

THE PHYTOGEOGRAPHY OF TARAXACUM, WITH SPECIAL REFERENCE TO EUROPE

by

J. L. VAN SOEST

(Rijksherbarium, Leiden)

(Issued Oct. 2nd, 1958)

1. **Introduction.** The genus *Taraxacum*, lacking in the tropical regions, is widely distributed in the northern hemisphere and only locally found in the southern one. The evolutionary history has been discussed by von Handel-Mazzetti; though this seems to be a speculative business, according to its extrapolative character, his study contains many valuable thoughts. He places the origin of *Taraxacum* in western central Asia, with which I can agree. The density of sections is also greatest here. The genus in evolution expanded to the East, the North and the West; though partly interrupted, the tracks can be more or less reconstructed.

From a morphological point of view, he concluded to the existence of species of lower and higher organization level, the latter also called by him "young" species. Restricting ourselves to the fruit characters, we can list these as follows:

Lower organization	Higher organization
Achenes small, smooth, gradually ending into a cone.	big, spinulate, suddenly ending into a cone.
Rostrum absent or short.	long.
Pappus short, dirty white.	longer, pure white.

The sections of *Taraxacum*, of interest in this study, are:

Glacialia H. M.

Microcephala ined.¹⁾, *Serotina* v. S., *Leptocephala* v. S., *Leucantha* ined.²⁾, together: the *Rhodotricha* H. M.

Scariosa H. M. em. Dahlst., *Obovata* v. S., *Glaucantha* ined.³⁾, together: the *Scariosa* H. M.

Parvula H. M. (sens. str.).

Obliqua Dahlst., *Eu-erythrocarpa* Dahlst., *Erythrosperma* Dahlst. em. Lindb. f., together: the *Erythrocarpa* H. M.

Sections to be published at a later date:

¹⁾ *Microcephala*, containing *T. microcephalum* H. M. p. max. p., *T. oliganthum* Schott et Kotschy, *T. primigenum* H. M. and other species.

²⁾ *Leucantha*, containing *T. leucanthum* Ledebour, *T. dealbatum* H. M. p.p.

³⁾ *Glaucantha*, containing *T. glaucanthum* (Ledebour) DC., *T. monochlamydeum* H. M., *T. wallichii* H. M. p.p. non DC., and other species.

Rhodocarpa v. S., Glabra Dahlst., Pachera v. S., Arctica Dahlst., Ceratophora Dahlst., Spectabilia Dahlst., Boreigena (Dahlst.) Hagl., Vulgaria Dahlst., Palustria Dahlst., Alpina Hagl., Cucullata ined. ⁴), Fontana ined. ⁵); together: the Borealia H. M.

Certainly the Microcephala and the Glacialia belong to the sections of lowest organization level; the Glauantha, the Erythrosperma and the Vulgaria belong to those of highest level.

2. The oldest types of *Taraxacum* occur in **Rhodotricha** H. M., to be split up into four sections. The most primitive one is sect. **Microcephala** (Fig. 1, grey), common in the Orient and having two disjunctions: Barbary and S. Africa (introduced in the latter ?); they are not known for Europe, though a link from the Orient to Barbary might have crossed the north-eastern mediterranean region. The **Leucantha**, having white flowers, radiate from central Asia into arctic Europe (only one locality there). The **Serotina** v. S. (Fig. 2) are widely spread in the pontic and pannonic regions of south-eastern Europe; furthermore a disjunction exists in Iberia and Barbary. According to v. Handel-Mazzetti, before the last glacial period ⁶), a link might have existed, probably north of the Alps. The **Leptocephala** v. S., entering from central Asia into the pontic region, have spread also into the pannonic region (Fig. 1, black); a remarkable endemic station even exists in central France (*T. salsugineum* Lamotte); the main species is *T. bessarabicum* (Hornem.) H. M., which appears to be diploid.

3. The distribution of the **Glacialia** H. M. (Fig. 1, +) differing from the *Microcephala* mainly by a pure white pappus, is restricted to two localities, practically coinciding with the *Microcephala*-link from the Orient to Barbary; there exists only one species: *T. apenninum* Arcangeli, non (Tenore) DC.

4. The supersection **Scariosa** H. M. consists of at least three sections. The **Scariosa** s. str. have followed, from the Orient, a southern track through the mediterranean region in its whole, however, with a richest development in its eastern part (Fig. 3, A). On the contrary the **Obovata** v. S., probably developed from the *Scariosa*, occur only in the western part (Fig. 3, B). The section **Glauantha**, belonging to a "younger" type of *Taraxacum*, is composed of several species in central and W. Asia; it enters Europe into the pontic region (Fig. 3, C), only with *T. glauanthum* (Ledebour) DC.

5. The section **Parvula** H. M., in its narrow sense, is mainly Asian; only one species: *T. dissectum* Ledebour (Fig. 4, X), in local forms, extends as far as the Pyrenees, along a highly interrupted track of relict stations through the Caucasian and Alpine mountains; a more continuous track might have existed long ago, certainly before the last glacial period.

6. From a morphological point of view it seems rational to treat the **Obliqua** Dahlst. next to the *Parvula*, though they are generally treated in connection to the *Erythrocarpa* group. The *Obliqua* (Fig. 4) have a

⁴) Cucullata, f. i. *T. cucullatum* Dahlst., *T. tirolense* Dahlst., *T. cucullatiforme* v. S., and other species.

⁵) Fontana: *T. fontanum* H. M. p. p., to be considered as a macro-species.

⁶) With "last glacial period" I generally mean the Würm period, but I hesitate to give here a too exact fixation in time.



Fig. 1. Black: sect. *Leptocephala v. S.*; gray: sect. *Microcephala*; + sect. *Glacialia H. M.*



Fig. 2. Sect. *Serotina v. S.*; black: *T. serotinum* (W. et Kil.) Poir; horizontal shading: *T. haussknechtii* Uechtr.; vertical shading: *T. pyropappum* Boiss. et Reut.



Fig. 3. A: sect. *Scariosa H. M. em. Dahlst.*; B: sect. *Obovata v. S.*; C: sect. *Glaucantha* (approximate).



Fig. 4. X X: sect. *Parvula s. str.*; *T. dissectum* (Ledebour) Ledebour; drawn area: sect. *Obliqua* Dahlst.

very limited area in western Europe. The generation of this section might have taken place in the postglacial period and the section might have reached the present area from the South-west during the Subboreal period, suitable for these thermophytes.

7. The **Arctica** Dahlst., belonging to a rather primitive type of *Taraxacum*, show relicts outside the arcto-boreal regions (Fig. 5, D): *T. handelii* Murr and *T. reichenbachii* (Huter) Huter occur in a small area in the central Alps; v. Handel-Mazzetti (2) has shown that they must have been present on these localities already during the last glacial period.

The close connection to the *Antarctica* H. M., distributed in the southern hemisphere, is a point of interest; possibly the high mountain chain from N. to S. America has served, long ago, as a link. As far as known, no relicts or relict stations have been left along this track nowadays.

The *Arctica* find their origin in northern central Asia, where allied groups exist; they must have extended their area to the North into the whole arctic region during an interglacial period. A retreat from arctic N. America through the whole mountain chain to S. America surely must have taken place in a glacial time period or probably more than one; the dispersion over the antarctic region must have followed in a next interglacial period. In the meantime the morphological features of this invading group must have changed into what is now called sect. *Antarctica*, probably to be split up in a few, smaller sections.

8. Between the **Glabra** Dahlst. and the **Pachera** v. S. (Fig. 5, B and 5, C) there exists a parallelism; the first is restricted to the arctic region, the second to the high mountains of central and S. Europe; in the last glacial period they probably constituted one section. The *Pachera*, unknown in eastern Europe and in Asia, probably have originated from the *Glabra*, representing an older type and considered as rather primitive; v. Handel-Mazzetti even places this branch of the genealogical tree close to the root of the genus, dating it in the pleiocene time period. The origin of the *Glabra* is central Asia, where they still exist in its northern part.

9. The **Ceratophora** Dahlst. (all tetraploid) are distributed in the circumboreal and arctic region and, more or less like the *Arctica*, still exist as relicts in the alpine regions of Europe and of central Asia (Fig. 5, A). During the last glacial period the area of the section undoubtedly covered a great part of Europe and of northern central Asia, where the *Ceratophora* show relationship with other sections. They may have originated here and have spread over Eurasia and N. America, very probably before the last glacial period.

10. The **Spectabilia** Dahlst. belong to the atlantic flora of western Europe, Iceland and the extreme north-east of America; this suggests that they were already present there before the last glacial period. The characteristic taxa, all occurring in the North-west (Fig. 6, A) are tetraploid; less characteristic ones, allied to the *Vulgaria*, are triploid and differ in geographic distribution. One species: *T. nordstedtii* Dahlst. is hexaploid (the only species known of this kind) and is distributed in the southwestern area (Fig. 6, B); it surely belongs to the youngest type in the section.

11. The **Boreigena** (Dahlst.) Hagl., belonging to the Flora of western N. Europe (Fig. 7, A) and the **Fontana** (Fig. 7, B), distributed in the sub-

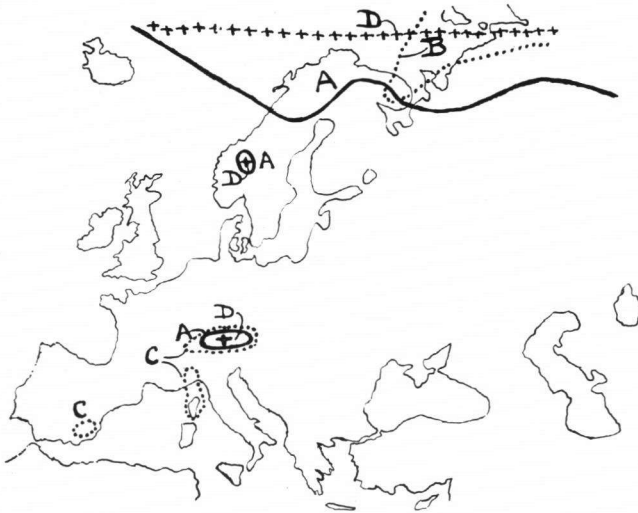


Fig. 5. A: sect. *Ceratophora* Dahlst.; B: sect. *Glabra* Dahlst.; C: sect. *Pachera* v. S.; D: sect. *Arctica* Dahlst. (distribution in Russia only approximate).



Fig. 6. A: sect. *Spectabilia* Dahlst., only typical species;
B: *T. nordstedtii* Dahlst.; C: sect. *Cucullata* v. S.

alpine regions of central and southeastern Europe, are closely allied to the *Vulgaria*; tetraploidy is found in the *Fontana*. During or shortly after the last glacial period they may have constituted together one section; a retreat to the North and to the high mountains may have coincided with a slight, but distinct morphological divergence into two sections. The *Boreigena* and the *Spectabilia* certainly are allied to the *Ceratophora*; the *Fontana* show some relationship with the *Alpina*.

12. The **Alpina** Hagl. are distributed from the high mountains of the Balkans, the Alps and Vosges, the Jura and Corse to the Pyrenees and the high mountains of Iberia; in Asia (Orient and Altai) they are only scarcely found, perhaps only in allied forms? The short rostrum is a more primitive characteristic as the long one, such as in the *Fontana*. The origin of the *Alpina* is uncertain: western or central Asia again?

The **Cucullata** (Fig. 6, C), with straw-coloured flowers, are allied to both foregoing sections.

13. The **Palustria** Dahlst. are only known from Europe, avoiding boreal and subalpine regions. From a phylogenetic point of view they can be considered as a group parallel to the *Vulgaria*, with a slightly older and a little bit relictic character. Tetraploidy is found, triploidy uncertain.

14. The **Vulgaria** Dahlst. are distributed in the whole of Europe, with exclusion of arctic and high alpine regions; they diminish, quantitatively and qualitatively, more or less abruptly to the North, the South (mediterranean region) and the East (western Asia). By human influence species of this section have spread far outside this area. The climate of the last glacial period probably was not very suitable for the existence of *Vulgaria*, at least in central Europe. This section belongs to the youngest of *Taraxacum* and the supposition that the *Vulgaria* have come into being in the recent, postglacial period does not seem too risky. Practically all species of the section are triploid ($2n=24$); Sørensen and Gudjónsson (3) have recorded mutations with $2n=21, 22, 23$ and 48 , forms that can be distinguished as slight variations of the main species concerned. The *Vulgaria* certainly are still in effective evolution. They are closely allied to the *Boreigena*; probably both originated from the *Spectabilia* or the *Ceratophora*.

15. The section **Erythrosperma** Dahlst. em. Lindb.f. is mostly European, but it is also found in the Orient up to Persia. In the thermo- and xerophytic localities often many species occur together, with a highest density in the atlantic region in its broad sense; fig. 8 (A) represents the area, covering four or more specific areas; five specific areas are sketched in the same figure (B—F). Most of the *Erythrosperma* are triploid; a few, less typical, are tetraploid. The section belongs to the youngest type of *Taraxacum*; the extension of the *Erythrosperma* must have taken place in the subboreal period, mostly along the great rivertracks in central Europe and along the mediterranean-atlantic one. Probably the *Erythrosperma* can be deduced from the *Eu-Erythrocarpa* Dahlst., having their root in western central Asia; several species, existing in the Orient, are not yet described; from here this section radiates, in a few species, to south-western Europe.

16. The section **Rhodocarpa** v. S., mainly represented by one species



Fig. 7. A: sect. *Boreigena* (Dahlst.) Hagl., area in Russia insufficiently well known;
 B: sect. *Fontana* v. S., area in Balkans not yet certain.



Fig. 8. A: sect. *Erythrosperma* Dahlst. em. Lindb. f.: 4 or more species together;
 B: *T. friesii* Dahlst.; C: *T. agauron* v. S.; D: *T. silesiacum* Dahlst.;
 E: *T. decipiens* Dahlst.; F: *T. gasparrinii* Tinéo.

(*T. schroeterianum* H. M.), is rather common in the Alps; it has no clear relictic character, as is mentioned by v. Handel-Mazzetti. Its relation to other red-fruited groups (such as 4, p.p. and 15, p. max. p.) is obscure.

17. Since v. Handel-Mazzetti's treatise in 1907, information on the chromosome behaviour has been published (4, 5); as far as known, diploid *Taraxaca* correspond to his "primitive" forms. Tetraploidy is mostly recorded in those sections (such as the *Ceratophora* and the *Spectabilia*) belonging to a medium evolutionary type; their existence in Europe, during the Würm glacial period is doubtless. Especially in Europe, triploidy in *Taraxacum* is very common; this is only recorded in the "youngest" sections, such as the *Vulgaria* and the *Erythrosperma*, which might have come into existence after that period. Pentaploidy is found in the "young" section *Spuria* DC. (Orient), hexaploidy in *T. nordstedtii* (*Spectabilia*). Combining morphological, cytological and geographical facts one is led to the suggestion that the genealogic evolution in *Taraxacum* took place from diploidy to tetraploidy and afterwards to other compositions; all non diploid *Taraxaca* are apomictic.

This study, short as it is, is plenty open for critics and lacks sufficient reasoning; it indicates the need for further investigations in taxonomical, genetical and geographical respect.

Literature

1. H. VON HANDEL-MAZZETTI, Monographie der Gattung *Taraxacum*, 1907.
 2. —, in Verhand. Zool.-Bot. Ges. Wien 85 (1935) 26—41.
 3. TH. SØRENSEN & G. GUDJÓNSSON, in K. Dansk Vid. Selsk., Biol. Skr. IV. 2 (1946).
 4. A. GUSTAFSSON, in Hereditas 21 (1935/36) 1.
 5. DARLINGTON & JANAKI, Chromosome Atlas of cultivated plants, 1946.
- Furthermore:
- H. DAHLSTEDT, in Ark. f. Bot. 4. 8 (1905); Acta Hort. Berg. 4. 2 (1907); Ark. f. Bot. 6. 12 (1907); Acta Fl. Sue. 1 (1921); Ark. f. Bot. 20 A. 1 (1925); K. Sv. Vet. Ak. Handl. 3e s., 9. 2 (1930); Acta Hort. Berg. 9. 1 (1929); a.s.o.
- G. E. HAGLUND, in Nytt Mag. Naturv. 8 A (1941); Ber. Schweiz. Bot. G. 60 (1950).
- J. L. VAN SOEST, in Collect. Bot. 4 (1954), Vegetatio 5/6 (1954).