THE IDENTIFICATION OF CLOVERS IN NEW ZEALAND

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SUMMARY

A KEY is given for identification of all clovers and cloverlike plants known to occur in the adventive state in New Zealand, covering species in the genera *Lotus*, *Medicago*, *Melilotus*, *Oxalis*, *Parochetus*, and *Trifolium*. Features for recognition, abundance, usual habitats, and known distribution of the species in New Zealand are given.

The common name "clover" is applied to herbaceous plants of the pea family (*Leguminosae*) characterised by the trifoliate or shamrock-like leaves and extra-New Zealand origin; it is applied in the main to plants of the genus *Trifolium*, and to a lesser extent to species of *Medicago* and *Melilotus*.

In this paper "clover" is interpreted in the broad sense, and it was found desirable to include the normally sown or cultivated clovers because they often occur in habitats which give them the status of weeds. This is at variance with the title of the paper as given in the official programme, but has a possible advantage in that it enables a more comprehensive treatment of species of *Trifolium*, *Medicago*, *Melilotus*, *Lotus*, *Parochetus*, and the vegetatively similar *Oxalis*.

A key, based on various characters of both vegetative and more mature parts, is given for the identification of some 40 species, together with notes on the individual species. The characters used for differentiation of species are mostly visible to the naked eye, but a hand lens would be an advantage in some instances, especially when examining parts of stunted plants.

CHARACTERS IMPORTANT IN IDENTIFICATION

Characters significant in differentiation of species, and used in the key which follows are:

1. STEMS:

Whether prostrate and rooting at the nodes, for example, white clover (Fig. 1), or erect, for example, red clover, or prostrate but not rooting at nodes, for example, clustered clover, subterranean clover.

2. LEAVES:

(i) **Leaflets:** Typically three in number (occasionally 4 to 5); shape variable over the range of species, and from base to top of the stems; margins may be entire, for example, subterranean clover (Fig. 6F), or toothed, for example, white clover (Fig. 2D), and normally notched at the tip; the mid-rib may be prolonged as a spike-like projection in the notch or from the tip, as in species of medick (Fig. 4A) and markings or blotches may occur, either dark, for example, spotted bur clover, or light, for example, red clover.

(ii) **Stalks of leaflets:** The stalk (petiolule) of the central leaflet is distinctly longer than those of the lateral leaflets in all the species of *Medicago* and *Melilotus* (Fig. 3D) and in two species of *Trifolium*, while in the remaining clovers the stalks of all three leaflets are more or less equal in length, or $\pm$ absent (Fig. 2D); this is a useful character, as the clovers discussed fall into two major groups on this basis.

(iii) **Veins of leaflets:** Whether the veins as they near the margins are curved or straight, wide-spaced or close-spaced, thickened or unthickened, is useful in distinguishing non-flowering plants of two pairs of species—white clover and strawberry clover (Fig. 2C, 2D):

striated clover and rough clover (Fig. 7E, 7F). A hand lens is useful in checking this character, though with the first-mentioned pair of species, the venation is clear when a leaflet is held against a source of light.

- (iv) **Stipules:** The structures at the base of the leaf stalk (petiole) where it meets the stem (Fig. 1); variable in shape, colour and size, with the large leaflet-like ones in the birdsfoot-trefoils diagnostic (Fig. 2E).

3. HEADS:

Few-flowered or many-flowered; umbel-like as in the birdsfoot-trefoils (Fig. 1, 2E), or egg-shaped, globe-shaped (Fig. 6C) or cylindrical (Fig. 7A), the range being shown in the drawings accompanying this paper. The character of the head may change between the flowering and fruiting stages—the fruiting calyces may be directed downward, or may become inflated as in strawberry clover and its allies (Fig. 2C, 5E), or the head may elongate.

4. FLOWERS:

The flowers (florets) are made up of (a) calyx—the outer greenish part, tube-like below, with 5 teeth above (Fig. 1), and (b) corolla—the inner coloured part of unequal petals (Fig. 1). Individual flowers may be relatively large, for example, birdsfoot-trefoil, red clover, or small, for example, clustered clover. Flower colour is useful in differentiating groups of clovers (for example, medicks and birdsfoot-trefoil are yellow) but in general, less so in separating species. The length of the corolla (or petals) in relation to the calyx can be used to separate the species in two pairs of species—suffocated clover and clustered clover: striated clover and rough clover.

5. PODS (Fruits):

The pods may be straight or coiled, being in essence small-scale variants of the well-known garden pea or bean pods—in many species they are straight, several-seeded, and concealed in the withered petals. Whether distinctly longer than the fruiting calyx or $\pm$ equal in length to it or shorter is a useful character, as also is whether the pod is straight or spirally coiled.

Coiled pods covered with hooked spines or bristles are characteristic of some medicks, as also are sickle-shaped or circular coiled pods. The inflated fruiting calyces of three species of *Trifolium* distinguish them from all other clover species in New Zealand.

The distinction in the key of flowering and fruiting calyces should be noted, as the calyx in some species alters at fruiting, erect teeth in flower become spreading at maturity, giving a rough or bristly feel to the heads.

NOTE: (1) If possible, avoid making an identification on a single leaflet; examine several parts from one plant, or better, examine several plants.

(2) To gain facility in using the key, it is suggested that you run through the key with plants of species with which you are familiar, for example, white or red clover.

(3) Flower colour is indicated by letters following the name under each drawing in Figs. 2 to 8: B=Blue, C=Crimson, Cr=Cream, P=Pink, Pu=Purple, R=Red, S=Scarlet, W=White, Y=Yellow.

KEY TO CLOVER SPECIES

1. Stems prostrate, rooting at nodes (Fig. 1) 2
 Stems erect, or scrambling, or prostrate but not rooting at nodes,
 or above-ground stems absent (Fig. 1) 5
2. Margins of leaflets not toothed; flowers yellow or blue 3
 Margins of leaflets distinctly toothed; flowers white or pink 4
3. Stipules large, leaflet-like; flowers yellow (Fig. 2E, 9E) *Lotus pedunculatus*

- Stipules not leaflet-like, $\pm$ oblong, not pointed; leaf stalk jointed above stipule; leaflets green, reddish, brownish-green or hoary, without light markings or dark fleckings; flowers symmetrical, circular in outline, yellow, 1 to 5 per head (Fig. 2A, 9A) *Oxalis corniculata*
- Stipules not leaflet-like, drawn out into point; leaf stalk not jointed above stipules; leaflets green, with light crescent-shaped mark in lower half, and dark fleckings; flowers asymmetrical, large, pea-like, cobalt-blue, 1 to 2 per head (Fig. 2B, 9B) *Parochetus communis*
4. Veins of leaflets curving toward margins, close-spaced; fruiting heads inflated, strawberry-like in aspect (Fig. 2C, 9C) *Trifolium fragiferum*
- Veins of leaflets straight toward margins, wide-spaced; fruiting heads not inflated (Fig. 2D, 9D) *Trifolium repens*
5. Plants without above-ground stems; leaves on long stalks all arising from ground-level, either from top of a bulb or from a stout woody rhizome (underground stem); flowers red, pink, lilac, or yellow, circular and open (Fig. 1) *Oxalis* spp. 6
- Plants with distinct above-ground stems
6. Flowers symmetrical, circular in outline, yellow; heads 1 to 6 flowered; stipules minute, awl-shaped, or oblong, or absent; leaflets $\pm$ entire *Oxalis stricta*
- Flowers asymmetrical, narrow, colours various; head few to many flowered; stipules conspicuous, pointed leaflet-like in *Lotus* 7
7. Stipules large, leaflet-like, giving leaf appearance of having 5 leaflets (Fig. 2E); leaflet margins not toothed; flowers yellow or yellow tinged red, 1 to 12 in umbellate heads (that is stalk of head arranged like spokes of an umbrella); pods straight, much longer than fruiting calyces (Fig. 9E) 8
- Stipules not leaflet-like, leaves obviously of 3 leaflets; flower colours various; pods if straight usually shorter than to little longer than fruiting calyces and concealed in withered corolla, or if distinctly longer than fruiting calyx, then (i) coiled spirally and bur-like or (ii) coiled spirally and without hooked spines, or (iii) sickle-shaped and without spines, or (iv) short and egg-shaped with prominent veins or cross-wrinkled 12
8. Perennial, with stout crown with or without stolons; hairless or sparingly hairy; flowers $\frac{3}{8}$ in. or more long 9
- Annual; conspicuously hairy to shaggy-hairy; flowers $\frac{1}{4}$ in. to $\frac{5}{16}$ in. long 11
9. Stem hollow; plant often with stolons; flowers 5 to 12 per head; calyx teeth spreading and not pressed close against corolla in bud stage (Fig. 2E, 9E) *Lotus pedunculatus*
- Stem solid or nearly so; plant without stolons; flowers 2 to 6 per head; calyx teeth pressed against corolla in bud stage 10
10. Leaflets narrow, drawn out into long point, flowers $\pm$ 4 per head; pods slender (Fig. 2F, 9F) *Lotus tenuis*
- Leaflets broad; flowers 2 to 6 per head; pods stouter (Fig. 3A 9G) *Lotus corniculatus*
11. Heads 1 to 2 flowered, on stalks often shorter than leaves; flowers turning greenish with age; pods long and slender, 4 to 7 times longer than fruiting calyces (Fig. 3B, 9H) *Lotus angustissimus*
- Heads 3 to 4 flowered, on stalks often longer than leaves; flowers not turning greenish with age; pods shorter and stouter, $1\frac{1}{2}$ to 3 times longer than fruiting calyces (Fig. 3C, 9I) *Lotus hispidus*

12. Stalk (petiolule) of central leaflet distinctly longer than stalks of two lateral leaflets (Fig. 3D) 13
 Stalk (petiolule) of central and two lateral leaflets $\pm$ equal or absent (Fig. 2D) 25
13. Leaflets thick and $\pm$ fleshy, with strong odour when crushed, margins toothed nearly to base; flowers yellow or white, in elongated heads $\frac{1}{2}$ to 9 in. long; pods small egg-shaped, strongly wrinkled or veined (Fig. 3D, 9J) 14
 Leaflets thin, not fleshy, lacking strong odour when crushed, margins toothed, often in upper half only; flowers purple, blue, lilac, yellow or bluish-white; pods small and $\pm$ kidney-shaped, or sickle-shaped or spirally coiled and smooth, or spirally coiled and spiny (bur-like) (Fig. 9M, 9N, 10H) 16
14. Flowers white; in elongated heads 3 to 9 in. long; plants tall, 3 to 8 ft tall (Fig. 3D, 9J) *Melilotus alba* 15
 Flowers yellow; plants smaller 15
15. Flowers $\frac{1}{2}$ in. long or less; pods strongly veined; stems simple or sparingly branched to 2 ft tall (Fig. 3E, 9K) *Melilotus indica*
 Flowers $\frac{1}{2}$ in. long; pods with distinct cross-wrinkles; stem branching lowdown, giving a bushy plant, 2 to 3 ft tall (Fig. 3F, 9L) *Melilotus officinalis*
16. Flowers purple, blue, or bluish-white, plant perennial, with stout crown; pods spirally coiled or sickle-shaped, not spiny (Fig. 4A, 9M) (*Medicago sativa*)
 Flowers yellow or yellowish-white; plant annual or perennial; pods of various shapes (*Medicago x varia*) 17
17. Leaflets with conspicuous dark blotch; pod bur-like; stipules with evident teeth on margin (Fig. 4B, 9N) *Medicago arabica*
 Leaflets lacking conspicuous dark blotch; fruits various; stipules toothed or $\pm$ entire 18
18. Pod sickle-shaped or nearly straight; perennial (Fig. 4C, 10A) (*Medicago falcata*)
 Pod bur-like, or kidney-shaped, or spirally-coiled (Fig. 9M, 9N, 10H) (*Medicago x varia*) 19
19. Stipule with conspicuous teeth or lobes on margins (Fig. 4D) 20
 Stipules entire or with inconspicuous teeth on margins (Fig. 4F) 21
20. Stipules deeply cut into narrow segments; pod spirally-coiled, bur-like (Fig. 4D, 10B) *Medicago polymorpha*
 Stipules toothed only on margins; pod large, spirally-coiled, smooth, snail-like (Fig. 4E, 10C) *Medicago scutellata*
21. Notch at top of leaflet without projecting spike (prolongation of mid-rib); pod small, concealed in brownish withered corolla (Fig. 4F) 22
 Notch on top of leaflet with distinct projecting spike (prolongation of mid-rib); pod not concealed in withered corolla (Fig. 5D) 23
22. Flowers 25 to 50 per head (Fig. 4F, 10D) *Trifolium campestre*
 Flowers 5 to 20 per head (Fig. 5A, 10E) *Trifolium dubium*
23. Flowers large, $\frac{3}{4}$ to $\frac{1}{2}$ in. long; leaf stalks and lower side of leaflets whitish silky hairy; pods smooth, coiled; plant $\pm$ shrubby (Fig. 5B, 10F) *Medicago arborea*
 Flowers small, $\pm$ $\frac{1}{4}$ in. long; plant a spreading or prostrate herb 24

24. Flowers 1 to 8 per head; pod spirally coiled, bur-like (Fig. 5c, 10G) *Medicago minima*
 Flowers many, in compact heads on long stalks; pods small, kidney-shaped, smooth, black when ripe, (Fig. 5d, 10H) *Medicago lupulina*
25. Fruiting heads and calyces inflated (Fig. 5E, 10I) 26
 Fruiting heads and calyces not inflated 27
26. Fruiting heads pink to brown woolly, stalks shorter than leaves; nerves of fruiting calyces indistinct, teeth at tip concealed or nearly so in wool; not bur-like (Fig. 5E, 10I) *Trifolium tomentosum*
 Fruiting heads not woolly, stalks (except those of uppermost heads) longer than leaves; nerves of fruiting calyces distinct, teeth at tip clearly visible and projecting; head bur-like (Fig. 5F, 10J) *Trifolium resupinatum*
27. Flowers clear yellow 28
 Flowers red, crimson, pink, cream, or whitish 29
28. Heads large, dense, 40 or more flowered; broad petal of corolla grooved with age; plant erect, strong-growing (Fig. 6A, 10K) *Trifolium agrarium*
 Heads small, 1 to 6 flowered; flowers minute; plant small prostrate (Fig. 6B, 10L) *Trifolium filiforme*
29. Flowers cream or creamy-white: heads large, many-flowered 30
 Flowers red, crimson, pink or white; heads large or small, few or many flowered 31
30. Leaflets with whitish or bright crescent-shaped marking (usually in lower half) (Fig. 6C, 11A) *Trifolium pratense*
 Leaflets without whitish or light marking; flower heads smaller (Fig. 6D, 11B) *Trifolium ochroleucon*
31. Flower heads large, globe-shaped or egg-shaped, $\pm$ 1 in. diam.; flowers pink-purple or rosy; 2 to 3 times as long as calyx 32
 Flower heads cylindrical and many flowered, or few flowered (1 to 6), or if globe-shaped or egg-shaped, then $\frac{1}{2}$ in. diameter or less 33
32. Free part of stipule triangular with abrupt point; plant erect, branched; stems not prostrate or zigzag; pod opening by the top portion coming off like a cap (Fig. 6C, 11A) *Trifolium pratense*
 Free part of stipule drawn into long narrow point; plant prostrate; stems straggling or prostrate, zigzag; pod opening by splitting into two lengthwise (Fig. 6E, 11C) *Trifolium medium*
33. Leaflets distinctly hairy 34
 Leaflets hairless or nearly so 41
34. Stems prostrate; heads 2 to 6 flowered; flowers $\pm$ $\frac{3}{8}$ in. long, white to pinkish; leaflets usually with dark fleckings; stalk of fruiting head curved downward and pods anchoring in soil (Fig. 6F, 11D) *Trifolium subterraneum*
 Stems erect or spreading; heads many flowered; flowers white, pink, red, or crimson; pods not anchoring in soil 35
35. Leaflets narrow, at least 3 times as long as broad (Fig. 7A) 36
 Leaflets broad, at most $1\frac{1}{2}$ times as long as broad (Fig. 7D) 39
36. Leaflets $\frac{1}{8}$ in. broad or less 37
 Leaflets $\frac{1}{8}$ in. broad or more 38

37. Leaflets 1 to 2½ in. long, sharp-pointed at tip; points of stipules prominent, ± ½ in. long; fruiting heads cylindrical 1 to 3 in. long, rough (Fig. 7A, 11E) *Trifolium angustifolium*
 Leaflets ¾ to 1 in. long, oblong, usually notched at tip; point of stipules ± ½ in. long; fruiting heads short, cylindrical, ½ to 1 in. long, not rough bristly (Fig. 7B, 11F) *Trifolium arvense*
38. Heads egg-shaped to globe-shaped, fruiting heads not soft hairy (Fig. 7C, 11G) *Trifolium squamosum*
 Heads cylindrical; fruiting heads soft hairy (Fig. 7B, 11F) *Trifolium arvense*
39. Flowers crimson or scarlet; heads 1 to 4 in. long, cylindrical, long stalked (Fig. 7D, 11H) *Trifolium incarnatum*
 Flowers pink or whitish; heads short, cylindrical to egg-shaped, ½ to 1 in. long 40
40. Flowers distinctly longer than calyx; teeth of fruiting calyx erect; lateral veins of leaflets not thickened, and ± straight near margin (Fig. 7E, 11I) *Trifolium striatum*
 Flowers shorter than calyx; teeth of fruiting calyx spreading; lateral veins of leaflets thickened and curving near margin (Fig. 7F, 11J) *Trifolium scabrum*
41. Heads 1 to 6 flowered; pod distinctly longer than fruiting calyx, many seeded (Fig. 8A, 11K) *Trifolium ornithopodioides*
 Heads many flowered; pods as long as or shorter than fruiting calyx 42
42. Heads distinctly stalked 43
 Heads not stalked, or stalks less than ½ in. 44
43. Flowering heads at least ½ in. diam., globe-shaped; stalk of head stout at least 1 in. long; plant strong growing, erect, and branching; leaves and flower heads resemble white clover (Fig. 8B, 11L) *Trifolium hybridum*
 Flower heads small, to ½ in. diam.; stalks of heads slender, to ½ in. long; plants usually small, spreading, or prostrate (Fig. 8C, 11M) *Trifolium cernuum*
44. Corolla pink, distinctly longer than calyx; flower head small, globe-shaped, seated in leaf axil; upper leaves short-stalked; plant smaller usually, in dry places prostrate and stems radiating to give a circular mat-like form without raised centre (Fig. 8D, 11N) *Trifolium glomeratum*
 Corolla whitish, about as long as or shorter than calyx; heads in leaf axils, without or with short stalks; if stems elongate, upper leaves long stalked; plants small, prostrate, stems many and radiating to give a circular form, with raised centre (Fig. 8E, 11O) *Trifolium suffocatum*

COMMON NAMES AND THEIR BOTANICAL EQUIVALENTS

(Preferred common names in capitals)

Alfalfa	<i>Medicago sativa</i>
Alsike	<i>Trifolium hybridum</i>
BLACK MEDICK	<i>Medicago lupulina</i>
Blue oxalis	<i>Parochetus communis</i>
Birdsfoot fenugreek	<i>Trifolium ornithopodioides</i>
Birdsfoot trefoil	<i>Lotus corniculatus</i>
Greater	<i>Lotus pedunculatus</i>
Hairy	<i>Lotus hispidus</i>
Hispid	<i>Lotus hispidus</i>
Slender	<i>Lotus angustissimus</i>
	<i>Lotus tenuis</i>
Bokhara clover	<i>Melilotus</i> spp.

CLOVER

ALSIKE
 Bokhara
 BUR
 Cluster
 CLUSTERED
 CRIMSON
 DROOPING-HEADED
 Knotted
 LESSER SUCKLING
 NARROW-LEAVED
 Persian
 RED
 ROUGH
 SEA
 Shaftal
 SPOTTED BUR
 STRAWBERRY
 STRIATED
 SUBTERRANEAN
 SUCKLING
 SUFFOCATED
 SULPHUR
 Sweet
 WHITE
 WHITE BOKHARA
 WOOLLY
 YELLOW
 ZIGZAG

Cowgrass

Falcatula

LOTUS ANGUSTISSIMUS

LOTUS CORNICULATUS

LOTUS HISPIDUS

LOTUS MAJOR

LUCERNE

MEDICK

BLACK

Bur

Moon

SICKLE

SMALL BUR

SNAIL

Spotted

TREE

MELILOT

KING ISLAND

WHITE

OXALIS

SHAMROCK PEA

TREFOIL

Birdsfoot

English

Greater birdsfoot

Hairy birdsfoot

HARESFOOT

Hispid birdsfoot

HOP

Little

Slender birdsfoot

TRIGONEL

Trifolium hybridum
Melilotus spp.
Medicago polymorpha
Trifolium glomeratum
Trifolium glomeratum
Trifolium incarnatum
Trifolium cernuum
Trifolium striatum
Trifolium filiforme
Trifolium angustifolium
Trifolium resupinatum
Trifolium pratense
Trifolium scabrum
Trifolium squamosum
Trifolium resupinatum
Medicago arabica
Trifolium fragiferum
Trifolium striatum
Trifolium subterraneum
Trifolium dubium
Trifolium suffocatum
Trifolium ochroleucon
Melilotus alba
Trifolium repens
Melilotus alba
Trifolium tomentosum
Trifolium agrarium
Trifolium medium
Trifolium pratense
Trifolium ornithopodioides
Lotus angustissimus
Lotus corniculatus
Lotus hispidus
Lotus pedunculatus
Medicago sativa
Medicago spp.
Medicago lupulina
Medicago polymorpha
Medicago arborea
Medicago falcata
Medicago minima
Medicago scutellata
Medicago arabica
Medicago arborea
Melilotus officinalis
Melilotus indica
Melilotus alba
Oxalis spp.
Parochetus communis

Lotus corniculatus
Medicago lupulina
Lotus pedunculatus
Lotus hispidus
Trifolium arvense
Lotus hispidus
Trifolium campestre
Trifolium dubium
Lotus angustissimus
Lotus tenuis
Trifolium ornithopodioides

CONSPECTUS OF CLOVER GENERA AND SPECIES

Complementary to the key, this section gives the characteristic features of the genera and species together with their abundance and distribution in New Zealand. The species are enumerated in alphabetical order within the several genera, which are also listed alphabetically.

Over the years, a number of botanical or scientific names which are not now valid have been used in articles and papers dealing with clovers in New Zealand; these names are listed in their appropriate positions, together with the name which should be used.

The correct scientific name and preferred common or popular names are printed in capitals, with other less acceptable names in smaller type.

Falcatula ornithopodioides (DC.) Wilmott. Synonym of *Trifolium ornithopodioides* L.

Falcatula (*Trigonella*) *ornithopodioides* (L.) Brot. Synonym of *Trifolium ornithopodioides* L.

LOTUS (BIRDSFOOT-TREFOIL)

DIAGNOSTIC: **Stipules** large and leaflet-like, giving the leaf the appearance of having 5 leaflets; **leaflets** often asymmetrical; **flowers** yellow or reddish-tinged, 1 to 12 in umbellate heads; **Pods** straight, much longer than fruiting calyces, smooth.

LOTUS ANGUSTISSIMUS L. (LOTUS ANGUSTISSIMUS; slender birdsfoot-trefoil)

Annual, shaggy-hairy; closely related to and often confused with *L. hispidus*; recognised by the usually wiry, often reddish-stems, 1 to 2 flowers per head turning greenish with age, and long slender pods 4 to 7 times longer than the fruiting calyces.

DISTRIBUTION: Dry waste places and thin pastures in dry situations, often locally abundant in Auckland Province, less common south to Cook Strait. (W. and S. Europe, W. Asia, N. Africa) (Fig. 3B, 9H)

LOTUS CORNICULATUS L. (LOTUS CORNICULATUS; birdsfoot-trefoil)

Perennial, with well developed crown, no stolons; usually hairless, occasionally scattered hairy; more closely related to *L. tenuis* and *L. pedunculatus*, distinguished from the former by the broader leaflets and stouter pod, and from the latter by the solid stems and fewer, larger flowers.

DISTRIBUTION: Apparently occasional on roadsides and in pastures in both islands, its distribution and abundance poorly known because of confusion with the abundant *L. pedunculatus*. (Europe, Asia, N. and E. Africa) (Fig. 3A, 9G).

LOTUS HISPIDUS Desf. (LOTUS HISPIDUS; hispid birdsfoot-trefoil).

Annual, shaggy-hairy; often confused with the related *L. angustissimus* and distinguished by the more robust habit, flowers 3 to 4 per head and not turning greenish with age, and shorter, stouter pods only 1½ to 3 times as long as the fruiting calyces.

DISTRIBUTION: Common to locally abundant in dry waste places and thin pastures in dry situations in northern North Island district, less common in south of North Island and north of South Island, extending down the West Coast to south of Hokitika. (W. Europe, N. Africa) (Fig. 3C, 9I). *Lotus major* Scop. Synonym of *L. pedunculatus* Cav.

LOTUS PEDUNCULATUS Cav. (LOTUS MAJOR; greater birdsfoot-trefoil)

(syn. *L. Major* Scop.)

L. uliginosus Schkuhr.)

Perennial, almost hairless to hairy with long sparse hairs; distinguished from the related *L. corniculatus* by the stolons often produced from the rootstock, the more numerous and smaller flowers, and more slender heads.

DISTRIBUTION: The most widely distributed species of *Lotus* in New Zealand; occasional to locally abundant in wet pastures, swampy roadsides and waste places, through both islands; in higher rainfall districts stems

may reach 6 ft or more and scramble through hedges or shrubs in swamps etc.; in low rainfall areas as parts of Marlborough, Canterbury, and Otago, occurs along ditches and streams. (Europe, Central Asia, N. Africa) (Fig. 2E, 9E).

LOTUS TENUIS Waldst. et Kit. (LOTUS TENUIS; slender birdsfoot-trefoil)

Perennial, hairless or hairy, more slender than *L. corniculatus* and previously regarded as a variety of that species; distinguished from this and *L. pedunculatus* by the much narrower leaflets, and more slender stems.

DISTRIBUTION: Not uncommon in pastures, on roadsides and swampy situations generally in the Leeston district, and swampy places in the Swannanoa district, both localities in North Canterbury. (Europe, W. Asia, N. Africa) (Fig. 2F, 9F).

Lotus uliginosus Schkuhr. Synonym of *L. pedunculatus* Cav.

MEDICAGO (MEDICKS: BUR CLOVERS)

DIAGNOSTIC: **Stalk** (petiole) of central leaflet distinctly longer than those of two lateral leaflets; **mid-rib of leaflets** usually projecting as a small spike in notch at tip; **stipule margin** usually toothed or lobed; **flowers** mostly yellow; purple or blue in *M. sativa*; **Pods** longer than fruiting calyces, kidney-shaped, and smooth, or sickle-shaped and smooth, or spirally-coiled and smooth, or spirally-coiled and covered with hooked spines on margins (bur-like).

MEDICAGO ARABICA (L.) Huds. (SPOTTED BUR CLOVER: spotted medick)

(syn. *M. maculata* Sibth.)

Annual, almost hairless; recognised by the purplish-brown blotch on each leaflet and the coiled, bur-like pod; the characteristic blotch is sometimes absent, and the species is then distinguished from the closely related *M. polymorpha* by the stipule margins which are distinctly toothed, but not cut into fine segments, and the hairs are multicellular (use hand lens).

DISTRIBUTION: Occasional to locally common in dry waste places, about sheep yards and farm yards and in thin pastures on dry soils in both islands. Pods catch in wool and on animal hair, the plant being dispersed by this means. Occasionally grown as a curiosity in gardens because of the blotched leaves, under the name "Calvary clover". (Mediterranean to W. Asia) (Fig. 4B, 9N).

MEDICAGO ARBOREA L. (TREE MEDICK; moon medick)

Perennial, silky hairy; recognised by the shrubby habit, the leaf-stalks and lower sides of leaflets silky-hairy, large yellow to golden flowers, and large, spirally-coiled smooth pods.

DISTRIBUTION: A hedge escape in coastal waste places in scattered localities in both islands, rarely in adjacent pasture. (S. Europe) (Fig. 5B, 10F)

Medicago denticulata Willd. Synonym of *M. polymorpha* L.

MEDICAGO FALCATA L. (SICKLE MEDICK)

Perennial, recognised by the lucerne-like habit, the yellow flowers which distinguish it from the common lucerne, and the sickle-shaped pods.

DISTRIBUTION: Known only from plants gathered from sandy soils near Christchurch in 1949, but could well be found elsewhere as result of introduction in lucerne seed from overseas. (Europe, W. Asia, N. Africa) (Fig. 4C, 10A).

Medicago falcata x *M. sativa*. Constitution of the hybrid *M. x varia*

Medicago hispida Gaertn. Synonym of *M. polymorpha* L.

Medicago lupulina L. (BLACK MEDICK; English trefoil)

Annual to perennial, downy; similar in general aspect to and confused with *Trifolium dubium*, but distinguished by the downy hairy stems and leaves, the more compact and long-stalked flower heads, the spike-like projection in the notch at tip of the leaflets, and the black kidney-shaped to almost circular pod.

DISTRIBUTION: Occasional to locally abundant throughout, especially in limestone areas in low rainfall districts; in waste places and pastures,

especially in some coastal districts, and extending into modified low tussock-grassland in Canterbury and Otago. (S. Europe, W. Asia, N. Africa). (Fig. 5d, 10h).

Medicago maculata Sibth. Synonym of *M. arabica* (L.). Huds.

MEDICAGO MINIMA (L.) Barta (SMALL BUR MEDICK)

Annual, densely hairy or downy; in the vegetative stage very similar to small forms of *M. lupulina* with which it is usually growing, distinguished by the few flowered heads and small, bur-like pods.

DISTRIBUTION: Occasional to locally abundant on dry river beds, thin pastures on stony river terraces and on adjacent rolling country, and in adjacent modified low tussock-grassland, south from the Waiau River to the Kowai River, North Canterbury. (Europe, W. Asia, N. Africa). (Fig. 5c, 10g).

MEDICAGO POLYMORPHA L. (BUR CLOVER; bur-medick)

(syn. *M. denticulata* Willd.

M. hispida Gaertn.)

Annual, hairless, or sparingly hairy; recognised by the coiled bur-like pods, the large leaflets without blotches, and the stipule margins deeply cut into fine segments. A distinct variety (var. *confinis* (Koch) Burnet) with the spines of the pod absent or reduced to wart-like swellings is occasional in both islands.

DISTRIBUTION: Common to locally abundant in dry waste places, about sheep and farm yards, sheep camps, and thin pastures in dry situations in both islands. (C. and S. Europe, Asia, N. Africa). (Fig. 4d, 10b).

MEDICAGO SATIVA L. (LUCERNE; alfalfa)

Perennial, stout tap root, and stout crown, hairless, or with scattered hairs; recognised by the stout underground parts, the rather narrowish leaflets toothed along the upper half of the margins, the purple or bluish flowers in many-flowered heads, and the smooth spirally-coiled pods of 2 to 3 turns. Well-known commercial strains of this species are Argentine, Booborowie, Hungarian, Hunter River, Italian, Marlborough, Peruvian, Spanish, and Turkestan.

DISTRIBUTION: Sown in many localities in both islands, especially in low rainfall districts; occasional to locally common as an adventive on roadsides, railway embankments, and waste places in both islands. (Mediterranean, W. Asia). (Fig. 4a, 9m).

MEDICAGO SCUTELLATA (L.) All. (SNAIL MEDICK)

Annual, hairy; recognised by the toothed stipule margins, the few flowered heads, and the large smooth, spirally-coiled, snail-like pods.

DISTRIBUTION: Known only from a single gathering at Swannanoa, North Canterbury. (Mediterranean). (Fig. 4e, 10c).

MEDICAGO X VARIA Martyn

(= *M. falcata* x *M. sativa*)

A fertile hybrid which back-crosses with both parents giving a variety of forms. Flowers yellow, purple, or yellow changing to purplish or other colours. Pods almost straight to spirally-coiled with 2 to 3 turns. Some adventive forms appear to belong to this hybrid series. The commercial strains—Grimm, Ladik, and Provence—are of this hybrid origin.

MELILOTUS (MELILOT; BOKHARA CLOVER)

DIAGNOSTIC: **Leaflets** thick ± fleshy, margins toothed almost to base, with a strong odour when crushed; **stalk** of central leaflet distinctly longer than those of lateral leaflets; **flowers** yellow or white, in long narrow, lax- or dense-flowered heads; **Pods** egg-shaped, small, longer than fruiting calyces, with prominent nerves and cross-wrinkled.

MELILOTUS ALBA Medic. (WHITE BOKHARA CLOVER; white melilot; sweet clover)

Annual to biennial, hairless; recognised by the tall, stiffly erect habit, 4 to 8 ft tall and white flowers in often 1-sided elongated heads 3 to 9 in. long terminating the branches.

DISTRIBUTION: Strains of the biennial form grown for seeding, grazing and green manuring; sometimes grown as a source of nectar for bees. Rare to locally abundant on dry roadsides, waste places, coastal sands in localities in both islands, especially abundant on roadsides in parts of Central Otago. (Europe, Asia). (Fig. 3D, 9J)

Melilotus altissimus: A valid species, but the name incorrectly applied in New Zealand to plants belonging to *M. officinalis* (L.) Pallas.

MELILOTUS INDICA (L.) All. (KING ISLAND MELILOT; Bokhara clover) (syn. *M. parviflora* Desf.)

Annual, hairless; recognised and distinguished from *M. officinalis* by its smaller size, stem often with few branches near top in dry habitats, flowers small and only about half the size, the heads often shorter and more compact at flowering and fruiting, and the pods strongly veined, not cross-wrinkled.

DISTRIBUTION: Occasional to locally abundant on light coastal soils, elsewhere in dry waste places as roadsides, railway yards, etc., occasional in cultivated land in both islands.

Grazing the herbage of this and other species of *Melilotus* causes tainting of dairy produce, while the occurrence of this plant in wheat crops has serious consequences as seeds milled with the wheat taint the resultant flour. (Mediterranean, India). (Fig. 3E, 9K).

MELILOTUS OFFICINALIS (L.) Pallas (MELILOT)

(syn. *M. altissimus* of N.Z. authors)

Biennial, hairless; recognised by its branching, bushy habit, 3 ft or more tall, flowers yellow in long, lax-flowered heads; distinguished from *M. indica* by its larger size, longer lax heads, larger flowers and pods with cross-wrinkles.

DISTRIBUTION: Rare to occasional on roadsides and in waste places, usually in dry situations in scattered localities in both Islands. (Europe, Asia). (Fig. 3F, 9L).

Melilotus parviflora Desf. Synonym of *M. indica* (L.) All.

OXALIS

Species of *Oxalis* are unrelated to the clovers and are members of another family—*Oxalidaceae*; several species are treated in this paper as they are sometimes confused with clovers because of their trifoliate leaves and the occurrence of several species in habitats where clovers would be expected.

DIAGNOSTIC: Leaves of 3 leaflets, resembling those of a clover (other species in the genus *Oxalis* have more than 3 leaflets); leaflet margins $\pm$ entire, notched at tip, usually with distinct acid taste when chewed; flowers symmetrical, open, petals free; three types of growth habit may be encountered (i) with tap root, above-ground stems either prostrate and rooting at the nodes, or erect to prostrate but not rooting at nodes, flowers yellow (ii) with underground bulbs, erect or scrambling above-ground stems, sometimes with small bulbils in leaf axils, flowers red or lilac or (iii) underground parts either bulbs or stout, woody $\pm$ horizontal rhizomes, above-ground stems absent, leaves all from ground-level flowers symmetrical, red, pink, lilac, yellow, or near white, open, $\pm \frac{1}{2}$ in. diam., petals separate.

OXALIS CORNICULATA L.

Perennial, hairy, some forms almost hoary; recognised by the mat-forming habit, the prostrate rooting stems, the leaflet margins entire and notched at tip, the stipules not drawn out into points, and the open yellow flowers which distinguish it from all the clovers.

DISTRIBUTION: A common to abundant weed of waste places, pastures on hill country, modified tussock grassland throughout both islands; sometimes a troublesome weed in lawns and playing greens, in crevices of pathways, and on soil of pots in glasshouses. (Cosmopolitan; while some forms of the species are native to New Zealand, it is probable that others have been introduced). (Fig. 2A, 9A).

OXALIS STRICTA L.

Perennial, hairy; similar to *O. corniculata*, but usually more vigorous, stems erect or scrambling but *not rooting* at nodes, and flowers larger.

DISTRIBUTION: Occasional to locally common in drier waste places, dry roadside banks, in thin pastures on dry soils, in modified low tussock grassland, and from time to time in cultivated land; forms of this species are abundant in badly depleted modified tussock grassland in parts of North Canterbury and Marlborough. (Europe, Asia, N. America, Australia, New Zealand; several distinct forms, possibly distinct species, are included under this name in New Zealand, and it is possible that the plant which occurs as a weed of gardens and other habitats closely associated with man is in fact introduced).

PAROCHETUS (SHAMROCK PEA)

DIAGNOSTIC: **Perennial**, stems, leaf and flower stalks and undersides of leaflets hairy, upper side of leaflets hairless; **stems** prostrate or scrambling, rooting at nodes, mat-forming; **leaflets** entire with light crescent-shaped marking in lower third, usually with dark flecks elsewhere on upper surface. **Stalks** of leaflets $\pm$ equal; heads 1 to 2 flowered, long-stalked from leaf axils, stalk with distinct joint in upper half; **flowers** large, pea-like, cobalt-blue.

PAROCHETUS COMMUNIS Buch.-Hamilt. (SHAMROCK PEA; blue oxalis)

A single species with characters as above; could be confused in the non-flowering stage with *Trifolium subterraneum* because both have prostrate hairy stems and leaflets with light markings and dark fleckings; *Parochetus* is distinguished by the stems rooting at the nodes and the upper surface of the leaflets $\pm$ hairless.

DISTRIBUTION: Cultivated as an ornamental ground cover, as a rockery plant, and in hanging baskets; escaped from cultivation and established in moist, often shady situations as about forest margins—Hutt River, near Akatarawa; Eastbourne; Wellington City, and suburbs; localities between Westport and Franz Josef. (Himalayas; E. Africa). (Fig. 2B, 9B).

TRIFOLIUM (CLOVERS)

DIAGNOSTIC: **Stalk** of central leaflet $\pm$ same length as those of the lateral leaflets (exceptions are *T. campestre* and *T. dubium*); **flowers** small in the main, in many-flowered heads (exception *T. filiforme*, *T. ornithopodioides*, *T. subterraneum*), red, pink, yellow, cream or white; **pods** small, smooth, straight, shorter or longer than fruiting calyces and concealed in the withered corolla—conspicuously longer in *T. ornithopodioides*.

TRIFOLIUM AGRARIUM L. em. Schreb. (YELLOW CLOVER)

(syn. *T. aureum* Poll.)

Annual, hairless or slightly hairy; recognised by the usually stout erect habit, the stalks of all leaflets $\pm$ equal, the heads large, many flowered, the flowers yellow with the broad petal notched, and strongly grooved as it withers. This is the stoutest growing and largest-headed of the group of 4 species, which can be arranged in descending order on the basis of size of head: *T. agrarium*, *T. campestre*, *T. dubium*, *T. filiforme*.

DISTRIBUTION: Occasional to locally common in the lower part of the drainage area of the Lower Waikato River, in modified tussock grassland in the Lewis Pass locality, about Broken River where it was originally recorded in 1899, and near Lake Hawea. Reported from Marlborough, but I can find no specimens from there. (Europe, C. Russia, Asia Minor). (Fig. 6A, 10K).

TRIFOLIUM ANGUSTIFOLIUM L. (NARROW-LEAVED CLOVER)

Annual, hairy; recognised by the erect, ribbed stems, simple or sparingly branched, the long (1 to 2½ in.), very narrow leaflets, the long (1 to 3 in.) cylindrical heads with pink flowers longer than calyces; fruiting calyces with stiff teeth, giving fruiting head a rough or bristly feel. These characters readily distinguish this plant from the other two species with narrow leaflets—*T. arvense* and *T. squamosum*.

DISTRIBUTION: A rare casual which has never established, occurrences depending on introductions from time to time as an impurity in agricultural seeds. Known occurrences are Waiharahara, North Auckland; Auckland; Tauranga; Tokomaru Bay; Matapiro, Hawke's Bay; Masterton; Wellington; Fairlie. (Mediterranean). (Fig. 7A, 11E).

TRIFOLIUM ARVENSE L. (HARESFOOT TREFOIL)

Annual, greyish soft-hairy; recognised by the soft-feeling greyish-hairy narrow leaflets, the often reddish, wiry stems, the soft-hairy, pinkish, cylindrical flowering heads, flowers pink to whitish, shorter than calyx teeth; masses of this plant at flowering time give the impression of a pink haze in the distance. Highly variable in size according to habitat conditions, specimens from an inch or so tall with a single flower head to those a foot or so across and tall with many heads may be found within a short distance; under favourable conditions, plants may take several months to reach maturity, under drought conditions, maturity is reached in a matter of weeks. Value in pasture is negligible.

DISTRIBUTION: Common to locally abundant in dry waste places, on river beds, thin pastures on light soils, modified tussock grassland at lower altitudes, and light cultivated land in both islands. (Europe, Asia, N. Africa). (Fig. 7B, 11F).

Trifolium aureum Poll. Synonym of *T. agrarium* L. em. Schreb.

TRIFOLIUM CAMPESTRE Schreb. (HOP TREFOIL)

(syn. *T. procumbens* L. pp.)

Annual, usually scattered hairy; one of the group of four yellow-flowered species of *Trifolium*, but because of the stalk of the central leaflet much longer than those of the lateral leaflets, can only be confused with *T. dubium*, from which it differs in being normally a larger plant, with 25 to 30 flowers per head.

DISTRIBUTION: Occasional to locally common in waste places, on roadsides, in pastures in dry situations in both islands, extending into low tussock grassland in parts of Marlborough and Canterbury; often growing with the related *T. dubium*. (Europe, W. Asia, N. Africa). (Fig. 4F, 10D).

TRIFOLIUM CERNUUM Brot. (DROOPING-HEADED CLOVER)

(syn. *T. parviflorum* of N.Z. authors)

Annual, hairless; confused with *T. glomeratum* because of the usually prostrate habit and hairless nature, but distinguished by the small globular heads being distinctly stalked; flowers small, pink, slightly longer than calyx.

DISTRIBUTION: Occasional, rarely locally common, in waste places, shingle verges of roads and thin pastures in dry situations in southern half of North Island; similar situations in Canterbury and Marlborough, extending into modified low tussock grassland. Kill-spraying with herbicide for nassella tussock control on dry north-west faces at Fairhall, Marlborough, induced an abundant growth of this species which is occasional in adjacent tussock grassland. (S. Europe). (Fig. 8C, 11M).

TRIFOLIUM DUBIUM Sibth. (SUCKLING CLOVER: little trefoil)

(syn. *T. minus* Sm.)

Annual, ± hairless to sparingly hairy; a variable species as regards size and number of stems, in open dry situations sometimes few-stemmed, sometimes many-stemmed and assuming a circular prostrate form; under more favourable conditions, stems many, long, semi-erect or scrambling; stems and leaves often reddish to purplish. Recognised by the stalk of central leaflet distinctly longer than those of lateral leaflets, thin wiry stems and yellow flowers, 5 to 20 per head; small or stunted plants with few flowered heads are confused with *T. filiforme*, but the shorter internodes and ± equal leaflet stalks distinguish that species.

DISTRIBUTION: Abundant over a range of habitats, especially so in pastures on light land, waste places, cultivated land, and modified low tussock grassland. The most abundant and widely distributed of the four yellow-flowered species of *Trifolium*. Sometimes a weed of lawns and playing greens, growing with *T. filiforme*. (Europe, Asia). (Fig. 5A, 10E).

Fig. 1—Drawings showing parts of a clover plant important in identification and habit of Oxalis without above-ground stems.

Fig. 2—Clovers: a, flowering head; b, leaf; c, stipule.

Fig. 3—Clovers: a, flowering head; b, leaf; c, stipule.

Fig. 4—Clovers: a, flowering head; b, leaf; c, stipule.

Fig. 5—Clovers: a, flowering head; b, leaf; c, stipule.

Fig. 6—Clovers: a, flowering head; b, leaf; c, stipule.

Fig. 7—Clovers: a, flowering head; b, leaf; c, stipule.

Fig. 8—Clovers: a, flowering head; b, leaf; c, stipule; d, growth habit.

Fig. 9—Clovers: fruiting calyces and pods.

Fig. 10—Clovers: fruiting calyces and pods.

Fig. 11—Clovers: fruiting calyces and pods.

TRIFOLIUM FILIFORME L. (LESSER SUCKLING CLOVER)

(syn. *T. micranthum* Viv.)

Annual, $\pm$ hairless to sparingly hairy; recognised by the usually short, wiry, prostrate stems, short internodes, short leaf stalks, stalks of all leaflets $\pm$ equal or virtually absent, and flowers minute, yellow, 1 to 5 per head; confused with *T. dubium*, but smaller in all its parts; the smallest of the group of yellow-flowered species of *Trifolium*.

DISTRIBUTION: Occurs over the range of habitats of *T. dubium*, but occasional to not uncommon over both islands; not uncommon on lawns and playing greens, with *T. dubium*. Knowledge of distribution and abundance not certain, because of confusion with small forms of the closely related *T. dubium*. (Europe, Asia). (Fig. 6B, 10L).

TRIFOLIUM FRAGIFERUM L. (STRAWBERRY CLOVER)

Perennial, hairless or with hairs on stalks of leaflets; similar to *T. repens* in its creeping, rooting stems and hairless vegetative parts, but distinguished by the narrower leaflets, the lateral veins curving toward margins and close-spaced, flowers pink to reddish in tighter heads, and the fruiting heads inflated and strawberry-like in size and shape; stunted plants with small fruiting heads can be confused with *T. resupinatum*, but this species has erect to scrambling, non-rooting stems, smaller pink to purplish flower heads, and smaller, bur-like heads.

DISTRIBUTION: Sown for pasture purposes, especially in coastal localities, as it tolerates saline soils; occasional to locally common through both islands over a wide range of habitat conditions; occasional in lawns, either sown or volunteer. (Europe, W. Asia, N. Africa). (Fig. 2C, 9C).

TRIFOLIUM GLOMERATUM L. (CLUSTERED CLOVER; cluster clover)

Annual, hairless; recognised by the wiry, prostrate or scrambling stems, hairless leaflets and small, globe-shaped heads of pink to purplish flowers seated in the leaf axils; liable to be confused with *T. cernuum*, which is distinguished by its less dense, distinctly stalked heads. Varies considerably in size with habitat conditions.

DISTRIBUTION: Occasional to locally common in dry places and dry pastures in both islands, extending into modified low tussock grassland in Marlborough and Canterbury. (Mediterranean). (Fig. 8D, 11N).

TRIFOLIUM HYBRIDUM L. (ALSIKE CLOVER; alsike)

Perennial, hairless; recognised by the erect branching habit of a red clover, combined with hairless leaves (in leaflet shape, size and texture) and stalked pink flower heads resembling those of white clover.

DISTRIBUTION: Not uncommon in damp pastures and waste places in both islands; in drier East Coast, South Island localities, occurs along stream banks, drains and irrigation channels. (Europe, W. Asia). (Fig. 8B, 11L).

TRIFOLIUM INCARNATUM L. (CRIMSON CLOVER)

Annual, shaggy-hairy; recognised by its erect stems, long cylindrical heads at ends of branches, flowers crimson or scarlet, longer than calyces, and fruiting calyces with spreading teeth.

DISTRIBUTION: Rare, plants appearing from time to time in pasture and sown crops in localities in both islands, originating as an impurity in imported agricultural seeds. (Mediterranean). (Fig. 7D, 11H).
Trifolium maritimum Huds. Synonym of *T. squamosum* L.

TRIFOLIUM MEDIUM L. (ZIGZAG CLOVER)

Perennial, nearly hairless or with hairs pressed close to stems and leaflet surfaces; recognised by the straggling habit, the stems zigzag, the leaflets narrow-elliptic and similar in size to *T. pratense*, the heads large, stalked, globe-shaped, the flowers reddish-purple, large, several times longer than calyx, and pod splitting lengthwise; has something of the general aspect of *T. pratense*, distinguished by the narrow leaflets, the spreading zigzag stems and the way the pod splits.

DISTRIBUTION: Rare in pastures and waste places in both islands now, apparently more common in earlier years according to published reports. (Europe, Asia). (Fig. 6E, 11C).

Trifolium micranthum Viv. Synonym of *T. filiforme* L.

Trifolium minus Sm. Synonym of *T. dubium* Sibth.

TRIFOLIUM OCHROLEUCUM Huds. (SULPHUR CLOVER)
(*T. ochroleucum*)

Perennial, spreading hairy; recognised by its general similarity in growth habit to *T. pratense*, distinguished by the flowers cream or whitish-yellow, and the leaflets lacking a whitish or light crescent-shaped marking.

DISTRIBUTION: Rare, one collection only having been made in the last 20 years, from near Wellington; cream-flowered forms of *T. pratense* have been incorrectly identified as this species. (Europe, W. Asia). (Fig. 6D, 11B).

TRIFOLIUM ORNITHOPODIODES L. (TRIGONEL)

(syn. *Falcatula ornithopodioides* (DC.) Wilmott)

F. (Trigonella) ornithopodioides (L.) Brot.

Annual to perennial, hairless; characterised by the prostrate habit giving a $\pm$ circular mat-like form, 1 to 6 in. or so diam.; stems wiry, flowers 1 to 5 in short-stalked heads in leaf axils, white to pink, longer than calyx, and pods distinctly longer than fruiting calyx, 4 to 8 seeded. Not likely to be confused with any other species because of the few flowered heads.

DISTRIBUTION: Occasional to locally common in dry waste places and thin pastures on light soils in localities in both islands—near Auckland; Tutira, Hawke's Bay; Fielding; Martinborough, Titahi Bay, and localities about Wellington; Wairau and Awatere Rivers, Marlborough; various localities in North Canterbury; Alexandra; Dunedin. Though with a preference for dry habitats, grows about Lake Ellesmere in places which are periodically inundated, and along the Hurunui River, common and turf-forming on river-flats, in hollows which are inundated for varying periods in some seasons. (Mediterranean). (Fig. 8A, 11K).

Trifolium parviflorum Name incorrectly applied in New Zealand to *T. cernuum* Brot.

TRIFOLIUM PRATENSE L. (RED CLOVER; cowgrass)

Annual, soft-hairy; recognised by the $\pm$ erect, much-branched habit, soft hairy stems and leaves, leaflets usually with light-coloured crescentic marking in lower half, stipules with tuft of spreading hairs at free end, heads large and globe-shaped with two short-stalked leaves at base, flowers large, pink-purple, pink or cream, several times longer than calyx, pods opening by the top lifting off, cap-fashion. Likely to be confused only with *T. medium*, the forms with whitish flowers with *T. ochroleucum*. The cultivated form var. *sativum* (Crome) Schreb., has the leaflets $\pm$ entire, and stems hollow, while the wild form, var. *silvestre* Syme, has leaflets with toothed margins and usually solid stems. An important species agriculturally with a number of named strains, including Broad Red or Cowgrass and Montgomery.

DISTRIBUTION: Common to abundant in pastures and waste places in both islands. (Europe, W. Asia). (Fig. 6C, 11A).

Trifolium procumbens L.p.p. Synonym of *T. campestre* Schreb.

TRIFOLIUM REPENS L. (WHITE CLOVER)

Perennial, hairless; recognised by being perfectly hairless, with creeping, rooting stems, long-stalked white (occasionally pink or almost red) heads, flowers longer than calyx. May be confused with *T. fragiferum*, but distinguished by the lateral veins of the leaflets straight toward the margin and wide spaced, and the fruiting calyxes and head not inflated. A variable species with some distinct forms of great agricultural importance; these vary in size, leaf marking, and head colour, and some are cyanophoric. A number of strains are recognised, including Ladino, Kentish, and New Zealand certified types.

DISTRIBUTION: Occasional to abundant throughout New Zealand over a wide range of habitats. (Europe, Asia, N. Africa). (Fig. 2D, 9D).

TRIFOLIUM RESUPINATUM L. (REVERSED CLOVER; Persian clover; shaftal clover).

Annual, hairless, except on calyx; recognised by the erect or spreading stems, relatively small flowering heads on stalks usually longer than the leaves (except near ends of branches), flowers small, purple, longer than calyx, fruiting calyces and fruiting heads inflated. One of three species characterised by the inflated fruiting heads; distinguished from *T. fragiferum* by the stems not rooting, the flower head small and flowers purple, the fruiting heads smaller with fewer inflated calyces, and from *T. tomentosum* by the more robust habit, the long-stalked heads, the fruiting calyces not woolly and the teeth projecting and clearly visible.

DISTRIBUTION: Occasional to locally common in damp pastures and waste places in Auckland Province, occasional southward in North Island; a single gathering known from the South Island near Lake Ellesmere, Canterbury, as an impurity in experimental sowings. (Asia). (Fig. 5F, 10J).

TRIFOLIUM SCABRUM L. (ROUGH CLOVER)

Annual, soft-hairy; stems erect or spreading, 6 to 8 in. high, heads at ends of branches or axillary, not stalked, with leaf at base, egg-shaped, to $\frac{1}{2}$ in. long, flowers small, shorter than or as long as calyx, white, teeth of fruiting calyx curved downward, stiff, giving head a bristly feel; similar to and confused with *T. striatum*, the significant differences being the lateral nerves of the leaflet thickened and curving backward near margin, the short flowers, and the downwardly curved teeth of the fruiting calyx.

DISTRIBUTION: Rare; previously reported as infrequent in both islands, but all herbarium material examined under this name proved to be *T. striatum*. A single collection from Miranda, Firth of Thames, in 1958 appears to be the only definite occurrence. A plant of dry or sandy habitats, it should be watched for in suitable places. (Europe, W. Asia, N. Africa). (Fig. 7F, 11J).

TRIFOLIUM SQUAMOSUM L. (SEA CLOVER)

(syn. *T. maritimum* Huds.)

Annual, hairy (overseas specimens said to be almost hairless at times). Characterised by the $\pm$ erect habit, the narrow, wedge-shaped leaflets, distinctly stalked egg-shaped or globe-shaped heads with paired (opposite) leaves below, flowers pink, slightly longer than calyx. The few New Zealand specimens examined have some general resemblance to *Trifolium arvense*, but are distinguished by the more robust habit, the longer broader leaflets, the egg-shaped to globe-shaped heads, and the fruiting heads not soft hairy to the touch.

DISTRIBUTION: Rare, not observed during the last 20 years; known from three collections from dry coastal habitats; Glendowie, St. Heliers, and Onehunga, all localities in the Auckland district. (W. and S. Europe, W. Asia, N. Africa). (Fig. 7C, 11G).

TRIFOLIUM STRIATUM L. (STRIATED CLOVER: knotted clover)

Annual, densely hairy; characteristically light green to almost hoary in aspect, prostrate in dry habitats, tending erect or spreading in moister situations; leaflets sometimes diamond-shaped; heads egg-shaped to $\frac{1}{2}$ in. long, not stalked, at ends of branches and in leaf axils, basally enveloped in the much enlarged stipules of the adjacent short-stalked leaves; flowers small, pink, longer than calyces, fruiting calyces strongly ribbed, teeth $\pm$ erect. In dry habitats it is shortlived; with the leaves withered, the prickly fruiting heads at the nodes give an appearance of cords with knots at intervals. Confused with *T. scabrum*, from which it differs in the flower and calyx characters given above, and in the lateral veins of the leaflets not thickened and $\pm$ straight near the margins.

DISTRIBUTION: Occasional to locally abundant in dry waste places and thin pastures on hill country or light soils in both islands, especially on the drier east coast districts; in modified low tussock grassland in eastern South Island. (Europe, Asia, N.W. Africa). (Fig. 7E, 11I).

TRIFOLIUM SUBTERRANEUM L. (SUBTERRANEAN CLOVER)

Annual, soft hairy; recognised by the prostrate, non-rooting stems, the

marking or dark fleckings of the broad leaflets, the long white (occas. pink) flowers in stalked, few flowered, axillary heads, the fruiting calyx anchoring in the soil, and the large purplish-black seed—the largest and darkest-coloured seed of the species of *Trifolium* in New Zealand. Liable to be confused only with *Parochetus communis*, and then only in the vegetative stage, but distinguished by its preference for a dry habitat, the stems *not* rooting, and both surfaces of the leaflets hairy. A number of strains of Australian origin are recognised in agriculture, including Bacchus Marsh, Dwalganup, Mount Barker, Nangeela, and Tallarook.

DISTRIBUTION: Occasional to locally common in dry waste places in both islands, the distribution and abundance having markedly increased over the years with increasing use of the species in agriculture; seed dispersed by sheep. (Mediterranean). (Fig. 6F, 11D).

TRIFOLIUM SUFFOCATUM L. (SUFFOCATED CLOVER)

Annual, hairless; recognised by the short prostrate stems, the long-stalked, hairless, wedge-shaped leaflets, the almost adjacent heads and whitish flowers shorter than calyx. The plant is usually circular in outline, in cross-section, raised or mound-like in the centre due to the closeness of the heads; in outline, plants show a dense centre made up of the closely packed heads, out of which project the leaf stalks, the leaves making a peripheral ring; when the leaves wither, the central part of the plant appears a mass of fruiting calyces, the stems not being visible. Variable in size, ranging from $\frac{1}{4}$ in. to 6 in. diam.

DISTRIBUTION: Occasional to locally common in dry waste places and thin pasture on dry hill faces in localities in both islands—Otaki; Eastbourne; Martinborough; Paekakariki; Sinclair Head, Wellington Harbour; Culverden; in modified tussock grassland, lower Wairau and Awatere River, Marlborough; Port Hills, Christchurch. This species is possibly more common than the above distribution indicates, and may have been overlooked because of its short life and small size. (W. Europe, Mediterranean). (Fig. 8E, 11D).

TRIFOLIUM TOMENTOSUM L. (WOOLLY CLOVER)

Annual, hairless except for the woolly heads; recognised by the prostrate habit, $\pm$ circular growth form from bright green hairless leaves; flowers pink, longer than calyces, in heads with short stalks; calyces becoming inflated in fruit, covered with dense pink wool, giving a dense globe-like head with the calyx teeth concealed in the wool; wool turning brown with age. Liable to be confused only with *T. resupinatum*, which lacks the dense wool covering the inflated fruiting head, and has the calyx teeth prominently projecting, giving a bur-like appearance.

DISTRIBUTION: In dry waste places and less frequently thin pastures throughout North Island and south to North Otago, rare to locally common; occasional about Wellington, common in Marlborough and Canterbury, especially on the light soils of terraces of the major rivers. (Mediterranean). (Fig. 5E, 10I).

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DISCUSSION ON MR HEALY'S PAPER

Mr Bascand—Would Mr Healy elucidate regarding the definition of stipules in the genus *Lotus* in that the large stipules as Mr Healy explained are frequently referred to as leaflets, while at the base of the junction of the stem there are also small enations which have the appearance of stipules as well.

Mr Healy—These two large structures at the base of the *Lotus* leaflet stalk are regarded by some botanists as stipules and also regarded by others as leaflets. In the main the formal botanists usually accept them as leaflet-like stipules. The structure here at the leaf stalk in the ordinary clovers is quite distinct and nothing like the shape or size of a leaflet. With *Lotus* spp. you have three leaflets as in the ordinary clover and you have what would be the small stipules, greatly enlarged. It is a moot point, I think. I always regard them as stipules myself, and I think it is in the main, that they are accepted by botanists as stipules. There are some who regard those enlarged stipules as leaflets and then refer to the *Lotus* as a genus, as having a leaf with five leaflets. In this particular paper I have accepted those as stipules and specified that they are large and leaf-like, and that they give the leaf the appearance of having five leaflets, but I have not stated that the leaf has five leaflets.

Mr Boyce—Are there means of identifying the clover-type weeds at the very early stages of up to the first or second trifoliate leaf stage?

Mr Healy—We have not done any work at Botany Division on the seedling stages of *Trifolium*s. There are one or two publications from overseas which do deal with a very limited number of *Trifolium*s and I think there is an article in the "Journal of Agriculture" many years ago dealing with three or four species at the seedling stages. It was one of the things that worried me when I gave this paper. Many people would want to identify clovers in the early stages. I presume probably the early stages of leaves and leaflets may have some characteristics if you had a whole lot together. My difficulty, of course, was that I could not get the set of 40 odd species that I have treated in the paper. I could not get fresh material to give the artist to draw from.

Mr Meeklah—In the genus *Lotus* is the first true leaf simple as is the case in the genus *Trifolium*.

Mr McNeur—The first true leaf is simple as for *Trifolium*s.

Comment:

Mr Matthews—I would like to ask Mr Healy whether in his knowledge any of the lesser known clovers are likely to demand high fertility conditions for growth and become a problem such as barley grass?

Mr Healy—The bur clovers can be troublesome if left to the bur stage, as burs are very abundant and these cling to dogs.