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FIG CHARACTERISTICS USEFUL IN THE IDENTIFICATION OF VARIETIES

IRA J. CONDIT

UNIVERSITY OF CALIFORNIA · BERKELEY, CALIFORNIA

H I L G A R D I A

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FIG CHARACTERISTICS USEFUL IN THE IDENTIFICATION OF VARIETIES[1, 2]

IRA J. CONDIT[3]

INTRODUCTION

CULTURE OF THE FIG, *Ficus Carica* L., began many centuries ago somewhere in Eurasia. Primitive man recognized the delectable qualities of the fruit, selected seedling trees bearing superior kinds, and thus established definite fig clones or varieties. Egyptian hieroglyphics and other pictographs give us some idea of the high regard in which the fig was held, but the Greeks have given us what is probably the earliest written indication of fig taxonomy. In the Odyssey, Ulysses says to his father: "Through these very trees we were going and thou didst tell me the names of each of them. Pear trees thirteen thou gavest me, and ten apple trees, and figs two score" (Homerus, 1909).[4] In the third century B.C., varieties of fruits were not only named but studied. Theophrastus (1916) says: "Most of the wild kinds [plants] have no names and few know about them, while most of the cultivated kinds have received names and they are more commonly observed; I mean such plants as vine, fig, pomegranate, apple, pear, bay, myrtle, and so forth; for, as many people make use of them, they are led also to study the differences."

During the centuries in which the fig has been cultivated, varieties have so greatly multiplied that the present number is not even approximately known. In the first century of the present era, Pliny (Plinius Secundus, 1855–90) listed 29 varieties of figs, and Columella (1745) mentioned 8 varieties under locality names. La Quintinie (1692) described 9 varieties of French figs, mostly in terms of color, as, for example, "the

[1] Received for publication September 6, 1940.

[2] Paper no. 427, University of California Citrus Experiment Station, Riverside, California.

[3] Associate Professor of Subtropical Horticulture and Associate Subtropical Horticulturist in the Experiment Station.

[4] See "Literature Cited" at the end of the paper for complete data on citations, which are referred to in the text by author and date of publication.

great yellow fig." Noisette (1829) described 37 kinds grown in France. Descriptions and synonymies of 68 figs found in England were given by Hogg (1866). Barron (1891) described 66 varieties being grown in hothouses of the Royal Horticultural Society, Chiswick, England. The varieties in the Chiswick collection were obtained by the United States Department of Agriculture in 1894 and established in California, first at Niles, later at Chico, then at Fresno, and finally at Riverside.

Vallese (1909) describes 9 varieties of caprifigs and 38 varieties of edible figs found in Italy; he also lists, without descriptions, the names of 94 other Italian varieties. Probably the most comprehensive treatment of fig varieties is that of Eisen (1901), who lists or describes 406 varieties, although some of the names are undoubtedly synonymous. Among others who have contributed original descriptions of fig varieties may be mentioned Starnes and Monroe (1907), describing 118 varieties grown in the state of Georgia; Estelrich (1910), 50 varieties grown in the Balearic Islands; Bobone (1932), 27 varieties found in Portugal; and Mauri (1939*a*, *b*), 16 varieties of caprifigs and 19 of edible figs cultivated in Kabylia. There are now 162 distinct varieties of caprifigs and edible figs in the collection of the University of California at Riverside.

The dearth of adequate descriptions of fig varieties has long been recognized. Lindley (1831), for example, wrote:

> I have searched for authorities and descriptions to enable me to point out those differences which should distinguish one sort from another, but I have not succeeded in satisfying myself. I have indeed found names in books on gardening accompanied by what the writers might have considered as descriptions; but several of them have been so defective as to give the reader but little chance of applying them to the fruit they were intended to designate.

Eisen (1901) also pointed out that figs had been insufficiently described and that both authors and nurserymen copied the available descriptions without giving them critical research and comparison. The descriptions by Eisen himself leave much to be desired, and Waugh (1908), with Eisen's work available, wrote regarding figs: "Along with defective descriptions goes an almost entire lack of classification."

CLASSIFICATION

A previous publication (Condit, 1933) presents a section on the botany and classification of figs, which may be summarized as follows. The fig fruit is a hollow receptacle or syconium, on the inner surface of which the flowers are produced. Fundamentally, the flowers are of two kinds, staminate and pistillate. Staminate flowers are found only in receptacles bearing short-styled flowers. Pistillate flowers are found in

all figs and may be either short-styled or long-styled. Figs having short-styled flowers belong to the most primitive horticultural group, the caprifigs. All figs having long-styled flowers develop under favorable conditions into edible fruits and are classified, horticulturally, into three groups: Smyrna, San Pedro, and common.

Caprifig Type.—The caprifig is the primitive type of cultivated fig, the other three types having undoubtedly evolved from it. The short-styled flowers or gall flowers of caprifigs are adapted to oviposition by an insect, the fig wasp (*Blastophaga psenes* L.); and receptacles of the three crops of the caprifig tree harbor the larvae, pupae, or, temporarily, the adults of this insect. The three crops of the caprifig are the profichi (April to June), the mammoni (June to November), and the mamme (November to April).

Stanford and Roeding No. 3 are two standard varieties of caprifigs in California. Croisic (Cordelia) is a caprifig which is completely parthenocarpic in the profichi crop, the fruit becoming pulpy and edible rather than remaining dry and pithy as do most caprifigs.

A type of fig was described by Pontedera (1720) as "Erinosyce." According to Eisen (1896), profichi of this type contain male flowers as well as gall flowers with wasps, and mammoni figs contain "perfect female flowers" and gall flowers with wasps. Now, however, it is recognized that all pistillate fig flowers are potentially fertile, and there is no valid distinction between "perfect female flowers" and gall flowers in mammoni figs. If not used for oviposition by the blastophaga, any of these flowers may become pollinated and fecundated. Apparently, therefore, Erinosyce is a caprifig with normal profichi and with mammoni which have fertile seeds.

Smyrna Type.—Figs of Smyrna type mature only after the pollination of their long-styled flowers and the resultant development of fertile seeds. Without such stimuli, immature figs both of the breba crop (first crop) and of the main crop usually shrivel and drop when about an inch in diameter. Sometimes a few brebas develop without this stimulus. The commercial fig industry of Asia Minor, that of Greece, Algeria, Portugal, and to a considerable extent that of California, are based upon this type of fig. Calimyrna or Lob Injir, Kassaba, and Bardajik are varieties of this type.

Common Type.—Figs of common type are parthenocarpic; that is, they do not require the stimulus of caprification and seed development in order to have the fruit mature. Commercial varieties such as Trojano and Dottato of Italy, Fraga and Lepe of Spain, Adriatic and Mission of California are of common type.

San Pedro Type.—Figs of San Pedro type combine the characteris-

tics of both Smyrna and common type: brebas develop without the stimulus of flower pollination and fecundation; second-crop figs are of Smyrna type and drop unless they are caprified. In California, varieties of this type, such as San Pedro, Dauphine (grown near Indio), and Gentile, are of little or no commercial importance. According to Bobone (1932), several varieties of this type are produced in Portugal. Dauphine is grown commercially in the vicinity of Tokyo, Japan.

Botanical Classification.—Ficus Carica was described by Linnaeus (1753) as follows:

> *Ficus carica.*
> *Ficus foliis palmatis.* Hort. cliff. 471. Hort. ups. 305. Mat. med. 478. Amoen. Acad. 1. p. 24. Roy. lugdb. 211.
> *Ficus communis.* Bauh. pin. 457.
> *Ficus.* Dod. pempt. 812.
> ♂ *Caprificus.* Bauh. hist. 1. p. 134.
> β *Ficus humilis.* Bauh. pin. 457.
> Habitat in Europa, australi, Asia.

Bauhin (1623) had already used the terminology *Ficus communis* and *F. humilis.* Since the time of Linnaeus, various botanists have suggested other terminologies for certain types. For example, Gallesio (1817–20) recognized the following types among the caprifigs: ***Fico selvaggio,*** the normal caprifig; *Fico della natura,* a caprifig with only one crop a year; *Fico mostro,* a caprifig which matures no perfect fruit, only pollniferous figs; *Fico mula,* a fig which becomes pomologically but not botanically ripe; *Fico semi-mula,* a fig which, when pollinated, becomes both botanically and pomologically mature.

Gasparrini (1845) expressed the opinion that the caprifig was not the male form of the fig but a species so different that it could well be taken as the type of a distinct genus. Few if any botanists, however, accepted this opinion, and Solms-Laubach (1882) showed that the edible fig and the caprifig are forms of one species, *Ficus Carica.*

Eisen (1896) stated that his studies and experiments were concerned principally with four classes of figs: Caprifigs, *Ficus Carica silvestris;* Smyrna figs, *Ficus Carica smirniaca;* Common figs, *Ficus Carica hortensis;* and San Pedro figs, *Ficus Carica intermedia.* He designated the Cordelia type of fig as *Ficus Carica relicta* and (Eisen, 1901) listed a large number of Italian and French figs with a Latin terminology, as *Fico dorato, Ficus lutea,* and so forth.

Celi (1907) proposed the following nomenclature: *Ficus Carica sylvatica,* nonedible caprifigs; *Ficus Carica sub-sativa,* reverted figs with fruit slightly or not at all edible; and *Ficus Carica sativa,* common edible figs with fertile seed (slightly improved kinds) or sterile seed (more highly improved kinds).

Later, Tschirch (1911) proposed the following classification: *Ficus Carica crinosyce,* the wild fig; *Ficus Carica alpha caprificus,* the caprifig; and *Ficus Carica beta domestica,* the cultivated edible fig. However, according to Silvestri,[5] this classification of *Ficus Carica,* which was also published by Ravasini (1911) is incorrect.

Pomological Classification.—The classification of figs into types, as outlined in the preceding section of this paper, is based mainly on botanical characters and is, therefore, fairly definite. Pomological classification of fig varieties, however, is not so simple. This is true of other fruits, such as apples, of which Beach *et al.* (1905, p. 23) wrote: "In fact they vary so greatly that they almost defy any attempt to classify them into groups." And yet various authors have found that the grouping of fig varieties according to certain characters aids considerably in their identification.

Noisette (1829) classified figs into two groups based on external color: (1) yellow or green figs and (2) reddish, violet, or brown figs. Each of these two groups he subdivided into fruits spherical or oblate, and fruits oblong.

Hogg (1866) based his classification (1) upon shape—fruit round, roundish, or turbinate, and fruit long, pyriform, or obovate; (2) upon color of skin—skin decidedly dark and skin pale or tinged with brown; and (3) upon color of flesh—flesh red and flesh white or opaline.

Celi's (1907) classification was based (1) upon shape—ovoid, spherical, or oblate; (2) upon the fruit peduncle—short or long; and (3) upon external color. Vallese (1909) grouped varieties into two sections: those maturing early and those maturing late; and under each section he made two classes: white fruits and dark-colored fruits. Estelrich (1910) simply grouped Mallorcan figs into six classes: top-shaped, egg-shaped, pyriform, conical, spherical, and oblate.

Bobone (1932) is apparently the only author who differentiates between brebas and second-crop figs in a pomological key. He further subdivides figs on the basis of external color, shape of the base, shape of the body, and color of the pulp.

Variety studies over a period of twenty years have convinced me that the construction of artificial keys is of decided value in the identification of fig varieties; that such keys serve to bring out and emphasize minor fruit characters which would otherwise be overlooked; and that it is impossible for any key to be infallible, since the fig, like most other fruits, is markedly affected by environmental conditions. For personal use I have constructed keys of both profichi- and mamme-crop caprifigs and of both breba- and second-crop edible figs. These keys are based on

[5] Silvestri, F. In letter to author from Portici, Italy, March 28, 1929.

the following fruit characters: external color, form, size, neck, fruit stalk or peduncle, ribs, eye and eye scales, skin, bloom, surface markings such as hairs and white flecks, color of meat and pulp, and seeds.

Latex is a character common to all trees of the genus *Ficus*, including *F. Carica*. Characters which show little if any variety differences are: wood, roots, bark (some exceptions noted later in the section, "Bark," p. 52), burrknots, and bark tubers. The following characters do, however, have significance in variety descriptions: leaves, habit of tree growth or branching, buds, crops, fruitfulness, and season.

THE FRUIT

Pomologically speaking, the fruit of the fig is a "syconium," a name originally suggested by Mirbel (1813):

> 2e Genre. Sycône, Syconus.
> Clinanthe très-dilaté, de forme et de consistance variables, portant des fruits carcérulaires ou des drupéoles (ficus, ambora, dorstenia).

"Syconium" may be further defined as a collective fleshy fruit, in which the ovaries are borne upon an enlarged, more or less succulent, concave or hollow receptacle. Botanically, the fruits of the fig are the one-seeded ovaries which line the inner wall of the receptacle. According to Smith *et al.* (1928, p. 451), "The fig resembles a multiple fruit in including many individual fruits, each developed from a single flower. It differs in the fact that the individual fruits are not adherent." The fig is unique among fruits in having an apical orifice or ostiole which connects the cavity of the receptacle with the exterior.

Syconia of *Ficus Carica* are borne in the axils of leaves. Those produced late in the season generally persist throughout the winter as dormant fruit buds and push out with, or sometimes slightly in advance of, the leaves. Brebas or first-crop figs are therefore produced on wood of the previous season. Syconia of the main crop are usually single or solitary, but in some varieties are borne in pairs (fig. 1), one on each side of the vegetative bud.

Color of Figs.—There are three general color classes into which fresh figs may be segregated as shown in plate 1: (1) fruit green or yellow; (2) fruit more or less shaded with bronze, copper, or violet; and (3) fruit decidedly dark, violet, or purplish black. The limits of these color classes are not always sharply defined, the external color depending upon the light intensity, temperature, humidity, and upon the presence or absence of fertile seeds. Thus the Kadota fig in a cool coastal climate is green in color, while in the hot inland climate it is a bright lemon yellow. Adriatic, as Eisen (1901) states, is green or bluish green in color

in the cool climate of San Francisco Bay, while in the hot inland valleys it is often golden yellow. In some Calimyrna orchards there are two color classes of fruit: most trees bear fruit typically golden yellow in color; but for reasons not yet explained, some trees bear figs light lemon

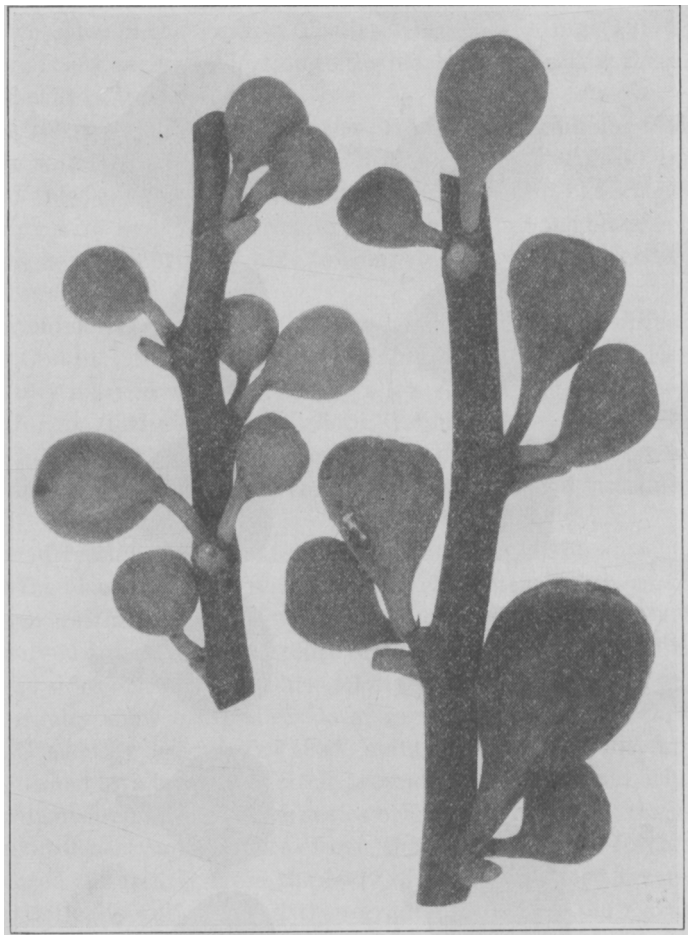

Fig. 1.—The Kadota (left) and the Turkey (right), as well as many other varieties of figs, produce two syconia in the axil of a single leaf. (× 0.6.)

yellow in color and still more attractive in appearance than the golden-yellow fruit typical of the variety. The Stanford Smyrna fig remains green or yellowish green until mature and then fades to a straw color as the fruit dries.

Examples of bronze or copper-colored figs are (plate 1): Brunswick, Celeste, Gouraud Rouge, Pied de Boeuf. Figs shaded with violet are St.

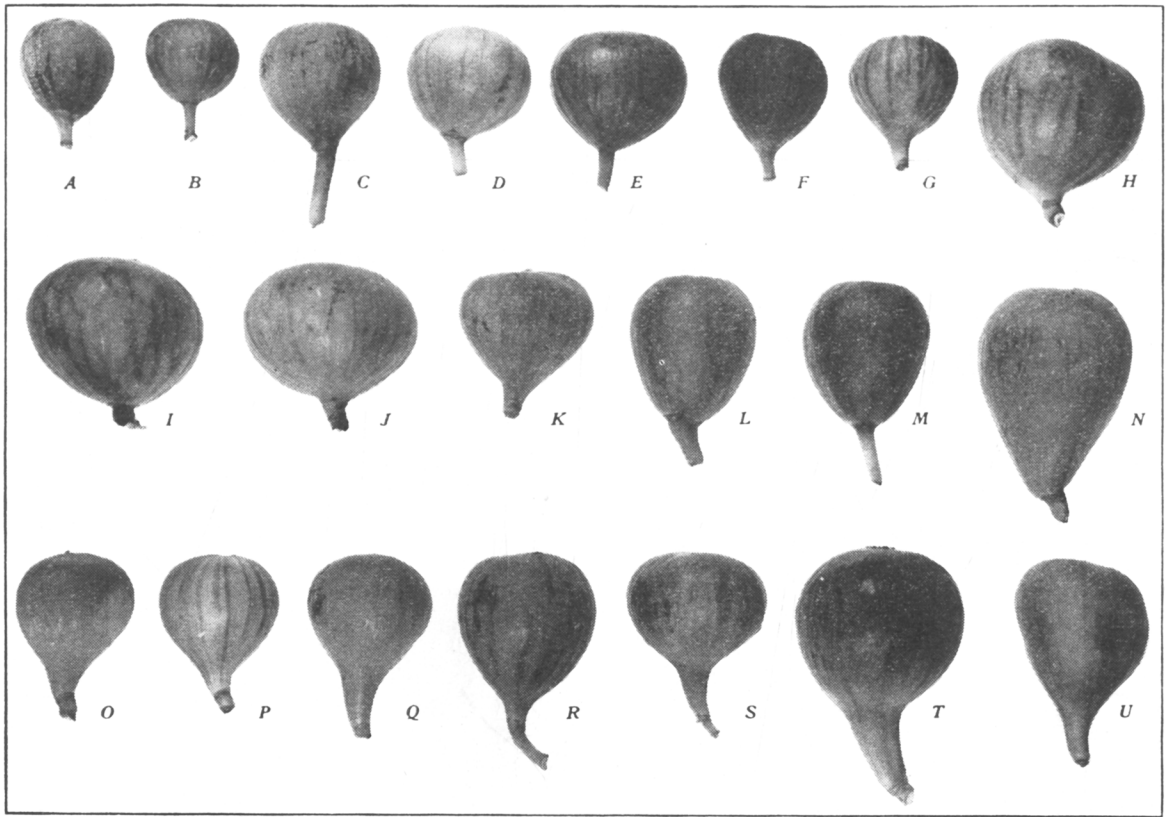

Fig. 2.—Forms of fig fruits: *A–E*, spherical without neck; *F–H*, spherical with neck; *I*, oblate without neck; *J*, oblate with neck; *K–M*, turbinate; *N*, pyriform, with neck undifferentiated from body; *O–T*, pyriform; *U*, oblique-pyriform. *A*, Precoce de Barcelone; *B*, Ischia; *C*, Pastiliere; *D*, Madeleine; *E*, Marseilles; *F*, Toulousienne; G, Martinique; *H*, Dauphine; *I*, San Pedro; *J*, Calimyrna; *K*, Bourjassotte Grise; *L*, Brunswick; *M*, Gouraud Rouge; *N*, San Pietro; *O*, Fraga; *P*, Panaché; *Q*, Gota de Mel; *R*, Pied de Boeuf; *S*, *Ficus palmata;* *T*, Marabout; *U*, Datte. (× 0.35.)

Jean Grise and Partridge Eye. Seldom are these intermediate figs so attractive in color for the fresh-fruit market as the clear yellow or the purplish-black figs. Mission, Turkey, Ischia Black, and Pastiliere are deep purplish black in color (plate 1). The black color persists in the dried fruit of the Mission and Ischia Black, but changes to an undesirable brown color in the Turkey. The late George Roeding (1917) wrote: "If there is any serious objection to the black [Mission] fig, there is only one and that is, it is black."

Black color is objectionable in the dried fruit since black figs do not compete well in the market with light-colored California or imported figs and they are generally unmarketable for use in bakery products. Bleaching with hydrogen peroxide removes most of the black color, but the fruit is apparently not able to compete successfully with dried figs of lighter shades.

Color chimeras or sports in figs have been described by Collins (1919) and by Condit (1928). Such a fig is Panaché (plate 1, *B*), a French fig beautifully marked with green and yellow stripes and seen occasionally in California. Twigs bearing Kadota, Calimyrna, or Adriatic figs with purplish-black sectors or with variegated leaves are sometimes found. These should be marked for further observation and possible propagation.

Color of fresh figs, like that of other fruits, is often obscured or modified by the bloom, which is a surface skin character. Furthermore, color is seldom uniform over the whole surface. Purplish-black Barnissotte commonly shows irregular patches of green persisting around the apex or on the sides of the body. Dark-colored Constantine and Bourjassotte Grise usually show a broad circle of green around the eye of mature fruits. Grasovsky and Weitz (1932) state that Shunnari "is very easily distinguished by a bright red circle around the eye," the skin being green with brownish ribs and the eye scales bright red. It is well, therefore, to note color of neck, apex, scales of eye, shaded side, and so forth, if these are colored differently from the body of the fruit. Most figs are green until practically full size and then gradually assume the mature color characteristic of the variety. A few figs, notably Violette de Bordeaux and Ischia Black, show a distinct reddish-brown color before they are half grown. In some cases the skin color is modified by colored meat. Thus green Monstreuse (described by Eisen, 1901, p. 255) and caprified Adriatic often have a violet shade due to the underlying violet meat. Miller (1768) says of Ischia Green that "the skin is thin, of a green color, but when it is fully ripe, it is stained through by the pulp to a brownish cast."

Form.—The form of the fig fruit, like the color, is affected by cli-

matic conditions, by the presence or absence of fertile seeds, and, to some extent, by vigor of growth. Although there is considerable variation in fruit on the same tree and during the same season, forms of fresh figs are fairly characteristic of the variety. Form is commonly associated with the presence or absence of a neck.

Bobone (1932) uses three measurements in determining the form of the fruit: *C*, length; *D*, diameter; and *A*, the distance between the base and the point of greatest diameter. The shape of the fruit is then expressed by the ratios D/C, $D/2A$, or A/C. When D/C is greater than 1.1, the fruit is said to be oblate; when between 0.9 and 1.1, round; and when less than 0.9, oblong. Or when $D/2A$ is greater than 1.0, the fruit is said to be oblate; when between 0.7 and 1.0, round; and when less than 0.7, oblong.

Forms of fig fruits illustrated in figure 2 and specified in the following outline are typical of varieties found in the variety orchard of the Citrus Experiment Station at Riverside.

Spherical:
- Without neck—Precoce de Barcelone (fig. 2, *A*), Ischia (fig. 2, *B*), Pastiliere (fig. 2, *C*), Madeleine (fig. 2, *D*), and Marseilles (fig. 2, *E*)
- With neck—Toulousienne (fig. 2, *F*), Martinique (fig. 2, *G*), and Dauphine (fig. 2, *H*)

Oblate:
- Without neck—San Pedro (fig. 2, *I*)
- With neck—Calimyrna (fig. 2, *J*)

Turbinate—Bourjassotte Grise (fig. 2, *K*), Brunswick (fig. 2, *L*), and Gouraud Rouge (fig. 2, *M*)

Pyriform:
- Neck undifferentiated from body—San Pietro (fig. 2, *N*)
- Neck prominent:
  - Thick and short—Fraga (fig. 2, *O*), Panaché (fig. 2, *P*), Pied de Boeuf (fig. 2, *R*)
  - Elongated, often curved—Gota de Mel (fig. 2, *Q*), *Ficus palmata* (fig. 2, *S*), and Marabout (fig. 2, *T*)

Oblique-pyriform—Datte (fig. 2, *U*)

Form of fresh fruit is of importance both in canning and in fresh-fruit shipping. It is partly on account of their compact spherical or oblong shape (without a prominent neck) that Brunswick and Kadota are excellent varieties for canning. Calimyrna, oblate in form, with short neck (fig. 2, *J*), is ideal in form for packing in the egg-cell fillers (fig. 3) widely used for long-distance shipments. Pyriform figs, like Mission, are commonly wrapped in tissue and packed on their sides in one-layer baskets.

Size.—Figs are, in general, large, medium, or small. For fresh fruit, average diameter of the body gives a good indication of size. Arbitrary

limits can be established for each size grade, as shown in table 1. On account of the very diverse forms found in figs, a more accurate size classification would be one which considered weight as well as diameter, as suggested by Bioletti (1938) for grapes.

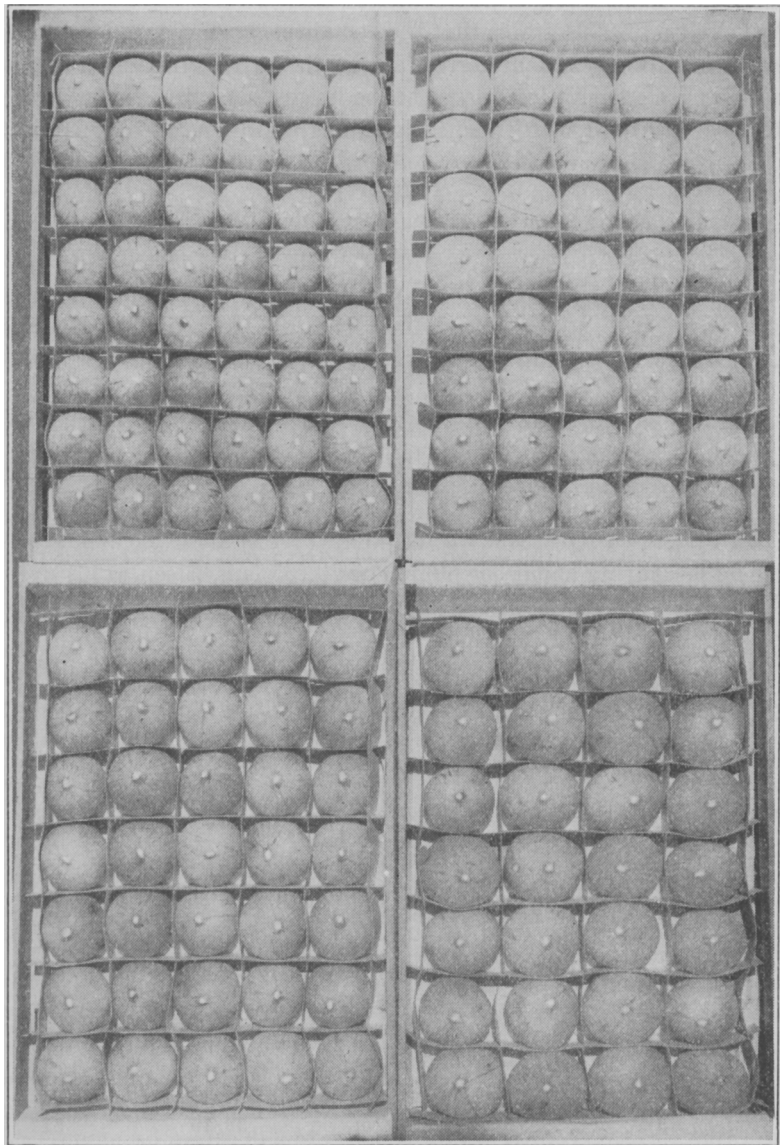

Fig. 3.—Calimyrna figs packed in egg-cell fillers in standard boxes for long-distance shipment: upper left, 6 × 8; upper right, 5 × 8; lower left, 5 × 7; lower right, 4 × 7.

In their descriptions of fig varieties, Starnes and Monroe (1907) give measurements of (1) perpendicular and (2) transverse axes of fruits. The limits of these measurements for figs of the various sizes are: small, 29–46×28–38 mm; medium, 38–54×35–49 mm; large, 52–70×41–56 mm; very large, 75×66 mm.

Van Velzer (1909) states that the "smallest figs measure less than an inch in each dimension" and gives as an illustration, Lipari, "the smallest of all edible figs." He adds that "the largest sometimes grow 5 inches long with an equal width" and illustrates with Black Portugal as the

TABLE 1

SIZE GRADES OF FRESH FIGS BY BODY DIAMETER

Class	Size limits, millimeters	Variety example
Very small	<25	Celeste
Small	25–32	Ischia
Below medium	33–38	Ischia Black
Medium	39–48	Mission and Brunswick
Above medium	49–54	Osborn
Large	55–60	Calimyrna
Very large	>60	Turkey

largest fig grown. Grasovsky and Weitz (1932) describe Khdari as a large fig measuring about 65×60 mm or 70×65 mm. Eisen (1901) refers to Lipari as "the smallest of all figs of the *Ficus Carica* species—about three fourths inch to 1 inch long."

Size grades for figs shown in table 1 are satisfactory for most purposes, although they are approximate only. Size grades for certain varieties are sometimes designated. For example, in packing fresh Calimyrna figs for shipment in egg-cell fillers (fig. 3), the California Fruit Exchange (Anonymous, 1938, p. 26) specifies that the figs "shall conform to the following sizes and shall be so marked: 28, 35, 40, 48, 54, 60, and 72. It is recommended that no sizes smaller than 48 be packed except Kadotas, and in this variety no sizes smaller than 60 be packed." The size of the standard fig box used by the Exchange is $7\times16\frac{7}{16}$ inches, inside measurement. Fillers for Calimyrna figs (fig. 3) have compartments as follows:

Number	Size, inches	Fig diameter, inches	Fig diameter, millimeters
28 (4×7)	35/16×39/16	38/16	60
35 (5×7)	32/16×34/16	34/16	55
40 (5×8)	30/16×32/16	32/16	51
48 (6×8)	26/16×30/16	30/16	48

In contracts with growers, some canners specify that Kadota figs shall

be not less than 1 inch and not over 1¾ inches in diameter. Figs for canning are run through a sizer and packed in various containers. The California Packing Corporation reports[6] the following counts in a no. 10 can, based on a fill of 81 ounces of fruit: fruit size 21/16 inches, 117; size 25/16 inches, 67; size 27/16 inches, 55; and fruit size 30/16 inches, 38.

Figs on the same tree may vary in size—markedly so in some varieties. Size is affected by climate, vigor or health of tree, size of crop, cultural conditions such as pruning or irrigation, and by the character of the seeds. In cool coastal climates, such figs as Adriatic and Osborn reach an unusually large size—at least twice the volume of figs of the same variety grown in the hot valleys of the interior. The largest Turkey figs are grown on heavily pruned and copiously irrigated trees in cool climates near the coast. As pointed out later in this paper (see section, "Effects of Caprification," p. 32), Kadota figs having fertile seeds are considerably larger than those of the same variety having sterile seeds.

Caprifigs of the profichi crop are similar in size to edible figs. Mamme caprifigs, however, range much smaller in size than profichi, seldom reaching 48 mm in diameter.

Neck.—The neck is that part of the body of some figs located next to the stalk. There are figs, such as Marseilles (fig. 2, *E*), that have no neck. Others, such as San Pietro (fig. 2, *N*) and Brunswick (fig. 2, *L*), have the basal half narrowing so gradually between the body and stalk that they also can generally be described as without neck.

In some figs the neck is thick and joins the body abruptly, as in Calimyrna (fig. 2, *J*); in others, such as Col de Dame, it is thick but tapers more gradually from stalk to body. The neck may be long and slender, as in Marabout (fig. 2, *T*); if so, it is often curved or somewhat falcate.

In most figs the neck is round in cross section; in a few it is angular or triangular. The neck of some figs is characteristically compressed or flattened laterally, as in Calimyrna and many of its seedlings, such as Maslin caprifigs No. 147 and No. 148. Some common figs also have a flattened neck, examples being Bourjassotte and Martinique.

Stalk.—The stalk joins the fig body or neck to the twig. It may be short, medium, or long, thick or slender, straight or curved, and rounded or angular in cross section. The stalks of some figs, such as Violette de Bordeaux (fig. 4, *E*), Yellow Neches (fig. 4, *B*), and many specimens of Brunswick (fig. 4, *A*), are prominently swollen or enlarged, especially near the body.

The stalk is generally firmly attached to the twig; it loosens naturally after an abscise layer is formed and allows partly dried figs to drop.

[6] Dodd, H. In letter to author from San Francisco, California, September 11, 1939.

Figs intended primarily for drying are seldom picked from the tree in California, although the practice is common in some Mediterranean districts, especially those near the seacoast. Pickers of fresh Calimyrna figs commonly give the fruit a twist which breaks the neck loose and leaves the stalk on the tree. On the other hand, Turkey figs grown near Los Angeles are picked and marketed with the stalk attached to the

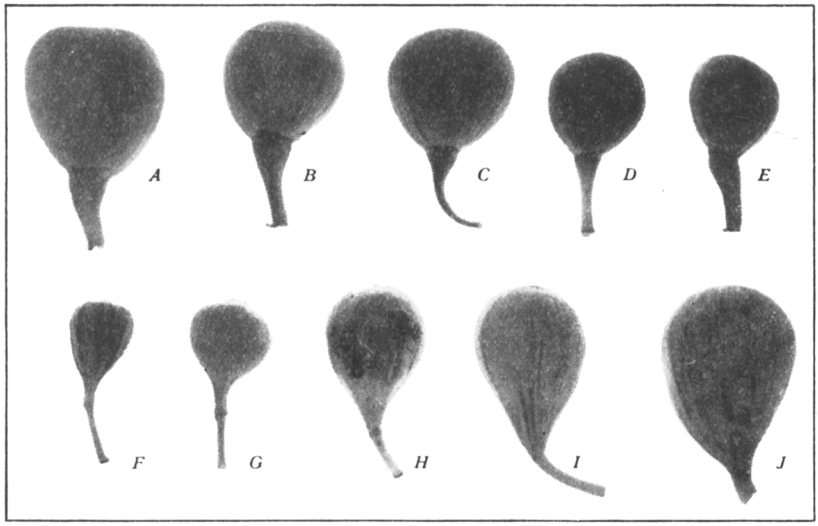

Fig. 4.—Fruit stalks: *A–E*, variously enlarged; *F–I*, long and slender; *J*, short and thick. *A*, Brunswick; *B*, Yellow Neches; *C*, Monaco Bianco; *D*, Precoce de Barcelone; *E*, Violette de Bordeaux; *F*, *Pseudo-Carica capri*; *G*, Palmata capri; *H*, Celeste; *I*, Hunt; *J*, Mission. (× 0.75.)

fruit. In a few figs, notably Pastiliere and Barnissotte, the stalk is rather loosely attached and permits many mature fruits to drop before drying starts.

At the apex of the stalk next to the body are three more or less prominent bracts. These are generally closely appressed to the body but are sometimes loose and flaring. They may be large, medium, or small, green or colored the same as the body, triangular or rounded, and uniform or scarious-margined.

Ribs of the Fruit.—The ribs of the fig fruit are longitudinal ridges running from base to apex (Eisen, 1901). The surface of some figs, like that of second-crop Kadotas, is smooth and almost entirely devoid of ribs. At the other extreme are Pied de Boeuf and Castellana, the ribs of which are so prominent as to make the surface corrugated.

Ribs are mostly confined to the body of a fig, seldom being prominent on the neck or at the apex. They may be continuous and unbranched or

may dissolve toward the apex into branches. Sometimes, especially in immature fruit, they show as mere lines colored more darkly than the body. Ribs are narrow and well elevated in Marseilles and Martinique, while in the Turkey fig they are broad and only slightly elevated. The presence of prominent well-elevated ribs is a detriment for fresh-fruit shipping, because the skin is thus more subject to injury in handling.

Ostiole and Eye.—"Ostiole" or *ostiolum* means literally "little door." In many fungi and lichens, the mouth or terminal pore of the perithecium is called the ostiole. According to Gwynne-Vaughan and Barnes (1927, p. 130) the ascocarp "may assume a flask-shaped outline, opening by a terminal pore, the ostiole." Gaumann and Dodge (1928, p. 134) state that at the top of some perithecia "there is formed . . . a special opening (ostiole) whose canal is often closely covered with hyphal ends." In mycology, the term "ostiole" clearly refers to the whole structure, both entrance, or eye, and canal, and not to the eye alone.

The apical opening characteristic of the receptacles of fig species is also commonly called ostiole. For example, Cunningham (1888, p. 15) wrote of receptacles of *Ficus Roxburghii* that "the ostiole is at this time closed by a firm, solid plug of closely appressed ostiolar bracts." Hutchinson and Dalziel (1927–37) use the ostiole (mouth) of the receptacle as one of the main characters for separating species of *Ficus* into subgenera.

Eisen (1901) refers to this structure as the "eye" and states that it is "the opening in the broad end or apex of the fig." He adds that "Some writers refer to the eye as the 'mouth' of the fig or 'ostiolum.'" Brown and Walsingham (1917) in their account of *Ficus Sycomorus* in Egypt, note that the female fig wasp makes her way through the "eye" of the fig to the open air. Corner (1933) uses the term "orifice" in his revision of the Malayan species of *Ficus*. The eye is sometimes referred to as the "umbilicus." Roxburgh (1832, p. 529) states that in *Ficus hirsuta* the "umbilicus [is] scaly and scarcely elevated above the surface of the fruit." King (1887–88, p. 1) also used this term in describing the structure of fig fruits: "receptacles closed at the mouth by numerous scales arranged in rows, the uppermost of which often partly project externally and form an umbilicus."

In view of the foregoing statements, it seems best to differentiate between the ostiole or complete orifice of the syconium and the eye or umbilicus, the part which is apparent at the surface. The eye of the immature syconium of *Ficus Carica* appears to be completely closed by the scales or ostiolar bracts. The female blastophaga, however, is able to push her way between the scales, as previously described (Condit, 1918*a*). Hansen (1929) found that thrips enter freely. As figs mature,

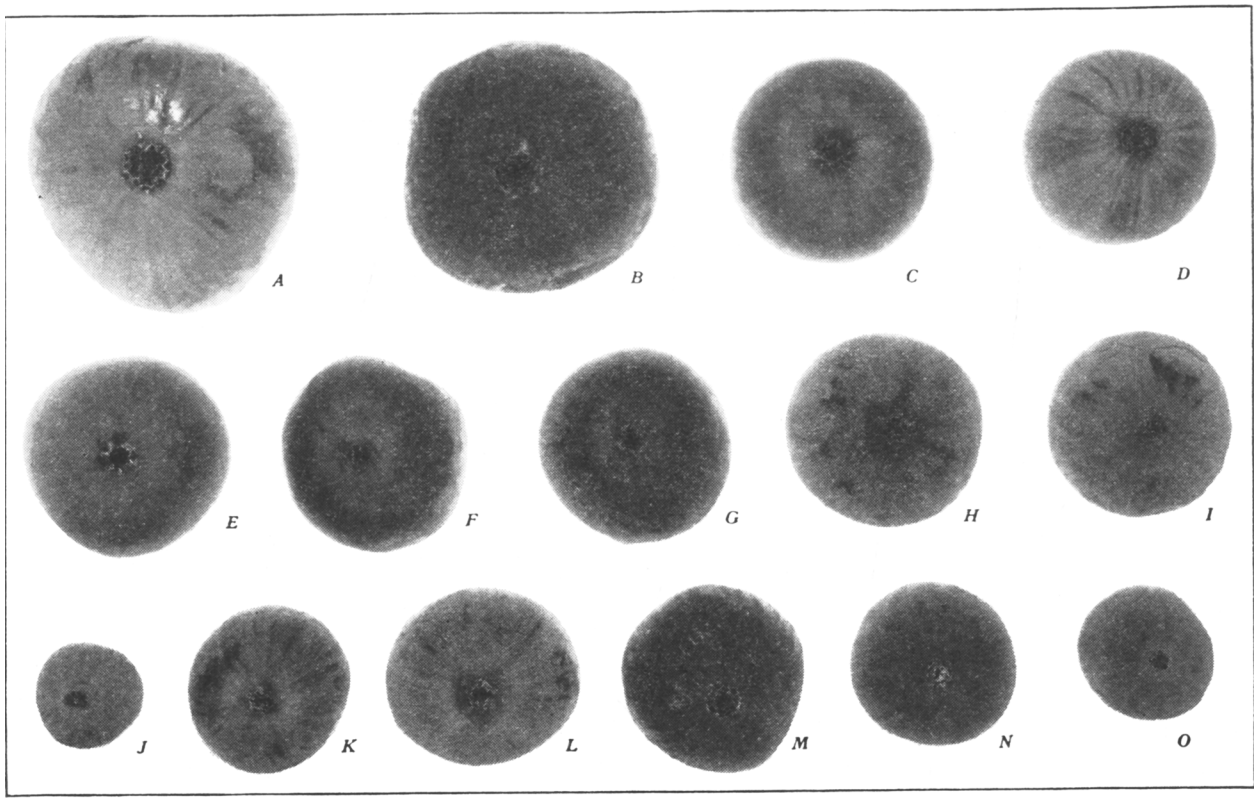

Fig. 5.—Fig varieties showing types of eyes: *A*, Calimyrna; *B*, Turkey; *C*, Fraga; *D*, Panaché; *E*, Brunswick; *F*, Osborn; *G*, Madeline; *H*, Mission; *I*, Castellana; *J*, Palmata capri; *K*, Martinique; *L*, Constantine; *M*, Barnissotte; *N*, Partridge Eye; *O*, Celeste. *A* and *B* are large; *C–G* and *K–M*, medium, and more or less open; *H*, *I*, *N*, *O*, small; and *J* has a craterlike protuberance. (× 0.7.)

the eye may remain fairly well closed, sufficiently so in Mission (fig. 5, *H*) and Kadota to prevent *Carpophilus* beetles from entering, as pointed out by Smith and Hansen (1927). Eisen (1901, p. 179) concludes that "there is no doubt that the principal function of the eye of the fig is to keep out bacteria and insects, and the closed form of the fig receptacle is undoubtedly effected by nature in order to prevent parasites from spoiling the sugary juice of the fig."

Hansen and Davey (1932), investigating the transmission of smut and mold in figs, found that

> While the fig is very young, up to about the size of a large hazelnut, the eye scales are quite pliable, but, as it develops further, the scales become hard and rigid and are able to offer considerable resistance to any insect trying to enter the fruit. Later, as the fruit matures, the eye scales again loosen and spread apart until at full maturity there may be a clear passage to the interior of the fig from 2 to 5 mm in diameter.

According to Smith and Hansen (1931), the diameter of the ostiolar opening varies from 2 to 10 mm in the different varieties. Celeste (fig. 5, *O*) is an example of a fig with a small, well-closed eye. Figs with medium eyes, sufficiently open, however, to allow beetles to enter, are Brunswick (fig. 5, *E*) and Adriatic.

Stansel and Wyche (1932, p. 23, fig. 11) report that "the fruit of the Magnolia variety remains upright and has a more open end than that of the other varieties, which probably accounts for its tendency to sour readily, especially during damp weather." Potts (1917) also refers to the open eye of Magnolia which may be entered and injured by insects. Calimyrna and Turkey figs have large, open eyes (fig. 5, *A* and *B*) allowing easy penetration of beetles and even larger insects, such as honeybees (fig. 6). Actual diameter measurements of body of fruit and of ostiolar opening of different fig varieties are given in table 2 for comparison.

As mentioned by Hansen and Davey (1932), there may, at maturity, be a clear passage to the interior of the fig. This is especially true of uncaprified figs and of those having a hollow center, such as Turkey, Madeleine, Datte, and Brunswick. On the other hand, as is often the case in Kadota, Turkey, Calimyrna, and especially in caprified figs having a solid pulp, the eye may be wide open but the ostiole closed at the base by scales or turgid flowers.

In some caprifigs the eye is in the center of a broad depression; in others, the eye protrudes from the rounded or flattened apex like an umbilicus. The eye of Maslin 150 and of *Ficus palmata* caprifigs (Palmata capri, fig. 5, *J*) is surrounded by a prominent craterlike protrusion.

Some figs, such as Kadota and Calimyrna, exude at maturity a clear,

sparkling, topaz-colored drop of gum into the ostiole and eye and are, therefore, "self-sealed." A seedling Smyrna-type fig from the Maslin orchard at Loomis, California, was selected as a "self-sealing" fig and

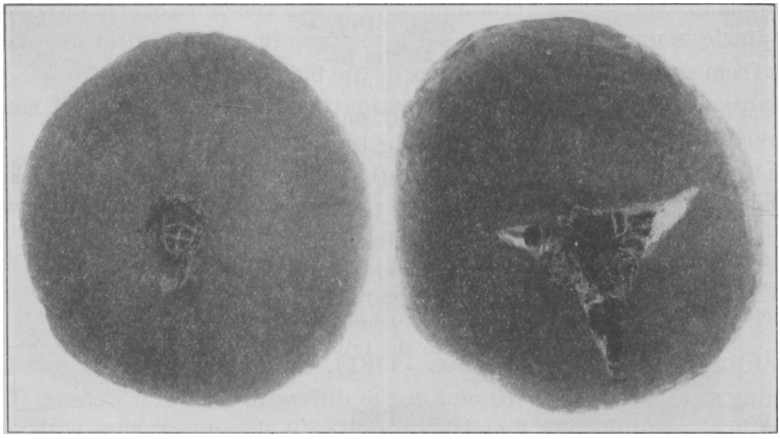

Fig. 6.—Calimyrna figs showing (left) the body of a honeybee in the eye of the fruit and (right) a triangular split common in this variety.

named "Rixford" by W. T. Swingle. He reported (Swingle, 1909) that the self-sealed figs "show a drop of pellucid gum completely filling the very narrow mouth of the fruit when it matures. . . . The drop of hard-

TABLE 2

COMPARATIVE DIAMETERS OF BODY OF FRUIT AND OSTIOLAR OPENING OF DIFFERENT FIG VARIETIES*

Variety	Range of body diameter	Range of ostiolar-opening diameter
	mm	*mm*
Adriatic	33–45	2.5– 4.5
Calimyrna	54–68	6.0–12.0
Kadota	33–44	3.0– 8.0
Mission	35–48	2.0– 5.0
Turkey	43–56	4.0– 9.0

* Measurements were made on ten figs of each variety, selected at random on the tree.

ened gum that closes the mouth is usually from one-sixteenth to one-eighth inch in diameter, sometimes concealed just within the mouth, but usually protruding outside." The variety is not consistent in its self-sealing behavior, however, and has not succeeded in commercial plantings because of this and other faults.

According to Fowler (1865), when Castle Kennedy is "within a few days of being ripe, a clear honey-looking substance of exquisite flavor commences to drop from the eye of each fruit. When quite ripe this substance becomes somewhat viscid, hanging like an elongated dewdrop, from half an inch to three-quarters in length, clear as crystal, giving a very remarkable appearance to the fruit." Moore (1872) reports that Negro Largo grown in pots in England has an open eye and generally a globule of sirup. And Estelrich (1910) finds in Spain that Bordissot Negra, when grown in suitable soil, is apt to have in its eye a drop of liquid of a sweet, gummy consistency.

Clear drops of gum from Kadota figs are completely soluble in water and show the following analysis: reducing sugars, 45.53 per cent of the dry weight; total reducing sugars, after hydrochloric acid inversion at room temperature, 46.86 per cent, the sucrose being 1.33 per cent of the dry weight.[7]

Eye Scales.—The surface scales of the eye of the fig may be large, medium, or small, broad or narrow, acute or rounded, with or without scarious margin, same color as body of fruit or of a contrasting color, and flat or erect at maturity. In Turkey and some other figs, the eye scales are pinkish, even in the small green fruit. In mature Fraga and Gota de Mel, the rose-pink eye contrasts beautifully with the green or yellowish body. Almost without exception, eye scales of caprifigs, at least of the profichi crop, assume an erect position at maturity. This is also commonly true in such edible figs as Calimyrna, Adriatic, and Kadota, though in many varieties eye scales remain appressed to the body.

As pointed out and illustrated by Cook (1922), misplaced scales are commonly found in figs. These abnormal figs (fig. 7), with scales near the apex, on the body, or sometimes in a more or less spiral ring, help to explain the structure of the fig receptacle as a shortened, fleshy branch composed of a series of fused internodes, the scales or reduced leaves of which remain distinct.

Merioun (*Fico fetifero*), according to Eisen (1901), has a very large, open eye "emitting one or more small figs similar to the mother fig.... The monstrosity of this fig is similar to the one found, for instance, in roses, where the axis is prolonged, forming a new rose; or as in certain citrus fruits, such as the navel orange." Tapa Cartin also "frequently develops a monstrosity—another receptacle cropping out of the apex of the first one" (Eisen, 1901). A fig constricted at the middle by a row of misplaced scales is figured by Gasparrini (1845).

[7] Material for analysis collected by Sheldon Jackson, Assistant in Agricultural Extension, Merced, California. Analysis by Walton B. Sinclair, Assistant Professor of Plant Physiology and Assistant Plant Physiologist in the Experiment Station.

Iris.—The iris, according to Eisen (1901), "is a colored zone surrounding the scales of the eye, situated between them and the elevated ridge. It is not identical with the ridge itself." In his variety descriptions, Eisen frequently mentions the iris; for example, he says that Drap d'Or has a small eye "with distinct violet iris" and rosy amber scales. While Eisen defines the iris as being "a colored zone," he sometimes uses other

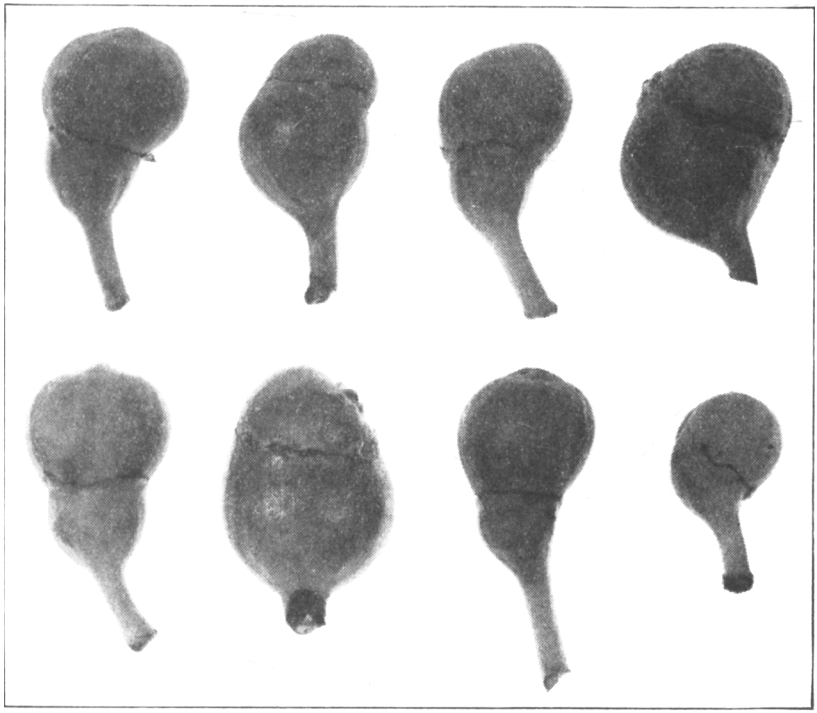

Fig. 7.—Deformed figs with misplaced scales help to show that the fig fruit is a shortened, fleshy branch composed of a series of fused internodes, the scales or reduced leaves of which remain distinct.

than color terms in describing it, as in Hirta du Japon, which has, he says, an "iris small, but rough." Of Martinique White he writes, "eye open, large, with elevated iris"; and of Monaco Bianco, "iris slightly elevated from a surrounding depression, with faint color of dark green."

Starnes (1903) seldom describes the iris. He states, however, that Brunswick has an "iris with rosy red scales," thus apparently confusing iris and eye scales. The iris is occasionally mentioned by Hogg (1866) in his descriptions of varieties; for example, of Gros de Draguignan he writes: "The eye is open and has a dark brown, or rather reddish brown, iris round the opening"; and of Panaché: "Eye closed, and with a nar-

row iris round it." Specimens of Panaché grown at Riverside show colored eye scales, but not an iris. According to Rixford (1918), Lob Injir (Calimyrna) has a large, open eye "bordered by whitish protruding scales a little lighter than the skin, surrounded by a dark ring or iris."

The character "iris" has not been used in blank forms for fig variety description at the California Citrus Experiment Station.

Skin.—The skin of a fig, according to Winton and Winton (1935), consists of an outer epiderm of polygonal cells with thickened outer walls, raised stomata, unicellular and multicellular hairs; and of a hypoderm of rounded polygonal cells, some containing small oxalate crystal rosettes. There is no thick cuticle, such as that found in the apple and the grape. The epidermal cells and the unicellular hairs are colorless. The color of dark figs is found in parenchyma cells lying just beneath the epidermis.

In some varieties, such as Mission, the skin of mature fruit can be readily peeled back from the stem end before eating; in others, the skin adheres rather firmly to the meat. Starnes and Monroe (1907) mention the following figs among those that peel readily: Adriatic, Belle Dame, Datte, and Negro Largo. They describe Abruzzes, Celestial, Castle Kennedy, and Monaco Bianco as having a skin which adheres to the flesh. Some canners label their product "skinless figs"—a misleading term. A more correct label would be "skinned figs," since the skin of the fresh figs is removed with lye, as described by Reed (1933) and by others.

The skin may be dull, as in Ischia, or glossy, as in Kadota. In Madeleine, the skin has a beautiful clear waxy appearance. Some varieties, as already mentioned, have a rough surface due to the presence of ribs.

Texture of skin has an important bearing upon the commercial value of the fig. The firm or rubbery texture of the skin of the Kadota, for instance, makes this variety almost ideal for canning purposes (Condit, 1927); the fruit is not easily bruised and can be satisfactorily transported fresh to distant markets. Mission, Calimyrna, and Turkey figs do not have rubbery skins, but they do withstand fairly well the processes of picking and packing for the fresh-fruit market. The skin of such figs as Marseilles is thin, delicate, and easily bruised. Starnes and Monroe (1907) describe the skin of Peau Dure in Georgia as thin but tough and elastic; this fig is therefore deserving of its name, "Tough Skin."

Checking of the skin (fig. 8) is a characteristic of some fig varieties, more common in varieties having thin, tender skin than in those having skin of firmer texture. Both Kadota and Calimyrna show some checking of skin, which does not, however, impair the naturally good shipping quality of these two varieties. Commission men in New York understand that this checking indicates maturity, and unless "too pronounced, there

is no particular objection to it."[8] Euscaire (fig. 8, *A*) and Mission (fig. 8, *B*) show some longitudinal checking, while Panaché (fig. 8, *D*) and many others show fine crisscross checks as they mature. Starnes and Monroe (1907) state that the skin of St. Jean Grise is medium thick, brittle, and splits at maturity in a network of small "crevasses," like that of Ischia. Bourjassotte Grise in England has been described as follows: "When thoroughly ripe, the skin cracks slightly crossways and length-

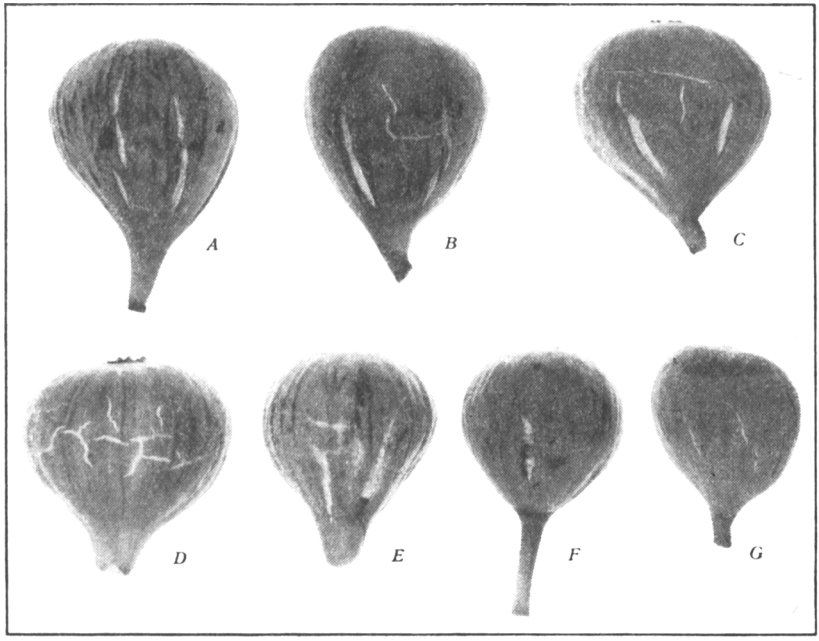

Fig. 8.—Checked skin of different fig varieties: *A*, Euscaire; *B*, Mission; *C*, Fraga; *D*, Panaché; *E*, Gota de Mel; *F*, Pastiliere; *G*, St. Jean Grise. (× 0.6.)

ways over the whole surface, allowing the juices to exude and to stand out like drops of dew" (M., 1871).

Checking of the skin is a character which denotes a good fig ready for eating. A Spanish proverb describing the perfect fig reads: "A neck for the hangman, a robe for the beggar, a tear for the penitent." And Mary Boyd (1911) states that the figs which she bought in Majorca had all the required attributes of perfection: the slender neck, the rent in the skin, the oozing drop of juice.

Bloom.—A surface character present in some figs is the bloom. Miller (1768) reported of Genoa Black that the skin "hath a purple farina over

[8] McDonald, M. H. In letter to author from California Fruit Exchange, New York City, September 27, 1939.

it like that on some plums." But according to Waugh (1908), the bloom of fruits has no real color or is merely waxy gray, the apparent color coming from the underlying skin. Bloom, therefore, is best described by such terms as "prominent," "moderate," "thin," "delicate."

The prominent bloom of such purplish-black figs as Mission and Pastiliere is pruinose. Eisen (1901), describing the bloom of Celeste, states that it "is confined to the neck and upper part of the body, is bounded by a distinct and sharp line, and is thick and pale blue." Apparently this zonation of bloom is not a constant character in Celeste, since at Riverside it is seen only in occasional specimens. According to Reed,[9] it is not a characteristic of Celeste in Texas. Eisen (1901) wrote of Grosse Grise Bifère as follows: "Bloom a very fine violet-pearl gray extending to the cheek, but not to the apex zone from which it is separated by a distinct line, between which and the apex there is no trace of the bloom. This is the most characteristic feature of this fig." This describes accurately the bloom character found in St. Jean Grise (fig. 8, *G*) grown at Riverside and tends to show that this variety is the same as that described by Eisen about forty years ago.

Flecks.—The skin of most immature figs shows numerous white flecks or spots scattered over the surface (fig. 9). Brookshaw (1812) stated that Malta Brown is spotted or speckled with small whitish flecks. These flecks are a more important variety character than Eisen (1901) leads one to believe, as he states only that the skin "may be dotted over with light specks or large spots." The flecks vary in size from small indistinct spots to large conspicuous dots scattered more or less thickly over the surface. In Verdal Longue (caprified), the flecks are often 1 mm in diameter. On most green figs, the white flecks persist until full maturity, then gradually fade. On deeply colored figs, the flecks either become masked by violet or purplish black or are still in evidence as reddish-brown dots. On Toulousienne (fig. 9, *C*) and on Pasquale, the flecks are elongated, frequently 2 to 2½ mm long by ½ mm wide, especially at the apex of the fruit. Large flecks, 2 to 3 mm long, are conspicuous on the basal half of Turkey figs. Rixford (1918) stated that Lob Injir (Calimyrna) has scattered white dots, some of which are elongated.

Hairs.—The epidermis of most fig fruits is studded more or less thickly with unicellular attenuate hairs interspersed with multicellular capitate hairs (fig. 10). A unicellular hair is figured by Tschirch (1889, p. 254, fig. 270). According to Winton and Winton (1935), who figure both kinds of hairs, "the unicellular hairs of the outer periderm are pointed and thick-walled, varying from short to long."

Varieties of figs differ markedly in the abundance and prominence

[9] Reed, H. M. In letter to author from Angleton, Texas, September 12, 1939.

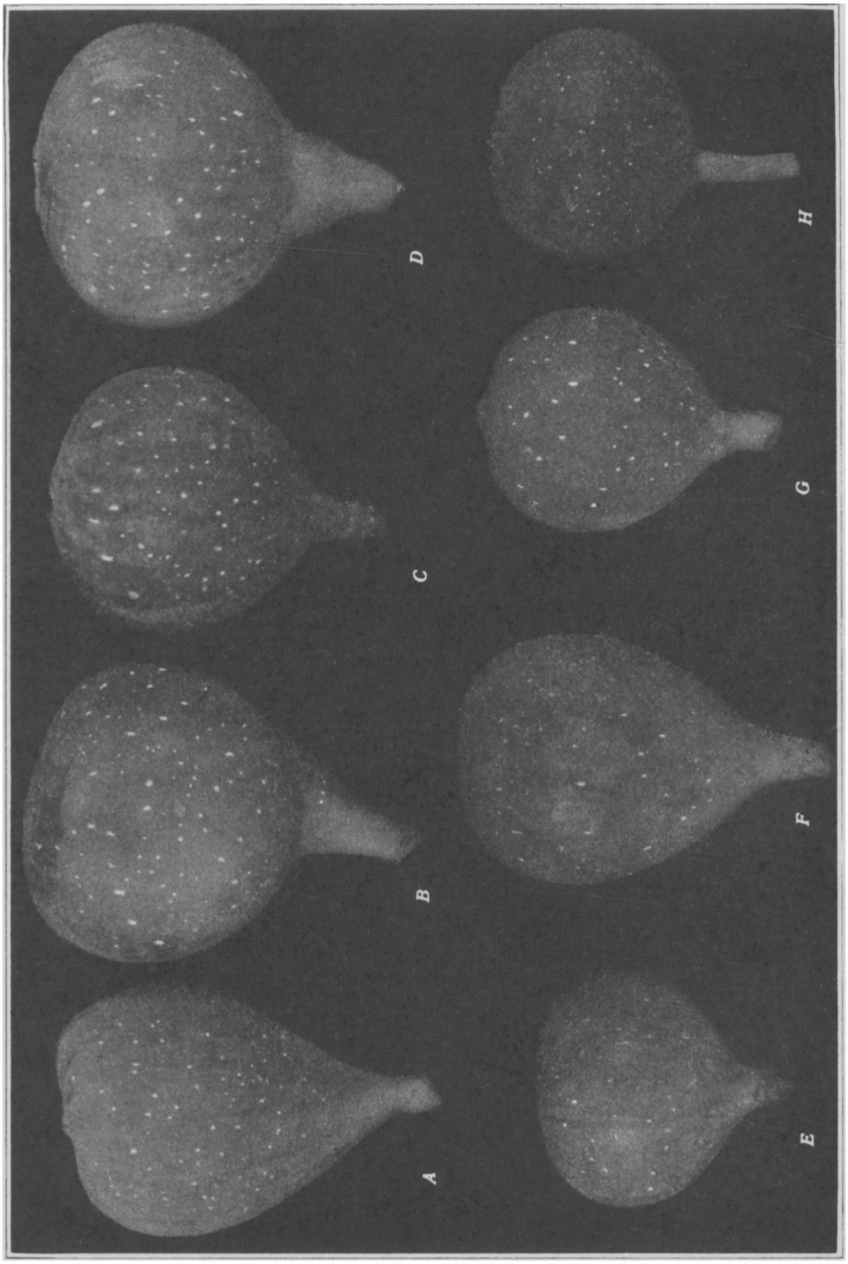

Fig. 9.—White flecks on fruit of different fig varieties: *A*, Barnissotte; *B*, Brunswick; *C*, Toulousienne; *D*, Violette de Bordeaux; *E*, Bourjassotte; *F*, Mission; *G*, Kadota; and *H*, Ischia. (× 0.85.)

of hairs on the epidermis of the fruit. Monaco Bianco and Hirta du Japon (literally, "hairy fig of Japan") both show very prominent hairs. On the Turkey fig, hairs are more numerous and more prominent than

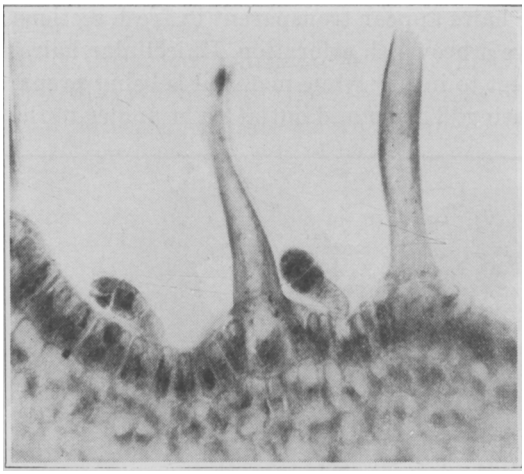

Fig. 10.—Both unicellular attenuate hairs and multicellular capitate hairs occur on the surface of the fig fruit. (Photomicrograph by F. M. Turrell; magnification, × 380.)

on Kadota. For example, on a section of epidermis 6,930 μ long from a Kadota fig, 16 unicellular and 3 capitate hairs were counted; while on a similar section from the epidermis of a Turkey fig, there were 38 uni-

TABLE 3

COMPARATIVE MEASUREMENTS OF EPIDERMAL HAIRS OF FRUIT OF DIFFERENT FIG VARIETIES

Variety	Unicellular hairs				Capitate hairs		
	Number measured	Average length	Longest hair	Average thickness near base	Number measured	Average length	Average thickness near base
		μ	μ	μ		μ	μ
Ficus Carica var. Kadota....	15	58.6	113.2	17.7	4	38.8	16.9
Ficus Carica var. Turkey....	11	189.3	360.0	31.6	5	37.9	15.2
Ficus palmata.....	8	186.9	309.6	24.9	3	35.4	16.3
Ficus Pseudo-Carica.....	9	145.7	360.0	22.3	3	29.2	16.3

cellular and 13 capitate hairs. Abundance and harshness of the hairs can be roughly determined by rubbing the surface of the mature fruit over the tender skin of arm or cheek.

Measurements of hairs of 4 fig varieties, representing 3 species (table

3), show considerable variation in length and in thickness near the base. The longest hairs of Turkey, for example, are over three times as long as the longest found on Kadota. Capitate hairs of the 4 varieties are remarkably uniform in size and shape.

Unicellular hairs appear transparent in fresh sections of fruit; capitate hairs have a brownish coloration. Unicellular hairs are brittle and are very subject to injury while material is being prepared for sectioning and mounting. They stand out at right angles to the surface of the

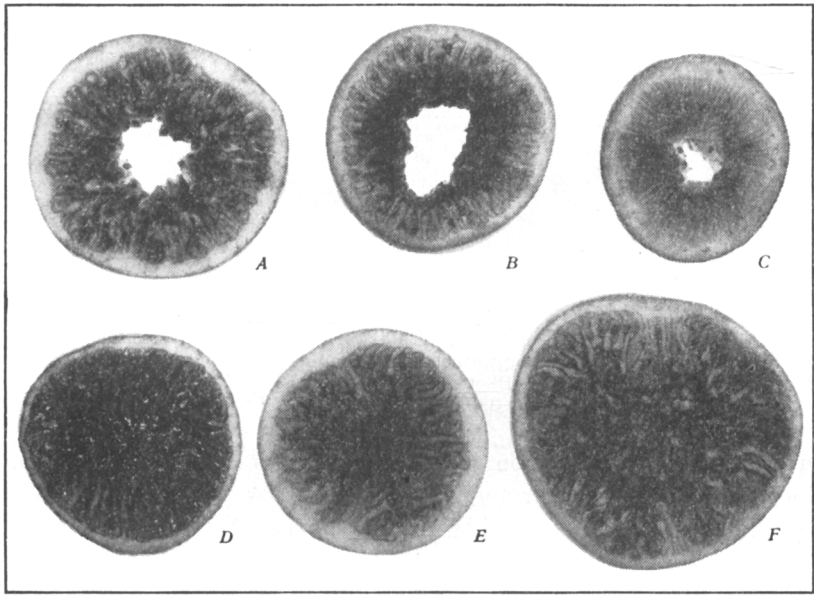

Fig. 11.—Meat and pulp of different fig varieties: *A*, Turkey; *B*, Brunswick; *C*, Madeleine; *D*, Barnissotte; *E*, Kadota; *F*, Calimyrna. All except *A* and *C* are caprified and have fertile seeds. (× 0.66.)

fruit, whereas capitate hairs recline at an angle of approximately 45°. A capitate hair ordinarily consists of a stalk and a four-celled body, oblong or obovate in shape. Unicellular hairs of *Ficus Pseudo-Carica capri* arise from prominent papillae or nipplelike protuberances. Some of the epidermal cells of the papillae show a purplish pigmentation.

Hairs on fig fruits (and leaves) are partly responsible for irritation of the skin suffered by some fig pickers. According to Davidson (1899), "these prickly hairs readily penetrate the flexor surfaces of the fingers and wrists, and in individuals with irritable skins a dermatitis follows in twenty-four hours . . . probably produced by the mere mechanical presence of the bristle-like hairs, as examination shows that the hair points are solid at the tip" but hollow at the base when mature.

Meat of the Fig Fruit.—The meat of the fig is that part lying between the skin and the pulp (fig. 11). It is generally white, but is sometimes colored. In first-crop Kadota figs the meat is streaked with violet. The same is true of a variety in the Citrus Experiment Station collection under the name of Monstreuse.

The meat may be thick, medium thick, or thin. Thickness of meat is usually correlated with size of fruit, the larger figs having the thicker meat. Some actual measurements are shown in table 4. Thickness and

TABLE 4

THICKNESS OF MEAT IN RELATION TO SIZE OF FIG*

Variety	Size of fruit	Range of body diameter	Range of meat thickness
		mm	*mm*
Celeste	Small	23–32	1.5–3.0
Ischia	Below medium	30–42	2.0–3.0
Precoce de Barcelone	Below medium	31–39	1.5–2.0
Mission	Medium	37–51	2.0–4.0
Castellana	Medium	40–43	4.0–4.5
Marabout	Large	52–58	3.5–5.0
Sultane	Large	48–55	3.0–5.0
Turkey	Large	47–54	3.5–6.0

* Measurements made on ten figs of each variety.

texture of meat have some bearing upon the value of caprifig varieties. Thus Condit (1922, p. 352) reports that

> The texture of profichi figs varies somewhat in different varieties. Some have a thick pithy meat or rind which contains considerable moisture and resists drying. Such figs, known by some growers as "wet figs," are favored, since they presumably enable the insects to issue over a longer period after the figs are placed in the baskets. Markarian No. 2 and Roeding No. 3 are of this nature. Other figs are known as "dry figs," since the meat is thin and dry, Roeding No. 1 and No. 2 and Pseudocarica being typical examples.

This distinction between "wet" and "dry" profichi figs is not a very important one, however, as blastophagas apparently issue freely from both kinds. On the other hand, caprifigs with thick meat, inclined to become pulpy, attract and harbor *Carpophilus* and other beetles which carry fruit-spoilage organisms.

The rubbery texture of certain figs, such as Kadota, is partly due to the firmness of the meat. Such figs when dried, often have a thick, woody meat which is difficult to process for fancy packing. The texture of meat in dried figs is influenced both by climatic conditions during the ripening period and by methods used in the drying process. Excessively high temperatures ripen figs prematurely, toughen the skin and meat, and

increase the proportion of overdried leathery fruit. Starnes and Monroe (1907) use the terms "spongy," "very spongy," "slightly spongy," "firm," and "fibrous" in describing the texture of fig meat.

Pulp.—The pulp of the fig consists of the inner part of the meat, the floral peduncles and the perianth, the parenchymatous outer cell wall of the ovaries, and the seed. The parenchyma cells of the floral organs become greatly enlarged or swollen and serve as storage tissue, as described by Condit (1932). The flowers as they mature may completely fill the cavity and form a solid pulp, as in most, but not all, caprified figs, whether of Smyrna or common type. In many common figs, such as Turkey, Brunswick, and Madeleine (fig. 11, *A, B,* and *C*), the mature flowers do not fill the cavity, and the pulp is therefore hollow at the center. "Hollow center" is mentioned by Eisen (1901) in descriptions of Gouraud Rouge, Royal Vineyard, and other figs.

The mature pulp may be white, as in Marseilles, Osborn, and Croisic (Cordelia), or it may become somewhat amber yellow as the fruit softens, though in the majority of figs it is some shade of strawberry. A few figs, such as Beall and Euscaire, which are purplish black externally, have an amber-white pulp. Eisen (1901) wrote of Pied de Boeuf: "A very good fig, remarkable on account of the color of its pulp, which is amber, while the skin is dark." However, Pied de Boeuf grown in the Citrus Experiment Station variety plot at Riverside shows a strawberry pulp. Mission, Turkey, Adriatic, and Genoa are other examples of figs having a light-strawberry pulp. Light strawberry corresponds to "shrimp pink," and medium strawberry to "jasper red," as designated by Ridgway (1912). Deep strawberry or blood red as seen in the pulp of caprified Adriatic corresponds to "blood red" of Maerz and Paul (1930). As previously reported (Condit, 1927), Kadota brebas have a pulp which is distinctly violet-tinted. Second-crop Kadota figs show an amber pulp in hot interior valleys but a violet-tinted pulp in cool coastal climates. The pulp of Calimyrna is either amber yellow or a very light strawberry.

The fact that Kadota in California and Brunswick (Magnolia) in Texas have an uncolored pulp is another reason for their being especially adapted to canning, for the finished product is thus attractively clear throughout. White Pacific and Kadota (both identical with Dottato of Italy) have long been regarded by some as distinct varieties on account of skin and pulp-color variations. The effect of caprification upon color of pulp and upon other fruit characters of common figs is discussed in a later section of this paper ("Effects of Caprification," p. 32).

On the basis of internal color, there are two classes of caprifigs inhabited by blastophagas: (1) those like Stanford, Palmata, and several of the Maslin seedlings, which are white inside; and (2) those like Roed-

ing No. 3, Milco, Samson, and Excelsior, which have the inner part of the meat and the flower stalks colored violet-purple.

The pulp constitutes about 83 per cent of a mature fig, the meat and adhering skin forming the rest of the fruit. Comparisons between skin and pulp weight of a few varieties are given in table 5. As the fig matures and dries, the following changes take place. The moisture content decreases from about 80 per cent to 16 per cent or less; the sugar content increases from around 16 per cent to 60 per cent or more; the individual flowers lose their identity; and the pulp becomes a more or less coherent, sirupy, or gummy mass enveloping the seeds.

Colby (1894) in his fruit descriptions apparently referred to the flesh as including meat, juice, and pulp, and gave the proportion of juice

TABLE 5

PROPORTION OF SKIN TO PULP IN CERTAIN SECOND-CROP FIGS

Variety	Number of figs in sample	Per cent skin (including stalk)	Per cent pulp
Celeste	35	21.0	78.9
Euscaire	20	17.2	82.7
Mission	32	16.7	83.2
Precoce de Barcelone	23	13.7	86.2
Turkey	18	15.0	84.9

to pulp as follows: Rose Blanche (the juiciest fruit), 90 per cent juice; Missone, 88.6 per cent; Brunswick, 86.7 per cent; and very dry fruit such as Coucourelle Blanche, only 38.5 per cent juice. Traub and Fraps (1928) show that the fresh Magnolia fig in Texas consists of 14.7 per cent skin and 83.3 per cent pulp, while the moisture content averages 74.8 per cent. Colby (1894) described California Black as having a coarse flesh; Constantine, a hard and fibrous flesh; Du Roi, a hard and rather dry flesh; Adriatic, a firm and solid flesh; and Brunswick and certain others he described as being full-fleshed. Of all California fresh fruits, the fig is probably the most difficult to put on the market in a state approximating the texture and quality of figs allowed to mature properly on the tree. For this reason, Colby's notes would be more conclusive had they been made on mature, freshly picked fruits selected in the orchard, rather than on miscellaneous fruits after they had been shipped 250 miles to Berkeley.

Coarse texture of fig pulp is indicated by large, conspicuously swollen flowers and flower parts. Starnes and Monroe (1907) seldom if ever described the pulp as coarse, but they did use such descriptive terms as "fine-grained," "delicate," and "smooth." Eisen (1901) described pulp

texture of fruits as follows: Blanche, "very juicy, finely grained"; Bontard, "usually coarse and uneven, but sometimes . . . fine-grained"; Martinique, "very sirupy and juicy"; Datte Quotidienne, "thick, oily." He did not signify what was meant by "oily" pulp. At Riverside, Mission, Kadota, and Adriatic figs show a pulp of fine texture, while Castellana, Marabout, and Euscaire have a coarse-textured pulp. Some figs, notably San Pedro and Dauphine, when mature, show a gelatinous consistency of juice in the pulp.

Seeds.—Seeds, fertile or infertile, are characteristic of fig fruits. As previously pointed out (Condit, 1932, p. 459), such varieties as Mission, Turkey, and Marseilles have numerous hollow and infertile achenes with the ovary wall fully sclerified. Other varieties with infertile achenes, such as Dottato (Kadota) and Brunswick (Magnolia), do not have the ovary wall so fully sclerified nor so well developed as in the plump achenes of most common figs. To call such figs seedless is incorrect. Traub and Fraps (1928) record an average of 406 infertile achenes in Magnolia figs. Price and White (1902), also Starnes (1903), refer to the infertile seeds of common figs as "seed rudiments."

According to Winton (1916), "the stone cells of the sclerenchyma in the ovary wall of fig flowers are sufficiently characteristic of the species to enable their identification in food preparations such as marmalade, jam, and coffee substitutes." Winton reproduces the account and illustrations of Moeller (1886), showing that the outer sclerenchyma consists of a single layer of small stone cells, 15 μ in diameter. The endocarp or inner sclerenchyma is composed of one or more layers of rounded or angular stone cells about 50 μ in diameter. Each cell has a narrow lumen and thick walls with distinct, concentric layers perforated by branching pores.

Fig seeds may be large, medium, or small, few or many, conspicuous or indistinct. According to Eisen (1901), "The size of the seeds of the imported Smyrna figs may be considered as a standard with which to compare others." Seeds of Marseilles, though infertile, are unusually conspicuous, partly because they stand out sharply against the background of white pulp. Starnes and Monroe (1907) describe seeds as few, small; and seed rudiments as large, crisp, crackling under teeth, large and numerous, medium to large, small to medium, yellow, numerous, buff, soft. Eisen (1901) only occasionally mentions the seeds in his descriptions of fig varieties and then describes them as few, small, large, exceedingly minute, few but very large, large flattened, amber in color, very hard.

In 1936, an experiment was conducted at the Citrus Experiment Station to determine whether either xenia or metaxenia, or both, occur in

the Calimyrna fig. In the caprification of this variety, 10 different caprifigs were used, and 10 lots of seed were secured. Careful examination of seeds of each lot under a low-power binocular (6× eyepiece and 55-mm objective) failed to reveal any consistent differences in size, shape, markings, or color. The seeds were somewhat flattened, slightly pointed or protruding at the hilum, ridged somewhat along one side, very minutely pitted over the surface, and light chestnut in color. Five hundred seeds of each lot showed an average weight of 0.62 gram, the range being from 0.55 to 0.67 gram.

The number of seeds found in figs is surprisingly large. Rixford (1918) reports an average of 1,600 fertile seeds in each of three caprified Adriatic figs. My records show (Condit, 1922) that in Adriatic, fertile seeds in 11 caprified specimens varied in number from 472 to 1,288; in 4 caprified Kadota figs, fertile seeds numbered as follows: 544, 412, 402, and 667. Mauri (1939*b*) lists 18 varieties of Kabylian figs and gives the average number of seeds as determined from a 5-fruit sample of each variety. Fertile seeds ranged in number from 716 to 1,831 per fig; sterile seeds, from 15 to 218. If fig seeds are immersed in water, fertile seeds can readily be separated from those that are infertile or sterile, for the fertile seeds sink, while the lighter, sterile seeds come to the surface. Recent studies of seeds in caprified common figs are summarized in table 6.

TABLE 6

NUMBER AND WEIGHT OF SEEDS IN CAPRIFIED COMMON FIGS

Variety	Number of figs in sample	Average number of seeds per fig			Weight of 500 seeds, grams	
		Sterile	Fertile	Total	Sterile	Fertile
Adriatic*	11	611	986	1597	0.2395	0.5800
Celeste†	19	56	187	243	.2605	.5740
Kadota‡	8	199	719	918	.2052	.5647
Kadota†	16	30	537	567	.2105	.5420
Mission†	9	292	408	700	.2202	.4775
Precoce de Barcelone†	23	187	215	402	.2600	.4577
Turkey†	15	115	967	1082	0.1820	0.4627

* Dried figs from Merced.
† Fresh figs grown at Riverside.
‡ Dried Figs from Fresno.

Flavor.—Flavor in figs, as in many other fruits, is a difficult character to describe. Some figs, such as Mission, have a peculiar flavor which may be described, though inadequately, as a distinctive fig flavor. Kadota is sweet but lacks character or distinct flavor (Condit, 1927). Edible figs of *Ficus palmata* Forsk. and most of its hybrids with *F. Carica* have a strong, disagreeable flavor making them definitely unpalatable.

Many caprified common figs and some Smyrna-type figs have a distinct acidic taste. Lindley (1831) wrote of Nerii: "It is much the richest of its species and there is in its juice a slight degree of very delicate acid which renders it peculiarly agreeable to most palates." Eisen (1901) compared Atwater with Peters White and stated that "the latter has less vinous acid." Starnes and Monroe (1907) said of Peau Dure: "quality very good, distinctly vinous, a very unusual characteristic with figs and rendering this variety unique." Grasovsky and Weitz (1932) refer to the pulp of N'eimi as "sour-sweet in taste" and to that of Sharrawi as "sourish in taste." Of Hmadi they write: "variety also considered to be a delicious fresh fig by many fellaheen, mainly due to its sour-sweet sub-acid taste."

Edible figs of *Ficus Pseudo-Carica* Miq. have a decidedly acid flavor. This character is also pronounced in some seedlings having *F. Pseudo-Carica* caprifig as the male parent. The juice of uncaprified Kadota figs in August, 1939, showed 13.2 mg of citric acid; caprified figs of the same variety showed 14.0 mg; while a seedling of Calimyrna × *F. Pseudo-Carica,* which had an especially sour taste, showed 44.3 mg of citric acid.[10]

Other terms used in describing flavor are: "sweet," "rich," "highly flavored," "lacking flavor." Such terms as "agreeable," "exquisite," and "poor," apply more to one's opinion of quality than to flavor. Fresh figs lack any such well-defined aroma as that found in some vinifera grapes (Bioletti, 1938). As with most fruits, marked differences in fig flavors can be distinguished only by those who have a delicate sense of taste.

Quality.—Terms describing quality of fig fruits, as pointed out by Waugh (1908), "are all relative, and all express a personal judgment. Men may honestly disagree as to quality." Quality depends to a considerable extent upon the use to which a fruit is put. Thus, there is little disagreement over the opinion that Magnolia fig in Texas and Kadota in California both have excellent canning quality; or that the shipping quality of fresh Calimyrna, Kadota, Turkey, and Mission figs is good to very good; or that Calimyrna, Adriatic, and Mission have excellent drying quality. Eisen (1901) says of Cotignana: "very inferior in quality as fresh, but superior for drying." General terms used in designating quality in figs are as follows: poor, inferior, medium, fair, good, very good, superior, fine, excellent.

Effects of Caprification.—Caprification, which results in the formation of fertile seeds, markedly affects most common figs in size, color of skin, color of pulp, tendency to split, texture, flavor, quality, and in com-

[10] Juice samples prepared and titrated by Walton B. Sinclair, Assistant Professor of Plant Physiology and Assistant Plant Physiologist in the Experiment Station.

mercial value. These effects, described by Condit (1927), are especially noticeable in the Kadota variety. Some black figs like Mission and Turkey are not externally changed to any great extent by caprification, and caprified specimens are difficult to distinguish from uncaprified ones.

In general, caprified figs are larger than uncaprified figs of the same variety. For example, at Riverside, 32 caprified Celeste figs averaged 30.8 mm in diameter and 17.2 grams in weight, while 16 uncaprified figs averaged 26.6 mm in diameter and 11.8 grams in weight; and 50 caprified Kadota figs averaged 44.4 mm in diameter and 45.4 grams in weight, while 50 uncaprified figs from the same or neighboring trees averaged 38.1 mm in diameter and 32.3 grams in weight. Caprified Brunswick figs, also, are considerably larger than those that are uncaprified. Ischia, however, is apparently little affected in size by caprification, for various-sized specimens can be found in both caprified and uncaprified figs of this variety.

The skin of normally yellow or greenish-yellow figs, such as Kadota, Fraga, and Adriatic, remains a grass-green color in caprified specimens, even at full maturity. The normal bronze color of uncaprified Celeste and Brunswick figs becomes darker and shaded with violet if their fruits have fertile seeds. Verdal Longue figs that are caprified show a much deeper violet color of skin than do uncaprified specimens.

Leclerc du Sablon (1908) states that in studying 3 varieties of common figs, he found it easy to recognize by external appearance the specimens having fertile seeds: Caprified fruits of Madeleine, for example, are larger and fleshier than those that are uncaprified, their exterior color is violet-gray instead of yellowish gray, and the pulp is rose color rather than golden yellow. The comparative average weights of caprified and uncaprified figs of the 3 varieties he found to be as follows: Madeleine, 37 and 29 grams, respectively; Datte, 23 and 20 grams; Bourjassotte Black, 68 and 40 grams.

Although caprification affects color of pulp of most figs, some common figs, such as Marseilles, show a white pulp whether caprified or not. Most common figs, such as Kadota, Osborn, and Brunswick, which normally have an amber or uncolored pulp, have strawberry-colored pulp when caprified. The strawberry pulp of Adriatic, Turkey, San Pietro, Barnissotte, Col de Dame, and Verdal Longue becomes much deeper strawberry or even blood red when the fruit is caprified. Fertile seeds in mammoni caprifigs, as pointed out by Rixford (1918), are found in flowers with red succulent perianth lobes; these flowers are accordingly readily distinguishable from the white or violet, dry gall flowers containing blastophagas.

Fertile seeds and flower parts pack the interior of the fig more or less

solidly. The swelling of these flower parts during the later stages of fruit maturity often creates an expansive force which the meat or receptacle wall cannot withstand. The result often is a splitting of the fruit at the apex (fig. 6), described by Condit (1918*b*, 1919). Celi (1907) concluded that caprified figs have a greater tendency to split and, further, that caprification increases the size of the fruit but injures the quality. Splitting of caprified figs is generally not serious in California except in periods of unusual weather during the ripening season—that is, high humidity, showers, or cool nights followed by hot days.

The effects of caprification of common figs in relation to quality are discussed by Eisen (1901), Celi (1907), Leclerc du Sablon (1908), Rixford (1912, 1918), Condit (1922), and by Bobone (1932). As pointed out by Bobone, caprified figs ordinarily have a pulp texture coarser than that of uncaprified figs of the same variety. This is due to the larger and more swollen flower parts of the caprified specimens. The excellent flavor and quality of Calimyrna figs are due in a considerable degree to the oily or nutty kernel of the fertile seeds; fertile seeds in common figs also have a nutty flavor which is imparted in some degree to the pulp. Rixford (1918) stated that a caprified fig "is considerably increased in size, and the seeds contain plump kernels which give a delicious nutty flavor not apparent in uncaprified figs. Dr. Eisen was the first investigator to make the suggestion." Caprification of common figs, however, often results in an increased amount of fruit spoilage.

Taylor[11] writes on the subject of the caprification of common figs as follows:

> ... Adriatic, Mission, and Kadota should never be caprified. While the size of the fruit is improved, the quality is definitely impaired. I do not have in mind endosepsis or rot. Clean capris might overcome that particular hazard. I am, however, convinced that the skin, texture, flavor, and color are impaired by caprification. The skins are made thick and pulpy in each case. The meat of the Adriatic is turned to a dark purple and has a decidedly increased acid flavor. With Black Mission, the outside color is a lustreless blue instead of the rich black, and the meat is coarse and stringy. Kadota seems affected principally towards a thick, pulpy, rough skin.

LATEX

Latex cells or tubes are characteristic of certain families of plants including the Moraceae. According to Strasburger *et al.* (1912, p. 80),

> ... latex cells ... arise from cells which are already differentiated in the embryo. Growing as the embryo grows, they branch with it and penetrate all its members, and may thus ultimately become many metres long.... They are provided with a peripheral layer of living cytoplasm and numerous nuclei. Their sap is a milky, usually white fluid, which contains gum-resins, *i.e.* mixtures of gums and resins,

[11] Taylor, Charles. In letter to author from Fresno, California, October 6, 1939.

caoutchouc, fat and wax in emulsion. In addition, they sometimes hold in solution enzymes, leptomin, tannins, often poisonous alkaloids, and salts, especially calcium malate, also in the case of *Ficus carica* and *Carica papaya* peptonising ferments.

The latex cell, then, is a single cell, the growing tips of which make their way through the tissues much as the hyphae of a parasitic fungus penetrate between the cells of a plant. According to Flückiger and Tschirch (1887), latex cells of the fig are so striking that by means of them, one may easily recognize an adulteration of "fig coffee." Winton (1916) states that these tubes in the fig are chiefly remarkable for their numbers and that numerous minute granules, colored intensely yellow by iodine, are suspended in the milky contents.

Solereder (1908) found that in *Ficus Carica* and certain other species of Moraceae "the contents of the laticiferous tubes include large grains, the nature of which has not been determined." The grains frequently show stratification, as first observed by Caruel (1865). Popovici (1926) found that by fixation of latex cells of *Ficus Carica* by Regaud's method, the individuality of the vacuoles was retained. He says (see Moyer, 1937): "... it was found that the single vacuole contained latex. Many fusiform nuclei lay in the envelope of cytoplasm while droplets of caoutchouc were seen both in the cytoplasm and in the vacuole, where they were larger."

Several investigators have studied the enzyme present in the latex of the fig. Bouchert (1880) proved that there is a strong ferment in fig latex capable of digesting albuminoid substances. Gerber (1912*a*, *b*) studied the latex of the fig in comparison with that of the paper mulberry and found that the fig latex is a vegetable pancreatic juice with proteolytic diastase predominating; that it contains a lipase which is one twelfth as active in a neutral medium as that of the paper mulberry; and that its starch-splitting properties are one eighth as strong as those of the latex of the latter. Its power to coagulate milk, however, is one-hundred times as great as that of the paper mulberry. Gerber and Guiol (1912) found that pancreatin from fig latex has twice the proteolytic activity of Merck's trypsin and that its amylolytic activity is slightly greater. Gerber (1913) also reported that latex of mulberry, fig, and paper mulberry each hydrolyze carbohydrates and proteins.

Gerber and Salkind (1913) determined that subcutaneous injections of fig latex into a pigeon, produced fever, local congestion, lesions of a necrotic character, convulsions, and finally death in a state of coma. According to Gerber (1914), the casease and trypsin of latex of fig and paper mulberry are the same. Deleanu (1916) found that the peptolytic enzyme from fig latex is identical with that from papaya. Robbins and Lamson (1934) examined the enzymatic activity of the sap from four

genera of Moraceae and found it less than one fifth of that noted in sap of *Ficus Carica* collected in Alabama at the same time. The concentration of enzyme has a marked seasonal variation, according to Robbins (1935), and is lowest in early summer.

Latex cells are found in the cortex of root and stem and in the parenchyma of leaves and fruit. According to Tippo (1938, p. 16), "the latex tubes in the Moraceae may vary from small to large. There may be few or many in the xylem . . . usually in the center of a ray, rarely near the top." Healthy fig trees show a copious exudation of latex from the bark, but frost or drought may injure the latex tubes. The degree of frost damage to young fig trees can be ascertained by slitting the bark with a knife and noting the decreased amount of exudation; nursery trees badly frozen or dried out show no latex and should not be planted.

Some species of *Ficus* have been used for the production of rubber, and it is not strange, therefore, that the possibilities of utilizing the latex of *F. Carica* have been considered. One writer (Anonymous, 1928) reports that rubber in commercial quantities may be obtained from the Panaché, or French fig, and that the common California varieties, Kadota and Adriatic, are being subjected to research processes. The fig and many other latex-producing plants are not being used as sources of rubber, however, since other and cheaper sources are available.

Merezhkovskii (1931, p. 16), in his *Romance of Leonardo da Vinci,* states that the latter suggests fixing "the temper for the color [of paints] with the yolk of an egg and the milky sap of young branches of the fig tree, mixed with water and wine."

As previously stated (see "Hairs," p. 23–26), fig pickers sometimes experience an acute irritation of the skin, due partly to the hairs on fruits and leaves. Since the same sensation occurs while handling fresh fig wood when budding, grafting, or making cuttings, and especially when picking mamme caprifigs from leafless trees in late winter, the latex, also, must cause irritation. Maiden (1909) reported that "the irritation caused by the skin of the common edible fig is so well-known that people usually peel it before eating it; if they omit to do so, they are reminded by the irritation of the mouth."

Schwartz and Tulipan (1939, p. 439) in their book, *A Text-Book of Occupational Diseases of the Skin,* include a paragraph describing dermatitis from figs. Legge (1921) gives an account of a similar dermatitis among dried-fig packers and states that "the abrasive action on the cuticle of the hands of the operators when pulling open the dried figs, permits directly this protein enzyme to produce a digestive and dissolving action of the tissues and is the etiology that is responsible for the lesions." The preventive measures offered are the use of cotton gloves in

picking fresh figs or the anointing of the hands with a high-grade mineral oil, such as the lighter automobile lubricants. According to Gould (1919), "some pickers wear gloves or rubber finger tips. Others smear beef suet or some other form of grease or oil on the hands and also on the arms where the latter are exposed." Frequent washing of the hands in vinegar helps to counteract the effect of the juice. Gasoline is also effective in removing latex, although most pickers depend primarily upon strong soapsuds and water.

THE LEAF

Leaf characters of taxonomic value in the fig are similar to those described by Bioletti (1938) for the grape. In the fig, these characters include form of leaf, size, sinuses, margin, color, surface, texture, petiole, and cystoliths; and they are sufficiently stable in fig varieties to be of value in classification and identification. For example, Miller (1768) in describing Brunswick or Hanover fig stated that the leaves are much more divided than those of most varieties. And Brookshaw (1812) reported that Ischia Green "has a small leaf in comparison to some others and is not much divided."

Considerable variation exists in forms of leaves from a single tree. Juvenile fig leaves in general show much deeper sinuses and narrower lobes than leaves on fruiting branches. A single leaf typical of the variety must, therefore, be selected with considerable care. Starnes and Monroe (1907) illustrate a single leaf as typical of a variety, as does Mauri (1939*a*) in his study of caprifigs. The latter, however, in his treatment of edible figs of Algeria the same year (Mauri, 1939*b*), illustrates nine leaves of each variety to show the variation in a single variety.

Swingle (1905) described in detail the leaf characters of 7 varieties of Neapolitan caprifigs and presented a key for their identification, based on length of petiole as compared to depth of sinuses, width of sinuses, apex of middle lobe, and decurrence of lamina.

Form of Leaf.—Starnes (1903), after a close study of the foliage of some 25 fig varieties in Georgia, decided that there are apparently five distinct forms or types of fig leaves. Four of these he named as follows: "okra," "grape," "maple," and "oak," after the plant which each chanced to resemble; the other leaf type he named "spoonbill." Starnes and Monroe (1907, p. 54) changed these names and published the following leaf chart:

Type I. Cordate—base rounded; no subdivisions or groups:
(Transition to type II.)
Type II. Calcarisate—base spurred; 4 subdivisions or groups.
Group 1. Latate—lobes broad.
(Transition to group 2.)

Group 2. Lyrate—lobes incised.
(Transition to group 3.)
Group 3. Spatulate—lobes spoon-like.
(Transition to group 4.)
Group 4. Lineate—lobes narrow.

These authors state that this classification

... will be found to contain, in many cases, amorphous or varying types of foliage that seem to prevail while the trees are young; but this apparent tendency to amorphism more or less disappears as the specimens attain age, although it frequently persists and occasionally causes some confusion in deciding into which of two divisions certain varieties should be placed.

. . . . . .

Of the value of this arrangement, there can be no question, since it has greatly simplified our initial work, limited though it may have been, and the process will prove of much greater value when a more critical comparison becomes necessary as the study proceeds.

In his descriptive catalogue, Eisen (1901, p. 206) briefly describes leaves of the principal fig varieties and reports that, in general,

The leaves are either "large" or "small," "entire" or "deeply lobed," "dark" or "light," "glossy" or "hairy," "regular" or "lop-sided." The lobes are either 3, 5, or 9 in number, or the margin may be "entire." They may be "acute," "pointed," "rounded," "obtuse," "cuneate," "wavy," or "smooth." As the leaves vary on each tree, an average leaf adjoining a fig should always be taken as a model for description. Finally, it should be stated whether the stalk of the leaf is unusually "short" or "long," "dark" or "light."

Both Vallese (1909) and Estelrich (1910) pay some attention to leaf characters in their descriptions of fig varieties. Vallese not only describes the foliage, but gives an outline sketch of two typical leaves. Of the Italian Dottato (synonymous with Kadota of California), for example, he writes as follows:

Leaves scabrous with some rigid, sharp hairs in the spaces between the veins; the color deep green on the upper surface, pale green and velvety below; lamina asymmetrical, longer than broad, almost always three-lobed, more rarely five-lobed or entire; lobes short, obtuse, the middle one cordate, the lateral ones triangular, the superior lobe of the five-lobed leaf hardly at all acute; sinuses large, very shallow; petiolar sinus in the form of a V-opening, often very broad and almost absent; teeth small, obtuse, irregular; veins projecting prominently from the lower surface, of the same greenish-yellow color as the stalk.

It is interesting to compare this Dottato leaf sketch by Vallese with a photograph of 35 Kadota leaves, all taken from a single tree (Condit, 1927, p. 10, fig. 3). This photograph shows leaves that are predominantly five-lobed.

Bobone (1932), in his taxonomic study of figs, does not include leaf

forms in classifying varieties, nor does he describe the foliage of any of the 27 varieties discussed. He does state, however, that the leaves of *Ficus Carica* are described by Pereira Coutinho (1913) as petiolate, large, rough-pubescent, cordiform, three- to seven-lobed or almost entire, sinuate-dentate. Bobone refers also to Melo Leote (1900), who took into account leaf form and margin in classifying figs and who pointed out that such characters are variable; that, in fact, three-, five-, and seven-lobed leaves occur simultaneously on the same tree.

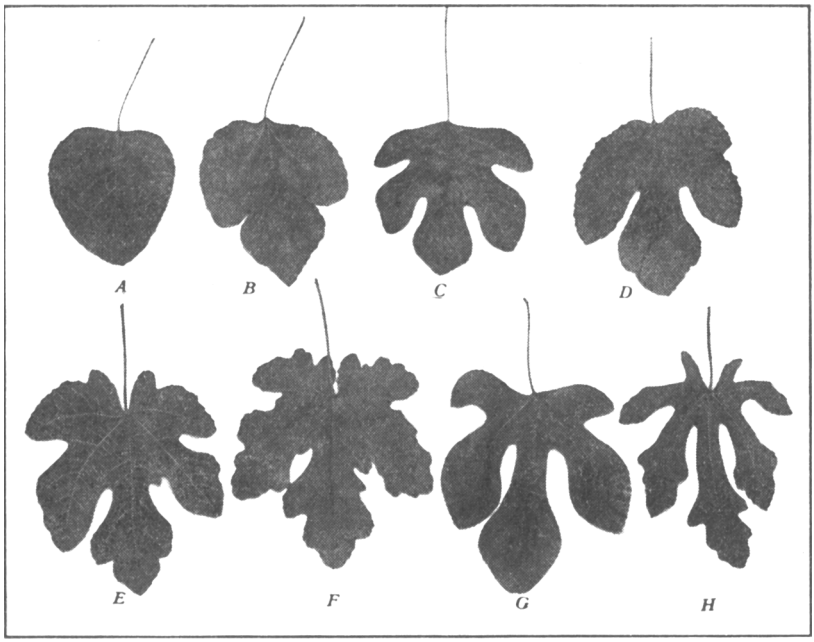

Fig. 12.—Leaf types: In *A*, the leaf is entire (Hamma); and in *B–H* the leaves are palmately lobed; *B*, base decurrent (Ischia); *C*, base truncate (Stanford capri); *D*, base cordate, three-lobed (Constantine); *G*, base cordate, five-lobed, lobes spatulate (Calimyrna); *E*, base calcarate, lobes latate (Mission); *F*, base calcarate, lobes lyrate (Turkey); *H*, base calcarate, lobes lineate (Brunswick).

According to Post and Dinsmore (1932–33), trees of *Ficus Carica*, both cultivated and "wild," are common in Syria. Of the "wild" varieties, *F. Carica rupestris* Haussk. has undivided ovate to oblong leaves. Trees of *F. Carica* in California show an occasional entire leaf, but such leaves are never typical of a variety. One caprifig type of *F. palmata*, on the other hand, shows all leaves entire. Hamma also has entire leaves (fig. 12, *A*), and this character along with others seems to indicate that it is a variety of *F. palmata* rather than of *F. Carica*.

Fig varieties which typically have three-lobed leaves are apparently

common in Algeria, as judged by illustrations published by Mauri (1939*b*), for at least 7 of the 18 varieties illustrated show three-lobed leaves. Several of the single caprifig leaves illustrated by Mauri (1939*a*) are also three-lobed. Starnes and Monroe (1907) illustrate one leaf each of Vernissenque, Angelique, Bourgeassotte (Bourjassotte) Grise, and Versailles as three-lobed and included in the cordate type. Three-lobed leaves are the prevailing type on trees of Constantine (fig. 12, *D*) and Ischia (fig. 12, *B*) in California.

Five-lobed leaves are more or less typical of Celeste, Datte, Kadota, Pastiliere, Adriatic, and Calimyrna (fig. 12, *G*). Seven-lobed leaves or leaves with the base spurred (fig. 12, *E*, *F*, and *H*) are commonly found on trees of Jerusalem, Turkey, Brunswick, Mission, and Euscaire. On trees of most if not all these varieties, however, there are practically as many five-lobed as seven-lobed leaves, if not more—a fact which emphasizes the doubtful value of an illustration showing a single leaf as typical of a variety. In a sample of 50 leaves taken from one tree of Turkey, there were 20 five-lobed, 11 six- or seven-lobed, 12 three-lobed, and 7 almost entire leaves; in a similar Brunswick sample, 24 five-lobed, 22 six- or seven-lobed, and 4 three-lobed leaves; and in a sample of Euscaire, 18 five-lobed, 22 six- or seven-lobed, and 10 three-lobed leaves.

The following outline is suggested for use in classifying leaf types:

Leaf entire, base truncate—Hamma (fig. 12, *A*)
Leaf palmately lobed:
  Base decurrent—Ischia (fig. 12, *B*)
  Base truncate—Stanford capri (fig. 12, *C*)
  Base cordate:
    Three-lobed—Constantine (fig. 12, *D*)
    Five-lobed, lobes spatulate—Calimyrna (fig. 12, *G*)
  Base calcarate:
    Lobes latate—Mission (fig. 12, *E*)
    Lobes lyrate—Turkey (fig. 12, *F*)
    Lobes lineate—Brunswick (fig. 12, *H*)

Leaf Size.—Dimensions used in determining the size of the fig leaf are as follows: width of blade, W; length of blade, L; and length of petiole, P. The leaf-measuring card shown in figure 13, like that suggested by Bioletti (1938) for the measurement of grape leaves, facilitates the measurement of large numbers of leaves and the computation of average figures for W, L, and P. Relative size can then be indicated by the product $W \times L$ and the general form by the ratio W/L.

According to Bioletti (1938, p. 270), "In leaf measurements of several hundred varieties of vinifera vines at Davis, the latter ratio [W/L] has been found always greater than 1." In leaf measurements of figs, the ratio W/L is sometimes less and sometimes greater than 1; for example:

in the Calimyrna leaf it is 0.99; in Turkey, 0.96; in Datte Quotidienne, 1.0; and in Bontard, 1.1. Leaves for measuring should be selected from normal trees and from fruiting branches, at least 50 specimens being collected from a single tree.

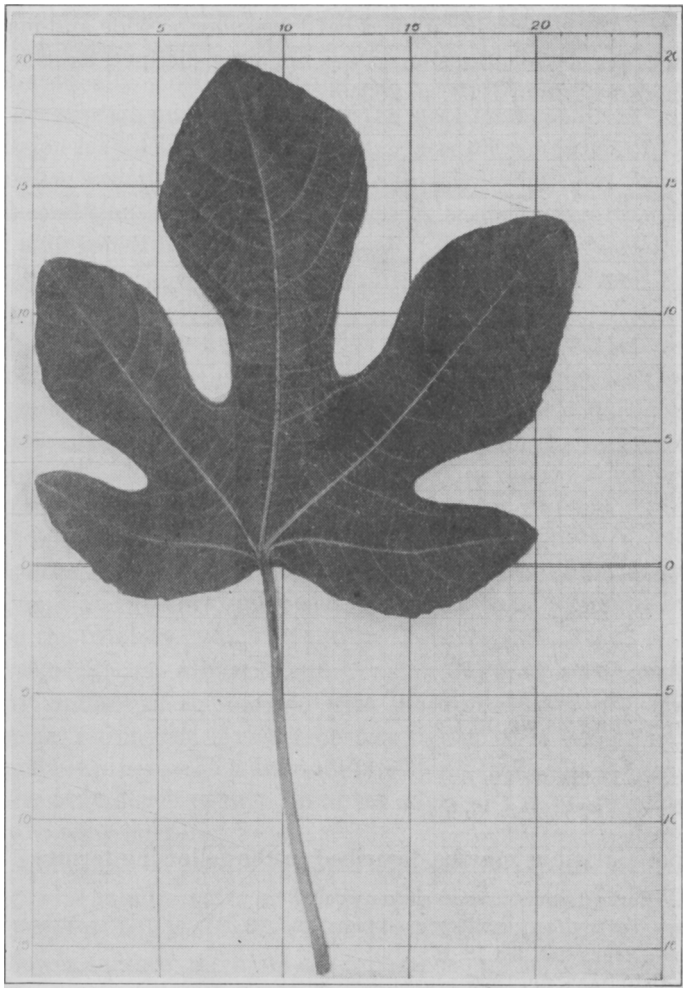

Fig. 13.—Fig leaf (lower surface, showing prominent venation) on a leaf-measuring card. Measurements, in centimeters: $L=20$; $W=21.6$; $P=16.3$; $W\times L=432$; $W/L=1.08$; $P/L=0.815$.

Size classes of fig leaves are shown in table 7. Some varieties, such as Ischia, Celeste, and Roeding No. 3, have relatively small leaves. Some like Biskra and Marabout have large or very large leaves. Some very small leaves can be found on trees of *Ficus Carica,* but none of the varie-

ties studied have leaves averaging as small as those of *F. Pseudo-Carica* (table 7) or of many seedlings of *F. palmata.*

Leaf Sinuses.—The leaf of the fig, like that of the grape, commonly has five main veins, each originating at the petiole and supplying a corresponding lobe. Between these lobes are the five sinuses—two upper, two lower, and the petiolar sinus. Leaf lobes may be wide and may overlap each other so that the sinuses are not very distinct, as in leaves of Pingo de Mel (Eisen, 1901, p. 262).

TABLE 7
SIZE CLASSES OF LEAVES

Class	Leaf area limits (W×L)	Example (Riverside)			
		Variety	Length (L)	Width (W)	Area (W×L)
	sq. cm		*cm*	*cm*	*sq. cm*
Very small	<150	*Ficus Pseudo-Carica* (edible)	10.0	6.4	64.0
Small	151–250	Ischia	15.6	14.2	221.5
Medium	251–400	Turkey	17.6	18.2	320.3
Large	401–550	Calimyrna	22.0	21.8	479.6
Very large	>550	Marabout	25.0	24.0	600.0

The upper and lower sinuses vary considerably (fig. 12) and may be classified according to depth and form as follows:

Depth:
- Shallow—Ischia, fig. 12, *B*
- Medium—Mission, fig. 12, *E*
- Deep—Calimyrna, fig. 12, *G*

Form:
- Narrow—Ischia, fig. 12, *B*
- Wide—Calimyrna, fig. 12, *G*

The petiolar sinus may be described in the following terms:

Closed—Turkey (sometimes on sucker wood)
Narrow—Turkey (on heavily pruned trees), fig. 12, *F*
Medium—Brunswick, fig. 12, *H*
Wide—Calimyrna, fig. 12, *G*

Leaf Margins.—None of the fig varieties studied have leaves with entire margins, although some leaves, like those of Martinique, are nearly entire. In leaves of Calimyrna (fig. 12, *G*), Adriatic, and Sultane, the lower margins of lobes are entire, while the upper margins are crenate. Entire leaves like those of Hamma (fig. 12, *A*) and *Ficus palmata* have crenate margins. Many varieties, Mission (fig. 12, *E*), for example, have

leaves with coarsely crenate margins. Mauri (1939*b*) describes the leaves of several Kabylian varieties as having margins "dentes," although in his illustrations, the teeth are rounded or crenate.

Leaf Color. — Leaves of cultivated fig varieties are predominantly bright green. Some varieties, such as Baalie and Marabout, show a distinctly lighter green foliage than others. Eisen (1901) describes Mission as having glossy leaves, lighter green than most other figs and most characteristically mottled with lighter, yellowish green. The last part of this description probably refers to the mosaicked condition common to the Mission leaf. Either mosaic spots or a rusty condition of the lower leaf surface sometimes make the color appear lighter, but these are abnormal conditions and are not characteristic of the variety. The lower side of a fig leaf is invariably of a much lighter shade of green than the upper, partly because of the numerous epidermal hairs on the lower surface.

Leaf Surface.—The five main veins of a typical fig leaf are very light green or almost white, the color contrasting sharply with the deep green of the general leaf surface. On the upper side of the leaf, the larger veins may protrude slightly or be practically level with the leaf surface. On the lower side, all the larger veins and many of the small white veinlets project somewhat above the surface, so that the fine meshes of mesophyll, about 1 mm across, can readily be seen by the unaided eye. The upper surface of most fig leaves is fairly smooth, while that of some—Panaché, Fraga, and Barnissotte, for example—is somewhat raised or bulging between the veinlets.

Leaves of Fraga, Adriatic, and Constantine have a somewhat glossy or shiny surface in comparison with the dull surface of Kadota and Calimyrna. Calimyrna leaves generally lie flat or in one plane, in contrast to many others which are undulate. Some leaves, like those of Adriatic, have a tendency to turn up at the edges and have, consequently, a slightly concave surface.

The epidermis on both the upper and the lower side of the leaf is studded with minute hairs or spicules. On the upper surface, the hairs are stiff and widely scattered, rendering it like sandpaper to the touch; on the lower surface, the hairs are numerous and soft, making this surface velvety. As pointed out by Renner (1906), there are on the lower leaf surface some capitate three- to four-celled hairs, as well as numerous unicellular hairs of various lengths. Examination of leaves of 7 fig varieties at Riverside shows that hairs on the lower surface are much more numerous and much longer than those on the upper surface. Measurements of the longest hairs are as follows: on the upper surface, 19.9 μ; on the lower surface, 31.1 μ. Capitate hairs are scarce and almost

identical in shape and size with those on the surface of the fruit. Hairs on leaves and petioles of some horticultural forms of *Ficus Pseudo-Carica* and of *F. palmata* are so very numerous that these organs are prominently pubescent. Eisen (1901) states that the leaves of Albo are fairly hairy or pubescent, more so than those of most other varieties.

Texture of Leaves.—Mature leaves of *Ficus Pseudo-Carica* and of *F. palmata* are fairly thin and pliable. Leaves of *F. Carica* are comparatively thick and stiff, although among the different kinds there is considerable variation in thickness and texture. Adriatic leaves are stiff and harsh and make the harvesting of the fresh fruit more difficult than that of Kadota and Calimyrna, both of which have more pliable leaves.

TABLE 8

VARIATION IN PETIOLE IN FIG VARIETIES; AVERAGE DIAMETERS IN MILLIMETERS

Slender		Medium		Thick	
Variety	Diameter	Variety	Diameter	Variety	Diameter
Hamma	3.5	Turkey	5.0	Pastiliere	6.6
Ischia	3.8	Calimyrna	5.2	Sultane	7.1
Bontard	4.1	Mission	5.7	Euscaire	7.6
Constantine	4.2	Kadota	5.9	Marabout	7.7

Panaché, Fraga, and Pastiliere commonly have rather thick and brittle leaves.

Petiole.—The petioles (leaf stalks) are described in terms of length, thickness, surface, and color. Mauri (1939*b*) describes petioles as thick, thin, long, short, slender, green, or, sometimes, as tinted with rose-carmine. The terms "long," "medium," and "short" have little meaning unless some standard of comparison is used. Such a standard, as in the study of grapes, can be the relation of petiole length to length of midvein. Bioletti (1938) found that in grapes, the midvalue P/L ranged from 0.6 to 1.2. In figs, the highest value found for P/L was 0.75 in Marseilles, although Croisic and Marabout actually have the longest petioles, each averaging 12 cm.

Petiole length varies considerably, leaves growing in the shade having longer petioles than those exposed to the sun. Sometimes the petioles are slightly flattened, as shown in a cross section. Baalie has curved petioles with drooping leaves.

Thickness of the petiole can best be determined by actual measurement of the diameter about one-fourth inch back from the point of union with the twig, as recorded in table 8.

Color of petiole is apparently closely correlated with color of fruit

and of terminal bud. Mission, Ischia Black, Violette de Bordeaux, Precoce de Barcelone, all have black fruit, pinkish or brown terminal buds, and pinkish petioles. This correlation is also exemplified in a population of 328 chance seedlings of Marabout, another black-fruited variety which has both petioles and terminal buds pinkish. Of these seedlings, 166 showed pink terminal buds and pink petioles, 85 showed green buds and green petioles, and 77 showed intermediate-colored buds. Of the

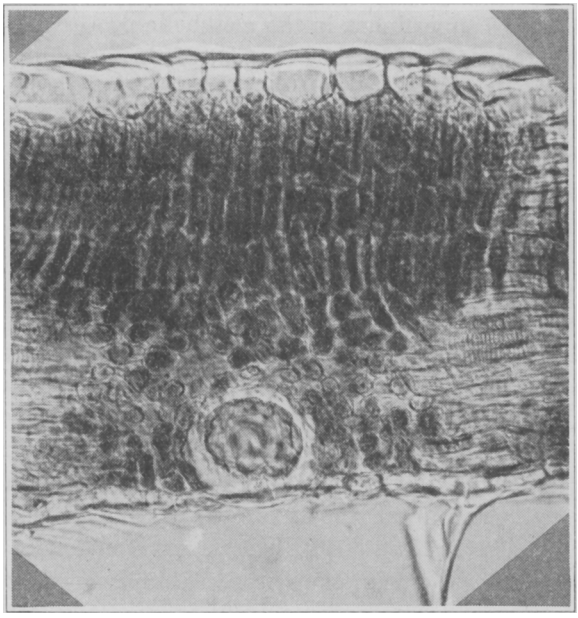

Fig. 14.—A cystolith or stalked spherical body incrusted with successive layers of calcium carbonate, formed in an enlarged epidermal cell of the lower surface of a fig leaf. (Photomicrograph by F. M. Turrell; magnification, × 240.)

last-named group, 10 seedlings showed green petioles, 61 showed pink petioles, and 6 showed intermediate-colored petioles. Roeding No. 3 and Euscaire, which show pinkish terminal buds, have green petioles. Green is the predominant color of petiole in figs that have green or yellow fruits.

Cystoliths.—Most species of such plant families as the Urticaceae, Moraceae, and Acanthaceae develop in specialized leaf cells peculiar calcified bodies termed "cystoliths," which have been studied or described by various botanists including Kohl (1889), Renner (1906), Solereder (1908), Haberlandt (1914), and Berg (1932).

When sectioned, fig leaves commonly show among the spongy paren-

chyma cells of the lower leaf surface very much enlarged epidermal cells, each containing a peculiar stalked body covered with blunt projections. This body, or cystolith (fig. 14), is built up from the epidermal portion of the cell wall as a stalked protrusion on which are gradually deposited successive layers of calcium carbonate. The stalk itself is strongly silicified and ordinarily extends beyond the surface of the cell into a sharp nipplelike protuberance. Apparently, cystoliths are bodies of an excretory nature providing special reservoirs for the calcium carbonate that becomes superfluous in the metabolic process.

Kohl (1889) found that the lime content of the cystolith diminishes in the autumn and concluded that it was withdrawn into the stem. Berg (1932), however, examined at intervals cystoliths from green fig leaves on the tree, from leaves picked and placed in a moist chamber, and from leaves which dropped naturally. He found that cystoliths remain normally incrusted with lime so long as the leaf cells are alive and become decalcified only as the cells discolor and shrivel, when it is too late for any movement of material into the stem.

While Turgano (1926) found that cystoliths have some taxonomic significance in separating different species of *Ficus,* I am convinced that they have no value in classifying varieties of *F. Carica.* A study of 7 fig varieties at Riverside shows that cystolith cells are very widely scattered among cells of the lower leaf surface. Cystoliths which are strongly calcified are torn loose during the sectioning process, leaving only the large empty cell. In general, they are oval or almost spherical, with blunt protuberances (fig. 14). Measurements made on 24 cystoliths show the following averages: thickness of leaf, 177.2 μ; length of cystolith cell, including the protruding nipple, 55.9 μ; breadth of cell, 44.6 μ.

THE TREE

Tree characters which are worthy of consideration in a taxonomic study of the fig are: size, habit of growth, wood, bark, roots, burrknots, bark tubers, nodal swellings, buds, odor, crops, fruitfulness, and season.

Size of Tree.—In Europe, the fig tree does not reach the venerable age, nor does it attain the size of trunk common to the olive. It apparently succumbs more readily than many other fruit trees to root troubles, sunburn of the bark, borers, and fungi. J. L. (1890), in an account of the Tarring Fig Gardens at Sussex, England, stated, however, that the first tree at Tarring was planted by Thomas à Becket 800 years earlier and that the identical tree was still there. It was struck by lightning in 1885; the dead trunk was still standing in 1890 and was 5 feet in circumference at the base. Wright (1891–94) reported that the grand old Marseilles tree in the Tarring Gardens was 9 feet in circumference

in 1872, the trunk separating into four main limbs, each nearly 3 feet in circumference.

California and Arizona boast of several fig trees as "the largest in the world." The oldest fig tree in California is probably a Mission planted

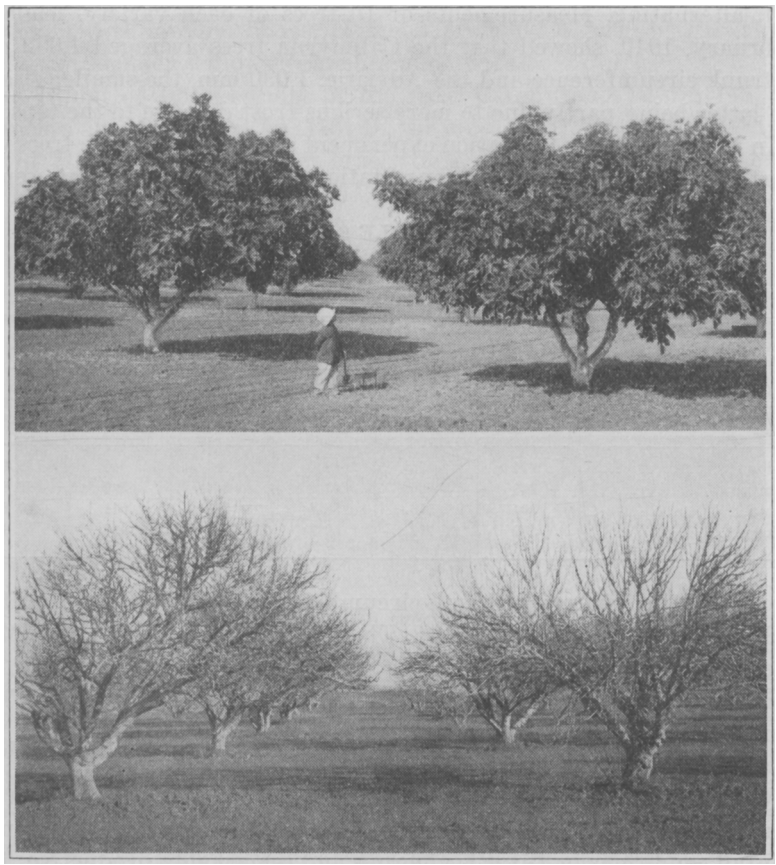

Fig. 15.—Fig orchard in Yosemite Colony, Merced, California, in which Calimyrna trees alternate with Adriatic. The upper photograph (taken in November, 1921) shows Calimyrna on the left and Adriatic on the right. In the lower photograph (taken in December, 1939), Adriatic is on the left and Calimyrna on the right. Note the more upright and open habit of growth of the Calimyrna trees.

about 1800 by Don Valentin Higuera, alcalde of Mission San Jose. This tree is now on the William Curtner place between Warm Springs and Milpitas. The largest of which I have a record is in a group of Mission fig trees planted in 1852 on the Henry Clark place, about 6 miles northwest of Corning, California. The circumference of the trunk, 4 feet

above the ground, measures 14 feet, 1 inch. Other trees in the group have trunks from 11 feet, 4 inches to 13 feet in circumference.

Varieties differ somewhat in vigor of growth and consequently in size or circumference of trunk. An orchard planted in Yosemite Colony, near Merced, in 1918, consisted of Calimyrna and Adriatic trees (fig. 15), alternating. Measurements of 10 trees of each variety, made in February, 1940, showed that the Calimyrna trees averaged 1,052 mm in trunk circumference and the Adriatic, 1,030 mm, the smaller size of the latter being partly due to more serious frost damage to the tops.

In March, 1928, an irrigation experiment on 4 varieties of fig trees was started at the Citrus Experiment Station at Riverside. As representa-

TABLE 9

EFFECT OF IRRIGATION ON SIZE OF FIG TREES; TRUNK CIRCUMFERENCES IN MILLIMETERS

Variety	Irrigated twice a month			Unirrigated		
	Circumference in 1930	Circumference in 1939	Per cent gain	Circumference in 1930	Circumference in 1939	Per cent gain
Mission	294	978	69.9	183	545	66.4
Calimyrna	323	865	62.6	224	598	62.8
Kadota	364	876	58.4	211	531	60.2
Turkey	282	712	60.3	179	426	57.9

tive of the growth made, trunk-circumference measurements for 1930 and for 1939 are given in table 9. These measurements show that Mission, which started next to smallest in size, was the largest tree in the irrigated row in 1939 and next to largest in the unirrigated row. The Turkey tree was smallest of the 4 varieties, partly on account of the dwarfing effect of its heavy crops.

Vigor of growth and size of tree are markedly affected by environmental conditions. The Brunswick (Magnolia) tree grown under summer rainfall conditions in Texas is vigorous and remarkably productive. The Brunswick grown in California under the usual 30-day-irrigation schedule is comparatively dwarf and unproductive.

Habit of Growth.—Fig trees have a habit of growth, or a system of branching, which is more or less characteristic of the variety. Adriatic trees are, in general, round-topped, with broad spreading branches. This is also the characteristic form of Stanford and Samson caprifig trees. Calimyrna trees (fig. 16) have a more upright habit of growth, with fewer laterals than Adriatic, and unless they are pruned properly, the branches often tend to droop badly. The Stanford Smyrna (fig. 16), on the other hand, has a more compact system of branches, with little tend-

ency to droop. Some Mission trees have a massive columnar top, while others have spreading branches, the tips of which often reach the ground and take root, and thus form new trunks. The Roeding No. 3 caprifig tree has a dense growth of slender branches, while Roeding No. 2 has willowy branches, upright in habit. Col de Signora Nigra tree has an unusually tall, upright habit of growth. Pastiliere and Sultane have gnarled stubby branches with swollen nodes. Hamma, probably a form of *Ficus palmata,* has slender willowy branches and twigs.

In 13 out of 100 seedlings of the cross Calimyrna × Maslin 148, the branches are brachytic (fig. 17). Of the cross Calimyrna × Stanford, 12 out of 115 seedlings also show brachytic growth. Brachysm, however, is

Fig. 16.—The Calimyrna fig tree, on the right, has an open habit of growth, with outer branches inclined to droop. The Stanford Smyrna, on the left, has a dense habit of growth.

not a variety character, for such a seedling would hardly be worthy of perpetuation as a variety, on account of its poor growth habit.

Hardiness.—In the fig tree, hardiness is correlated with vigor of growth, slow-growing trees such as Brunswick and Turkey usually being most hardy. Hodgson (1933) found evidence of varietal differences as to hardiness, "the apparent descending order of resistance being as follows: Brunswick, white varieties (Kadota, Calimyrna, Adriatic), Mission." Time of leafing out in spring sometimes affects the degree of frost injury in case of cold weather; thus Adriatic, which leafs out about 10 days earlier than Calimyrna, may suffer frost injury, while the latter escapes uninjured.

Wood.—Fig wood, like that of willow, is soft and of comparatively little value. Theophrastus (1916) regarded fig wood as strong when set upright and as of some value in kindling a fire. Cato (1933) suggested the use of fig wood for crosspieces after seasoning in a manure pile or under water. Noisette (1829) reported that locksmiths and gunsmiths sometimes use fig wood for rubbing and polishing, since it readily takes up oil and emery.

Tests made of wood of 4 varieties of fig,[12] show the average specific gravity to be 0.43, based on volume when green and on weight when oven dry. For comparison, the specific gravity of certain hardwoods and softwoods, as determined by Markwardt and Wilson (1935), is given here: catalpa, 0.53; elm, 0.55; ponderosa pine, 0.42; redwood, 0.40.

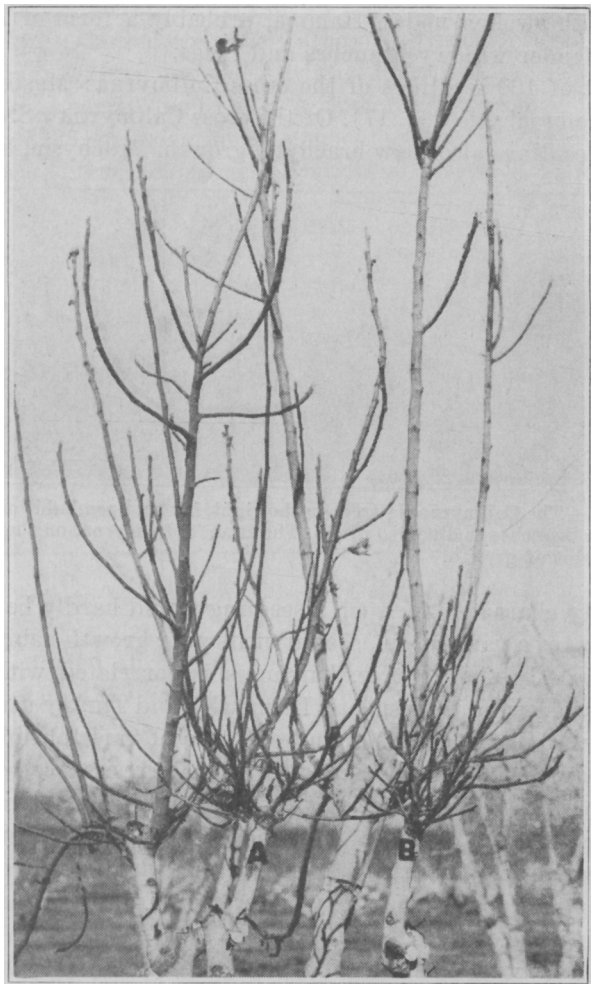

Fig. 17.—Seedling buds: *A*, *B*, showing brachytic growth; those on the other stubs show vigorous and normal growth.

Fig wood is so soft that it cuts "almost like butter," at least pruners think so when passing from fig-tree pruning to the cutting of hardwood

[12] Specific gravity tests of fig wood were made by R. A. Cockrell, Assistant Professor of Forestry and Assistant Forester in the Experiment Station.

trees such as the olive and orange. The color is very light or almost white. Annual rings are not easily distinguishable because of the uniform color of the wood. As pointed out by Solereder (1908), the pith is homogeneous in *Ficus*. Photomicrographs of fig-wood sections (fig. 18) show

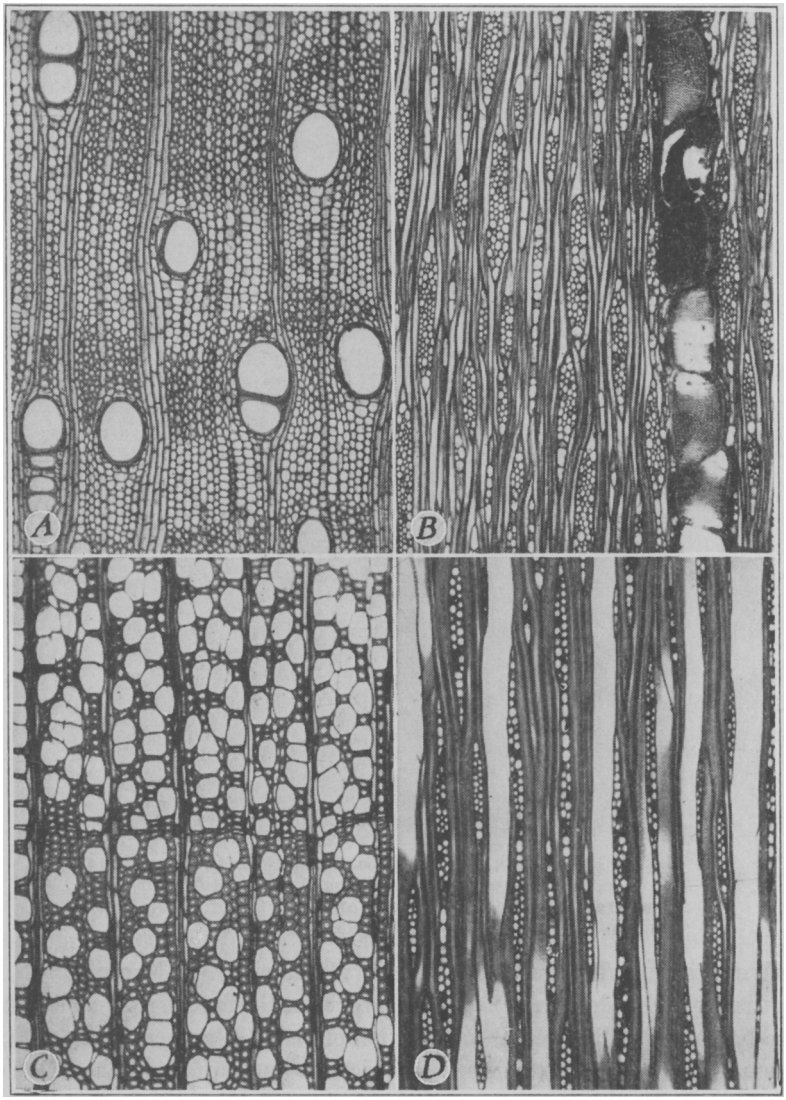

Fig. 18.—*A, B,* Transverse and tangential sections of fig wood (*Ficus Carica*); *C, D,* sections of hardwood (*Liquidambar Styraciflua*). Note the comparative differences in amount of parenchyma and relative wall thickness of parenchyma and fiber cells. (Photomicrographs by R. A. Cockrell; magnification, × 70.)

alternating bands of thin-walled wood parenchyma and relatively thin-walled fibers. Wood with such a preponderance of parenchyma tissue is not comparable in strength to that of a commercial hardwood, such as *Liquidambar Styraciflua* L., which has thick-walled fibers (fig. 18).

Bark.—The bark of fig trees is comparatively smooth (fig. 19) and seldom fissured, as in many other trees. Varieties differ very little in

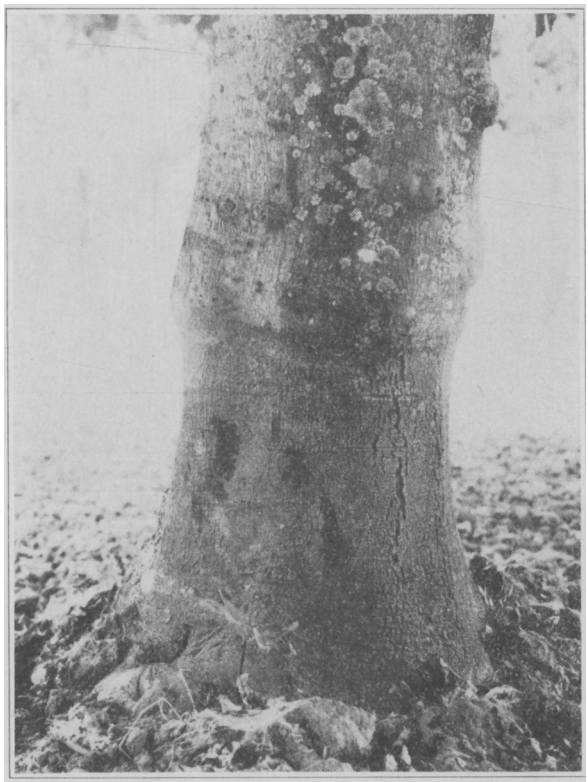

Fig. 19.—Trunk of a fig tree showing the graft union between the Mission stock and the Adriatic top and the comparatively smooth bark characteristic of most figs. Lichens are growing on the Adriatic bark.

bark characters. The bark of Samson (Markarian No. 1) caprifig is, on the trunk and older branches, characteristically fissured or corrugated. The bark of Roeding No. 2 caprifig is not smooth but scaly (fig. 20), at least on the trunk. Lenticels are conspicuous on young branches. Devaux (1900) included the fig in a long list of plants having lenticels composed of thin, flattened scales much like those of the oak. He illustrated and described hypertrophy in the fig lenticel.

Roots.—The fig tree has a system of fibrous roots which spread con-

siderable distances laterally and, in some soils, to a surprisingly great depth. Theophrastus (1916) noted that some trees, such as fig, oak, and plane, have many long roots, the fig probably having the longest of any. Traub and Stansel (1930) found in Texas that five-year-old Magnolia fig trees had a root spread of 50 feet, a single lateral reaching 35 feet from the main trunk. Some roots were traced in calcareous clay to a

Fig. 20.—The bark of Roeding No. 2 caprifig tree is scaly, at least on the trunk

depth of 5 feet and probably extended a couple of feet deeper. Condit (1920) studied the root systems of young fig trees on hardpan land near Fresno and found roots penetrating either the hole made by blasting or natural cracks in the hardpan. Reports made verbally by growers indicate that fig roots on lands near Fresno extend to a depth of 20 feet and probably much deeper. No published data are available on comparative root systems of the different varieties.

Burrknots.—A burrknot is a rough excrescence often present on the trunk or roots of certain trees and characteristic of some varieties. Refer-

ences to their occurrence on various forest and fruit trees and to their use in plant propagation are given by Hatton *et al.* (1926) and by C. F. Swingle (1925); the latter has also discussed (Swingle, 1927) burrknot formations in relation to the vascular system of the apple stem. Neither of these writers describes such excrescences on the fig tree, although Hatton *et al.* refer to the article by Wolf (1913) discussed later in this section. Swingle (1925) states that except for the bare mention of their occurrence on willow, he "has been unable to find a single sentence in American literature regarding nonpathological, dormant, stem-borne

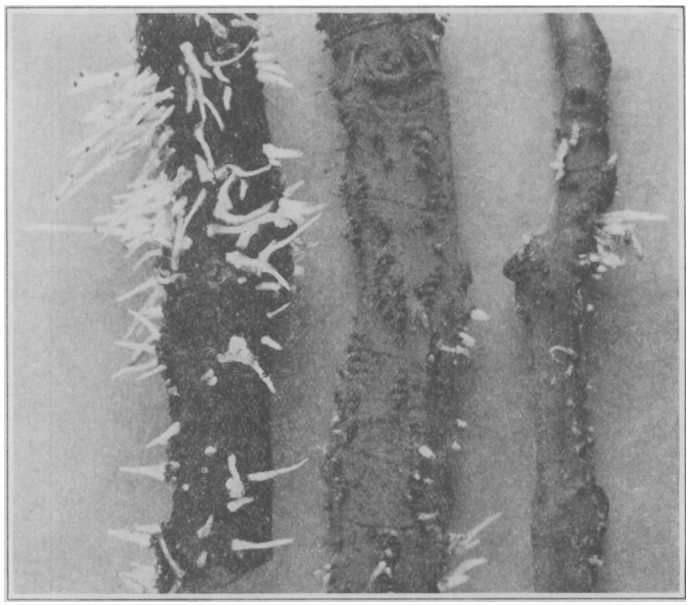

Fig. 21.—Bark excrescences or burrknots, which develop into roots, as shown, when placed in moist soil or moss, are common on fig trees in humid climates.

roots in any plant." The account by Wolf (1913) is entitled "Abnormal Roots of Figs," and in it he refers to "several cuttings of these diseased figs." This apparently explains the omission of the fig from Swingle's (1925) account, as he was only investigating "nonpathological" roots.

Many species of the genus *Ficus*, the banyan (*F. benghalensis* L.) being a good example, produce aerial roots in profusion from the trunk and large branches. *F. Carica* does not produce aerial roots in nature but does generate root initials very profusely when branches are placed in a suitable rooting medium. It is not strange, therefore, that trees of this species exhibit these burrknots when growing under favorable conditions. Wolf (1913) found on orchard trees in Alabama "that these

processes were present also upon the trunk and larger branches, occurring for the most part upon the lower side of the limbs or on the north side of the trees." He concluded that these processes are morphologically roots which may function as roots in response to a superabundance of moisture. In California, burrknots (fig. 21) occur commonly on fig trees in humid coast climates and sparingly in dry interior districts. They are

Fig. 22.—Bark tubers commonly occur on the trunk and larger branches of the fig tree. Nodal swellings may be seen on the branch at the left.

located at random both at or near the nodes and on the internodes. Apparently, the origin of adventitious roots which appear on fig cuttings in the soil is the same as, or similar to, that of burrknots.

Bark Tubers.—The bark of the trunk and larger branches of most fig trees shows numerous excrescences or tubers (fig. 22) similar to those which have been described by Sorauer (1922) as occurring on

various other plants. It was probably these bark tubers which Theophrastus (1916) described as being characteristic of the alder, bay, fig, and other smooth-barked trees. Such tubers are formed from dormant buds whose apex dies, but whose base retains its vascular connection with the wood (fig. 23), the fibrovascular body continuing to form its own bark and new wood layers without the aid of foliage.

Tuber initials, 1 mm in diameter or smaller, can sometimes be found by carefully shaving off thin layers of bark in certain places. When first

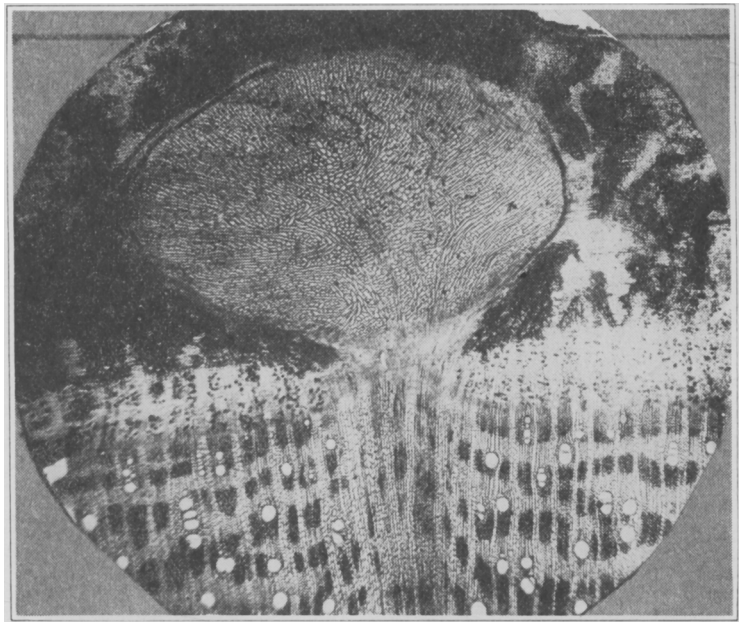

Fig. 23.—Cross section of a bark tuber, which is a dormant bud whose apex dies, but whose base retains its vascular connection with the wood, the fibrovascular body continuing to form its own bark and wood without the aid of foliage. (Photomicrograph by F. M. Turrell; magnification, × 15.)

visible on bark of the fig tree, the tubers measure approximately 2 mm in diameter; some large ones measure 20 mm in diameter. They are mostly spherical, although some become elongated. No tubers have been seen on fig branches under three years old; they apparently form on trunk and branches of older trees and continue to form until trees are many years of age. They appear very commonly on the bark of nodal swellings.

Nodal Swellings.—The branches of several varieties of figs show prominent enlargements or swellings at the nodes (fig. 22). These swellings are seldom apparent during the first growing season, but gradually be-

come prominent during ensuing seasons and continue to enlarge indefinitely. They form under and on both sides of the leaf scar, gradually covering a little over half the branch circumference. They are especially prominent on Sultane and Pastiliere and are also found on trees of at least 12 varieties in a collection consisting of 162 distinct varieties. Nodal swellings are apparently of wide occurrence, for they have appeared on new growth of fig scions secured from Texas, England, and southern Russia.

The famous widespreading tree of San Pedro at Parlier, California,

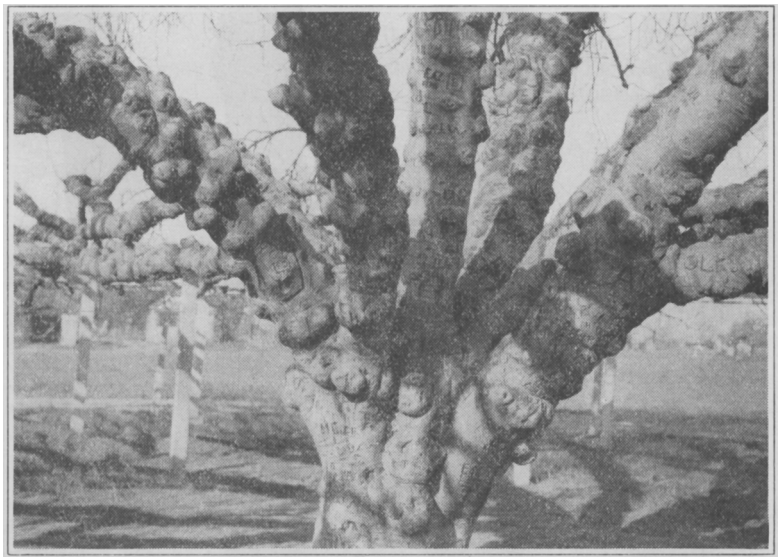

Fig. 24.—Nodal swellings are unusually prominent on the trunk and branches of the famous park tree, San Pedro variety, at Parlier, California.

shows unusually prominent nodal swellings (fig. 24). Such swellings are common on old trees of Calimyrna, notably so in the William Pugh orchard at Planada, California. The fact that practically all trees in this orchard show prominent nodal swellings would seem to indicate that there is a type or strain of Calimyrna tree in which the swellings are unusually pronounced.

Buds.—The tree of *Ficus Carica* is ordinarily deciduous, the length of the dormant season depending upon local climatic conditions. During the late summer and fall, both fruit and vegetative buds form in axils of leaves and remain on the tree during the winter. Moreover, in mild climates, partly grown figs of some varieties remain on the tree and mature in the spring.

Dormant fruit buds are distinguishable from the vegetative buds by

Fig. 25.—Dormant fruit buds and terminal buds of different fig varieties: *A*, Marabout; *B*, Maslin 150; *C*, Kadota; *D*, Mission. These all have conical, sharp-pointed buds. *E*, Pastiliere, and *F*, Milco, have short thick buds. The terminal bud is inclined at an angle from the center in *G*, Kearney. *H*, Hamma, has a slender twig and small plump bud.

their large size and plump, rounded appearance. The number and size of fruit buds are closely related to the vegetative growth of the tree and the size of the crop maturing in summer and fall. Caprifigs which have a very light mammoni or summer crop commonly produce an enormous number of fruit buds, which expand in the spring and mature a crop in June. Color of fruit buds is approximately that of the terminal bud.

Characters of the terminal bud, such as color, shape, and size, have some taxonomic significance. Color of bud is largely correlated with color of fruit, most green-fruited varieties having green buds and most

TABLE 10

COMPARATIVE SIZES OF TWIGS AND TERMINAL BUDS OF FIG VARIETIES*

Variety	Twig diameter	Bud		
		Diameter at base (D)	Length (L)	L/D
	mm	*mm*	*mm*	*ratio*
Hamma	5	4	7	1.7
Kadota	11	6	13	2.1
Kearney	11	7	12	1.7
Marabout	13	9	14	1.5
Maslin 150	13	6	10	1.6
Milco	10	7	8	1.1
Mission	10	6	11	1.8
Pastiliere	11	7	9	1.3

* Average measurements of eight specimens of twigs and terminal buds of each variety.

dark-fruited varieties having dark-colored buds. Green color in the bud varies from bright grass green to yellowish green; dark color in the bud means any shade of pink, brick red, or violet-purple. Some varieties, such as Col de Signora Nigra and Gouraud Rouge, having dark figs show green terminal buds; and, vice versa, some with green figs, notably Genoa, have dark-colored buds. Shapes of terminal buds are, in general, conical, the tip being more or less attenuate. In some varieties, such as Pastiliere and Milco, the bud is thick and short (fig. 25, *E* and *F*), while in others it is more conical and sharp-pointed, as in Maslin 150, Kadota, and Mission (fig. 25, *B*, *C*, and *D*). Varieties such as Marabout and Pastiliere, which have thick, stubby branches and twigs (fig. 25, *A* and *E*), generally have large thick buds. The terminal bud in Kearney (fig. 25, *G*) and in some other varieties is inclined at an angle rather than located centrally. Buds of Hamma (fig. 25, *H*) are slightly constricted at the base. Comparative measurements of twigs and terminal buds of several different varieties are given in table 10.

Odor.—Various parts of the fig tree have a more or less distinctive

odor or fragrance which one can often distinguish while driving along a road bordered by leafy fig trees. Wilder (1932, p. 338) reports that leaves of the fig tree have a delicious odor which they keep for years when dried. Tobacco companies recognize this fact and in some years obtain quantities of dried fig leaves to blend with tobacco for cigar wrappers.

As already pointed out, whole fresh figs do not have a distinctive aroma, although the pulp often has a pleasing odor which augments the eating quality. Caprifigs do, however, emit a characteristic fragrance, which apparently attracts the female blastophaga to the figs when the flowers are receptive to pollen or to oviposition. Mr. Francis Heiny of Brawley, California, named one of his seedling caprifigs "Fragrant," because of its unusually strong fragrance.

Crops.—Caprifig trees, as explained by Condit (1932), ordinarily produce three series of fruit buds each growing season. The first series of buds gives rise to the profichi or spring crop, the second series to the mammoni or summer crop, and the third series to the mamme or winter crop. In cool climates only two crops mature, while in hot desert locations as many as seven crops of caprifigs are said to develop in one year.

Trees bearing figs with long-styled flowers have the first series of buds maturing into a breba crop (in Italy called the *fiori*) ; the second series of buds develops into the main crop (*pedagnuoli* or *forniti* of Italy). Common figs often produce a third series of buds (*cimaruoli* in Italy) which may develop and mature the same season, may be destroyed by frost, or may remain dormant during the winter and mature the following spring.

Varieties such as Verdal Longue, Ischia, and Partridge Eye seldom produce any breba crop, probably on account of the enervating effect of the heavy summer and fall crops. Trees of such varieties usually have some dormant fruit buds which push out in the spring but drop when still small.

Fruitfulness.—Theophrastus (1916) made the general observation that copious production of leaves on a fruit tree reduces the quantity of fruit. He mentioned the fig and grape as exceptions, however, bearing best in years of luxuriant foliage. This is apparently true of some varieties of figs, but not of others. For example, trees of Kadota, Turkey, and Brunswick, which are pruned heavily and develop strong vegetative growth, are usually very prolific of fruit; some other varieties, such as Mission, when making vigorous sucker growth, are notably unproductive.

Barron (1868) noted that "as a general rule the smallest varieties are the most prolific. Of these, White Ischia, Black Provence and Oeil de

Perdrix bear fruit as profusely as an ordinary gooseberry bush." This is characteristic of Ischia in California and, to a lesser extent, of Celeste, another small-fruited variety. Euscaire is a medium-sized black fig of excellent quality, but it is a light producer as compared to Mission. Some caprifig trees, notably one variety of *Ficus palmata,* bear more fruits than leaves, the profichi crop being such a drain upon the tree that little if any vegetative growth takes place until after this crop matures.

Season.—According to Chandler *et al.* (1937, p. 25–26),

> The fig and the Oriental persimmon, *Diospyros kaki,* are examples of deciduous trees with chilling requirements so slight that they can be grown satisfactorily in the parts of California where the winters are the warmest.
>
> It seems probable that they have at least a slight rest period, for they usually remain dormant through favorable conditions for growth in autumn and early winter. In fact, after the warmest winters in the warmest sections of southern California, they show a slightly uneven starting of buds on the trees, as they would if there was not enough chilling to break the rest period completely. They are reported to show this tendency even more in southern Florida.

The Adriatic leafs out earlier than the Calimyrna. Precoce de Barcelone is so named because of the early maturity of its fruit; it ripens several days before that of the Mission. An entire-leaf form of *Ficus palmata* starts new growth in the spring and matures its profichi crop much earlier than other varieties of caprifig. Earliness in *F. palmata* is a dominant character and is transmitted to seedlings of which it is the male parent. The four numbered Roeding caprifigs mature fruit in the following order: No. 3, No. 1, No. 2, No. 4. Stanford is a midseason caprifig variety, while Milco is late.

The fig season in California begins in the Coachella Valley the first week in May with the ripening of Turkey figs a week or 10 days before Mission figs are mature. In the San Joaquin Valley, Mission brebas mature about the second week in June and continue until early July. Very few figs are available in any district in July; but in August, Calimyrna and Mission figs from the San Joaquin Valley and Turkey figs from Coachella and Imperial valleys flood the city markets. In seasons free from severe frosts, figs continue to ripen along the southern California coast and in the Coachella and Imperial valleys until Christmas or later. Verdal Longue, which is naturally a late-season variety, can by heavy pruning be induced to produce sucker wood which fruits unusually late. Pasquale is also a late-season variety. Marabout, at Riverside, continues to mature fruit several weeks longer than Calimyrna.

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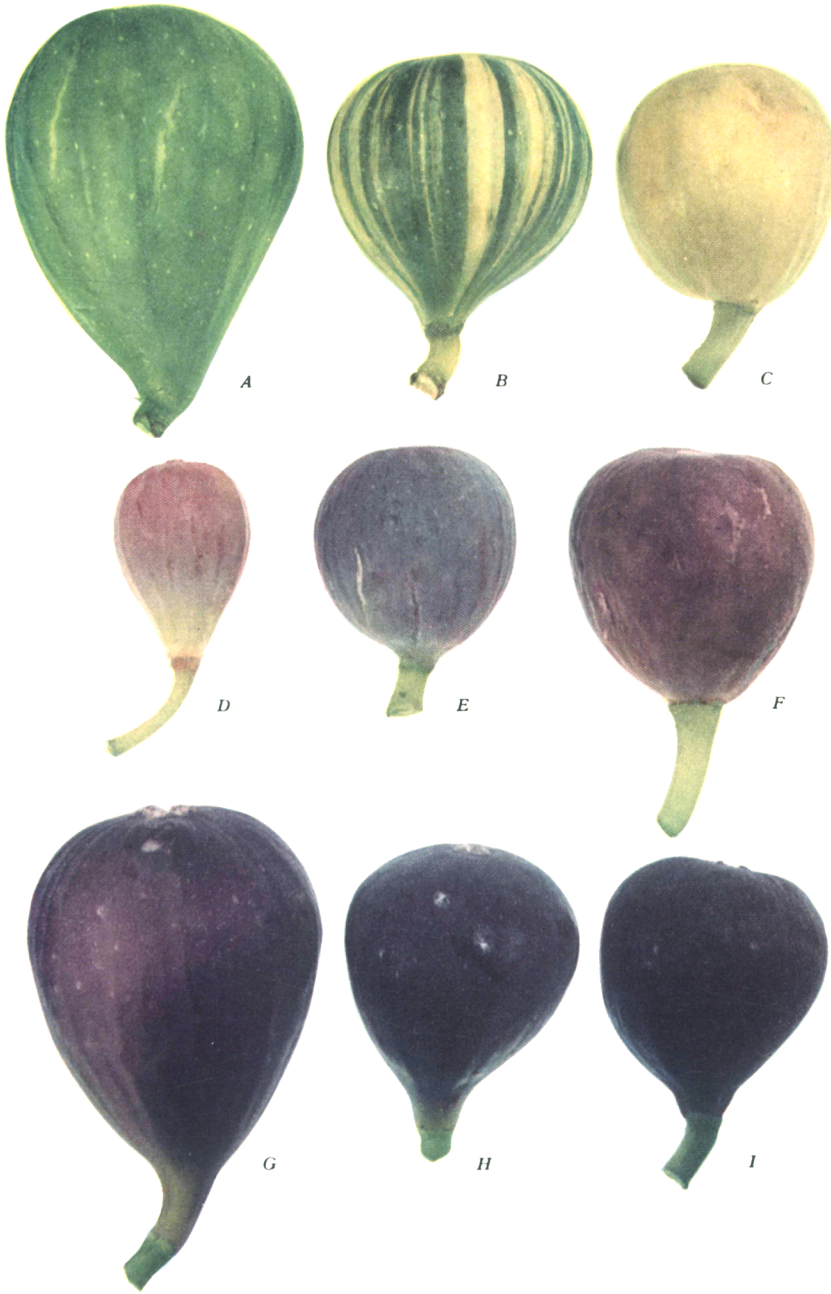

Plate 1.—Fig varieties, showing differences in external coloration: *A*, San Pietro, green; *B*, Panaché, striped green and yellow; *C*, Panaché, lemon yellow; *D*, Celeste, bronze; *E*, St. Jean Grise, violet-green; *F*, Gouraud Rouge, reddish brown; *G*, Turkey, purplish brown; *H*, Bourjassotte Grise, violet; and *I*, Ischia Black, purplish black. (Type B Kodachrome by John W. McCalley.)