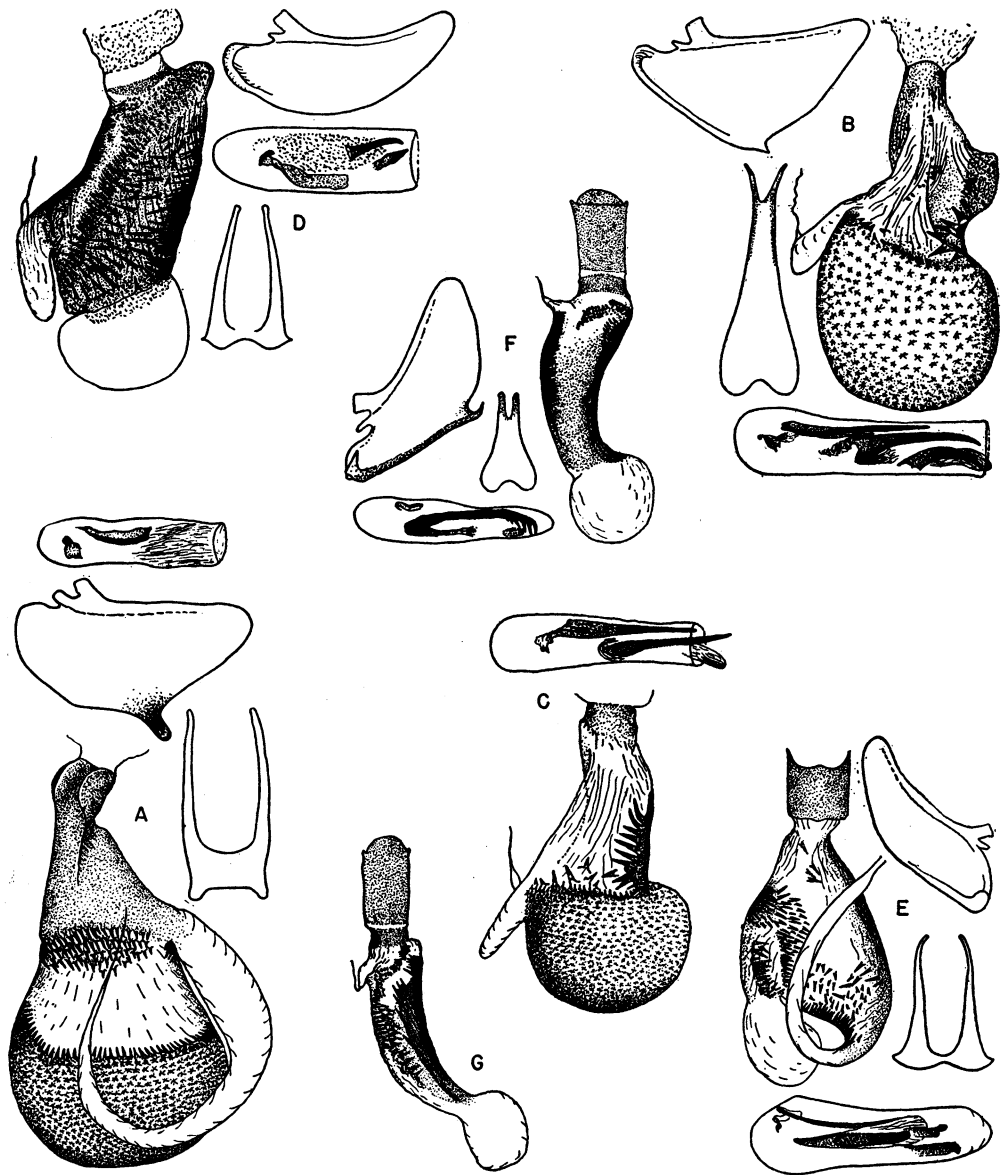


FIG. 12. A. *Eupithecia georgii* McDunnough, right clasper, aedeagus, ventral plate, ventral view of bursa; all of topotypical material. B. *E. sobrinata interruptofasciata* Packard, right clasper, aedeagus, ventral plate of specimen from Trenton, Ontario, and, of holotype of *E. quebecata* Taylor, dorsal view of bursa. C. *E. niphadophilata* Dyar, aedeagus of a Wyoming specimen and, of a paratype, dorsal view of bursa. D. *E. subcolorata* Hulst, right clasper, aedeagus, ventral plate, dorsal view of bursa. E. *E. appendiculata* McDunnough, left clasper, aedeagus, ventral plate, ventral view of bursa; all of type material. F. *E. zelmira* Cassino and Swett, right clasper, aedeagus, ventral plate, dorsal view of bursa. G. *E. vitreolata* Cassino and Swett, dorsal view of bursa of specimen from White Mountains, Arizona.

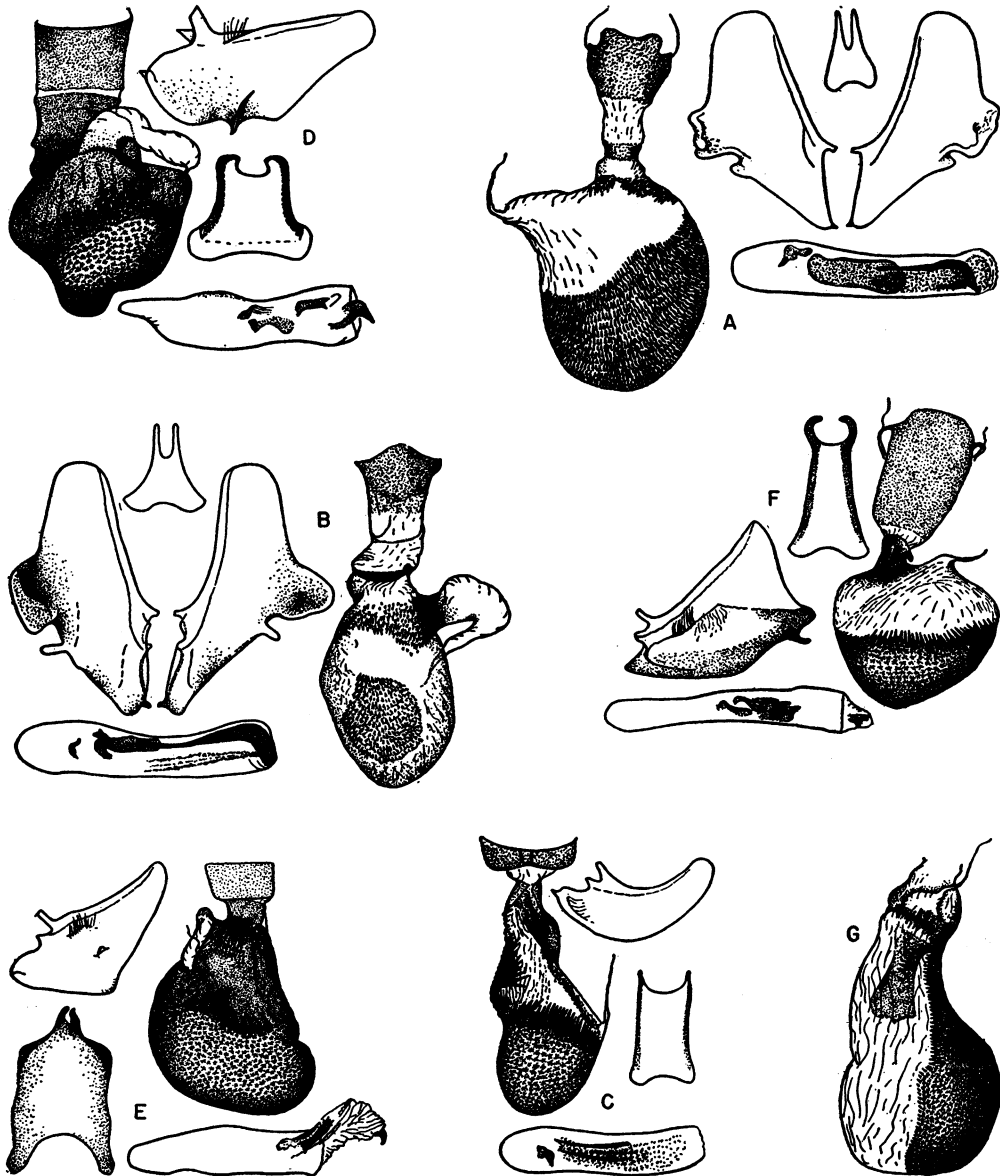


FIG. 13. A. *Eupithecia segregata* Pearsall, right and left claspers, aedeagus, ventral plate, and, of a specimen from Plumas County, California, dorsal view of bursa. B. *E. pinata* Cassino, right and left claspers, aedeagus, ventral plate, ventral view of bursa. C. *E. tenuata* Hulst, right clasper, aedeagus, ventral plate, ventral view of bursa. D. *E. agnesata* Taylor, right clasper, aedeagus, ventral plate, ventral view of bursa. E. *E. huachuca* Grossbeck, right clasper, aedeagus, ventral plate, dorsal view of bursa. F. *E. woodgatata* Cassino and Swett, right clasper, aedeagus, and ventral plate of a specimen from New Mexico, and, of allotype, ventral view of bursa. G. *E. stellata* Hulst, ventral view of bursa.

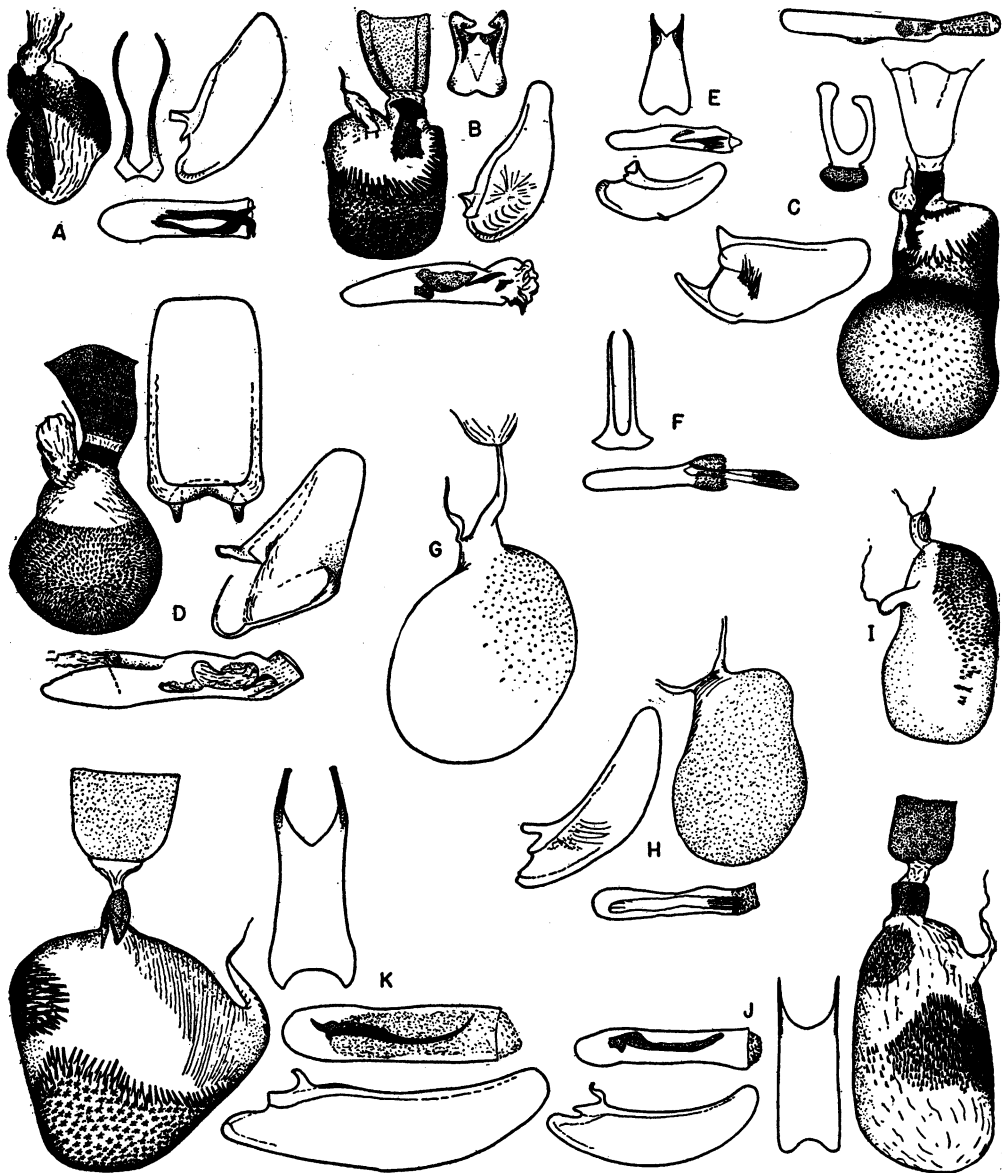


FIG. 14. A. *Eupithecia bowmani* Cassino and Swett, right clasper, aedeagus, ventral plate, ventral view of bursa; all of type material. B. *E. niveifascia* Hulst, right clasper, aedeagus, ventral plate, and, of a specimen from Fort Wingate, New Mexico, dorsal view of bursa. C. *E. joanata* Cassino and Swett, right clasper, aedeagus, ventral plate, and, of a paratype of *balboata* Cassino and Swett, ventral view of bursa. D. *E. flavigutta* Hulst, right clasper, aedeagus, and ventral plate of holotype, and, of an Arizonan specimen, dorsal view of bursa. E. *E. sperryi* McDunnough, right clasper, aedeagus, ventral plate; all of type material. F. *E. johnstoni* McDunnough, aedeagus, ventral plate of holotype. G. *E. dichroma* McDunnough, ventral view of bursa of holotype. H. *E. rindgei* McDunnough, right clasper, aedeagus of holotype, and, of a paratype, ventral view of bursa. I. *E. cocoata* Pearsall, dorsal view of bursa of holotype. J. *E. albicapitata* Packard, right clasper, aedeagus, ventral plate, semilateral view of bursa. K. *E. mutata* Pearsall, right clasper, aedeagus, ventral plate, and, of allotype, left lateral view of bursa.

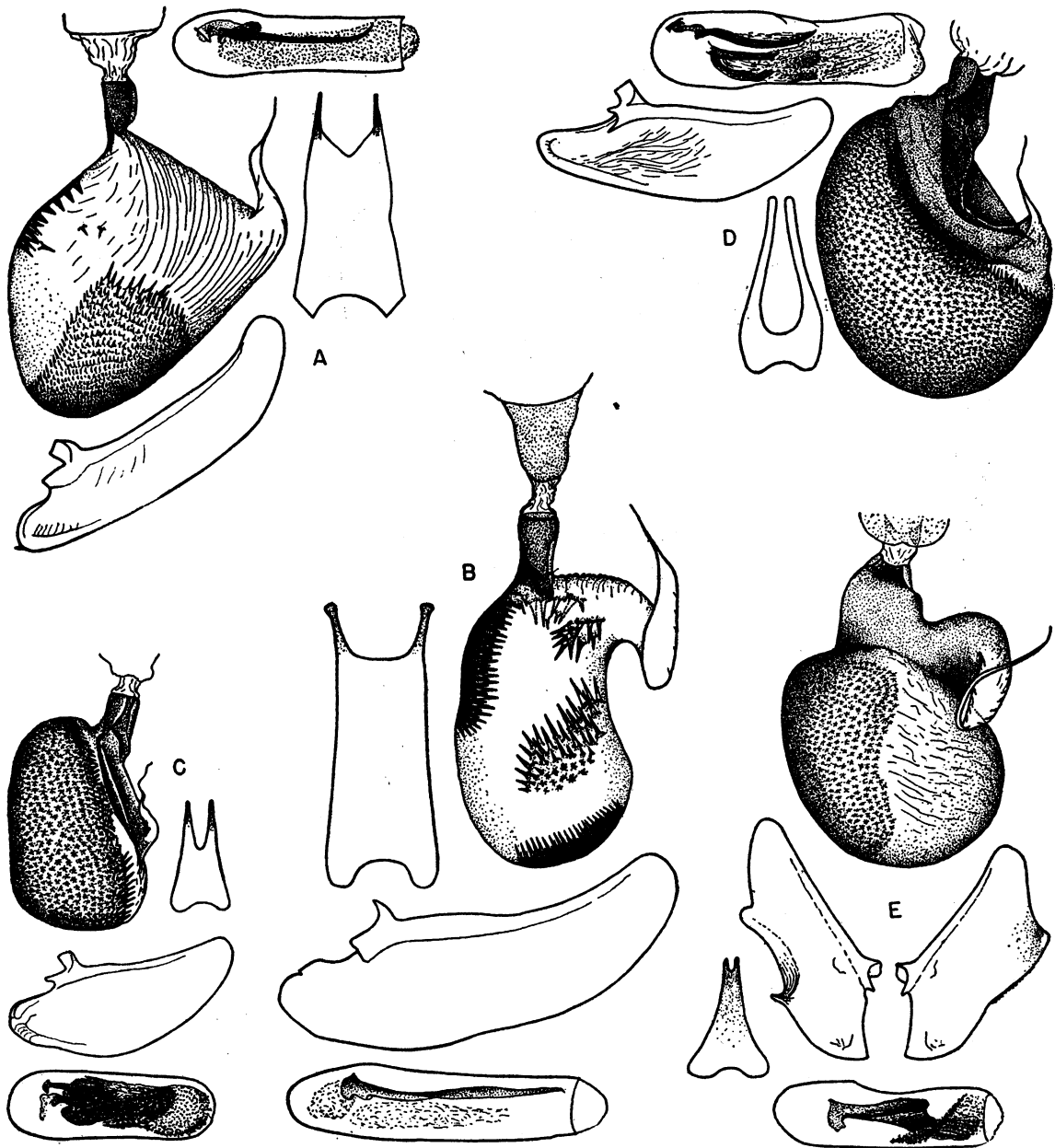


FIG. 15. A. *Eupithecia columbrata* McDunnough, right clasper, aedeagus, ventral plate, left lateral view of bursa; all of type material. B. *E. spermaphaga* Dyar, right clasper, aedeagus, and ventral plate of a paratype from Ashland, Oregon, and, of one of the type lot, lateral view of bursa. C. *E. purpurissata* Grossbeck, right clasper, aedeagus, ventral plate, semiventral view of bursa. D. *E. mysthata* Cassino, right clasper, aedeagus, ventral plate, semiventral view of bursa. E. *E. gilvipennata* Cassino and Swett, right and left claspers, aedeagus, ventral plate of the male cotype of *scabrogata* Pearsall, ventral view of bursa.

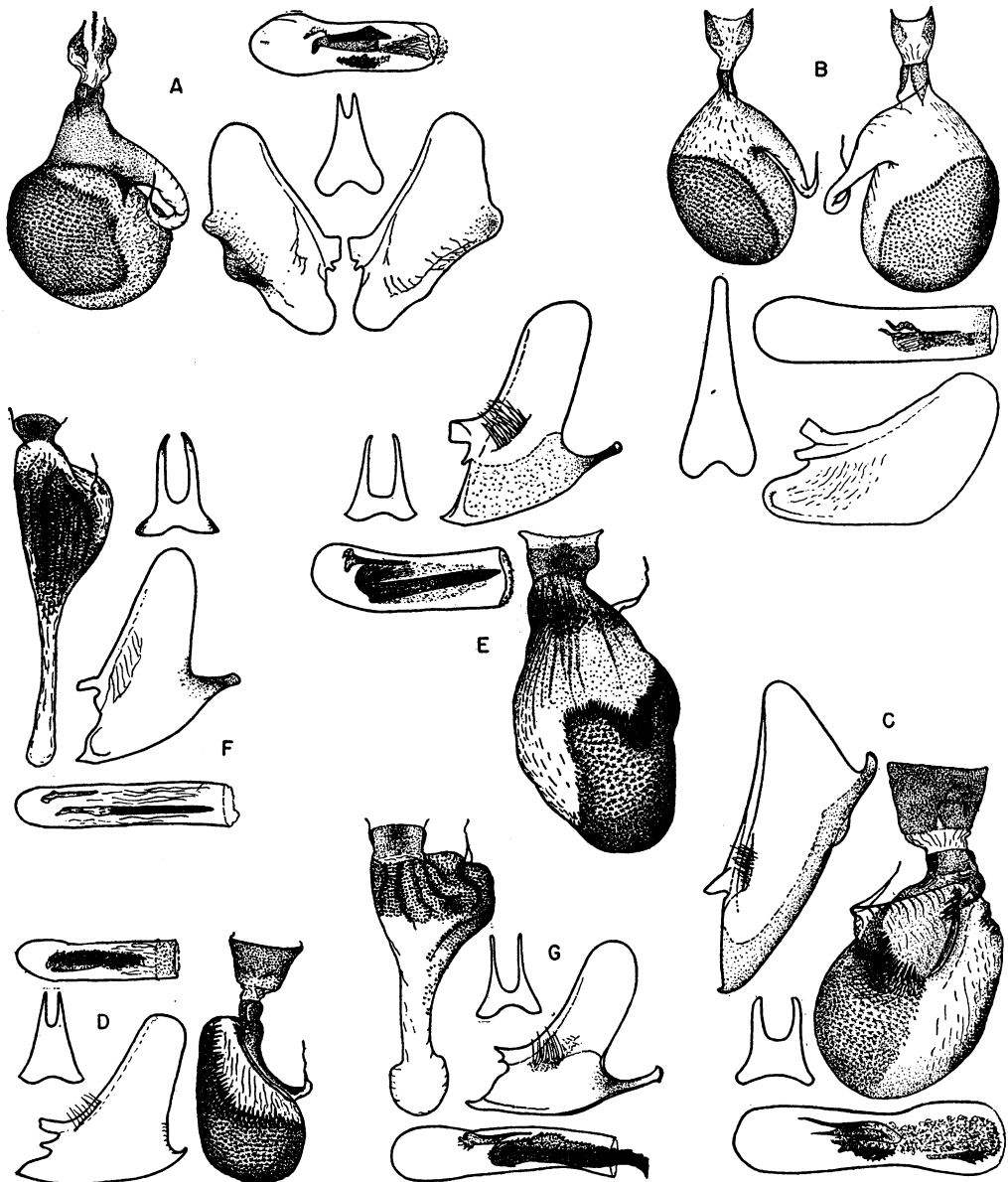


FIG. 16. A. *Eupithecia miamata* Cassino, right and left claspers, aedeagus, ventral plate of a paratype, and, of allotype, ventral view of bursa. B. *E. scabrogata* Pearsall, right clasper, aedeagus, ventral plate of an Arizona male and, of holotype, right lateral view of bursa; on left, left lateral view of an Arizona female. C. *E. adequata* Pearsall, right clasper, aedeagus, ventral plate, and, of a paratype, dorsal view of bursa. D. *E. acutipennis* Hulst, right clasper, aedeagus, and ventral plate of holotype, sublateral view of bursa. E. *E. subapicata* Guenée, right clasper, aedeagus, ventral plate, ventral view of bursa. F. *E. shirleyata* Cassino and Swett, right clasper, aedeagus, ventral plate, ventral view of bursa. G. *E. redingtonia* McDunnough, right clasper, aedeagus, ventral plate, ventral view of bursa; all of type material.

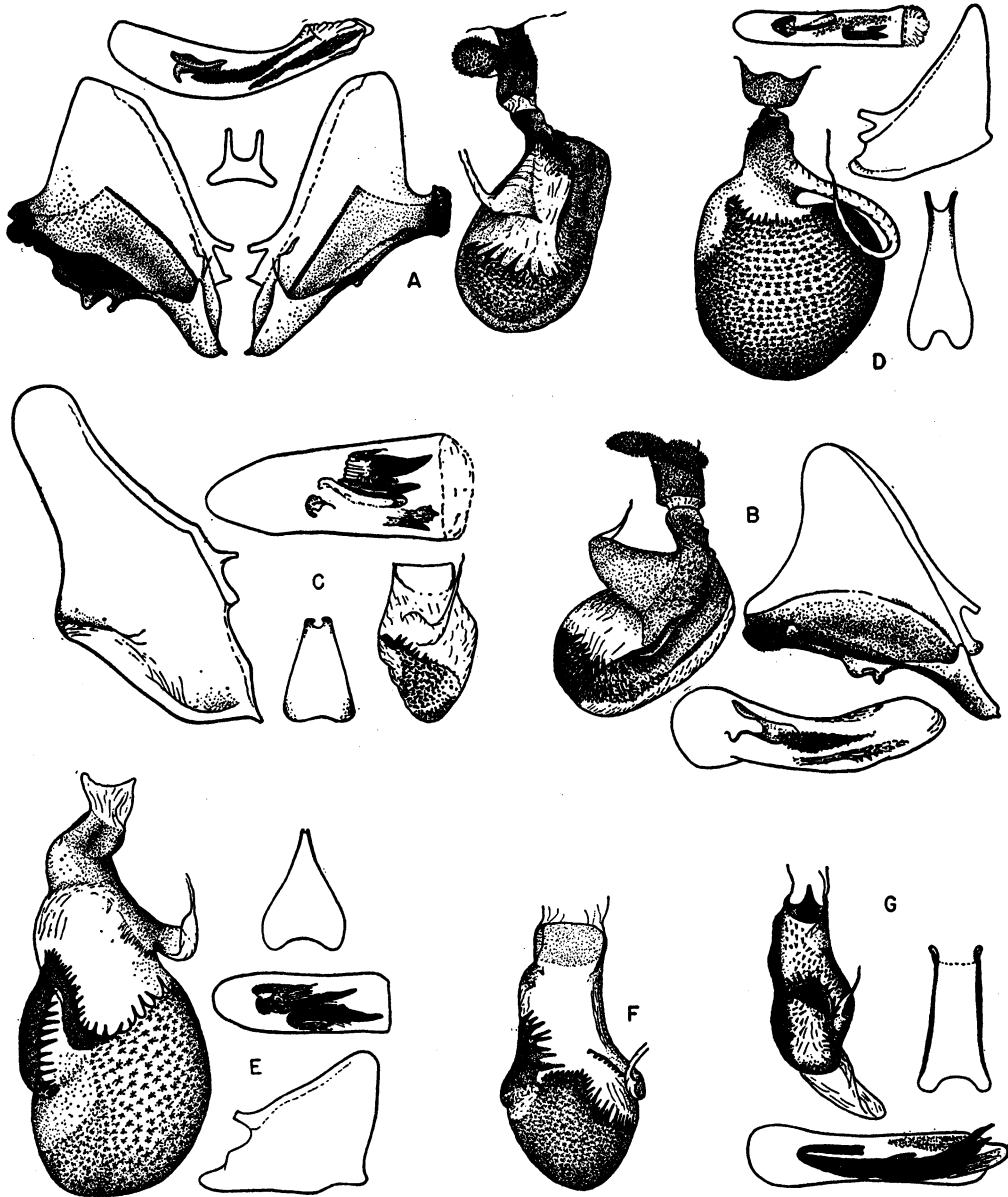


FIG. 17. A. *Eupithecia gilata* Cassino, right and left claspers, aedeagus, ventral plate, dorsal view of bursa. B. *E. plumasata* McDunnough, left clasper, aedeagus of holotype, and, of a topotypical female, dorsal view of bursa. C. *E. deserticola* McDunnough, left clasper, aedeagus, and ventral plate of type material, and, of a topotypical specimen, dorsal view of bursa. D. *E. anticaria* Walker, right clasper, aedeagus, ventral plate of male from Rangeley, Maine, ventral view of bursa. E. *E. pertusata* McDunnough, right clasper, aedeagus, ventral plate, ventral view of bursa; all of type material. F. *E. tricolorata* Cassino, ventral view of bursa of holotype. G. *E. carneata* McDunnough, aedeagus, ventral plate, ventral view of bursa; all from type material.

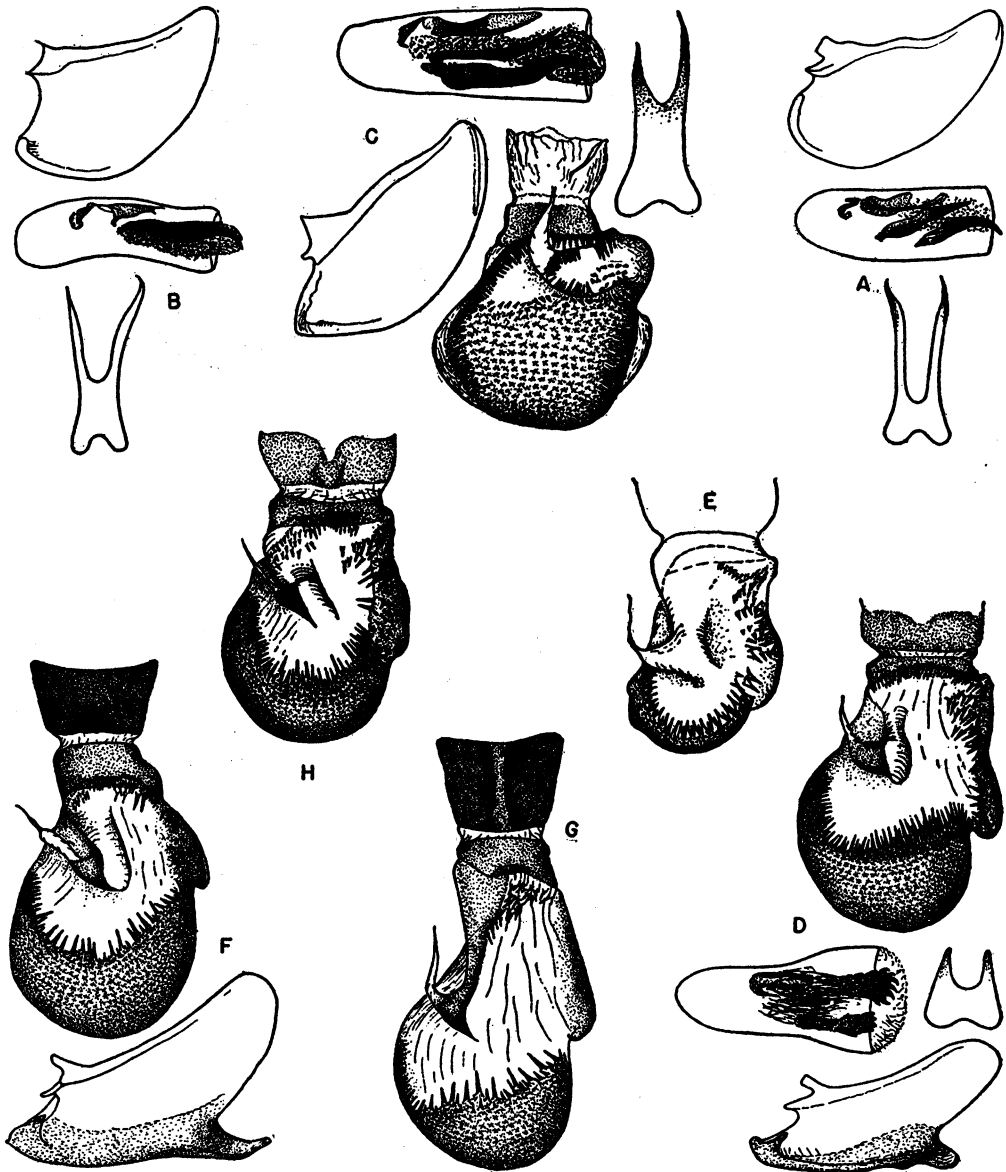


FIG. 18. A. *Eupithecia classicata* Pearsall, right clasper, aedeagus, and ventral plate of holotype. B. *E. penumbrata* Pearsall, right clasper, aedeagus, and ventral plate of allotype. C. *E. graefii* Hulst, right clasper, aedeagus, and ventral plate of holotype, and, of a specimen from Plumas County, California, ventral view of bursa. D. *E. nevadata* Packard, right clasper, aedeagus, and ventral plate of specimen from Havilah, California, and, of a specimen from Riverside, California, dorsal view of bursa. E. *E. implorata* Hulst, dorsal view of bursa of holotype, poorly inflated. F. *E. cestata* Hulst, right clasper of specimen from Sonoma County, California, dorsal view of bursa. G. *E. cestatoides* McDunnough, dorsal view of bursa of a paratype. H. *E. ravocostaliata* Packard, dorsal view of bursa of specimen from New Hampshire.

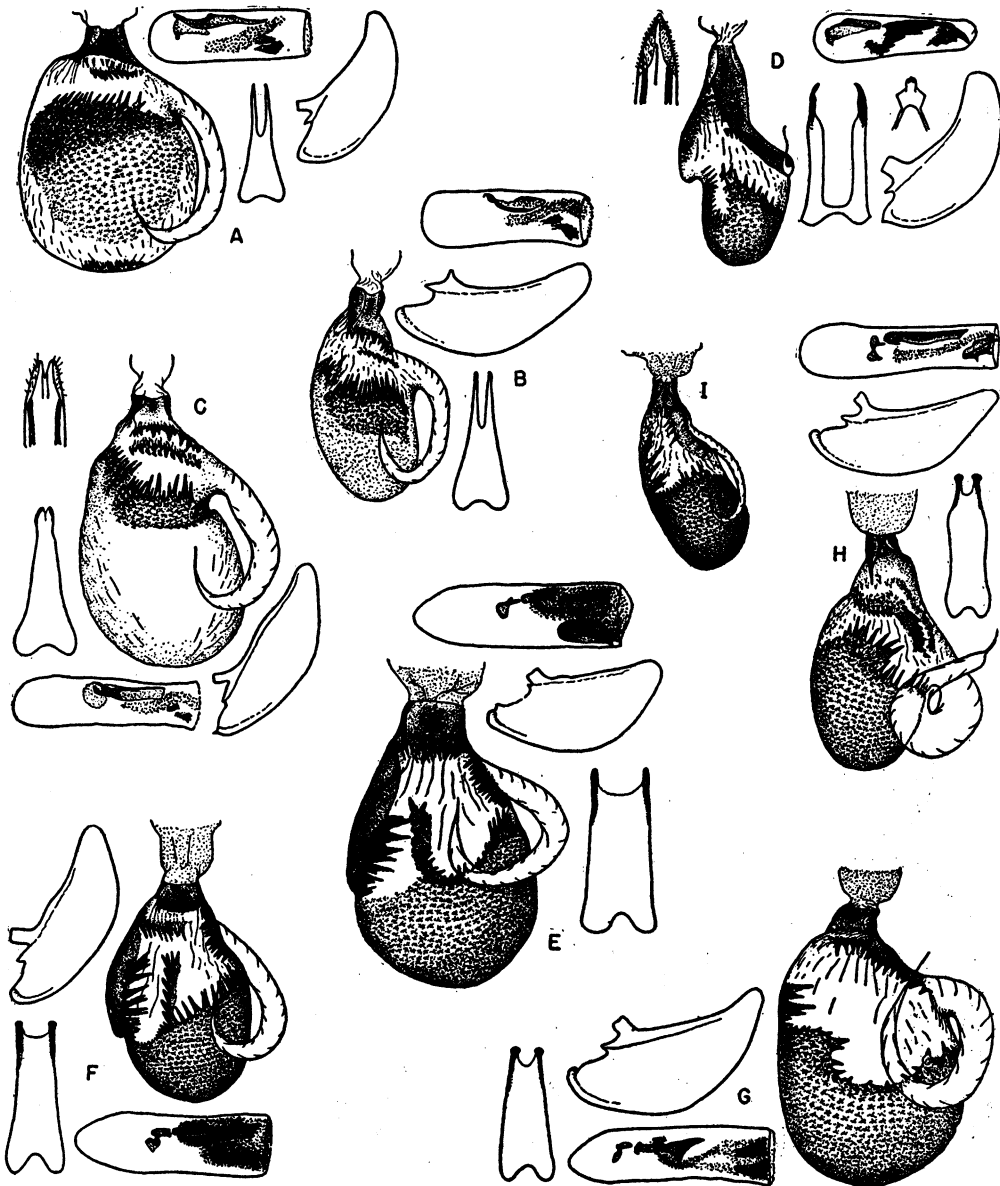


FIG. 19. A. *Nasusina inferior* Hulst, right clasper, aedeagus, ventral plate, ventral view of fully inflated bursa. B. *N. vaporata* Pearsall, right clasper, aedeagus, ventral plate, and, of a cotype, ventral view of bursa. C. *N. mendicata* Barnes and McDunnough, right clasper, aedeagus, ventral plate, ovipositor lobes, ventral view of bursa. D. *N. minuta* Hulst, right clasper, uncus, aedeagus, ventral plate, ovipositor lobes, ventral view of bursa. E. *Prorella gypsata* Grote, right clasper, aedeagus, and ventral plate of specimen from Arizona, and, of a specimen from southwest Texas, ventral view of bursa. F. *P. discoidalis* Grossbeck, right clasper, aedeagus, ventral plate, ventral view of bursa; all of Arizonan specimens. G. *P. leucata* Hulst, right clasper, aedeagus, ventral plate, ventral view of bursa; all of specimens from Eureka, Utah. H. *P. albida* Cassino and Swett, right clasper, aedeagus, and ventral plate of a specimen from Stockton, Utah, and, of a paratype, ventral view of bursa. I. *P. ochrocarnea* McDunnough, ventral view of bursa of holotype.

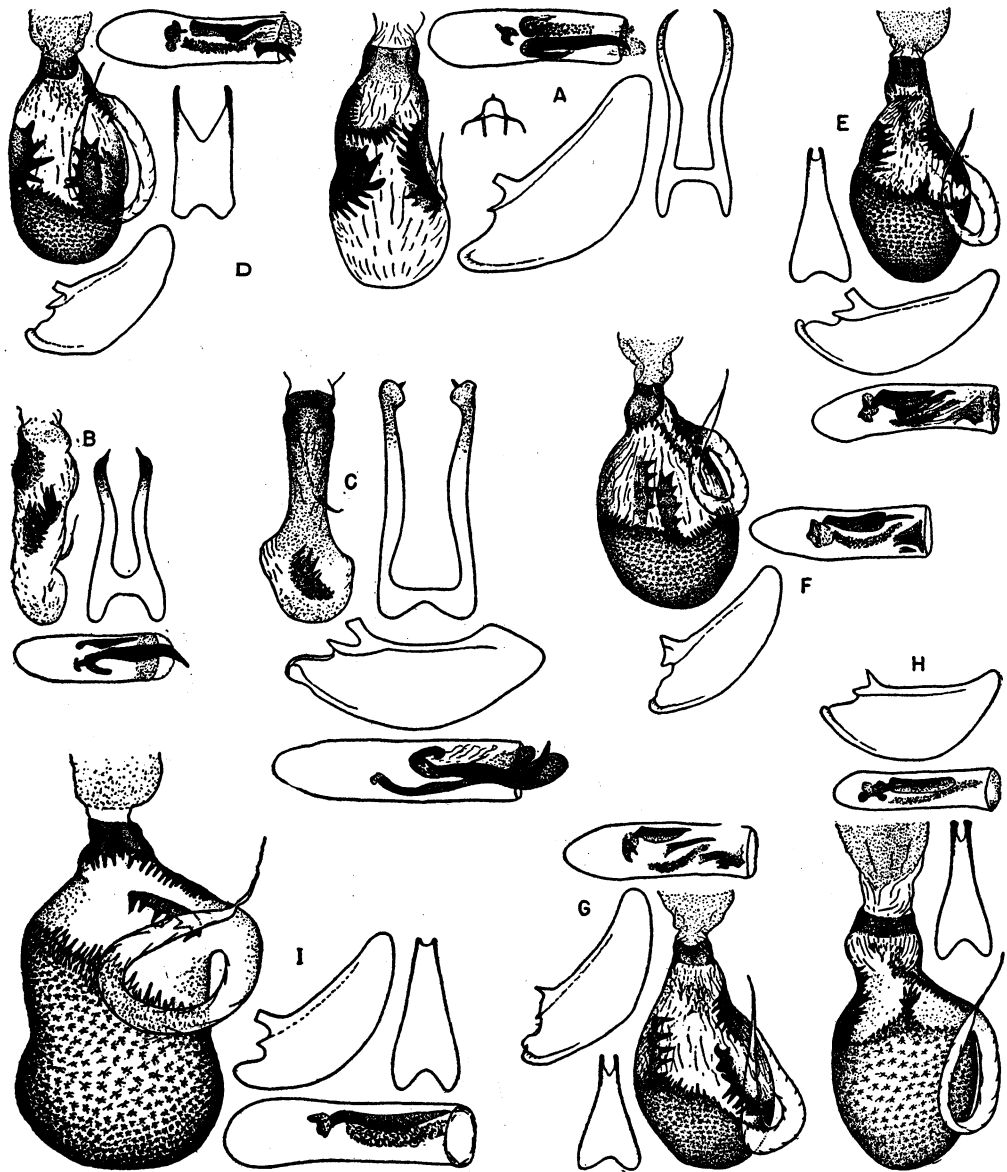


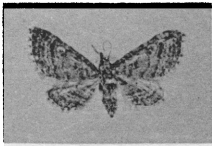
FIG. 20. A. *Prorella irremorata* Dyar, right clasper, uncus, aedeagus, and ventral plate of topotypical male, and, of a specimen from Borego, California, ventral view of bursa. B. *P. tremorata* McDunnough, aedeagus, ventral plate, ventral view of bursa; all of type material. C. *P. remorata* Grossbeck, right clasper, aedeagus, and ventral plate of specimen from Tucson, Arizona, and, of a cotype, ventral view of bursa. D. *P. desperata* Hulst, right clasper, aedeagus, ventral plate, ventral view of bursa; all of specimens from southwestern Texas. E. *P. artestata* Grossbeck, right clasper, aedeagus, ventral plate, ventral view of poorly inflated bursa; all of specimens from Huachuca Mountains, Arizona. F. *P. mellisa* Grossbeck, right clasper, aedeagus of holotype, and, of a specimen from southwestern Texas, ventral view of bursa. G. *P. insipidata* Pearsall, right clasper, aedeagus, and ventral plate of specimen from Prescott, Arizona, and, of a specimen from Frijoles Canyon, New Mexico, ventral view of bursa. H. *P. opinata* Pearsall, right clasper, aedeagus, and ventral plate of holotype, and, of a specimen from southwestern Texas, ventral view of bursa. I. *P. protoptata* McDunnough, right clasper, aedeagus, ventral plate, ventral view of bursa; all of type material.

PLATES 26-32

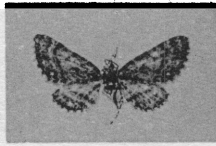
All the specimens illustrated in the plates are, unless otherwise indicated, in the American Museum of Natural History collection and are there labeled "photo."

PLATE 26

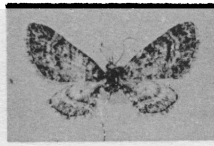
1. *Eupithecia palpata* Packard, female, Franconia, New Hampshire.
2. *Eupithecia slossonata* McDunnough, male, holotype, Florida.
3. *Eupithecia albimontanata* McDunnough, female, Estes Park, Colorado.
4. *Eupithecia longidens* Hulst, female, Colorado (Bruce), topotypical.
5. *Eupithecia longidens kerrvillaria* Cassino and Swett, female, Kerrville, Texas, topotypical.
6. *Eupithecia ornata* Hulst, female, holotype, Glenwood Springs, Colorado (Rutgers University).
7. *Eupithecia monacheata* Cassino and Swett, female, upper Santa Ana River, San Bernardino County, California.
8. *Eupithecia terrestrata* McDunnough, male, Santa Catalina Mountains, Arizona, topotypical.
9. *Eupithecia columbiata* Dyar, male, Vancouver Island (?).
10. *Eupithecia columbiata erpata* Pearsall, male, holotype, Big Indian Valley, Catskill Mountains, New York.
11. *Eupithecia columbiata erpata* Pearsall, female, allotype, Big Indian Valley, Catskill Mountains, New York.
12. *Eupithecia maestososa* Hulst, female, holotype, Colorado (Bruce) (Rutgers University).
13. *Eupithecia maestososa* Hulst, female, Mohawk, Plumas County, California.
14. *Eupithecia subvirens* Dietze, female, Petaluma, Sonoma County, California.
15. *Eupithecia laisata* Strecker, female, holotype, California (Chicago Natural History Museum).
16. *Eupithecia castellata* McDunnough, female, Mt. Shasta, Siskiyou County, California, topotypical.
17. *Eupithecia chiricahuata* McDunnough, female, holotype, Barfoot Park, Chiricahua Mountains, Arizona (Canadian National Collection).
18. *Eupithecia insolabilis* Hulst, female, holotype, Arizona (Rutgers University).
19. *Eupithecia catalinata* McDunnough, female, Redington, Pima County, Arizona.
20. *Eupithecia edna* Hulst, male, holotype, Colorado (Bruce) (Rutgers University).
21. *Eupithecia edna* Hulst, female, Jemez Springs, New Mexico.
22. *Eupithecia owenata* McDunnough, female, paratype, Graham Mountains, Arizona (Canadian National Collection).
23. *Eupithecia longipalpata* Packard, male, Victoria, British Columbia.
24. *Eupithecia sabulosata* McDunnough, female, Plumas County, California.
25. *Eupithecia macrocarpata* McDunnough, male, paratype, Half Moon Bay, San Mateo County, California.
26. *Eupithecia placidata* Taylor, male, Petaluma, Sonoma County, California.
27. *Eupithecia placidata* Taylor, female, Petaluma, Sonoma County, California.
28. *Eupithecia unicolor* Hulst, female, Forest Hill, Placer County, California (Canadian National Collection).
29. *Eupithecia miserulata* Grote, male, Lakehurst, New Jersey.
30. *Eupithecia miserulata* Grote, female, St. Petersburg, Florida.
31. *Eupithecia miserulata* Grote, female, Bexar County, Texas.
32. *Eupithecia miserulata zela* Swett and Cassino, male, Los Angeles County, California.
33. *Eupithecia misturata* Hulst, male, Shasta Retreat, Siskiyou County, California, topotypical (Canadian National Collection).
34. *Eupithecia misturata* Hulst, female, Petaluma, Sonoma County, California (Canadian National Collection).
35. *Eupithecia misturata* Hulst, male, Barton Flats, San Bernardino County, California.
36. *Eupithecia misturata* Hulst, female, Victoria, British Columbia, topotypical of *sublineata* Taylor (Canadian National Collection).



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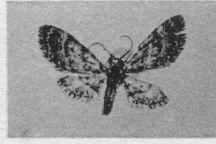
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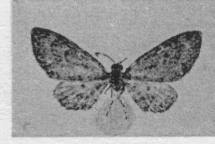
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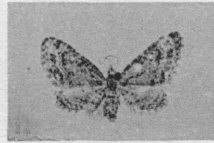
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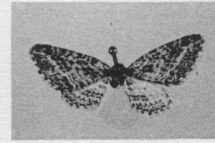
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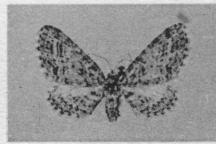
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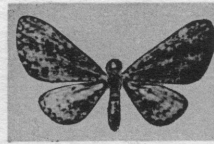
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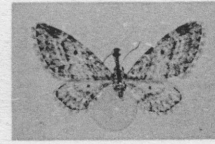
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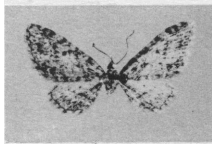
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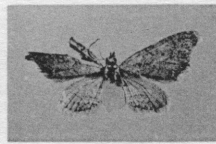
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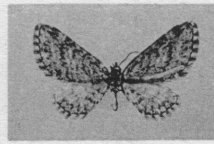
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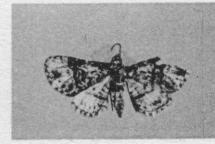
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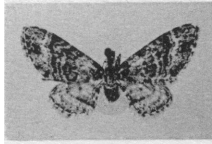
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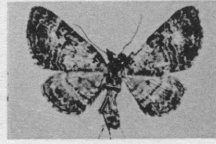
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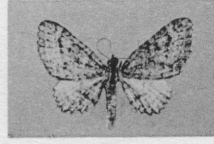
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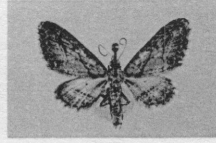
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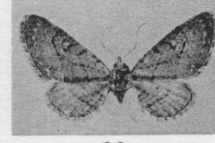
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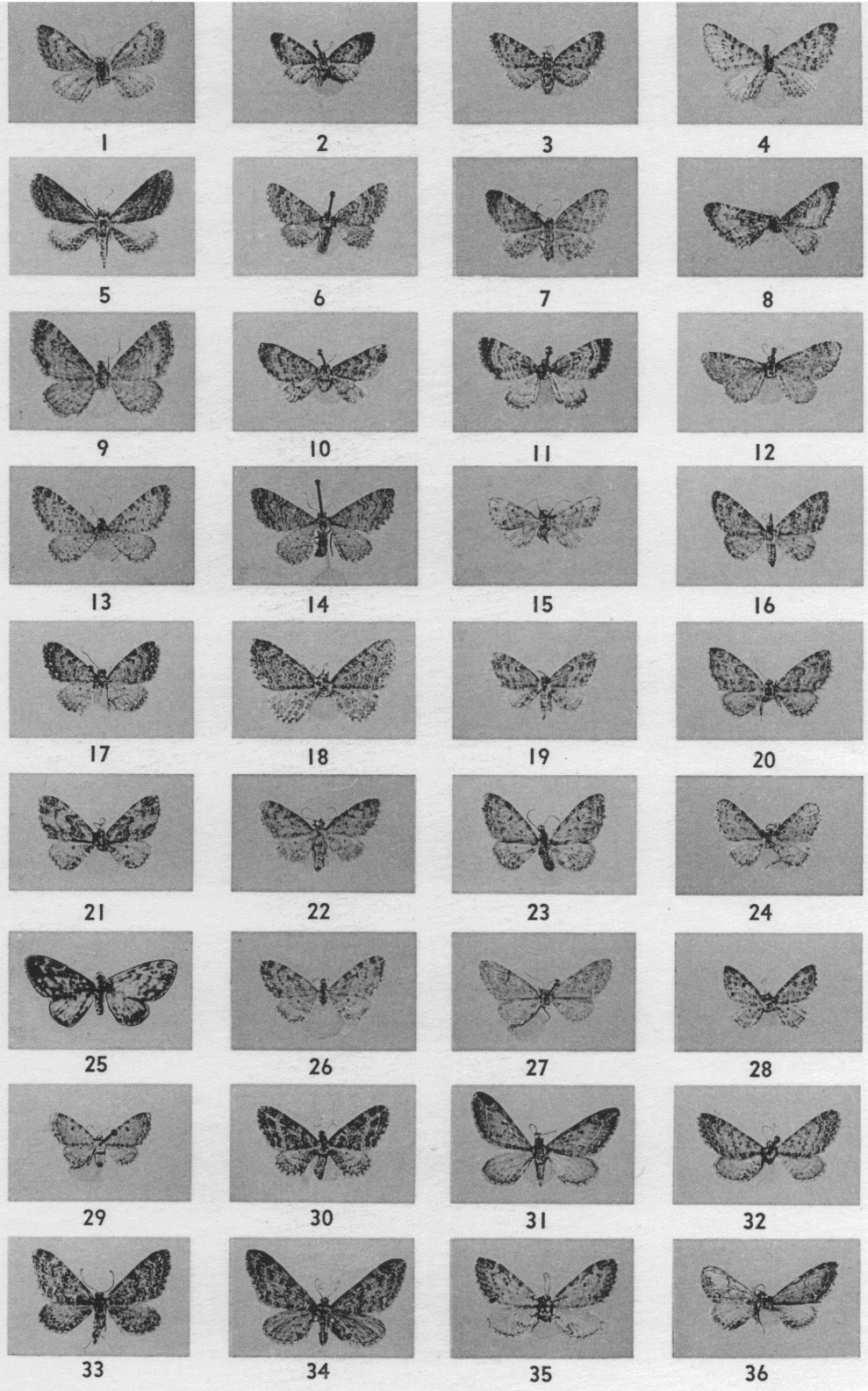
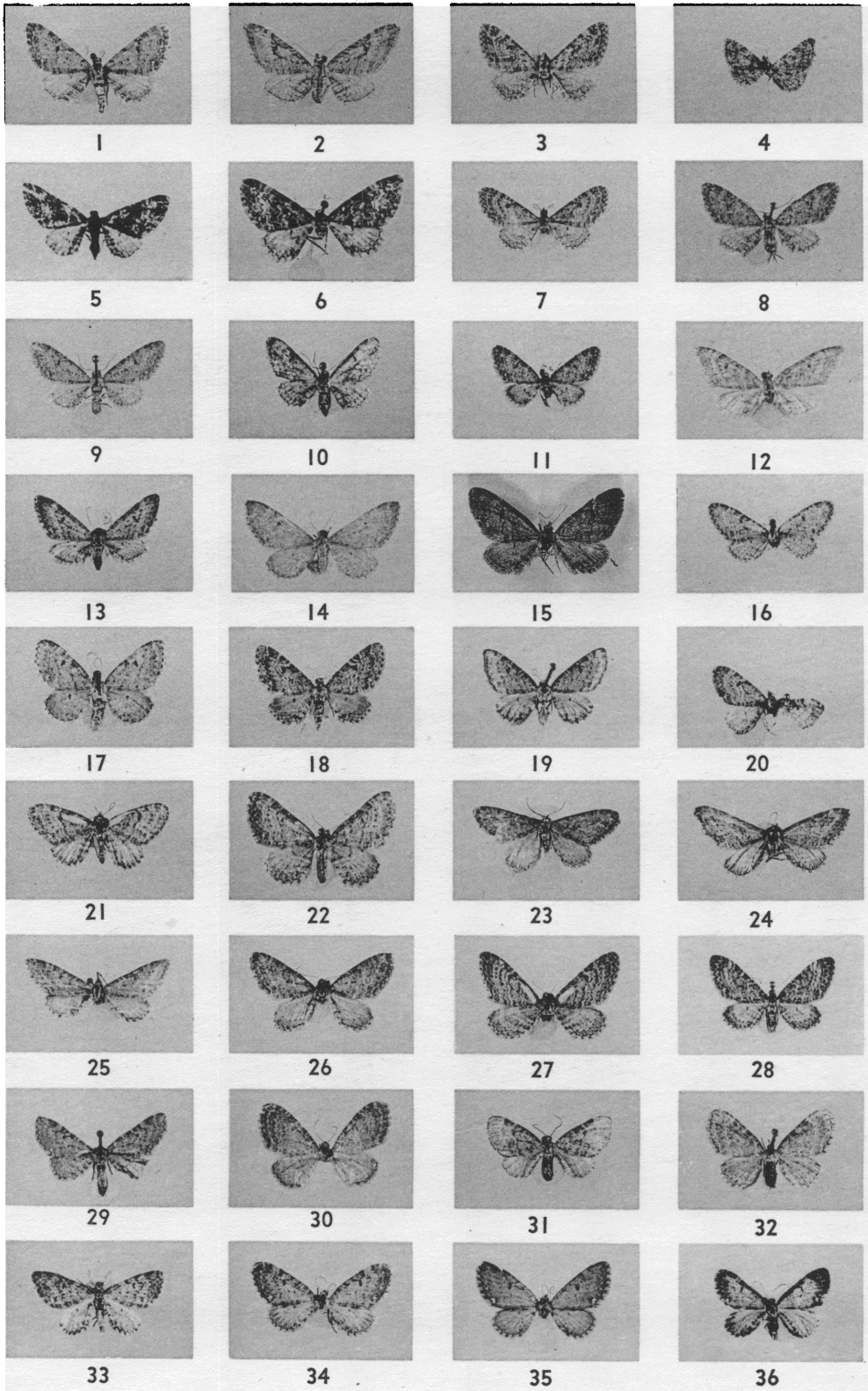


PLATE 27

1. *Eupithecia misturata* Hulst, female, Seton Lake, Lillooet, British Columbia, typical of *scelestata* Taylor (Canadian National Collection).
2. *Eupithecia conformata* Pearsall, male, holotype, Big Indian Valley, Catskill Mountains, New York.
3. *Eupithecia conformata* Pearsall, female, allotype, Bronx, New York.
4. *Eupithecia harveyata* Taylor, female, Victoria, British Columbia.
5. *Eupithecia bivittata* Hulst, female, Inverness, Marin County, California.
6. *Eupithecia fortunata* Pearsall, female, allotype, Chimney Gulch, Golden, Colorado.
7. *Eupithecia bryanti* Taylor, male, Waterton Lakes, Alberta (Canadian National Collection).
8. *Eupithecia coloradensis* Hulst, male, holotype, Colorado (Rutgers University).
9. *Eupithecia coloradensis* Hulst, male, Greer Road, White Mountains, Arizona, agrees with type of *spenceata* Cassino (Canadian National Collection).
10. *Eupithecia carolinensis* Grossbeck, male, holotype, valley of Black Mountains, North Carolina.
11. *Eupithecia cretata* Hulst, male, holotype, Colorado (Bruce) (Rutgers University).
12. *Eupithecia regina* Taylor, female, allotype, Calgary, Alberta (Dod).
13. *Eupithecia undata* Freyer, female, Hedley, British Columbia.
14. *Eupithecia borealis* Hulst, female, Calgary, Alberta (Dod) (Canadian National Collection).
15. *Eupithecia jejuna* McDunnough, female, holotype, Georgetown, Texas (Canadian National Collection).
16. *Eupithecia castigata* Hübner, female, Stowe, Vermont.
17. *Eupithecia albipunctata* Haworth, male, White Point Beach, Queens County, Nova Scotia.
18. *Eupithecia albipunctata* Haworth, female, Big Indian Valley, Catskill Mountains, New York (allotype of *promulgata* Pearsall).
19. *Eupithecia catskillata* Pearsall, male, holotype, Big Indian Valley, Catskill Mountains, New York.
20. *Eupithecia luteata* Packard, female, Mt. Mansfield, Vermont.
21. *Eupithecia luteata bifasciata* Dyar, male, Bon Accord, British Columbia.
22. *Eupithecia flecherata* Taylor, male, Meach Lake, near Hull, Quebec (agrees with type) (Canadian National Collection).
23. *Eupithecia promulgata* Pearsall, male, holotype, New Brighton, Pennsylvania.
24. *Eupithecia dolorosata* Pearsall, male, holotype, Big Indian Valley, Catskill Mountains, New York.
25. *Eupithecia kasloata* Dyar, female, holotype, Kaslo, British Columbia (United States National Museum).
26. *Eupithecia bradorata* McDunnough, male, Percé, Gaspé County, Quebec (Canadian National Collection).
27. *Eupithecia sheppardata* McDunnough, male, Norway Bay, Pontiac County, Quebec (Canadian National Collection).
28. *Eupithecia affinata* Pearsall, male, holotype, New Brighton, Pennsylvania.
29. *Eupithecia affinata* Pearsall, female, New Brunswick, New Jersey.
30. *Eupithecia rotundopuncta* Packard, male, Petaluma, Sonoma County, California.
31. *Eupithecia sierrae* Hulst, male, Salida, Colorado (matches Hulst's type).
32. *Eupithecia conceptata* Pearsall, male, holotype, Chimney Gulch, Golden, Colorado.
33. *Eupithecia sierrae* Hulst, male, upper Santa Ana River, San Bernardino County, California (dark gray variety).
34. *Eupithecia sierrae* Hulst, female, upper Santa Ana River, San Bernardino County, California (dark gray variety).
35. *Eupithecia litoris* McDunnough, male, San Diego, California.
36. *Eupithecia quakerata* Pearsall, male, holotype, San Miguel, Colorado.

PLATE 28

1. *Eupithecia quakerata* Pearsall, female, Provo, Utah.
2. *Eupithecia bolterii* Hulst, female, Davis Mountains, Jeff Davis County, Texas (Canadian National Collection).
3. *Eupithecia palmata* Cassino and Swett, female, Borego, San Diego County, California (Canadian National Collection).
4. *Eupithecia piccata* Pearsall, female paratype, Las Vegas, New Mexico.
5. *Eupithecia pretansata* Grossbeck, female, holotype, Carr Canyon, Huachuca Mountains, Cochise County, Arizona (Academy of Natural Sciences of Philadelphia).
6. *Eupithecia sinuata* McDunnough, female, paratype, White Mountains, Arizona (Canadian National Collection).
7. *Eupithecia neomexicana* McDunnough, female, Yavapai County, Arizona.
8. *Eupithecia alpinata* Cassino, female, Davis Mountains, Jeff Davis County, Texas (Canadian National Collection).
9. *Eupithecia prostrata* McDunnough, male, Davis Mountains, Jeff Davis County, Texas (Canadian National Collection).
10. *Eupithecia persimulata* McDunnough, female, paratype, southwestern Texas (Canadian National Collection):
 11. *Eupithecia exudata* Pearsall, male, holotype, New Brighton, Pennsylvania.
 12. *Eupithecia herefordaria* Cassino and Swett, female, Newton, Massachusetts (Canadian National Collection).
 13. *Eupithecia suspiciosata* Dietze, female, Spring Mountain, Napa County, California.
14. *Eupithecia nabokovi* McDunnough, female, paratype, Alta, Utah (Canadian National Collection).
15. *Eupithecia cupressata* Pearsall, female, holotype, Monterey County, California (United States National Museum).
16. *Eupithecia albigrisata* Pearsall, male, holotype, Atlanta, Georgia.
17. *Eupithecia gibsonata* Taylor, male, Aylmer, Quebec.
18. *Eupithecia arceuthata taylorata* Swett, male, Hull, Quebec.
19. *Eupithecia satyrata fumata* Taylor, male, Montreal, Quebec.
20. *Eupithecia satyrata intimata* Pearsall, female, holotype, valley of Black Mountains, North Carolina.
21. *Eupithecia mackieata* Cassino and Swett, male, paratype, Nordegg, Alberta.
22. *Eupithecia terminata* Taylor, male, Kaslo, British Columbia.
23. *Eupithecia nimbicolor* Hulst, male, holotype, Calgary, Alberta (Rutgers University).
24. *Eupithecia obscurior* Hulst, male, holotype, Colorado (Bruce) (Rutgers University).
25. *Eupithecia incresata* Pearsall, male, holotype, Princeton Summit, British Columbia.
26. *Eupithecia nimbicolor* Hulst, male, Calgary, Alberta.
27. *Eupithecia nimbicolor* Hulst, male, Nordegg, Alberta (well marked).
28. *Eupithecia nimbicolor* Hulst, male, Mer Bleue, Ottawa, Ontario (eastern form).
29. *Eupithecia strattonata* Packard, female, Winchendon, Massachusetts.
30. *Eupithecia cimicifugata* Pearsall, female, paratype, Scranton, Pennsylvania.
31. *Eupithecia cimicifugata* Pearsall, male, Washtenaw County, Michigan.
32. *Eupithecia grata* Taylor, female, Montreal, Quebec.
33. *Eupithecia russeliata* Swett, male, Franconia, New Hampshire.
34. *Eupithecia russeliata* Swett, female, paratype, Winchendon, Massachusetts.
35. *Eupithecia russeliata brauneata* Swett, female, paratype, Mountain Lake, Virginia.
36. *Eupithecia ammonata* McDunnough, male, paratype, Indian Head, Saskatchewan (Canadian National Collection).



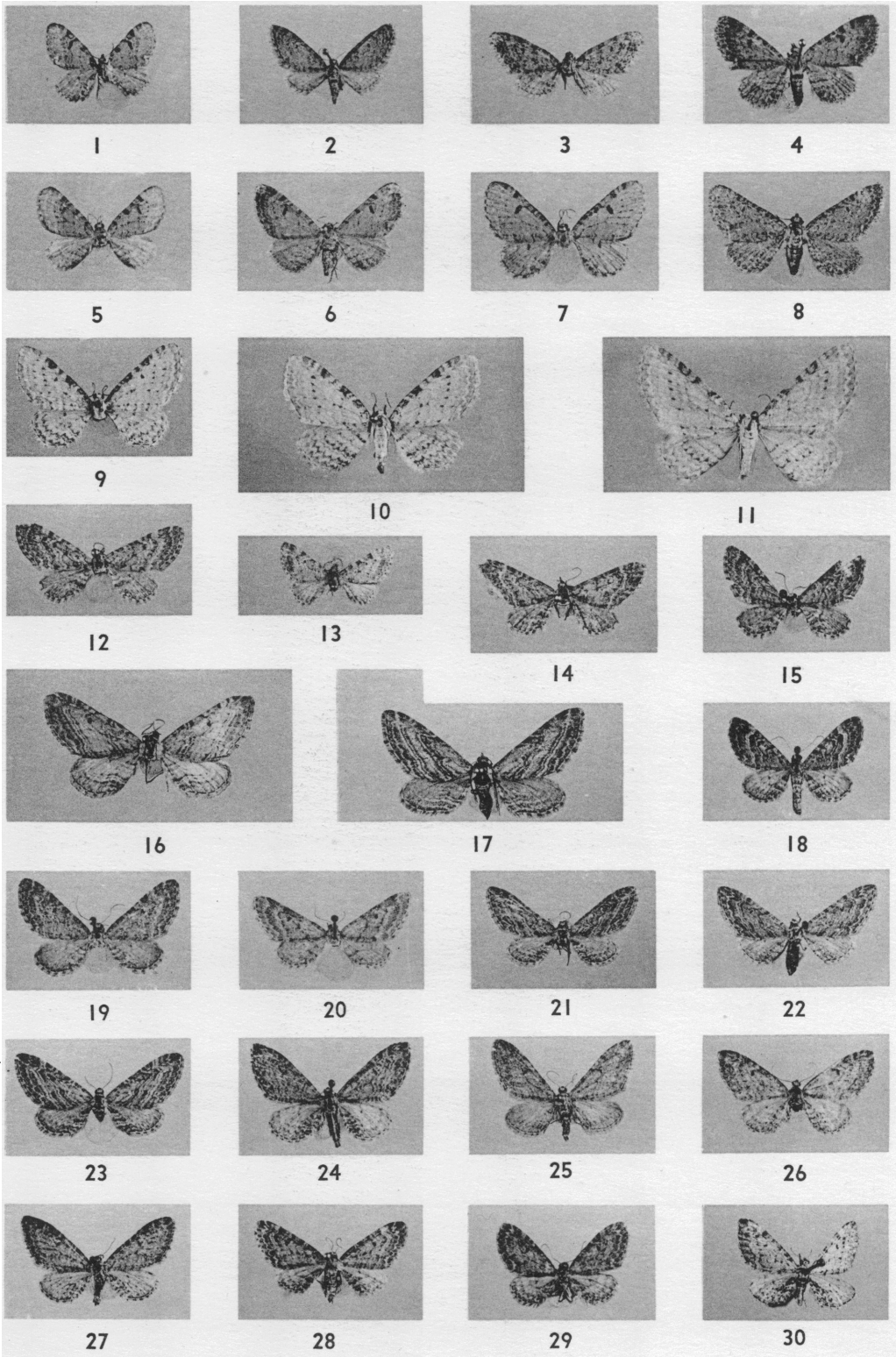
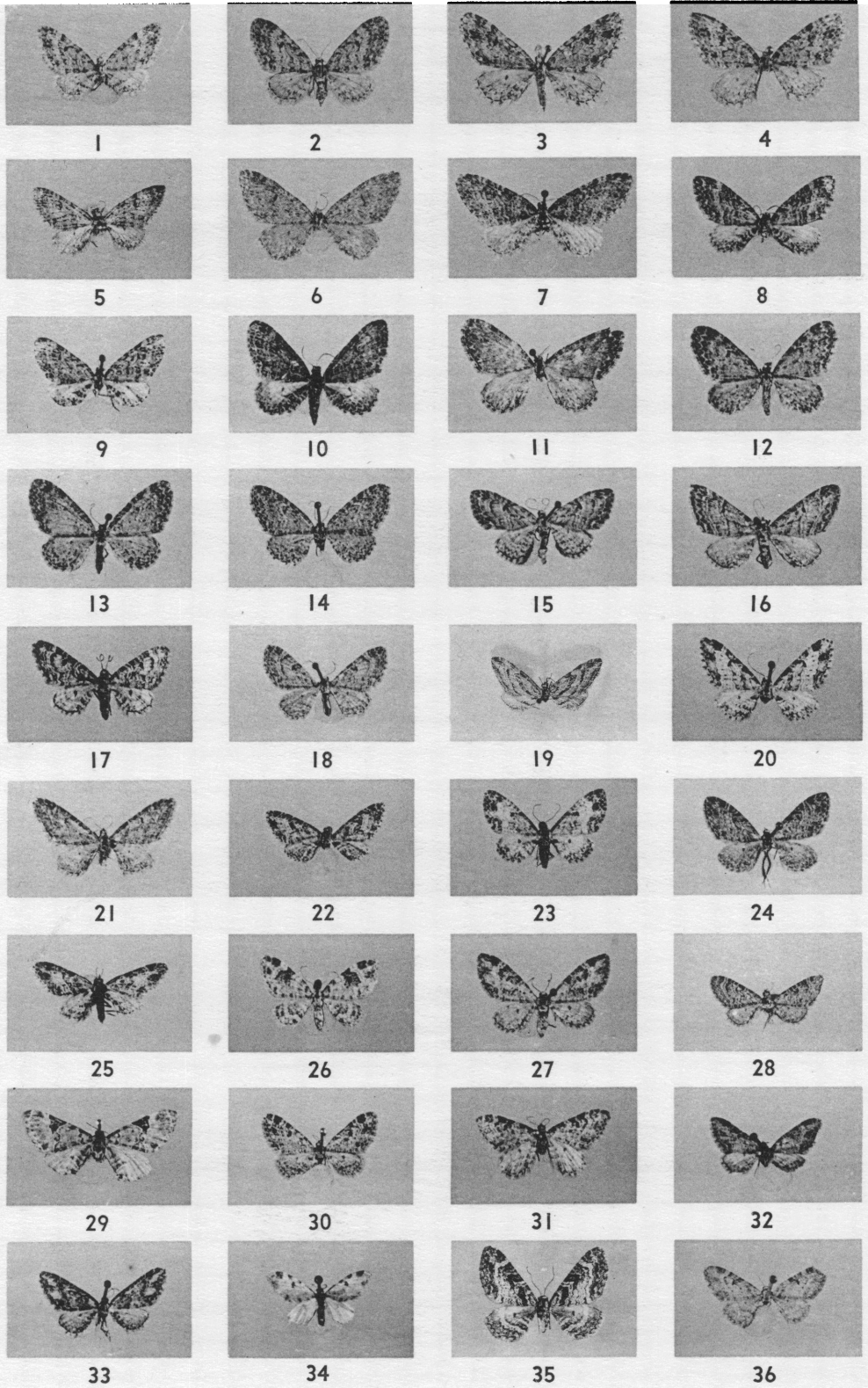


PLATE 29

1. *Eupithecia coagulata* Guenée, male, New Brighton, Pennsylvania.
2. *Eupithecia swettii* Grossbeck, male, Ramapo, New Jersey.
3. *Eupithecia swettii* Grossbeck, female, allotype, Framingham, Massachusetts.
4. *Eupithecia geminata* Packard, female, Franconia, New Hampshire.
5. *Eupithecia meritata* Pearsall, male, holotype, Big Indian Valley, Catskill Mountains, New York.
6. *Eupithecia meritata* Pearsall, female, allotype, Big Indian Valley, Catskill Mountains, New York.
7. *Eupithecia indistincta* Taylor, female, Big Indian Valley, Catskill Mountains, New York, topotypical.
8. *Eupithecia tenebrescens* Hulst, female, holotype, Texas (Rutgers University).
9. *Eupithecia cretacea* Packard, male, Stowe, Vermont.
10. *Eupithecia cretacea* Packard, female, Victoria, British Columbia.
11. *Eupithecia cretacea* Packard, female, Cisco, Placer County, California.
12. *Eupithecia plenoscripta* Hulst, female, Senator, Arizona.
13. *Eupithecia plenoscripta bindata* Pearsall, male, paratype, Pullman, Washington.
14. *Eupithecia nimbose* Hulst, female, holotype, Arizona (Rutgers University).
15. *Eupithecia nimbose* Hulst, (?), male, Colter's Ranch, White Mountains, Arizona (Sperry collection).
16. *Eupithecia perillata* Pearsall, male, holotype, San Diego, California.
17. *Eupithecia multiscrypta* Hulst, female, holotype, Glenwood Springs, Colorado (Rutgers University).
18. *Eupithecia gelidata* Moeschler, male, Mer Bleue, Ottawa, Ontario.
19. *Eupithecia plenoscripta* Hulst, male, Alta, Utah (Canadian National Collection).
20. *Eupithecia nimbose* Hulst, (?), female, McNary, White Mountains, Arizona (Canadian National Collection).
21. *Eupithecia multistrigata* Hulst, female, holotype, Glenwood Springs, Colorado, (Rutgers University).
22. *Eupithecia multistrigata* Hulst, male, Eureka, Utah.
23. *Eupithecia multistrigata* Hulst, male, Calgary, Alberta (so-called dark first brood).
24. *Eupithecia perfusca* Hulst, male, Alta, Utah.
25. *Eupithecia perfusca* Hulst, male, Barton Flats, San Bernardino County, California.
26. *Eupithecia perfusca kootenaiata* Dyar, male, Kaslo, British Columbia, topotypical.
27. *Eupithecia perfusca alberta* Taylor, male, Nordegg, Alberta, topotypical.
28. *Eupithecia perfusca youngata* Taylor, male, Catskill Mountains, New York.
29. *Eupithecia perfusca youngata* Taylor, female, Montreal, Quebec.
30. *Eupithecia hanhami* Taylor, male, Victoria, British Columbia, topotypical.

PLATE 30

1. *Eupithecia filmata* Pearsall, male, holotype, Big Indian Valley, Catskill Mountains, New York.
2. *Eupithecia filmata* Pearsall, female, Bell's Corners, Ottawa, Ontario.
3. *Eupithecia limnata* Pearsall, male, holotype, Victoria, British Columbia.
4. *Eupithecia limnata* Pearsall, female, allotype, Victoria, British Columbia.
5. *Eupithecia annulata* Hulst, female, holotype (Rutgers University).
6. *Eupithecia usurpata* Pearsall, male, holotype, Victoria, British Columbia.
7. *Eupithecia olivacea* Taylor, male, Victoria, British Columbia, topotypical.
8. *Eupithecia cognizata* Pearsall, male, holotype, Witch Creek, San Diego County, California.
9. *Eupithecia cognizata* Pearsall, female, allotype, Witch Creek, San Diego County, California.
10. *Eupithecia cognizata* Pearsall, male, Spring Mountain, Napa County, California (probable dark form).
11. *Eupithecia lachrymosa* Hulst, male, holotype, Marion County, Oregon (Rutgers University).
12. *Eupithecia lachrymosa* Hulst, (?), male, Mohawk, Plumas County, California.
13. *Eupithecia georgii* McDunnough, male, Kaslo, British Columbia, topotypical.
14. *Eupithecia georgii* McDunnough, female, Kaslo, British Columbia, topotypical.
15. *Eupithecia sobrinata interruptofasciata* Packard, female, Casco Bay, Maine.
16. *Eupithecia niphadophilata* Dyar, female, paratype, Field, British Columbia.
17. *Eupithecia subcolorata* Hulst, male, Yavapai County, Arizona (specimen on which Grossbeck's redescription was based).
18. *Eupithecia appendiculata* McDunnough, male, Mohawk, Plumas County, California.
19. *Eupithecia emmedonia* Grossbeck, male, holotype, Monterey County, California (United States National Museum).
20. *Eupithecia zelmira* Swett and Cassino, female, Spring Mountain, Napa County, California.
21. *Eupithecia vitreolata* Cassino, female, Miami, Arizona (Sperry collection).
22. *Eupithecia segregata* Pearsall, male, allotype, southern Arizona.
23. *Eupithecia segregata* Pearsall, female, Spring Mountain, Napa County, California, typical.
24. *Eupithecia segregata* Pearsall, female, Mohawk, Plumas County, California (dark form).
25. *Eupithecia pinata* Cassino, male, paratype, Pinal County, Arizona (Canadian National Collection).
26. *Eupithecia tenuata* Hulst, female, Seton Lake, British Columbia.
27. *Eupithecia agnesata* Taylor, female, Mohawk, Plumas County, California.
28. *Eupithecia huachuca* Grossbeck, male, paratype, Carr Canyon, Huachuca Mountains, Arizona.
29. *Eupithecia stellata* Hulst, female, Colorado.
30. *Eupithecia niveifascia* Hulst, female, Pecos, New Mexico.
31. *Eupithecia niveifascia perbrunneata* Taylor, male, Vancouver Island, British Columbia, topotypical.
32. *Eupithecia balboata* Cassino and Swett, male, paratype, San Diego, California.
33. *Eupithecia flavigutta* Hulst, female, Mud Springs Station, Catalina Mountains, Arizona.
34. *Eupithecia sperryi* McDunnough, male, White Mountains, Arizona.
35. *Eupithecia johnstoni* McDunnough, male, holotype, Lone Pine, California (Canadian National Collection).
36. *Eupithecia rindgei* McDunnough, female, allotype, Keddie, Plumas County, California.



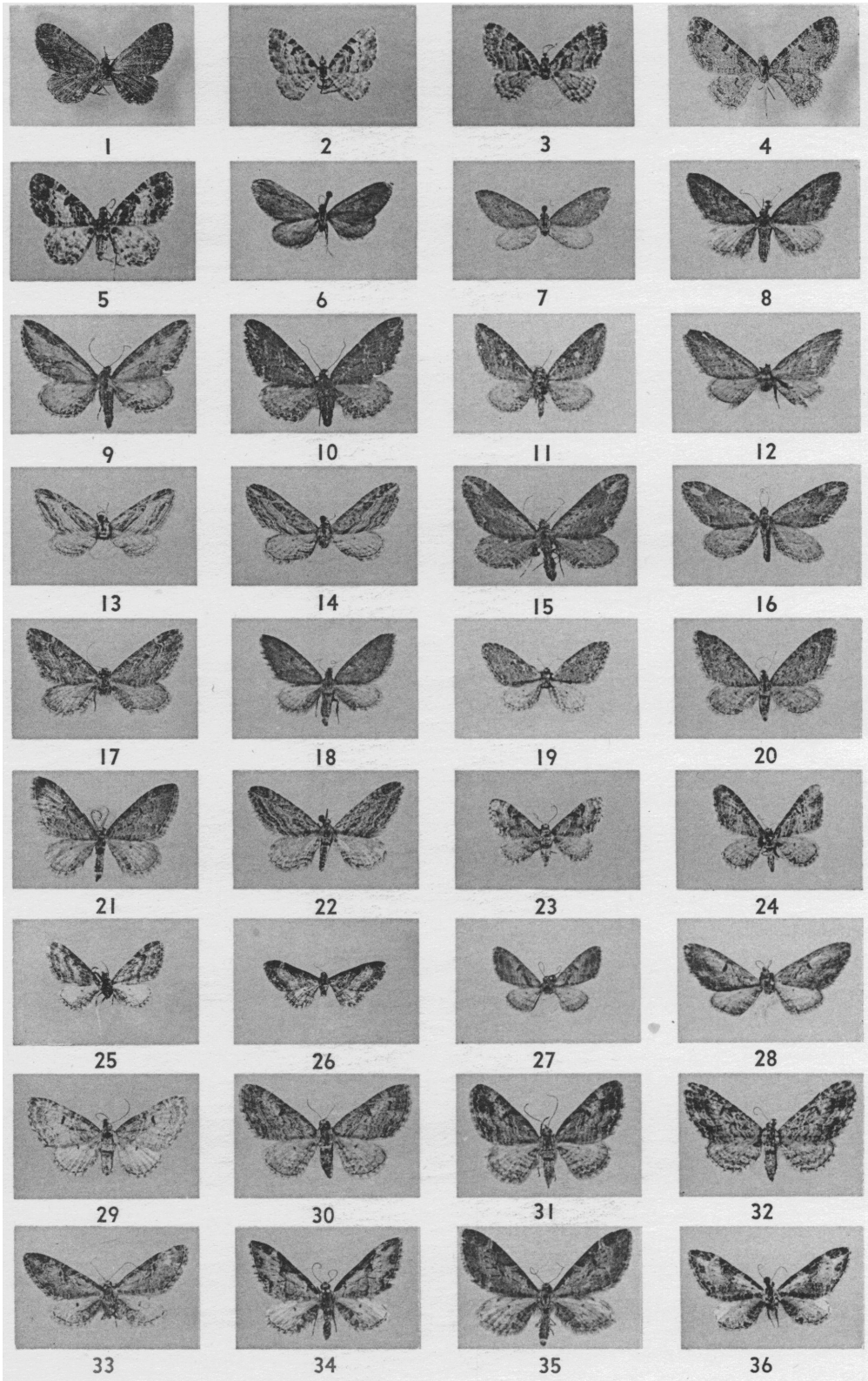


PLATE 31

1. *Eupithecia cocoata* Pearsall, female, holotype, Plummers Island, Maryland (United States National Museum).
2. *Eupithecia albicapitata* Packard, female, Big Indian Valley, Catskill Mountains, New York.
3. *Eupithecia mutata* Pearsall, male, holotype, Big Indian Valley, Catskill Mountains, New York.
4. *Eupithecia helena* Taylor, male, holotype, Pinal Mountains, Arizona (United States National Museum).
5. *Eupithecia columbrata* McDunnough, female, paratype, Steelhead, British Columbia.
6. *Eupithecia purpurissata* Grossbeck, female, holotype, Monterey County, California.
7. *Eupithecia purpurissata valariata* Pearsall, male, holotype, San Diego, California.
8. *Eupithecia mystiata* Cassino, male, Glen Ellen, Sonoma County, California.
9. *Eupithecia gilvipennata* Cassino and Swett, male, Fairfax, Marin County, California, typical.
10. *Eupithecia gilvipennata* Cassino and Swett, female, Lafayette, Contra Costa County, California (dark form).
11. *Eupithecia miamata* Cassino, male, Miami, Arizona (Sperry collection).
12. *Eupithecia scabrogata* Pearsall, female, holotype, California (Henry Edwards).
13. *Eupithecia adequata* Pearsall, male, holotype, Eureka, Utah.
14. *Eupithecia acutipennis* Hulst, male, San Diego, California.
15. *Eupithecia subapicata* Guenée, female, Pacific Grove, Monterey County, California.
16. *Eupithecia shirleyata* Cassino and Swett, female, Alta Vista, Pasadena, California.
17. *Eupithecia redingtonia* McDunnough, female, holotype, Redington, Arizona.
18. *Eupithecia gilata* Cassino, female, Spring Mountain, Napa County, California.
19. *Eupithecia gilata* Cassino, female, Miami, Arizona (Sperry collection).
20. *Eupithecia plumasata* McDunnough, female, Mohawk, Plumas County, California, topotypical.
21. *Eupithecia plumasata* McDunnough, male, Johnsville, Plumas County, California.
22. *Eupithecia deserticola* McDunnough, male, Borego, San Diego County, California, topotypical.
23. *Eupithecia anticaria* Walker, male, Big Indian Valley, Catskill Mountains, New York.
24. *Eupithecia anticaria* Walker, male, Colter's Ranch, White Mountains, Arizona.
25. *Eupithecia pertusata* McDunnough, male, holotype, southwestern Texas (Canadian National Collection).
26. *Eupithecia carneata* McDunnough, female, holotype, Oak Creek Canyon, near Prescott, Arizona (Canadian National Collection).
27. *Eupithecia classicata* Pearsall, male, Desert Arboretum, Superior, Arizona (agrees with holotype).
28. *Eupithecia penumbrata* Pearsall, female, holotype, Palmerlee, Arizona.
29. *Eupithecia graefii* Hulst, female, Mt. Hood, Oregon, topotypical.
30. *Eupithecia graefii* Hulst, female, Mohawk, Plumas County, California.
31. *Eupithecia graefii* Hulst, male, Spring Mountain, Napa County, California (dark coastal form).
32. *Eupithecia graefii vancouverata* Taylor, female, Wellington, British Columbia, topotypical.
33. *Eupithecia nevadata* Packard, female, Newhall, Los Angeles County, California, typical.
34. *Eupithecia nevadata* Packard, male, The Geysers, Sonoma County, California (well-marked form).
35. *Eupithecia nevadata* Packard, male, Spring Mountain, Napa County, California (dark form).
36. *Eupithecia nevadata* Packard, female, Mohawk, Plumas County, California (form easily confused with *cestata*).

PLATE 32

1. *Eupithecia nevadata morensata* Cassino and Swett, female, San Diego, California, topotypical.
2. *Eupithecia nevadata moirata* Swett and Cassino, female, Kaslo, British Columbia (paler than typical).
3. *Eupithecia nevadata probata* Swett and Cassino, female, Victoria, British Columbia, topotypical (Canadian National Collection).
4. *Eupithecia implorata* Hulst, female, holotype, Havilah, California (Rutgers University).
5. *Eupithecia implorata* Hulst, male, Barton Flats, San Bernardino County, California, typical.
6. *Eupithecia implorata* Hulst, male, Lafayette, Contra Costa County, California (dark form).
7. *Eupithecia cestata* Hulst, female, holotype, California (Rutgers University).
8. *Eupithecia cestata* Hulst, female, Inverness, Marin County, California, typical.
9. *Eupithecia cestatoides* McDunnough, female, holotype, Half Moon Bay, California.
10. *Eupithecia ravocostaliata* Packard, male, New Hampshire, typical.
11. *Eupithecia ravocostaliata* Packard, female, Wellington, British Columbia.
12. *Nasusina inferior* Hulst, female, San Diego, California.
13. *Nasusina (Eupithecia) vaporata* Pearsall, male, holotype, San Diego, California.
14. *Nasusina mendicata* Barnes and McDunnough, male, Santa Rosa, California.
15. *Nasusina minuta* Hulst, female, Morongo Valley, California.
16. *Prorella gypsata* Grote, male, Prescott, Arizona.
17. *Prorella discoidalis* Grossbeck, female, Palmerlee, Cochise County, Arizona.
18. *Prorella leucata* Hulst, female, Eureka, Utah.
19. *Prorella ochrocarneata* McDunnough, female, holotype, Huachuca Mountains, Arizona.
20. *Prorella (Nasusina) albida* Cassino and Swett, female, paratype, Eureka, Utah.
21. *Prorella irremorata* Dyar, male, Borego, California.
22. *Prorella tremorata* McDunnough, male, holotype, Tub Canyon, Borego, California.
23. *Prorella (Gymnocelis) remorata* Grossbeck, female, paratype, Yuma County, Arizona.
24. *Prorella desperata* Hulst, male, southwestern Texas.
25. *Prorella artestata* Grossbeck, male, Chiricahua Mountains, Cochise County, Arizona.
26. *Prorella (Gymnocelis) mellisa* Grossbeck, male, holotype, Minnehaha, Arizona.
27. *Prorella insipidata* Pearsall, female, Frijoles Canyon, New Mexico.
28. *Prorella (Nasusina) opinata* Pearsall, female, allotype, Prescott, Arizona.
29. *Prorella opinata* Pearsall, female, Eureka, Utah (ochreous form).

