A RE-EVALUATION OF PECTIS L.

SUBGENUS PECTIDOPSIS (DC.) FERNALD

(COMPOSITAE: PECTIDINAE)

A DISSERTATION

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the Graduate School of The Ohio State University

by

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* * * * * * * * * * *

The Ohio State University

1973

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VITA

David John Keil was born on December 13, 1946 in Elmhurst, Illinois. He is the third of six children of John B. Keil and Clara E. Keil. He received his elementary education from the Villa Park, Illinois public school system and graduated from Willowbrook High School, Villa Park, Illinois, in 1964. He received his undergraduate education at Arizona State University, majoring in botany, and in 1968 he graduated with distinction with the degree, Bachelor of Science. At the same time he received a commission as a second lieutenant in the United States Army Reserves. Continuing his education at Arizona State University, Mr. Keil received his Master of Science degree in botany in 1970 with the thesis: "Vegetation and Flora of the White Tank Mountains Regional Park, Maricopa County, Arizona." In 1971, after a brief tour of military duty, he resumed his education at The Ohio State University as an N. D. E. A. Title IV Fellow in Botany. For the past year he has served as a graduate teaching associate in botany at The Ohio State University. He is not married.
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INTRODUCTION

Pectis is by far the most widespread and over most of its range the most common genus of the New World Composite subtribe Pectidinae. The yellow-rayed, aromatic plants of this genus are found from northern Nebraska to northern Argentina in an almost continuous distribution. Recent estimates of the number of species in Pectis have ranged from 70 (Airy Shaw, 1966) to 100 (Correll & Johnston, 1970). Although several regional revisions have been published for the genus (Baker, 1884; Fernald, 1897; Urban, 1905; Rydberg, 1916), no one since A. P. de Candolle (1836) has attempted to treat the genus over the whole of its range. I have undertaken the project of comprehensively revising the genus.

Because of the size and complexity of Pectis, my initial study was originally limited to a revision of subgenus Pectidopsis, as delimited by Fernald (1897). I soon discovered, however, that the actual species relationships transcend Fernald's subgeneric boundaries. The present study consequently has been expanded to include additional species, particularly from subgenus Pectothrix.

During the present study, approximately 4000
specimens of Pectis have been received on loan from 37 herbaria. In addition, approximately 500 collections of various Pectis species were made during field excursions to the western United States, Mexico and Central America. Cytological investigations have been carried out on many of the specimens gathered on these trips.

TAXONOMIC HISTORY

Generic History of Pectis

Pectis has had a long, diverse nomenclatural history, dating back to 1707 when Sloane described a plant he had observed in Jamaica as "Hieraceum fruticosum, angustissiums gramineis follis capitulis parvis."
Linnaeus in 1759 described the genus Pectis and included Sloane's plant as one of his two original species, P. linifolia. The subsequent nomenclatural history is quite complex, and rather than describe it in detail, I will outline the major events. For a more detailed account, see Fernald (1897).

1759 Linnaeus described Pectis with two species.
1816-1836 Various workers contributed to a proliferation of small ill-defined genera in what is now considered to be Pectis.
1816 Lorentea Lag.
1817 Chthonia Cass.; Cryptopetalon Cass.
1830 Lorentea Less. (non Lag.)
1831 Pectidium Less.
1833 Heleoreos Raf.
1836 Pectidopsis DC.

1836 A. P. de Candolle treated all known species of Pectis (s.l.) as four genera, Lorentea Less., Pectidium, Pectidopsis, and Pectis, making up the division Euptectideae of the tribe Vernoniaceae.

1850 Gray recognized the unreliability of pappus characteristics for distinguishing genera in the Pectis complex, and reorganized Pectis as a single genus with six sections: Euptectis, Heterpectis, Lorentea, Pectidium, Pectidopsis and Pectothrix.

1856 Schultz Bipontinus transferred all the species of Lorentea to Pectis.

1883 Gray reduced the number of infrageneric taxa to three and treated them as subgenera: Euptectis, Pectidium and Pectothrix.

1884 Baker revised Pectis from Brazil.

1897 Fernald revised the United States and Mexican species of Pectis, recognizing 26 species in five subgenera: Euptectis, Heterpectis, Pectidium, Pectidopsis and Pectothrix.

1905 Urban revised the West Indian species of Pectis
and accepted a total of 18 species, without delimiting section or subgenera.

1916 Rydberg revised the North American and West Indies species of Pectis and divided the genus into 71 species without recognizing infrageneric taxa.

Since 1916, a number of new species have been reported and the genus has been treated for various floras. No major revision of the genus has been attempted until now.

History of subgenus Pectidopsis

Torrey (1828) described a plant collected by Edwin James in the Rocky mountains as Pectis angustifolia. Unlike all previously described species of Pectis, P. angustifolia lacked a pappus. Soon after Torrey had published this new species, Rafinesque (1833), in characteristic style, proposed a new genus, Heleoreos, for Torrey's plant. de Candolle (1836) also considered this epappose plant to be different from Pectis, and consequently described his own new genus, Pectidopsis, for the species.

Gray (1849) described a new Pectis, P. fastigiata, from Texas. A year later, when confronted with a plant
intermediate in pappus between his *Pectis fastigiata* and de Candolle's *Pectidopsis angustifolia*, Gray concluded that the two were probably the same. Extrapolating to the remainder of de Candolle's Eupectideae, Gray concluded that these genera all should be considered a part of *Pectis*. Additionally he proposed that *Pectis* should be treated as one genus with six sections, one of which was de Candolle's *Pectidopsis*.

In 1883, Gray lumped *Pectidopsis* with subgenus\(^1\) *Eupectis* (= Subg. *Pectis*). Fernald (1897) reinstated *Pectidopsis* as a subgenus and placed into it a mixed assemblage of twelve species. He characterized this subgenus as composed of plants with a pappus of 1–6 awns with or without a short crown of squamellae. Subsequent workers (Urban, 1905; Rydberg, 1916) chose not to recognize subgeneric or sectional categories for *Pectis* but added numerous new species. Various other authors also have proposed new taxa for the genus. The subgeneric concepts thus remain as Fernald described them in 1897.

**RE-EVALUATION OF INFRAGENERIC BOUNDARIES**

Workers since Lessing (1830, 1831) have emphasized in varying degrees the features of the pappus as

\(^1\)Subgeneric and sectional categories have been used almost interchangeably by earlier workers. Most names proposed for one category are also available in the other.
characters for subdividing *Pectis*, first into genera and later into sections or subgenera. Although pappus characters can be used in some cases in conjunction with other features in delineating infrageneric categories in *Pectis* (e.g., sect. *Heteropectis*), the use of these features alone, like any other one-character taxonomy, is subject to error. Section *Pectidopsis* is such an error.

After field and herbarium studies of a number of the taxa included by Fernald (1897) in subgenus *Pectidopsis*, I began to doubt the naturalness of the taxon. Several lines of evidence led to this conclusion. First, the taxa included in subgenus *Pectidopsis* fall into two morphologically dissimilar groups. The two groups have mutually exclusive patterns of variation, differing in several features including less glandularization, bud morphology, amount of pollen produced, etc. Second, each of these groups of species has a counterpart in another of Fernald's subgenera, *Pectothrix*. Thus, some species in subgenus *Pectidopsis* appear to be more closely related to some species of subgenus *Pectothrix* than they are to species in their own subgenus (Fig. 1). In one case, taxa of different subgenera, upon close examination, have proven to be conspecific (e.g., *P. palmeri* of subgenus *Pectothrix* is the same as *P. rusbyi* of subgenus *Pectidopsis*). A third line of evidence comes from the
Subgenus *Pectidopsis*  
- *P. angustifolia*  
- *P. filipes*  
- *P. pringlei*  
- *P. rosea*  
- *P. rusbyi*  
- *P. tenella*  

Subgenus *Pectothrix*  
- *P. palmeri*  
- *P. papposa*  
- *P. stenophylla*  

**GROUP I**  
- *P. berlandieri*  
- *P. capillaris*  
- *P. dichotoma*  
- *P. fasciculiflora*  
- *P. uniaristata*  

**GROUP II**  
- *P. fasciculata*  

**Fig. 1.** Relationships of species included by Fernald in *Pectis* subgenera *Pectidopsis* and *Pectothrix*.  
- *P. canescens*  
- *P. haenkeana*  
- *P. liebmannii*  
- *P. longipes*  
- *P. aquatica*
variability of the pappus itself. In some species (e.g., *P. angustifolia*, *P. rusbyi*), the pappus is sometimes so variable at the populational level that even infraspecific classifications which rely on pappus characters are unsatisfactory.

Based upon this evidence, I have expanded the scope of my original study to include those species of subgenus *Pectothrix* which are related to taxa in subgenus *Pectidopsis*. In addition, I have included various species not treated by Fernald which appear to be associated with one or the other groups of species in subgenus *Pectidopsis*. The remaining species of Fernald's subgenus *Pectothrix* (those not associated with species of subgenus *Pectidopsis*) will be treated at a later date.

Each of the two groups of species appears to be worthy of taxonomic recognition as sections. The name *Pectidopsis*, however, cannot be retained for either section. Under the provisions of Article 21 of the International Code of Botanical Nomenclature (Stafleu, 1972), this name cannot be used at either the sectional or subgeneric rank. One of the two original species of sect. *Pectothrix* (for which no type species was ever designated), *P. papposa*, is now included in the same section as *P. angustifolia* (the type species for sect. *Pectidopsis*). I have chosen to designate *P. papposa* as the
lectotype for sect. Pectothrix, which thus becomes the name of one of the two newly delimited sections. No available name for the other new section is known to exist. I am, therefore, proposing that this section be called sect. Agloneta (an anagram of elongata), with the earliest described taxon in the section, P. elongata as the type.

TAXONOMIC CHARACTERS

In the following paragraphs, the various morphological features of Pectis species are discussed, which by their uniformity or lack of it, have or have not proven useful as taxonomic characters within the portion of the genus under study. Pectis is remarkable for the number of features which remain constant throughout the genus, thus limiting their utility as taxonomic characters within the genus. Those features which do vary considerably sometimes do so to such an extent at the populational level that their taxonomic utility likewise is reduced. The characters that have proven useful taxonomically are thus fewer than would ordinarily be expected for so large and diverse a genus.
Habit

All species of Pectis are herbaceous, ranging from coarse perennials to delicate ephemerals. The perennial taxa frequently become somewhat suffrutescent at the base. A number of species are facultatively perennial, capable of reaching reproductive maturity in a single growing season, but under favorable conditions persisting for several years. Some species are known only as annuals.

Plants vary from strictly erect and few-branched to diffusely many-branched. Branching in the upper portion of the plants is primarily pseudodichotomous, with each stem terminating in a head, and subsequent branches arising below the insertion of the peduncle. Stems are commonly slightly six-angular and are often infused with dark red pigmentation.

Leaves

Leaves are opposite in all Pectis species, except sometimes alternate in the inflorescence. The leaf shape for most species is linear or slightly broader, and all species except P. incisifolia have essentially entire margins, broken only by the presence of one to several pairs of bristly cilia. Leaves are characteristically
one-nerved, with the midvein prominent on the undersurface, and secondary vein inconspicuous. Pubescence varies from glabrous to densely scaberulous. All species have leaves punctate with conspicuous oil glands. The distribution of glands is mostly marginal in sect. Pectothrix and scattered on the undersurface in sect. Agloneta. The pattern of glandularization is occasionally useful at the specific level, but is for the most part relatively constant within sections.

Inflorescence

The heads in Pectis species are solitary, or more commonly, are distributed in open to very condensed cymose clusters. Peduncles range from very short to elongate and often filiform. The arrangement of heads and the degree of condensation of the inflorescence is a useful character at the specific level.

Involucre

The involucre of Pectis is always uniseriate. Each phyllary individually subtends a ray floret; thus the ratio of ray florets to phyllaries is always 1 : 1. Within sect. Pectothrix, two species groups may be defined on the basis of phyllary-ray number, the P. angustifolia group with 8-rayed heads and the P. filipes group with
5-rayed heads. All species of sect. *Agloneta* are five-rayed taxa (except for some forms of *P. linearis*).

In all species considered in the present study and in all but one in the genus, the phyllaries are free to the base. The involucral bracts are thin-hyaline margined and are variously erose-ciliolate near the apex. Each phyllary bears a prominent corky keel which is thickest near the base and commonly protrudes as a conspicuous gibbosity. The phyllaries are variously punctate with oil glands of differing sizes and arrangements. Phyllary morphology is particularly useful in distinguishing taxa in sect. *Pectothrix* but is less so in sect. *Agloneta*.

**Receptacle**

The receptacles of all species of *Pectis* are slightly convex and are essentially naked except for the presence of minute papillae. The features of the receptacle are of little taxonomic value.

**Ray florets**

All heads of *Pectis* are radiate, and as mentioned above, the ray floret number is usually constant for a given species in the groups considered in the present study. Ray corolla color is generally yellow, but may
change to rose-pink or white with drying or with age. In sect. *Pectothrix* rays are usually showy and bright yellow, whereas in sect. *Agloneta* they are mostly inconspicuous and pale. The ligules are mostly ovate, but frequently become involute, thus appearing narrower. The tube is slender, usually shorter than the ligule and may be glandular-puberulent, as in most species of sect. *Pectothrix* or glabrous, as in the species of sect. *Agloneta*.

**Disc florets**

Unlike the ray floret number, the disc floret number is relatively unstable and is subject to genetic and environmental modification. Within ranges of variation, the number of disc florets is a useful taxonomic feature. Disc corolla color is usually the same as that of the rays. The tubes of the disc florets of most taxa of sect. *Pectothrix* are glandular-puberulent, whereas those of sect. *Agloneta* are glabrous.

Within the groups studied, the disc corollas are either regular, with five equal, short deltoid to lanceolate teeth, or are bilabiate, with one tooth more deeply cleft than the other four. The type of disc florets is generally constant within species.


**Anthers**

Anthers throughout the genus are short sagittate at the base and possess a short, emarginate terminal appendage. Those of sect. *Pectothrix* are much larger and contain many more pollen grains than do those of sect. *Agloneta*. Within the sections, the features of the anthers are of little taxonomic value.

**Style branches**

The style branches of the disc florets of *Pectis* are unique in the Pectidinae in being very short, densely papillose and unappendaged. As taxonomic characters within the genus, however, their utility is limited.

**Achenes**

The achenes of *Pectis* are mostly black, cylindrical or fusiform, longitudinally many ribbed, and variously pubescent, and are narrowed to a short, knoblike carpodium. Achene size and sometimes pubescence are often useful characters.

**Pappus**

Previous workers unfortunately greatly overestimated the value of pappus features as taxonomic
characters in organizing their classifications of *Pectis*. In several taxa, the pappus is so variable at the population level that it cannot be afforded much taxonomic value. The pappus of ray and disc may be of the same or different structure for a given species, and may be variously coroniform, aristate, setose, or combinations of these types. Essentially epappose forms occur in a number of taxa.

**Odor**

The essential oils of most species considered in the present study are strong-scented. The odors of the oils are rather good taxonomic characters for comparing related taxa. Their utility as taxonomic characters for use in identification is limited, however, by the lack of reference scents with which to compare. A few of the scents are easily recognizable and can be ascribed to familiar scents (e.g. lemon-scented, stinkbug-scented). Most, however, either cannot be referred to as known scents or resemble rather unfamiliar spices. The use of scents is further limited by the fact that the oils, while sometimes remaining liquid in the glands for many years (over 100), are unstable and change odor or lose their scent entirely. Thus either good field notes or fresh material are needed.
Gas-liquid chromatography of the essential oils of Pectis is a promising avenue of approach for the investigation of populational variation and species relationships. This procedure has been utilized in various groups of plants with considerable success (Adams and Turner, 1970; Emboden and Lewis, 1967; von Rudloff, 1969). The oils of Pectis are abundant (up to 0.7 percent of fresh weight) and quite variable (Albers, 1942; Arrillaga, 1943; Bradley and Haagen-Smit, 1949). The relatively consistent scent patterns of the various species suggests that species specific patterns of oil composition may be detectable.

This method has several limitations, however. The composition of the oils may vary seasonally (Adams, 1970), with the age of the plant (Hanover, 1955), from one part of a plant to another (Zavarin, 1968), or with the collection procedures (Bradley and Haagen-Smit, 1949). The instability of the oils usually necessitates the use of fresh or quick-frozen material although Emboden and Lewis (1967) report successful results using fairly recent herbarium material. In addition, similarly scented oils may be found in quite different species, suggesting that similar oil composition may result from parallel evolution rather than from close patristic relationship.
CHROMOSOME STUDIES

Methods

Immature capitula were killed and fixed in the field in modified Carnoy's Fixative (4 chloroform : 3 ethanol : 1 glacial acetic acid) and were kept under refrigeration prior to examination. In a modification of the methods of Beeks (1955), whole floret buds were stained (usually without heat) for 2-48 hours in standard acetocarmine solution and were squashed without prior maceration in a drop of Hoyer's solution. Camera lucida drawings were prepared from meiotic microsporocytes to document each reported count (Figs. 2-15).

Results

Chromosome counts were made from ten taxa of *Pectis* sect. *Pectothrix* and from four taxa of sect. *Agloneta* (Table 1). All plants examined were diploid and, with the exception of a few individuals with accessory chromosomes, all had a chromosome number of \( n = 12 \). Plants from a few populations exhibited meiotic irregularities such as anaphase I bridges and fragments, and incomplete synapsis.
Fig. 2-15. Camera lucida drawings of meiotic chromosomes of *Pectis* taxa. Fig. 2, *P. angustifolia* var. *angustifolia*, K 7638, n = 12, diakinesis; Fig. 3, *P. angustifolia* var. *tenella*, K & M 7879B, n = 12, metaphase I; Fig. 4, *P. berlandieri*, K & C 9240A, n = 12, metaphase I; Fig. 5, *P. elongata* var. *floribunda*, K 9413B, n = 12, metaphase I; Fig. 6, *P. filipes* var.* filipes*, K & C 8725A, n = 12, anaphase I; Fig. 7, *P. filipes* var. *subnuda*, K & M 8528A, n = 12, metaphase I; Fig. 8, *P. incisifolia*, K & M 8101A, n = 12, anaphase I; Fig. 9, *P. papposa* var. *papposa*, K & M 8496B, n = 12, metaphase I; Fig. 10, *P. papposa* var. *grandis*, K 7654C, n = 12, diakinesis; Fig. 11, *P. pringlei*, K & M 8218A, n = 12, diakinesis; Fig. 12, *P. rusbyi*, K & C 8654, n = 12, diakinesis; Fig. 13, *P. stenophylla* var. *biaristata*, K & C 8752C, n = 12, metaphase I; Fig. 14, *P. uniaristata* var. *jangadensis*, K & C 8997A, n = 12, metaphase I; Fig. 15, *P. uniaristata* var. *holostema*, K 9512A, n = 12, diakinesis. All figures same scale.
Table 1. Previously reported chromosome counts for *Pectis*.

<table>
<thead>
<tr>
<th>Reported count (n)</th>
<th>Taxon</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td><em>P. angustifolia</em> Torr. var. <em>angustifolia</em> [as <em>P. cf. texana</em> Cory]</td>
<td>Powell and Turner (1963)</td>
</tr>
<tr>
<td>12</td>
<td><em>P. depressa</em> Fern.</td>
<td>Powell and Turner (1963)</td>
</tr>
<tr>
<td>12</td>
<td><em>P. filipes</em> Harv. &amp; Gray var. <em>subnuda</em> Fern. [as <em>P. filipes</em> Harv. &amp; Gray]</td>
<td>Powell and Sikes (1970)</td>
</tr>
<tr>
<td>12</td>
<td><em>P. papposa</em> Harv. &amp; Gray var. <em>papposa</em> [as <em>P. papposa</em> Gray]</td>
<td>Raven and Kyhos (1961)</td>
</tr>
</tbody>
</table>
Table 1. (continued)

<table>
<thead>
<tr>
<th>Reported count (n)</th>
<th>Taxon</th>
<th>Reference</th>
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<tbody>
<tr>
<td>12</td>
<td><strong>P. papposa</strong> Harv. &amp; Gray var. <strong>grandis</strong> Keil</td>
<td>Powell and Sikes (1970)</td>
</tr>
<tr>
<td>12 + fragment</td>
<td>[as <strong>P. papposa</strong> Harv. &amp; Gray]</td>
<td>Powell and Sikes (1970)</td>
</tr>
<tr>
<td>12</td>
<td>[as <strong>P. papposa</strong> Harv. &amp; Gray]</td>
<td>Keil (in press)</td>
</tr>
<tr>
<td></td>
<td><strong>P. purpurea</strong> Brandeg. var. <strong>sonorae</strong> Keil</td>
<td>Turner and Flyr (1966)</td>
</tr>
<tr>
<td>12</td>
<td>[as <strong>P. palmeri</strong> S. Wats.]</td>
<td>Keil (in press)</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>P. rusbyi</strong> Greene ex A. Gray</td>
<td>Turner and Flyr (1966)</td>
</tr>
<tr>
<td>12</td>
<td>[as <strong>P. palmeri</strong> S. Wats.]</td>
<td>Turner and Flyr (1966)</td>
</tr>
<tr>
<td>12</td>
<td>[as <strong>P. puberula</strong> Greenm.]</td>
<td>Turner and Flyr (1966)</td>
</tr>
<tr>
<td>12</td>
<td><strong>P. saturataoides</strong> (Mill.) Schultz Bip.</td>
<td>Turner, Ellison and King (1961)</td>
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<td>12</td>
<td>&quot;</td>
<td>Powell and Turner (1963)</td>
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Table 1. (continued)

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<thead>
<tr>
<th>Reported count (n)</th>
<th>Taxon</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td><em>P. sinaloensis</em> Fern.</td>
<td>Turner and Flyr (1966)</td>
</tr>
</tbody>
</table>
Discussion

Previous reports (Table 1) have established the chromosome base number for \textit{Pectis} as $x = 12$. Aneuploid changes from this base number are not known to have become established in any \textit{Pectis} species. Accessory chromosomes occur sporadically in some species of sect. \textit{Pectothrix} but their occurrence usually is not regular even at the popational level. In one hybrid population, between \textit{P. angustifolia} var. \textit{angustifolia} and \textit{P. papposa} var. \textit{grandis}, as many as six small accessory chromosomes were present in the karyotypes of some individuals. Powell and Sikes (1970) report the presence of regularly occurring centric fragments in some populations of \textit{P. papposa} which probably represent the same entities that I have termed accessory chromosomes.

Polyploidy, although reported for other sections of the genus (Powell & Turner, 1963; Wiggins & Porter, 1971), is not known to occur either in sect. \textit{Pectothrix} or in sect. \textit{Agloneta}. In sect. \textit{Pectothrix}, this may be due to the lack of chromosomal sterility between species. In those cases where hybrids have been observed between species of this section, meiosis was generally regular or nearly so. An amphidiploid in this complex therefore would be expected to face the same disadvantages as an autopolyploid (i.e. multivalent formation, irregular
<table>
<thead>
<tr>
<th>Chromosome number (n)</th>
<th>Taxon with location and voucher&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
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<tbody>
<tr>
<td>12</td>
<td><strong>Pectis angustifolia Torr. var. angustifolia</strong></td>
</tr>
</tbody>
</table>
|                      | **MEXICO. CHIHUAHUA:** 13.6 mi S of Cd Jimenez, K & M 8226A; 4.5 mi N of Galeana, K & M 8387A; 25.6 mi N of Janos, K & M 8432A, B. **DURANGO:** 1.8 mi E of Nazareno, K & M 8014A. **UNITED STATES. COLORADO:** Fremont Co.: Indian Springs Campground, K 7637A; Canyon City, K 7638; Sedgwick Co.: 1.5 mi S of Ovid, K 7634. **NEBRASKA:** Keith-Lincoln Co. line at S Platte River, K 7635; Lincoln Co.: S Platte River at Hershey Rd, K 7603; S Platte River at Sutherland, K 7620A. **NEW MEXICO:** Grant Co.: S of Sherman along Mimbres River, K & M 8465A; 6.5 mi E of Santa Rita, K & M 8470; 4 mi N of Silver City, K & M 8481A<sup>b</sup>; Hidalgo Co.: 7.2 mi NE of jctn w/ US 70 on NM 90, K & M 8494A. **TEXAS:** Brewster Co.: Big Bend Natl Park, K & M 7795A; 15.1 mi N of Castolon, K & M 7798A; Culberson Co.: 1.4 mi SE of Hudspeth Co. line on I-10, K & M 7687; Hudspeth Co.: SE of Pt Hancock, K & M 7665A, B;
TABLE 2—continued

<table>
<thead>
<tr>
<th>Chromosome number (n)</th>
<th>Taxon with location and voucher</th>
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<tbody>
<tr>
<td>12</td>
<td>Pectis angustifolia Torr. var. tenella (DC.)</td>
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<tr>
<td></td>
<td>Keil</td>
</tr>
<tr>
<td></td>
<td>MEXICO. COAHUILA: 107 mi S of Piedras Negras, K &amp; M 7849A, B, C; 114 mi S of Piedras Negras, K &amp; M 7860A; between Nueva Rosita and Monclova, K &amp; M 7865A; 11.4 mi S of Monclova, K &amp; M 7875; 27 mi S of Monclova, K &amp; M 7879A, B; 60 mi S of Monclova, K &amp; M 7911A; 22.5 mi E of Paila, K &amp; M 7944A; 16.7 mi E of Paila, K &amp; M 7950A, B; 5.3 mi E of Paila, K &amp; M 7954A C; 13 mi W of Paila, K &amp; M 7960A, B; 8.6 mi E of Emiliano Zapata, K &amp; M 7996; 4.2 mi S of Acatita, K &amp; M 8052A; 2.1 mi N of Acatita, K &amp; M 8065A; 7.8 mi N of Acatita, K &amp; M 8072A; 1.1 mi S of Rancho el Cinco, K &amp; M 8102A; 10.3 mi S of Rancho los Charcos, K &amp; M 8165A, B. DURANGO: E of Mapami, K &amp; M 8186A.</td>
</tr>
<tr>
<td></td>
<td>UNITED STATES. TEXAS: Hidalgo Co.: 0.8 mi E of jctn w/Texas FM rd 886 on US 83, K &amp; C 9247 A, B; Starr Co.: 1 mi W of jctn w/Texas FM</td>
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<tr>
<td>Chromosome number (n)</td>
<td>Taxon with location and voucher</td>
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</tr>
<tr>
<td>rd 1430 on US 83, K &amp; C 9248B; 11.6 mi SE of jctn w/Texas FM rd 2098 on US 83, K &amp; C 9249A.</td>
<td></td>
</tr>
<tr>
<td>12 <strong>Pectis filipes</strong> Harv. &amp; Gray var. <em>filipes</em></td>
<td></td>
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<tr>
<td><strong>MEXICO. SONORA:</strong> 28 mi S of Hermosillo, K &amp; C 8617A, B, C; 3.8 mi E of jctn w/Mexico 15 on rd to Alamos, K &amp; C 8659A, B; 11.8 mi E of jctn w/Mexico 15 on rd to Alamos, K &amp; C 8665A, B&lt;sup&gt;d&lt;/sup&gt;, C; 7.2 mi SE of Navojoa, K &amp; C 8725A.</td>
<td></td>
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<tr>
<td>12 <strong>Pectis filipes</strong> Harv. &amp; Gray var. <em>subnuda</em> Fern.</td>
<td></td>
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<td><strong>MEXICO. CHIHUAHUA:</strong> 24 mi N of Nueva Casas Grandes, K &amp; M 8406A, B.</td>
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<td><strong>UNITED STATES. ARIZONA:</strong> Cochise Co.: 0.5 mi S of Paradise, K &amp; M 8512A; Chiricahua Natl Monument, K &amp; M 8528A. <strong>TENNESSEE:</strong> Presidio Co.: 18.5 mi S of Marfa, K &amp; M 7742A, B; 1.4 mi N of Cibola Creek on US 67, K &amp; M 7749A; Brewster Co.: 15.1 mi N of Castolon, K &amp; M 7797A, B, C, D; 12.5 mi N of Castolon, K &amp; M 7811A.</td>
<td></td>
</tr>
<tr>
<td>12 <strong>Pectis incisifolia</strong> I. M. Johnst.</td>
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<tr>
<td><strong>MEXICO. COAHUILA:</strong> S of Laguna del Rey, K &amp; M 8101A, B, D, E; 8102A, 8105A, B; 8109A,B,C.</td>
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<tr>
<td>Chromosome number (n)</td>
<td>Taxon with location and voucher</td>
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<tr>
<td>12</td>
<td><em>Pectis papposa</em> Harv. &amp; Gray var. <em>papposa</em></td>
</tr>
</tbody>
</table>

12 *Pectis papposa* Harv. & Gray var. *grandis* Keil |
TABLE 2--continued

<table>
<thead>
<tr>
<th>Chromosome number (n)</th>
<th>Taxon with location and voucher</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.6 mi NW of Tornillo exit on I-10, K &amp; M 7664A; Presidio Co.: 2.7 mi SE of Redford, K &amp; M 7778A.</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Pectis pringlei Fern.</td>
</tr>
<tr>
<td></td>
<td>MEXICO. CHIHUAHUA: 0.6 mi N of jctn w/rd to Escalon on Mexico 49, K &amp; M 8206-2A, B, C; 29.9 mi S of Cd Jimenez, K &amp; M 8218A. COAHUILA: 36.9 mi W of Paila, K &amp; M 7976A, B, C, D; jctn w/rd to San Pedro on Mexico 40, K &amp; M 7988A, B; 10.3 mi S of Rancho los Charcos, K &amp; M 8164A. DURANGO: 17.5 mi S of Nazareno, K &amp; M 8033B, C; 22 mi S of Nazareno, K &amp; M 8041A.</td>
</tr>
<tr>
<td>12</td>
<td>Pectis rusbyi Greene ex A. Gray</td>
</tr>
<tr>
<td>Chromosome number (n)</td>
<td>Taxon with location and voucher</td>
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<tr>
<td></td>
<td>of jctn w/rd to Bahia Kino on Mexico 15, K &amp; C 8629A; jctn w/rd to Bahia San Carlos on Mexico 15, K &amp; C 8632A; 0.7 mi S of jctn w/sonora 19 on Mexico 15, K &amp; C 8654.</td>
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<tr>
<td></td>
<td>UNITED STATES. ARIZONA: Maricopa Co.: White Tank Mts Regional Park, K 8570; Yavapai Co.: 2.5 mi S of Beaver Creek Ranger Station, K 8575AA, BB.</td>
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<tr>
<td>12</td>
<td>Pectis <em>stenophylla</em> A. Gray var. <em>biaristata</em> (Rydb.) Keil</td>
</tr>
<tr>
<td></td>
<td>MEXICO. SINALOA: 16.8 mi SW of El Fuerte, K &amp; C 8752A, B, C.</td>
</tr>
<tr>
<td></td>
<td>SECTION AGLONETA KEIL</td>
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<tr>
<td>12</td>
<td>Pectis <em>berlandieri</em> DC.</td>
</tr>
<tr>
<td></td>
<td>MEXICO. TAMAULIPAS: just E of Magiscat- zan, K &amp; C 9235A, B, C; 3 mi E of Mante, K &amp; C 9238B; 8.9 mi W of Magiscatzan, K &amp; C 9240A, B.</td>
</tr>
<tr>
<td>12</td>
<td>Pectis <em>elongata</em> H.B.K. var. <em>floribunda</em> (A. Rich) Keil</td>
</tr>
<tr>
<td></td>
<td>GUATEMALA. DEPT. JUTIAPA: 7.7 km E of jctn w/rd to Quesada on CA-1, K 9413B.</td>
</tr>
<tr>
<td>Chromosome number (n)</td>
<td>Taxon with location and voucher</td>
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<td>-------------------------------------------------------------------------------------------------</td>
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<tr>
<td>12</td>
<td><em>Pectis uniaristata</em> DC. var. <em>holostema</em> A. Gray</td>
</tr>
<tr>
<td></td>
<td>EL SALVADOR. DEPT. LA LIBERTAD: 10.1 km N of Quetzaltepeque exit on El Salvador 1, K 9452A, B.</td>
</tr>
<tr>
<td></td>
<td>HONDURAS. DEPT. CHOLUTECA: 24 km W of Choluteca, K 9512A; 20 km W of Choluteca, K 9515A.</td>
</tr>
<tr>
<td>12</td>
<td><em>Pectis uniaristata</em> DC. var. <em>jangadensis</em> (S. Moore) Keil</td>
</tr>
<tr>
<td></td>
<td>MEXICO. GUERRERO: 12 mi S of Chilpancingo, K &amp; C 9127 pop. JALISCO: 2.1 mi NW of Magdalena</td>
</tr>
<tr>
<td></td>
<td>airport, K &amp; C 9004A, B; 1.7 mi NW of jctn w/Mexico 70 on Mexico 15, K &amp; C 9021A; 39 mi SE of</td>
</tr>
<tr>
<td></td>
<td>Magdalena, K &amp; C 9024 pop. NAYARIT: 18 mi SE of Tepic, K &amp; C 8971-1 pop.; 16.3 mi W of</td>
</tr>
<tr>
<td></td>
<td>Nayarit-Jalisco boundary on Mexico 15, K &amp; C 8997A, B, D.</td>
</tr>
</tbody>
</table>

\[a\] Abbreviations of collectors' names: K = David Keil; K & M = David Keil & Lyle A. McGill; K & C = David Keil & Judith M. Canne. Voucher specimens deposited at the Ohio State University Herbarium (OS).

\[b\] 12 II + 2 small supernumeraries.

\[c\] Anaphase I bridge observed in some cells.

\[d\] 12 II + 1 small supernumerary.
TABLE 2—continued

Some cells contained one or two anaphase I bridges and associated fragments. Synapsis in at least one cell resulted in 10 II + 1 IV.

meiotic segregation, etc.).

Of the counts reported for sect. Pectothrix, four represent previously uncounted taxa: P. filipes var. filipes, P. incisifolia, P. pringlei and P. stenophylla var. biaristata. Of this section, only P. vollmeri and the remaining varieties of P. stenophylla are yet to be counted.

All the counts here reported for taxa of sect. Agloneta are new and are the only counts available for the section. Much cytological work remains to be done in this section, particularly in the perplexing P. linearis complex. The primary course of evolution in sect. Agloneta appears to have been at the diploid level, but not enough evidence is yet available to determine if additional levels are present as well.

EVOLUTIONARY RELATIONSHIPS

Pectis appears to have had a long evolutionary history. In total number of species and in overall range, Pectis has diversified to a greater extent than any of the other large genera in the Pectidinae (Johnson, 1969;
Neher, 1965; Strother, 1969). Several features of *Pectis* (e.g. very short style branches, emarginate anther appendages) appear to be unique in the Pectidinae, suggesting, as was pointed out by Strother (1969), that *Pectis* has long pursued an independent course of evolution in the Pectidinae.

An examination of the evolutionary relationships throughout the entire genus is beyond the scope of the present study. However, the relationships between the two sections recognized in the present treatment, *Pectothrix* and *Agloneta*, and the relationships among the taxa included within these sections are examined.

*Pectis* as a whole has a chromosome base number of \(x = 12\) (Johnston and Turner, 1962; Strother, 1969). All the species sampled to date in both sect. *Pectothrix* and in sect. *Agloneta* are diploids (Tables 1, 2). With the widespread occurrence of diploids throughout the genus, though, the similarity of ploidy level does not necessarily indicate a close relationship between the sections. It does, however, suggest that the mode of evolution within both sections has probably been primary allopatric speciation rather than hybrid speciation.

Section *Pectothrix* and sect. *Agloneta* do not appear to be closely related. As mentioned earlier, these sections are well marked morphologically. Although the
features of the pappus vary in similar patterns in the two sections, this similarity appears to be a case of parallel evolution rather than of close patristic relationship. The two sections have diversified in different geographical and ecological zones. I believe that these sections have developed from different ancestral stocks within the genus.

An evolutionary trend within both sections appears to be a reduction of the pappus from a multisetteose form to a few-setose, aristaless, or coroniform condition. The selective value of this reduction is not readily apparent, as a setose pappus seems better adapted to dispersal. Within some taxa, considerable pappus diversity exists at the population level. Plants of P. angustifolia var. tenella, for instance, may have a pappus of anywhere from 0-7 setae. Within such populations, there appears to be little selective pressure on pappus structure.

Strother (1969) postulated that within the genera of the subtribe Tageteae [=Pectidinae] annuals are generally more advanced than perennials and that xerophytes are more advanced than mesophytes. Such trends have been supported for other plant groups (Grant, 1959; Raven, 1969) and appear to be the case for Pectis.

Both sections Pectothrix and Agloneta contain mostly annuals. Perennial taxa are present as well.
When the perennial (and putatively the most primitive) taxa of the two sections are compared, they have scarcely more in common than do the most advanced members of the sections. If the two sections were derived from similar ancestral forms, the most primitive species would be expected to be more similar.

The two sections have diversified into different ecological zones. Section Pectothrix comprises some of the most xerophytic species in the genus and includes species from all four of the North American deserts. The plants of sect. Agloneta are more mesophytic and occur in a variety of vegetation zones in much of tropical America and the Caribbean.

Pectis stenophylla appears to be the most primitive member of Pectis sect. Pectothrix. It occurs in less xeric habitats than most other species of the section, and two varieties have retained the perennial habit. In addition, some forms of this species also possess a multi-setose pappus. The nearest relative of P. stenophylla appears to be P. rusbyi, a somewhat more xeric annual species.

Two distinct lines of evolution have occurred within sect. Pectothrix. In one line, with the ray floret number fixed at five, are P. filipes and P. vollmeri. The remaining species all have a ray number
of eight. Although there has been considerable divergence between these lines, sporadic hybridization occurs where species of the two groups grow together. The hybrids are meiotically normal and possess highly stainable pollen.

The evolutionary significance of this fixation of ray number is not certain. A number of perennial species and some annual species have a variable ray number. Within the more advanced groups, such as in sect. Pectothrix, however, the number of ray florets is apparently under rigid genetic control and seldom varies within a species or species group. In cases where five-rayed and eight-rayed species hybridize, intermediate numbers do occur. These intermediates apparently do not become established in the populations even though the selective disadvantage of the intermediate numbers is not at all clear.

_Pectis incisifolia_, which occurs only on a few Chihuahuan Desert sand dunes, has been subjected to severe ecological conditions. Two features of this plant, the prostrate habit and the unique, sticky-glandular achenes, appear to be adaptations to its restricted habitat. The selective value of the pinnatifid leaves of this taxon is less clear. _Pectis incisifolia_ appears to have no close relatives within the
section. It is perhaps distantly related to *P. angustifolia* or to *P. papposa*. The divergence of *P. incisifolia* from the other members of the section may be the result of rigorous selection in its limited habitat.

The three remaining species in the section, *P. angustifolia*, *P. papposa*, and *P. pringlei* form a tight knit group which appears to have diverged at some time in the past from the *P. stenophylla*-*P. rusbyi* line. The putative evolutionary lines within section *Pectothrix* are illustrated in Fig. 16.

Within *Pectis* sect. *Agloneta*, the most primitive species is also a perennial. *Pectis diffusa* is a large-headed, long-peduncled perennial with a several-setose pappus. Closely related to *P. diffusa* are *P. linearis* and *P. uniaristata*. These relationships indicate two evolutionary trends within sect. *Agloneta*. Large-headed plants appear to be more primitive than small-headed species, and plants with open inflorescences appear to be less advanced than those with more condensed clusters of heads. Both *P. linearis* and *P. uniaristata* have smaller heads than *P. diffusa*. Within *P. uniaristata* the three varieties illustrate both trends. Some forms of *P. linearis* appear to have retained or perhaps regained the perennial habit.

*Pectis elongata*, *P. berlandieri*, and *P. gardneri*
Fig. 16. Putative evolutionary relationships among the species of *Pectis* section *Pectothrix*.
are likewise related. Within this group, the trend toward condensation of the inflorescence culminates in the congested inflorescence of *P. elongata* var. *fasciculiflora*. *Pectis berlandieri* is the most xerophytic species of this section.

Although *P. diffusa* appears to have the attributes of a primitive species for the section, I feel that it is unlikely that it is the progenitor for the section. Probably a common ancestral form existed for the *P. diffusa* line and the *P. elongata* line (Fig. 17).

**TAXONOMIC PHILOSOPHY**

Previous treatments of *Pectis* (Fernald, 1897; Urban, 1905; Rydberg, 1916) were based almost entirely upon herbarium studies. These workers did not have an overview of the degree of inter- and intra-populational variation in the various taxa of *Pectis*. All too often, the taxa recognized in these treatments are in reality minor variants not worthy, in my opinion, of taxonomic recognition. Rydberg (1916) accepted a total of 71 species of *Pectis* from North America and the Caribbean. Keck (1946) commented on the deficiencies in Rydberg's taxonomy.

Rydberg had come to believe that any striking morphological form deserved a name, and that this should be a specific name,
Fig. 17. Putative evolutionary relationships among species of *Pectis* section *Agloneta*. 
since he could see no advantage in using trinomials. The significance of geographical range was rarely considered. Rydberg's species often represent morphologically well-marked forms, but all too frequently they are found to be thoroughly linked with others by intermediates, or to be unique variants, or to have no natural range of their own. Often his species are based on one morphological character, which is soon found to occur sporadically here and there over a large area in which other characters in the same plants show trends of variation in other directions. These limitations in Rydberg's species concept makes his entities artificial rather than natural.

In the present treatment, I have chosen to follow a conservative approach at the specific level. My field work with _Pectis_ has given me a perspective of the range of natural variation at the population level, which in many cases has enabled me to recognize the variants worthy of taxonomic acceptance. In those cases in which minor morphological variants do appear to be worthy of taxonomic recognition, I have placed these entities at the varietal rather than specific rank. The treatment thus emphasizes overall similarities rather than minor morphological differences.

Raven (1969) argued that subspecies should be the only infraspecific rank used in a classification. Kapadia (1963) on the other hand suggested that the primary infraspecific rank should be that of varietas, and that subspecies should be recognized only in those cases
where grouping of varieties is desirable to show relative relationships. I have chosen to follow Kapadia rather than Raven and have used varietas rather than subspecies as my primary infraspecific rank. This is in part a pragmatic approach, in that none of the previous workers who have described infraspecific taxa have used the rank of subspecies.
TAXONOMIC SECTION

PECTIS L.


Seala Adanson, Fam. Pl. 131. 1763. [No species ever described within this genus].


Pectidopsis DC. Prodr. 5:98. 1836. TYPE SPECIES: Pectidopsis angustifolia (Torr.) DC. l. c.


Theilodiscus Durand, Index Gen. Phan. 216. 1888. orthogr. var.

Glabrous or pubescent annual or perennial herbs, often strong-scented. Stems slender, usually much branched. Leaves simple, 1-nerved, marginally ciliate with stiff bristles, variously punctate with oil glands. Heads radiate, solitary, or clustered in open or condensed cymose inflorescences. Phyllaries uniseriate, distinct (except in one species), thin margined, corky keeled, apically ciliolate, variously punctate. Ray florets pistillate and fertile, equal in number to and individually subtended by the phyllaries; corollas yellow, ligulate. Disc florets perfect and fertile, few to many; corollas yellow, regular or bilabiate, 4 or 5 toothed; anthers weakly sagittate, tipped with a short, truncate or emarginate appendage; stigma lobes very short, unappendaged,
densely papillose. Achenes terete, weakly many ribbed, glabrous or variously pubescent. Pappus coroniform, aristate, setose, paleaceous or absent. Chromosome base number: $x = 12$.

Distribution: Southwestern United States and southern Florida throughout tropical America to Peru and northern Argentina. Species of Pectis occupy a diverse array of habitats; but are particularly common on dry or disturbed sites with little overhead cover.

**KEY TO THE TAXA OF PECTIS SECTIONS PECTOTHRIX AND AGLOMETA**

a. Foliar oil glands marginal; phyllaries broadly obtuse to subacute; disc corollas usually glandular-puberulent at least on the tube; ray florets 5 or 8 [Section Pectothrix] (b)

b. Leaves pinnatifid ............... 6. *P. incisifolia*

b. Leaves entire or nearly so (c)

c. Ray florets 5 (rarely 4 or 6) (d)

    d. Phyllaries 6-8 mm long; disc corollas 4-5 mm long; pappus 2-6 aristate; plants of Baja California ......................... 8. *P. vollmeri*

    d. Phyllaries 3.5-6 mm long; disc corollas 2.5-4 mm long; pappus 0-3 aristate (e)

    e. Fascicles of leaves usually present in upper
axils; peduncles mostly 10-25 mm long; disc florets 2-8; plants of central and southern Sonora .......... 7a. *P. filipes* var. *filipes*

e. Fascicles of leaves usually absent; peduncles mostly 10-50 mm long; disc florets 7-22; plants with more northern or eastern distribution .......... 7b. *P. filipes* var. *subnuda*

c. Ray florets 8 (rarely 7, 9 or 10) (f)

f. Inflorescence rather congested; peduncles mostly less than 15 mm long (g)

g. Pappus bristles (if present) subplumose; trichomes on achenes with curled, bulbous tips; leaf bases not flared (h)

h. Phyllaries 3-5 mm long; disc florets 6-14; disc pappus 1.5-2.5 mm long ............... ............... 3a. *P. papposa* var. *papposa*

h. Phyllaries 5-8 mm long; disc florets 12-24 (-34); disc pappus 2.5-4 mm long ............... ............... 3b. *P. papposa* var. *grandis*

g. Pappus bristles (if present) scabrid; trichomes on achenes with straight, bifurcate tips (i)

i. Bases of upper leaves conspicuously flared, often partially concealing the peduncles; pappus usually only coronoiform (except in
some Texas and Chihuahuan populations);
plants usually lemon-scented when fresh ...
.... 4a. **P. angustifolia** var. **angustifolia**
i. Bases of upper leaves seldom flared; pappus mostly 1-7 arista or setose (though sometimes coroniform); plants spicy-scented (j)
j. Plants often perennial; phyllaries broad-
est near the apex, with the subterminal oil gland 0.5-1 mm long; pappus usually not more than 1 mm long; endemic to the Edwards Plateau of Texas .....................
.... 4c. **P. angustifolia** var. **fastigiata**

j. Plants strictly annual; phyllaries broad-
est near the middle, with subterminal gland less than 0.5 mm long; widespread in south Texas and Mexico ..................

....... 4b. **P. angustifolia** var. **tenella**

f. Inflorescence open; peduncles more than 15 mm long (k)

k. Phyllaries broadly obtuse, conspicuously lon-
gitudinally striate; pappus of about 20 bris-
tles or rarely reduced to a crown ............
................................. 2. **P. rusbyi**

k. Phyllaries either not broadly obtuse or not longitudinally striate (l)
1. Pappus of disc achenes 1-4 aristate, the awns slender, 2-4 mm long; achenes 3-4.5 mm long ......................... 5. P. pringlei

1. Pappus either not aristate or achenes shorter (m)

m. Phyllaries 5-8 mm long; disc pappus 2.5-4 mm long, subplumose ......................

............ 3b. P. papposa var. grandis

m. Phyllaries 3.5-5.5 mm long; disc pappus 1-2 mm long, scabrid (n)

n. Plants perennial with a stiff woody caudex (o)

o. Herbage glabrous or nearly so ........

1a. P. stenophylla var. stenophylla

o. Herbage densely hirtellous ............

.... 1b. P. stenophylla var. gentryi

n. Plants annual, without a woody caudex (p)

p. Heads mostly broadly campanulate, 17-26 flowered .........................

. 1e. P. stenophylla var. biaristata

p. Heads narrowly campanulate to cylindrical, 8-17 flowered (q)

q. Herbage glabrous, leaves very narrow, mostly less than 1 mm wide ...
1c. *P. stenophylla* var. *rosei*

q. Herbage densely hirtellous, leaves often more than 2 mm wide ...........

ld. *P. stenophylla* var. *puberula*

a. Foliar oil glands inframarginal on undersurface of leaves; phyllaries acute to acuminate; disc corollas glabrous; ray florets 4 or 5 [Section *Agloneta*] (r)

r. Peduncles mostly less than 2 cm long; plants not caespitose (s)

s. Heads conspicuously peduncled (t)

  t. Pappus bristles 3 or fewer, little if at all exceeding the disc corollas (u)

  u. Peduncles mostly 2-10 mm long; inflorescence crowded, usually very convex, plants strongly lemon-scented ......................

     ........ 10b. *P. uniaristata* var. *jangadensis*

  u. Peduncles mostly 10-20 mm long; inflorescence open; odor sometimes not lemon-scented (v)

  v. Phyllaries 3-4 mm long; pappus coroniform or rarely 1-setose ......................

     ........ 10c. *P. uniaristata* var. *holostema*

  v. Phyllaries 4.5-6 mm long; pappus often 1-3 setose ..............................

     ....... 10a. *P. uniaristata* var. *uniaristata*

  t. Pappus bristles (at least of the disc florets)
4-20, usually much exceeding the disc corollas

(w)

w. Pappus bristles mostly 4-10 (x)

x. Plants perennials with a woody rootstock; inflorescence few-headed; ray corollas 5-8 mm long ................. 11. P. diffusa

x. Plants annual; ray corollas 2.5-4 mm long (y)

y. Foliar oil glands in a single row on each side of the midrib; plants with medicinal odor .................. 12. P. berlandieri

y. Foliar oil glands scattered on undersurface of leaf; plants with odor of lemon oil or stinkbug ....................... .............................

........ 13b. P. elongata var. floribunda

w. Pappus bristles mostly 15-20 .................

........ 13a. P. elongata var. elongata

s. Heads sessile or nearly so, aggregated into dense axillary and terminal glomerules ..................

........ 13c. P. elongata var. fasciculiflora

r. Peduncles mostly more than two cm long, or if less than 2 cm, then plants low and more or less caespitose (z)

z. Pappus bristles 15-20 (aa)

aa. Involucre usually campanulate at anthesis, or
soon becoming campanulate

............. 13a. P. elongata var. elongata

aa. Involucre cylindric ......... 14. P. gardneri

z. Pappus bristles 0-10 (bb)

bb. Phyllaries 4-6 mm long, pappus conspicuously

exserted beyond the phyllaries (cc)

cc. Plants perennial ........... 11. P. diffusa

cc. Plants annual (dd)

dd. Stems stiffly erect, very leafy below;

glands scattered

........ 13b. P. elongata var. floribunda

dd. Stems ascending to spreading; leaves more

evenly distributed on stem; glands in sub-
marginal rows

............ 9a. P. linearis var. linearis

bb. Phyllaries 3.5-4 mm long (ee)

ee. Ray corollas 2-3 mm long; Central and South

American .. 9c. P. linearis var. graveolens

ee. Ray corollas 3-5 mm long; Mexican ............

............ 9b. P. linearis var. exilis

PECTIS L. SECTION PECTOTHRIX A. GRAY

Pectis L. sect. Pectothrix A. Gray, Smithsonian

Contr. Knowl. 3:83. 1850. Pectis subgenus Pectothrix


Annual or perennial strong-scented herbs. Stems erect to prostrate, one to many from the base, much-branched above. Leaves linear to linear-elliptic (pinnatifid in one species), ciliate toward the base with 1-several pairs of bristles, marginally punctate with conspicuous oil glands. Inflorescence open or condensed, more or less dichasial. Phyllaries usually either 5 or 8, obtuse to acutish, strongly carinate, falling individually. Ray florets 5 or 8; corollas showy, bright yellow, usually glandular puberulent. Disc florets 5-50; corollas bright yellow, regular or bilabiate, 5-toothed, usually glandular-puberulent; anther sacs with many pollen mother cells. Achenes variously pubescent, black. Pappus coroniform and/or setose or aristate, the ray pappus
often differing from the disc pappus. Chromosome base number: $x = 12$.

Distribution: California and Nebraska south to Sinaloa, Aguascalientes and San Luis Potosí. Locally abundant throughout much of the arid and semi-arid portion of North America.


Annual or perennial herbs from a slender taproot or woody caudex. Stems 10-30 cm long, one to many from the base, erect to decumbent, glabrous to densely hirtellous. Leaves linear to narrowly elliptic, 0.5-4.5 cm long, 1-4.5 mm broad, obtuse to acute, mucronate, glabrous to densely hirtellous, ciliate with 1-3 pairs of basal bristles 1-3 mm long, punctate marginally with golden-brown oil glands 0.1-0.5 mm diameter or in some forms, punctate submarginarily on the abaxial surface with tiny black glands 0.1-0.2 mm diameter. Peduncles filiform, 2.5-7 cm long, glabrous or hirtellous; bracteoles 3-8, linear to lanceolate, glabrous or hirtellous, sometimes punctate. Heads terminal or axillary; involucre campanulate. Phyllaries linear to oblong, 3.5-5.5 mm long, 0.5-2 mm broad, obtuse to acutish, basally rounded and gibbous,
Fig. 18. A-Q, Pectis stenophylla; A-D, var. biaristata, K & C 8752 (OS); E-H, var. puberula, Gentry 5495 (NY); I-K, var. stenophylla, Kimnach & Brandt 950 (US); L-N, var. gentryi, Gentry 7323 (MICH); O-Q, var. rosei, E. Palmer 730 (GH); R-U, Pectis rusbyi, K & C 8658 (OS). A, E, R, habit; B, F, I, L, O, S, phyllaries, C, G, J, M, P, T, ray achenes; D, H, K, N, Q, U, disc achenes. Habit sketches all same scale; phyllaries and achenes all same scale.
slender-keeled nearly to the apex, glabrous to hirtellous, punctate with 1 or 2 subterminal and 2-3 pairs of slender submarginal glands, these either brown and swollen or tiny and black. Ray florets 8; corollas 2-6 mm long, yellow or becoming reddish tinged, with ligules glabrous and tubes glandular-puberulent. Disc florets 8-26, bilabiate, 1.7-3 mm long, glandular-puberulent. Achenes 1-2.5 mm long, strigillose. Pappus of the ray achenes biaristate, 1-2 mm long; pappus of the disc achenes variable, setose, aristate, and/or coroniform, 1-2 mm long. Chromosome number: \( n = 12 \).

**Distribution.** Eastern Sonora and southwestern Chihuahua to central Sinaloa and western Durango, from 300 to 1500 meters elevation. Very local in thorn forest and oak forest zones (Fig. 19).

*Pectis stenophylla* is an unusually variable taxon. Local races, isolated from other populations, often by considerable distances, have undergone marked divergence. In 1916 Rydberg recognized a total of five species from this complex, a logical treatment based upon the limited samples then available. Each taxon, however, was known from only one or two collections.

In the intervening period since Rydberg's treatment, a number of collections from additional populations have
Fig. 19. Geographical distribution of *Pectis* stenophylla.
been made. Members of several of these populations have character combinations intermediate to those of species accepted by Rydberg. Because of this observed intermediacy, I have chosen to regard all members of this complex as one polymorphic species and to recognize the more extreme variants at the varietal level. The species thus recognized is comparable to other variable species recognized within section Pectothrix.

Some objection might be raised to the inclusion of the perennial Pectis stenophylla (s. str.) in the same species as several annual forms. There is, however, precedent and ample justification for such an approach. Indeed, in one population of P. stenophylla var. puberula, annuals and apparently perennial individuals occurred side by side, thus indicating the plasticity of the habit in these plants (Gentry 5282).

One feature of particular interest in P. stenophylla is the vestigial nature of the oil glands in some local races. Collectors' notes on herbarium labels indicate that the oils of plants with swollen brown glands are quite aromatic. In some populations, however, the glands are small, black, and shrunken, and apparently lack any detectable odor (personal observation). This feature has a secondary effect. In those plants with odorless glands, the latter are apparently displaced from the leaf
margin during ontogeny. This relationship is quite apparent from an examination of the type collection of _Pectis scabra_, in which plants with either one or the other type of oil glands co-existed in the same population. Those foliar oil glands that are swollen and brown are marginal; those that are tiny and black are inframarginal on the lower surface of the leaves. Because this variation can occur within a population, I consider the taxonomic significance of this character to be minor for this species. This is the only instance known in sect. _Pectothrix_ in which the glands are not strictly marginal.

1a. _Pectis stenophylla_ A. Gray, Proc. Amer. Acad. Arts 21:393. 1886. var. _stenophylla_ (Fig. 18).

   TYPE: MEXICO. CHIHUAHUA. near Batopilas, Aug 1885, E. Palmer 81. (HOLOTYPE: GH!; ISOTYPES: K! PH!).

   Plants perennial. Stems 15-25 cm long, woody and rigid at the base, glabrous or nearly so. Leaves linear, 1-3 cm long, 1-2 mm wide, glabrous, marginally punctate with golden-brown oil glands. Peduncles 2.5-5 cm long, glabrous. Phyllaries 4-4.5 mm long, 1 mm wide, punctate with a conspicuously enlarged subterminal gland and smaller submarginal glands. Ray corollas 4-6 mm long.
Pappus of the rays 1.5-2 mm long; pappus of the disc 10-20 setose, 1-2 mm long. Chromosome number unknown.

Distribution. Eastern Sonora and southwestern Chihuahua at 600 to 1500 meters elevation (Fig. 19).

In some areas, local residents boil the herbage of *P. stenophylla* and use the decoction as a medicine (Gentry, 1942). Since the plants of var. *stenophylla* are not very common (as evidenced by the paucity of collections), such usage, if very common, must put a considerable strain on the populations of this taxon. In species with large population systems, local harvesting is probably of little overall significance. For a taxon as uncommon as var. *stenophylla*, though, man's influence may have profound effects.

lb. *Pectis stenophylla* A. Gray var. *gentryi* Keil, var. nov. (Fig. 18).

Plantae perennes. Caules 15-30 cm longi, basi lignosi et rigides, dense hirtelli. Folia linearia vel anguste elliptica, 1-2 cm longa, 1-3 mm lata, dense hirtella, margine punctate. Pedunculi 3-5 cm longi, hirtelli vel glabrescentes, 3-5 bracteolati. Phyllaria 4-4.5 mm longa, dense hirtella. Corollae flosculorum
radiorum 4 mm longae. Flosculi disci 8-10; corollae 2.5-2.7 mm longae. Achenia 2.5 mm longa. Pappus radiorum biaristatus, 1.5 mm longus; pappus discorum circa 20-setosus, 1-2 mm longus. Chromosomatum numerus ignotus.


Plants perennial. Stems 15-30 cm long, woody and rigid at the base, densely hirtellous. Leaves linear or narrowly elliptic, 1-2 cm long, 1-3 mm wide, densely hirtellous, marginally punctate. Peduncles 3-5 cm long, hirtellous or glabrescent, 3-5 bracteolate. Phyllaries 4-4.5 mm long, densely hirtellous. Ray corollas 4 mm long. Disc florets 8-10; corollas 2.5-2.7 mm long. Achenes 2.5 mm long. Pappus of the rays biaristate, that of the disc ca 20-setose, 1-2 mm long. Chromosome number unknown.

Distribution. Known only from the type locality in northern Sinaloa, at 300 meters elevation (Fig. 19).

Gentry's collection is from the Sierra Surotato, a mountain mass isolated from the main cordillera of the Sierra Madre Occidental by a distance of about 40 miles.
(Gentry, 1946). This plant differs from the more northern var. stenophylla in being densely scaberulous rather than almost completely glabrous. In addition, the leaves appear to be mostly shorter and thicker in var. gentryi than in var. stenophylla.

lc. _Pectis stenophylla_ A. Gray var. _rosei_ (Fern.) Keil, comb. nov. (Fig. 18).


Plants annual. Stems 20–30 cm long, glabrous. Leaves linear, 2–3 cm long, 1 mm wide, glabrous, punctate on the abaxial surface with tiny black glands. Peduncles 3–5 cm long, glabrous. Heads cylindric. Phyllaries very narrowly linear, 3.5–4 mm long, ca 0.5 mm broad, punctate with linear red-black glands. Ray corollas 3 mm long. Disc florets 11–12; corollas 2 mm long. Achenes 2 mm long. Pappus of the rays 1–1.5 mm long; pappus of the disc 2–3 aristate, ca 1.5 mm long. Chromosome number unknown.

_Distribution_. Known only from the type locality
in southern Sonora at ca 1500 meters elevation (Fig. 19).

Pectis stenophylla var. rosei is perhaps most closely related to var. stenophylla, which it resembles in being glabrous and in having very narrow leaves. The two differ in habit, foliar oil glands and pappus structure. Since var. rosei is still known only from its type collection, the full range of variation remains unknown.

1d. Pectis stenophylla A. Gray var. puberula (Greenm.) Keil, comb. nov. (Fig. 18).


Plants annual or sometimes persisting more than one growing season. Stems 10-30 cm long, sparsely to densely hirtellous. Leaves linear to narrowly elliptic, 1-4 cm long, 1-5 mm wide, densely hirtellous, punctate either marginally with golden-brown glands or on the abaxial
surface with tiny black glands. Peduncles 3-6 cm long, glabrous to puberulent, 3-6 bracteolate. Heads cylindric to narrowly campanulate. Phyllaries 3-4.5 mm long, glabrous to densely hirtellous, punctate with either black or brown glands. Ray corollas narrow, 2-3.7 mm long. Disc florets 8-17; corollas 1.7-3 mm long. Achenes 1-2.5 mm long. Pappus of the rays 1-1.5 mm long; pappus of the disc coroniform, 2-4 arista or 10-20 setose, highly variable, 1-2 mm long. Chromosome number unknown.

Distribution. Central Sinaloa and western Durango at 200 to 900 meters elevation (Fig. 19).

The pappus of var. puberula is highly variable. Within populations from both the type locality of P. puberula (Palmer 1605) and from the type locality of P. scabra (Gentry 5495), a full range from coroniform to short arista to setose pappus forms occur.

McVaugh (1956) was unable to determine for certain if Lodiego, the type locality of P. puberula, was in Sinaloa or Durango. The location is near the boundary between these two states and is only a few miles from Cofradia, Sinaloa, the type locality of P. scabra. The exact site has been lost, however.
Representative specimens. MEXICO. DURANGO:

1e. Pectis stenophylla A. Gray var. biaristata (Rydb.)
Keil, comb. nov. (Fig. 18).

TYPE: MEXICO. SINALOA: vicinity of Fuerte,
13537 (HOLOTYPE: NY!; ISOTYPE: UC!).

Plants annual. Stems 5-25 cm high, sparsely to
densely hirtellous. Leaves linear to narrowly elliptic,
1-3 cm long, 1-3 mm wide, nearly glabrous to densely hir-
tellous, punctate marginally with brown oil glands or
submarginally on the abaxial surface with black glands.
Peduncles 3-5 cm long, glabrous to densely hirtellous.
Heads broadly campanulate. Phyllaries linear to oblance-
olate, 4-5 mm long, 1-2 mm broad, glabrous or hirtellous,
punctate with small dark glands. Ray corollas 4.5-5 mm
long. Disc corollas 17-26, ca 3 mm long. Achenes 2.3-2.5 mm long. Pappus of the rays 1.7-1.8 mm long; pappus of the disc 1-3 aristate or 10-20 setose, 1-2 mm long. Chromosome number: n = 12.

The collection from southern Sonora (Sikes & Babcock 178) is referred with some doubt to var. biaristata. It appears to be a mixed collection including some putative hybrids with another species. The plants resemble var. biaristata, but because of their depauperate nature the determination is done with some reservations.

This variety is the only one which I have observed in the field. It was very locally very common south of Fuerte, Sinaloa along about a one mile stretch of highway in open thorn forest (Keil & Canne 8752). Elsewhere I was unable to find it.

Distribution. Southern Sonora to central Sinaloa (Fig. 19).

2. *Pectis rusbyi* Greene ex A. Gray, Syn. Flora North Amer. 1(2):361. 1884. (Fig. 18)

**TYPE:** UNITED STATES. ARIZONA. Yavapai Co., Beaver Creek [or Beaver Head], 10 Aug 1883, H. H. Rusby 317 [=s. n. or 655] (HOLOTYPE: GH!; ISOTYPES: F! K! MICH! PH! RSA! UC! US!).


Plants strong-scented, tap-rooted annuals, erect or branching from the base. Stems 5-50 cm long, erect or decumbent, often dichotomously branched, glabrous or sparsely puberulent on the angles. Leaves linear to narrowly elliptic, 1-5 cm long, 1-5 mm broad, often revolute, ciliate with 1-3 pairs of basal bristles 1-2 mm long, otherwise entire, glabrous or glabrescent, marginally punctate with rounded oil glands 0.2-0.7 mm diameter.
Peduncles 2-8 cm long, glabrous, with 3-6 lance-attenuate or setiform bracteoles 1-3 mm long. Heads in forks of stems and axillary, becoming somewhat crowded in age. Phyllaries 8, oblong or narrowly obovate, 4-7 mm long, 1-2 mm broad, very obtuse to subacute, longitudinally striate with 3-5 usually conspicuous nerves on each side of the conspicuous, corky, basally gibbous midrib, hyaline margined, apically ciliolate, otherwise glabrous, punctate with 0-2 subterminal oil glands and 2-4 pairs of inconspicuous, rounded to narrow-elongated submarginal glands. Ray florets 8; corollas 5-11 mm long, with broadly ovate glabrous ligules and slender, glandular-puberulent tubes. Disc florets (7-) 20-55; corollas 3.5-5 mm long, bilabiate with the narrow lobe ca twice the length of the teeth on the broad lobe, glandular-puberulent. Achenes 3-4.5 mm long, strigillose or pilosulous. Pappus of the ray achenes 0-4 aristate and/or coroniform; awns slender, 1-4 mm long, antrorsely barbed towards the tips. Pappus of the disc achenes coroniform or 15-30 setose; bristles, when present, 2.5-5 mm long, entrorsely barbed. Chromosome number: \( n = 12 \).

Distribution. Central Arizona to southern Baja California and northern Sinaloa at elevations of 0-1200 meters. (Fig. 20).
Fig. 20. Geographical distribution of *Pectis rusbyi* and *Pectis incisifolia*. Half-barred line indicates Sonoran Desert boundary (redrawn from Shreve, 1942).
Pectis rusbyi has a mostly Sonoran Desert distribution, barely extending beyond the desert into the grassland in central Arizona and occurring sporadically in the thorn forest of southern Sonora and northern Sinaloa.

In central Arizona, P. rusbyi exhibits a striking dimorphism in pappus structure. The type of P. rusbyi is essentially epappose whereas the type specimen of P. mearnsii, collected only a few miles from that of P. rusbyi, has a setose pappus. However, based on personal field observation, both pappus forms may co-exist in plants of the same population. For example, in both Maricopa and Yavapai Counties of Arizona, some individuals were found with a setose pappus and numerous others with only a coroniform pappus (Keil 8569, 8575). As a result of these observations, I regard P. rusbyi and P. mearnsii as conspecific.

Keaneey and Peebles (1942) placed P. mearnsii in synonymy with P. palmeri, a decision with which I heartily concur. The two taxa are essentially indistinguishable. However, with the present evidence of the conspecificity of P. mearnsii and P. rusbyi, Pectis palmeri must necessarily be treated also as a synonym of P. rusbyi.

In lowland areas of southern Sonora, a weedy, large-headed race occurs commonly along roadsides and in cultivated areas (Keil & Canne 8632, 8652). On some sites,
this form is so common that it becomes an aspect dominant, coloring large areas with its showy yellow flowers. In less disturbed areas, this form grades into the smaller-headed forms more typical of the species.

P. rusbyi usually can be readily distinguished from other related species by its broad, apically-flattened, longitudinally striate phyllaries. A few populations from Baja California and Sinaloa (e.g. Plyr 68, Wiggins 15533A) have smaller, more convex, and less conspicuously striate phyllaries. In other respects these plants are so similar to other populations of P. rusbyi that taxonomic separation even at the varietal level does not seem to be warranted.

Pectis rusbyi sometimes hybridizes with P. papposa var. papposa and P. filipes var. filipes in Sonora where complex hybrid swarms may develop locally. In Arizona, however, where P. papposa var. papposa and P. rusbyi have been observed to grow together, no hybrids have been found.

Representative specimens. MEXICO: BAJA CALIFORNIA: Purissima, 1 Feb 1889, Brandegee s.n. (GH, US); La Paz, 20 Jan-5 Feb 1890, E. Palmer 115 (GH, US); W of Los Dolores, 17 Nov 1959, Wiggins 15533A (MICH, TEX); 10 mi S of Mission Dolores, 5 Dec 1959, Wiggins, Carter & Ernst
321 (MICH, US); Isla San José, 6 Dec 1959, Wiggins, Carter & Ernst 368 (MICH, US); 4.5 mi N of La Purissima, 18 Dec 1959, Wiggins & Ernst 582 (MICH, US). SINALOA: Bahia Topolobampo, 26-30 Sep 1954, Gentry 14344 (US); near Topolobampo, 29 Dec 1963, Flyr 69 (TEX, WIS); 20.6 mi S of Sonora-Sinaloa boundary on Mexico 15, 10 Sep 1971, K & C 8738 (OS); 1.8 mi E of San Blas on Sinaloa 32, 10 Sep 1971, K & C 8744 (OS). SONORA: Guaymas, 23 Oct 1939, Gentry 4682 (F, GH, MICH, MO, PH, SD, US); just S of Magdalena, 6 Sep 1971, K & C 8594 (OS); 42 mi S of jctn w/rd to Benjamin Hill on Mexico 15, 6 Sep 1971, K & C 8603 (OS); 6.5 mi S of jctn w/rd to Bahia Kino on Mexico 15, 7 Sep 1971, K & C 8628 (OS); jctn w/rd to Bahia San Carlos on Mexico 15, 7 Sep 1971, K & C 8632 (OS); 11 mi NW of rd to Cd Obregon airport on Mexico 15, 8 Sep 1971, K & C 8652 (OS); 2.9 mi S of Navojoa on Mexico 15, 10 Sep 1971, K & C 8724 (OS); near Mirimar, 18 Aug 1956, Waterfall 12835 (GH, MICH, US). UNITED STATES. ARIZONA. Maricopa Co.: White Tank Mountains Regional Park, 3 Sep 1971, Keil 8569, 8570 (OS); 3 mi S of Camp Creek, 21 Oct 1972, McGill 588 (OS); Pima Co.: 4 mi W of Havanakya, 28 Aug 1945, Gould & Haskell 3198 (RSA); Yavapai Co.: Ft. Whipple, 6 Sep 1865, Coues & Palmer 522a (MO); 2.5 mi S of Beaver Creek Ranger Station, 3 Sep 1971, Keil 8575 (OS).
3. *Pectis papposa* Harv. & Gray in A. Gray, Mem. Amer. Acad. Arts 4:62. 1849. (Fig. 21).

Plants bushy strong-scented annuals. Stems 1-30 cm long, much branched, glabrous or minutely puberulent. Leaves linear, 1-6 cm long, 1-2 mm wide, basally ciliate with 1-3 pairs of bristles 1-2 mm long, otherwise entire, glabrous, marginally punctate with rounded to oval oil glands 0.3-0.5 mm diameter. Peduncles 3-40 mm long, glabrous, with 2-6 hyaline, lanceolate bracteoles ca 1 mm long. Heads clustered at tips of branches. Involucre cylindric to campanulate. Phyllaries 8, rarely 7, 9 or 10, linear, 3-8 mm long, 0.5-1.7 mm wide, apically acutish, basally truncate, gibbose, strongly convex-keeled almost to the tips, narrowly hyaline margined, apically ciliolate, otherwise glabrous, punctate with 1-5 swollen subapical glands and 2-5 pairs of smaller, inconspicuous submarginal glands, occasionally with additional dorsal glands. Ray florets 8, rarely 7, 9 or 10; corollas 3-8 mm long, with narrowly to broadly ovate glabrous ligules and slender glabrous or glandular-puberulent tubes. Disc florets 6-34; corollas 2-5.5 mm long, bilabiate, with the narrow lobe ca twice the length of the teeth on the broad lobe, glabrous or glandular-puberulent below. Achenes 2-5.5 mm long, strigillose or
Fig. 21. *Pectis papposa*. A-D, var. papposa, K & C 8578 (OS); E-H, var. grandis, K & M 7786 (OS).
A, E, habit; B, F, phyllaries; C, G, ray achenes; D, H, disc achenes. Habit sketches all same scale; phyllaries and achenes all same scale.
Suspected Missing Page 77
Pectis papposa
- var. papposa
- var. grandis
- intermediates
these populational differences seems worthy of formal taxonomic recognition.

3a. **Pectis papposa** Harv. & Gray in A. Gray, Mem. Amer. Acad. Arts 4:62. 1849. var. **papposa** (Fig. 2i).

**TYPE:** MEXICO. "California," [probably collected near Hermosillo or Guaymas, Sonora], [no date],
T. Coulter 331 (HOLOTYP: TRIN!; ISOTYPES: GH! K[2]!).


Stems 1-20 mm long. Leaves 1-3 cm long, 1-2 mm broad. Peduncles 3-10 (25) mm long, 3-6 bracteolate. Heads densely clustered at tips of branches or in some forms more diffuse. Phyllaries 3-5 mm long, ca 0.5 mm broad, punctate with 1-3 subapical glands and 2-3 pairs of submarginal glands. Ray corollas 3-6 mm long, glabrous or glandular-puberulent. Disc florets 6-14 (-18); corollas 2-3.5 (-4) mm long, glabrous or glandular-puberulent. Achenes 2-4.5 mm long. Pappus of disc achenes setose or sometimes coroniform; bristles 1-2.5 mm long. Chromosome number: \( n = 12 \).
Distribution. Southern California and southwestern Utah to southwestern New Mexico, south to Baja California and central Sinaloa at elevations of minus 60 to 1500 meters (Fig. 22).

**Pectis papposa** var. **papposa** often colors large areas of the Sonoran Desert during late summer. It is particularly abundant in central Arizona on the broad intermountain alluvial plains, but also occurs on the low desert mountain ranges as well.

Bradley and Haagen-Smit (1949) reported that a large portion of the essential oils of **P. papposa** [var. **papposa**] is composed of cumin and suggested that **P. papposa** might be grown as a commercial crop for this oil. This suggestion has apparently not been followed up, however.

**Representative specimens.** MEXICO. BAJA CALIFORNIA:
"Las Lomas de Anita," Loreto, 7 Oct 1967, **Carter** 5395a (GH, SD, TEX); S of Laguna Seca Chapala, 9 Nov 1947, **Carter, Alexander & Kellogg** 1890 (DS, GH, MO, SD); 12 mi S of Muleje, (17)18 Oct 1941, **Gander** 9617 (CAS, SD); 15 mi NE of El Arco, 18 Nov 1938, **Gentry** 4036 (DS, GH, MO); Picachos de Santa Clara, 5-10 Nov 1947, **Gentry** 7760 (DS, SD); between Rosarito and Canipoli, 3 Oct 1941, **Hammerly** 154 (CAS, DS, SD); 6 mi S of La Paz, 8 Oct 1941, **Hammerly**
235 (CAS, DS, SD); 14 mi N of Rancho Laguna Chapala, 13 Oct 1963, Hastings & Turner 63-193 (DS, SD); 50 mi NW of San Felipe, 19 Dec 1962, Kaune 686 (CAS, DS); Sierra San Borja, 16 Oct 1962, Moran 9914 (DS, SD); Laguna Magueta, 5 Oct 1890, Orcutt 2231 (MO, NMC); Los Angeles Bay, Nov 1887, E. Palmer 657 (GH, HDG, NY, UC, US); 104 km NW of La Paz, 17 Nov 1968, Rzedowski 26554 (DS, ENCB); Rancho la Pierra, 22 May 1959, Thomas 7941 (DS, ENCB); 25 mi SE of Catavina on rd to Laguna Chapala, 16 Oct 1959, Thomas 8183 (DS, ENCB); S end of Laguna Chapala, 16 Oct 1959, Thomas 8198 (DS, ENCB, TEX); 14 mi S of Mexicali, 3 Oct 1946, Wiggins 11238 (CAS, DS, GH); S side of Laguna Chapala, 27 Oct 1946, Wiggins 11296 (CAS, DS, GH); Rancho Mesquital, 31 Oct 1946, Wiggins 11333 (DS, GH); 16 mi S of El Refugio, 24 Nov 1946, Wiggins 11498 (DS, GH); 4 mi S of village at Bahia de los Angeles, 26 Sep 1959, Wiggins 15003 (DS, ENCB); 12 mi S of El Solito, 21 Oct 1959, Wiggins 15137 (CAS, DS, ENCB, TEX); 2 mi N of El Pilar, 13 Nov 1959, Wiggins 15428 (CAS, DS); 10 mi E of Ojos Negros, 10 Sep 1961, Wiggins 16689 (DS, ENCB); near Puerto de Azufre, 11 Nov 1967, Wiggins 20795 (DS, ENCB, TEX); 12.8 mi W of hwy on rd to San Matias Pass and Valle Trinidad, 11 Nov 1967, Wiggins 20826, 20826A (DS, KANU, SD, TEX). SINALOA: Altata Bay, 21 Dec 1957, Alava & Cook 1450 (UC); Altata, 20 Sep 1904, Brandegee s.n. (GH);
near Las Animas beach, 28 Jan 1964, *Flyr* 106A (TEX, WIS); 1 mi E of Altata, 28 Jan 1964, *Flyr* 113 (TEX, WIS).


**UNITED STATES. ARIZONA:** Coconino Co.: Camp Bowie, Aug 1874, *Rothrock* 446 (F, GH, PH); Coconino Co.: Moencopi, 31 Aug 1923, *Jaeger* s.n. (POM); Gila Co.: Rye Creek, 15 Sep 1933, *Collom* 186 (GH, MO, ND, NY); Graham Co.: US 70 at San Carlos River, 18 Oct 1968, *Pinkava, Keil & Lehto* 15089 (ASU, KANU); Greenlee Co.: 8.6 mi E of Solomonville, 8 Oct 1942, *Wolf & Everett* 11413 (DS); Maricopa Co.: White Tank Mountains Regional Park, 3 Sep 1971, *Keil* 8573, 8574 (OS); 1.2 mi NW of Riggs Rd on I-10, 5 Sep 1971, *K & C* 8576 (OS); near Phoenix, 17 Jun 1882, *Pringle* s.n. (F, MO, PH); Mohave Co.: Willow Springs, 20 Aug 1959, *Demaree* 41527 (ASC, ASU, GH, KANU, SMU); Pima Co.: 13.6 mi NW of Cortaro Rd on I-10, 5 Sep 1971,
K & C 8579 (OS); Organ Pipe Cactus Natl Monument, 24 Sep 1972, Nash, Brown, Macintyre, McGill & Pinkava 9961 (ASU, OS); Pinal Co.: 2.1 mi NW of jctn w/Ariz 187 & 387 on I-10, 5 Sep 1971, K & C 8577 (OS); Maricopa, 25 Oct 1882, Pringle s.n. (F, GH, MO, PH); Yavapai Co.: 1 mi W of Congress Jctn, 20 Aug 1961, R. R. Johnson s.n. (KANU); Yuma Co.: 10 mi E of Wenden, 4 Sep 1936, Shreve 7775 (F, MICH, MO). CALIFORNIA: Imperial Co.: 5 mi E of Calexico, 16 Oct 1912, McGregor 1064 (DS); Inyo Co.: Panamint Valley, 28 Oct 1929, Hoffman s.n. (CAS); Riverside Co.: 2.7 mi W of Desert Center, 18 Sep 1963, Blakeley 6182 (DES); La Quinta, 24 Nov 1961, L. S. Rose 61063 (CAS, ENCB, TEX); San Bernardino Co.: Needles, 10 May 1884, M. E. Jones 3872 (CAS, DS, F, PH); Clark Mtn, Pachalka Spring, 5 Oct 1935, Wolf 7596 (DS, GH, MO, SD); San Diego Co.: near Calexico, 25 Jul 1903, Abrams 3994 (CAS, DS, SMU). NEVADA: Clark Co.: Charleston Mts, 25 Jul 1938, Clokey 8197 (CAS, DS, F, GH, KSC, MICH, MO, PH, SD, SMU, TEX, WIS); Lincoln Co.: Timpahute Range, 23 Aug 1968, Reveal & Holmgren 1904 (DS, KANU, KSC, MICH, SMU, TEX); 5 mi S of Hiko, 28 Aug 1938, Train 2390 (DS, F, MO); Nye Co.: 4.5 mi N of jctn of Orange Rd & Pahute Mesa Rd, 18 Aug 1968, Reveal & Holmgren 1854 (DS, KANU, KSC, MICH, SMU, TEX). NEW MEXICO: Hidalgo Co.: 10 mi N of Animas, 9 Sep 1950, Clark 8945 (UNM); Cienega Lake turnoff on US

3b. Pectis papposa Harv. & Gray in A. Gray var. grandis Keil, Brittonia (in press) (Fig. 21).


Stems 5-30 cm long. Leaves 2-6 cm long, 1-2 mm broad. Peduncles 1-4 cm long, 2-6 bracteolate. Heads usually several at tips of branches. Phyllaries 5-8 mm long, 1-1.7 mm broad, punctate with 1-5 subterminal glands and 2-5 pairs of submarginal glands. Ray corollas 5-8 mm long, glabrous or sparsely glandular-puberulent. Disc florets 12-24 (-34); corollas 3-5 mm long, glabrous or glandular-puberulent. Achenes 3-5.5 mm long. Pappus of disc achenes 2.5-4 mm long, setose or rarely short-coroniform. Chromosome number: \( n = 12 \).

Distribution. Southern New Mexico and southwestern
Texas to Chihuahua and northern Coahuila; disjunct in Arizona and northeastern New Mexico (Fig. 22).

Representative specimens. MEXICO. CHIHUAHUA: 36 mi S of Samaluyuca, 26 Sep 1965, Cronquist 10221 (CAS, GH, KANU, KSC, MICH, WIS); 15.4 mi N of Cd Camargo, 25 Aug 1971, K & M 8252-1 (OS); 37.7 mi N of Cd Camargo, 25 Aug 1971, K & M 8254 (ASU, F, NY, OS, POM, US); 25.5 mi N of Janos, 29 Aug 1971, K & M 8431 (ARIZ, DS, OS, UC); 7.5 mi E of jctn/w/rd to Palomas on Chihuahua 2, 29 Aug 1971, K & M 8435 (OS); 50.6 mi E of jctn w/rd to Palomas on Chihuahua 2, 29 Aug 1971, K & M 8444 (OS); 46.6 mi S of Juarez, 22 Jul 1972, McGill, Brown & Pinkava 9209 (ASU, OS); 30 mi N of Villa Ahumada, 22 Jul 1972, McGill, Brown & Pinkava 9215 (ASU, OS); 20 km NW of Jaco, 6 Jul 1941, Stewart 674 (GH); vicinity of Pierro, 8 Jul 1941, Stewart 742 (GH); 10 mi W of Julimes, 8 Oct 1941, Stewart & Johnston 2094 (GH); 28 mi W of jctn w/Rte 45 on rd to Casas Grandes, 22 Aug 1967, Stuessy 1109 (TEX).


Plants annual or perennial herbs from a slender tap-root or ligneous caudex. Stems 1-20 cm long, usually branched from the base, glabrous or minutely puberulent. Leaves linear, 1-4.5 cm long, 1-3 mm broad, 2-5 ciliate at the base with bristles 1-2 mm long, mucronate, often strongly revolute, glabrous, marginally punctate with glands 0.2-0.7 mm diameter. Peduncles 1-20 mm long, with 2-5 bracteoles 1-3 mm long. Heads congested at ends of branches, narrowly campanulate or cylindrical. Phyllaries linear or narrowly oblanceolate, 2.5-5.5 mm long, obtuse, basally truncate and strongly gibbous, very strongly convex-keeled nearly to the apex, glabrous, punctate subterminally with 1 or 2 swollen oil glands, and submarginally with 2-5 pairs of smaller glands. Ray florets 8; corollas 3-5 (-7) mm long, glandular puberulent or nearly glabrous. Disc florets (7-) 10-20; corollas 2.5-3.5 mm long, regular or bilabiate, glandular puberulent. Achenes 2.5-4 mm long, strigillose with bifurcate trichomes. Pappus variable, coroniform and/or 1-7 aristate or setose, 1-2 mm long. Chromosome number: \( n = 12 \).

Distribution. Wyoming and Nebraska south to Durango, San Luis Potosi and Veracruz (Fig. 24).
Fig. 24. Geographical distribution of *Pectis angustifolia*. 
In the *Pectis angustifolia* complex previous workers (Gray, 1884; Fernald, 1897; Rydberg, 1916) have relied primarily on the features of the pappus as taxonomic characters. Three taxa traditionally have been recognized in the complex on the basis of differences in pappus structure: *Pectis angustifolia*, *P. angustifolia* var. *subaristata* and *P. tenella*. Another group of plants has twice been named as a species (*P. fastigiata* Gray, 1849; *P. texana* Cory, 1937) and twice reunited with *P. angustifolia* (Gray, 1850; Correll & Johnston, 1970).

The value of the pappus as a character in this complex has been overemphasized. Although easily distinguishable extreme forms exist in some regions, in other areas there is so much variation in pappus structure that as many as three "taxa" could be recognized from the individuals of an otherwise homogeneous population. A re-examination of taxonomic boundaries, necessitated by the breakdown of the traditionally accepted scheme, has led me to two conclusions. First, the *Pectis angustifolia* complex should be recognized as a single species with three varieties: *P. angustifolia* var. *angustifolia*, var. *tenella*, and var. *fastigiata*. Second, Gray's var. *subaristata* has been often mis-applied, and in its strict interpretation, cannot be distinguished from var. *angustifolia*. 

TYPE: UNITED STATES. [COLORADO or NEW MEXICO]: "on the Rocky Mountains," [1820], E. James s.n. (HOLOTYPE: NY!).

Heleoreos angustifolius (Torr.) Raf. Atlantic J. 1:145. 1832.

Pectidopsis angustifolia (Torr.) DC. Prodr. 5:98. 1836.


Plants bushy lemon-scented annuals. Stems 1-20 cm long, densely leafy at the tips. Leaves 1-4.5 cm long, 1-3 mm wide, conspicuously flared at the bases.
Feduncles mostly 1-10 mm long, 1-4 bracteolate, often wholly or partially concealed by the bases of the sub-tending leaves. Phyllaries 2.5-5.5 mm long, linear, strongly keeled to the tips, abruptly truncate, punctate with 1 or 2 subterminal glands 0.2-0.5 mm long, and smaller submarginal glands. Ray corollas 3-5 mm long. Disc florets (7-) 10-20; corollas 2.5-3.5 mm long, slightly bilabiate. Achenes 2.5-4 mm long. Pappus coroniform, 0.1-0.3 mm long, or in some Texas and Chihuahua populations also 1-7 aristate or setose. Chromosome number: \( n = 12 \).

Distribution. Western Nebraska to eastern Arizona, West Texas, Chihuahua and northern Durango. Grading into var. \textit{tenella} in eastern Chihuahua and Durango (Fig. 24).

The present interpretation of morpho-geographical variation in the \textit{Pectis angustifolia} complex has necessi-
tated a re-interpretation of var. \textit{subaristata} described by A. Gray (1899). This name has been widely applied over the years to any individual with a few-bristled pappus. An examination of type material of this variety, however, reveals that with the exception of the slightly bristly pappus, these plants are not distinguishable from other individuals of var. \textit{angustifolia}.

The "subaristate" forms to which this name has been
applied are of several different origins. Spontaneous "subaristate" variants occasionally occur throughout the range of var. *angustifolia*. Within populations of var. *tenella*, individuals may be "subaristate" or even completely epappose. A similar condition occurs sporadically in var. *fastigiata*. In some areas, individuals intermediate between var. *tenella* and var. *angustifolia* may have a "subaristate" pappus. Finally, in eastern Chihuahua and western Texas, "subaristate" races have developed apparently as a result of hybridization and introgression between var. *angustifolia* and *P. papposa* var. *grandis*.

Cochise Co.: Light District, 2 Sep 1928, Letcher s.n. (SD); Coconino Co.: 12 mi N of Cameron, 28 Sep 1939, Cutler 3122 (DS, CH, MO, NY, US); Navajo Co.: Holbrook, 10 Aug 1896, Zuck s.n. (MO, NY, US); Yavapai Co.: 5 mi E of Seligman, 8 Aug 1955, Parker 8414 (ARIZ, CAS).
COLORADO: Baca Co.: 5 mi SW of Kirkwell, 29 Aug 1949, W. A. Weber 5137 (RSA, SMU, UC); Bent Co.: Rule Creek, 9 Jun 1910, Osterhout s.n. (WIS); Chaffee Co.: Salida, Aug 1886, Harper s.n. (F, MO, WIS); El Paso Co.: El Paso, 6 Jul 1876, Popeo s.n. (KSC); Fremont Co.: Royal Gorge, 5 Sep 1937, Owenby 1508 (DS, CH, MO, NY, UC); Indian Springs Campground, 12 Aug 1971, Keil 7637 (OS); Huerfano Co.: Walsenburg, 24 Aug 1896, Biltmore Herb. exped. 6760a (US); Las Animas Co.: Mesa de Maya, 23 Jun 1948, Rogers 6069 (MICH); Logan Co.: Sterling, 11 Aug 1896, Osterhout s.n. (MICH, POM, WIS); Morgan Co.: 1/2 mi S of Snyder, 18 Aug 1965, Richardson & Robertson 1338 (KANU); Otero Co.: 15 mi NE of La Junta, 24 Jul 1937, Rollins 1873 (DS, MO, ND, NY, US); Pueblo Co.: Pueblo, Jul 1891, Eastwood s.n. (DS, MO, NY, UC, US); Sedgwick Co.: 1-1/2 mi S of Ovid, 11 Aug 1971, Keil 7629 (OS); Teller Co.: 6 mi NE of Cripple Creek, 14 Aug 1937, Beetle 2244 (MO); Weld Co.: Kersey, 18 Jul 1916, E. L. Johnston 371b (MO, US). KANSAS: Ellis Co.: 12 mi SW of Hays, 27 Aug 1935, Runyon & Bondy 288 (MO, PH, SMU); Gove Co.: vicinity of
Park, 1945, C. Weber s.n. (KSC); Kearney Co.: [without loc], 29 Aug 1897, Hitchcock s.n. (KSC); Meade Co.: 16 mi S of Plains, 13 Aug 1955, Hoor 4880 (KANU); Reno Co.: Medora, 1932, Neher s.n. (KSC); Seward Co.: Arkalon, [no date], Carleton s.n. (KSC); Trego Co.: [without loc], 19 Jul 1895, Hitchcock 294 (GH, KSC, MO, NMC, NY).

4 mi S of Silver City, 31 Aug 1971, K & M 8481 (OS); Guadalupe Co.: 1 mi E of Santa Rosa, 18 Jun 1951, Castetter & Dittmer s.n. (UNM); Hidalgo Co.: 7.2 mi NE of jctn w/US 70 on NM 90, 31 Aug 1971, K & M 8494 (OS); Lea Co.: 1-11 mi N of Hobbs, 31 Aug 1966, Pearce 2549 (ARIZ); Lincoln Co.: Gray, 28 Jul 1898, Skehan 45 (F, GH, KSC, MO, NMC, NY, POM, UC, US); Luna Co.: Nutt, 6 Oct 1919, Eggleston 16259 (MO); McKinley Co.: Navajo Expt Station, 22 Sep 1936, Bell s.n. (NMC); Quay Co.: Nara Visa, 14 Aug 1910, Fisher 90 (US); Sandoval Co.: Bandelier Natl Mon, 29 Aug 1957, Yarnell 132 (UNM); San Juan Co.: Cutter Canyon, 19 Sep 1970, Wynhoff KL-0 (ASU); San Miguel Co.: between Anton Chico & Las Vegas, 29 Sep 1913, Rose & Fitch 17618 (NY, US); Santa Fe Co.: vicinity of Santa Fe, 4 Oct 1913, Rose & Fitch 17768 (MO, NY, US); Sierra Co.: Berendo Creek, Black Range, 22 Sep 1904, Metcalfe 1387 (CAS, F, GH, MO, NMC, NY, POM, UC, US); Socorro Co.: 8.1 mi SW of Socorro, 10 Oct 1948, Dunn & Lint 5210 (UNM); Torrance Co.: near Gran Quivera, 24 Jul 1938, Hitchcock, Rethke & Raadschooven 4206 (CAS, DS, GH, UC); Union Co.: Capulin Natl Mon, 21 Aug 1964, Turner 5093 (TEX). OKLAHOMA: Cimarron Co.: 2 mi S of Kenton, 30 Jul 1936 Demaree 13381 (GH, MO, NY, PH, POM, SMU). TEXAS: Andrews Co.: Shafter Lake, 4 Aug 1926, Tharp 4572 (TEX); Brewster Co.: Calamity Creek S of Alpine,
21 Jul 1941, Warnock 21190 (NY, TEX); Culberson Co.: 1.4 mi S of Hudspeth Co line on I-10, 14 Aug 1971, K & M 7687 (OS); Deaf Smith Co.: 1 mi S of Glenrio, 20 Aug 1967, Waller 1526 (ASU, ENCB, SMU, TTC); Ector Co.: 5.5 mi E of Penwell, 13 Nov 1960, Rowell 60-063 (TTC); El Paso Co.: Hueco Mts, 25 Jul 1946, Tharp 46063 (GH, TEX, UC); Gaines Co.: S of Seminole, 7 Jul 1937, Reed 3451 (TTC); Hudspeth Co.: McNary, 19 Nov 1941, Craig 4176 (POM); Jeff Davis Co.: Ft Davis, 10 Oct 1926, E. J. Palmer 32151 (MO, PH); Loving Co.: between Wink & Mentone, 13 Jul 1952, Warnock 10692 (SMU); Lubbock Co.: Lubbock, [no date], Reed 3164 (US); Lynn Co.: Odonnell, 1 Sep 1930, Reed 3164 (TTC); Mitchell Co.: 1/4 sec 45, T & P RR Block 27, 23 Sep 1944, Pohl 4619 (SMU); Presidio Co.: 18.5 mi S of Marfa, 15 Aug 1971, K & M 7741 (OS); Reeves Co.: 6 mi SW of Toyahvale, 14 Sep 1940, Shreve 9977 (ARIZ, GH); Terrell Co.: Sanderson, Nov 1907, Crockatt 95 (NMC); Terry Co.: 11 mi S of Brownfield, 7 Jul 1937, Reed 3778 (TEX, TTC); Ward Co.: 8 mi S of Monahans, 10 Oct 1968, Massey, Perino & Adams 2310 (SMU); Winkler Co.: 9 mi E of Kermit, 26 Oct 1952, Correll 15194 (US). UTAH: San Juan Co.: Copper Canyon, 4 Oct 1939, Cutler 3164 (GH, MO, NY, SMU). WYOMING: Goshen Co.: 12 mi below Ft Laramie on N Platte, 30 Jul 1858, Simpson's Exped. s.n. (MO).
4b. *Pectis angustifolia* Torr. var. *tenella* (DC.) Keil, comb. nov. (Fig. 23).

*Pectis tenella* DC. Prodr. 5:99. 1836. TYPE:
MEXICO. TAMAILIPAS: "prope Laredo," Jul 1829, J. L. Berlandier 2009 [=599] (HOLOTYPE: G-DC, photo of holotype US!, microfiche IDC 800. 787. III. 5!; ISOTYPES:

Plants bushy, strong-scented annuals. Stems 2-15 cm long. Leaves 1-4 cm long, not or scarcely flared at the base, evenly distributed on the stem. Peduncles 5-15 mm long, 1-4 bracteolate, not or scarcely concealed by the bases of the subtending leaves, the heads evidently slender peduncled. Phyllaries 3-5 mm long, linear, widest near the middle, punctate with a solitary sub-terminal gland 0.2-0.5 mm long, and smaller submarginal glands. Ray corollas 3-5 mm long. Disc florets 10-18; corollas 2.5-3.5 mm long, regular or slightly bilabiate. Achenes 2.5-4 mm long. Pappus highly variable, coroniform and/or 1-7 setose or aristate, 1-3 mm long. Chromosome number: \( n = 12 \).

Distribution. Eastern Chihuahua and southern Texas to Aguascalientes, San Luis Potosi and Veracruz. Also
one station in northern New Mexico, where probably adventive (Fig. 24).

In most areas, var. tenella is easily distinguished from var. angustifolia. Some individuals from Chihuahua, Durango, Aguascalientes and Zacatecas, however, sometimes possess the flared leaf bases or lemon scent of var. angustifolia, but in most other respects they resemble var. tenella. Because these individuals usually have the more open branching pattern and bristly pappus of var. tenella, they are referred to this variety in the present treatment.

8072 (OS); 57 mi N of Rancho Acatita, 22 Aug 1971, K & M
8098 (OS); Cuatro Cienegas, 23 Aug 1939, Marsh 2046 (F,
GH, SMU, TEX); Ramos Arispe, 29 Aug 1939, Muller 3023 (F,
GH, MICH, UC); 60 mi E of San Pedro de los Colonias,
3 Aug 1961, Powell & Edmondson 524 (F, MICH, TEX); 24 mi
W of Saltillo, 15 Sep 1938, Shreve 8738 (ARIZ, US); 5 mi
W of El Oro, 24 Jul 1939, White 1995 (ARIZ, CAS, GH,
MICH); 25 mi SW of Sabinas, 19 Jun 1936, Wynd & Muller
Yerbanis & Cuencame, 7 Oct 1943, Gentry 6941 (GH, MICH,
US); 2 mi W of Bermejillo, 18 Sep 1938, I. M. Johnston
7752 (GH, US); 27 mi N of Zaragoza, 20 Sep 1938,
I. M. Johnston 7796 (GH); 25 mi N of Bermejillo, 24 Aug
1971, K & M 8192 (OS). NUEVO LEON: 25 km NE of Monterey,
20 Oct 1959, Dieterle 3678 (MICH); Laredo-Monterey hwy at
turnoff to Mier, 10 Nov 1959, Graham & Johnston 4587A
(TEX); Monterrey, Nov 1960, Smith M313 (TEX); halfway to
Reynosa from Monterrey, Nov 1961, Smith M633 (TEX). SAN
LUIS POTOSI: 2 km W of San Lorenzo, 13 Sep 1955,
Rzedowski 720 (ENCB, US); km 20 carretera San Luis-Rio
Verde, 22 Sep 1955, Rzedowski 6615 (MICH, ENCB); Santo
Domingo, 12 Oct 1959, Rzedowski s.n. (ENCB); San Luis
Potosi, Sep 1976, Schaffner 325 [235, 751] (F, GH, MICH,
NY, UC, US). TAMALIPAS: Hwy 85, km 1197, 21 Dec 1954,
Carlson 2678 (F, GH); 20 mi N of Victoria, 4 Feb 1960,
Crutchfield & Johnston 5017 (MICH, TEX); Mier, 31 May 1847, Gregg s.n. (GH, MO, PH); 24 km S of N Laredo, 28 Nov 1959, King 2210 (TEX); 1 km from Victoria on Matamoros Hwy, 2 Oct 1956, Martinez & Borja F-2261 (TEX); vicinity of Victoria, 1 May-13 Jun 1907, E. Palmer 431 (F, MO, NY, UC, US). VERACRUZ: Chinameca, Dec 1908, Peniche 27 (F, US). ZACATECAS: 16 mi NE of Zacatecas, 20 Oct 1966, Gould 12339 (MICH); 6 mi S of Sierra Hermosa, 4-5 Sep 1938, I. M. Johnston 7412 (GH); near San Raphael, 12 Sep 1939, Shreve 9390 (ARIZ). UNITED STATES. NEW MEXICO: Rio Arriba Co.: Capulin Volcano, 21 Aug 1931, Clark 4608 (UNM). TEXAS: Austin Co.: Industry, [no date], Boyd s.n. (F); Brewster Co.: Boquillas, 3 Aug 1919, Hanson 711 (GH, KSC, US); Cameron Co.: Rio Hondo, 17 Aug 1941, Parks 1850 (MO); Dimmit Co.: Carrizo Springs, 28 Aug 1931, Hoglund s.n. (TEX); El Paso Co.: 4 mi from El Paso, 24 May 1898, Bray s.n. (TEX); Hidalgo Co.: 0.8 mi E of jctn w/Texas FM rd 886 on US 83, 24 Sep 1971, K & C 9247 (OS); Hudspeth Co.: 2 mi SE of McNary, 16 Aug 1942, Waterfall 3967 (ARIZ, GH, MO); LaSalle Co.: 2 mi N of Cotulla, 26 Oct 1950, Reed 1110 (SMU); McMullen Co.: 11-1/4 mi S of Tilden, 1 Apr 1949, Cory 55339 (SMU, US); Starr Co.: 11.6 mi SE of jctn w/Texas FM rd 2098 on US 83, 24 Sep 1971, K & C 9249 (OS); Webb Co.: [no loc], 1 Dec 1940, Tharp s.n. (GH, MO, TEX, UC); Zapata Co.:
9 mi SSE of Zapata, 31 Jan 1954, Shinners 17696 (SMU).

4c. Pectis angustifolia Torr. var. fastigiata (A. Gray)
    Keil, comb. nov. (Fig. 23).

    Pectis fastigiata A. Gray, Mem. Amer. Acad. Arts
    4:62. 1849. TYPE: UNITED STATES. TEXAS: Travis Co.:
    Austin, 28 Aug 1842, C. Wright s.n. (HOLOTYPE: GH!;
    ISOTYPES: GH! NY! US!).

    Pectis texana Cory, Rhodora 39:421. 1937. TYPE:
    UNITED STATES. TEXAS: Sutton Co.: Ranch Experiment Sta-
    tion, 7 Aug 1935, V. L. Cory 15382 (HOLOTYPE: GH!;
    ISOTYPE: TEX!).

    Plants fibrous-rooted strong-scented perennials or
    sometimes annuals. Stems 5-15 cm long, sometimes woody
    at the base. Leaves 1-4 cm long, 1-2 mm wide, not or
    scarcely flared at base, not crowded at tips of branches.
    Peduncles 3-30 mm long, 3-6 bracteolate. Phyllaries 2.5-
    4.5 mm long, narrowly ob lanceolate, punctate with a con-
    spicuous subterminal oil gland 0.5-1 mm long and 1 or 2
    pairs of smaller submarginal glands. Ray corollas 4-6 mm
    long. Disc florets 8-21; corollas regular, 2.7-4 mm
    long. Achenes 2.5-3.5 mm long. Pappus 0-4 aristate,
    0.5-1 (-2) mm long, also ± coroniform. Chromosome number
unknown.  

Distribution. Endemic to the Edwards Plateau area of central Texas, mostly on limestone soils (Fig. 24).

\textit{P. angustifolia} var. \textit{fastigiata} has some unique features. The perennial nature of some of the plants in this variety until now has not been noted. Some individuals of this taxon develop a strongly lignified root crown. Although both \textit{P. fastigiata} and \textit{P. texana} were described as annuals, it is apparent from examination of additional specimens of var. \textit{fastigiata} that the perennial condition prevails in most populations. The restriction of this variety to limestone soils in central Texas is in contrast to the wide edaphic tolerances of the other, more widespread varieties, which are found on a diverse array of substrates ranging from sand to alkaline silt and from limestone to basalt.

In west central Texas, on the western edge of the Edwards Plateau, several populations occur which are somewhat similar morphologically to var. \textit{tenella} (\textit{Tracy 1852; Eggert s.n. 13 Jun 1900}). These sites, however, are well outside the general range of this variety. The

\textsuperscript{2}The count reported for this taxon (as \textit{Pectis cf. texana Cory}) by Powell & Turner (1963) is from a plant of \textit{P. angustifolia} var. \textit{angustifolia}.
populations are situated within the range of var. *angustifolia* though, and not far outside the range of var. *fastigiata*. Although none of these plants appear to have the perennial habit of var. *fastigiata*, some individuals possess the elongated subterminal oil glands of the phyllaries and the short aristate pappus of this variety as well as the flared leaf bases of var. *angustifolia*. Because of their geographical location, and the evidence of morphological intermediacy, it seems best to treat these populations as intermediates between var. *angustifolia* and var. *fastigiata* rather than as disjunct populations of var. *tenella*.

Representative specimens. UNITED STATES. TEXAS:
Bell Co.: 10 mi W of Belton, 6 Sep 1936, Tharp s.n. (GH, MO, NY, SMU, TEX, UC); Bosque Co.: Clifton, 9 Sep 1940, Albers s.n. (SMU, TEX); Edwards Co.: 30-1/2 mi NW of Rocksprings, 4 Oct 1946, Cory 52456 (DS, MICH, SMU);
Lampasas Co.: Lampasas, 21 Sep 1892, Plank s.n. (NY)
Real Co.: Frio River W of Kerr Co., 30 Sep 1929, Normand s.n. (TEX); Sutton Co.: 24 Mi SSE of Sonora, 4 Oct 1946, Cory 52453 (DS, MICH, SMU, UC); Travis Co.: near Jollyville, 3 Oct 1945, Tharp & Warnock 45-30 (ARIZ, DS, KSC, MICH, MO, MY, PH, RSA, SMU, TEX, TTC, US, WIS); Mt. Barker, Austin, 19 Nov 1940, Tharp s.n. (CAS, KSC, MO,
ND, NY, UC); Williamson Co.: Georgetown, 12-19 Oct 1879, E. Palmer 703 (MO, US).

5. *Pectis pringlei* Fern. Proc. Amer. Acad. Arts 33:76. 1897. (Fig. 25)

**TYPE:** MEXICO. COAHUILA: Jimulco, 15 May 1885, C. G. Pringle 125 (HOLOTYPE: GH!).

Plants strong-scented, tap-rooted annuals, branching from the base. Stems 2-25 cm long, erect to decumbent, dichotomously branched, glabrous or puberulent. Leaves linear, 1-5 cm long, 1-2 mm broad, often revolute, basally ciliate with 2-4 pairs of bristles 1-2 mm long, glabrous or abaxially puberulent, marginally punctate with conspicuous elliptic to round oil glands 0.2-0.7 mm diameter. Peduncles 8-50 mm long, glabrous, with 1-4 scattered lanceolate bracteoles 1-2 mm long. Heads in forks of stems and axillary, becoming somewhat crowded in age. Phyllaries 8, linear to narrowly oblong, 4-6.5 mm long, 1-1.5 mm broad, obtuse, conspicuously hyaline margined, with slender, corky, basally gibbous midribs, apically villous ciliolate, otherwise glabrous, each punctate with a solitary large subterminal oil gland and 1-4 pairs of smaller, elongated submarginal glands. Ray florets 8; corollas 5.5-6 mm long, with narrowly to
Fig. 25. A-D, *Pectis pringlei*, K & M 7976 (OS); E-H, *Pectis incisifolia*, K & M 8105 (OS). A, E, habit; B, F, phyllaries; C, G, ray achenes; D, H, disc achenes. Habit sketches both same scale; phyllaries and achenes all same scale.
broadly ovate glabrous ligules and sparsely glandular-puberulent tubes. Disc florets 10–21; corollas 3–4 mm long, regular, glandular-puberulent. Achenes 3–4.5 mm long, strigillose. Pappus 1–4 aristate; awns slender, antrorsely barbed, 2–4 mm long. Chromosome number: \( n = 12 \).

Distribution. Southern Chihuahua, southern Coahuila and northern Durango at 1100 to 1800 meters elevation (Fig. 26).

*Pectis pringlei* is locally quite common on dry stony sites in the southern parts of the Chihuahuan Desert. Unlike the more widespread *P. angustifolia*, however, it does not usually occupy sites on the broad alluvial plains of this region. The species occurs on a variety of substrates including both igneous and sedimentary rocks.

Extreme forms of *Pectis pringlei* approach *P. papposa* var. *grandis* in habit and general aspect. The two taxa are easily distinguished by their very different pappus structure and by the morphology of their phyllaries (Fig. 21, 25). Some small, rather depauperate individuals of *P. pringlei*, on the other hand, resemble *P. angustifolia* var. *tenella*. The overall size and less congested appearance of the heads of *P. pringlei*,
Fig. 26. Geographical distribution of *Pectis pringlei*. 
however, make distinguishing the two taxa rather easy. I have observed *P. pringlei* growing with both *P. papposa* var. *grandis* and with *P. angustifolia* var. *tenella* without any evidence of hybridization. The similarities observed have probably resulted from similar localized selection pressures.

Representative specimens. MEXICO. CHIHUAHUA: 48 km S of Jimenez, 2 Oct 1970, Cronquist & Fay 10759 (MICH, NY, OS); 14 mi N of Escalón, 22 Sep 1938, I. M. Johnston 7836 (GH); Sapio, Sierra Madre Mts, 10 Sep 1903, M. E. Jones s.n. (POM); 3.6 mi S of Escalón, 25 Aug 1971, K & M 8199 (OS); 0.6 mi N of jctn w/rd to Escalón on Mexico 49, 25 Aug 1971, K & M 8206-2 (OS); 37.2 mi S of Jiménez, 25 Aug 1971, K & M 8215 (OS); 29.9 mi S of Jiménez, 25 Aug 1971, K & M 8218 (OS); 12.8 mi N of jctn w/Mexico 49 on Mexico 45, 25 Aug 1971, K & M 8246 (OS); 19.5 mi S of Cd Camargo, 25 Aug 1971, K & M 8251 (OS); 4 mi E of Carrillo, 21 Sep 1938, Shreve 8850 (ARIZ); 14 mi N of Escalón, 22 Sep 1938, Shreve 8854 (ARIZ, US); 3 mi SW of Camargo, 1 Aug 1964, Torres 1515 (KANU).

COAHUILA: 36.9 mi W of Paila, 19 Aug 1971, K & M 7976 (OS); jctn of rd to San Pedro & Mexico 40, 20 Aug 1971, K & M 7988 (OS); 10.3 mi S of Rancho los Charcos, 24 Aug 1971, K & M 8164 (OS); Sabinas, 20 Nov 1957, Paray 2636
(ENCW); Jimulco, 10 Oct 1905, Pringle 10091 (ARIZ, ASU, CAS, F, GH, MICH, MO, NY, PH, SMU, UC, US); Peña, Feb 1905, Purpus s.n. (UC); 12 mi S of Jimulco, 14 Sep 1939, Shreve 9408 (ARIZ, GH, MICH, PH, UC); 10 mi S of Saltillo, 3 Aug 1964, Torres 1520A (KANU). DURANGO: 25 mi SW of Lerdo, 6 Nov 1964, Flyr 249a (TEX); 10 mi NW of Cuencame, 24 Sep 1943, Gentry 6886 (GH, MICH, NY); 32 mi S of El Entronique (La Zarca), 7 Oct 1955, M. C. Johnston 2963 (SMU, TEX); 17.5-22 mi SW of Nazareno, 21 Aug 1971, K & M 8033, 8038, 8041 (OS); Huarichic, 6 Sep 1934, Pennell 18603 (MICH, NY, PH).

6. Pectis incisifolia I. M. Johnst. J. Arn. Arb. 21:75. 1940. (Fig. 25)


Plants strong-scented tap-rooted annuals. Stems decumbent to prostrate, dichotomously branched, 5-40 cm long, glabrous, stramineous to red-purple. Leaves linear to elliptic in outline, 1-4 cm long, 2-15 mm wide, irregularly pinnatifid with 2-4 pairs of remote, linear to triangular, acute, mucronate or bristle-tipped lobes 1.5 mm long and 1-2 mm wide, basally incised-ciliate with
2-4 pairs of slender, bristle-tipped teeth 1-2 mm long, glabrous on both surfaces, marginally punctate with rounded oil glands 0.2-0.4 mm diameter. Peduncles 5-10 mm long, glabrous, with 1-3 linear-acute bracteoles to 2.5 mm long. Heads solitary in the forks of the stem, cylindric or campanulate. Phyllaries 8, narrowly linear, 5-6 mm long, 0.5-0.7 mm broad, strongly convex-keeled, basally gibbous, very narrowly scarious-margined, apically narrowed and subacutish, tipped with a tuft of minute hairs, otherwise glabrous, each punctate with a solitary rounded subterminal oil gland ca 0.5 mm diameter and 1-4 pairs of slender, inconspicuous submarginal glands. Ray florets 8; corollas 4-6 mm long, with laminas 2-4 mm long, glabrous, and tubes 1-2 mm long, glandular-puberulent. Disc florets 12-15; corollas 3-4 mm long, regular, with teeth ca 1 mm long, glandular-puberulent on the tube and throat. Achenes 3.5-5 mm long, glandular puberulent. Pappus absent. Chromosome number: \( n = 12 \).

Distribution. Very local in southeastern Chihuahua and west-central Coahuila on sand dunes. Chihuahuan Desert endemic (Fig. 20).

*Pectis incisifolia* appears to have a relict distribution. This species occurs only on the sand dunes which border certain playas or lagunas in the interior
of the Chihuahuan Desert. *Pectis incisifolia* may have occupied a wider range before the post-Pleistocene drought (Kellum, 1936) brought about the formation of the large playas. As noted by Johnston (1940), these areas are remarkable for the endemism of their floras.

*Pectis incisifolia* is a very distinctive species, well differentiated from all other taxa in sect. *Pectothrix* by its prostrate habit, pinnatifid leaves, and glandular, completely epappose achenes. This taxon does not appear to be closely related to any of the other species. Johnston (1940) suggested that *P. incisifolia* might be most closely related to *P. angustifolia*. While not ruling out that possibility, I feel that, based upon phyllary morphology, a more close relative would be *P. papposa*. However, any relationship of *P. incisifolia* to either of these species is distant.

Representative specimens. **MEXICO. CHIHUAHUA:**
5 mi NE of Laguna Palomas, 21 Sep 1938, I. M. Johnston 7827 (GH); 5 mi E of Carrillo, 15 Sep 1939, Muller 3317 (GH, MICH, UC). **COAHUILA:** S of Laguna del Rey, 22-23 Aug 1971, K & M 8101, 8102A, 8105, 8109, 8117, 8120 (OS); 6 mi N of Noria near Laguna del Rey, 21 Sep 1938, Shreve 8844 (ARIZ, US).
7. *Pectis filipes* Harv & Gray in A. Gray, Mem. Amer. Acad. Arts 4:62. 1849. (Fig. 27)

Strong-scented, diffusely branched tap-rooted annuals. Stems 5-40 cm long, slender, dichotomously branched, glabrous to puberulent. Leaves linear to narrowly elliptic, 1-6 cm long, 0.5-5.5 mm wide, often strongly revolute, basally ciliate with 1-4 pairs of bristles 1-2 mm long, otherwise entire, glabrous or puberulent, marginally punctate with rounded glands to ca 0.5 mm diameter. Peduncles filiform, 1-6.5 cm long, glabrous or puberulent, with 1-3, usually subterminal, lanceolate bracteoles ca 1 mm long. Heads solitary in the forks of the stem, cylindric to narrowly campanulate. Phyllaries 5, narrowly oblong to oblong-obovate, 3.5-6 mm high, ca 1 mm broad, basally truncate and gibbous, apically ciliolate, obtuse to acute, hyaline margined, convex and slender keeled, glabrous or puberulent, punctate with 0-2 small to large subterminal glands and 2-3 pairs of smaller, rounded to elongated, submarginal glands. Ray florets 5; corollas 4-9 mm long, with narrowly to broadly obovate, glabrous ligules and glandular-puberulent tubes. Disc florets 2-22; corollas 2.5-4 mm long, bilabiate, with the narrow lobe ca twice the length of the teeth on the broad lobe, sparsely to densely
glandular-puberulent. Achenes 2.5-4 mm long, shorter than the phyllaries, strigillose or short-pilose with bifurcate hairs. Pappus 0-3 aristate, antrorsely barbed to nearly smooth, usually with an additional low crown ca 0.2 mm high. Chromosome number: \( n = 12 \).

Distribution. Southeastern Arizona and west Texas to southern Sonora and southern Chihuahua, at 0-200 meters elevation (Fig. 28).

Within the broad altitudinal tolerances of P. filipes, two varieties may be distinguished. *Pectis filipes* var. *filipes* has a primarily Sonoran Desert distribution, occurring mostly below 500 meters elevation. *Pectis filipes* var. *subnuda* grows mostly at higher elevations and barely reaches the fringes of the Sonoran Desert. It occurs mostly in the grassland and pine-oak-juniper zones.

Both varieties of *P. filipes* occasionally grow together with other species of sect. *Pectothrix* and sometimes form hybrids with these species. *Pectis filipes* var. *subnuda* locally hybridizes with *P. pringlei* in Chihuahua, with *P. papposa* var. *grandis* in New Mexico, and with *P. papposa* var. *papposa* in New Mexico and Arizona. *Pectis filipes* var. *filipes* hybridizes with both *P. papposa* var. *papposa* and with *P. rusbyi*. In one locality
Fig. 28. Geographical distribution of *Pectis filipes* and *Pectis vollmeri*. Half-barred line indicates Sonoran Desert boundary (redrawn from Shreve, 1942).
Pectis filipes
○ var. filipes
● var. subnuda
▲ Pectis vollmeri
south of Hermosillo, Sonora, all three of these taxa were found to be involved in a single complex hybrid swarm.

Although interspecific hybridization involving *P. filipes* is relatively common, there is little evidence to suggest that the effects of the crossing are more than local. Throughout most of its range, *P. filipes* remains well differentiated from other species in the section.

7a. *Pectis filipes* Harv. & Gray in A. Gray, Mem. Amer. Acad. Arts 2:62. 1849. var. *filipes* (Fig. 27).

**TYPE:** MEXICO. "California," [probably collected in Sonora near Guaymas or Hermosillo], [no date],

*T. Coulter* 329 (HOLOTYPE: TRIN!; ISOTYPES: K! GH [fragment]!).

Herbage densely puberulent. Leaves linear, 1-3 cm long, 0.5-2.5 mm wide. Fascicles of several short narrow leaves usually developed in upper axils. Peduncles 1-2.5 (-3.5) cm long. Involucre cylindric; phyllaries acute, lacking subterminal oil glands. Disc florets 2-8; corollas 2.5-3.5 mm long. Oils of plants from southern Sonora lemon-scented. Chromosome number: \( n = 12 \).

Distribution. Central and southern Sonora, mostly below 500 meters elevation (Fig. 28).
Coulter's type locality was listed as "California," a state where P. filipes is not known to occur. Rydberg (1916) suggested that this species was collected by Coulter in Arizona. Coulter's itinerary in Arizona, however, did not include any areas where P. filipes grows (Coville, 1895). Upon examination of the type of P. filipes, I found that it very closely resembles the Sonoran race of the species. Coulter is known to have collected at both Guaymas and Hermosillo, Sonora (Coville, 1895; McVaugh, 1943), and therefore it is likely that the type collection came from this region.

Representative specimens. MEXICO. SONORA: 28 mi S of Hermosillo, 7 Sep 1971, K & C 8617 (OS); 11.8 mi E of jctn w/Mexico 15 on rd to Alamos, 8 Sep 1971, K & C 8665 (OS); 7.2 mi SE of Navojoa, 10 Sep 1971, K & C 8725 (OS); S of Trincheras, 2 Sep 1933, Shreve 6372 (ARIZ, DS, F); 37 mi S of Santa Ana, 15 Sep 1934, Shreve 6671 (ARIZ, F, GH, MO); 6 mi E of Rancho Garumbullo, 28 Oct 1932, Wiggins 6131 (DS, MICH, US); 14 mi S of Divisaderos, 26 Sep 1934, Wiggins 7469 (ARIZ, DS, MO, TEX, US).

7b. Pectis filipes Harv. & Gray var. subnuda Fern.
Proc. Amer. Acad. Arts 33:76. 1897. (Fig. 27)
SYNTYPES: MEXICO. CHIHUAHUA: Janos, [no date],
A. Schott s.n. (GH!); SONORA: Cochuto, 1 Oct 1890, C. V. Hartman 70 (GH!). UNITED STATES. ARIZONA: Cochise Co.: Bisbee, 4 Oct 1890, F. E. Lloyd s.n. (GH!).

LECTOTYPE (here chosen): A. Schott s.n. (GH!).

Herbage glabrous to moderately puberulent. Leaves linear to narrowly elliptic, 1-6 cm long, 1-5.5 mm wide. Peduncles (1-) 2-6.5 cm long. Involucre cylindric to campanulate. Phyllaries obtuse or acute, with or without subterminal oil glands. Disc florets 7-22; corollas 3-4 mm long. Oils spice-scented but never lemon-scented. Chromosome number: \( n = 12 \).

Distribution. Southeastern Arizona and west Texas to northeastern Sonora and southern Chihuahua, mostly 1000-2000 meters elevation (Fig. 23).

The present treatment of \( P. \) \textit{filipes} var. \textit{subnuda} as a widespread geographical race differs markedly from the much more restricted concept of Fernald, who considered var. \textit{subnuda} to be merely a minor morphological variant in the much more widespread species, \( P. \) \textit{filipes}. As this epithet is available in the varietal rank, however, I have necessarily used it for my own concept, but have completely redefined its limits.
Representative specimens. **MEXICO.** **CHIHUAHUA:**

10-14 mi W of Hidalgo del Parral, 11 Sep 1948, **Gentry** 8257 (GH, MICH, US); 6 mi W of Piloncillo, 23-24 Sep 1938, I. M. **Johnston** 7873 (CAS, GH, UC); 19 mi WSW of Jiménez, 8 Oct 1955, M. C. **Johnston** 2985 (SMU, TEX); 24 mi N of N Casas Grandes, 28 Aug 1971, K & M 8406 (OS); 5.4 mi N of Janos, 28 Aug 1971, K & M 8414 (OS); Mts NW of Chihuahua, 9 Sep 1936, **LeSueur** 1019 (CAS, F, GH, MO, TEX, UC); near Chihuahua, 30 Aug 1886, **Pringle** 1083 (F, NY, US); 14 mi N of Escalón, 22 Sep 1938, **Shreve** 8855 (ARIZ, US).

**SONORA:** Guadalupe Canyon, 27 Aug 1893, **Mearns & Merton** 2048 (DS, NY, US); N of Horconcitos, 6 Sep 1940, **Phillips** 848 (ARIZ, MICH); Cañon de Huepari, 2-3 Sep 1939, **White** 2694 (GH, MICH). **UNITED STATES.** **ARIZONA:** Cochise Co.: Chiricahua Mts, 21 Sep 1907, **Blumer** 1708 (ARIZ, DS, F, GH, KSC, MO, NMC, NY, US); Lanner Canyon, Huachuca Mts, 24 Aug 1910, **Goddinng** 826 (ARIZ, ASC, GH, NY, US); Guadalupe Mts, 4 Oct 1947, **Gould & Haskell** 4534 (ARIZ, MO, NY, UC); Bowie, 16 Sep 1884, M. E. **Jones** 4227 (ARIZ, DS, F, MICH, MO, NMC, NY, PH, POM, UC, US); Miller Canyon, Huachuca Mts, 1 Sep 1971, K & M 8552 (OS): Graham Co.: Mt Turnbull, 1873, **Loew** s.n. (F); Greenlee Co.: Big Lue Range, 21 Oct 1946, **Gould & Haskell** 4091 (ARIZ, CAS, DS, F, NY, UC); 0.5 mi S of Granville Recreation Area, 7 Oct 1968, **Pinkava, Keil & Lehto** 13526 (ASU, KANU, NY); Pima
Co.: Santa Rita Game Preserve, 9 Sep 1907, Goodding 2479 (DS, MO, NY, POM, SMU, UC); Santa Rita Mts, 8 Sep 1884, Pringle s.n. (CAS, F, GH, MICH, MO, NY, PH, US); Pinal Co.: Oracle, 9-13 Sep 1905, Thornber s.n. (ARIZ); Santa Cruz Co.: Patagonia Mts, 15 Sep 1934, Kearney & Peebles 10041 (ARIZ, CAS, POM, US); Nogales to Ruby, 25 Aug 1940, Kearney & Peebles 14898 (ARIZ, CAS, GH, POM); Pena Blanca Lake, 5 Sep 1971, K & C 8582 (OS). NEW MEXICO. Catron Co.: W Fork, Gila River, 20 Sep 1919, Eggleston 16064 (GH, MO, NY, US); Doña Ana Co.: Mesa W of Organ Mts, Fall 1890, Wootton s.n. (ARIZ, NMC); Grant Co.: 18 mi NW of Silver City, 13 Sep 1903, Metcalfe 685 (ARIZ, MO, NDG, NMC, NY, POM, UC); Burro Mts, Sep 1880, Rusby 185 (F, MICH, MO, NY, PH, UC, US); Coppermine Creek, 1851, C. Wright 1125 (GH, K, MO, NY, PH, TRIN, UC, US); Guadalupe Mts, 22 Aug 1956, Castetter 11274 (UNM); Luna Co.: Tres Hermanas Mts, 12 Sep 1942, Clark 10640 (UNM); Sierra Co.: Black Range, 14 Sep 1904, Metcalfe 1357 (CAS, F, GH, MO, NMC, NY, POM, UC); Socorro Co.: Socorro, 20 Aug 1895, Plank s.n. (NY). TEXAS: Brewster Co.: Big Bend Natl Park, 11 Nov 1967, Correll & Correll 35379 (ENCB, MICH, SD, TEX, US); 15.1 mi N of Castolon, 16 Aug 1971, K & M 7797 (OS); Lone Mtn, 3 Sep 1937, Marsh 267 (GH, TEX, UC); N of Chisos Mts, 28 Oct 1939, Sperry 1494 (GH, UC, US); Presidio Co.: Tigna Canyon, Chinati Mts,
10 Nov 1946, Hinckley & Warnock 46945 (RSA, TEX); 18.5 mi S of Marfa, 15 Aug 1971, K & M 7742 (OS); 5 mi S of Marfa, 12 Jul 1952, Warnock 10570 (SMU, TEX).

8. _Pectis vollmeri_ Wiggins, Contr. Dudley Herb. 4:27. 1950. (Fig. 27)


Plants strong-scented, tap-rooted annuals. Stems 5-50 cm long, erect to decumbent, dichotomously branching, glabrous, purplish. Leaves linear, 1-6 cm long, 1-2 mm broad, often revolute, basally ciliate with 2-3 pairs of cilia to 2 mm long, rarely with 1-3 short basal lobes, otherwise entire, glabrous, marginally punctate with round to elliptic oil glands ca 0.3 mm diameter. Peduncles 3-8 cm long, glabrous, with two to three scattered, linear acuminate glabrous bracteoles 1-2 mm long. Heads solitary in the forks of the stem. Phyllaries 5, narrowly obovate, 6-8 mm long, 1.5-2.5 mm broad, apically obtuse, ciliolate, basally truncate and gibbous, hyaline-margined, convex on the back, round-keeled below, glabrous, punctate with 0-3 small, rounded subterminal oil glands, and 3-7 pairs of narrow scattered submarginal
glands. Ray florets 5; corollas 6-10 mm long, with broadly ovate glabrous ligules and glandular-puberulent tubes. Disc florets 9-19; corollas 4-5 mm long, weakly bilabiate, with the narrow lobe ca twice as long as the teeth on the broad lobe, glandular-puberulent. Achenes 4-6 mm long, cylindric, strigillose to short-pilose. Pappus 2-6 aristate; awns stiff, spreading, 3-4 mm long, purplish, antrorsely scaberulous toward the tips. Chromosome number unknown.

Distribution. Endemic to a narrow strip along the eastern coast of Baja California at elevations of 0-500 meters (Fig. 28).

Pectis vollmeri appears to be most closely related to P. filipes. Both species share the characteristics of slender, diffuse habit, five-rayed heads and aristate pappus. Pectis vollmeri, however, is somewhat stouter and has larger heads and flowers. Wiggins (1950) suggested that P. vollmeri was closely related to P. linifolia L. of sect. Pectidium. Although both species do have similar pappus structure, the two taxa differ in the size of the florets, number of disc florets, the placement of foliar oil glands, glandularization of the disc corollas, and in overall habit. In my opinion, the relationship between P. vollmeri and P. linifolia is distant,
and the similarities in pappus structure are the result of parallel evolution rather than of patricic relationship.

PECTIS SECTION AGLONETA KEIL, SECT. NOV.


Annual or perennial strong-scented herbs. Stems erect or branched from the base, often much-branched above. Leaves linear to linear-elliptic, marginally ciliate, punctate on the undersurface with scattered small oil glands. Inflorescence open or condensed, usually more-or-less dichasial. Phyllaries 4 or 5, acute to acuminate, carinate, falling individually. Ray florets 4 or 5; corollas usually small, inconspicuous, pale yellow, glabrous. Disc florets 5-10; corollas bilabiata, glabrous; anther sacs with few pollen mother cells. Achenes black, strigillosae. Pappus coroniform and/or setose or aristate. Chromosome base number: $x = 12$. 
Distribution: Northern Mexico through the Caribbean, south to Brasil.


(Fig. 29)

Slender, strongly-scented annual or perennial herbs. Stems erect to decumbent, one to several from the base, dichotomously branched above, often purplish. Leaves linear, 1-3 cm long, 1-2 mm wide, punctate on the undersurface with tiny round oil glands usually in submarginal rows. Heads small, terminal and axillary, on long filiform peduncles. Involucres cylindric to campanulate; phyllaries 4-5, narrow, acute to acuminate, 3-6 mm long, 0.5-1 mm wide, slender keeled, basally gibbous, thin margined, minutely ciliolate, otherwise glabrous, punctate along the midrib with very narrow, elongate oil glands. Ray florets 4-5; corollas yellow, or commonly reddening in age, with narrowly ovate ligules and slender tubes. Disc florets 5-9; corollas yellow or reddening in age, bilabiate, with the narrow lobe 3-6 times as long as the teeth on the broad lobe. Achenes slender, strigillose. Pappus 0-10 setose and sometimes also with a short irregular crown.
Fig. 29. A-K, Pectis linearis; A-D, var. exilis, Pringle 8760 (CAS); E-G, var. linearis, P. Palmer 760 (GH); H-K, var. graveolens, Haught 6340 (GH); L-O, Pectis gardneri, Eiten & Eiten 3986 (US). A, L, habit; B, E, H, M, phyllaries; C, F, J, N, ray achenes; D, G, K, O, disc achenes. Habit sketches both same scale; phyllaries and achenes all same scale.
Distribution: West central Mexico through the West Indies, south to northern South America (Fig. 30).

The *Pectis linearis* complex, as here recognized, is much broader in concept than that of previous workers. I have combined under *P. linearis* several species which had not been treated as closely related in past revisions of the genus. In my opinion, though, the characters used in the past to distinguish these taxa as species are rather minor and are greatly outweighed by the overall morphological unity of the plants. Those races which do seem worthy of formal recognition are here treated as varieties. One group of populations from Panama, referred to as *P. capillaris* (=*P. linearis*) by Rydberg (1916), is excluded from the *P. linearis* complex in the present treatment. I am in full agreement with Standley (1928) that these plants cannot be distinguished from *P. elongata*.

9a. *Pectis linearis* Llave, Reg. Trimestre 1:451. 1832. var. *linearis*. (Fig. 29)

TYPE: MEXICO. OAXACA: "prope Las Bacas," Sep [no year], A. Pineda s.n. (LECTOTYPE CHOSSEN: G-DC, microfiche IDC 800. 787:II. 7!; photo F! US!).

*Pectis capillaris* DC. Prodr. 5:99. 1836. nom. illeg. (based on the same type collection as *P. linearis*
Fig. 30. Geographical distribution of *Pectis linearis*. 
Llave, l. c.).

_Pectis febrifuga_ Van Hall, Ann. Hort. Bot. 4:33. 1861. TYPE: NETHERLANDS ANTILLES: Curacao: [without locality or date], Ter Laag s.n. (HOLOTYPE: L!).


Stems 10-25 cm high, much branched, glabrous or pubescent, often purplish. Leaves obtuse to acute, with 1-6 pairs of setae, puberulent on upper surface and mid-rib beneath or glabrescent. Peduncles mostly 2-4 cm long, 1-4 bracteolate. Phyllaries 5, linear to narrowly elliptic, 4-6 mm long, 0.5-1 mm wide, often purplish. Ray florets 5; corollas 3.5-6 mm long, with narrowly ovate ligules. Disc florets 5-9; corollas 2-4 mm long. Achenes 2-2.5 mm long. Pappus 2-10 setose, 2-5 mm long, usually much exceeding the disc florets. Chromosome number unknown.

Distribution. Jalisco and Oaxaca through the West Indies south to Venezuela (Fig. 30).
Llave's description of *P. linearis* and Candolle's description of *P. capillaris* were probably based on the same specimen. After Llave died in 1833, his herbarium was incorporated into the herbarium at Geneva. Candolle (1836) described *P. capillaris* based upon a specimen that he had received from an individual named Mairet (perhaps the executor of Llave's estate?). This specimen bears the same data as that described earlier as *P. linearis* by Llave, except that no collector is given. The two descriptions match rather well, and both fit the specimen in Candolle's herbarium. It seems likely that both descriptions were based upon the same specimen. However, because of the possibility that Candolle and Llave may have had different specimens of the same collection, I have chosen to designate Candolle's specimen as a lectotype rather than cite it as a holotype.

Fernald (1897) noted the close relationship between *P. febrifuga* and *P. capillaris* (=*P. linearis*), but, as his revision did not include the Caribbean area, he did not formally treat *P. febrifuga*. Rydberg (1916) maintained the two taxa as distinct species, but the characters that he used to separate the two seem to be imaginary. There does not appear to be any good way of distinguishing the "awn-tipped squamellae" of *P. febrifuga* from the "squamellate-based bristles" of *P. linearis*. 

9b. *Pectis linearis* Llave var. *exilis* Keil, var. nov. (Fig. 29)


Plantae annuae vel perennae, graciles. Caules 2-20 cm longi, saepe basi plus minusve suffrutescentes, dichotome ramosissimi, puberulent, purpurascentes. Folia linearia, acuta, puberulenta. Pedunculi filiformes, 2.5-3.5 mm longi, 2-7 bracteolati. Phyllariae 5, ob lanceolate, 3.5-5 mm longa, 0.5-1 mm lata, acuta vel attenuata, purpurascentia. Flosculi radii 5; corollae 3-5 mm longae, ligulis linearibus vel anguste ovata. Flosculi disci 5-9; corollae 2-3 mm longae. Achenia 2 mm longa. Pappus 0-3 setosa atque coroniformis, setis gracilibus, 1-4 mm longis. Chromosomatum numerus ignotus.

Slender annual or perennial herbs. Stems 2-20 cm long, often more or less suffrutescent at the base, dichotomously much branched, puberulent, often purplish. Leaves linear, puberulent on upper surfaces, margins and on midribs beneath. Peduncules filiform, 2.5-3.5 mm long, 2-7 bracteolate. Phyllaries 5, ob lanceolate, 3.5-5 mm long, 0.5-1 mm wide, acute to acuminate, purplish. Ray
florets 5; corollas 3-5 mm long, with linear to narrowly ovate ligules. Disc florets 5-9; corollas 2-3 mm long. Achenes 2 mm long. Pappus 0-3 setose, and also short coroniform, not or only slightly exceeding the disc corollas; bristles very slender, 1-4 mm long, minutely scabrid. Chromosome number unknown.

Distribution. Jalisco, Mexico and Morelos at elevations of 100-1700 meters (Fig. 30).

The delicate branches and peduncles, the dark red phyllaries and yellow flowers of P. linearis var. exilis make this a rather attractive little plant. Both annual and perennial individuals of this taxon appear to coexist within the same population (Pringle 8760), indicating that this variety, like most Pectis species studied during the current project, reaches reproductive maturity in the first growing season.

Palmer (no 760) collected both var. linearis and var. exilis near Guadalajara, Jalisco. The two taxa are strikingly different when viewed together in this collection (Fig. 31). The close relationship between these taxa is indicated, however, by the presence of additional collections (e.g. Paray 231 [ENCB]) which cannot be referred with certainty to either variety.
Fig. 31. Comparison of Pectis linearis var. linearis and var. exilis in mixed collection, E. Palmer 760 (GH).

9c. Pectis linearis Llave var. graveolens (Klatt) Keil, comb. nov. (Fig. 29).


Plants annual (or sometimes perennial?). Stems 5-25 cm long, slender, much branched, often somewhat caespitose, glabrous or puberulent. Leaves 0.5-2 cm long, 0.5-2 mm wide, ciliate toward the base, or sometimes nearly to the tips, sometimes fasciculate on older plants. Peduncles filiform, 2-3 cm long, 3-7 bracteolate. Phyllaries 4-5, linear-oblanceolate, 3-3.5 (4) mm long, 0.5-1 mm wide, acute to acuminate, dotted with 3-4 pairs of tiny glands. Ray florets 4-5; corollas 2-2.5 mm long, with short-ovate ligules. Disc florets 4-6; corollas 1.5-2 mm long. Achenes 2-2.3 mm long. Pappus 0-5 setose and also with a short irregular crown. Chromosome number unknown.

Distribution. Costa Rica, Colombia and Venezuela (Fig. 30).

The situation surrounding the collection, Smith 528, is rather confusing. Smith evidently assigned this number to a series of plants that he had collected over a period of several months. Based upon the specimens of this collection deposited at the New York Botanical Garden, Rusby named both P. rosea and P. densa. My examination of additional material from this collection series, deposited in a number of additional herbaria, has convinced me that Rusby named two extremes of one taxon
rather than two different taxa. The specimens at New
York bear Smith's original hand-written field notes and
have more explicit collection data than those in other
herbaria. Most specimens not at New York, for instance,
lack exact collection dates, and some bear Smith's number
alone. One collection at New York, on the other hand,
bears collection data that would exclude it as a type of
either *P. rosea* or *P. densa*. Any decision regarding iso-
types in this collection series must, therefore, be rather
arbitrary.

The collection of Tonduz (no. 13791) from Costa
Rica, referred by Fernald (1904) to *P. lessingii*, and by
Urban (1905) to *P. febrifuga* (*=P. linearis var. linearis*),
seems to me to be best placed in *P. linearis* var.
graveolens. The small heads and short pappus of these
plants, as well as their overall morphology, are very
similar to those of Smith's collection, and appear anoma-
lous in var. *linearis*.

*Pectis linearis* var. graveolens, like other taxa of
northern South America, needs to be studied in the field.
Little information is currently available about habitats
where the plants of this taxon occur, and the full range
of morphological variation is very likely not represented
by the few specimens presently available.

10. *Pectis uniaristata* DC. Prodr. 5:99. 1836. (Fig. 32)

Strong-scented annual herbs. Stems erect or branched from the base, diffusely many-branched above. Leaves linear or linear-elliptic, 0.5-7 cm long, 1-5 mm wide, obtuse to acute, mucronate or setose-tipped, ciliate with 2-8 pairs of marginal bristles, glabrous to minutely puberulent, punctate on the undersurface with numerous small round oil glands 0.1-0.3 mm diameter. Heads small, in repeatedly-branched compound dichasia, on peduncles 2-25 mm long. Involucres cylindric; phyllaries 5, linear-oblongolate, acute to acuminate, with
Fig. 32. *Pectis uniaristata*. A-D, var. *uniaristata*, Brandege s.n., 24 Oct 1893 (UC); E-H, var. *jangadensis*, K & C 8997 (OS); I-L, var. *holostema*, K 9509 (OS). A, E, I, habit; B, F, J, phyllaries; C, G, K, ray achenes; D, H, L, disc achenes. Habit sketches all same scale; phyllaries and achenes all same scale.
erect to spreading tips, glabrous, punctate along the sides of the narrow midrib with tiny rounded to linear glands. Ray florets 5; corollas pale yellow or becoming rose pink. Disc florets 5-7; corollas pale yellow or becoming rose pink, bilabiate with the narrow lobe much longer than the teeth on the broad lobe. Achenes about half the length of the phyllaries. Pappus coroniform and 0-3 setose.

Distribution. Southern Sonora, southern Baja California and southwestern Chihuahua along the Pacific slope to Costa Rica; disjunct in Colombia and southern Brasil (Fig. 33, 34).

10a. Pectis uniaristata DC. Prodr. 5:99. 1836. var. uniaristata (Fig. 32).

TYPE: MEXICO. [without locality], 1831, L. Alaman s.n. (HOLOTYPE: G-DC; fragment of holotype F!; photo of holotype US!; microfiche 1DC 800. 787:III. 31).

Fig. 33. Geographical distribution of *Pectis uniaristata* in North America and northern South America.
Fig. 34. Geographical distribution of *Pectis uniaristata* and *Pectis gardneri* in South America.
Stems 20-100 cm tall, erect or branched from the base, glabrous or minutely puberulent, usually purplish. Leaves 1-7 cm long, 1-5 mm wide, ciliate with 2-8 pairs of bristles 1-3 mm long. Inflorescence openly branched; branches spreading or ascending but not strongly recurved. Peduncles 9-25 mm long, Phyllaries 4.5-6 mm long, 0.5-1 mm wide. Ray corollas 3-5 mm long. Disc corollas 2-4 mm long. Achenes 2-3.5 mm long. Pappus bristles 0-3, scabrid, 3-4 mm long. Chromosome number unknown.

Distribution. Southern Baja California, southern Sonora and southwestern Chihuahua to Morelos and Oaxaca at elevations of 100-1500 meters (Fig. 33).

Several collections (e.g. Brandegee s.n. 24 Oct 1893, Palmer 61), here included in Pectis uniaristata var. uniaristata, have in the past been referred to P. capillaris DC. (=P. linearis Llave), because of their elongate peduncles and several-bristled pappus. In overall aspect, however, these collections bear scant resemblance to P. linearis. The collection, Palmer 61, referred doubtfully by Gray to P. berlandieri and by Fernald to P. capillaris, falls well outside the ranges of variation for both of these species, but is quite similar to several northern collections of P. uniaristata var. uniaristata.
Most collections of var. uniaristata have swollen brown foliar glands filled with aromatic oils. One collection from Oaxaca, however, Cronquist & Fay 10850, has tiny shrunken black glands apparently devoid of aromatic oils, a condition similar to that found in several populations of P. stenophylla of sect. Pectothrix. In overall aspect, the plants of this collection appear to be somewhat more delicate than the individuals of other populations of var. uniaristata. Until more material of P. uniaristata becomes available from Oaxaca, though, I feel that this collection should remain in var. uniaristata.

Representative specimens. MEXICO. BAJA CALIFORNIA: La Mesa, 24 Oct 1893, Brandegee s.n. (NY, UC). COLIMA: on trail to Coahuayana, Nov 1906, Emrick 24 (F); 10 mi S of Colima, 7 Dec 1959, McVaugh & Koelz 1558 (MICH); Algada, 4 Nov 1910, Orcutt 4676 (DS); Tuxpan Canyon, 3 Nov 1910, Orcutt 6528 (US); MORELOS: near Cuernavaca, 1905, Lemmonn 63 (UC); Cuernavaca, 12 Sep 1903, Pringle 8747 (CAS, ENCB, F, GH, MICH, MO, NMC, NY, PH, POM, SMU, UC, US); Yautepec, 3 Oct 1902, Pringle 9944 (F, MO, NY, US); near Yautepec, 27 Aug 1903, Rose & Painter 6601 (US). OAXACA: 13 km ESE of Guajinicuilapa, Guerrero, Cronquist & Fay 10850 (OS). SINALOA: Culiacan, 22 Sep 1904,

10b. Pectis uniaristata DC. var. jangadensis (S. Moore) Keil, comb. nov. (Fig. 32).


Plants strongly lemon-scented. Stems erect, 5-50 cm tall, glabrous or sparsely scaberulous on the angles, usually purplish. Leaves 1-4 cm long, 1-5 mm wide, ciliate with 5-7 pairs of bristles 1-5 mm long. Inflorescence relatively compact, rounded, the ultimate branchlets usually recurved. Peduncles 2-10 (-15) mm long. Phyllaries 3.5-4.5 mm long, 0.5-1 mm wide. Ray corollas 2-4 mm long. Disc corollas 1.5-2.5 mm long. Achenes 1.5-2 mm
long. Pappus bristles 0-3, minutely scabrid, 1-2.5 mm long. Chromosome number: \( n = 12 \).

Distribution. Southern Sinaloa to Jalisco and Guerrero at elevations of 150-1700 meters; disjunct in southern Brazil (Fig. 33, 34).

\textit{Pectis uniaristata} var. \textit{jangadensis} has an amphitropical distribution. Although separated by over 5000 kilometers, the Brazilian and Mexican plants are essentially indistinguishable (Fig. 35). Undoubtedly the two population systems are completely reproductively isolated, but because they do not appear to have differentiated significantly in morphological features, I have chosen to regard them as disjunct populations of the same taxon.

Similar disjunct distributions have been reported for taxa in other genera (e.g. \textit{Bowlezia incana} [Mathias and Constance, 1965]; \textit{Dyssodia pentachaeta} subsp. \textit{pentachaeta} var. \textit{belenidium} [Strother, 1965]; and many others [Raven, 1963]). Raven (1963) strongly supported long-distance dispersal to explain most of these amphitropical distributions. Mathias and Constance (1965), on the other hand, argue that the present distribution for \textit{Bowlezia incana} is a result of human introduction [probably during the Spanish colonial period]. For \textit{P. uniaristata} var. \textit{jangadensis}, I feel that long-distance
Fig. 35. Brazilian and Mexican collections of *Pectis uniaristata* var. *jangadensis*, *Malme* 3110 (GH) and *Feddema* 2190 (MICH).
dispersal is probably the most likely explanation for the present distribution. The role of man as a dispersal agent cannot be ruled out, but the remoteness of the Brazilian area of distribution weighs against this possibility. The principal area of distribution for P. uniaristata var. jangadensis is probably Mexico. The relatively small area of distribution in Brazil, the diversity of the species in Mexico, and the lack of related Brazilian taxa all argue against a primary center in Brazil.


NAYARIT: Tecolote, 3 Oct 1923, Collins & Kempton 41 (US); 10 km E of Jesus Maria, 20-21 Sep 1960, Feddema 1430 (MICH); 1 km N of El Cuatante, 18 Nov 1963, Feddema 2642 (MICH); Tepic-Puga Rd, 5 Nov 1925, Ferris 5801 (DS, GH, US); ca 18 mi SE of Tepic, 15 Sep 1971, K & C 8971-1 (OS); 16.3 mi W of Nayarit-Jalisco boundary on Mexico 15, 16 Sep 1971, K & C 8997 (OS); 9 mi N of Compostela, 13 Nov 1959, McVaug & Koolz 569 (MICH). SINALOA: "la Rata" 4 leagues N of La Noria, 17 Oct 1925, Mexia 387 (CAS, MO, POM, UC); Municipalidad de Rosario, Sep 1932, Ortega 7164 (CAS).

10c. Pectis uniaristata DC. var. holostema A. Gray, Proc. Amer. Acad. Arts 19:46. (Fig. 32).


Pectis dichotoma Klatt, Leopoldina 20:92. 1884.

Based on P. uniaristata DC. var. holostema A. Gray, l. c.
9:245. 1954. TYPE: COLOMBIA. MAGDALENA: Magdalena valley, savanna Rincon Hondo, 12 Aug 1924, C. Allen 392
(HOLOTYPE: MO!; ISOTYPE: K!).

Plants with combined odor of stinkbug and lemon.
Stems 5-50 cm long, diffusely much-branched, glabrous or minutely puberulent on the angles, stramineous or purplish.
Leaves 0.5-4 cm long; 1-5 mm wide, ciliate with 1-5 pairs of bristles 1-3 mm long. Inflorescence usually very open, many branched, spreading, the ultimate branchlets not appearing conspicuously recurved. Peduncles 8-25 mm long. Phyllaries 3-4 mm long, often slightly bowed out near the base. Ray corollas 2-3 mm long. Disc corollas 1.5-2 mm long. Achenes 1.5-2.5 mm long. Pappus bristles 0 or rarely 1, scabrid, 1-2 mm long. Chromosome number: \( n = 12 \).

Distribution. Oaxaca south and east to Costa Rica from sea level to 1000 meters; disjunct in Colombia (Fig. 33, 34).

The size of individual plants varies greatly from population to population of \( P. \) uniaristata var. holostema. Some Mexican populations (King 1869, Rzedowski 21367) appear to be made up entirely of rather diminutive
plants. Farther south, in Central America, populations sometimes consist wholly of rather robust individuals (Keil 9509, 9515). This variation appears to be clinal in nature, however, and a full range of intermediates are known. Although the extreme forms are quite distinctive, the clinal pattern of variation in size makes inadvisable any taxonomic recognition of the variants.


TYPE: MEXICO. JALISCO: [without locality or date], F. W. Beechey s.n. (HOLOTYPE: not seen, probably at E; ISOTYPES: K[2], photo of K isotypes, MICH!).


Fibrous rooted, strong-scented perennial herbs. Stems erect to decumbent, densely leafy, solitary or numerous from the base, often somewhat suffrutescent at base, few to many branched above, sparsely puberulent, stramineous to purplish. Leaves linear, 1-4 cm long,
Fig. 36. A-D, Pectis diffusa, Pringle 11557 (MICH); E-H, Pectis berlandieri, K & C 9235 (OS).

A, E, habit; B, F, phyllaries; C, G, ray achenes; D, H, disc achenes. Habit sketches both same scale; phyllaries and achenes all same scale.
1-3 mm wide, mucronate to setose tipped, marginally ciliate, often nearly to the apex with 4-10 pairs of bristles 2-4 mm long, minutely scaberulous or glabrous, densely punctate on the undersurface with scattered oil glands ca 0.2 mm diameter. Heads in few-branched inflorescences; peduncles 3-6 bracteolate, 2-4 cm long. Involucres narrowly campanulate to cylindric at anthesis; phyllaries 5, linear-oblanceolate, 4-6 mm long, 1-1.5 mm wide, rounded to acute, strongly keeled below, punctate with 3-5 pairs of oil glands. Ray florets 5; corollas yellow or becoming rose-pink, 5-8 mm long, with narrowly to broadly ovate ligules. Disc florets 4-6; corollas yellow or becoming rose-pink, 3.5-4.5 mm long, bilabiate, with the narrow lobe ca 5 times the length of the teeth on the broad lobe. Achenes 2-3 mm long, strigillose. Pappus 5-10 setose or sometimes essentially epappose; bristles 3-4 mm long. Chromosome number unknown.

Distribution. Nayarit to Michoacán, Jalisco and Mexico at elevations of 750-1500 meters (Fig. 37).

Pectis diffusa appears to be most closely related to P. uniaristata with which it is sympatric. Of the two taxa, P. uniaristata is by far the more common species; P. diffusa is seldom collected. The perennial rootstock of P. diffusa, a feature which readily distinguishes it
Fig. 37. Geographical distribution of *Pectis* berlandieri and *Pectis diffusa*. 
from *P. uniaristata*, becomes quite ligneous in some plants. The tendency of other species to have both annual and perennial forms (e.g. *P. angustifolia* var. *fastigiata*, *P. linearis* var. *exilis*), however, suggests a note of caution in differentiating *P. diffusa* and *P. uniaristata* by this one character alone. Although I have not seen annual forms of *P. diffusa*, I would not be at all surprised to find some.


12. *Pectis berlandieri* DC. Prodr. 5:100. 1836. (Fig. 36).

**TYPE:** MEXICO. VERACRUZ: Tantoyuca, Jan 1831,

A notation on the sheet at GH in Berlandier's handwriting indicates that "732 = 2152" and that the same collection data apply to both numbers.

Bushy strong-scented, fibrous-rooted annual herbs. Stems 5-25 cm long, solitary or much-branched from the base, diffusely branched above, glabrous or puberulent on the angles, stramineous or purplish. Leaves all linear, 1-3 cm long, 1-2 mm wide, mucronate, basally ciliate with 2-4 pairs of bristles 1-2 mm long, otherwise entire, minutely puberulent on the margins and sometimes on the midribs below, otherwise glabrous, punctate on the undersurface with submarginal rows of oil glands 0.2-0.4 mm diameter. Heads solitary or in small clusters at tips of branches. Peduncles 2-3 bracteolate, 5-8 mm long. Involucres cylindrical at anthesis, the phyllaries spreading with age, 5, 4-5 mm long, 0.5-0.7 mm wide linear-ob lanceolate, acute to acuminate, strongly keeled below, punctate with 3-5 pairs of round to elongate oil glands on the sides of the midrib. Ray corollas pale yellow or becoming reddish in age, 2.5-3 mm long, with narrowly elliptic ligules. Disc florets 5-8; corollas yellow or
becoming reddish in age, 1.5-2 mm long, bilabiate, with
the narrow lobe ca 3-10 times as long as the teeth on the
broad lobe. Achenes 2.5-3 mm long, sparsely strigillose.
Pappus of the ray florets usually 3-setose and of the
disc florets 4-5 setose; bristles 2-4 mm long, mostly
much exceeding the disc florets. Chromosome number:
\( n = 12 \).

Distribution. Tamaulipas to San Luis Potosí and
Veracruz (Fig. 37).

**Pectis berlandieri** is apparently most closely
related to *P. elongata*, from which it differs in its
lower, more diffuse growth habit, slender leaves with
fewer glands, and medicinal-scented rather than lemon-
scented essential oils. This species is not very wide-
spread, but where it occurs, it often grows in abundance.
The plants of *P. berlandieri* are rather inconspicuous
though, and can be easily overlooked, a fact which per-
haps explains the paucity of collections of this taxon.

Representative specimens. MEXICO. SAN LUIS POTOSÍ:
1 mi S of Tamaulipas line on Antiguo Morelos-Valles hwy,
25 Oct 1959, M. C. Johnston 4494A (TEX). TAMAULIPAS:
San Fernando, Oct 1835, Berlandier 1537 (GH, MO), 3037
(GH, MO, NY, US); Papalote de la Mirandena, 16 Sep 1960,
Crutchfield & M. C. Johnston 5579 (MICH, TEX); 15 mi E of Mante, 10 Dec 1959, M. C. Johnston 4927 (TEX); just E of Magiscatzan, 23 Sep 1971, K & C 9235 (OS); 30 mi E of Manta, 23 Sep 1971, K & C 9238 (OS); 8.9 mi W of Magiscatzan, 23 Sep 1971, K & C 9240 (OS).

13. *Pectis elongata* H.B.K. Nov. Gen. Sp. Pl. 1(4);262. 1816. (Fig. 38).

Strong-scented, fibrous-rooted annuals or sometimes apparently perennial. Stems usually erect, 5-100 cm high, usually solitary, much branched above, glabrous or minutely puberulent on the angles, stramineous or purplish. Leaves linear to narrowly elliptic or ob lanceolate, 1-4 cm long, 1-5 mm wide, obtuse to acute, basally ciliate with 2-7 pairs of bristles 1-3 mm long, glabrous or minutely scaberulous on the upper surface, margins and midrib below, punctate on the undersurface with scattered round oil glands 0.2-0.4 mm diameter. Heads axillary and terminal, sometimes aggregated into tight leafy-bracted clusters; peduncles 1-6 bracteolate, 1-40 mm long. Involucres cylindric to campanulate at anthesis; phyllaries linear or linear ob lanceolate, 3-5.5 mm long, 0.5-1 mm wide, obtuse to acuminate, strongly to weakly keeled, punctate with 2-6 pairs of slender glands. Ray florets 5;
Fig. 38. *Pectis elongata*. A–D, var. *elongata*, Pittier 7359 (GH); E–H, var. *floribunda*, K 9413 (OS); I–L, var. *fasciculiflora*, Langlassé 747 (MICH). A, E, I, hab-t; B, F, J, phyllaries; C, G, K, ray achenes; D, H, L, disc achenes. Habit sketches all same scale; phyllaries and achenes all same scale.
corollas yellow or becoming rose-pink, 3-7 mm long. Disc florets 5-9; corollas 2-4 mm long, bilabiate, with the narrow lobe 3-10 times as long as the teeth on the broad lobe. Achenes 2-3 mm long, short strigillose. Pappus of the ray achenes 2-20 scabrid-setose; pappus of the disc achenes 5-20 setose, bristles 3-4 mm long.

Distribution. Central Mexico and Puerto Rico to Ecuador and Brasil at elevations of sea level to 1200 meters (Fig. 39,40).

**Pectis elongata** is a very polymorphic species and has been variously treated in the past. The three varieties which I am recognizing here have all been recognized as species by one or another authority. Some have even been further subdivided into additional species or varieties. I do not believe, however, that the degree of variation in the complex is adequate to justify the specific rank for the assorted variants. Indeed, in populations of var. *elongata* and var. *floribunda*, there are sometimes complete ranges of intermediates between strikingly different morphotypes.


**TYPE:** COLOMBIA: "Prope Popayan?," 1802,
Fig. 39. Geographical distribution of *Pectis elongata* in North America, the Caribbean, and northern South America.
Fig. 40. Geographical distribution of *Pectis elongata* in South America.
Pectis elongata
\[\text{var. elongata}\]
\[\text{var. floribunda}\]
A. Humboldt & A. Bonpland s.n. (HOLOTYPE: P; ISOTYPE: B; Microfiche of holotype, IDC 6209: !; photo of B isotype, F! US!).


Erect, strong-scented annuals. Stems 20-75 cm long, with ascending to divaricately spreading branches above, glabrous to densely puberulent, stramineous to purplish. Heads solitary on slender ascending to divaricately spreading peduncles 4-40 mm long. Involucre cylindric to campanulate at anthesis; phyllaries 4-5.5 mm long, 0.5-1 mm wide, obtuse to acute. Ray corollas 3-6 mm long. Disc corollas 2.5-3 mm long. Achenes 2-3.5 mm long. Pappus bristles 10-20, 3-5 mm long. Chromosome number unknown.

Distribution. Colombia to northern Brazil at elevations of 100-1200 meters (Fig. 39, 40).

The collections of *P. elongata* var. *elongata* presently available exhibit a diverse array of growth forms. Peduncle length is highly variable, ranging from the very
short-peduncled forms of Humboldt and Bonpland's type collection to the very long-peduncled var. *divaricata* of Hieronymous. The variability in these plants is rather perplexing, and I have been unable to discern consistent patterns of variation. Field studies of the populations of this taxon will be necessary for a full understanding of this complex.


BOLIVAR:  Cano Piña rd to Río Aro, 1943, Cardona 617 (US); 2 km S of Cd Piar, 18 Oct 1953, Maquire, Wurdack & Bunting 35850 (F); 5 km W of Upata, 31 Jul 1944, Steyermark 57542 (F, US).  CARABABO:  Brahel, 27 Sep 1950, Curran s.n. (NY); La Barbula, Dec 1939, Ll. Williams 11097 (F, US).

COJEDES:  Savanas de San Carlos, 14 Sep 1940, Chardon 217 (US); between El Tinaco & San Carlos, 25 Dec 1925, Pittier 12002 (US).  DISTRITO FEDERAL:  Middle Cotiza, near Caracas, 2 Sep 1917, Pittier 7359 (GH, US); Lower Cotiza, 23 Sep 1917, Pittier 7423 (GH, US); Upper Cotiza, 18 Sep 1921, Pittier 9828 (US); Cotiza, 14 Oct 1926, Woronow 7390 (US).

13b.  Pectis elongata H.B.K. var. floribunda (A. Rich. in Sagra) Keil, comb. nov.  (Fig. 38).

**Pectis plumieri** Griseb. Flora Brit. W. Ind. 378. 1864. TYPE: JAMAICA. [without locality or date], McNab s.n. (Type not seen, probably at GOET or K).


Mostly erect, lemon-scented herbs (sometimes with additional odors as well). Stems 10-100 cm long, usually purplish; branches ascending to strict. Heads in tight axillary and terminal leafy clusters or sometimes fewer and long-peduncled. Peduncles 2-25 mm long. Involucres cylindric at anthesis; phyllaries 4-5 mm long, with erect to spreading acuminate tips. Ray florets 2.5-4 mm long. Disc florets 2-3 mm long. Achenes 2-2.5 mm long. Pappus (2-) 4-8 bristled, 2-4 mm long. Chromosome number: \( n = 12 \).

Distribution: Eastern Mexico and Puerto Rico south through Panama and the West Indies, from sea level to
1200 meters; disjunct in Ecuador (Fig. 39, 40).

Recent floristic workers (Liogier, 1963; Adams, 1972) have treated P. floribunda as a species distinct from P. elongata, although earlier workers (Rydberg, 1916; Urban, 1905) had considered them to be conspecific. I am in agreement with the recent workers regarding the distinctness of the Central American and West Indian forms from the South American typical P. elongata. I do not, however, believe that the differences between the taxa warrant their distinction at the specific level.

Although Standley (1938) considered Pectis oerstediana to be a taxon distinct from P. elongata, I have been unable to find any satisfactory way of distinguishing the two. There seems to be a complete range of intermediates between the short-peduncled P. oerstediana and the longer-peduncled plants that Standley treated as P. elongata. Liogier (1963) included Central America within the range of P. floribunda. I concur with his decision that the West Indian and Central American Plants are the same taxon.

Representative specimens. COSTA RICA. ALAJUELA: vicinity of San Ramon, 8 Jan 1927, Brenes 5326 (F, GH, NY); Buenos Aires, 26 Dec 1933, Valerio 834 (F).

GUANACASTE: 5 mi S of La Cruz, Liberia, 11 Feb 1963,
Jimenez 315 (F); Nicoya, Jan 1900, Tondon 13598 (CH, NY, US); 5-15 km S of La Cruz, 1 Jan 1964, L. O. Williams, Molina & T. P. Williams 26392 (F, MO, NY). PUNTARENAS: Saban de Boruca, Nov 1891, Pittier 4517 (CH, US).


HANOVER: 3 mi SE of Askenish, 30 Oct 1952, Proctor 7288
(A). WESTMORELAND: 1/2 mi S of Mt Moreland School, 19 Nov 1955, Proctor 11179 (ARN). LESSER ANTILLES.
GUADALOUPE: Vieux-Fort, 12-3 1966, Le Gallo 3145 (US).
MARTINIQUE: 2 km E of Ft de France, 10 Apr 1944, Stehle 5452 (US); St. Pierre, 18 Jun 1945, Stehle 6840 (US).
ST. LUCIA: Castries, 15 Oct 1967, Krasuu 1214 (US); Vegie, 17 Sep 1958, Ramsammy 97 (US); Mount du Cap, 28 Jul 1959, Webster, Ellis & Miller 9318 (MICH). MEXICO.


13c. Pectis elongata H.B.K. var. fasciculiflora (DC.)

Keil, comb. nov. (Fig. 38).

Pectis fasciculiflora DC. Prodr. 5:100. 1836.

TYPE: MEXICO: [without locality or date; probably collected near Acapulco, Guerrero], T. Haenke s.n. (HOLOTYPE: G-DC; Microfiche, IDC 800. 788: 1. 4!; Photo, MICH!).
Erect strong-scented annuals. Stems 15-30 cm tall, solitary or few-branched from the base, few-branched above, the branches strict or slightly spreading. Heads leafy bracted in dense axillary and terminal glomerules, sessile or on peduncles up to 10 mm long. Involucre cylindrical; phyllaries 3.5-6 mm long, 0.5-1 mm wide, acute to acuminate with spreading tips. Ray corollas 4-7 mm long. Disc corollas 3.5-4 mm long. Achenes 1.3-2 mm long. Pappus 0-4 scabrid setose, 3-4 mm long and also coroniform. Chromosome number unknown.

Distribution. Known only from the vicinity of Acapulco, Guerrero at 150-700 meters evaluation (Fig. 39).

Pectis elongata var. fasciculiflora is seldom collected and its full extent of variation is unknown. The range of this taxon is well separated from that of the more widespread varieties. The reasons for its restricted distribution are uncertain.

One collection of P. elongata var. fasciculiflora (Nelson 2268) approaches var. floribunda in having less densely glomerulate heads than most other collections. In most collections of this variety, the heads are so densely aggregated that they appear superficially to compose secondary heads. In this feature, var. fasciculiflora approaches the distantly related P. carthusianorum
Less. of the Caribbean region. This condition is clearly derived in both var. *fasciculiflora* and *P. carthusianorum*, with the nearest relatives of each taxon having a more open inflorescence.

Representative specimens. MEXICO. GUERRERO: 5 mi N of Ocotito, 4 Nov 1960, Crutchfield & Johnston 5992 (TEX); Acapulco, 1882, Hancock 20 (F); Rincon Viejo, 7 Dec 1959, Kruse 130 (ENCB); El Reparo, 14 Jan 1899, Langlasse 747 (GH, NICH, US); San Marcos, 7 Feb 1895, E. W. Nelson 2268 (GH, US; photo of US specimen at NY); Tierra Colorada, 10 Dec 1957, Paray 2654 (ENCB).

14. *P. gardneri* Baker in Mart. Flora Bras. 4:287. 1887. (Fig. 29).

**TYPE:** BRAZIL. GOYAZ: "prope San Pedro," G. Gardner 4197 (Type not seen).

Slender much branched fibrous-rooted annuals. Stems 10-25 cm long, solitary or several from the base, erect or ascending, glabrous or puberulent. Leaves linear, 0.5-3 cm long, 1-2 mm wide, mucronate, ciliate with 2-5 pairs of bristles 1-3 mm long, glabrous or minutely puberulent, punctate on the lower surface with scattered glands 0.2 mm diameter. Heads on slender peduncles 2-4 cm long. Involucres cylindric; phyllaries linear-oblong,
4-5 mm long, ca 1 mm wide, obtuse to acute, slender keeled, punctate with 2-4 pairs of slender, inconspicuous glands. Ray florets 5; corollas yellow or becoming reddish, 3-5 mm long. Disc florets 2-7; corollas yellow, 2-2.5 mm long, bilabiate, with the narrow lobe ca 5 times the length of the teeth on the broad lobe. Achenes 2-2.5 mm long, strigillose. Pappus 15-20 setose, 2-2.5 mm long or sometimes reduced to short scales. Chromosome number unknown.

Distribution. Brazil from Goiás to Maranhão and Ceará at elevations of 250-550 meters (Fig. 34).

_Pectis gardneri_ is known to me at present only through a few collections. These plants appear to be distinct from the widespread and polymorphic _P. elongata_. I would not be surprised, however, if later field work demonstrates that _P. gardneri_ is really just another well marked variety of _P. elongata_. Until further data is available, however, I feel that the best treatment for _P. gardneri_ is to maintain it at the specific level.

Representative specimens. BRAZIL. CEARÁ: Acude S. Antonio das Russas, 17 Sep 1935, _Drouet_ 2482 (GH). GOIÁS: 10 km S of Gaura, 18 Mar 1968, _Irwin, Maxwell_ & _Wasshausen_ 21329 (MICH). MARANHÃO: 35 km S of Loreto,
4-5 Apr 1962, Eiten & Eiten 3986 (US), 4001 (US), 4017 (US).

EXCLUDED AND DOUBTFUL TAXA

_Pectis fasciculata_ Poir. in Lam. and Poir. Encycl. Method. Bot. 5:120. 1804. Known to me from description only. Grown from seed collected at an unknown locality. Type (if extant) not located.
LITERATURE CITED


Von Rudloff, E. 1969. Scope and limitations of gas chromatography of terpenes in chemosystematic

