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PLANT INDUMENTUM
A Handbook Of Terminology

Helen J. Hewson

Illustrations by Margaret Menadue



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Cover:

Dendritic trichomes of *Pityrodia uncinata* (Turcz.) Benth. Drawing by Margaret Menadue

Bureau of Flora and Fauna
GPO Box 1383
Canberra ACT 2601
Australia

Foreword

The *Australian Flora and Fauna Series* comprises occasional publications designed to make available as widely as possible the results of biogeographical and taxonomic activities undertaken on behalf of the Australian Biological Resources Study.

From the beginning of the *Flora of Australia* project, inconsistent usage of terms for plant indumentum has been a problem. This handbook has been prepared to help overcome the problem.

Bureau of Flora and Fauna
1988

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PLANT INDUMENTUM

'The meanings here attached to the . . . terms are such as appear to have been most generally adopted, but there is much vagueness in the use practically made of many of them by different botanists. This is especially the case with the terms pilose, hispid, hirsute, pubescent and tomentose.' (Bentham, 1863).

INTRODUCTION

Plants frequently possess a cover arising from the epidermis. The individual components are hairs or trichomes and the collective cover is an indumentum. The indumentum has an adaptive value — usually a role in plant defense, sometimes a role in transpiration control. A consequence of this is that a wide range of species-specific types of indumenta are found in nature. They provide the taxonomist with additional character-states for the delimitation of species. Hence a terminology has developed. However it is only partially satisfactory. Indeed after more than a century, Bentham's comment is still relevant. This handbook has been prepared to standardise the use of the more common terms applied to plant indumenta. Its primary aim is to assist contributors to achieve this objective when preparing text for the *Flora of Australia*, but it should be useful to all who have to write descriptions of plants. Since further refinement may be necessary, the Bureau of Flora and Fauna would welcome any constructive suggestions for improvement.

From the outset it was clear that some basic concepts such as 'what is a hair?' needed to be clarified. The available terminology is encumbered with major drawbacks: (i) it is so general that it is capable of diverse interpretation and application; and (ii) it does not take into account the huge range of variation and intergradation exhibited. Consequently it is unsatisfactory for use in detailed taxonomic research (see Theobald *et al.*, 1979; Behnke, 1984). Hence it has been necessary to investigate an alternative approach. This is presented as a descriptive formula.

In addition a Glossary of the common terminology is presented. The terms defined in the Glossary are generally convenient for use in floras where the descriptions aim to be diagnostic. In general, the definitions should be meaningful to someone equipped with a hand lens or dissecting microscope. The use of plain English descriptive terminology is encouraged, e.g. 'bifid T-shaped trichome' is preferred to 'Malpighiaceus'.

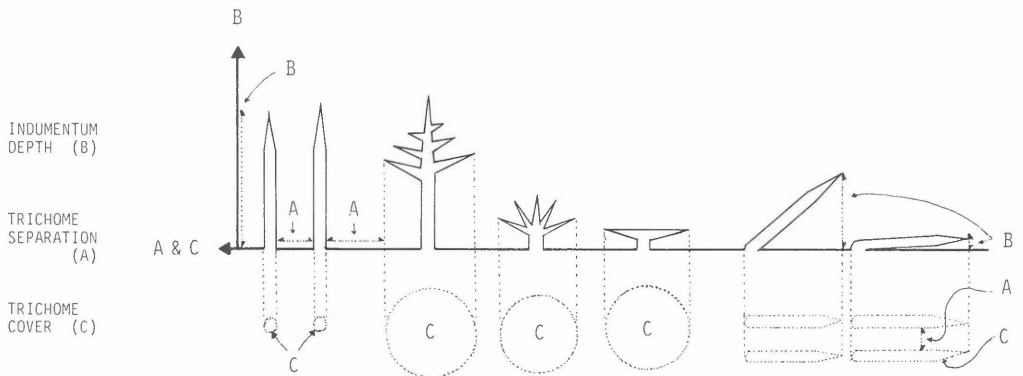
BASIC CONCEPTS

WHAT IS A HAIR?

Trichome vs Hair. Most authors agree that a hair is (i) an epidermal outgrowth, (ii) may be unicellular or multicellular and (iii) is elongate. The definition of a hair, however, has been used by some (at least by implication) to include bristles, prickles and scales. Others imply that bristles, prickles and scales are 'hair-like' and therefore, strictly, are not hairs. Hence there is a broad and a narrow definition of a hair.

Some authors regard hair and trichome as synonymous terms. Most extend the definition of trichome to include the hair-like structures — bristle, prickle and scale. For example, Jackson (1928) defined a trichome as 'any hair-like outgrowth of the epidermis, as a hair or bristle.' Payne (1978) defined it as 'any epidermal outgrowth which prevents classification of a plant surface as glabrous; hair'. Payne's definition is very dependent on the definition of glabrous. Glabrous is a term denoting hairlessness, but it too has problems of

Estimation:



1. estimate mean trichome-cover of individual trichome (C). (This is necessary for the estimation of the distance between trichomes).
2. estimate mean distance between trichome-cover areas (A).
3. estimate mean depth of indumentum (B).

4. compare A with B:

Indumentum **Dense** if $A < B$

Indumentum **Sparse** if $A = B$ to $5 \times B$

Trichomes **Isolated** if $A > 5 \times B$

c. Feel

Most indumenta have a characteristic feel, e.g. rough, harsh, silky, pungent, viscid etc.

d. Sheen

Sheen is to be described if possessed, e.g. glossy.

e. Colour

If the indumentum is not colourless, colour is to be described, e.g. rusty.

TRICHOMES

Many indumenta are heteromorphic — composed of more than one type of trichome. Each type in the complement may require individual description.

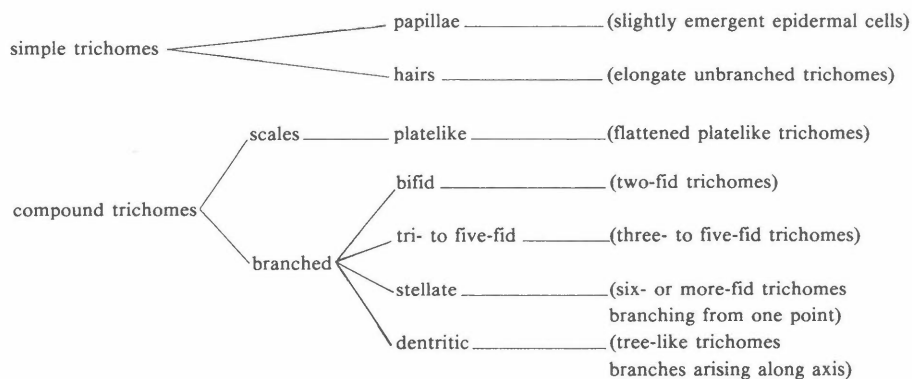
a. Glandularity

Trichomes may be eglandular or glandular (accumulatory or secretory). If glandular then the type of gland is to be specified e.g. secretory: mucilage; accumulatory: salt.

b. Morphology

i. Form.

The diagram below portrays morphological relationships of the major trichome types — papillae, hairs (*s. str.*), scales, bifid trichomes, tri- to five-fid trichomes, stellate trichomes and dendritic trichomes.



n.b. While this diagram provides a morphological classification of major trichome types it does not imply phylogeny or homology. It is possible for each major trichome type to be unicellular. For example, Rollins & Benerjee (1976), reported six major trichome types, each being unicellular, in the genus *Lesquerella* (Brassicaceae). Thus, peltate scales may be phylogenetically closer to rotate, stellate trichomes than to sessile scales.

ii. Features

It may sometimes be necessary to describe the features listed below:

Length — the terms long and short should be adequate for descriptions aimed at the 10× hand lens user. It is recommended that less than 0.5 mm is short and 0.5 mm or more is long. Frequently workers apply these terms relatively within the group they work with, in which case either a definition of long and short or actual measurements should be provided.

Rigidity — e.g. weak, stiff, etc.

Straightness — e.g. curled, flexuose, etc.

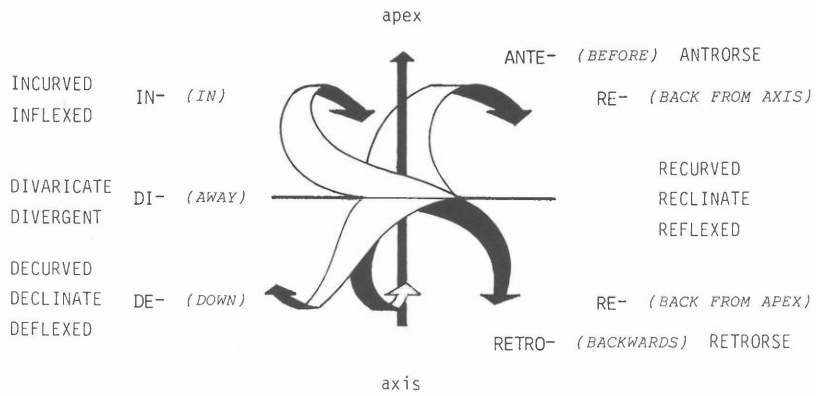
Orientation — e.g. erect, spreading, reflexed, appressed, etc.

There are several sources of confusion in the terminology of angle and orientation, e.g. point of reference, degree of disposition, reference to structure of origin or to identical structures, reference to surface of origin or to geographic vertical and horizontal. The recommended terms for angle and orientation have been defined in the Glossary (also see the diagram on p. 6). It should be noted that some terms may be defined differently when used to describe the morphology of whole plants.

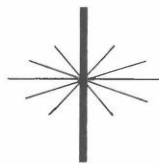
The terms erect, spreading (= patent) and erecto-patent are not used in the *Flora of Australia* for describing trichome orientation. Instead the axis or surface is to be regarded as 0°, and the perpendicular 90°. Appressed (antrorse or retrorse) ranges from 0°–15° and the remaining orientation is 'retrorse (or antrorse) at X°' OR 'retrorse (or antrorse) from "point of attachment" at X°'.

TERMS IMPLYING ORIENTATION TO APEX OR AXIS

- PREFIX



- DIVARICATE, DIVERGENT (OF LIKE STRUCTURES)



DIVARICATE



DIVERGENT

TERMS IMPLYING ORIENTATION TO SURFACE OR SPECIFIED POINT OF REFERENCE (E.G. MIDRIB)

- SUFFIX



-CURVED

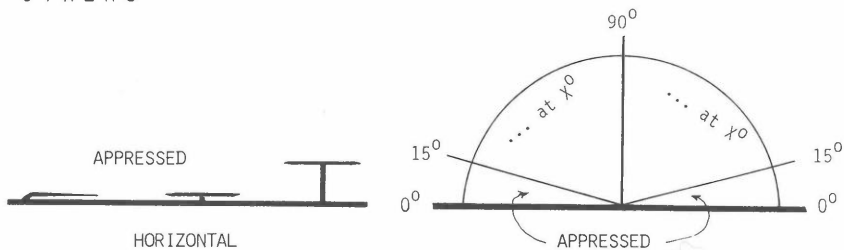


-CLINATE



-FLEXED

- OTHERS



c. Anatomy (Histology)

i. Cell number

The total number of cells, including the basal cell should be noted, e.g. unicellular, bicellular, multicellular.

ii. Cell seriation

Cell seriation should be noted, e.g. uniseriate, multiseriate.

iii. Cell shape and differentiation within trichome

Cell shape and differentiation within trichomes is to be described, e.g. base, axis, apex, etc.

The basic shapes as defined by the Systematics Association Committee for Descriptive Biological Terminology, *Taxon* 11(8): 246–247 (1962) should be used for outlines. See also Stearn, 318–319 (1980).

iv. Wall structure

Thickness, lignification, cuticle thickness, impregnation with silica or calcium carbonate and surface features are all characters which may need description.

v. Cellular contents

Cytoplasm density, vacuole size, presence of crystals or cystoliths etc., may require description.

n.b. Some features of trichome anatomy will not be appropriate in *Flora of Australia*.

GLOSSARY AND KEY TO TERMS

Definitions of common terms for indumentum and trichome types have been investigated. A Glossary of Plant Hair Terminology (Payne, 1978) was used as the basis for the choice of terms. Payne presented two lists: 'Terms for Trichomes' and 'Terms for Induments'. Most of the terms in the 'Induments' list have been treated herein. Those excluded are not recommended for use in the *Flora of Australia*. Some additional terms from the 'Trichomes' list have been included for definition. It should be noted that Payne included some terms for surfaces (e.g. pruinose) in his 'Terms for Induments' list; although strictly not indumenta, a selection of these is included here too. For further information on surfaces see Juniper & Jeffree (1983).

The terminology for micro-hairs (e.g. minute hairs on Poaceae epidermis) is not included. For further information on micro-hairs see Tateoka *et al.* (1959).

As an aid, a synoptic key to the indumentum and trichome terms defined in the Glossary is presented. Orientation terms are excluded.

KEY TO TERMS

(g) — generic or general term.

'terms between quotes' — not strictly an indumentum or trichome term.

Many surfaces have more than one trichome type — each may be keyed out individually.

A–L — see end of Key.

1 Surface without processes, i.e. without trichomes, protuberances or emergences

2 Surface covered with waxy, pruinose, powdery or granular substance . . .
'Glaucous', 'Mealy', 'Powdery'

A

2: Surface without a bloom or other cover . . . Glabrous, Glabrate, Glabrescent,
'Smooth'

B

- 1: Surface with processes which have obvious structure, i.e. with trichomes, protuberances or emergences
- 3 Process woody and rigid and including vascular tissue . . . 'Spine' C
- 3: Process arising from the epidermis and possibly quite rigid, but without vascular tissue (Trichome) (g). Note: process may be eglandular or glandular. If glandular, see Glandular Trichome, Latex Trichome, Mucilage Trichome, Stinging Trichome, Vesciculose (D)
- 4 Process flat and membranous . . . Scale (g), Chaff, Peltate Trichome E
- 4: Process otherwise. Note: process may be simple or branched. If branched, see Branched Trichome (g), Barbed Trichome, Bifid Trichome, Dendritic Trichome, Plumose Trichome, Stellate Trichome (F)
- 5 Indumentum restricted to certain parts of an organ (e.g. margins) . . . Beard, Ciliate, Coma, Fimbriate, 'Pappus' G
- 5: Indumentum generally dispersed over entire organ
- 6 Indumentum of sharp and rigid or hard trichomes . . . 'Prickly' H
- 6: Indumentum otherwise; trichomes soft to hard, not sharp
- 7 Indumentum with trichomes stiff, rigid or hard . . . Bristle, Hirsute, Hispid, Scabrous, Strigose, 'Warty' I
- 7: Indumentum with trichomes soft or weak
- 8 Indumentum with trichomes intertwined or interlocked or entangled . . . Cobwebbed, Cottony, Felted, Floccose, Hoary, Tomentose, Woolly J
- 8: Indumentum with trichomes discrete (may be touching or overlapping, but not with any degree of matting)
- 9 Indumentum with trichomes swollen or inflated . . . Papillose, Vesciculose K
- 9: Indumentum with trichomes not swollen . . . Pilose, Puberulous, Pubescent, Silky, Velvety, Villous L

Further description may be required:

A — for colour, thickness and coarseness. These are not indumenta. Note (i) some surfaces may bear both a bloom and an indumentum; (ii) glaucous, glabrous and smooth are not mutually exclusive terms.

B — for gloss. Surfaces which are glabrate or glabrescent do bear trichomes at an earlier stage. These trichomes may require description.

C — for origin, shape and size.

D — for glandularity. Both glandular and eglandular types should be keyed out further on for other features.

E — for shape and size.

F — each type requires individual description — a huge range of forms exist and each may be quite diagnostic (a drawing or a photograph may be more instructive than a description).

G — for specific distribution and individual hairs for structure, shape and size.

H, I — for rigidity, structure, shape and size.

J, L — for trichome complement, indumentum cover and texture.

K — for structure, shape and size.

See Description Formula pp. 3-7.

GLOSSARY

Compiled from several references, the major ones being: Featherly (1954); Jackson (1928); Lawrence (1951); Payne (1978); Stearn (1966).

* — terms that through varied usage are imprecise or ambiguous are denoted by an asterisk.

'terms between quotes' — not strictly an indumentum or trichome term.

Latin — all words are in the nominative case and the declension codes are those listed in Stearn (1966).

Phrases (e.g. glandular trichome) — are listed as nouns as if they were one word.

Abbreviations:

adj. — adjective

dim. — diminutive

e.g. — example

f. — feminine

Gk — Greek

I — indumentum

L. — Latin

L. equiv. — Latin equivalent (recommended for use in Latin descriptions)

m. — masculine

n. — noun

neut. — neuter

n.r. — terms which are synonyms but not recommended for use

opp. — opposite

part. — participle

T — trichome

A

B

I

II

III

IV — declension codes according to Stearn for Latin equivalent terms.

Antorse adj. (L. *ante[or]* — before; *versus* — turned).

Directed towards the apex.

L. equiv.: *antorsus* — adj.A.

opp.: retrorse.

Appressed adj. (L. *ad-* — to; *primere* — to press).

The whole structure lying flatly and closely against surface.

n.r.: adpressed.

L. equiv.: *apressus* — part.A, *adpressus* — part.A.

Barbed trichome n.T (L. *barba* — beard).

A trichome with terminal or lateral retrorse projections, each projection being a barb. Fig. 3G.

dim.: barbella, barbellula.

L. equiv.: *hamus* — n.m.II, *hamulus* — n.m.II, *uncus* — n.m.II.

n.r.: barbule n.

Note: hamate, uncate, uncinata and their Latin equivalents are terms describing trichomes with a terminal hook or barbs. Glochids are barbed trichomes, the barbs sometimes defined as lateral and sometimes terminal.

e.g.: *Acaena* fruits, *Opuntia* spp., *Bidens* spp., *Triumfetta chaetocarpa*.

***Beard n. I** (Old Germanic *bart* — beard).

A tuft, line or zone of hairs. Fig. 2J.

adj.: bearded.

dim.: barbulate adj.

L. equiv.: *barba* — n.f.I, *barbatus* — adj.A, *crinitus* — adj.A.

n.r.: barbata adj., crinate adj., crinite adj.

opp.: imberbate.

Note: Stearn included 'long weak hairs' in the definition. Some workers have regarded awn as a synonym of beard, e.g. Jackson, but this term should be restricted to the stiff, subulate point of many grass glumes and lemmas.

e.g.: *Trichoryne* spp. anther filaments, *Stypandra* spp. anther filaments, *Acrotriche* spp. petals.

Bifid trichome n. T (L. *bi-* — two, *fidus* — cleft).

A trichome divided into two branches. Fig. 3H.

L. equiv.: *bifidus* — adj.A.

Note: Dichotomous, dolabriform and malpighiaceus are related words which are not recommended when describing trichomes. Bifid is intended as a general term. Further description may be necessary. The depth of division and the angle of spread of the branches may be indicated by the shorthand terms T-, U-, V-, Y- and J-shaped.

e.g.: *Stenopetalum nutans*, *Nanophyton erinaceum*, *Halgania preissiana*, *Leontodon taraxacoides*, *Erophila verna*.

Branched trichome n. T (Old French *branche* — arm).

Trichome divided into two or more branches. Figs 3H–J.

L. equiv.: *ramosus* — adj.A.

Note: see bifid trichome, dendritic trichome, stellate trichome.

e.g.: *Verbascum thapsus*, *Harmsiodoxa* spp., *Hibiscus setulosus*.

Bristle n. T (Anglo-Saxon *byrst* — bristle).

A rigid trichome similar to pig's bristles. Fig. 3D.

L. equiv.: *seta* — n.f.I.

n.r.: bristly adj.

Note: Stearn defined echinate broadly so as to include bristles — this is not recommended (see prickly). Sometimes the pappus units of Asteraceae fruits are bristlelike (e.g. *Bidens* spp.). Strictly they are not trichomes.

e.g.: *Papaver hybridum* fruits, *Hibiscus goldsworthii*, *Conostylis aculeata*.

Chaff n. I (Anglo-Saxon *ceaf* — chaff).

Small, dry, membranous scales, attached at margin or base. Fig. 1A.

adj.: chaffy.

L. equiv: *palea* — n.f.I, *ramentum* — n.neut.II.

n.r.: paleaceous.

Note: see scale. Chaff may result from degeneration of bracts.

e.g.: *Cyathea cooperi*, base of frond-rhachis.

Ciliate adj. I (L. *cilium* — eyelid, eyelash).

Having fine hairs resembling an eyelash, confined to the margin. Fig. 3A.

n.: cilium T, cilia T.

dim.: ciliola n., ciliolate adj.

L. equiv: *ciliatus* — adj.A.

e.g.: involucral bracts of *Helipterum pterochaetum*.

Cobwebbed adj. I (Anglo-Saxon *cop(pe)* — spider + Old English *web* — web).

Covered with long, weak, loosely entangled, thin hairs, resembling spiderwebs; usually white.

Fig. 1B.

adj.: cobwebby.

L. equiv.: *arachnoideus* — adj.A., *araneosus* — adj.A.

n.r.: arachnoid, araneous, histoid, histioid.

e.g.: *Eremophila arachnoides*, *Helipterum albicans*.

Coma n. I (Gk *kome* — hair of head).

A tuft of hairs, especially on a seed or fruit, usually apical. Fig. 2K.

adj.: comate, comose.

L. equiv.: *coma* — n.f.I.

Note: see pappus.

e.g.: seed of some *Epilobium* spp.

Cottony adj. I (Arabic *kutn* — cotton).

With long, soft, weak, filamentous hairs, somewhat flocculent and entangled, like the cotton of *Gossypium* seeds. Fig. 1C.

n.: cotton, should strictly refer to *Gossypium*.

L. equiv.: *gossypinus* — adj.A, *byssaceus* — adj.A.

n.r.: byssaceous, gossypine.

e.g.: seed of *Gossypium* spp.

Declinate adj. (L. *de-* — down, out; *clinare* — bend).

Bent downward from axis, attachment, or point of reference but not curving. See reclinate.

L. equiv.: *declinatus* — part.A.

Decurved adj. (L. *de-* — down, out; *curvare* — to bend).

Bent downwards from axis, attachment, or point of reference and curved or curled. See recurved.

L. equiv.: *decurvus* — adj.A., *decurvatus* — adj.A.

***Deflexed** adj. (L. *de-* — down, out; *flectere* — to bend).

Bent abruptly downwards from axis, attachment, or point of reference. See reflexed.

L. equiv.: *deflexus* — part.A.

Dendritic trichome n. T (Gk *dendron* — tree)

Branched trichome with the branches arising along the main axis, giving the appearance of a tree. Fig. 3 I.

L. equiv.: *dendriticus* — adj.A.

Note: The number, orientation and position of branches may be diagnostic.

e.g.: *Eremophila bowmanii*, *Dampiera lanceolata*, *Newcastelia cladotricha*, *Pityrodia uncinata*.

Divaricate adj. (L. *dis-* — apart; *varicare* — to straddle).

Of like structures spreading widely or extremely divergent from axis, attachment, or point of reference and from each other. (i.e. \pm perpendicular to axis) e.g.: branches of a peltate scale, or branches of pappus of *Tragopogon porrifolius*. See divergent.

L. equiv.: *divaricatus* — part.A.

Divergent adj. (L. *dis-* — apart; *vergere* — to bend).

Of like structures spreading widely but separating by degrees from axis, attachment, or point of reference and from each other, e.g. branches of pappus of *Carthamus lanatus*. See divaricate, spreading.

L. equiv.: *divergens* — part.B.

Felted adj. I (Old English *felt* — felt).

Covered with very dense, interlocked and matted trichomes having the appearance or texture of felt or woollen cloth. (cf. tomentose). Fig. 1D.

n.: felt.

L. equiv.: *pannosus* — adj.A, *coactus* — part.A.

n.r.: pannose, panniform.

e.g.: *Newcastelia hexarrhena*, *Pityrodia verbascina*.

Fimbriate adj. I (L. *fimbria* — fringe).

Having margin fringed with long, coarse, hair-like processes (cf. ciliate). Fig. 3B.

n.: fimbrium T.

dim.: fimbriilla n., frimbrillate adj.

L. equiv.: *fimbriatus* — adj.A.

n.r.: fimbriate, fringed.

e.g.: *Thysanotus* spp. petals; *Nymphoides* spp. petals; *Bulbostylis barbata* leaf sheath; *Caladenia patersonii* labellum margin.

Floccose adj. I (L. *floccus* — a lock of wool).

Covered with soft woolly trichomes which are entangled, tufted and tend to rub off and adhere in small masses or pills. Fig. 1E.

n.: floccus.

dim.: flocculent.

L. equiv.: *floccosus* — adj.A.

Note: Some workers treat flocculent as a possible synonym of cottony, but this is not recommended. See cottony.

e.g.: *Maireana carnosae*, *Pityrodia subfloccosa*, *Astrotricha floccosa*.

***Glabrate** adj. I (L. *glaber*, *glabri-* — hairless).

Glabrous, having obviously had an indumentum (i.e., defines the result).

L. equiv.: *glabratus* — adj.A.

Note: Not a synonym of glabrous nor meaning 'slightly but persistently hairy'. See glabrescent.

***Glabrescent** adj. I (L. *glaber*, *glabri-* — hairless).

Becoming glabrous especially with age or maturity (i.e., defines the process).

L. equiv.: *glabrescens* — part.B.

n.r.: depilation.

Note: Not to be confused with 'slightly but persistently hairy'.

***Glabrous** adj. I (L. *glaber*, *glabri-* — hairless).

Without trichomes.

L. equiv.: *glaber* — adj.A.

Note: Some authors, e.g. Stearn, include smooth in the definition but this is not recommended. See also glabrescent, glabrate and smooth.

Glandular trichome n. T (L. *glans* — an acorn).

Trichome terminating in a gland or functioning as a secretory organ or accumulatory organ. Fig. 3C.

L. equiv.: *glandulosus* — adj.A.

Note: Latex trichomes, mucilage trichomes and stinging trichomes are all secretory glandular, trichomes. Bladder hairs are accumulatory glandular trichomes e.g. accumulating salt as in Chenopodiaceae.

e.g.: *Persicaria elatior*, *Persicaria strigosa*, *Atriplex* spp. bladder hairs, *Dodonaea humilis*, *Halgania solanacea*, *Diplopeltis huegelii*.

Glaucous adj. 'I' (Gk *glaukos* — bluish grey).

With a whitish surface-film which rubs off easily.

n.: glaucousness, glaucescence, bloom.

L. equiv.: *glaucus* — adj.A.

n.r.: pruinose — the film is waxy; caesious — the film is blue-grey; glaucescent — becoming sea-green. Some workers define glaucescent as becoming glaucous, others as somewhat glaucous.

Note: a term strictly not describing an indumentum.

e.g.: *Eucalyptus cinerea*, *Acacia baileyana*.

***Hair** n. T (Anglo-Saxon *haer*, *her* — hair).

An elongate single-celled or multi-celled outgrowth from the epidermis, without vascular tissue.

adj.: hairy = bearing hairs I. Sometimes used as a collective term — not a recommended use.

L. equiv.: *pilus* — n.m.II.

***Hirsute adj. I** (L. *hirsutus* — rough hairy).

Bearing coarse, long hairs. Fig. 1F.

n.: hirsuteness.

dim.: hirsutellous.

L. equiv.: *hirsutus* — adj.A.

Note: Stearn includes 'stiff long erect or ascending straight hairs' in the definition and Jackson includes 'tolerably distinct'. *Hirtus* (L.) and hirtose are regarded by some workers as synonyms of hirsute but both have a checkered history and are not recommended terms.

e.g.: *Persicaria orientalis* stems.

Hispid adj. I (L. *hispidus* — bristly).

Having long, erect, rigid hairs or bristles, harsh to the touch. Fig. 1G.

dim.: hispidulous adj., setulose adj.

L. equiv.: *hispidus* — adj.A.

n.r.: bristly, setose.

Note: see strigose.

e.g.: *Brassica tournefortii*, *Echium vulgare*, *Heliotropium asperillum*.

Hoary adj. I (Anglo-Saxon *har* — grey-haired).

With a short dense cover of white or grey trichomes so dense as to make surface appear white or grey.

L. equiv.: *incanus* — adj.A.

n.r.: canous, canus, incanus, incanous, canescent, incanescent.

Note: Canescent and incanescent imply becoming hoary.

e.g.: *Dampiera incana* leaves.

Horizontal adj. (Gk *horizon* — limiting; *-alis* — pertaining to).

Lying in a plane parallel with the surface of the organ, usually applied when the organ is also oriented horizontally.

L. equiv.: *horizontalis* — adj.B.

Incurved adj. (L. *in-* — in; *curvare* — to curve).

Curving from without inwards. See inflexed.

adj.: indumented.

L. equiv.: *incurvus* — adj.A, *incurvatus* — adj.A.

Indumentum n. I (L. *indumentum* — a garment).

A covering of trichomes.

L. equiv.: *indumentum* — n.neut.II.

n.r.: hairy adj., pilose adj., pubescent adj., tomentose adj., vestiture n., vesture n.

Inflexed adj. (L. *in-* — in; *flectere* — to bend).

Bent abruptly inwards. See incurved.

L. equiv.: *inflexus* — adj.A.

e.g. the marginal trichomes of *Aldrovanda vesiculosa* and *Conostylis deplexa* leaves.

Latex trichome n. T (L. *latex* — liquid).

A glandular trichome which secretes latex (milky juice) when broken.

adj.: lactiferous, laticiferous I/T.

L. equiv.: *latex* — n.m.III.i/9.

e.g. some members of the trib. Cichorieae (Asteraceae).

Mealy adj. 'T' (Anglo-Saxon *melu* — meal).

Covered with meal-like or flour-like particles. Fig. 1H.

n.: meal.

L. equiv.: *farinosus* — adj.A.

n.r.: farina, farinose, granular.

Note: Some workers include farinaceous as a synonym but Jackson includes the possession of starch in the definition of farinaceous. The mealy condition may be due to disintegration of trichomes.

e.g.: *Rhagodia* spp.

Mucilage trichome n. T (L. *mucus* — nasal secretion).

Glandular trichomes which secrete mucus or slimy gummy substances. Fig. 3C.

L. equiv.: *mucus* — n.m.II.

e.g.: *Boerhavia* spp.

***Papillose adj. I** (L. *papilla* — a nipple).

Covered with nipple-shaped protuberances of even or uneven shape or size. Fig. 1 I.

n.: papilla T.

L. equiv.: *papillosus* — adj.A, *papillatus* — adj.A.

n.r.: papillate.

Note: in the extreme a papilla may be only a projection of part of the epidermal cell wall and not strictly a trichome.

e.g. *Lepidium papillosum*.

Pappus n. 'T' (Gk *pappos* — down on seeds).

The tuft of trichome-like sepals or sepal-derivatives of Asteraceae fruits. Fig. 2L.

adj.: pappose, pappous.

L. equiv.: *pappus* — n.m.II.

Note: Sometimes applied to the apical tuft of trichomes on other fruits. See also coma.

e.g.: Asteraceae fruits (e.g. *Helichrysum* spp., *Helipterum* spp.).

Peltate trichome n. T (Gk *pelte* — a small shield).

Trichomes attached by the centre or some point distinctly within the margin. Figs 3K, L.

L. equiv.: *peltatus* — adj.A.

n.r.: lepidote adj. (Some workers regard lepidotes as small peltate trichomes, others as a general term for scales).

Note: Compare with paleaceous which has trichome attachment at margin. See chaff. This type of trichome grades into the rotate type of stellate trichome. See stellate trichome. When the division between the rays is greater than half the radius of the trichome, it should be regarded as stellate.

e.g.: *Leptocarpus* spp., *Alyssum linifolium*, *Pityrodia lepidota*, *Pityrodia loricata*.

***Pilose adj. I** (L. *pilus* — a hair).

Covered with hairs which are soft, weak, thin and clearly separated. The hairs are usually defined as long and sometimes as ascending. Fig. 1J.

n.: pilus T, pilosity I — these terms usually have a general rather than a specific application.

L. equiv.: *pilosus* — adj.A.

n.r.: pilous.

Note: pilose, piliferous and piligerous have been used as opposites of glabrous — i.e. bearing trichomes. Not a recommended use.

e.g.: *Tribulus terrestris* leaflets, *Plantago lanceolatus* leaves, *Banksia pilostylis*, *Caladenia huegelii* stems and leaves.

Plumose trichome n. T (L. *pluma* — down feather).

Trichomes which are themselves 'hairy', similar to down feathers. Fig. 3J.

dim.: plumulaceous, plumulate, adjs.

L. equiv.: *plumosus* — adj.A.

n.r.: feathery, downy I (usually refers to soft hairs as in pubescent *s. str.*), pappose (usually means having a pappus, see pappus) all adjs.

Note: Strictly a type of dendritic trichome, *q.v.* Some structures may appear plumose due to their indumentum (e.g. stigmas of Poaceae and fruits of *Clematis* spp.).

e.g.: *Triumfetta plumigera*, *Helipterum albicans* pappus.

Porrect adj. T (L. *porrigere* — to stretch out).

Peltate and stellate trichomes which have the branches in one plane (rotate) and have an additional central erect branch giving the trichome the appearance of having an axle. Fig. 3K.

L. equiv.: *porrectus* — part.A.

e.g. *Solanum sisymbriifolium*, *Solanum eleagnifolium*.

Powdery adj. 'P' (Middle English *poudre* — dust, from L. *pulvis*).

Covered with fine, powdery particles.

L. equiv.: *pulverulentus* — adj.A.

n.r.: pulverulent, pulverulaceous.

Note: the powdery condition may be due to disintegration of trichomes.

e.g.: *Eucalyptus accedens* bark, *Eucalyptus mannifera* subsp. *maculosa* bark.

Prickle n. T/'T' (Old English *pricel* — prickle).

A hard, sharp outgrowth of the epidermis or bark without vascular tissue — cf. bristle, spine. Fig. 3E.

adj.: prickly I/'P'.

L. equiv.: *aculeus* — n.m.II.

n.r.: aculeate adj., acanaceous adj., acantha n., acanthaceous adj. — all general terms which include spines and thorns; echinate adj. — Stearn treats as a general term including spines and bristles.

opp.: unarmed (L. *inermis* — adj.B) — a general term which also defines absence of spines and thorns, see spine.

Note: most prickles will include some subepidermal tissue, making them emergences rather than trichomes.

e.g.: *Solanum* spp. (e.g. *S. ferocissimum*), *Rubus* spp.

***Puberulous** adj. I (L. *puber* or *pubes* — down, ripeness).

Minutely hairy with somewhat dense cover of very short soft hairs. Fig. 1K.

L. equiv.: *puberulus* — adj.A.

Note: This should not be used to denote slightly hairy in the sense of sparse or isolated trichome cover, rather it is a diminutive of pubescent *s. str.* See pubescence.

e.g.: *Acacia dealbata*.

***Pubescence** n. I (L. *puber* or *pubes* — down, ripeness).

A somewhat dense cover of short, weak, soft hairs. Fig. 1L.

adj.: pubescent.

dim.: puberulous.

L. equiv.: *pubescentia* — n.f.I, *pubes* — n.f.III.vii/8.

n.r.: downy (also applied to plumose, see plumose trichome) adj.

Note: pubescent is frequently used as an opposite of glabrous — bearing trichomes. Not a recommended use.

e.g. *Lepidobolus preissianus* stems.

Reclinate adj. (L. *re-* — back; *clinare* — to bend).

Bent back from the axis, attachment, or point of reference, but not curving. See declinate.

L. equiv.: *reclinatus* — part.A.

***Recurved** adj. (L. *re-* — back; *curvare* — to bend).

Curved or curled backward from axis, attachment, or point of reference. (Some workers include downward. See decurved).

L. equiv.: *recurvus* — adj.A, *recurvatus* — part.A.

***Reflexed** adj. (L. *re-* — back; *flectere* — to bend).

Abruptly bent backwards from axis, attachment, or point of reference. (Some workers include downward. See deflexed).

L. equiv.: *reflexus* — part.A.

Retrorse adj. (L. *retro-* — backwards; *versus* — turned).

Directed away from the apex.

L. equiv.: *retrorsus* — adj.A.

opp.: antrorse.

Scabrous adj. I (L. *scaber* — rough).

Rough to the touch with short hard rigid emergences or hairs. Fig. 2A.

dim.: scabrid, scabridous — in the sense of somewhat rough; scabridulous, scaberulent, scaberulous — in the sense of slightly or minutely rough; asperulate.

L. equiv.: *scaber* — adj.A., *asper* — adj.A.

n.r.: scabrate, asperate, asperous, exasperate, radulous.

e.g.: *Trema aspera*, *Ficus opposita*, *Thysanotus triandrus*, *Dasyogon bromeliifolius* leaf margins, *Acanthocarpus* spp. leaf margins.

Scale n. T (Old English *scealu* — husk, shell).

A thin scarios trichome which is flattened, somewhat plate-like, variously shaped in outline, with or without a stalk. A general term. Figs 1A, 3L.

adj.: scaly.

L. equiv.: *squama* — n.f.I.

Note: *lepides*, *paleae*, *ramenta* and *squamae* (all n. and all n.r.) are particular types of scale. *Lepides* are scales attached by a central stalk, sometimes used as a general term for scale; see *peltate trichome*. *Paleae* (some add *erect* to the definition), *ramenta* (some add *shrivelled* and *brown-coloured*) and *squamae* are scales which are attached by the margin or base; see *chaff*. *Scurf* is usually a general term for a cover of scales.

e.g.: *Pityrodia loricata*, *Triumfetta plumigera*.

Silky adj. I (L. *sericum* — silk).

Densely covered with fine, soft, straight, appressed hairs, with a lustrous sheen and satin-like to the touch. Fig. 2B.

L. equiv.: *sericeus* — adj.A.

n.r.: *sericate*, *sericeous*.

e.g.: *Patersonia sericea* scape and inflorescence bracts, *Pimelea argentea* leaves.

***Smooth adj. 'T'** (Old English *smoth* — akin to Old English *smethe*, *smooth*).

Of surfaces, even, without roughness or indumentum.

L. equiv.: *laevis* — adj.B.

Note: Not a synonym for *glabrous*. Sometimes used more strictly as an opposite for *scabrous*.

Spine n. 'T' (L. *spina* — thorn).

A strong, stiff, sharp-pointed, woody process, formed by modification of an organ with vascular tissue such as a branch, petiole or stipule. Strictly not a trichome. Fig. 3F.

adj.: *spiny*, *spinose*, *spinous* 'T'.

dim.: *spinulose*.

L. equiv.: *spina* — n.f.I.

n.r.: *thorn*; *acantha* — a term sometimes applied to prickles.

opp.: *unarmed* (L. *inermis* — adj.B).

e.g.: *Bursaria spinosa*, *Lycium* spp., *Crenidium spinescens*, *Acacia pulchella*.

Stellate trichome n. T (L. *stella* — star).

A branched trichome with six or more branches radiating from a single point. Fig. 3K.

dim.: *stellular*, *stellulate*.

L. equiv.: *stellatus* — adj.A, *stellaris* — adj.B.

n.r.: *stelliform*.

Note: The branches may radiate in one plane (*rotate*) or in all directions (*multiangulate*).

e.g.: *Solanum mauritianum* (*multiangulate*); *Alyssum linifolium* (*rotate*).

Stinging trichome n. T (Old English *stingan* — to sting or pierce).

A hollow trichome seated on a gland which, when broken, secretes an irritating fluid.

L. equiv.: *stimulosus* — adj.A, *urens* — part.B.

n.r.: *urticating trichome*, *stimulose adj.*, **T** or **I**.

e.g.: *Urticaceae* (e.g. *Dendrocnide moroides*).

Strigose adj. I (New L. *striga* — a bristle).

Covered with appressed, rigid, bristle-like, straight trichomes. Fig. 2C.

n.: striga T.

L. equiv.: *strigosus* — adj.A.

Note: This is the appressed equivalent of hispid. Some workers include swollen bases in the definition but this is not recommended.

e.g.: *Persicaria strigosa* stems, *Papaver hybridum* stems.

***Tomentose adj. I** (L. *tomentum* — cushion stuffing).

Densely covered with matted, short, trichomes. Fig. 2D.

n.: tomentum.

dim.: tomentulose.

L. equiv.: *tomentosus* — adj.A.

n.r.: shortly woolly.

Note: A somewhat subjective term because it grades into villous, felty and woolly. Often used as a general term for bearing an indumentum but this is not a recommended use.

e.g.: *Enchylaena tomentosa*, *Banksia robur*, *Diplopeltis intermedia*.

Trichome n. T (Gk *thrix* — hair).

Hair, bristle, scale, prickle or other hair-like outgrowth of the epidermis, without vascular tissue.

L. equiv.: *trichoma* — n.neut.III.xi/13.

Velvety adj. I (Old Italian *velluto* — velvet).

Very densely covered with fine, short, soft, erect hairs. Fig. 2E.

L. equiv.: *velutinus* — adj.A.

n.r.: velutinous.

e.g.: *Trema orientalis*, *Acacia podalyriifolia* young phyllodes.

Vesicle n. T (L. *vesicula* — a little bladder).

An inflated bladder-like trichome which is an enlargement of a single epidermal cell. Fig. 2F.

adj.: vesiculose I.

L. equiv.: *vesicula* — n.f.I.

n.r.: bladder-like, vesiculous, vesiculate.

Note: bladder hairs are accumulatory glandular hairs.

e.g.: *Tetragonia* spp. (e.g. young stems of *T. tetragonioides*); *Rhagodia* spp.

***Villous adj. I** (l. *villus* — shaggy hair).

Covered with long, soft, weak hairs, the covering somewhat dense. Fig. 2G.

n.: villus T, villi T, villosity I.

L. equiv.: *villosus* — adj.A.

n.r.: villose, shaggy.

Note: Stearn uses *hirtus* as a synonym in Latin, while Jackson states that *hirtus* is 'hairy, practically the same as *hirsute*'. Most definitions state that villous indumentum is free of matting. Some authors stipulate straight hairs, some curly, and some include appressed in the variation.

e.g.: *Bonamia rosea*, *Eremaea beaufortoides* fruits.

Warty adj. 'T' (Anglo-Saxon *wearte* — a wart).

Covered with wart-like protuberances. Fig. 2H.

n.: wart 'T'.

L. equiv.: *tuberculatus* — adj.A., *verrucatus* — adj.A.

n.r.: tuberculate, verrucose.

Note: Warts will include some subepidermal tissue making them emergences rather than trichomes.

e.g.: *Adenanthos detmoldii*, *Acanthocarpus* spp. fruits, *Eremophila latrobei* stems.

Woolly adj. I (Anglo-Saxon *wull* — wool).

Very densely covered with long, soft, more or less matted or intertwined trichomes, resembling sheep's wool. Fig. 2 I.

n.: wool.

dim.: lanulose, lanuginose.

L. equiv.: *lanosus* — adj.A.

n.r.: lanate, lanose, ulotrichous.

e.g.: *Actinobole* spp., *Maireana georgei*, *Leptospermum lanigerum*, *Lachnostachys eriobotrya*.

Voucher specimens for Figures 1-3

Figure 1. A. R.Hoogland 8502, CANB. B. N.Burbidge 3529, CANB. C. M.Parker 749, CANB. D. T.Halliday 130, CANB. E. P.Martenz 985, CANB. F. G.Carr 10385, CANB. G. N.Donner 3143, CANB. H. P.Wilson s.n., PERTH. I. D.Symon 542, CANB. J. D.Symon 13251, CANB. K. 20 Oct. 1976, R.Pullen, CANB. L. K.Newbey 10823, CANB.

Figure 2. A. R.Perry 1027, CANB. B. P.Heyligers, CANB. C. 22 Oct. 1949, C.Moore, CANB. D. K.Kenneally 7355, CANB. E. R.Story & G.Yapp 283, CANB. F. P.Wilson 12751, PERTH. G. M.Lazarides 5792, PERTH. H. R.Cranfield 5248, CANB. I. M.Corrick 8182, CANB. J. Hj.Eichler 21116, CANB. K. P.Raven 25834, *et al.*, CANB. L. N.Burbidge 3529, CANB.

Figure 3. A. 20 Sept. 1966, G.Chippendale, CANB. B. L.Nunn 4, CANB. C. Mar. 1968, W.Jones, CANB. D. 22 Oct. 1949, C.Moore, CANB. E. L.Craven 6632, CANB. F. 22 Sept. 1983, P.Bahri, CANB. G. K.Newbey 10276, CANB. H. C.Moore 2615, CANB; S.Everist 2794, CANB. I. 17 Oct. 1967, A.Main, CANB. J. L.Craven 6765, CANB. K. E.D'Arny 68, CANB; 23 Jan. 1967, G.Howard, CANB; L.Craven 3481, CANB. L. A.George 15609, CANB.

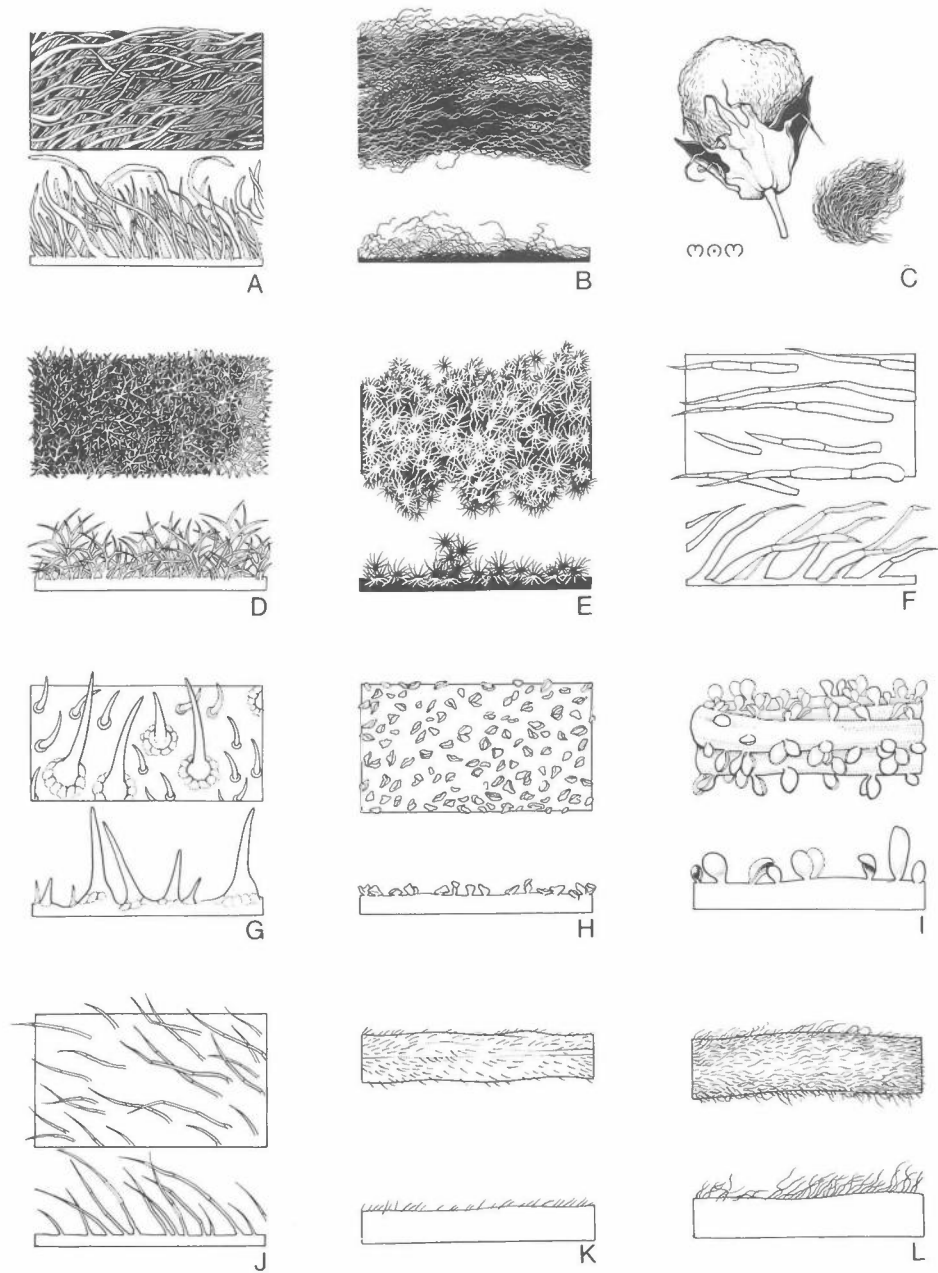


Figure 1. Indumentum types. A. Chaffy *Cyathea cooperi* $\times 5$. B. Cobwebbed *Helipterum albicans* $\times 10$. C. Cottony *Gossypium hirsutum* var. *punctatum*, fruit $\times 0.5$, indumentum $\times 10$. D. Felted *Pityrodia verbascina*, surface $\times 5$, section $\times 10$. E. Floccose *Astrotricha floccosa* $\times 10$. F. Hirsute *Plantago* aff. *coronopus* $\times 12.5$. G. Hispid *Heliotropium asperrimum* $\times 7.5$. H. Mealy *Rhagodia baccata* $\times 30$. I. Papillose *Lepidium papillosum*, surface $\times 30$, section $\times 20$. J. Pilose *Plantago bellardii* $\times 10$. K. Puberulous *Acacia dealbata* $\times 10$. L. Pubescent *Lepidobolus preissianus* $\times 10$.

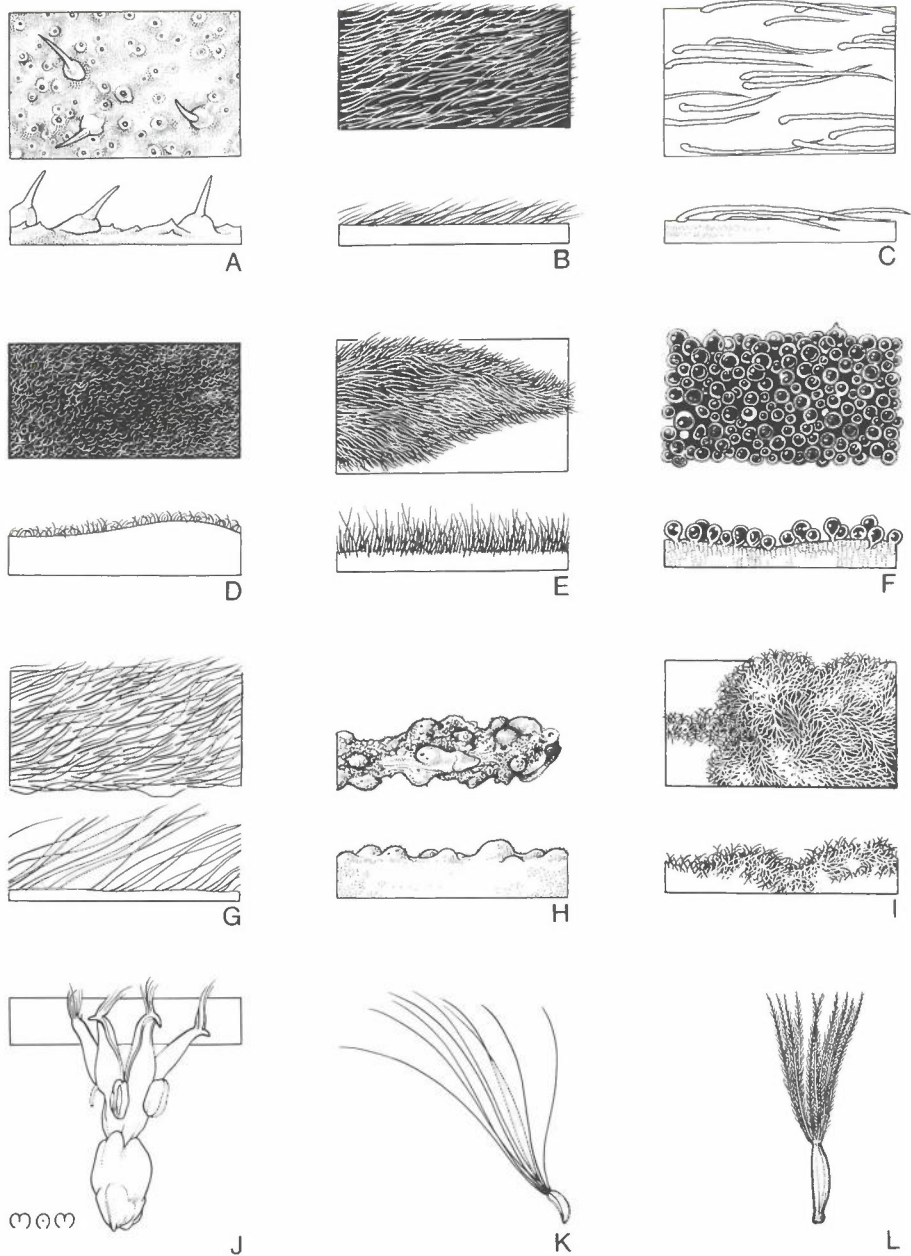


Figure 2. Indumentum types. A. Scabrous *Ficus opposita* var. *macrantha* $\times 10$. B. Silky *Spinifex sericeus* $\times 10$. C. Strigose *Papaver hybridum* $\times 10$. D. Tomentose *Diplopeltis intermedia* var. *incana* $\times 10$. E. Velvety *Acacia podalyriifolia* $\times 7.5$. F. Vesciculose *Tetragonia decumbens* $\times 10$. G. Villous *Maireana villosa* $\times 10$. H. Warty *Eremophila latrobei* var. *latrobei* $\times 10$. I. Woolly *Lachnostachys eriobotrya* $\times 6$. J. Bearded *Acrotriche ramiflora*, flower $\times 7.5$. K. Coma *Epilobium cinereum*, seed $\times 5$. L. Pappus *Helipterum albicans*, fruit $\times 2$.

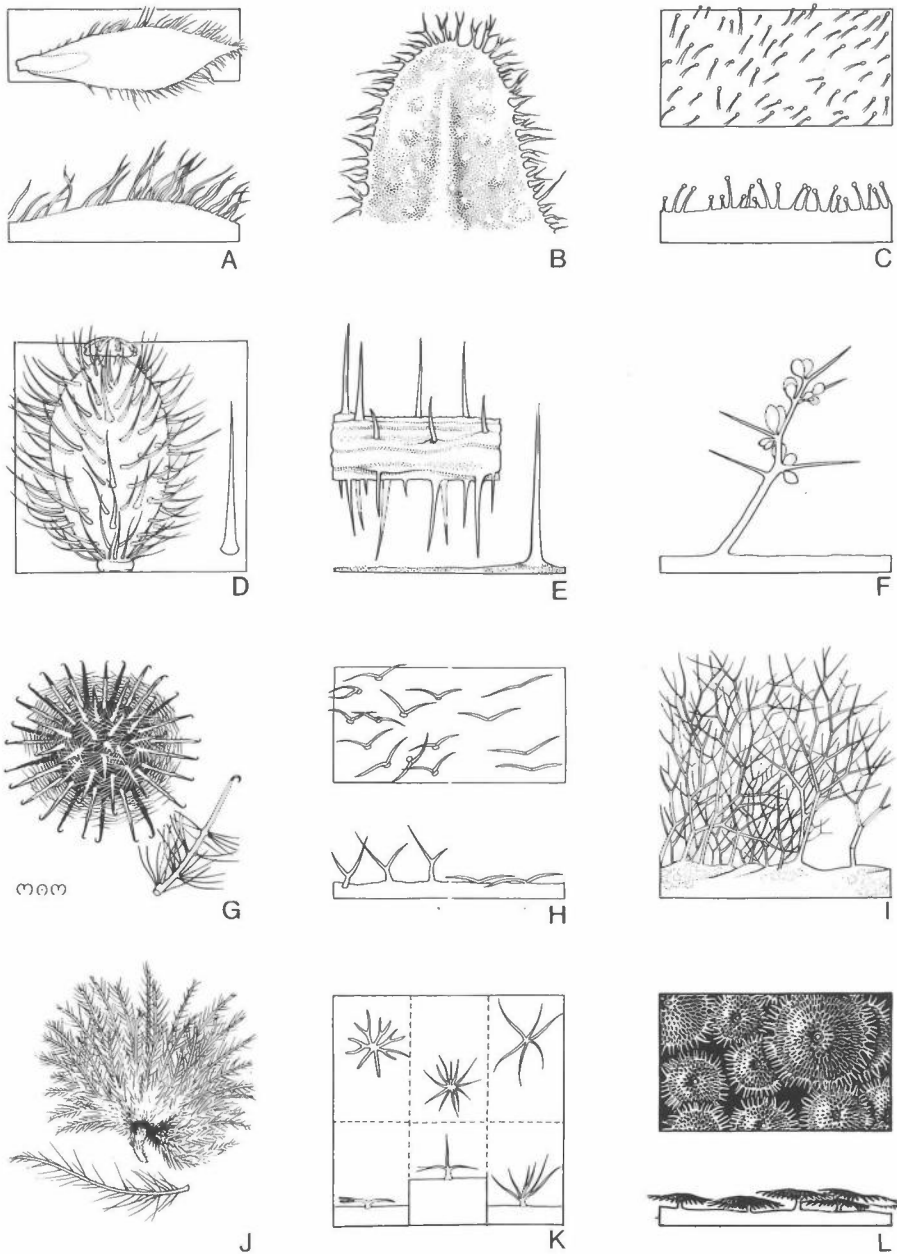


Figure 3. Trichome types. A. Ciliate *Helipterum pterochaetum*, bract $\times 12.5$, margin $\times 20$. B. Fimbriate *Chamelaucium cilatum* $\times 10$. C. Mucilage Trichome *Boerhavia diffusa* $\times 10$. D. Bristle *Papaver hybridum*, fruit $\times 2.5$, bristle $\times 12$. E. Prickle *Solanum asymmetriphyllum*, stem $\times 2$, prickle $\times 3.5$. F. Spine *Bursaria spinosa* $\times 1$. G. Barbed Trichome *Triumphetta chaetocarpa*, fruit $\times 2$, trichome $\times 5$. H. Bifid Trichomes *Erophila verna* subsp. *praecox*, trichomes $\times 15$; *Stenopetalum nutans*, trichomes appressed $\times 20$. I. Dendritic Trichomes *Pityrodia uncinata* $\times 12.5$. J. Plumose Trichomes *Triumphetta plumigera*, fruit $\times 5$, trichome $\times 7.5$. K. Stellate Trichomes. Peltate *Alyssum linifolium* $\times 15$; Porrect *Solanum elaeagnifolium* $\times 15$; Multiangulate *Hibiscus setulosus* $\times 5$. L. Peltate Scales *Pityrodia loricata* $\times 10$.

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This handbook has evolved out of a need to clarify and standardise the use of the terminology of plant indumenta in the text of the *Flora of Australia*. Many people have assisted with constructive comment. A large number of suggestions has been taken up and incorporated. All assistance is gratefully acknowledged from: *Flora of Australia* Editorial Committee; Dr A.McCusker, Dept. of the Arts, Sport, the Environment, Tourism and Territories; Dr R.J.Hnatiuk, Mr A.S.George, Mr A.D.Chapman, Bureau of Flora & Fauna; Dr R.W.Purdie, Heritage Commission; Mr C.R.Dunlop, while Australian Botanical Liaison Officer; Dr R.J.Chinnock, Dr J.P.Jessop, Mr D.E.Symon, Mr J.Z.Weber, AD; Dr R.W.Johnson, BRI; Dr B.A.Barlow, Mr L.A.Craven, Dr H.J.Eichler, Mr M.Gray, Dr T.G.Hartley, Mr M.Lazarides, Dr J.G.West, CANB; Dr A.E.Orchard, HO; Dr C.Jeffrey, Dr A.Radcliffe-Smith, K; Dr D.M.Churchill, MEL; Dr B.G.Briggs, Mrs J.G.Harden, Dr S.W.L.Jacobs, Dr L.A.S.Johnson, Mrs K.L.Wilson, NSW; Dr B.P.M.Hyland, QRS; Dr N.G.Marchant, Mr B.R.Maslin, Mr P.G.Wilson, PERTH, Dr J.A.Carnahan, Australian National University; Prof. D.J.Griffiths, Dr B.R.Jacks, James Cook University of North Queensland; Dr D.R.Selkirk, Miss D.Bergstrom, Macquarie University; Dr G.A.M.Scott, Dr S.L.Duigan, Dr I.Clark, Mr S.Cropper, University of Melbourne; Mr P.Adam, Mr C.J.Quinn, University of New South Wales; Prof. R.C.Carolin, University of Sydney and Prof. H.T.Clifford, University of Queensland. (Herbarium acronyms used where applicable.)

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LIST OF TERMS

- | | | | | | |
|-------------------|-----|-----------------|--------------------|-----|------------------------------|
| acanaceous | see | prickle | comose | see | coma |
| acantha | see | spine | cotton | see | cottony |
| acanthaceous | see | prickle, spine | cottony | | |
| aculeate | see | prickle | cover | see | p. 3 |
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| antrorse | | | crinite | see | beard |
| appressed | | | declinate | | |
| arachnoid | see | cobwebbed | decurved | | |
| araneous | see | cobwebbed | deflexed | | |
| arrect | see | erect | dendritic trichome | | |
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| asperous | see | scabrous | dichotomous | see | bifid trichome |
| asperulate | see | scabrous | divaricate | | |
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| barbed trichome | | | downy | see | plumose trichome, pubescence |
| barbate | see | beard | echinate | see | prickle |
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| bifid trichome | | | exasperate | see | scabrous |
| bladder hair | see | glandular hair | farina | see | mealy |
| bladder-like | see | vesicle | farinaceous | see | mealy |
| bloom | see | glaucous | farinose | see | mealy |
| branched trichome | | | feathery | see | plumose trichome |
| bristle | | | felt | see | felted |
| bristly | see | bristle | felted | | |
| byssaceous | see | cottony | fimbria | see | fimbriate |
| caesious | see | glaucous | fimbriate | | |
| canescent | see | hoary | fimbriate | see | frimbriate |
| canous | see | hoary | fimbrilla | see | fimbriate |
| canus | see | hoary | fimbrillate | see | fimbriate |
| cataphyll | see | scale | fimbrium | see | fimbriate |
| chaff | | | floccose | | |
| cilia | see | ciliate | flocculent | see | floccose, cottony |
| ciliate | | | floccus | see | floccose |
| ciliola | see | ciliate | fringed | see | fimbriate |
| ciliolate | see | ciliate | glabrate | | |
| cilium | see | ciliate | glabrescent | | |
| cobwebbed | | | glabrous | | |
| coma | | | glandular trichome | | |
| comate | see | coma | glaucescence | see | glaucous |

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 glochid see barbed trichome
 gossypine see cottony
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 hamate see barbed trichome
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 incanus see hoary
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 indumentum
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 lactiferous see latex trichome
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 lanose see woolly
 lanuginose see woolly
 lanulose see woolly
 latex trichome
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 lepidote see peltate trichome
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 multiangulate see stellate trichome
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 piligerous see pilose
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 prickly see prickly
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 pruinose see glaucous
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 setose see hispid
 setulose see hispid
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 spinous see spine
 spinulose see spine
 spiny see spine
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ulotrichous see woolly
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uncate see barbed trichome
urticating trichome see stinging trichome
velutinous see velvety
velvety
verrucose see warty
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vesiculate see vesicle
vesiculose see vesicle
vesiculous see vesicle
vesture see indumentum
vestured see indumentum
vestiture see indumentum
villose see villous
villosity see villous
villous
villus see villous
wart see warty
warty
wool see woolly
woolly