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A Revision of the Pacific Coast Irises

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A REVISION OF THE PACIFIC COAST IRISES

LEE W. LENZ

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INTRODUCTION

The Iridaceae, and the genus *Iris* in particular, are richly endowed with species which are of prime importance to ornamental horticulture. About one hundred years ago plant breeders began working with various members of the bearded or *Pogoniris*, and since that time they have developed a series of races of bearded iris which can be grown successfully throughout much of the temperate world. Indeed, at the present time the bearded irises have reached a very high state of development, and they are now recognized as being one of the most important elements in any perennial border.

More recently, hybridizers have begun to explore the possibilities of other species in the genus, especially members of the beardless, or *Apogon*, series. One natural subdivision of the Apogons is that of the *Californicae*, the so-called Californian Irises, species of which, however, are to be found in all three of the Pacific Coast States:

California, Oregon and Washington. Because of their distribution it is felt that it is better to refer to them as the Pacific Coast Irises rather than the Californian Irises. In 1948 a breeding program was undertaken at the Rancho Santa Ana Botanic Garden for the development of new and improved garden forms of this group. It was soon apparent that despite the work of earlier investigators, the taxonomy of the *Californicae* was in a state of considerable confusion and many of the plants collected in the field could not be satisfactorily identified by any of the existing taxonomic works. It was decided, therefore, that a systematic investigation of this group should be made in conjunction with the ornamental breeding program. This work has been carried on intensively since 1948 in the experimental garden, in the laboratory, in the herbarium and in the field. During that time all the entities included in this series have been studied in the field—most of them over a period of years. Plants have been transplanted to the experimental garden from the wild and hybrids between nearly all members of the series have been grown.

The present taxonomic revision of the *Californicae* is to be followed by a detailed treatment of natural interspecific hybridization within the group.

ACKNOWLEDGMENTS

Work on the Pacific Coast irises was begun nearly ten years ago. During the long period of time that this investigation has been in progress many people have very kindly contributed information, seeds and plants. Without such help and information this study would have been much more difficult and time consuming. It is unfortunate that all those who have made contributions to this work cannot be named and thanked individually. Since that is impossible I would like to take this opportunity of thanking all those who have contributed in any way to this study.

I would like to especially thank Philip A. Munz, Director of the Rancho Santa Ana Botanic Garden, for his interest and support during the course of this investigation. I would also like to express my appreciation to E. K. Balls who accompanied me on many of the field trips over the years. His kindness and understanding have been much appreciated. I also want to express my appreciation to C. Leo Hitchcock and LeRoy Davidson for records for Washington. John Thomas Howell kindly measured one of the types for me and LeRoy Detling supplied me with additional information for Oregon. Thanks are also due the curators of the various herbaria for the loan of specimens and for providing me with facilities for study at their institutions. The outline maps are those published by the University of California Press and are used with their permission.

I also want to thank Steve Tillett who made all the drawings and Cal Dodson who helped with the distribution maps. And finally I would like to thank my colleague Verne Grant for comments and suggestions received during the course of preparation of this paper.

DISTRIBUTION

Members of the *Californicae* are not restricted, as the name might imply, to the state of California, but, rather, they are found in all three of the western states, California, Oregon and Washington. Within the borders of these states there exist two series of mountain ranges running in a more or less north and south direction, the easternmost being composed of the Sierra Nevada of California, and the Cascades of northern California, Oregon and Washington. To the west of the Sierra Nevada-Cascade axis, and more coastal, are the Pacific Coast Ranges composed of the Olympic

FIG. 1. Distribution of *Iris*, series *Californicae*.

Mts. of northern Washington, the Oregon Coast Range, the Klamath Mts. of northern California and adjacent southwestern Oregon, and the Coast Ranges of California. Between the Sierra Nevada and the Coast Ranges of California is the Great Valley of California, while to the north, the Puget Sound Lowland-Willamette Valley occupies the area between the Cascades and the Olympic-Coast Range system of Washington and Oregon.

The species of the *Californicae* are all to be found to the west of the crest of the Sierra Nevada-Cascade axis. From the western slopes of these mountains they extend to the Pacific Ocean, distributed generally throughout the Coast Ranges of Oregon, south to central California (a single subspecies occurs in southern California), and north into Washington. They are not found in the densely forested Olympics or in the broad flat trough of the Great Valley. The species of this series, with one exception, are all essentially plants of mountainous and forested areas—from the oak-covered hills of the Willamette-Umpqua Valleys, the Mixed Evergreen forest of northern California, the Valley Woodland of the Sierra Nevada and Coast Range foothills of California to the Yellow Pine forests of the Sierra Nevada. They are not normally found in heavily timbered lands where there is much shade, but rather in the open forest in partial or light shade. Some species are more shade tolerant than others. *Iris douglasiana* is an exception, being a maritime species common on wind-swept headlands and grassy knolls along the ocean and the bare or sparsely forested hills immediately inland from the beaches. It may also penetrate inland from the coast for a distance up open sunny river valleys or along road banks.

Within an area as great as that occupied by this series, edaphic and climatic factors vary a great deal. Nevertheless, there are a few factors that appear to be relatively constant. The entire area is one characterized by great seasonal variation in precipitation, most of the moisture being received during the winter either as rain or, at higher elevations, by snow. The summers are almost without exception long and dry with very small amounts of moisture being received as occasional showers in the mountains. Summer fogs are frequent along the coast. While edaphic factors may vary a great deal, most of the irises will be found growing in gritty and well drained soil. Usually it will contain considerable humus but at times the plants are found in heavy sticky clays, though even these soils usually contain rocks and gravel and are well drained. *Iris douglasiana* is again the exception. It is a vigorous and aggressive species and is sometimes found in pasture lands in heavy poorly drained loams in association with grasses and sedges. The soil reaction wherever tested has been found to be neutral to slightly acid. In no instance has it been found to be strongly acid nor on the alkaline side.

Temperatures throughout the area also vary a great deal but if the isothermal line showing the 50°F. annual mean temperature is drawn on a map of California, Oregon and Washington it will be found to coincide almost exactly with the geographical limits of distribution of the *Californicae*, the only exception being that the 50°F. temperature line extends farther into Washington than do the irises.

CYTOLOGY

Cytological investigation of the members of the *Californicae* have been made in the past by Simonet (1934), R. C. Foster (1937), Lenz (1950), Clarkson (1955), and Smith and Clarkson (1956). The counts are based on a wide sampling of the species; all but *I. hartwegii* subsp. *columbiana*, *I. b.* subsp. *pinetorum*, *I. tenax* subsp. *klamathensis* and *I. tenuissima* subsp. *purdyiformis* having been counted. With but one exception, the somatic counts have all been $2n=40$ chromosomes, and meiotic

counts $n=20$. The one exception is *I. tenuis* which has been reported to have $2n=28$ (Simonet, 1934). Numerous interspecific hybrids between various members of the *Californicae* (exclusive of *I. tenuis*) have been examined by Clarkson (1955) and Smith and Clarkson (1956) who report no cytological irregularities in the F_1 hybrids. These authors attribute the 1-5% sterile pollen produced by most of the hybrids as due to other factors. Cytological examinations made by the author of interspecific hybrids grown at the Rancho Santa Ana Botanic Garden would tend to confirm the findings of Smith and Clarkson.

Numerous attempts to produce hybrids between *I. tenuis* and members of the *Californicae* by Smith and Clarkson, and others, have all resulted in failure. As will be pointed out under Excluded Species, there is good morphological evidence for the exclusion of this species from the group. Cytological evidence here would tend to support this conclusion.

If *I. tenuis* is eliminated from the *Californicae*, the remaining species form a remarkably homogeneous group in which there has apparently been no major chromosomal repatterning in the speciation of the group.

TAXONOMIC HISTORY

The species here included in the series *Californicae* were first separated as a group from the rest of the *Apogon*, or beardless and rhizatomous irises, by Dykes (1913) in his monograph of the genus. In this work he divided the Apogons into fifteen 'groups', one of which he called 'The Californian Group'. Earlier, Baker (1892) in his *Handbook of Irideae* had placed all the Apogons together, separating only the linear-leaved from the ensiform-leaved.

Diels (1930) in Engler and Prantl, *Die Natürlichen Pflanzenfamilien* accepted Dykes' groupings but latinized the epithets and treated them formally as subsections of the genus. R. C. Foster (1937) in his *A Cyto-Taxonomic Survey of the North American Species of Iris* follows Diels and uses the name *Californicae* for the subsection. Lawrence (1953) in *A Reclassification of the Genus Iris* reduces the Apogons to a subsection, rather than a section of the genus, and then divides the subsection *Apogon* into thirteen 'series', one of which he calls the 'series, *Californicae*'. Clarkson (1955) and Smith and Clarkson (1956) do not cite Lawrence's paper and they follow Diels and R. C. Foster and use 'subsection, *Californicae*.'

While there has been considerable difference of opinion on the nomenclatorial status that this group should have at the infra-generic level, there has been general agreement by all workers since the time of Dykes as to the species which should be included within the group, the only exception being the exclusion of *I. tenuis* from the *Californicae* by Clarkson (1955) and the present author.

The members of this series, as delimited here, form a closely knit group of species well isolated morphologically, cytologically and geographically from their nearest relatives, the *Sibiricae*, which are all native to the Old World. The *Californicae* are also well separated morphologically and cytologically from the only other series which occurs in western North America, the *Longipetalae*, and from *I. tenuis* whose relationships at the present time are rather obscure.

As will be shown later, natural hybridization is a common occurrence among a number of the species of this series, and some of the resulting hybrids are as fertile as the parental species. After excluding *I. tenuis* from the *Californicae*, Clarkson (1955), working with the Oregon species, concluded that since there was no apparent cytological barriers between the species there was good reason to suppose that hybrids

would be found wherever two of the taxa occur together. On this basis he then reduced all six of the Oregon species to subspecies of *I. tenax*, that being the oldest valid name within the series. This appears to be an extremist approach to the problem. After ten years of study of the group both in the field and experimental garden, it is my feeling that the taxa recognized in the present work represent a series of closely related species which in the past have been reproductively isolated populations with distinct morphological characters and occupying distinct ecological niches or geographical areas. The majority of the taxa have been recognized as species by competent taxonomists since the time of Dykes. The occurrence of hybrids within the group has been brought about as the result of a breakdown of the isolating barriers. Such a situation is not unknown in other groups of the Pacific Coast flora and *Quercus*, *Diplacus*, *Ceanothus*, *Pinus*, and *Aquilegia* might be listed as examples. A full treatment of speciation and natural hybridization and their bearing on the species concept in *Iris* will appear in a forthcoming paper.

TAXONOMIC CHARACTERS

Fortunately, the members of the *Californicae* possess a number of fairly distinct taxonomic characters which makes their determination relatively easy even on the average herbarium sheet. The principal exceptions are the shape of the floral segments and the flower color. As will be pointed out later, flower color is of very limited value in determining species within this group. The characters listed below are those which have been used in the present investigation. The measurements given were in all cases made from living material.

1. *Spathes*. The two spathe valves immediately below the flower (or first flower in inflorescences containing two or more flowers) vary in shape from ovoid to linear and in width from 3 mm. to as much as 14 mm. In length they vary from 30 mm. to 130 mm. and they may be sub-equal or one may be shorter than the other. In arrangement they may be opposite, or they may be separated as much as 92 mm. If opposite they may be connivent or divergent. In texture ours are all herbaceous, sometimes with scarious margins, and in a few instances they are somewhat inflated. In color they are usually green although in some species they may be flushed, especially on the margins, with red or pink anthocyanin pigment. The measurements given were in all cases made on the outer spathe valve; the width was taken at the widest place. Spathe valve width is one character in which measurements taken from fresh material and from herbarium specimens may not coincide exactly since there is a tendency for the spathe valves to curl on drying. For that reason figures given here may be somewhat greater than those usually given in the literature since in many instances the earlier measurements were taken from dried material.

2. *Sepals*. The two measurements made of the sepal were those of maximum length and width. Length was measured from the base of the stamen to the tip, and width was determined at the widest place on the sepal. Sepal shape is extremely variable within the limits of most of the species and in general is not of great taxonomic significance. In addition to size and shape of the sepals, characters which can be measured and scored, there are more subtle differences which can be seen in fresh material. Among these differences is curvature of the sepal. The sepals on some flowers curve gracefully for almost their entire length; others bend back at an angle at the junction of the blade with the claw; while in still others the sepals remain nearly straight throughout their full length. In living material these differences combine to produce flowers that are very different from one another in appearance, and it is these

differences which are of such great value to the plant breeder. Unfortunately they are for the most part destroyed as soon as the specimen is placed in the plant press. Sepal and petal margins may also be smooth and even or they may be crisped. Again this character is lost on making herbarium specimens.

3. *Petals*. As in the case of the sepals, the two measurements made on the petal were those of maximum length and width. Since there is no exact limit to the petal, such as there is in the case of the sepal, it was arbitrarily decided to measure the length as the distance from the tip to the point where the petal breaks off naturally when pulled over backwards. This length is in nearly all instances a few millimeters less than the length of the sepal. While there are some differences in petal form, they do not tend to be as conspicuous as they are in the case of the sepals. In some flowers both sepals and petals may be emarginate. While this character has been used by workers in the past, it has been found to be extremely variable and of no taxonomic value.

4. *Perianth tube*. The length and shape of the perianth tube is one of the most useful of the taxonomic characters in this group. In the *Californicae* it may range in length from 5 mm. or less to as much as 120 mm. The length is measured from the base of the stamen to the junction with the ovary. Of all measurements taken, perianth tube length is probably one of the most difficult to determine, at least in some specimens. The reason for this is that it is often difficult to tell exactly where the ovary begins and the perianth tube stops. Besides total length of the tube there are other characters which are useful taxonomically. Relative thickness of the tube is of limited value, whereas the nature of the upper portion of the tube may be of great use. The diameter of the tube may remain nearly the same up to its junction with the perianth segments, or it may become bowl-like below the base of the perianth, or again the diameter of the tube may be abruptly increased in its upper part.

5. *Ovary*. As with the perianth tube, the exact length of the ovary may be difficult to determine because of its gradual fusion into the perianth tube on the one hand and into the pedicel on the other. However, in most instances a slight ridge, or demarcation, is visible and can be used as a point for measuring. On the whole, ovary length is not an especially useful taxonomic character. Shape of the ovary, however, may be of value, both longitudinal and cross section outline being significant. One species has a rather pronounced triangular cross section, whereas the others are for the most part nearly circular. One species also displays an unusual nipple-like projection on the upper end of the ovary.

6. *Pedicel*. The length of the pedicel may vary from 5 mm. to as much as 60 mm., and it varies approximately inversely with the length of the perianth tube. In certain species the length of the pedicel increases as the inflorescence continues to bloom so that the second flower has a longer pedicel than the first and the third a longer pedicel than the second. Measurements given here were always made at the time of anthesis of the first flower in the inflorescence.

7. *Style branch* and *Style crest*. Measurements taken were those of total length of the style branch and the length of the crest. The style branch was measured from the stigmatic lobe to the point of fusion of the three branches. The style crest was measured on a line running through the base of the stigmatic lip to the tip of the crest. In addition to differences in ratio of the style crest to the length of the style branch, the crests may vary in form from long slender rabbit-ears to broadly rounded overlapping structures.

8. *Stigma*. The stigmas in most of the members of this series are sharply triangular to rather tongue-shaped; however, there is one species in which it is distinctly truncate or even bilobed.

9. *Stamens*. In this group the stamens possess few if any characters which are useful taxonomically. One species has been reported to have stamens which are exerted beyond the stigmas but this has been found to be a variable condition within the species and consequently of no value taxonomically. Anther color varies from yellow through lavender to purple.

10. *Number of flowers*. In the *Californicae* the inflorescence may contain from 1-3 or even occasionally 4 flowers in an unbranched inflorescence and up to 9 flowers if the stem is branched. Flower number varies to a certain extent with the vigor of the plant. Most species are characterized as usually being single, or 1-2-flowered, whereas others usually have 3 and sometimes 4 flowers. However, flower number is of only limited value taxonomically.

11. *Flower color*. In the past, flower color has been considered to have value in separating the species within this series. Extensive field work has now shown that this character must be used with the utmost caution. Although there are several species in which only a limited range of color is known, other species display a very wide range of colors, varying from deep purple, lavender-blues, and lavenders to cream color and even deep golden-yellow.

12. *Fragrance*. A distinctive and very pleasant fragrance has been noted in one species but it is not a constant character; one colony may be fragrant whereas a short distance away another one will be entirely lacking in odor. Only occasionally have collectors recorded fragrance, or lack of it, in their field notes.

13. *Seeds*. In general the seeds may be D-shaped, cubical, ovoid or pyriform, and they range in color from tan through brown to deep blackish-brown. The surface may be finely reticulate to coarsely wrinkled. In no instance is there any raphae or aril.

14. *Flower stem*. In the *Californicae*, flower stem height is extremely variable and at the most it has only limited value as a taxonomic character. In the majority of the recognized species, forms are known which are nearly stemless whereas others may be several decimeters tall. Limits of extreme height, however, do vary, with the tallest forms of certain species reaching as much as 10-11 dm. Stem branching is common in one species, and it has been recorded in another.

15. *Basal leaves*. In our species the basal leaves are all tough and fibrous, varying in width from 2 mm. to 25 mm. and in length from 1 dm. to as much as 9 dm. In color they may be deep green on both sides, deep green on one side and yellow-green on the other, or they may be bluish-green or gray-green and glaucous. In some species the leaves are strongly nerved. A widespread misconception is that the leaves of the *Californicae* are all evergreen. Although this is true for some of the species, others are definitely deciduous and in early spring, after the snow melts and before new growth commences, it is often difficult to find any trace of the plants. Even when grown in mild climates these species retain their deciduous character. In other cases the leaves remain green throughout the winter even though covered with snow. A second misconception, and one that has been used in the past as a key character in separating the *Californicae* from the *Sibiricae* is that in the *Californicae* the leaf bases are colored pinkish, red or purple. Again, this is a character which is variable and care must be exercised in using it taxonomically. Certain species usually have colored leaf bases, but occasional populations may be found which show no color. Again,

species which usually show no color will, in some instances, have slightly colored bases.

16. *Stem leaves*. The flower stem usually bears one to several leaves. These are often tightly clasping with $\frac{1}{3}$ - $\frac{1}{2}$ of their length free. In other instances the stem leaves may be short, bract-like, inflated and overlapping with only the tips free.

17. *Rhizome*. In the past, the character of the rhizome also has been used to separate the *Californicae* from the *Sibiricae*; the *Californicae* were described as having slender reddish or pinkish rhizomes and the *Sibiricae* as having stout brown rhizomes. This criterion is not valid since the *Californicae* usually have dark brown rhizomes which may be slender; in at least two species, however, they are as stout as those of the *Sibiricae*.

TAXONOMIC TREATMENT

KEY TO THE SPECIES

In the following key to the species no attempt has been made to key out hybrid forms. However, under the treatment of each species, all known natural hybrids are listed with localities given for each of them. The distribution maps also show the known locations for the hybrids.

- A. Perianth tube short, not over 1 cm. long, usually thick. B.
- AA. Perianth tube over 1 cm. long, slender to somewhat stout. G.
 - B. Spathe valves opposite, connivent, 6-10 mm. wide; leaves dark green above and pale yellow-green below; stems covered with short bract-like leaves; flowers yellow; Josephine County, Oregon, and adjacent Del Norte County, California. *I. bracteata* (p. 11)
 - BB. Spathe valves usually divergent and separated; stems not covered with bract-like leaves; leaves not distinctly two-sided. C.
 - C. Plants large; flower stem to 7 dm. tall, usually 3-flowered; leaves to $\frac{1}{2}$ m. long and 2 cm. wide, distinctly glaucous; spathe valves 8-14 mm. wide; flowers lavender to purple; plants of low altitudes in Sierra Nevada foothills; Tulare County, California. *I. munzii* (p. 53)
 - CC. Plants smaller; flower stem seldom over 4 dm. tall, 1-3 flowered; spathe valves 3-9 mm. wide; flower color various. D.
 - D. Flower stem usually 3-flowered; leaves to 1 cm. wide; flowers yellow; Tuolumne County, California. *I. bartwegii* subsp. *columbiana* (p. 37)
 - DD. Flower stem usually 1-2-flowered; leaves less than 1 cm. wide. E.
 - E. Outer spathe valve linear to linear-lanceolate, 3-5 mm. wide; plants usually caespitose; sepals obovate to oblanceolate; flower color yellow to purple; Oregon and Washington. *I. tenax* (p. 61)
 - EE. Outer spathe valve 4-9 mm. wide; plants generally not caespitose; sepals lanceolate to broadly oblanceolate. F.
 - F. Spathe valves 4-7 mm. wide; flower stem to 3 dm. tall; flowers pale yellow to golden yellow or lavender; plants of middle altitudes in Sierra Nevada, California. *I. bartwegii* (p. 30)
 - FF. Spathe valves 6-9 mm. wide; flower stem to 4 dm. tall; flower color lavender to purple; Riverside and San Bernardino counties, California. *I. bartwegii* subsp. *australis* (p. 35)

- G. Spathes separated and divergent; perianth tube not over 2 cm. long; 1-2 flowers per stem H.
- GG. Spathe valves opposite (occasionally separated in *I. douglasiana* and, if so, then 3-flowered); perianth tube more than 15 mm. long I.
- H. Perianth tube 11-20 mm. long, rather stout; sepals oblanceolate to broadly obovate; leaf bases brilliantly colored red or pink; style crests 8-16 mm. long, narrowly ovate, usually obtuse; flower color buff-yellow veined with brown or maroon lines; Humboldt County, California *I. tenax* subsp. *klamathensis* (p. 64)
- HH. Perianth tube 12-15 mm. long, divided into a short tube above the ovary, then dilated to form a broad throat; sepals narrowly oblanceolate; flower color pale creamy-yellow; style crests 9-13 mm. long, very slender; leaf bases slightly if at all colored; Plumas County, California *I. bartwegii* subsp. *pinetorum* (p. 40)
- I. Stigmas truncately flattened to bilobed; stem covered with short usually overlapping bract-like leaves; flower color yellow or whitish with lavender flush on sepals; Sonoma to Humboldt and Trinity counties, California *I. purdyi* (p. 56)
- II. Stigmas triangular to tongue-shaped or rounded; stem leaves tightly clasping, free for $\frac{1}{2}$ - $\frac{1}{3}$ their length, or if somewhat inflated, not overlapping J.
- J. Perianth tube not more than 30 mm. long K.
- JJ. Perianth tube over 30 mm. long, usually slender L.
- K. Stems usually branched, each branch with 2-3 flowers; spathe valves lanceolate acuminate, 7-12 mm. wide, 60-120 mm. long (occasionally separated and divergent); perianth tube 15-28 mm. long; ovary triangular in cross section and with nipple-like projection at tip; leaves to 2 cm. wide; coastal California and Oregon *I. douglasiana* (p. 17)
- KK. Stems not branched; spathes broadly lanceolate to ovate, 5-7 mm. wide, 33-60 mm. long; perianth tube 15-30 mm. long; flower stem 1-2-flowered; leaves narrow, grass-like; southwestern Oregon and adjacent California *I. innominata* (p. 41)
- L. Style crests long and very slender; flower parts usually very narrow, widespreading, fragile; flower color whitish to cream with dark veining M.
- LL. Style crests short, rounded; flower color various O.
- M. Perianth tube lacking distinct throat, upper part often with short bowl-like enlargement; western Oregon and adjacent Del Norte County, California *I. chrysophylla* (p. 14)
- MM. Upper part of perianth tube dilated to form a conspicuous throat N.
- N. Stems with short inflated bract-like leaves, not overlapping, free only at their tips; spathe valves broadly lanceolate; somewhat inflated; stigmas broadly tri-triangular to rounded; Plumas and Sierra counties, California *I. tenuissima* subsp. *purdyiformis* (p. 71)
- NN. Stem with 1-3 bract-like leaves free for most of their length, not inflated; spathe valves lanceolate; stigmas triangular to tongue-shaped; northern California from Glenn and Trinity counties to Butte County *I. tenuissima* (p. 66)
- O. Spathe valves 4-9 mm. wide; linear-lanceolate perianth tube never with a distinct throat; flowering stem to 2.5 dm. tall; leaves to 5 mm. wide, leaf bases usually colorless;

flower color variable, deep purple to golden-yellow; central California on both sides of the Great Valley..... *I. macrosiphon* (p. 47)

- OO. Spathe valves 6-11 mm. wide, broadly lanceolate, often flushed with pink or red; perianth tube sometimes showing a distinct throat; flower stem 2-4 dm. tall; leaves to 7-8 mm. wide, drying a peculiar gray-green color; entire plant often intensely colored with red pigment; flower color creamy-yellow, sometimes veined darker; west central California, Lake and Napa counties to Santa Cruz County *I. fernaldii* (p. 25)

IRIS BRACTEATA S. Watson Proc. Amer. Acad. 20: 375, 1885

(Fig. 3)

Rhizome 6-9 mm. in diameter; leaves usually few, thick, rigid, strongly ribbed, deep glossy green on upper surface, lower surface yellow-green, to 1 cm. wide and 60 cm. long, leaf bases usually pink to strongly red in color; flower stalk 2-flowered usually shorter than leaves, unbranched, to 30 cm. tall with 3-6 cauline leaves, lower ones short, bract-like, overlapping, the upper ones free for about $\frac{1}{3}$ of their length, all more or less strongly colored pink to red; spathe valves opposite and subequal, 6-10 mm. wide (aver. 8 mm.), 52-90 mm. long (aver. 73 mm.), lanceolate, acuminate; pedicels 30-62 mm. long (aver. 45 mm.); ovary 12-25 mm. long (aver. 17 mm.), tapering abruptly into the perianth tube and gradually into the pedicel, nearly circular in cross-section; perianth tube short, thick, funnelform, 5-10 mm. long (aver. 9 mm.); sepals oblanceolate to obovate, 43-78 mm. long (aver. 61 mm.), and 17-30 mm. wide (aver. 23 mm.); petals oblanceolate, 48-78 mm. long (aver. 54 mm.) and 8-20 mm. wide (aver. 13 mm.); flower color yellow, distinctly and attractively veined with deep maroon or brown lines; style branches 22-30 mm. long (aver. 25 mm.); style crests 9-17 mm. long (aver. 12 mm.); stigmas triangular; capsule 2-3 cm. long, tapering abruptly and equally at both ends, nearly circular in cross section; seeds dark brown, irregular in shape and finely wrinkled.

Type.—Waldo, Josephine County, Oregon, June, 1884. T. Howell, Gray Herbarium. (Type seen.)

Distribution.—CALIFORNIA: Del Norte County. OREGON: Josephine County.

Representative specimens.—CALIFORNIA. Del Norte County: Near Elk Valley, Forest Camp, Route 199, A. N. Steward 6137; Oregon boundary, A. Eastwood 12026. OREGON. Josephine County: Waldo, L. R. Abrams and G. T. Benson 10364; 3 mi. west of Gasquet Trail marker, O'Brien-Sourdough Camp road, A. R. Kruckeberg 1866; near west fork Illinois River, L. E. Detling 4715; 3 mi. south of Takilma, J. W. Thompson 8660c; Rough and Ready Creek, 5 mi. south of Cave Junction, L. Constance and R. C. Rollins 2988; near Waldo, L. W. Lenz 18304; Sanger Peak road, L. W. Lenz and E. K. Balls 21677.

Iris bracteata is a very distinct species quite different from other members of the series and unlikely to be confused with any other species. The leaves are very broad and distinctly two-sided, they are also stiffer and thicker than those of other members of the group, and they are usually few in number. The flowers of *I. bracteata* are among the largest and most attractive in the *Californicae*. So far the only color known in the species is yellow—a rather unusual situation in a group where flower color is so variable. *Iris bracteata* is usually found in rather shady situations and is most abundant in the ponderosa pine forest, although, as Clarkson (1955) points out, it may occur in cut-over land in the shade of bracken ferns. In the area around Cave Junction, Josephine County, a form of this species is known which is identical with the rest of the species except for its size. Some of these plants are only about one-half as large as those a few miles away at Selma. Seeds from this small form, when grown at

FIG. 2. Distribution of *Iris bracteata* and its natural hybrids.

FIG. 3. *Iris bracteata*. a, general habit; b, style branch; c, petal, d, sepal; e, f, inner and outer spathe valves; g, seed capsules. a, g, $\times \frac{1}{3}$; b, c, d, e, f, $\times \frac{2}{3}$.

the Botanic Garden, have produced plants which retain their small size. There is no evidence that these plants are of hybrid origin although they are often found growing near *I. chrysophylla*. Plants intermediate in size between this small form and the very vigorous form from Selma are known and it does not seem wise to attempt to recognize this small form with a formal designation.

Natural hybrids.—

Iris bracteata × *I. chrysophylla*. CALIFORNIA: Del Norte County. OREGON: Josephine County.

Iris bracteata × (*I. douglasiana* × *innominata*). CALIFORNIA: Del Norte County.

When one considers the overlap in their distributions, it is surprising that more definite hybrids between *I. bracteata* and *I. chrysophylla* have not been found. Clarkson (1955) reports only one individual which he could consider as intermediate. This plant was collected near Bridgeview, Josephine County, where the two species occupy the same general area. In the Dudley Herbarium there is a specimen collected by Abrams and Benson (10315) at "Deer Creek to Kerby," Josephine County, which Foster annotated as a possible hybrid between *I. bracteata* and *I. tenax*. This specimen is obviously of hybrid origin, but I would designate it as a hybrid between *I. bracteata* and *I. chrysophylla* rather than *I. bracteata* and *I. tenax*. Morphologically it is rather intermediate between the former two. *Iris tenax* is not known to occur in Josephine County whereas both *I. chrysophylla* and *I. bracteata* are rather abundant in the Kerby-Deer Creek area.

The hybrid combination *I. bracteata* × (*I. douglasiana* × *I. innominata*) is common in the Smith River Canyon of Del Norte County, California, and it is discussed in detail under *I. × thompsonii*.

IRIS CHRYSOPHYLLA Howell. Fl. N. W. Amer. 1: 633, 1902

Rhizome slender, dark brown; leaves exceeding the stems, linear, 3-5 mm. wide, finely ribbed, light green and often somewhat glaucous, leaf bases colored pink to red; flowering stem slender, unbranched, to 20 cm. tall, usually 2-flowered, cauline leaves usually 1-3; spathe valves opposite, lanceolate to linear-lanceolate, unequal, outer one often shorter, outer spathe valve 6-10 mm. wide (aver. 8.3 mm.), and 50-86 mm. long (aver. 69 mm.), herbaceous and often flushed with red or purple; pedicels usually short, 5-15 mm. long (aver. 9 mm.), at anthesis; ovary 11-18 mm. long (aver. 14 mm.), tapering gradually into the perianth tube and somewhat abruptly into the pedicel; perianth tube long and slender, 43-120 mm. long (aver. 57 mm.); sepals oblanceolate, 46-67 mm. long (aver. 54 mm.), and 10-20 mm. wide (aver. 15 mm.), blade tapering gradually into the claw; petals lanceolate, shorter than the sepals, 31-55 mm. long (aver. 49 mm.), and 6-12 mm. wide (aver. 8.5 mm.); flower color pale creamy-yellow to nearly white, sometimes with faint bluish tinge, usually veined darker; style branches long and slender, 17-25 mm. long (aver. 22 mm.); style crests very long and slender, 15-22 mm. long (aver. 20 mm.), sometimes exceeding the length of the style branch, usually nearly entire; stigmas triangular; capsule oblong, 2-3 cm. long, sharply beaked.

Type.—No type was designated in the original description, but there is a specimen in the University of Oregon Herbarium labeled "type specimen" in the handwriting of Thomas Howell. This specimen was collected at Grants Pass, Josephine County, Oregon, May 1887. (Type seen.)

Distribution.—CALIFORNIA: Del Norte County. OREGON: Benton, Coos, Douglas, Jackson, Josephine, Klamath, Lane, Linn, Marion, and Polk counties.

FIG. 4. Distribution of *Iris chrysophylla* and its natural hybrids.

Representative specimens.—CALIFORNIA. Del Norte County: Sanger Peak road, *L. W. Lenz* and *E. K. Balls* 21678. OREGON. Western Cascades (and westward), *W. C. Cusick* 2853; Summit of Cascade Mts. on Ashland-Klamath Falls road, *M. E. Peck* 9231; Douglas County: 2 mi. south of Myrtle Creek, *A. Eastwood* and *J. T. Howell* 1471; Along Mystic Creek, west of Camas Valley, *W. H. Baker* 5421; Silver Butte, *L. E. Deiling* 6371; Nickel Mt., *L. E. Deiling* 6343; Near top of Mount Bolivar, Cow Creek Mts., *W. C. Cusick* 4712; 5 mi. west of Camas Valley, *J. W. Thompson* 4447; 8 mi. from Douglas County line, Hwy. 99, road to Canyonville, *L. W. Lenz* 19141; 1 mi. west of Brockway, *L. W. Lenz* 19143 Jackson County. West of Pinehurst, *H. D. Ripley* and *R. C. Barneby* 6691; Near Trail, *A. Eastwood* and *J. T. Howell* 1645; Applegate Valley, 1.5 mi. east of Forest Creek, *L. E. Deiling* 4678; 2 mi. west of Medford, *L. Constance* and *R. C. Rollins* 2941; Lower wooded slopes of Huckleberry Mt., *J. W. Thompson* 13007; High hills east of Brownsboro, Cascade Mts., *J. H. Heckner*; 9.4 mi. southeast of Ashland, *L. W. Lenz* and *E. K. Balls* 21712; Jacksonville, *L. W. Lenz* 18299; Siskiyou Summit, Hwy. 99, *L. W. Lenz* 19139. Josephine County: Mt. Grayback, *J. W. Thompson* 12965; 2 mi. from Grants Pass, *W. C. Cusick* 4612; Northeast slope of Mt. Boliva, ca. midway between Grants Pass and Agness, *C. L. Hitchcock* 19380; 8 mi. from Cave Junction, *L. W. Lenz* 18305; Cave Junction, *L. W. Lenz* 18303. Klamath County: 1 mi. west of south entrance to Crater Lake Natl. Park, *E. I. Applegate* 11117; 20 mi. southwest of Headquarters in Crater Lake, *C. L. Hitchcock* and *J. S. Martin* 4960. Lane County: McKenzie Highway near Rainbow, *A. Eastwood* and *J. T. Howell* 1617; 16 mi. up Fall Creek, *L. F. Henderson* 18526; Castle Rock, *L. E. Deiling* 2832. Linn County: Trail between Fish Lake and Smith River, *E. P. Sheldon* 12707. Marion County: South Breitenbush Trail, *L. E. Deiling* 5668. Polk County: Dry bank of Mill Creek, 4 mi. southwest of Buell, *M. E. Peck* 16201.

Iris chrysophylla is native to the open coniferous forests of Oregon from as far north as central Lane County, south to the crest of the Siskiyou Mts. In southwestern Oregon it occurs in rather dry Yellow Pine-Douglas Fir communities at altitudes up to at least 5500 feet. According to Clarkson (1955), excessive moisture appears to be the limiting factor in the distribution of the species. *Iris chrysophylla* tolerates more shade than does *I. tenax* which is the most widespread species in Oregon. This species varies, as do others of the *Californicae*, in having some forms which produce definite stems whereas others are nearly stemless. The flowers of *I. chrysophylla* usually have narrow flower parts similar to those of *I. tenuissima*, and so far no flower color is known except pale creamy-yellow to nearly white, all, however, distinctly veined with some darker color. *Iris chrysophylla* is remarkable in being one of the two species of the *Californicae* possessing long narrow style branches with style crests which, in the case of this species, are sometimes greater than the length of the entire style branch. This character is also shared by *I. tenuissima*, the species most closely related to *I. chrysophylla*. It is, however, easily separated from *I. tenuissima* by lacking the distinctly dilated throat of that species. *Iris chrysophylla* is rather widespread in Oregon, but, so far as now known, it occurs in California in only a single locality, that a short distance south of the California-Oregon border but still to the north of the crest of the Siskiyou Mts. The more or less east-west axis of the Siskiyou apparently acts as an effective barrier in the distribution of these two closely related species.

Natural Hybrids.—

I. bracteata × *I. chrysophylla*. CALIFORNIA: Del Norte County. OREGON: Josephine County.

I. chrysophylla × *I. innominata*. OREGON: Curry County.

I. chrysophylla × *I. tenax*. OREGON: Coos, Douglas, Lane, Marion, and Polk counties.

This species is known to hybridize with two other members of the *Californicae* and possibly a third species. Hybrids between *I. bracteata* and *I. chrysophylla* are known to occur only in Del Norte County, California, and Josephine County, Oregon, and they are discussed under *I. bracteata*. Hybrids between *I. chrysophylla* and *I. tenax* are rather widespread in Oregon and so far have been recorded from five counties. A discussion of this combination will be found under *I. tenax*.

I have not seen living material that I would interpret as representing a hybrid between *I. chrysophylla* and *I. innominata*; however, there are two sheets in the University of Oregon Herbarium which Clarkson has labeled "*I. chrysophylla* Howell (Int. to *I. innominata* Hend.)." The label I read as meaning *I. chrysophylla* introgressed to *I. innominata*. Both collections were made by L. E. Detling; one (Detling 6288) was obtained at Bear Creek about one mile above its confluence with the Winchuck River, Curry County, whereas the other (Detling 6296) was collected on Pack-saddle Mt., also in Curry County. The plants from Bear Creek have perianth tubes about 30 mm. long. The spaths valves are about 47 mm. long and 3-5 mm. wide. All these are within the range of variation of *I. innominata*. The style crests are not those of *I. chrysophylla*. The second collection (6296) appears to me to be typical of the colored form of *I. innominata*. Clarkson does not mention these plants in his 1955 treatment of the Oregon species.

IRIS DOUGLASIANA Herbert. Hooker and Arnott. Bot. Voy. Beech. 395. 1841
(Fig. 6)

Iris beecheyana Herbert. Hooker and Arnott. Bot. Voy. Beech. 395. 1842.

Type preserved at Kew according to Dykes (1913). Type not seen by me.

Iris douglasiana var. *bracteata* Herbert. Hooker and Arnott. Bot. Voy. Beech. 395. 1841.

The varietal name was spelled 'bacteata' in the original description but as R. C. Foster (1937) has pointed out, this was probably a misprint since the description reads "caule superne bacteata (ut in *I. tenace*) . . ."

Iris douglasiana var. *nuda* Herbert. Hooker and Arnott. Bot. Voy. Beech. 395. 1841. According to Dykes.

Iris douglasiana var. ? *major* Torrey. Pacif. Rail. Rep. 4:1444. 1857.

Type from Corte Madera, California. Bigelow 1854. Type not seen by me.

Iris watsoniana Purdy. Erythea 5:128. 1897. Collected at Eureka, Humboldt County, California.

Iris douglasiana var. *alpha* Dykes. Gard. Chron. (third series) 55:392. 1914.

Iris douglasiana var. *altissima* Purdy ex Jepson. Fl. Calif. 1:325. 1921.

Iris douglasiana forma *alpha* Dykes (R. C. Foster). Contr. Gray Herb. No. 119:35. 1937.

Iris douglasiana var. *oregonensis* R. C. Foster. Contr. Gray Herb. No. 119:35. 1937.

Type.—Near Myrtle Point, Coos County, Oregon. 13 May, 1924. L. R. Abrams and G. T. Benson 10545. Rocky Mountain Herbarium. (Isotype seen.)

Iris douglasiana var. *mendocinensis* Eastw. Leaf. West. Bot. 2:263. 1940.

Type.—Near Point Arena, Mendocino County, California. 11 July, 1938. A. Eastwood and J. T. Howell 6249. Calif. Acad. Sci. Herb. (Type seen.)

Rhizome moderately stout, to 9 mm. in diameter, covered with the remains of old leaves; leaves to 2 cm. wide and 1 m. long, prominently ribbed, yellow-green to very deep green, upper surface dull to shiny, leaf bases usually bright pink or red; flower stalk 1.5 to 7-8 dm. tall, mostly shorter than the leaves, flower stem usually but not always branched, up to 4 side branches on some plants; spathes 2-3-flowered, usually 3-flowered; spathe valves usually opposite but occasionally separated and divergent, or opposite and divergent, lanceolate-acuminate 7-12 mm. wide (aver. 9.6 mm.), 60-120 mm. long (aver. 92 mm.); pedicels variable, 20-53 mm. long (aver. 30 mm.) at anthesis; ovary elliptic-oval, 24-48 mm. long (aver. 36 mm.), strongly triangular in cross section, tapering to either end, upper end with distinct nipple-like projection; perianth-tube 15-28 mm. long (aver. 22 mm.); sepals oblanceolate to obovate, 50-87 mm. long (aver. 64 mm.) and 14-30 mm. wide (aver. 23 mm.); petals oblanceolate, 45-70 mm. long (aver. 58 mm.) and 9-18 mm. wide (aver. 14 mm.); flower color extremely variable from pale cream color through light and dark lavender to deep red-purple; style branches 17-35 mm. long (aver. 28 mm.); style crests subquadrate, coarsely toothed, 10-20 mm. long (aver. 14 mm.); stigmas triangular; filament about

8 mm. long; anthers 10-15 mm. long; capsule sharply triangular in cross section, 25-50 mm. long, tapering at either end, not dehiscent as widely as other members of the *Californicae*; seeds dark brown, pyriform, finely wrinkled.

Type.—Collected by David Douglas probably somewhere near Monterey, California.

Distribution.—CALIFORNIA. Del Norte, Humboldt, Marin, Mendocino, Monterey, San Francisco, San Luis Obispo, San Mateo, Santa Barbara, Santa Cruz and Sonoma counties. OREGON. Coos and Curry counties.

Representative specimens.—CALIFORNIA. Del Norte County: Coast hills south of Klamath River, J. P. Tracy 8581; Wilson Creek between Requa and Crescent City, L. R. Abrams and R. Bacigalupi 8320. Humboldt County: Big Legoon, L. R. Abrams and R. Bacigalupi 8274; Bald Hills road east of Orick, J. P. Tracy 14001; Mattole Valley, J. P. Tracy 12257; Among Redwoods, White Thorn Valley, J. P. Tracy 6306. Marin County: Bank of Hare Creek near its mouth, 5 miles south of Noyo, L. Constance 2499; South of Van Damme State Park, L. W. Lenz 14429. Monterey County: Laffley Creek, Big Sur, E. K. Balls 7886; Pfeiffer State Redwood Forest, R. C. Foster 206; Point Lobos State Park, E. Lee and H. Mason 9151; Little Sur River, J. R. Davy 7310; Anderson Canyon, Santa Lucia Mts., J. A. Ewan 9089. San Francisco County: Northwest base of Mt. Sutro, L. Constance 2237; Twin Peaks, R. F. Hoover 2812. San Luis Obispo County: San Carpoforo Creek near ocean, R. F. Hoover 6678. San Mateo County: Upper Pescadero Creek, W. R. Dudley; Crystal Springs Lake, C. F. Baker 343; Millbrae, J. B. Davy 1021. Santa Barbara County: Cañada Hondo Creek, L. W. Lenz and E. K. Balls 16359. OREGON. Coos County: Open bluffs and beaches at Bandon, J. W. Thompson 12787; 1 mile north of Broadbent, W. H. Baker 5422. Curry County: Cape Sebastin, L. E. Deiling 5918.

Iris douglasiana is geographically the most widespread species in the *Californicae*, extending along the Pacific Coast from Coos County, Oregon, south to Cañada Hondo Creek in Santa Barbara County, California. It is also one of the most variable species. In addition to its natural variability, *I. douglasiana* is hybridizing with several other species and through introgression is increasing its overall variability. In the past, various workers have segregated certain forms and have given them varietal standing. In 1897, Carl Purdy described a plant from Eureka in Humboldt County calling it *I. watsoniana* in honor of Sereno Watson. The dimensions given in the original description are such that an error must have been made; the sepals were said to be "1¾ inches long and 6 inches wide" and the petals "3 inches wide." The description was made from a fresh flower and no type specimen exists. In discussing this variety, R. C. Foster (1937) says that Dykes, working with living material, came to the same conclusion that he had reached from studying herbarium material; that the variety has paler green or yellow-green leaves which are wider and less conspicuously ribbed than in the species. Foster also says that the spathes are narrower, more linear-lanceolate, divergent and usually distant rather than opposite, although he says that there is some variation in this respect.

After studying a photograph of the type of *I. douglasiana* variety *bracteata* Herbert, which is preserved in the Kew Herbarium, Foster concluded that *I. watsoniana* was identical with it, and he applied the earlier name to the plant described by Purdy as *I. watsoniana*. Foster gives the distribution of the variety as "Coastal regions of California around Humboldt County, apparently occurring infrequently elsewhere." Yet specimens of *I. d.* variety *bracteata* bearing Foster's annotations are to be found from Curry County, Oregon, and from Humboldt, San Mateo and Monterey counties in California—areas widely separated from one another. In almost every instance the only distinction between these specimens and *I. douglasiana* is that the spathe valves are separated and in general tend to be rather narrower than the average *I. douglasiana*, yet well within the limits of the species. Field work has shown that spathe valve arrangement is somewhat variable in this species; usually they are opposite, but in some areas certain plants will have separated and divergent spathe valves, whereas in

FIG. 5. Distribution of *Iris douglasiana* and its natural hybrids.

others they will be opposite but divergent; the majority however will have opposite and connivent valves. Foster suggested that the plants which he called *I. d.* variety *bracteata* might have had their origin as a stabilized segregate from a cross between *I. douglasiana* and *I. tenax*, a cross that he says is not impossible from the present range of the two species. He says further, "the occurrence of variety *bracteata* on the southern edge of the limits of *I. tenax* and north of the principal location of *I. douglasiana* would favor such an hypothesis." It is difficult to see how much such an hypothesis could be arrived at from the known distributions of *I. tenax*, *I. douglasiana*, and *I. douglasiana* variety *bracteata*. The only area where the ranges of the two species approach one another is in Curry County, Oregon, which is the southernmost locality for *I. tenax*. From the Curry County locality (where the two species are known to hybridize) to the localities in Humboldt County where *I. d.* variety *bracteata* occurs is a distance of 100 miles, and from the southernmost locality for *I. tenax* to San Mateo and Monterey counties in central coastal California is a distance of perhaps 500 miles. And finally, many of the plants from Cañada Hondo Creek in Santa Barbara County, the southern limit of *I. douglasiana*, have separated and divergent spathes and would, according to Foster's interpretation, be called *I. d.* variety *bracteata*. This population is well isolated from other populations of *I. douglasiana* and is nearly 700 miles from the nearest *I. tenax*. Since the principal difference between typical *I. douglasiana* and *I. d.* variety *bracteata* is the separated spathe valves, and since field work has shown that this character is not constant even within a single population and that it occurs sporadically throughout much of the range of *I. douglasiana*, it seems best not to separate it as a variety but to recognize it as one form of variation to be found within the species, a conclusion reached earlier by Dykes (1913).

Iris douglasiana variety *oregonensis* was described by R. C. Foster (1937) who said that it was known to him from six cited specimens. It is described as having more nearly ovate spathes than the species, a shorter perianth tube, and usually only one flower. It is also reported as being different in sepal shape and color, the latter being recorded as lavender-gray. The distribution is given as Coos and Curry counties, Oregon. Of the six specimens cited by Foster, four have been seen, including the isotype preserved at the Dudley Herbarium. This specimen bears broad leaves, 17 mm. wide, with broad spathe valves 11 mm. in width; the number of flowers in the inflorescence cannot be determined from this specimen. Field work conducted at the type locality, near Myrtle Point, Coos County, has shown that the plants there vary considerably, but many of them have 2-3 flowers in each inflorescence and have spathe valves 6-9 mm. wide and 77-118 mm. long. Perianth tube length varies from 15-18 mm., somewhat shorter than normal for the species. It is my feeling that many of these plants show introgression of genes of *I. tenax* into *I. douglasiana*. These plants will be discussed in detail in Part II.

The specimen at the Dudley Herbarium collected at "cliffs at Bandon Beach" by Abrams and Benson (10606) has a perianth tube about 8 mm. long, with narrow spathes 5 mm. wide and is 1-flowered; the capsule is unlike that of *I. douglasiana* and more like that of *I. tenax*. In citing this collection Foster says "possibly a hybrid," a conclusion that I fully agree with. The third collection, also one made by Abrams and Benson (10633) at Cape Blanco, Curry County, Oregon, shows two plants both of which are 2-flowered, the spathe valves are relatively narrow (about 7 mm. wide), and the perianth tube is about 13 mm. long. These plants are probably of hybrid origin but show less of the influence of *I. tenax* than the plants collected at Bandon Beach. The fourth specimen, also at the Dudley Herbarium was collected by Abrams and Benson (10660) on the "hills back of Gold Beach." This specimen appears to be

FIG. 6. *Iris douglasiana*. a, general habit; b, inflorescence; c, style branch; d, petal; e, sepal; f, g, inner and outer spathe valves; h, seed capsules; i, cross section of seed capsule. a, $\times \frac{1}{6}$; b, h, $\times \frac{1}{3}$; c, d, e, f, g, i, $\times \frac{2}{3}$.

a hybrid between *I. douglasiana* and *I. innominata*, and it comes from an area where field work has shown that these species are hybridizing. Thus, it would appear that of the six specimens of *I. douglasiana* variety *oregonensis* cited by Foster, the four that have been seen by me represent hybrids, three of which are probably hybrids between *I. douglasiana* and *I. tenax* while one appears to be a hybrid between *I. douglasiana* and *I. innominata*.

More recently Clarkson (1955) studying the Oregon irises, came to somewhat the same conclusions that I have regarding *I. douglasiana* variety *oregonensis* except that he postulates that the variety represents crossing and back-crossing only between *I. douglasiana* and *I. innominata*. He does not mention the possibility of *I. douglasiana* and *I. tenax* hybridizing. From his work it does not appear that he has detected this combination in the field. He apparently has not seen the herbarium material cited by Foster and says that his assumptions concerning the variety are largely hypothetical.

Iris douglasiana variety *mendocinensis* was described by Alice Eastwood in 1940 from material collected near Point Arena in Mendocino County, California. The type deposited in the herbarium of the California Academy of Sciences shows a rather slender plant with somewhat narrow spathe valves and small flowers, but the plant is well within the range of variation of the species and thus is not accorded varietal rank here.

Iris douglasiana var. *alpha* was described by Dykes in the Gardeners' Chronicle in 1914. According to him, the plant was like the species except that the flowers were creamy-white with a few deep crimson-purple veins, and he further states that "I can see nothing in this plant that is not typical of *I. douglasiana*, which is so variable a species that in my experience, no two plants produce flowers exactly alike . . ." R. C. Foster reduced this taxon to *I. douglasiana* forma *alpha* saying that there are no specimens available. "However," says Foster, "forma *alpha* seems, *ex desc.*, to be sufficiently unlike the usual *I. douglasiana* in color to warrant the retention of the name . . ." Because of the extreme color variability known to occur in *I. douglasiana* it seems best to include forma *alpha* Foster within the limits of the species since there appears to be nothing else that would separate it from typical *I. douglasiana*.

As mentioned earlier, *I. douglasiana* is a widespread and extremely variable species whose total variability is being increased due to introgressive hybridization between it and other species with which it has come into contact. Well marked and distinct geographic races cannot be detected; however, pronounced variations are to be found within a single population. For these reasons no attempt is made here to segregate subspecific taxa within such a polymorphic species.

Ecologically *I. douglasiana* is a maritime species abundant on the grassy knolls and hills along the Pacific Coast from Coos County, Oregon, south to Santa Barbara County, California—a north-south distribution of nearly 700 miles. It also occurs on large rocks and small islets just off the coast, but it has never been found on any of the large islands farther off shore such as the Farallones or the Santa Barbara Islands. This species also extends up sunny river valleys for distances of perhaps 35 miles, and it may be found in coniferous forests in places where there is considerable sun. Of all the *Californicae* it probably requires, or at least tolerates, more sun than any other species in the series. Edaphically it appears to be most adaptable, being found in heavy clays and even boggy places as well as in areas of well-drained gritty soil with much leafmold. It also appears to tolerate more competition from other herbs than do some of the other species. Indeed, it even thrives in pasture land where there is a heavy sod of grass and sedges. In such situations cattle apparently avoid the iris leaves, preferring instead the grasses, thus favoring the spread of the iris. On grassy hills the plants

often form colonies 4-6 feet in diameter, each clump resulting from the spread of a single plant. Because of its aggressiveness, this species will quickly spread into any coastal area which has been logged or burned. Also because of its aggressiveness it has become a weed in certain areas in north coastal California and farmers and ranchers have taken steps to control it by the use of sprays.

Natural Hybrids.—

I. douglasiana × *I. fernaldii*. CALIFORNIA: Marin and Santa Cruz counties.

I. douglasiana × *I. innominata*. CALIFORNIA: Del Norte County. OREGON: Curry County.

I. × *thompsonii* R. C. Foster (pro sp.)

I. thompsonii R. C. Foster. *Rhodora* 38:199. 1936. *Type.*—Rocky hillsides about Douglas Park, Del Norte County, California. J. W. Thompson 4510. Gray Herbarium. (Type seen.)

I. douglasiana × *I. macrosiphon*. CALIFORNIA: Marin, San Mateo, and Santa Cruz counties.

I. douglasiana × *I. macrosiphon* × *I. purdyi*. CALIFORNIA: Mendocino County.

I. douglasiana × *I. purdyi*. CALIFORNIA: Humboldt and Mendocino counties.

I. douglasiana × *I. tenax*. OREGON: Coos and Curry counties.

Garden Hybrids.—

I. × *aureonympha* C. S. and E. H. English. *Nat. Hort. Mag.* 27: 161. 1948. *Iris douglasiana* (♀) × *I. innominata* (♂).

Type.—Garden hybrid. C. S. and E. H. English 3037.

C. S. and E. H. English Herbarium.

Hybrids between *I. douglasiana* and *I. innominata* are very common in Curry County, Oregon, where they are found in a number of places, especially along the Rogue River. These hybrids will be treated in detail in Part II.

In 1936 R. C. Foster described *I. thompsonii*, a plant reported by him as occurring in Del Norte County, California, and in Curry County, Oregon. However, in his *Cyto-Taxonomic Survey of the North American Species of Iris*, published in 1937, he does not mention the Curry County plants. As he wrote in his 1936 paper, *I. thompsonii* would not be confused with any other member of the *Californicae* except perhaps its nearest relative, *I. innominata*. These plants, Foster says, can be distinguished by having shorter perianth tubes, more narrowly lanceolate spathes, cauline leaves free for a greater portion of their length, perianth segments smaller, slighter, more nearly spatulate, and filaments and anthers equal in length.

From field work conducted in Del Norte County over a period of years, as well as garden studies made on plants grown from seed collected at the type locality, I have concluded that the name *I. thompsonii* has been used to cover a series of hybrids usually between *I. douglasiana* and *I. innominata* but occasionally also for plants showing introgression with *I. bracteata*. *Iris douglasiana* and *I. innominata* are known to hybridize in the area of the mouth of the Rogue River in Curry County, the next county north, and Henderson, in his original description of *I. innominata*, remarks about them by saying, "*I. douglasiana* in that area [the mouth of the Rogue River], shows more yellow color than elsewhere." Field work at Saunders Creek, also on the Rogue River, has shown that these species are hybridizing there at the present time and many of the intermediate forms are to be found in herbaria labeled as *I. thompsonii*. However, the forms found at Douglas Park and elsewhere in Del Norte County, California, have in no instance shown any signs of yellow flower color such as they do farther north. They are, rather, a uniform deep blue-purple to medium lavender, ex-

cept near Hazelview Summit where there has been introgression with *I. bracteata*. This can be explained by assuming that these plants have arisen through hybridization of *I. douglasiana* with the deep blue-purple form of *I. innominata* which is found at higher altitudes in the Siskiyou Mts. of Del Norte County (the High Divide form of *I. innominata* is identical with that from the Rogue River area except for color).

If large numbers of plants from Douglas Park are studied they will be found to be segregating for the various characters which separate the two species. Perhaps the most obvious characters are the nipple-like projection at the tip of the ovary in *I. douglasiana*, as well as the triangular cross section of the ovary found in that species,

FIG. 7. Cape Sebastian, Curry County, Oregon. *Iris douglasiana* leaves in foreground. This species is common on sunny grassy hillsides near the coast.

and the short but proportionally broad spathes of *I. innominata*. Plants labeled *I. thompsonii* are often intermediate in these characters or sometimes very much like one or the other of the two species. Leaf width and length also vary, *I. innominata* having narrow grass-like leaves and *I. douglasiana* having long and usually quite broad leaves. Seed collected in 1948 from plants of *I. thompsonii* growing at the type locality produced in the experimental garden a population of plants varying from ones having leaves 5 inches long and very grass-like to others with leaves almost 1 cm. wide and up to 24 inches long. Flower color varied from lavender to deep purple.

The type specimen of *I. thompsonii* shows a plant that is very slender with grass-like leaves and small delicate flowers, and it could almost be considered as a depauperate form of *I. innominata*. However, other specimens annotated by R. C. Foster as *I. thompsonii* show plants much more intermediate in character than the type specimen.

Clarkson, working independently, reached very much the same conclusion regarding *I. thompsonii*. He says: "There is a strong suggestion of the hybrid origin of that taxon." He says further that *I. thompsonii* has been collected along the Rogue River and along U. S. Highway 101 from Carpenterville to Brookings, Curry County, Oregon. According to him, the principal differences between *I. thompsonii* and *I. innominata* are, in the former, the more lanceolate spathes, in the purple to lavender color, and the greater height of the plant. All these he believes could be fixed by backcrossing *I. douglasiana* $\times$ *I. innominata* to *I. innominata*. However, from my own work I do not believe that *I. thompsonii* at the present time represents a "fixed" population, but merely represents hybridization and backcrossing between the two species.

Hybrids between *I. douglasiana* and *I. fernaldii* have been observed several times. One specimen, preserved in the Dudley Herbarium, was collected by R. C. Foster (241) at Corte Madera Ridge, Marin County, and a second, also from Marin County, was collected by L. Constance and A. A. Beetle (2568) above Alfred Lake southeast of Fairfax. The latter specimen is also in the Dudley Herbarium. In 1955 the author studied a large hybrid population of this cross at Eagle Rock in Santa Cruz County (L. W. Lenz and E. K. Balls 20768 RSA Herb.). This population is treated in detail in Part II.

Hybrids between *I. douglasiana* and *I. macrosiphon* have been detected in Marin, San Mateo, and Santa Cruz counties. A specimen collected on Inverness Ridge, Marin County, by J. T. Howell (25316) and deposited in the California Academy of Sciences Herbarium appears to be such a hybrid. A second specimen, deposited in the Dudley Herbarium, was collected by W. R. Dudley in the Santa Cruz Mts., Santa Cruz County, in 1883. This specimen was annotated by R. C. Foster as probably a hybrid, a conclusion with which I agree.

Hybrids between *I. douglasiana* and *I. purdyi* are fairly common in western Mendocino and Humboldt counties. Among the localities in Mendocino County where it has been studied is one 10 miles west of the junction of Highway 101 with the road to Rockport (L. W. Lenz and E. K. Balls 16522 RSA Herb.). In Humboldt County it is found along the Eel River between Fortuna and Pepperwood. The finest hybrid population so far observed was along the Mattole River southeast of Petrolia along the Old Coast Road (L. W. Lenz and E. K. Balls 20742 RSA Herb.). This population will be discussed in detail in Part II.

The trihybrid *I. douglasiana* $\times$ *I. macrosiphon* $\times$ *I. purdyi* is known only from a single locality along the Faulkner Park road near Boonville (L. W. Lenz and E. K. Balls 16530 RSA Herb.).

The only hybrid population between *I. douglasiana* and *I. tenax* known to me occurs on Langlois Hill near the town of Langlois in northern Curry County. However, a number of herbarium sheets have been seen which seem to be plants of this parentage. These include one collection made by L. R. Abrams and G. T. Benson (10606) at "cliffs at Bandon Beach." This specimen, as well as others believed to be hybrids between these two species, is discussed under *I. douglasiana* variety *oregonensis*.

IRIS FERNALDII R. C. Foster. Iridis Species Novae 1-2, 1953

(Fig. 9)

Rhizome about 6 mm. in diameter, base covered with the remains of old leaves; leaves long, slender, to 7-8 mm. wide and up to 4 dm. long, usually brilliantly colored at the base, leaves gray-green and often quite glaucous, drying to an unusual gray-green color, nerves fairly prominent; flowering stem 2-4 dm. tall, shorter than the

leaves, with 2-several cauline leaves free about $\frac{1}{2}$ of their length, not inflated; spathes 2-flowered; spathe valves opposite, rather broadly lanceolate, 6-11 mm. wide (aver. 7.7 mm.) and 50-90 mm. long (aver. 72 mm.), often flushed with anthocyanin pigment; pedicels variable, 9-22 mm. long (aver. 13 mm.) at anthesis; ovary elliptical, 15-23 mm. long (aver. 18 mm.); perianth tube long, slender, 30-62 mm. long (aver. 48 mm.), in most specimens upper portion rather abruptly dilated to form a conspicu-

FIG. 8. Distribution of *Iris fernaldii* and its natural hybrids.

ous throat; sepals oblanceolate to spatulate, 47-68 mm. long (aver. 54 mm.) and 12-21 mm. wide (aver. 17 mm.); petals narrowly oblanceolate 43-60 mm. long (aver. 51 mm.), and 6-14 mm. wide (aver. 9 mm.); flower color a soft creamy-yellow often variously veined; style branches 22-30 mm. long (aver. 27 mm.); style crests linear to narrowly lunate, 10-17 mm. long (aver. 13 mm.); stigmas triangular; capsule oblong, distinctly beaked, 2.5-3.5 cm. long.

Type.—Along the open roadside, 5 miles west of the Petrified Forest on the Santa Rosa-Calistoga Highway. 17 May, 1937. R. C. Foster No. 203. Gray Herb. In the original description Foster places the type locality in Lake County whereas it should be Sonoma County. (Type seen.)

Distribution.—CALIFORNIA. Lake, Napa, San Mateo, Santa Clara, Santa Cruz, Solano, and Sonoma counties.

Representative specimens.—CALIFORNIA. Lake County: Mt. Sanhedrin, *A. Eastwood* 12810; Mt. St. Helena, *A. Eastwood* 6822. Napa County: Suisun Valley to Wooden Valley, *P. H. Raven* and *G. L. Stebbins* 5301; Between Franz Valley and Calistoga, *J. T. Howell* 16164; Highway south of Monticello, *M. S. Baker* 3955; Butts Canyon, *P. H. Raven* 2872. Santa Clara County: Above Las Trancas Woods, *L. W. Lenz* and *E. K. Balls* 17098. Santa Cruz County: East side of Loma Prieta Ridge, *W. R. Dudley*. Solano County: Wooded canyons, Weldon Canyon, Vaca Mts., *W. L. Jepson* 7192; Wooded hillsides, Gates Canyon, *W. L. Jepson*. Sonoma County: 5 miles east of Mark West Springs, *A. Eastwood* and *J. T. Howell* 5516; Santa Rosa-Calistoga road, .5 miles from junction with road from Mark West Spring, *L. W. Lenz* 14427; Ca. 1 mile from Petrified Forest on road to Calistoga, *L. W. Lenz* 14426; 4.4 miles northeast of Mark West Springs road to Kellogg, *L. W. Lenz* and *E. K. Balls* 17110.

Iris fernaldii was described by R. C. Foster in 1938 from plants collected near the Petrified Forest in Sonoma County, California. Foster placed the type locality in Lake County, but this is in error. Earlier, Foster had labeled these plants as doubtful hybrids between *I. douglasiana* and *I. amabilis* (= *I. macrosiphon*), but he concluded, after a study of *I. douglasiana* in the field and herbarium, that the species did not occur so far to the east and that consequently, opportunity for the production of a hybrid of such parentage seemed lacking. Thus he regarded the plants as distinct, and called them *I. fernaldii*.

Certainly *I. fernaldii* is related to *I. macrosiphon*, but there are distinct morphological differences. In general, the spathe valves are broader than they are in *I. macrosiphon* and the perianth tubes tend to be different. In *I. macrosiphon* the upper part of the tube is somewhat enlarged to form a bowl-like base below the perianth segments. In *I. fernaldii* the upper part of the tube is usually distinctly dilated to form a conspicuous throat much like that in *I. tenuissima*. The leaves of *I. fernaldii* are broader than those of *I. macrosiphon* but not so broad as in *I. douglasiana*. In color they are quite unique, being a peculiar gray-green, often glaucous, and with very strong basal coloring, especially in the form from near the type locality. *Iris macrosiphon* seldom has colored leaf bases and never any with as much coloring as *I. fernaldii*. On drying, the leaves of the latter take on a peculiar gray color and because of their width and length, and their unusual color, they are usually quite easily distinguished from *I. macrosiphon* in most herbarium material.

The flower stems are taller than all but the very tallest *I. macrosiphon* and no stemless plants of *I. fernaldii* such as are common in *I. macrosiphon*, are known. Except for possible hybrids, the flower color is probably always a light yellow. In herbaria this species is usually included under *I. macrosiphon* or sometimes listed as a yellow-flowered *I. douglasiana*. During the course of this study, herbarium specimens have been seen from other areas than Sonoma County which are indistinguishable from material collected at the type locality. These specimens are here placed in *I. fernaldii* and include plants from a number of counties in west coastal California centering around San Francisco Bay. Collections from the Santa Cruz peninsula are almost identical with the Sonoma material with the exception that in some instances these plants lack the anthocyanin coloring on the plant parts such as is found on the Sonoma County plants. It is believed that many of the 'yellow macrosiphons' from the hills west of Gilroy and elsewhere are better placed here than in *I. macrosiphon*.

FIG. 9. *Iris fernaldii*. a, general habit; b, inflorescence; c, petal; d, sepal; e, style branch; f, g, inner and outer spathe valves; h, seed capsule. a, $\times \frac{1}{6}$; b, h, $\times \frac{1}{3}$; c, d, e, f, g, $\times \frac{2}{3}$.

FIG. 10. *Iris fernaldii*. Type specimen.

Ecologically, the species is usually found in somewhat more shade than *I. macrosiphon*, and they most commonly are found in the Mixed Evergreen Forest. Plants grown in the experimental garden have retained their rather unusual leaf coloring.

Natural Hybrids.—

I. douglasiana × *I. fernaldii*. CALIFORNIA: Marin and Santa Cruz counties.

I. fernaldii × *I. macrosiphon*. CALIFORNIA: Napa and Sonoma counties.

In places *I. fernaldii* occurs in the same general area as does *I. macrosiphon* and definite hybrids have been found. One locality where they have been studied is on Troutdale Creek in Napa County (L. W. Lenz and E. K. Balls 17119 RSA Herb.). A second locality is on the slopes of Mt. St. Helena in Sonoma County (L. W. Lenz and E. K. Balls 22620 RSA Herb.). These will be discussed in Part II. Undoubtedly some of the specimens from other areas which do not entirely fit either species represent hybrids between these two rather closely related plants.

Hybrids believed to be between *I. douglasiana* and *I. fernaldii* have been observed from several localities. These include plants collected at Corte Madera Ridge, Marin County, by R. C. Foster (241, Dudley Herb.), and one from Marin County collected by L. Constance and A. A. Beetle (2568 Dudley Herb.). The latter came from above Alfred Lake. A third collection was made by C. Case at Anchorage, and the sheet is deposited in the University of California Herbarium. In 1955 the author studied a large hybrid population at Eagle Rock in the Santa Cruz Mts. (L. W. Lenz and E. K. Balls 20768). These will be treated in Part II.

IRIS HARTWEGII Baker. Gard. Chron. n.s. 6: 323, 1876

(Fig. 12)

Rhizome slender to moderately thick, 5-8 mm. in diameter, creeping and usually covered with the remains of old leaves; leaves relatively few in each clump, deciduous, slender, 2-6 mm. wide, up to 45 mm. long, pale green and sometimes glaucous; leaf bases usually without anthocyanin pigments; flowering stem slender, unbranched, 1-2-flowered, to 30 mm. tall with 1-several sheathing leaves which are free for about ½ their length; spathe valves linear to linear-lanceolate, acute, outer one 4-7 mm. wide (aver. 5.2 mm.), 50-115 mm. long (aver. 80 mm.), usually divergent and separated as much as 40 mm. (aver. 14 mm.), herbaceous; pedicels variable in length, 17-85 mm. long (aver. 47 mm.) at anthesis; ovary nearly cylindrical, 10-20 mm. long (aver. 16 mm.); perianth tube short, stout, 5-10 mm. long (aver. 8 mm.); sepals usually rather oblanceolate, 40-70 mm. long (aver. 52 mm.) and 14-20 mm. wide (aver. 16 mm.); petals narrowly oblanceolate, 35-60 mm. long (aver. 47 mm.) and 5-11 mm. wide (aver. 7 mm.); flower color variable, usually pale yellow or cream colored, but lavender and deep yellow forms are common in some areas; style branch 16-30 mm. long (aver. 23 mm.); style crests obtusely rounded, overlapping, 5-11 mm. long (aver. 10 mm.); stigmas triangular; anthers about 10 mm. long, filaments about the same; capsule oblong-oval, 20-30 mm. long, tapering rather abruptly on either end; seeds irregular in shape, yellowish-brown and coarsely wrinkled.

Type.—Bear Creek, Nevada County, California. Hartweg No. 373, 1847.

Distribution.—CALIFORNIA. Amador, Butte, Calaveras, El Dorado, Fresno, Kern, Madera, Mariposa, Nevada, Placer, Plumas, Sierra, Tulare, Tuolumne, and Yuba counties.

Representative specimens.—CALIFORNIA. Amador County: 4/10 mi. south of Pine Grove, C. B. Wolf 4929. Butte County: Doe Mill, Mrs. C. C. Bruce 2408; near Stirling, A. A. Heller 10803; De Sabla, H. M. Edwards; Forbestown, L. S. Rose 37373; Brush Creek Ranger Station,

FIG. 11. Distribution of *Iris hartwegii* and its subspecies and natural hybrids.

Mrs. H. C. Cantelow; Forest Ranch, A. A. Heller. Calaveras County: Mokelumne Hill, F. E. Blaisdell. El Dorado County: 3 mi. from Placerville on road to Green Valley, C. B. Wolf 4949. Fresno County: West Kaiser Camp on Daulton Road, C. H. Quibell 214; Pine Ridge, H. M. Hall and H. P. Chandler 65. Kern County: Greenhorn Mts. at summit, E. R. Weston 169. Madera County: 3 mi. west of Cold Spring Meadow, Bass Lake, L. Constance 2362; Bridge over North Fork of San Joaquin River between North Fork and South Fork, C. B. Wolf 4806. Mariposa County: Mariposa Big Trees, W. R. Dudley, June 15, 1894. Nevada County: Nevada City, A. Eastwood 530; Head of South Fork of Wolf Creek, H. M. Hall and F. M. Essig 10167; 7 mi. east of Nevada City, L. Constance 2283. Placer County: Ca. 1 mi. west of Baxter, C. L. Hitchcock 6329. Plumas County: North of Quincy, E. I. Applegate 8904. Tuolumne County: Strawberry, R. S. Ferris 7750; Twain Harte Post Office, A. M. Alexander and L. Kellogg 3603; Pine Crest Recreation Area, Stanislaus Natl. Forest, I. L. Wiggins 6799. Tulare County: Near top of ridge, Tobias Creek, L. W. Lenz 22472; 1 mi. above Camp Nelson on road to Quaking Aspen Meadows, L. W. Lenz 17263; Trail up Marble Fork, Upper Kaweah River Valley, W. R. Dudley 1311; 1/2 mi. above Shake Camp Grounds, road to Balch Park, R. S. Ferris and L. Lorraine 12342; Balch Park, Y. W. Winblad.

Iris hartwegii is common in the Yellow Pine forest of the Sierra Nevada at middle altitudes from Butte County south to Kern County. In much of the area it is closely associated with Mountain Misery (*Chamaebatia foliolosa*) and often grows up through the tight mats formed by this plant. It normally prefers sunny or partially

FIG. 12. *Iris bartwegii*. a, general habit; b, inflorescence; c, style branch; d, petal; e, sepal; f, g, inner and outer spathe valves; h, seed capsules. a, $\times \frac{3}{4}$; b, c, d, e, f, g, $\times \frac{2}{3}$; h, $\times \frac{1}{3}$.

FIG. 13. Yellow Pine Forest (*Pinus ponderosa*), Tuolumne County, California. Habitat of golden-flowered form of *I. hartwegii*.

shaded slopes and is not to be found in densely forested areas. If, however, the forests are cut or burned, *I. hartwegii* will quickly spread into the area. In Butte County the species occurs at about 2,000 feet altitude whereas in Tulare and Kern counties in the south it is usually found at 5000-6500 feet, always at altitudes greater than those at which *I. macrosiphon* and *I. munzii* are found. The only locality where another species occurs at a higher elevation than *I. hartwegii* is in Butte County where three species, *I. hartwegii*, *I. macrosiphon*, and *I. tenuissima*, reach the limits of their distribution. Here *I. hartwegii* occupies an intermediate position, with *I. macrosiphon* in the foothills below it and *I. tenuissima* in the woods above it. *Iris hartwegii* is perhaps less variable than are some of the other species of this series. It usually has been thought of as a species with cream or pale yellow flowers, but both lavender and deep yellow-flowered forms are common in some areas. In no instance do the colored forms approach the deep blue-purple that are so common in *I. douglasiana* and *I. macrosiphon*. R. C. Foster, in his treatment of this group, says that the anthers are "exserted nearly half their length beyond the stigmas." This character is not constant within the species or even within members of a single population.

Iris hartwegii and its subspecies, *australis* of San Bernardino and Riverside counties, *columbiana* of Tuolumne County, and *pinetorum* of Amador County, all of California, are closely related to *I. tenax* of Oregon and Washington and *I. tenax* subsp. *klamathensis* of Humboldt County, California, as well as to *I. munzii* of Tulare County, California. Together, these taxa form a distinct and rather clearcut subgroup within the *Californicae*. A full discussion of these plants will be found in Part II of this work.

Natural Hybrids.—

I. hartwegii × *I. macrosiphon*: CALIFORNIA: Placer and El Dorado counties.

FIG. 14. *Iris hartwegii*. Golden-flowered form growing at base of Yellow Pine.

FIG. 15. Near Placerville, El Dorado County, California. *Iris hartwegii* is common here growing associated with *Pinus ponderosa*, *Quercus kelloggii*, and *Corylus cornuta* var. *californica*.

The altitudinal and geographic distribution of this species separates it from most of the other species of the *Californicae*, the exception being *I. macrosiphon*. Where it occurs in the foothills of the Sierra Nevada, *I. macrosiphon* is usually found at altitudes of less than 2000 feet, and it is normally not found in the Yellow Pine zone where *I. hartwegii* occurs. However, near Placerville, in El Dorado County, the two species are often found within close proximity of one another, especially in disturbed and cut over lands. At no time have the two species been found actually occupying the same area, and few plants have been seen which could definitely be called hybrids between the two. One specimen, collected by G. T. Benson, 1 mi. north of Camino in El Dorado County, and deposited in the Dudley Herbarium, was annotated by R. C. Foster as a possible hybrid, a conclusion I fully concur with. In this specimen the flower shows characteristics intermediate between the two presumed parents, and it appears that it might be a first generation hybrid. A second specimen, collected by C. F. Stone in 1891 at Auburn, in Placer County, was annotated by Foster as "hybrid?". This specimen combines features of both *I. hartwegii* and *I. macrosiphon*, but it appears to be closer to *I. macrosiphon* than to *I. hartwegii*. A third specimen, collected by W. S. Shockley at Georgetown, seems to be closer to *I. hartwegii*.

IRIS HARTWEGII subsp. **AUSTRALIS** (Parish) comb. nov.

Iris hartwegii var. *australis* Parish. Erythea 6: 86. 1898.

Iris tenax var. *australis* (Parish) R. C. Foster. Contr. Gray Herb. No. 119: 19, 1937.

Rhizome moderately thick, 6-9 mm. in diameter, creeping and covered with the remains of old leaves; leaves relatively few in each clump, slender, 3-8 mm. wide, up to 4-5 dm. long, hardly longer than the flower stems, leaf bases usually pinkish; flower stem somewhat slender, unbranched, 1-4 dm. tall with 1-several sheathing leaves which are free for about $\frac{1}{2}$ of their length; spathes 2-flowered; spathe valves divergent, separated up to 9 cm. (aver. 4.3 cm.), outer spathe valve linear, 6-9 mm. wide (aver. 7.9 mm.), herbaceous with hyaline edges; pedicels variable, 7-40 mm. long (aver. 28 mm.) at anthesis, that of second flower longer; perianth tube short, stout, 7-10 mm. long (aver. 8.6 mm.); sepals broadly oblanceolate, 50-65 mm. long (aver. 60 mm.) and 15-27 mm. wide (aver. 22 mm.); petals 48-60 mm. long (aver. 54 mm.) and 8-14 mm. wide (aver. 11 mm.); flower color purple to bluish-violet; style branches 20-32 mm. long (aver. 25 mm.); style crests 11-15 mm. long (aver. 13 mm.); stigmas triangular; anthers about 15 mm. long; capsule and seed as in the species.

Type.—None designated.

Distribution.—CALIFORNIA. Riverside and San Bernardino counties.

Representative specimens.—CALIFORNIA. Riverside County: Big Oaks Canyon, Banning, R. L. Rutherford 1672. San Bernardino County: San Sevaine Flat, San Gabriel Mts., J. A. Ewan 11033; 4.2 miles north of junction of Mill Creek with Mt. Home Creek, E. K. Balls and P. C. Everett 19357; Fish Camp, I. M. Johnson 2849; City Creek road, P. A. Munz and I. M. Johnson 2837; Lake Arrowhead, M. E. Jones 24766.

Iris hartwegii subsp. *australis* is very common in the pine woods of the San Bernardino Mts. at altitudes of 5000-7000 feet. It usually grows on partially shaded slopes and on flats, and it seldom occurs in full sun. The variety also is found at a few places in the San Gabriel Mts., and it has been reported as rare in the San Jacinto Mts. Specimens from the latter area have not been seen, and its occurrence in the San Jacintos is doubtful.

No other taxon in this group has had its name changed as many times as has this

little iris. First mention of the plant appears to have been in *The Garden* for January 1, 1898, where in an article on California irises, Carl Purdy wrote:

"In Southern California, in the San Bernardino Mountains, there is a species long referred to

I. missouriensis.—This Professor Foster has named *Iris parishii*. I believe that *I. parishii* as it grows in the San Bernardino Mountains is identical with a form from the Southern Sierras which I had decided was unnamed until I saw specimens of *I. parishii*."

According to Dykes, Purdy's statement that Foster had described the plant from the San Bernardino Mts. as *I. parishii* was apparently based upon a misapprehension. Dykes found among Foster's papers two letters from Parish on the subject. The first, dated January 15, 1897, asks for a description of the plant to which Foster had tentatively given the name *I. parishii*. The second was written on February 1, 1898, and contains a statement that on going into the matter more carefully, he had found the proposed species to be too near *I. hartwegii* to merit a specific name. In 1912 Dykes received a letter from Parish in which he stated that since Foster had failed to publish any description of the plant, he himself had described it in *Erythea* under the name *I. hartwegii* var. *australis*. Dykes, in his monograph of the genus published in 1913, was inclined to the idea that there was no specific difference between *I. tenax* and *I. hartwegii*, and of the variety he wrote: "Unfortunately Mr. Parish does not say how his plant, which grows in open coniferous forests at an elevation of from 5000-6000 feet, is to be distinguished from either *I. hartwegii* or from *I. tenax*." In the *Handbook of Garden Irises* published in 1924, Dykes says: "There is in Tulare Co., California, at a height of about 2,000 feet in the foothills of the Sierra Nevada, a plant with rather scanty foliage of a grey, glaucous green which agrees with *I. tenax* in having the widely separated spathes, so characteristic of that species. This plant is, I believe, sometimes known as *Hartwegii australis* and has large flowers of the same shape as those of *tenax* and of varying shades of purple, usually with darker veins upon a paler ground." It is obvious that in this case Dykes was referring to what was later to be described as *I. munzii*.

In R. C. Foster's *Survey of the North American Species of Iris* (1937) he makes the San Bernardino plants a variety of *I. tenax*, *I. tenax* var. *australis*, saying, "In view of its resemblance to *I. tenax*, I am unable to see why this plant should any longer be recognized as a variety of *I. hartwegii* Baker." Since that time the variety has been placed variously under *I. tenax* or *I. hartwegii* by different workers. Field studies of the three taxa involved show conclusively that the southern form is definitely and closely related to *I. hartwegii* and morphologically it is sometimes difficult to separate the San Bernardino material from some collections of *I. hartwegii* made in the southern Sierra Nevada. Thus it appears that the question is not whether it is a variety of *I. tenax* or *I. hartwegii*, but rather, is it distinct enough to be separated from *I. hartwegii*? There are, however, slight but consistent differences, and these along with its distinct geographic distribution would appear to be sufficient to distinguish it as a separate though very closely related subspecies.

Iris hartwegii subsp. *australis* is separated from *I. tenax* in a number of ways. *Iris tenax* tends to form clumps, sometimes rather large ones, *I. b.* subsp. *australis* does not; the leaves of the two are also quite different, those of *I. tenax* being light green and of a rather soft texture whereas those of *I. b.* subsp. *australis* are dull gray-green and rather harsh. In the former the leaves are usually longer than the flower stalk, in the latter they are barely as long. As pointed out by R. C. Foster, (1937) the perianth tubes of *I. b.* subsp. *australis* are much broader than those of *I. tenax*. According to

S. Stillman Berry, as quoted by R. C. Foster, in the garden the plants are very different in habit of growth, a feature noted in the experimental plot at this Garden.

Ecologically *I. hartwegii* and *I. h.* subsp. *australis* are both plants of the Yellow Pine forests where they are found at middle altitudes. *Iris tenax* is a plant of sunny situations on the oak-covered hills of west central Oregon and north to Washington. It is especially abundant in the Willamette and Umpqua Valleys but always at relatively low elevations. D. P. Rogers, in writing about his experiences with the Oregon irises, says, "In west central Oregon, where we lived, *Iris tenax* seems ubiquitous. In reality it never grows in the big woods nor in the wet flat lands along the river. But on the open fields, even pastured ones, or the brushy hills not shaded by too many trees, it is one of the commonest of spring flowers."

Iris hartwegii subspecies *australis* can be distinguished from the species in several ways. In the subspecies the spathe valves are consistently broader than they are in the species, with an average of 5.2 mm. for *I. hartwegii* and 7.9 mm. for *I. h.* subsp. *australis*; the average for *I. tenax* is 4.1 mm. The pedicels are quite variable in both forms but the average for the species is 47 mm. whereas the average for the subspecies is 28 mm. Although flower color is of questionable value in delimiting species in this series, there is a constant difference between the flowers of *I. hartwegii* which may be cream colored, yellow, or light lavender, and those of *I. h.* subsp. *australis* which are always light purple or bluish-violet—in all instances a darker color than anything known in *I. hartwegii*. Geographically, the two are well separated.

Natural Hybrids.—There are no known natural hybrids.

IRIS HARTWEGII subsp. COLUMBIANA subsp. nov.

Rhizomata moderate crassum, ca. 7-9 mm. diam.; folia ad 9 dm. longa, 1 cm. lata, virida vel sub-glauc; caulis simplex, ad 35 cm. longus; spathae valvae herbaceae, remotae, exteriora 5-8 mm. latae, ad 120 mm. longae, 2-fl., pedicelli inaequilongi, primus quam secundus longior, 20-30 mm. longus; ovarium ellipticum; perianthii tubus ca. 8 mm. longus; perianthii segmenta exteriora anguste oblanceolata 50-65 mm. longa, 17-24 mm. lata, lutea clara; segmenta interiora lineari-oblanceolata, 45-59 mm. longa, ad 14 mm. lata, lutea clara; stigma triangulare vel acuminatum; capsula ca. 40 mm. longa, 18 mm. lata.

Rhizome moderately stout, about 7-8 mm. in diameter, covered with the remains of old leaves; leaves as much as 9 dm. long and 1 cm. wide, bright green, slightly if at all glaucous, leaf bases slightly tinged with red or sometimes colorless; flower stem as much as 35 cm. tall, unbranched and usually shorter than the leaves, usually 3-flowered, stem with about 3 sheathing leaves free for about ½ of their length; spathe valves separated and divergent, outer one linear lanceolate, 5-8 mm. wide and as much as 120 mm. long; pedicel of first flower 20-30 mm. long at anthesis, those of later flowers longer; ovary oblong, nearly round in cross section, tapering abruptly into the perianth tube and gradually into the pedicel; perianth tube about 8 mm. long; sepals broadly lanceolate to oblanceolate, 50-65 mm. long and 17-24 mm. wide; flower color pale clear creamy-yellow with golden-yellow veining; stigma triangular, anthers about 18 mm. long, filaments about 8 mm. long; capsules about 40 mm. long and 18 mm. in diameter, tapering abruptly at either end.

Type.—Between Five Mile Creek and Italian Bar, South Fork, Stanislaus River, Tuolumne County, California. 21 May, 1957. Lee W. Lenz and E. K. Balls 22497, Rancho Santa Ana Botanic Garden Herbarium. Isotypes have been deposited at the

FIG. 16. *Iris hartwegii* subsp. *columbiana*. Type specimen.

following herbaria: Gray, University of California (Berkeley), University of Oregon, University of Washington, New York Botanical Garden and Kew.

Distribution.—CALIFORNIA. Tuolumne County.

In December, 1956, while checking specimens in the Jepson Herbarium, I came across two sheets of a taxon that was entirely new to me. One collection was made by W. L. Jepson (6356) in 1915 in Tuolumne County at Italian Bar on the South Fork of the Stanislaus River. The second was that of Adele Grant (741), also made in Tuolumne County but at Five Mile Creek, given as being near Columbia. This collection was made in 1916. Actually the two localities, as later determined, are only about a mile apart. The plants of the two collections are very much alike. In both instances they show specimens with three flowers in each inflorescence and leaves which are rather broad and long. No species in the *Californicae* is known to possess three-flowered inflorescences except *I. munzii* and *I. douglasiana* and the latter is a maritime species, never getting inland more than perhaps thirty-five miles. In overall size the two Stanislaus collections show plants which are somewhat small for typical *I. munzii* from the Tule River area in Tulare County. Nevertheless, it appeared that these two collections were more closely allied with *I. munzii* than with *I. hartwegii*, the only other species with which they showed any affinity, and the two sheets were tentatively labeled as *I. munzii*. Since other specimens similar to these two collections had not been seen while examining herbarium specimens from most of the major West Coast herbaria, it was decided that a special effort would be made the following spring to search the South Fork of the Stanislaus to determine whether or not plants were still growing in the area. R. C. Foster does not mention these collections and presumably did not see them. In May, 1957, in company with Mr. E. K. Balls, I visited the area and found the iris growing in abundance on the hillsides between Five Mile Creek and Italian Bar. Apparently this is the first collection made of this plant in forty-one years. A large collection of specimens was made for distribution and live plants were brought back for growing in the experimental garden.

Neither Jepson nor Grant mention the flower color and I was surprised to find that they were pale yellow, a color unknown to *I. munzii* but common in *I. hartwegii* which has both yellow and lavender forms. A careful study of the plants showed that they were quite intermediate in appearance between *I. munzii* and *I. hartwegii*. In fact, they are very similar to an F_1 population produced in the experimental garden at the Rancho Santa Ana Botanic Garden several years ago. Within the area studied, the plants appeared to be rather uniform; in plant size they are intermediate between the two species; in flower size and color they more nearly approach *I. hartwegii*. In number of flowers in each inflorescence they favor *I. munzii* which usually has three, and sometimes four, flowers compared with *I. hartwegii* which has one or two flowers. The plants at Five Mile Creek are usually three-flowered and very occasionally two-flowered. Both yellow flower color and the three-flowered inflorescence are dominant in the F_1 over blue-lavender flower color and the one- or two-flowered inflorescence. In general, the plants lacked the peculiar glaucous blue-green leaves of *I. munzii*.

Ecologically, *I. munzii* is strictly a plant of the Foothill Woodland plant community (Munz and Keck classification), growing at altitudes of 1800-2400 feet, while *I. hartwegii* is a plant of the Yellow Pine Forest community where it grows at about 2000 feet in Butte County in the north to about 6500 feet in Kern County in the south. *I. hartwegii* subsp. *columbiana* is found in a habitat which is a mixture of both Foothill Woodland and Yellow Pine Forest.

Geographically, *I. hartwegii* subsp. *columbiana* grows within the area of distribu-

tion of *I. bartwegii* which is common on the western slopes of the Sierra Nevada at middle altitudes from Butte County south to Kern County. *Iris munzii* on the other hand is not known at present outside of Tulare County, a distance of about 140 miles from the plants at Five Mile Creek.

Further consideration of this subspecies will be found in Part II.

IRIS HARTWEGII subsp. PINETORUM (Eastw.) comb. nov.

Iris pinetorum Eastw. Proc. Calif. Acad. Sci. (ser. 4) 20: 137. 1931.

Rhizome slender with few roots, 5-6 mm. in diameter and covered with the remains of old leaves; leaves pale green, finely striated, linear, to 40 cm. long and 5 cm. wide; leaf bases usually faintly tinged with pink; flower stem slender, to 30 cm. tall, 2-flowered, unbranched, shorter than the leaves, covered with 2-4 closely cauline leaves which are free for about $\frac{1}{4}$ - $\frac{1}{3}$ of the length, not inflated; spathe valves separated 10-28 mm. (aver. 16 mm.), divergent, outer one linear lanceolate, herbaceous, 3-6 mm. wide (aver. 4.0 mm.), and 50-72 mm. long (aver. 60 mm.); pedicel 5-17 mm. long (aver. 9.4 mm.); ovary 12-15 mm. long, equally tapered at either end; perianth tube 12-15 mm. long (aver. 14 mm.), rather thick and in some specimens divided into a short tube above the ovary, then dilated to form a rather broad throat; sepals narrowly oblanceolate, 48-63 mm. long (aver. 59 mm.) and 12-20 mm. wide (aver. 16 mm.); petals 40-60 mm. long (aver. 51 mm.) and 6-12 mm. wide (aver. 9.3 mm.); flower color pale creamy-yellow with conspicuous deep gold veining on the sepals, flower parts wide spreading and usually rather crisped; style branches rather long (aver. 27 mm.); style crests 9-13 mm. long (aver. 10 mm.), slender, slightly emarginate; stigmas triangular; capsule broadly oblong, about 2 cm. long.

Type.—Forest Lodge, near Greenville, Plumas County, California. 11 June, 1927. A. Eastwood 11454. California Academy of Sciences Herbarium. (Type seen.)

FIG. 17. *Iris bartwegii* subsp. *pinetorum*.

Representative specimens.—CALIFORNIA. Plumas County: 1.2 mi. east of Lake Almanor, state Hwy. 89, L. W. Lenz and E. K. Balls 21839; Forest Lodge near Greenville, A. Eastwood 14454 (type); 5½ mi. n. of Quincy, state Hwy. 89, Mrs. H. C. Cantelow; Canyon above Pine Valley, M. S. Baker 12446; 3.1 mi. n. of Greenville, road to Lake Almanor, L. W. Lenz and E. K. Balls 20710.

Iris pinetorum was described by Alice Eastwood in 1931 from plants collected at Forest Lodge near Greenville in Plumas County, California. According to Eastwood the plants had narrow leaves and slender floral parts, resembling in these respects *I. tenuissima*, but the spathes were unlike those of that species. Further, she says that it might be considered a variety of *I. californica* Leicht (= *I. macrosiphon*), but its widely spreading and very slender floral parts separate it from that species. It is noteworthy that she did not mention its resemblance to *I. hartwegii* since it is much closer to that species than to *I. californica*. Foster (1937) said that it was known to him only from the type specimen and he remarks about the spathes being narrow and divergent as well as distant, a character of the *I. tenax-hartwegii-munzii* complex. He also mentions its resemblance to *I. tenuissima* and further postulates that it may prove to be a hybrid between *I. hartwegii* and *I. tenuissima*, or a stabilized segregate between the two. However, he felt that until it was better known it should retain the status given the plant originally.

Recent field work has shown that *I. b.* subsp. *pinetorum* is more widespread in its distribution than it once was believed to be. However, it has not been found outside of Plumas County. This subspecies is often abundant, growing in light to fairly heavy shade in the Yellow Pine forest between 4000-5000 feet altitude. Compared with many of the other species of the *Californicae*, the plants of this taxon are quite uniform, plant height being the most variable character. One rather unusual feature about it is that both flowers in the inflorescence may be open at the same time. In the other species the two (or more) flowers open consecutively. This entity is certainly closely allied to both *I. hartwegii* and *I. tenuissima* and may well have had its origin as a hybrid between the two, as originally postulated by R. C. Foster. It differs from *I. tenuissima* in having a short perianth tube and narrow separated spathe valves, and from *I. hartwegii* in having long narrow style branches and style crests and a perianth tube which is longer than those found in that species. A full consideration of this subspecies, as well as the reasons for placing it as a subspecies of *I. hartwegii* will be found in Part II.

Natural Hybrids.—No natural hybrids are known.

IRIS INNOMINATA Henderson. Rhodora 32: 23. 1930

(Fig. 19)

Rhizome slender, 3-4 mm. in diameter; leaves abundant, 2-4 mm. wide and up to 35 mm. long, dark shining green above, lighter green below; leaf bases colored pink to deep purplish-red; leaves longer or shorter than flower stem; flower stem slender, unbranched, to 2 dm. tall, cauline leaves 2-4, free for about ⅓ of their length, not inflated; spathe 1-2-flowered; spathe valves opposite, subequal, broadly lanceolate to ovate, herbaceous with scarious margins, 33-60 mm. long (aver. 45 mm.) and 5-7 mm. wide (aver. 5.5 mm.); pedicels 4-13 mm. long (aver. 8.5 mm.) at anthesis; perianth tube 15-30 mm. long (aver. 22 mm.), linear; sepals broadly lanceolate to oblanceolate, 44-63 mm. long (aver. 52 mm. and 17-30 mm. broad (aver. 22 mm.); petals slightly shorter than sepals, 39-57 mm. long (aver. 46 mm.) and 9-16 mm. wide (aver. 12 mm.); flower color variable, deep golden-yellow variously veined with darker colors, or occasionally clear yellow with no veining, to lavender and deep purple; style branches 19-26 mm. long (aver. 22 mm.); style crests 9-14 mm. long

FIG. 18. Distribution of *Iris innominata* and its natural hybrids.

FIG. 19. *Iris innominata*. a, general habit; b, inflorescence; c, style branch; d, petal; e, sepal; f, g, inner and outer spathe valves; h, seed capsules; i, cross section of seed capsule. a, $\times \frac{1}{6}$; b, c, d, e, f, g, i, $\times \frac{2}{3}$; h, $\times \frac{1}{3}$.

FIG. 20. *Iris innominata*. Type specimen.

(aver. 11 mm.), subquadrate to semi-ovate, irregularly and bluntly toothed; stigmas triangular; capsule oblong to oval, 2-3 cm. long; seeds round to irregular in shape, brown and finely wrinkled.

Type.—Dry sunny wooded banks of Rogue River, 5-8 miles above ferry. Curry County, Oregon, 23 May (flower), 14 July (fruit) 1929. L. F. Henderson 10086. University of Oregon Herbarium. (Type seen.)

Distribution.—CALIFORNIA. Del Norte County. OREGON. Coos, Curry, Douglas and Josephine counties.

Iris innominata is found in northern Del Norte County, California, and adjacent southwestern Oregon where it is often extremely abundant on sunny or slightly shaded hillsides. It is usually found in well-drained slightly acid soil rich in humus and in many places it is found in association with the Big-leaved Rhododendron (*Rhododendron macrophyllum*), Western Azalea (*R. occidentale*), and Bear Grass (*Xerophyllum tenax*). The plants are normally covered with snow during the winter months during which time the leaves usually remain green, turning brown only in the spring after the new growth has commenced. During the spring months the soil is quite moist, but later in the season the plants are subjected to severe drying and relatively high temperatures. In cultivation this species has proven to be very adaptable and it grows well in a variety of soils and climates, even doing well in southern California when exposed to full sun.

This species was discovered in 1928 by Mrs. John R. Leach, a well-known Portland botanist, gardener, and explorer. It was introduced into cultivation about 1932; since that time it has become a very popular species with horticulturists and much has been written about it.

In the past, *I. innominata* has been considered as a yellow-flowered species and colored forms have usually been referred to *I. thompsonii*. However, field work combined with studies made in the experimental garden have shown that many of the plants referred to as *I. thompsonii* are actually hybrids between *I. douglasiana* and *I. innominata*. However, in northern Del Norte County, California, near High Divide on the High Divide-Low Divide road, there are plants with deep blue-purple flowers which are impossible to separate from *I. innominata* in any way except flower color. These plants are here included with *I. innominata*. Riddle (1948), in his excellent account of the species, also reports flower color variation which he says is not due to hybridization and he reports that "In the interior, colonies of brilliant violet and orchid colored flowers are found interspersed among the yellow forms." As has already been mentioned elsewhere, flower color *per se* is of little value in distinguishing many of the species in the *Californicae* and the color range of yellow-lavender-purple is to be found in at least four other species, *I. douglasiana*, *I. hartwegii*, *I. macrosiphon*, and *I. tenax*.

Natural Hybrids.—

I. chrysophylla × *I. innominata*. OREGON: Curry County.

I. douglasiana × *I. innominata* (= *I. × thompsonii*).

CALIFORNIA: Del Norte County. OREGON: Curry County.

I. innominata × *I. tenax*. OREGON: Douglas County.

Garden Hybrids.—

I. × aureonympha C. S. and E. H. English. Nat. Hort. Mag. 27: 161, 1948. *Iris douglasiana* (♀) × *I. innominata* (♂).

Type.—Garden hybrid. C. S. and E. H. English, 3037.

C. S. and E. H. English Herbarium.

FIG. 21. *Iris innominata*. Near Iron Mt., Curry County, Oregon.

FIG. 22. Near Iron Mt., Curry County, Oregon. *Iris innominata* is common here associated with *Rhododendron macrophyllum* (center), *R. occidentale* (center distance), and *Xerophyllum tenax* (left foreground).

Iris innominata is known to hybridize in nature with *I. douglasiana* and *I. tenax* and other hybrid combinations have been reported or are suspected.

Hybrids between *I. douglasiana* and *I. innominata* are common in a number of areas where the ranges of the two species approach one another. *Iris* $\times$ *thompsonii* belongs here. This hybrid combination already referred to under *I. douglasiana* and treated in detail under *I. \times thompsonii* has been found at Saunders Creek along the Rogue River, Curry County, Oregon, and Henderson in his original report of *I. innominata* says, "*Iris douglasiana* was in places up the Rogue River associated with *I. innominata*, and wherever this was the case it had much more yellow than usual, showing the beginnings of hybridization." Hybrids between these species have also been found near Brookings, also in Curry County, and near the mouth of the Smith River in Del Norte County, California.

Clarkson (1955) in discussing flower color variation found along the Rogue River stated that where *I. douglasiana* and *I. innominata* are hybridizing he found no red or maroon colored flowers such as are common in garden hybrids. In 1951, the author collected material at one locality on the Rogue River (the Doyle Ranch) which showed all the range of color variation found in garden hybrids, including reds, bronzes, and maroons. A discussion of these hybrids will be found in Part II.

Hybrids between *I. innominata* and *I. tenax* are known to me only from a single collection made by L. F. Henderson (13026 Univ. Oregon Herb.) on "moist sandy banks of West Fork of Cow Creek, Douglas County, near bridge, Oregon." According to the label on the sheet, one of the plants was found growing associated with *I. innominata* and was probably a hybrid. From the appearance of the plant, I would assume that it was of hybrid origin.

I have seen no material that I would interpret as representing hybrids between *I. chrysophylla* and *I. innominata*. However, in the University of Oregon Herbarium, there are two sheets which have been annotated by Clarkson as possibly such a hybrid. These are discussed under *I. chrysophylla*.

IRIS MACROSIPHON Torrey. Pacif. Rail. Rep. 4: 144, 1857

(Fig. 24)

Iris amabilis Eastw. Bull. Torr. Bot. Club. 30: 484. 1903. *Type*.—Nevada City, Nevada County, California. May 1902. C. W. Kitts, Calif. Acad. Sci. Herb. (Type seen.)

Iris californica Leightlin. The Garden 52: 126. 1897. *Nomen nudum*; Purdy, The Garden 53: 1. 1898, *nomen subnudum*; Abrams, Illus. Fl. Pacif. States 1: 465, 1923.

Iris macrosiphon var. *elata* Eastw. Leaf. West. Bot. 2: 264. 1940. *Type*.—Clear Lake Park, 16 May, 1938. A Eastwood and J. T. Howell 5565. Calif. Acad. Sci. Herb. (Type seen.)

Rhizome slender, to 8 mm. in diameter, covered with the remains of old leaves; leaves linear, exceeding the stems, to 5 mm. wide and 4 dm. long, often glaucous, leaf bases usually colorless; flowering stem slender, unbranched, sometimes nearly absent or as much as 2.5 dm. tall with 2-4 cauline leaves which are free for about 1/2 of their length, spathes 1-2-flowered, usually 2-flowered; spathe valves opposite, lower one linear lanceolate, 4-9 mm. wide (aver. 6.2 mm.), and 39-95 mm. long (aver. 70 mm.); pedicels 3-20 mm. long (aver. 9 mm.) at anthesis; ovary ovoid, 12-14 mm. long (aver. 18 mm.); perianth tube slender 36-86 mm. long (aver. 53 mm.) with a more or less bowl-like enlargement below the base of the perianth segments; sepals variable in shape and size from narrowly oblanceolate to broadly ovate, 39-68 mm. long (aver. 53 mm.), and 12-16 mm. wide (aver. 18 mm.); petals slightly shorter than sepals, 34-67 mm. long (aver. 49 mm.) and 5-16 mm. wide (aver. 10 mm.); flower color extremely variable, deep golden-yellow, cream-colored, pale lavender to

deep blue-purple, usually distinctly veined and sometimes with a conspicuous white center in the sepal; some flowers delightfully fragrant; style branches 19-33 mm. long (aver. 26 mm.); style crests 8-18 mm. long (aver. 12 mm.), subquadrate to semi-ovate, erose margined; stigmas triangular; capsule oblong to ovoid, 2.5-3 cm. long; seeds angular, dark brown, finely wrinkled.

Type.—Hillsides, etc. Corte Madera, California. 10 April, 1854. J. Bigelow, New York Bot. Gard. Herb.

Distribution.—CALIFORNIA. Butte, El Dorado, Glenn, Lake, Marin, Mendocino, Napa, Nevada, Placer, Santa Clara, San Mateo, Santa Cruz, Sierra, Shasta, Sonoma, Tehama, Trinity, and Tuolumne counties.

Representative specimens.—CALIFORNIA. Butte County: 3 miles above Centerville, *A. A. Heller* 11844. El Dorado County: Near Forest Genetics Laboratory, Placerville, *L. W. Lenz* 19129. Lake County: Near Lakeport, *L. F. Henderson* 15361; 3 miles west of Lower Lakes on road to Kelseyville, *D. D. Keck* 2379; Southern slope of Mt. Sanhedrin above sawmill, *A. A. Heller* 5915; Between Calistoga and Middletown, *L. W. Lenz* and *E. K. Balls* 17122. Marin County: Big Rock Ridge, *G. T. Robbins* 1532; Mt. Tamalpais, *A. Eastwood* 2514. Mendocino County: Redwood Valley, 6 miles north of Calpella, *J. P. Tracy* 15721; Fort Bragg road, 6 miles from Willits, *I. L. Wiggins* and *R. S. Ferris* 10171; 4.8 miles from Covelo on road to Mina, *L. W. Lenz* and *E. K. Balls* 17178; 6.4 miles west of Highway 101, road to Boonville, *L. W.*

FIG. 23. Distribution of *Iris macrosiphon* and its natural hybrids.

Lenz and E. K. Balls 17151. Napa County: Howell Mt., P. H. Raven 4044; 2 miles west of Yountville, Miyaka Mts., L. Constance 2132. Placer County: At edge of Applegate, L. Constance and J. L. Morrison 2173. San Mateo County: San Bruno Mt., A. E. Borrell 58. Santa Clara County: 1 mile above Smith Creek Ranger Station, Mt. Hamilton, L. W. Lenz and E. K. Balls 17101; Above Packwood Creek, Mt. Hamilton Range, R. S. Ferris 840; Road to Madrone Springs, A. Eastwood and J. T. Howell 4321. Shasta County: West of Platina, L. W. Lenz and E. K. Balls 22543. Sonoma County: 4 miles north of Camp Meeker, E. Armstrong 937. Trinity County: Along Mad River, 5 8/10 miles above Eureka-Red Bluff on road to Ruth, C. B. Wolf 8920. Tuolumne County: Moccasin Creek, A. Eastwood and J. T. Howell 8756; Coulterville-Big Oak Flat road just north of Mariposa County line, C. B. Wolf 4867.

Iris macrosiphon is an extremely variable and widespread iris occurring on both sides of the Great Valley of California from Mt. Hamilton in Santa Clara County on the west, north to Glenn and Tehama counties. On the east side of the Valley it is found in the low foothills of the Sierra Nevada from Butte County south to Tuolumne County. Within this area it is found at altitudes of less than 100 feet to well over 3000 feet. It is a species which occupies sunny grassy hills, edges of woods or lightly shaded slopes. It is found in the Foothill Woodland, Northern Oak Woodland, and Mixed Evergreen plant communities. On the eastern slopes of the Inner Coast Ranges it is occasionally found in Yellow Pine islands surrounded by Chaparral.

This is undoubtedly the most confusing and difficult species in the *Californicae*, and R. C. Foster (1937) expressed the hope that with further field study it might be possible to make specific or varietal segregates. In his treatment he included *I. californica* Leicht., and *I. amabilis* Eastw. with *I. macrosiphon*, *sensu lato*.

As Foster points out, *I. californica* Leicht. is a *nomen nudum* and *I. californica* Leicht. ex Purdy at best is a *nomen subnudum* since the name was not used with an adequate description until 1923 when Abrams took it up in his *Illustrated Flora of the Pacific States*. Eastwood in 1903 described *I. amabilis* from material collected at Nevada City, in the foothills of the Sierra Nevada. Foster concluded that *I. amabilis* was conspecific with "many, if not most, of the northern specimens of '*I. californica*,'" and he further says that "since the later name apparently includes at least two entities and from the first has been loosely and indefinitely applied, it appears best to reject it as a *nomen dubium* and to extend the original concept of *I. amabilis* to cover the northern forms." This, however, was only a suggestion awaiting the test of field study.

Abrams in his *Illustrated Flora of the Pacific States* recognized both *I. californica* and *I. macrosiphon*, reserving the former name for the forms with stems 10-30 cm. tall, perianth tube 25-40 mm. long, and cream-colored flowers; *I. macrosiphon* he described as having very short stems, lilac-purple flowers, and perianth tubes 4-8 cm. long. He included *I. amabilis* within *I. macrosiphon*, saying that it was clearly a member of the *I. macrosiphon* group and doubtedly distinct from *I. californica*, the chief distinction being in its shorter perianth tube. Field work has shown that stem height is not a reliable character for separating taxa within this series; many of the other taxa are also represented by tall-stemmed and short-stemmed forms.

In recent years, the name *I. amabilis* has often been applied to certain tall-stemmed, cream-colored forms which are found in the hills of Santa Cruz County. This area is one which has been much disturbed in recent years and many of the plants found there are of hybrid origin. Others are separated out here as representing *I. fernaldii*.

In 1940, Eastwood described a plant collected at Clear Lake Park, Lake County, California, as *I. macrosiphon* var. *elata*, saying of the variety, "This specimen [the type] is 6 dm. tall, stem with 2-3 leaves, and flowers with delicate fragrance." The height given for the type is greater than that heretofore known in the species. Mr.

FIG. 24. *Iris macrosiphon*. a, general habit; b, inflorescence; c, style branch; d, petal; e, sepal; f, g, inner and outer spathe valves; h, capsules; i, cross section of capsule. a, $\times \frac{3}{4}$; b, c, d, e, f, g, i, $\times \frac{2}{3}$; h, $\times \frac{1}{3}$.

John Thomas Howell of the California Academy of Science was kind enough to measure the specimen for me and he reported that it was 3 dm. tall rather than 6 dm. This height is not uncommon for the tall-stemmed form of the species. Fragrance, as already mentioned, may be found in some plants of this species and not in others, and it is considered to have no taxonomic significance. Since this taxon differs in no other respect from typical *I. macrosiphon*, it is not recognized here as distinct from the species.

After several years of careful field work, during which time plants were studied over the entire range of this species, I have come to the conclusion that *I. macrosiphon* represents a highly polymorphic species within which it would be impossible to segregate clear-cut and distinct subgroups. In addition to the natural variation, it has hybridized, like *I. douglasiana*, with a number of other species, thus increasing its variability locally.

Natural Hybrids.—

I. douglasiana × *I. macrosiphon*. CALIFORNIA: Marin, San Mateo, and Santa Cruz counties.

I. douglasiana × *I. macrosiphon* × *I. purdyi*. CALIFORNIA: Mendocino County.

I. fernaldii × *I. macrosiphon*. CALIFORNIA: Napa and Sonoma counties.

I. hartwegii × *I. macrosiphon*. CALIFORNIA: Placer and El Dorado counties.

I. macrosiphon × *I. purdyi*. CALIFORNIA: Trinity County.

I. macrosiphon × *I. tenuissima*. CALIFORNIA: Trinity County.

Plants presumed to be hybrids between *I. douglasiana* and *I. macrosiphon* have been found in three counties within the San Francisco Bay region—Marin, San Mateo, and Santa Cruz counties. One such collection was made by J. T. Howell (25316) on Inverness Ridge, Marin County. This specimen is deposited in the California Academy of Sciences Herbarium. A second specimen deposited in the Dudley Herbarium was collected by W. R. Dudley in the Santa Cruz Mountains of Santa Cruz County in 1883. This particular specimen was annotated by R. C. Foster as probably being of hybrid origin, a conclusion that I agree with.

The trihybrid, *I. douglasiana* × *I. macrosiphon* × *I. purdyi*, is known only from a single locality, Faulkner Park road, near Boonville. This population will be treated fully in Part II.

Hybrids between *I. fernaldii* and *I. macrosiphon* have been studied in the field at two localities, one on Troutdale Creek in Napa County (L. W. Lenz and E. K. Balls 17119 RSA Herb.), and the other on the slopes of Mt. St. Helena (L. W. Lenz and E. K. Balls 22620 RSA Herb.). This hybrid combination is a little more difficult to detect than are some of the others and undoubtedly a number of specimens which do not entirely fit either *I. macrosiphon* or *I. fernaldii* represent introgressive hybridization between these two rather closely related species.

The hybrid combination, *I. hartwegii* × *I. macrosiphon*, is known only from three localities in the foothills of the Sierra Nevada on the east side of the Valley. In the Dudley Herbarium there is a collection made by G. T. Benson (13), 1 mile north of Camino in El Dorado County, which R. C. Foster annotated as a hybrid between these two species. After examining the sheet, I agree about its possible hybrid origin. A second specimen, one collected by C. F. Stone in 1891 at Auburn in Placer County, was annotated by Foster as "hybrid?". I interpret this specimen as being of hybrid origin but showing more of the characters of *I. macrosiphon* than *I. hartwegii*. A third specimen, also in the Dudley Herbarium, was collected by W. S. Shockley at George-

FIG. 25. Upper. *Iris tenuissima* showing perianth tube with conspicuous throat. Lower. *Iris macrosiphon* showing perianth tube with bowl-like enlargement below the perianth segments.

town in El Dorado County and appears to be closer to *I. hartwegii* than to *I. macrosiphon*.

Hybrids between *I. macrosiphon* and *I. purdyi* have been found at several places within Mendocino County. One plant of what appeared to be a possible F₁ hybrid was found about 2 miles west of U. S. Highway 101 on the road to Glen Alder Springs (L. W. Lenz and E. K. Balls 16413 RSA Herb.). In this plant the spathe valves were wide and rather typical of *I. purdyi* whereas the flower color was a rather deep lavender, more that of *I. macrosiphon*. The plant lacked the inflated bract-like leaves on the stem which are typical of true *I. purdyi*. One of the most characteristic things about *I. purdyi* is the truncate stigmas which are found in no other species of this series. In *I. macrosiphon* the stigmas are triangular or tongue-shaped; those in the presumed hybrid are intermediate between the two species and are rather rounded.

Hybrids between *I. macrosiphon* and *I. tenuissima* have been studied in the field at several localities in Trinity County. One hybrid population was found at an elevation of 2500 feet just west of the village of Peanut on the road to Forest Glen (L. W. Lenz and E. K. Balls 22557 RSA Herb.). *Iris tenuissima* is one of the few species in this series which shows little color variation. It is usually a pale creamy white with conspicuous dark veining. Some of the plants growing at this location were typically *I. tenuissima* in color whereas others had the distinctive form of *I. tenuissima* but were medium lavender in color, much like many of the forms of *I. macrosiphon*. Although both species possess long perianth tubes, *I. tenuissima* has a distinctive throat which *I. macrosiphon* does not have. Some of the plants here had the flower form of *I. tenuissima* but the perianth tube shape of *I. macrosiphon*. All the plants were very short-stemmed. Farther along on this same road, and near the village of Forest Glen, was another hybrid population (L. W. Lenz and E. K. Balls 22563 RRSA Herb.). Here the plants were growing in a Yellow Pine forest at an altitude of about 2330 feet.

IRIS MUNZII R. C. Foster. Iridis Species Novae, 1938

(Fig. 27)

Rhizome stout, about 1 cm. in diameter and covered with the remains of old leaves; leaves evergreen, to .5 m. long and 2 cm. wide, gray-green in color and distinctly glaucous; leaf bases usually colorless; flower stalks to 7 dm. tall, unbranched (one branched specimen has been found), rather stout; spathes 2-4-flowered, usually 3-flowered; spathe valves divergent and usually separated, as much as 190 mm. (aver. 66 mm.), rarely opposite, lower one 8-14 mm. wide (aver. 11 mm.) and 65-110 mm. long (aver. 95 mm.); pedicels variable, that of first flower 8-48 mm. long (aver. 22 mm.) at anthesis, those of later flowers longer; ovary nearly round in cross section, 14-30 mm. long (aver. 22 mm.), gradually tapering into the pedicel and abruptly into the perianth tube; perianth tube short, stout, funnellform, 7-10 mm. long (aver. 8 mm.); sepals variable in shape from oblong-ovate to broadly oblanceolate, 62-90 mm. long (aver. 71 mm.), and 18-37 mm. wide (aver. 26 mm.); petals oblanceolate to spatulate, 49-95 mm. long (aver. 66 mm.), and 12-21 mm. wide (aver. 16 mm.); flower color from pale lavender to bluish-violet or even reddish-violet; style branches about 3 cm. long; style crests subquadrate, 11-20 mm. long (aver. 15 mm.), edges entire to obscurely lobed; stigmas triangular; filaments about 15-20 mm. long; anthers about 25 mm. long; capsule oblong, tapering rather abruptly at either end, to 5 cm. long; seeds D-shaped to irregular, brown and coarsely wrinkled.

FIG. 26. Distribution of *Iris munzii*.

Type.—Hillside above Coffee Camp, Sequoia National Forest, about five miles east of Springville, 1400 ft. alt. 22-23 April, 1937. Fruit 30 May, 1937. R. C. Foster No. 204. Gray Herbarium. (Type seen.)

Distribution.—CALIFORNIA. Tulare County.

Representative specimens.—CALIFORNIA. Tulare County: Bear Creek, North Fork of Tule River, C. A. Purpus 1702; South bank of Tule River east of Springville, R. C. Foster 205; North Fork of Tule River, 1 mile below Milo, H. L. Mason 11810; Middle Fork, Tule River, 8/10 miles below Power House, C. B. Wolf 4627; 5 miles from Springville on road to Coffee Camp, L. W. Lenz 14417; 4/10 miles above Tunnel Rock and about 2 miles above checking station, Hwy. 198, Sequoia National Park, V. and A. Grant 17585.

Iris munzii is one of the most distinct species in the *Californicae*. It was first collected at least as early as during the 1890's, but it was not described as a species until 1938. The plant is known only from a few localities along the foothills of the Sierra Nevada where it occurs in the Foothill Woodland plant community at altitudes of 1800-2600 feet, just below the Chaparral which there separates the Foothill Woodland from the Yellow Pine Forest, the community where *I. bartwegii* is found. In the narrow altitudinal zone along the three forks of the Tule River where it occurs, *Iris munzii* is abundant. It is usually found in partially shaded areas and often along

FIG. 27. *Iris munzii*. a, general habit; b, inflorescence; c, style branch; d, petal; e, sepal; f, g, inner and outer spathe valves; h, seed capsules; i, cross section of seed capsule. a, $\times \frac{1}{6}$; b, h, $\times \frac{1}{3}$; c, d, e, f, g, i, $\times \frac{2}{3}$.

stream banks or on moist slopes; it does not grow on sunny dry slopes or hills. It occupies the same ecological habitat along each of the three branches of the Tule River and along Bear Creek, a tributary of the North Fork. More recently it has been found along the Middle Fork of the Kaweah River, the first major drainage system north of the Tule River system. At this locality, the species occupies an ecological habitat similar to that on the Tule River except that there is more brush. The known population on the Kaweah River is very small, possibly not over a hundred plants in all. Whether these plants represent a naturally occurring population or are the result of seed having been intentionally sown along the stream is not certain. W. B. Schortman, a long time resident of Porterville, California, has informed the author that about 1920 he sowed seed of *I. munzii* in draws and canyons along the Kaweah River during fishing expeditions. The seed had been collected earlier from the Coffee Creek camp grounds, an area where the species is still abundant. According to Schortman, he does not recall having seen plants later, and he does not know whether the seed that he distributed germinated or not.

Iris munzii has proven to be a most useful species in cultivation, and it is interesting to note that the flowers on some of the garden grown plants are among the purest blues known in the rhizotamous irises, a blueness that is not displayed by the species in its native habitat. This species appears to tolerate less cold than any species in the *Californicae*. This might be expected since the plants come from an area only a short distance away from producing citrus groves, an area that has a relatively mild climate.

Natural Hybrids.—*Iris munzii* is not known to be hybridizing with any other species at the present time.

IRIS PURDYI Eastw. Calif. Acad. Sci. (ser. 3) 1: 78, 1897

(Fig. 29)

Iris macrosiphon var. *purdyi* (Eastw.) Jepson. Fl. Calif. 1: 325, 1921.

Iris landsdaleana Eastw. Leaflet. West. Bot. 2: 186, 1939. *Type*.—About 5 miles south of Richardson's Grove, Mendocino County, California. 20 March, 1939. *A. Eastwood 18901*. Calif. Acad. Sci. Herb. (*Type seen*.)

Rhizome moderately slender, 4-6 mm. in diameter, dark reddish-brown and covered with the remains of old leaves; leaves somewhat two-sided, dark green above, gray-green below; leaf bases flushed brilliant pink or red; flowering stems unbranched, 1.5-3.5 dm. tall, covered with few to many overlapping, inflated bracts which are often flushed with anthocyanin pigment and free only at their tips; spathes usually 2-flowered; spathe valves opposite, somewhat inflated, outer one broadly lanceolate-ovate, 8-13 mm. wide (aver. 10 mm.) and 50-77 mm. long (aver. 66 mm.); pedicel 11-22 mm. long (aver. 16 mm.) at anthesis; ovary narrow, 13-20 mm. long (aver. 17 mm.); perianth tube linear, 28-48 mm. long (aver. 40 mm.), sometimes slightly dilated near the top; sepals oblanceolate, 55-84 mm. long (aver. 63 mm.) and 16-27 mm. wide (aver. 20 mm.); petals lanceolate, widespreading, 50-72 mm. long (aver. 56 mm.) and 9-20 mm. wide (aver. 13 mm.); flower color pale creamy yellow conspicuously veined with brownish-purple lines, or often pale cream or whitish with light lavender wash on the sepals; style branches 21-32 mm. long (aver. 25 mm.); style crests 9-21 mm. long (aver. 16 mm.), narrowly ovate, laciniate margined; stigmas truncate, broadly rounded or bilobed but never triangular, edge of stigma flap often set with minute teeth; capsule oblong ovoid, somewhat beaked, 2-3 cm. long; seeds thick D-shaped to irregular, light brown, finely wrinkled.

Type.—Ukiah, Mendocino County, California. May, 1897. Carl Purdy. Calif. Acad. Sci. Herb. (*Type seen*.)

Distribution.—CALIFORNIA. Humboldt, Mendocino, Sonoma, and Trinity counties.

Representative specimens.—CALIFORNIA. Humboldt County: 5.4 miles west of Garberville, road to Briceland, *Mrs. H. C. Cantelow*; 2 miles north of Garberville, *D. K. Kildare* 4370; Summit, ridge west of Bull Creek, *M. S. Baker* 2431a; 2.7 miles north and west of Ettersberg along Old Coast Road, *L. W. Lenz* and *E. K. Balls* 20744. Mendocino County: Near Bell Springs, *A. Eastwood* and *J. T. Howell* 4610; Ukiah, *A. Eastwood* 3292; Road from Hwy. 101 to Rockport, *L. W. Lenz* 14421; Mountains near Ukiah, *H. N. Bolander* 3909; 1 mile from Alder Glen Springs, road to Boonville, *L. W. Lenz* 14425; Idol House, *H. P. Chandler* 1076; Near summit between Westport and Branscomb, *L. R. Abrams* 8199. Sonoma County: .3 miles south of Mendocino-Sonoma County line, Hwy. 28, *L. W. Lenz* and *E. K. Balls* 16535. Trinity County: 1.8 miles east of Humboldt-Trinity County line, road from Alder Point to Zenia, *L. W. Lenz* and *E. K. Balls* 22610.

Iris landsdaleana was described by Eastwood in 1939 from plants collected south of Richardson's Grove in Mendocino County. In describing the species she said that it approached *I. purdyi* but differed in the color of the flower, being mauve instead of yellow, and that it possessed obtuse perianth segments. The stem leaves were also farther apart than in *I. purdyi*. After an examination of the type specimen preserved in the California Academy of Sciences Herbarium, as well as a study of the plants in

FIG. 28. Distribution of *Iris purdyi* and its natural hybrids.

the field over a period of several years, I am of the opinion that this plant cannot be satisfactorily separated from *I. purdyi* and I am, therefore, including it with that species.

In its pure form, *Iris purdyi* is one of the most distinctive species in this series. However, this species, which occurs over a relatively small area, has hybridized with at least three other species and many of the plants now found show introgression with the irises which surround the area where *I. purdyi* occurs. For this reason it is often difficult to apply a name to many of these plants. The type specimen, the one shown in Plate II in Dyke's monograph, and the one shown in Figure 30 all display characters which are believed to be characteristic of the pure species, spathes broad in relation to their length, sometimes slightly inflated, stems clothed with very conspicuous overlapping and inflated bracts, and finally, all with large, beautiful, light yellow flowers and the entire plant with a great deal of anthocyanin pigment on it. Other plants show most of these characters except that the bract-like leaves on the stem are not overlapping and the flowers are nearly white, often with a slight lavender wash on the sepals. Other than that, they are very similar to the yellow-flowered ones described above. In both instances the flowers have a truncate stigma which is different from any other species in the *Californicae*. Some of these whitish-flowered forms are here included with *I. purdyi*. The entire matter of introgression in this species will be taken up in Part II.

Iris purdyi has been called the Redwood Iris, but it is misleading to consider that it is a species of the heavy Redwood Forest. Within the redwoods it is found only in rather open places where there is considerable light. It is most abundant in the North Coastal Coniferous Forest which occupies the area between the Redwood Forest and the ocean. Here again, it is found only in relatively open areas with high light shade. In both of these plant communities the climate is mild and the rainfall generally heavy, being from 35-110 inches a year. In Trinity County, the plants are found in the Mixed Evergreen Forest.

Natural hybrids.—

I. douglasiana × *I. purdyi*. CALIFORNIA: Humboldt and Mendocino counties.

I. douglasiana × *I. macrosiphon* × *I. purdyi*. CALIFORNIA: Mendocino County.

I. macrosiphon × *I. purdyi*. CALIFORNIA: Mendocino County.

I. purdyi × *I. tenuissima*. CALIFORNIA: Humboldt and Trinity counties.

Hybrids between *I. douglasiana* and *I. purdyi* are fairly common in western Humboldt and Mendocino counties. In Mendocino County I have studied a hybrid population located 10 miles west of the junction of Hwy. 101 with the road to Rockport on the west slope of the Coastal Range (*L. W. Lenz* and *E. K. Balls* 16522, RSA Herb.). In Humboldt County this same hybrid combination is common along portions of Hwy. 101 along the Eel River between Fortuna and Pepperwood. The finest single hybrid population seen is located in Humboldt County about 2 miles southeast of Petrolia along the Old Coast Road (*L. W. Lenz* and *E. K. Balls* 20472 RSA Herb.). This population will be discussed in detail in Part II.

One of the most complex hybrid populations yet found in the *Californicae* is one involving the three species, *I. douglasiana*, *I. macrosiphon*, and *I. purdyi*. This combination is known to me only from a single locality in Mendocino County, an area along the Faulkner Park road near Boonville (*L. W. Lenz* and *E. K. Balls* 16530 RSA Herb.).

Hybrids between *I. purdyi* and *I. tenuissima* have been found in Humboldt County a short distance west of Willow Creek, along the road to Blue Lake (*L. W. Lenz*

FIG. 29. *Iris purdyi*. a, b, general habit; c, style branch; d, sepal; e, petal; f, g, inner and outer spathe valves; h, seed capsules; i, cross section of seed capsule. a, b, h, $\times \frac{1}{3}$; c, d, e, f, g, i, $\times \frac{2}{3}$.

FIG. 30. *Iris purdyi*.

18320 RSA Herb.) ; in Trinity County near Forest Glen (*L. W. Lenz* and *E. K. Balls* 22565 RSA Herb.) ; and near the Mad River Ranger Station (*L. W. Lenz* and *E. K. Balls* 22572 RSA Herb.). A specimen collected by *F. W. Gould* (832) on Horse Mt. in Humboldt County also appears to be of the same parentage.

The hybrid combination of *I. macrosiphon* and *I. purdyi* has been found at several localities in Mendocino County. One locality was about 2 miles west of Hwy. 101 on the road to Glen Alder Springs (*L. W. Lenz* and *E. K. Balls* 16413 RSSA Herb.). It is possible that the plants described by Eastwood as *I. landsdaleana* and here included within the limits of *I. purdyi* may have, through introgressive hybridization, acquired some genes of *I. macrosiphon*. This possibility will be discussed further in Part II.

IRIS TENAX Douglas ex. Lindley. Bot. Reg. 15 t. 1218, 1829

Ioniris tenax (Doug.) Klatt. Bot. Zeitung 30: 502. 1872.

Iris gormanii Piper. Proc. Biol. Soc. Wash. 37: 91. 1924. Type.—Scoggin's Creek, east slope of Coast Mountains, Washington County, Oregon. *M. W. Gorman*, 25 June, and 13 August, 1922. U. S. Nat. Mus. Herb. (Type seen.)

Iris tenax var. *gormanii* (Piper) R. C. Foster. Contr. Gray Herb. 119: 18. 1937.

Plants caespitose, rhizome slender; leaves deciduous, slender, light green, to 5 dm. long, 3-5 mm. wide, rather lax and usually longer than the flowering stem; leaf bases often colored red or pinkish; flowering stem slender, unbranched, 1½-3½ dm. tall; spathes 1-2-flowered; spathe valves linear to linear-lanceolate, outer one 3-5 mm. wide (aver. 4.1 mm.), and 53-80 mm. long (aver. 63 mm.), herbaceous; pedicels 11-40 mm. long (aver. 21 mm.) at anthesis, second one longer; ovary 15-25 mm. long (aver. 20 mm.), gradually tapering into pedicel and abruptly into the perianth tube; perianth tube short, 6-10 mm. long (aver. 8 mm.), stout, funnelliform; sepals usually obovate to oblanceolate, 55-64 mm. long (aver. 53 mm.) and 12-19 mm. wide (aver. 16 mm.); flower color extremely variable from white, which is rare, through pale lavender, lavender, to blue and purple, also yellow; style branches 22-32 mm. long (aver. 27 mm.); style crests 8-12 mm. long (aver. 10 mm.), subquadrate, reflexed, edges crenate to incised; stigmas triangular; filaments about 10 mm. long; anthers 15-18 mm. long; capsule oblong to 3½ cm. long; seeds D-shaped to irregular, brown and wrinkled.

Distribution.—OREGON. Benton, Clackamas, Clatsop, Columbia, Coos, Douglas, Lane, Lincoln, Linn, Marion, Multnomah, Washington, and Yamhill counties. WASHINGTON. Clark, Cowlitz, Grays Harbor, Lewis, Pacific, Skamania, Thurston, and Wahkiakum counties.

Representative specimens.—OREGON. Clackamas County: 8 mi. west of Cherryville, *C. L. Hitchcock* and *J. S. Martin* 4765; Near Eagle station, *W. Suksdorf* 3333; Banks of Eagle Creek, *J. W. Thompson* 4252. Clatsop County: Saddle Mt., *G. B.* and *R. P. Rossbach* 408; Near Astoria, *Mrs. E. C. Van Dyke*. Columbia County: Near Clatskanie drawbridge, *J. W. Thompson* 2460. Coos County: Middle Fork Coquille River, *L. E. Detling* 4081. Douglas County: 2 mi. south of Elkton, *L. E. Detling* 6319; 1 mi. east of Brockway, *L. W. Lenz* 19142. Lane County: Canyon of Suislaw River near Swiss Home, *A. Eastwood* and *J. T. Howell* 1565; Near the mouth of Big Creek, north of Heceta, *A. Cronquist* 6881; Eugene, *L. E. Detling* 2490. Lincoln County: Felder's Beach, 2½ mi. north of Waldport, *L. E. Detling* 5160. Marion County: North of Salem, *L. R. Abrams*. Multnomah County: North shore of Oswego Lake, 1 mi. north of Oswego, *C. L. Hitchcock* 19278. Tillamook County: Summit of Coast Mountains, toward Tillamook, *Mrs. N. P. Gale* 324. Washington County: Along Scoggin's Creek, *J. W. Thompson* 4289. Yamhill County: Bank of Scoggin's Creek, *M. E. Peck* 16194. Washington. Grays Harbor County: 1 mi. west of Elma, *C. L. Hitchcock* 19865. Lewis County: Open prairie near Toledo, *J. W. Thompson* 11520. Skamania County: Damp and wet ground at Cape Horn, *W. Suksdorf* 10474.

Iris tenax is the common iris found in the central part of western Washington and south from there to southern Oregon. It is especially common in unshaded or lightly

shaded areas on the oak-covered hills of the Willamette and Umpqua Valleys. According to Clarkson (1955), it does not extend into the coniferous areas unless the trees are cut, roads built, or conditions otherwise changed so that the amount of shading is reduced. According to this same author, the soil and moisture factors within this general area do not seem to be a limiting factor in its distribution. *Iris tenax* is a variable species both in flower size and color. Concerning flower color variation, R. C. Foster (1937) quotes the Starkers as saying "There were pure white forms beautifully marked with gold down the center of the falls; there were cream-colored and apricot forms; there were white blossoms edged with pink; there were pearl gray flowers; there were blossoms of orchid, lavender, blue, and deepest purple strikingly set off by a white blotch in the center of the falls, and there were other color variations almost without end."

A yellow-flowered form found along Scoggin's Creek in Washington County, Oregon, was originally described as *I. gormanii* Piper. R. C. Foster reduced it to a variety of *I. tenax*. As pointed out earlier, color, for the most part, is a very unsatisfactory character for delimiting taxa within this group, and in *I. tenax* there is as great a range of color as is to be found anywhere within the *Californicae*. Since *I. gormanii* differs in no respect from typical *I. tenax* except in color, Clarkson included the yellow-flowered form within that species, a conclusion with which I fully agree. Clarkson also cites a second yellow-flowered population from Monument Peak in Linn County, Oregon.

Iris tenax is an attractive species which was early introduced into cultivation. Douglas in his journal records the fact that the Indians used the tough fibers from the leaves to make snares, nets, and other small items requiring a tough fiber. In California the Indians used leaves of *I. macrosiphon* for the same purpose.

Natural hybrids.—

I. chrysophylla × *I. tenax*. OREGON: Coos, Douglas, Lane, Marion, and Polk counties.

I. douglasiana × *I. tenax*. OREGON: Coos and Curry counties.

I. innominata × *I. tenax*. OREGON: Douglas County.

Iris tenax is known to hybridize in nature with at least three other species, *I. chrysophylla*, *I. douglasiana*, and *I. innominata*. Clarkson, in his very excellent account of the Oregon irises, records finding hybrids between *I. chrysophylla* and *I. tenax* at three different localities: (1) 4½ miles up Mill Creek from the Dallas-Wallace bridge highway, Polk County; (2) 13¼ miles southwest of Roseburg, Douglas County, along Oregon state highway 42, and (3) Steep hills along the first tributary of the North Santiam River west of the Detroit Dam, Marion County. During the present investigation I have found hybrids between these species at two additional localities; (1) just west of Camas Summit, Oregon State Hwy. 42, Douglas County (L. W. Lenz 19148), and (2) 1 mile west of Brockway also in Douglas County (L. W. Lenz 19144). In the University of Washington Herbarium there is a specimen collected by C. L. Hitchcock (19936) at the west end of Eden Valley on the Powers-Glendale Pass road in Coos County which appears to be another hybrid of the same parentage. In the University of Oregon Herbarium there is a specimen collected by Lupher (7139) "well up the Row River," Lane County, which also appears to be a hybrid between *I. chrysophylla* and *I. tenax*.

Hybrids between *I. douglasiana* and *tenax* have been studied in the field only at a single locality. In 1954 a large hybrid population was found on Langlois Hill near the town of Langlois in northern Curry County, Oregon. A second locality, known only

FIG. 31. Distribution of *Iris tenax* and subspecies and natural hybrids.

from herbarium records, is located at "cliffs at Bandon Beach," where specimens were collected by L. R. Abrams and G. T. Benson (10606) and J. W. Thompson (12787). These specimens are deposited in University of Washington Herbarium.

The hybrid combination, *I. innominata* $\times$ *I. tenax*, is known to me only from a single sheet deposited in the University of Oregon Herbarium. This collection is made by L. F. Henderson (13026) on "moist sandy banks of West Fork of Cow Creek, Douglas County, near bridge." The sheet has four specimens mounted on it and it is labeled *I. tenax*. Three of the specimens look like that species, the fourth is marked (a) and according to the label, "This grew associated with *I. innominata* and is a probable hybrid."

IRIS TENAX subsp. KLAMATHENSIS subsp. nov.

(Fig. 32)

Rhizoma gracile, 3-5 mm. diam.; folia angusta, 3-5 mm. lata, ad 4 dm. longa, basi rubro-purpurea lucida; caulis simplex, angustus, ad 4 dm. longus, 1-2-fl.; spathae valvae herbaceae, remotae, exteriora 3-6 mm. lata, 47-67 mm. longa; pedicelli inaequilongi, primus quam secundus longior, 4-15 mm. longus; perianthii segmenta exteriora oblanceolata vel late obovata, pallid fulva, venis rubris, conspicuis; stylii rami 20-30 mm. longi; stigma triangulare; filamenta ca. 7 mm. longa; anthera 11-14 mm. longa; capsula oblonga, 3-4 cm. longa.

Rhizome slender, 3-5 mm. in diameter; leaves slender, 3-5 mm. wide, and up to 4 dm. long, usually overtopping the flowering stem; leaf bases brilliantly colored, deep pink to red; flower stem unbranched, slender, 1-2-flowered, usually 1-flowered, to 4 dm. tall with 1-several clasping leaves which are free for about $\frac{1}{3}$ of their length; spathe valves linear to narrowly lanceolate, divergent and usually separated, sometimes as much as 18 mm. (aver. 7 mm.), outer spathe valve 3-6 mm. wide (aver. 4.3 mm.) and 47-67 mm. long (aver. 61 mm.); pedicel 4-15 mm. long at anthesis (aver. 9 mm.); ovary 13-30 mm. long (aver. 21 mm.); perianth tube 11-20 mm. long (aver. 18 mm.), rather stout and somewhat funnellform; sepals oblanceolate to broadly obovate, 53-73 mm. long (aver. 60 mm.) and 15-24 mm. wide (aver. 10 mm.) and 7-11 mm. wide (aver. 10 mm.); flower color pale buff-yellow, sepals usually distinctly marked with deep maroon or brown veins; style branches 20-30 mm. long (aver. 25 mm.); stigmas triangular; filaments about 7 mm. long, anthers 11-14 mm. long; capsule oblong, 3-4 cm. long.

Type.—Wooded hillsides along the Klamath River, Orleans, Humboldt County, California. 13 May, 1953. Lee W. Lenz 18296. Rancho Santa Ana Botanic Garden Herbarium. Isotypes deposited at the following herbaria: University of California (Berkeley), University of Oregon, University of Washington, New York Botanical Garden and Kew.

Distribution.—CALIFORNIA. Humboldt County.

Representative specimens.—CALIFORNIA. Humboldt County: 2 miles north of Orleans, L. Constance and R. C. Rollins 2893.

Iris tenax subsp. *klamathensis* is known only from a small area in Humboldt County below the junction of the Klamath and Salmon rivers. The small community of Orleans appears to be in about the center of its very limited range. Here it is found in relatively shaded places with salal, bracken, madrone, Douglas Fir, *Rubus* sp. and Umbellularia.

This subspecies belongs with the *I. tenax-hartwegii-munzii* complex and it is most closely related to *I. tenax*. Indeed in many ways it might be considered as a member of

FIG. 32. *Iris tenax* subsp. *klamathensis*. Type specimen.

that species. However, there are certain morphological differences, most important of which is the difference in perianth-tube length, *I. t.* subsp. *klamathensis* being well outside the range of variation found within *I. tenax*. The style crests are also somewhat longer and narrower than those of typical *I. tenax*. In flower color and markings, *I. t.* subsp. *klamathensis* reminds one more of *I. bracteata* or the Iron Mt. forms of *I. innominata* than it does *I. tenax*, but in no other respect does it resemble those species with the exception that the subspecies and *I. innominata* both have narrow grass-like leaves, a character shared with other members of the *Californicae*.

Geographically, *I. t.* subsp. *klamathensis* is well isolated from *I. tenax* as well as all other members of that complex. Ecologically, it occupies a more shaded habitat than *I. tenax*. For these reasons it seems best to recognize this little endemic as a separate subspecies closely related to *I. tenax*.

Natural Hybrids.—

I. tenax subsp. *klamathensis* × *I. tenuissima*. CALIFORNIA: Humboldt County.

Iris tenax subsp. *klamathensis* is completely surrounded by *I. tenuissima* and at the southernmost extension of its range, near Crawford Creek south of Orleans, it was found to be hybridizing with *I. tenuissima* (L. W. Lenz 18318, RSA Herb.).

IRIS TENUISSIMA Dykes. Gard. Chron. (third series), 51: 18, 1912

(Fig. 34)

Iris humboldtiana Eastw. Leaf. West. Bot. 2: 263, 1940. *Type*.—Road to Horse Mt., Humboldt County, California, 24 June, 1937. A. Eastwood and J. T. Howell 4857. California Academy of Sciences Herbarium. (Type seen.)

Iris citrina Eastw. Leaf. West. Bot. 3: 125, 1942. *Type*.—Log Spring Ridge between Government Flat and Log Spring, Tehama County, California, 9 July, 1941. A. Eastwood and J. T. Howell 9722. California Academy of Science Herbarium. (Type seen.)

Rhizome slender with few roots; leaves linear, to 40 cm. long, about 6 mm. wide, gray-green and sometimes slightly glaucous, finely ribbed; leaf bases usually pink to red although colorless ones are known; flower stem slender, unbranched, with 1-3 cauline leaves; spathe usually 2-flowered; spathe valves opposite, lanceolate, 5-10 mm. wide (aver. 7.5 mm.), and from 40-80 mm. long (aver. 68 mm.), often flushed with pink or red; pedicels variable, 8-18 mm. long (aver. 12 mm.) at anthesis; ovary 10-20 mm. long (aver. 14 mm.), tapering equally at either end; perianth tube 30-58 mm. long (aver. 43 mm.), lower portion slender then dilated abruptly to form a broader throat $\frac{1}{4}$ - $\frac{1}{3}$ the length of the tube; sepals narrowly lanceolate to lanceolate, 47-75 mm. long (aver. 60 mm.), and 11-18 mm. wide (aver. 14 mm.); petals 44-64 mm. long (aver. 52 mm.), and 6-14 mm. wide (aver. 8.5 mm.); flower color usually pale cream with very distinct veining of lavender, reddish-brown or brown; flower parts often distinctly crisped; style branches usually very slender for their length, 20-30 mm. long (aver. 24 mm.); style crests linear, 11-23 mm. long (aver. 16 mm.); stigmas triangular; capsule oblong 3-4 cm. long, tapering abruptly into the pedicel and gradually into a rather distinct beak.

Type.—Near Pitt River Ferry, Shasta County, California, 700-900 feet altitude. H. E. Brown 239. United States National Herbarium. (Type seen.)

Distribution.—CALIFORNIA. Butte, Glenn, Humboldt, Shasta, Siskiyou, Tehama, and Trinity counties.

Representative specimens.—CALIFORNIA. Shasta Springs. A. Eastwood 11824. Butte County: Chico Meadows, A. A. Heller 11961; Butte Meadows, Mrs. G. E. Kelly. Humboldt County: Road to Horse Mt., A. Eastwood and J. T. Howell 4857 (type). Shasta County: Pitt River, L. E. Smith 180; Near Dunsmuir, L. F. Henderson 15363; 18 mi. from Hwy. 299, road to Trinity Center, L. W. Lenz 18308. Siskiyou County: Castle Creek, L. E. Smith 205; Ridges and meadows

FIG. 33. Distribution of *Iris tenuissima* and subspecies and natural hybrids.

near Marble Mt., H. P. Chandler 1570; Salmon River, $1\frac{1}{4}$ mi. above junction with Klamath River, L. W. Lenz 19138; Lassen Lodge, L. W. Lenz and E. K. Balls 21834. Trinity County: 1 mi. west of summit between Redding and Weaverville, P. A. Munz 13189; Burnt Ranch, J. P. Tracy 6656; .2 mi. east of Trinity-Humboldt County line, L. W. Lenz and E. K. Balls 20729.

In 1940, Alice Eastwood described *I. humboldtiana*, collected on the road to Horse Mt., Humboldt County, California, saying that "the long tube of the perianth allies it with *Iris macrosiphon*, but it is unlike it in other features . . ." The flowers were reported to be very pale but definite color notes were not made. Examination of the type preserved in the herbarium of the California Academy of Sciences shows plants which are typical of the tall-stemmed form of *I. tenuissima*, and thus this taxon is included within the limits of that species. In 1942, Miss Eastwood described *I. citrina*, collected on Log Spring Ridge between Government Flat and Log Spring, in Tehama County, California. This, she said, differed from *I. macrosiphon* in having glaucous foliage, yellow flowers, shorter perianth tube, longer throat, and general shape of the floral organs. Examination of the type, also in the herbarium of the California Academy of Sciences, shows a plant typical of the nearly stemless form of *I. tenuissima*, the only difference being that the style crests are slightly broader than average for the species. It is not believed that this slight difference is sufficient to warrant recognition of this entity with a formal designation and it is thus included here with *I. tenuissima*. *Iris macrosiphon* also occurs in Tehama County, and it is entirely possible

that this plant may show the results of introgression of that species into *I. tenuissima*. This could account for the slight difference in the style crest between Eastwood's *I. citrina* and typical forms of *I. tenuissima*.

Iris tenuissima is common in the dry sunny woods of northern California where it may be found in the Yellow Pine Forest, Mixed Evergreen Forest, Northern Oak Woodland, and Foothill Woodland plant communities. This species, for the most part, has been poorly understood by workers in the past and it has usually been included with *I. macrosiphon* although it is more closely related to *I. chrysophylla*. Jepson in his *Flora of California* did not recognize it at all, and Abrams in his *Illustrated Flora of the Pacific States* said that it was "an imperfectly known relative of *I. macrosiphon*, differing, probably inconstantly, in the narrower tapering perianth segments, stigma crests about as long as stigmas." R. C. Foster, in his *Cyto-Taxonomic Survey of the North American Species of Iris*, recognized it as a distant species, saying, "it is reasonably well differentiated from *I. macrosiphon*." *Iris tenuissima* is certainly as distinct a species as is to be found in the *Californicae*. It differs from *I. macrosiphon* in having generally more narrow perianth parts, although some forms approach that species. The long narrow styles with their proportionally very long style crests also separate it from *I. macrosiphon*. However, the most distinctive single feature is the peculiar perianth tube shape. In *I. tenuissima* the upper part of the perianth tube is abruptly dilated to form a distinct throat that remains the same diameter for its full length. In *I. macrosiphon* the perianth tube is long and narrow and just below the base of the perianth parts it is usually enlarged to form a rather broad shallow bowl. Never does it have a long distinct throat. These differences are clearly shown in Figure 25. *Iris chrysophylla* is much like *I. tenuissima* in having a long perianth tube and long narrow style branches and style crests. It does not, however, have the dilated throat of *I. tenuissima*, and in that respect it is more like *I. macrosiphon*.

Geographically, *I. tenuissima* occupies the area around the north end of the Great Valley of California which includes the southern portion of the Klamath Mts. east to the western slopes of the southern Cascades. The Siskiyou Mts., which form a part of the Klamath Mts., run roughly east and west and separate *I. tenuissima* from *I. chrysophylla*, the former being found to the south of the Siskiyou crest and the latter to the north.

The flowers of *I. tenuissima* are usually rather star-shaped, i.e., the sepals are bent outward at their base and then remain straight for their full length; the petals, too, open outward rather than remaining more or less together and upright as they do in the majority of the species. The flower parts are usually quite narrow and often crisped. The whole flower is very fragile and difficult to preserve. As in *I. chrysophylla*, no flower color is known except near whites to pale creamy-yellows, all, however, distinctly and attractively veined.

Natural hybrids.—

I. macrosiphon × *I. tenuissima*. CALIFORNIA: Trinity County.

I. purdyi × *I. tenuissima*. CALIFORNIA: Humboldt and Trinity counties.

I. tenax subsp. *klamathensis* × *I. tenuissima*. CALIFORNIA: Humboldt County.

Iris tenuissima is known to hybridize with at least three other taxa. I have found hybrids between *I. purdyi* and *I. tenuissima* to be relatively common a short distance west of Willow Creek, along the road to Blue Lake, Humboldt County, (L. W. Lenz 18320 RSA Herb.), as well as near Forest Glen (L. W. Lenz and E. K. Balls 22565 RSA Herb.), and also near the Mad River Ranger Station (L. W. Lenz and E. K. Balls 22572 RSA Herb.), both in Trinity County. I have also seen a specimen collected by F. W. Gould (832) on Horse Mt., in Humboldt County, which appears to

FIG. 34. *Iris tenuissima*. a, general habit; b, style branch; c, petal; d, sepal; e, f, inner and outer spathe valves; g, seed capsules; h, cross section of seed capsule. a, g, $\times \frac{1}{6}$; b, c, d, e, f, h, $\times \frac{2}{3}$.

FIG. 35. *Iris tenuissima* subsp. *purdyiformis*.

be of the same parentage. Near Crawford Creek, south of Orleans on the Klamath River, I have found specimens which combine characters of *I. tenax* subsp. *klamathensis* with those of *I. tenuissima*, and these I take to be of hybrid origin. This combination might well be expected since *I. tenax* subsp. *klamathensis* is completely surrounded on all sides by *I. tenuissima*.

Hybrids between *I. macrosiphon* and *I. tenuissima* have been found at several places in Trinity County; one hybrid population was studied near Peanut (L. W. Lenz and E. K. Balls 22557 RSA Herb.), and another colony was encountered near the village of Forest Glen (L. W. Lenz and E. K. Balls 22563 RSA Herb.).

IRIS TENUISSIMA subsp. PURDYIFORMIS (R. C. Foster) comb. nov.

(Fig. 35)

Iris tenuissima var. *purdyiformis* R. C. Foster. Contr. Gray Herb. No. 119: 28. 1937.

Rhizome slender, 5-6 mm. in diameter; leaves few to many, 3-5 mm. wide and to 4 dm. long, leaf bases colored; flower stems slender, unbranched, to 3.5 dm. tall, exceeded by the leaves; stem clothed with 3-4 closely clasping but not overlapping cauline leaves which are slightly inflated and free only at their tips, usually flushed with pink or red; spathes 2-flowered; spathe valves opposite, 7-10 mm. wide, (aver. 8.5 mm.), and 38-55 mm. long (aver. 45 mm.), broadly lanceolate, usually flushed pink to red especially on the edges; pedicels variable, 4-15 mm. long (aver. 8 mm.), at anthesis; ovary small, 8-14 mm. long (aver. 10 mm.); perianth tube 30-45 mm. long (aver. 37 mm.), slender and with abruptly dilated throat which may be nearly $\frac{1}{2}$ the length of the tube; sepals narrowly oblanceolate, 40-57 mm. long (aver. 48 mm.), and 10-17 mm. wide (aver. 14 mm.); petals 35-45 mm. long (aver. 40 mm.), and 7-10 mm. wide (aver. 9 mm.); flower color pale yellow or cream with few to no dark veins; style branch 20-29 mm. long (aver. 24 mm.); style crest 9-12 mm. long (aver. 10 mm.); stigmas variable, from broadly triangular to rounded but not truncate; capsule oblong-ovate, 15-20 mm. long.

Type.—Camp Rodgers, Plumas County, California. 11 April, 1934. E. P. Chase. Calif. Acad. Sci. Herb. No. 212,531. (Type seen.)

Distribution.—CALIFORNIA. Plumas and Sierra counties.

Representative specimens.—CALIFORNIA. Plumas County: 3 miles west of Beldon, Feather River Canyon, Mrs. H. C. Cantelow; Camp Rodgers, E. P. Chase (*type*) (CA No. 212,531); Between Tobin and Camp Rodgers, Feather River Canyon, L. W. Lenz and E. K. Balls 20699; Tobin, L. W. Lenz 19133. Sierra County: Cedar Glen, V. Jones. (CA No. 110,677).

This most interesting yet puzzling little endemic from Plumas and Sierra counties in the northern Sierra Nevada of California was first described by R. C. Foster as *I. tenuissima* var. *purdyiformis*. Foster knew it from only three specimens, two of which had originally been labeled *I. purdyi*. After studying the plant in the field for several years I have decided to retain, at least for the present, the status given it by Foster, i.e., a sub-entity under *I. tenuissima*. Foster was tempted to call it a hybrid between *I. purdyi* and *I. tenuissima*, but he pointed out that the only real floral resemblance to *I. purdyi* was in the stigma. It is true that this plant does display certain characters associated with *I. purdyi* and that other characters are more nearly those of *I. tenuissima*. Full consideration will be given to this plant in Part II.

Iris tenuissima subsp. *purdyiformis* occurs in rather shady places under pines in the Feather River Canyon, and it has been reported from Cedar Glen in Sierra County; living material from the latter locality has not been seen, however.

Nowhere does this plant appear in great abundance. The largest populations which have been seen are on the hillsides above Tobin, an area that at the present time is

being logged to a certain extent with the resulting disturbance to the area caused by the building of access roads, etc.

Natural hybrids.—No natural hybrids are known involving this taxon.

EXCLUDED SPECIES

Iris tenuis S. Watson. This interesting little endemic from Clackamas County, Oregon, has usually been placed with the *Californicae* although some authors have done so with hesitation. Dykes says that it is "at once distinguished from all other irises from Western America by its deeply forked stems." R. C. Foster in his treatment of the North American irises says "this very distinct endemic species is so unlike other members of the subsection that it is with some hesitation that I leave it in association with them." More recently, Clarkson (1955) in his study of the Oregon species removed it from the *Californicae*, saying, "clearly it does not belong in the subsection with the other members of the *Californicae*"—a conclusion that anyone who has studied the plants carefully could not possibly question. *Iris tenuis* differs in almost every respect from other members of the group. In addition to its great morphological differences, it also has a very different chromosome number than members of the *Californicae*, *I. tenuis* having $2n=28$ as contrasted with $2n=40$ for all known wild forms of the *Californicae*. All members of this series which have been tested have been found to be interfertile and many natural hybrids are known. No hybrids involving *I. tenuis* have ever been found in nature although in places it grows in association with *I. tenax*. Smith and Clarkson (1956) attempted to cross the two species under controlled conditions but in all instances the pollinations resulted in failure.

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