**Zeitschrift:** Candollea : journal international de botanique systématique = international journal of systematic botany
**Herausgeber:** Conservatoire et Jardin botaniques de la Ville de Genève
**Band:** 50 (1995)
**Heft:** 2

**Artikel:** Cytological data of Albanian plants
**Autor:** Baltisberger, Matthias / Baltisberger, Esther
**DOI:** https://doi.org/10.5169/seals-879478

# Cytological data of Albanian plants

MATTHIAS BALTISBERGER
&
ESTHER BALTISBERGER

RÉSUMÉ

BALTISBERGER, M. & E. BALTISBERGER (1995). Données cytologiques de plantes albanaises. *Candollea* 50: 457-493. En anglais, résumés français et anglais.

Les nombres chromosomiques de 69 espèces d'Angiospermes d'Albanie ont été déterminés. Les nombres pour *Cerinthe auriculata* ($2n = 18$), *Onosma mattirolii* ($2n = 14$) et *Petrorhagia obcordata* ($2n = 30$) sont nouveaux; pour *Achillea chrysocoma* ($2n = 8x = 72$), *Achillea neilreichii* ($2n = 2x = 18$) et *Geranium macrorrhizum* ($2n = 4x = 92$) de nouveaux niveaux de ploïdie sont rapportés. En outre, les nombres de 44 espèces sont mentionnés pour la première fois pour l'Albanie. Des chromosomes B ont été trouvés ds *Allium flavum* ($2n = 16 + 1B$) et *Onosma helvetica* ($2n = 26 + 2B$). Les karyotypes d'*Achillea, Allium, Festucopsis, Lilium, Nigella, Orlaya, Ranunculus* et *Torilis* sont discutés. Les références complètes des dénombrements précédemment publiés sont ajoutés. Les aspects taxonomiques et phytogéographiques de certaines espèces sont commentés.

ABSTRACT

BALTISBERGER, M. & E. BALTISBERGER (1995). Cytological data of Albanian plants. *Candollea* 50: 457-493. In English, French and English abstracts.

The chromosome numbers are reported for 69 species of Angiosperms from Albania. The numbers for *Cerinthe auriculata* ($2n = 18$), *Onosma mattirolii* ($2n = 14$) and *Petrorhagia obcordata* ($2n = 30$) are recorded for the first time. New ploidy levels are given for *Achillea chrysocoma* ($2n = 8x = 72$), *Achillea neilreichii* ($2n = 2x = 18$) and *Geranium macrorrhizum* ($2n = 4x = 92$). The numbers of 44 species are recorded for the first time from Albanian material. B-chromosomes were found in *Allium flavum* ($2n = 16 + 1B$) and *Onosma helvetica* ($2n = 26 + 2B$). Karyotypes are discussed for *Achillea, Allium, Festucopsis, Lilium, Nigella, Orlaya, Ranunculus* and *Torilis*. Full references to previous indications are given. Taxonomic and phytogeographical aspects of some species are discussed.

*KEY-WORDS:* Albania — Angiosperms — Chromosome numbers — Karyotypes.

In eastern Europe dramatic political changes took place during the last few years. In Albania, too, nothing is now like it was before. In earlier times it was very difficult to make botanical excursions in Albania; the only way was to ask for an invitation, but the Academy of Sciences, which represented the state concerning scientific contacts abroad, was not allowed to bring many people into the country. Once in Albania, everything was organized by officials: transportation, food, collecting materials, contacts with scientists, accompaning people on excursions, etc. Now it is no problem to enter Albania. Visas are sold at every port of entrance, at the airport, harbours and road borders. The problems start inside the country because the infrastructure which had been maintained by the communist system has completely collapsed. Almost nothing seems to function at the moment.

CODEN: CNDLAR
ISSN: 0373-2967
50(2) 457 (1995)

We have been on botanical excursions to Albania for several years in a row, twice during the communist regime in 1982 and 1989 (BALTISBERGER & LENHERR, 1984; BALTISBERGER, 1991a), and again in 1991 after the tremendous changes of 1990/91 (BALTISBERGER, 1992). Since then we have made several visits for personal and humanitarian reasons. Herbarium specimens, living plants and seeds were sampled on the three botanical excursions and on a stay in summer 1993, when we visited the Prespa and Ohrid lakes and went on two one-day excursions to Mali i Thatë (SE of Pogradec) and Mali i Gramosit (on the border with Greece, E of Erseka).

Most plants were collected for current biosystematic research projects in the genera *Betonica, Stachys* (Labiatae) and *Ranunculus* (Ranunculaceae), but some species of other families or genera were sampled as well. The living or seedborn plants were cultivated in the greenhouse of our institute. Since very little cytological data from Albanian plants exist, cytological investigations were carried out, and the results are presented here.

Families are arranged in alphabetical order, genera in alphabetical order within families and species in alphabetical order within genera. Nomenclature usually corresponds to "Flora Europaea". The taxa given in "Flora Europaea" as subspecies are treated here mostly as species (as e.g. in EHRENDORFER, 1973). After the indications of the site (localization of the respective site, see Fig. 1), altitude, date and number of herbarium specimen (in parenthesis specimen number of cultivated plants) are listed. Specimens are deposited at Z-ZT.

## Methods

All cytological investigations were done on root tips. These were pretreated with colchicine (0.05%) for 1/2 to 2 hours, then fixed in ethanol/acetic acid (3:1), and stained and squashed in lacto-propionic orcein (DYER, 1963). For the determination of the chromosome number, 5-10 metaphases were counted out of each individual, and if possible several individuals of each species were investigated (for the number of investigated individuals see Tab. 1). In some groups (e.g. *Achillea* and *Ranunculus*) karyotypes are discussed using the terminology for chromosomes proposed by LEVAN & al. (1964) who group the chromosomes according to the position of the centromers. This is expressed in the arm ratio, "long arm to short arm":

| | | |
|---|---|---|
| metacentric | arm ratio | 1.0-1.7 |
| submetacentric | arm ratio | 1.7-3.0 |
| subtelocentric | arm ratio | 3.0-7.0 |
| acrocentric | arm ratio | more than 7.0 |
| telocentric | | only one arm |

## *Boraginaceae*

**Cerinthe auriculata** Ten. (= *C. minor* L. subsp. *auriculata* (Ten.) Domac) ($2n = 18$).

Rocky slope, Mali i Melesinit, W of Leskoviku, district Kolonja, 900-1000 m, 4.8.1989 (cult. No. *12393*).

*C. auriculata* belongs to the complex of *C. minor* which is rather variable (DOMAC, 1972). *C. auriculata* grows in southern Europe, its chromosome number was previously unknown. With $2n = 18$ (Fig. 2A) it corresponds with most indications for *C. minor* (compilations see MOORE, 1973, 1974, 1977; FEDEROV, 1974; GOLDBLATT, 1984).


Fig. 1. — Map of Albania.

Table 1. — Alphabetical list of investigated species.
* First record; # new ploidy level; △ first record for Albania; L living plants; S seeds; B bulbs.

| Species | Voucher number | Collected material | Indiv. investigated | 2*n* |
|---|---|---|---|---|
| *Achillea abrotanoides* | 12813 | L | 6 | 18 |
| *Achillea chrysocoma* | 12917 | L | 14 | 72#△ |
| *Achillea coarctata* | 12819 | L | 15 | 18△ |
| *Achillea crithmifolia* | 12910 | L | 8 | 18△ |
| *Achillea fraasii* | 12916 | L | 12 | 18 |
| *Achillea neilreichii* | 12808 | L | 7 | 18#△ |
| *Aethionema saxatile* | 11914 | S | 9 | 48△ |
| *Ajuga chamaepitys* | 11916 | S | 1 | 28△ |
| *Allium flavum* | 12826 | B | 4 | 16+1B△ |
| *Allium moschatum* | 12825 | B | 9 | 16△ |
| *Alyssum alyssoides* | 12068 | S | 3 | 32△ |
| *Anthemis carpatica* | 12812 | L | 5 | 36 |
| *Asperula arvensis* | 12031 | S | 6 | 22△ |
| *Aurinia corymbosa* | 12084 | S | 9 | 16△ |
| *Betonica scardica* | 12479 | L | 7 | 16 |
| *Bupleurum veronense* | 11965 | S | 7 | 16△ |
| *Caucalis platycarpos* | 11960 | S | 2 | 20△ |
| *Caucalis platycarpos* | 12057 | S | 5 | 20 |
| *Cerinthe auriculata* | 12393 | S | 12 | 18* |
| *Euphorbia falcata* | 11959 | S | 9 | 36△ |
| *Euphorbia myrsinites* | 12388 | S | 9 | 20△ |
| *Festucopsis serpentini* | 12476 | S | 9 | 14 |
| *Galium tricornutum* | 12033 | S | 2 | 44△ |
| *Geranium macrorrhizum* | 11921 | S | 8 | 92# |
| *Lamium longiflorum* | 12985 | L | 4 | 18△ |
| *Lilium albanicum* | 12451 | B | 3 | 24△ |
| *Linaria peloponnesiaca* | 12186 | S | 11 | 12 |
| *Marrubium peregrinum* | 12806 | S | 2 | 32△ |
| *Marrubium thessalum* | 12821 | L | 8 | 20△ |
| *Marrubium vulgare* | 12805 | S | 3 | 34 |
| *Medicago prostrata* | 11969 | S | 9 | 16△ |
| *Moltkia petraea* | 12379 | S | 8 | 16△ |
| *Moltkia petraea* | 12384 | S | 5 | 16 |
| *Nigella damascena* | 12091 | S | 8 | 12 |
| *Nigella damascena* | 12115 | S | 9 | 12 |
| *Onosma helvetica* | 11926 | S | 5 | 26+2B△ |
| *Onosma mattirolii* | 12154 | L | 3 | 14* |
| *Orlaya daucorlaya* | 12067 | S | 9 | 14 |
| *Orlaya daucorlaya* | 12110 | S | 9 | 14 |
| *Orlaya grandiflora* | 12096 | S | 9 | 20△ |
| *Petrorhagia obcordata* | 12063 | S | 9 | 30* |
| *Potentilla speciosa* | 11940 | S | 6 | 14△ |
| *Potentilla speciosa* | 12824 | L | 6 | 14 |
| *Psoralea bituminosa* | 12090 | S | 6 | 20△ |
| *Pterocephalus bellidifolius* | 11945 | S | 5 | 18△ |
| *Ranunculus acris* | 12565 | S | 6 | 14△ |
| *Ranunculus arvensis* | 11909 | L | 9 | 32△ |
| *Ranunculus brevifolius* | 11948 | L | 9 | 16△ |
| *Ranunculus bulbosus* | 12054 | L | 3 | 16△ |
| *Ranunculus marginatus* | 11911 | S | 9 | 16 |
| *Ranunculus nemorosus* | 11907 | L | 6 | 16△ |
| *Ranunculus repens* | 12047 | L | 7 | 32△ |
| *Ranunculus serbicus* | 11908 | L | 7 | 28△ |
| *Salvia officinalis* | 12382 | S | 5 | 14△ |
| *Salvia officinalis* | 12386 | S | 1 | 14 |
| *Salvia officinalis* | 12387 | S | 9 | 14 |
| *Salvia verbenaca* | 12796 | S | 14 | 56△ |
| *Saxifraga adscendens* | 12464 | S | 1 | 22△ |
| *Saxifraga rotundifolia* | 12041 | L | 2 | 22△ |
| *Scabiosa crenata* | 11912 | S | 3 | 18△ |
| *Scabiosa crenata* | 12830 | L | 9 | 18 |
| *Scabiosa tenuis* | 11917 | S | 7 | 16 |

Table 1. — (cont.).

| Species | Voucher number | Collected material | Indiv. investigated | 2*n* |
|---|---|---|---|---|
| *Scabiosa tenuis* | 12167 | S | 9 | 16 |
| *Scabiosa tenuis* | 12168 | S | 9 | 16 |
| *Scabiosa triniifolia* | 12358 | S | 4 | 16△ |
| *Sideritis roeseri* | 12809 | L | 9 | 32 |
| *Sideritis roeseri* | 12822 | L | 7 | 32 |
| *Silene conica* | 12029 | S | 9 | 20 |
| *Silene conica* | 12151 | S | 8 | 20 |
| *Silene marginata* | 12814 | L | 7 | 24△ |
| *Silene otites* | 12385 | S | 4 | 24△ |
| *Silene vulgaris* | 12125 | S | 2 | 24 |
| *Stachys cretica* | 12392 | S | 2 | 30 |
| *Stachys germanica* | 12394 | S | 4 | 30 |
| *Stachys germanica* | 12811 | L | 6 | 30 |
| *Stachys salviifolia* | 12532 | S | 8 | 30 |
| *Teucrium chamaedrys* | 12911 | L | 5 | 62△ |
| *Teucrium chamaedrys* | 12915 | L | 6 | 62 |
| *Tordylium maximum* | 12189 | S | 7 | 20 |
| *Torilis arvensis* | 12095 | S | 9 | 12 |
| *Torilis arvensis* | 12107 | S | 9 | 12 |
| *Torilis arvensis* | 12169 | S | 9 | 12 |
| *Torilis arvensis* | 12341 | S | 4 | 12 |
| *Tremastelma palaestinum* | 12120 | S | 9 | 14 |
| *Trifolium arvense* | 11931 | S | 9 | 14 |
| *Vaccaria pyramidata* | 11958 | S | 9 | 30△ |
| *Vaccaria pyramidata* | 12032 | S | 6 | 30 |

**Moltkia petraea** (Tratt.) Griseb. ($2n = 18$).

Rocks near Raps, 35 km N of Shkodër, district Shkodër, 400-450 m, 13.8.1989 (cult. No. *12379*). Rocky slope, Mali i Melesinit, W of Leskoviku, district Kolonja, 900-1000 m, 4.8.1989 (cult. No. *12379*).

*M. petraea* is a Balkan endemic which is sometimes cultivated for ornament. The chromosome number, $2n = 16$, is the first record for Albanian plants and confirms the earlier indications of STREY (1931), BRITTON (1951), GRAU (1966) and LOVKA & al. (1972).

**Onosma helvetica** Boiss. (det. H. Teppner, Graz, Austria) ($2n = 26 + 2B$).

Rocky slope, NW of Mali i Çajupit, Mali i Lunxhërisë, 12 km NNE of Gjirokstra, district Gjirokastra, 1400-1450 m, 5.8.1989, No. *11926*.

*O. helvetica* occurs in the Alps, in Italy and on the Balkan Peninsula southwards to Mt. Stroungoula (Tsoumerka massif, central Greece, TEPPNER, 1991a). This is the first chromosome record for Albanian plants, all metaphases of all five plants investigated showed 28 chromosomes (Fig. 2B). According to TEPPNER (1971a, b), *O. helvetica* is an allotetraploid species with $2n = 26$ (12 large chromosomes from one parent and 14 small chromosomes from the other). The observed chromosome set of the Albanian plants must therefore be interpreted as follows: the 12 large chromosomes are of the *O. setosa* type, the 14 small chromosomes belong to the *O. echioides* type and the two smallest chromosomes are B-chromosomes. Additional chromosomes like this are not rare in *Onosma* (TEPPNER, 1971a, b; 1991a, b), but often vary within populations. This does not seem to be the case here, every metaphase having $2n = 26 + 2B$ chromosomes.

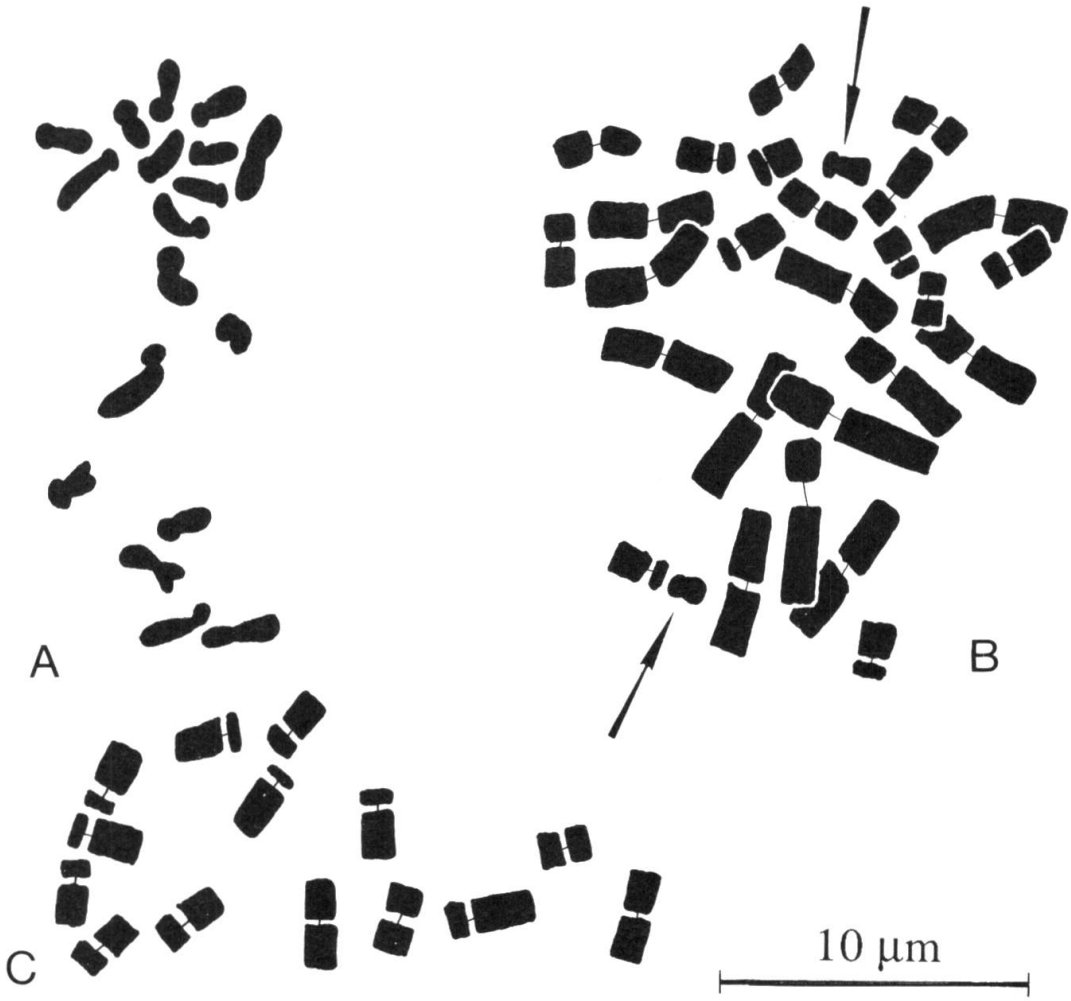


Fig. 2. — Somatic metaphases. **A,** *Cerinthe auriculata* (2*n* = 18); **B,** *Onosma helvetica* (2*n* = 26 + 2B; B-chromosomes arrowed); **C,** *Onosma mattirolii* (2*n* = 14).

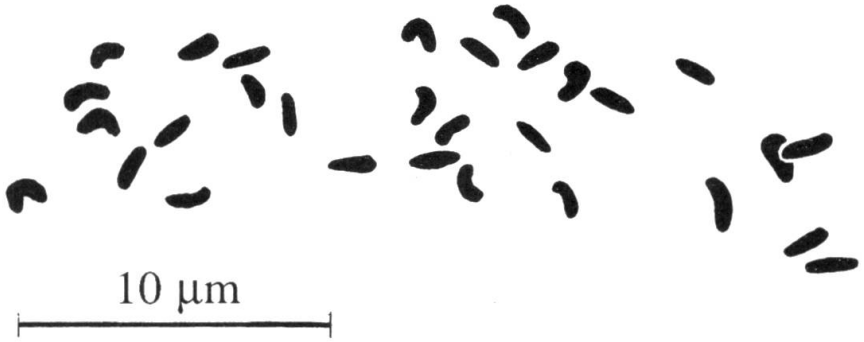


Fig. 3. — Somatic metaphase of *Petrorhagia obcordata* (2*n* = 30).

**Onosma mattirolii** Bald. (det. H. Teppner, Graz, Austria) ($2n = 14$).

Slope on E-side of Mali i Tomorit, W of Gjerbës, 20 km ESE of Berat, district Skrapar, 1900 m, 10.8.1989 (cult. No. *12154*);

*O. mattirolii* is an endemic species of central Albania, the reports in "Flora Europaea" from northwest Greece (BALL, 1972a) probably refer to *O. pygmaea* Riedl (TEPPNER, 1991a). The chromosome number of *O. mattirolii* was previously unknown. With its 14 chromosomes (Fig. 2C), *O. mattirolii* is a diploid species. The chromosomes are rather small; this and the number $2n = 14$ suggest that they probably represent the *O. echioides* type. Further investigations will be carried out by Teppner (Graz, Austria).

## *Caryophyllaceae*

**Petrorhagia obcordata** (Marg. & Reut.) Greuter & Burdet ($2n = 30$).

Rocky meadow, Livadhet-e-Dajtit, W-side of Mali i Dajtit, 10 km E of Tirana, district Tirana, 1050 m, 16.8.1989 (cult. No. *12063*).

*P. obcordata* belongs to a group of annual species (sect. *Kohlrauschia*) which was recently investigated (THOMAS & MURRAY, 1981, 1983; THOMAS, 1983). *P. obcordata* is a Balkan endemic (Greece and southern Jugoslavia [probably only Macedonia]) while the very closely related *P. glumacea* (Chaub & Bory) P. W. Ball & Heywood occurs only on Peloponnisos (THOMAS, 1983). The seeds of the Albanian plants are more or less flat, 1.3-1.6 mm long, and 0.9-1.1 mm wide, indicating that they belong to *P. obcordata*. Therefore, Albania should be counted to the distribution area of this species. The chromosome number of *P. obcordata* was previously unknown; with its $2n = 30$ chromosomes (Fig. 3) it corresponds to *P. glumacea*. The distribution patterns of the two species suggest that the chromosome number, $2n = 30$, given for *P. glumacea* in STRID & FRANZEN (1981, Mount Olymp) and FRANZEN & GUSTAVSSON (1983, Karpenision) may be probably transferred to *P. obcordata*.

**Silene conica** L. ($2n = 20$).

Rocky place between Bukova and Barmashi, on the road from Erseka to Leskoviku, district Kolonja, 850 m, 4.8.1989 (cult. No. *12151*). Rocky slope, NW of Mali i Çajupit, Mali i Lunxhërisë, 12 km NNE of Gjirokastra, district Gjirokastra, 1400-1450 m, 5.8.1989 (cult. No. *12079*).

*S. conica* is an annual and rather variable species, three subspecies are recognized (CHATER & al., 1993): subsp. *sartorii* (Boiss. & Heldr.) Chater & Walters is endemic in the southern part of the Aegean region, the other two may occur in Albania. Subsp. *conica* (calyx 8-15 mm, carpophore less than 1 mm) is widespread in central and southern Europe, subsp. *subconica* (Friv.) Gavioli (calyx 13-18 mm, carpophore 1-4 mm) occurs in southeastern Europe. The calyces of the Albanian plants measure 14-16 mm and the carpophores about 1 mm; they are therefore not clearly referable to one of the subspecies. As an additional character, MELZHEIMER (1986) indicates that subsp. *subconica* is distinguished from subsp. *conica* by its glandular pubescence, but plants of both sites have only few glandular hairs.

*S. conica* belongs to sect. *Conomorpha* which is clearly separated by its basic chromosome number of $x = 10$, whereas $x = 12$ is the common basic number of the other sections within *Silene*. Numerous counts of $2n = 20$ for *S. conica* have been published (compilations see MOORE, 1973, 1977; FEDEROV, 1974; LÖVE & LÖVE, 1974; GOLDBLATT, 1981, 1984, 1985; VAN LOON, 1987; GOLDBLATT & JOHNSON, 1994), the same number was found in the Albanian plants.

**Silene marginata** Kit. (= *S. vulgaris* (Moench) Garcke subsp. *marginata* (Kit) Hayek) ($2n = 24$).

Silicious scree, SE of top of Mali i Gramosit, E of Erseka, district Kolonja (at the border to Greece), 2200-2250 m, 12.8.1993, No. *12814* (cult. No. *12922*).

*S. marginata* belongs to the group of *S. vulgaris*. Although it is often treated as a synonym of *S. prostrata* Gaudin (= *S. vulgaris* subsp. *prostrata* [Gaudin] Schinz & Tellung, = *S. uniflora* Roth subsp. *prostrata* [Gaudin] Chater & Walters) (GREUTER & al., 1984; STRID, 1986a; CHATER & al., 1993) it is nevertheless well separated by morphological features and is geographically isolated (Abruzzi Mountains and Balkan Peninsula; AESCHIMANN, 1984). The chromosome number, $2n = 24$, found in the Albanian plants is the first record for this country and confirms earlier indications (compilation and comments see BALTISBERGER & AESCHIMANN, 1988).

**Silene otites** (L.) Wibel ($2n = 24$).

Rocks near Raps, 35 km N of Shkodër, district Shkodër, 400-450 m, 13.8.1989 (cult. No. *12385*).

The group of *S. otites* comprises 6 species, most of them very variable (WRIGLEY, 1986). The Albanian plants mostly correspond with *S. otites* which is the only taxa of this group indicated for Albania in JALAS & SUOMINEN (1986). All taxa of the group show the same chromosome number, $2n = 24$ (compilation of the numerous counts see MOORE, 1973, 1974, 1977; FEDEROV, 1974; LÖVE & LÖVE, 1974; GOLDBLATT, 1981, 1984, 1985, 1988). With $2n = 24$, this first record for Albanian plants confirms these counts.

**Silene vulgaris** (Moench) Garcke ($2n = 24$).

Voskopoja, 15 km W of Korça, 1200 m, 3.8.1989 (cult. No. *12125*);

The chromosome number of this widespread and extremely variable species is $2n = 24$ (compilation of the numerous indications see BALTISBERGER & AESCHIMANN, 1988) as found in the Albanian plants.

**Vaccaria pyramidata** Med. ($2n = 30$).

Weed in cultivated field, near Gjerbës, E of Mali i Tomorit, 25 km ESE of Berat, district Skrapar, 1250 m, 10.8.1989, No. *11958* (cult. No. *12034*). Weed in cultivated field, Voskopoja, 15 km W of Korça, district Korça, 1200 m, 3.8.1989 (cult. No. *12032*).

*V. pyramidata* is of Mediterranean origin, but as a weed also elsewhere. The chromosome number $2n = 30$ of the Albanian plants is the first record for Albania and confirms the numerous indications in literature (compilations see LÖVE & LÖVE, 1974; GOLDBLATT, 1981, 1984, 1988; GOLDBLATT & JOHNSON, 1990, 1991; SLAVIK & al., 1993). In root tips of the plants from Gjerbës (No. *11958*), cells with 60 chromosomes could often be observed, the same was communicated by FAVARGER (1946) in plants from Switzerland. Endomitosis seems therefore frequent in some populations.

## *Compositae*

**Achillea abrotanoides** (Vis.) Vis. ($2n = 18$).

Rocky slope, W-side of Mali i Gramosit, E of Erseka, district Kolonja, 1950-2000 m, 12.8.1993, No. *12813* (cult. No. *12983*).

*A. abrotanoides* grows in the mountains of the west Balkan Peninsula. The chromosome number of the Albanian plants is $2n = 18$ as indicated in literature (compilation see BALTISBERGER, 1993a). The karyotype consists of 14 metacentric and 4 submeta- to subtelocentric chromosomes, the latter 4 with satellites (Fig. 5A). The same karyotype for *A. abrotanoides* (and other *Achilleae*) has been published earlier (karyotypes and comments see BALTISBERGER, 1993a).

**Achillea chrysocoma** Friv. ($2n = 72$).

Calcareous rocks, W-side of Mali i Thatë, NE of Bletas, 15 km ESE of Pogradec, district Pogradec, 1650-1750 m, 16.8.1993 (cult. No. *12917*).

*A. chrysocoma* is a mountain species of the southern Balkan Peninsula. There is only one indication in literature; with the chromosome number of $2n = 6x = 54$, the plants from Korab and Sar Planina (both former Jugoslavia) are hexaploid (BALTISBERGER, 1992). The plants from Mali i Thatë (Albania) have $2n = 8x = 72$ chromosomes and thus are octoploid, a new ploidy level for *A. chrysocoma* (Fig. 4). 56 chromosomes are metacentric, and 16 are submeta- to subtelocentric with satellites (not all satellites are always visible). The plants from Jugoslavia have the same karyotype (on another ploidy level) (BALTISBERGER, 1992).

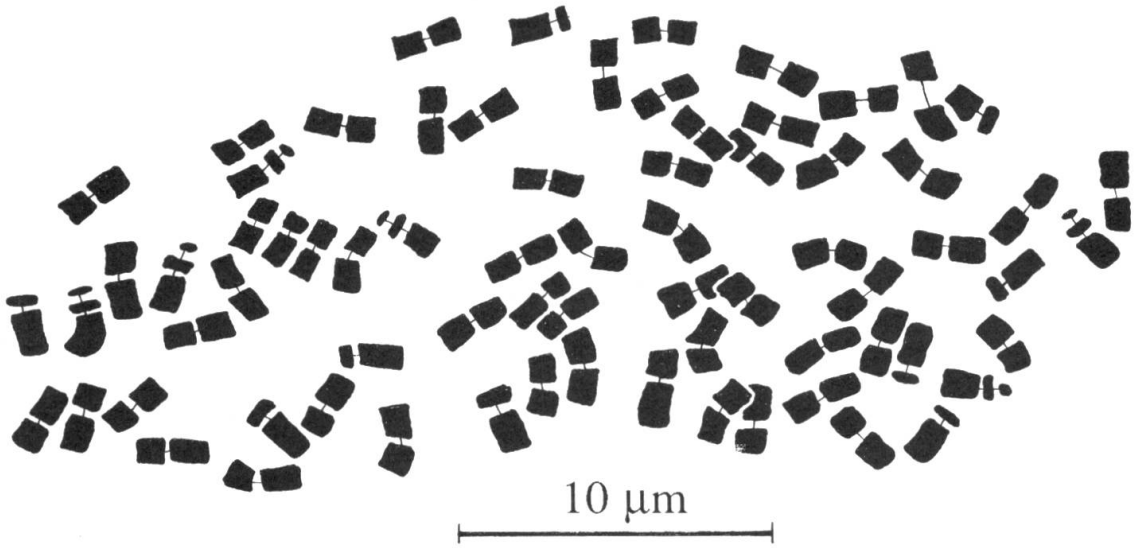


Fig. 4. — Somatic metaphase of *Achillea chrysocoma* ($2n = 8x = 72$).

**Achillea coarctata** Poir. ($2n = 18$).

Roadside at km 22, on the road from Korça to Erseka, district Kolonja, 1200 m, 12.8.1993, No. *12819* (cult. No. *12921*).

*A. coarctata* occurs in southeast Europe and southwest Asia. In literature two ploidy levels are given: $2n = 2x = 18$ (EHRENDORFER, 1959; SZ.-BORSOS, 1970) and $2n = 4x = 36$ (KUZMANOV & KOZUHAROV, 1970, 1973; in both papers the number of the same plants is reported). This is the first record for Albanian plants, they have 18 chromosomes and are diploid.

The karyotype of *A. coarctata* shows 7 pairs of metacentric and 2 pairs of submeta- to subtelocentric chromosomes (Fig. 5B), the latter bear satellites but not all four satellites can always be seen. This karyotype corresponds to that of other *Achillea* species (partly on higher ploidy levels), as e.g. to the related *A. clypeolata* (BALTISBERGER, 1993a), but also to unrelated species as e.g. *A. abrotanoides* (see above), *A. chrysocoma* Friv., and *A. distans* Waldst. & Kit. (BALTISBERGER, 1992), or *A. umbellata* Sibth. & Sm. (TZANOUDAKIS & IATROU, 1981).

**Achillea crithmifolia** Waldst. & Kit. ($2n = 18$).

Rocky slope near Gollomboç at Lake Prespa, 30 km NNE of Korça, district Korça, 860-900 m, 11.8.1993 (cult. No. *12910*).

*A. crithmifolia* occurs in Czechoslowakia, Hungary and Romania southwards to Greece and Turkey in Europe. Two ploidy levels are given in literature, $2n = 2x = 18$ and $2n = 4x = 36$ (compilation see BALTISBERGER, 1994); one single triploid plant, with $2n = 3x = 27$, has been published by EHRENDORFER (1959). This is the first record for Albanian plants, they are diploid with $2n = 2x = 18$ chromosomes. The karyotype consists of 14 metacentric and 4 submeta- to subtelocentric chromosomes, the latter 4 with satellites (Fig. 5C). This karyotype corresponds to that of *A. crithmifolia* from Greece (BALTISBERGER, 1994) and of other *Achillea* species (see above).

**Achillea fraasii** Schultz Bip. ($2n = 18$).

Calcareous rocks, W-side of Mali i Thatë, NE of Bletas, 15 km ESE of Pogradec, district Pogradec, 1650-1750 m, 16.8.1993 (cult. No. *12916*).

*A. fraasii* grows on stony grounds and rocks on limestone in the western part of the Balkan Peninsula (Montenegro, Macedonia, Albania, Greece, one site in Turkey; FRANZEN, 1991a; HUBER-MORATH, 1975). The chromosome number $2n = 2x = 18$ of the Albanian plants corresponds with the indications in literature (CONTANDRIOPOULOS & MARTIN, 1967; FRANZEN, 1986a; all material from Greece), but tetraploid plants also exist (BALTISBERGER, 1993a; plants from Albania). The karyotype consists of 14 metacentric and 4 submeta- to subtelocentric, satellited chromosomes (Fig. 5D). This corresponds (on another ploidy level) to the karyotype of tetraploid *A. fraasii* (BALTISBERGER, 1993a) and even with other unrelated *Achillea* species (see above).

**Achillea neilreichii** A. Kerner (= *A. nobilis* L. subsp. *neilreichii* (A. Kerner) Velen.) ($2n = 18$).

Stony slope above Rehovë, on the path from Erseka to Mali i Gramosit, district Kolonja, 1250-1300 m, 12.8.1993; No. *12808* (cult. No. *12924*).

*A. neilreichii* is a taxon of East Central Europe and the Balkan Peninsula. Its status is uncertain, it is very closely related to or even probably indistinguishable from *A. nobilis* (FRANZEN, 1991a). Only one indication of the chromosome number of *A. neireichii* exists, with $2n = 5x = 45$ (ZABORSKY in MAJOVSKI & al., 1970; material from Czechoslowakia). The plants from Albania are diploid with $2n = 18$. This corresponds with most of the numerous indications for *A. nobilis* (compilations see MOORE, 1973; GOLDBLATT, 1984, 1985; GOLDBLATT & JOHNSON, 1990, 1991; HUBER & BALTISBERGER, 1992). As in other species of the genus *Achillea* (see above), the karyotype consists of 14 metacentric and 4 submeta- to subtelocentric, satellited chromosomes (Fig. 5E).

**Anthemis carpatica** Willd. (= *A. cretica* L. subsp. *carpatica* (Willd.) Grierson) ($2n = 36$).

Rocky slope, W-side of Mali i Gramosit, E of Erseka, district Kolonja, 1900 m, 12.8.1993, No *12812* (cult. No. *12923*);

*A. carpatica* belongs to *A. cretica* s.l. (FRANZEN, 1986b) which is a polymorphic group in mountains of southern and central Europe and southwest Asia (FRANZEN, 1991b). *A. carpatica* grows from the Pyrenees eastwards to the Carpathians, including the Balkan Peninsula. With $2n = 4x = 36$, the Albanian plants are tetraploid and confirm the indications in literature (compilation see BALTISBERGER, 1993a).

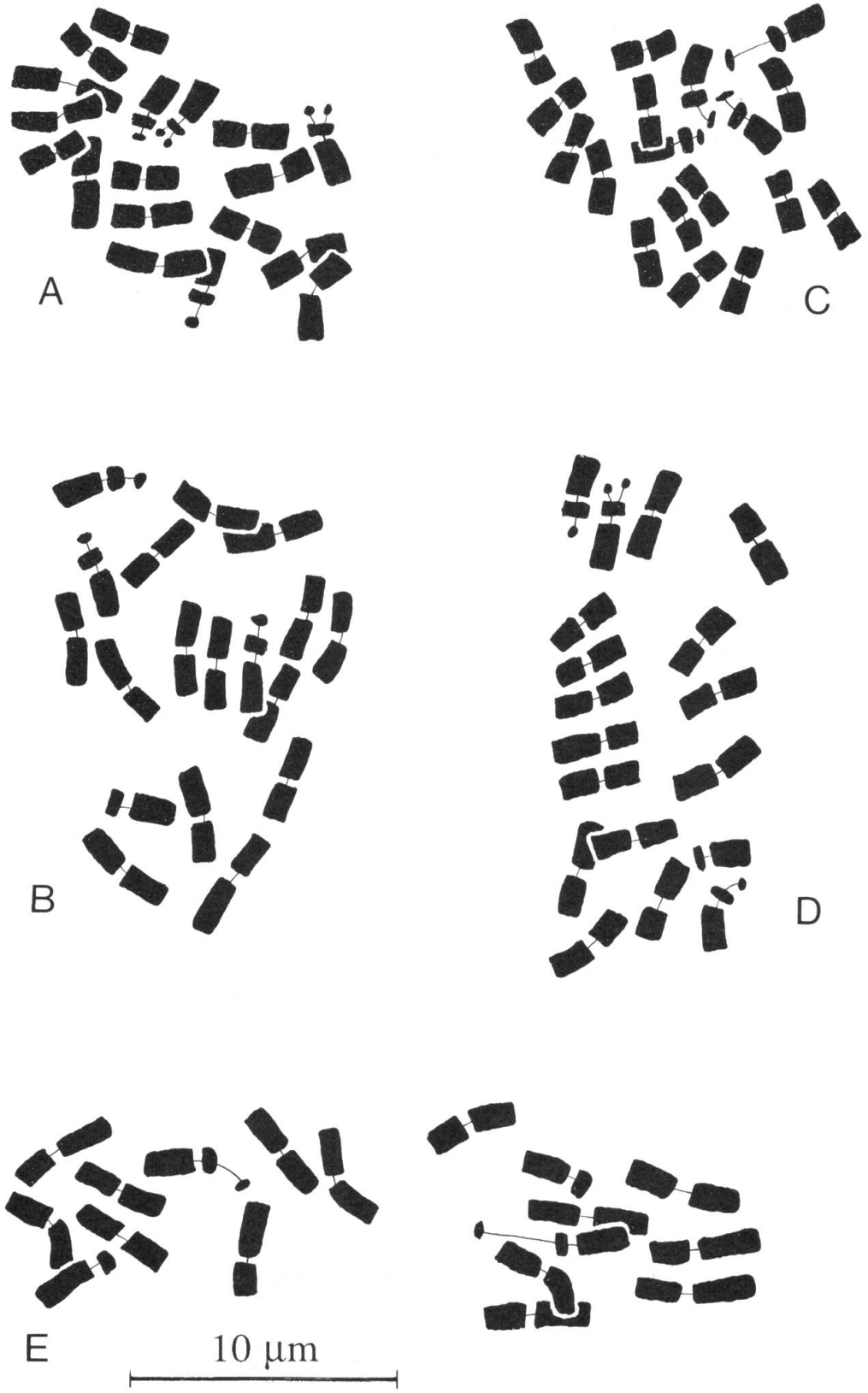


Fig. 5. — Somatic metaphases. **A,** *Achillea abrotanoides* ($2n = 18$); **B,** *Achillea coarctata* ($2n = 18$); **C,** *Achillea crithmifolia* ($2n = 18$); **D,** *Achillea fraasii* ($2n = 18$); **E,** *Achillea neilreichii* ($2n = 18$).

*Cruciferae*

**Aethionema saxatile** (L.) R. Br. ($2n = 48$).

Rocky place between Bukova and Barmashi, on the road from Erseka to Leskoviku, district Kolonja, 850 m, 4.8.1989, No *11914* (cult. No. *12153*).

The complex of *A. saxatile* comprises *A. saxatile* (with 6 subspecies) and *A. thomasianum* Gay, an endemic in northwestern Italy; two subspecies are indicated for Albania: subsp. *oreophilum* Andersson & al. in south Albania, and subsp. *saxatile* throughout the country (ANDERSSON & al., 1983). The plants investigated here belong to subsp. *saxatile*. For subsp. *saxatile* the chromosome numbers, $2n = 24$ and $2n = 48$, are indicated in literature (compilation see ANDERSSON & al., 1983). This first record for Albanian plants gives the latter number.

**Alyssum alyssoides** (L.) L. (= *A. calycinum* L.) ($2n = 32$).

Voskopoja, 15 km W of Korça, district Korça, 1200 m, 3.8.1989 (cult. No. *12068*).

*A. alyssoides* is a frequent and widely distributed Mediterranean species, growing as weed and ruderal on hot and dry places northwards to Scandinavia (HESS & al., 1977). This is the first record for Albanian plants, they have the same chromosome number as given in the very numerous indications in literature (compilations in LÖVE & LÖVE, 1974; GOLDBLATT, 1981, 1985, 1988; VAN LOON, 1987; GOLDBLATT & JOHNSON, 1990, 1994).

**Aurinia corymbosa** Griseb. (= *Alyssum corymbosum* (Griseb.) Boiss.) ($2n = 16$).

Rocky place on the road from Elbasan to Librazhdi, 16 km after Elbasan, district Librazhdi, 220 m, 2.8.1989 (cult. No. *12084*).

*A. corymbosa* is a Balkan species (from Dalmatia southwards to Greece). The chromosome number, $2n = 16$, given by JARETZKY (1928) and STRID & FRANZEN (1981) is confirmed by this first record from Albanian plants.

*Dipsacaceae*

**Pterocephalus bellidifolius** Boiss. (= *P. perennis* Coulter subsp. *bellidifolius* (Boiss.) Vierh., incl. *P. epiroticus* Contandr. & Quézel) ($2n = 18$).

Rocks near Llogarapass, 30 km SSE of Vlora, district Vlora, 1025 m, 9.8.1989, No. *11945* (cult. No. *12889*).

*P. perennis* s.l. is a Balkan endemic, and the two recognized taxa are geographically separated: *P. perennis* grows in the mountains of the south and east of Greece, *P. bellidifolius* occurs in northwest Greece and Albania. The recently described *P. epiroticus* (CONTANDRIOPOULOS & QUÉZEL, 1973) is treated as a synonym of the latter species (KOKKINI, 1991). Both species have the same chromosome number $2n = 18$ (compilation see VAN LOON, 1987; PERSSON in KOKKINI, 1991), all records from Greek material. The Albanian plants show the same number of $2n = 18$.

**Scabiosa crenata** Cyr. ($2n = 18$).

Stony slope near Gracen, on the road from Tirana to Elbasan, district Elbasan, 700 m, 18.8.1993, No. *12830* (cult. No. *12982*). Rocky place between Bukova and Barmashi, on the road from Erseka to Leskoviku, district Kolonja, 850 m, 4.8.1989, No. *11912* (cult. No. *12194*).

The group of *S. crenata* comprises 2 Asiatic and 3 Mediterranean species (VERLAQUE, 1986b). *S. crenata* has disjunct distribution areas from the Balkans through Italy and Sicilia to north Africa, and three subspecies are recognized (DAMBOLDT & al., 1981): subsp. *breviscapa* (Boiss. & Heldr.) Hayek in southern Greece, subsp. *crenata* throughout the range of the species (including Albania and the plants investigated here), and subsp. *dallaportae* (Heldr. ex Boiss.) Hayek in southeast Italy aynd west Greece. All investigated taxa of the group have the chromosome number of $2n = 18$ (compilation see VAN LOON, 1987). No Albanian plants were investigated before, the plants from both sites of Albania have the same number, $2n = 18$, as given in literature.

**Scabiosa tenuis** Spruner ex Boiss. ($2n = 16$).

Rocky place on the road from Elbasan to Librazhdi, 16 km after Elbasan, district Librazhdi, 220 m, 2.8.1989 (cult. No. *121679*). Rocky place between Bukova and Barmashi, on the road from Erseka to Leskoviku, district Kolonja, 850 m, 4.8.1989, No *11917* (cult. No. *12166*). Rocky place, ancient castle of Gjirokastra, district Gjirokastra, 370 m, 6.8.1989 (cult. No. *12168*).

*S. tenuis* is a Balkan endemic annual restricted to Albania and north Greece. The chromosome number of the Albanian plants is $2n = 16$ confirming earlier indications in literature (VERLAQUE, 1975, 1977a, 1978, 1980, 1986a; VAN LOON & SNELDERS, 1979; STRID & FRANZEN, 1981; BALTISBERGER, 1987).

**Scabiosa triniifolia** Friv. (= *S. silaifolia* Velen.) ($2n = 16$).

Voskopoja, 15 km W of Korça, district Korça, 1200 m, 3.8.1989 (cult. No. *12358*).

*S. triniifolia* belongs to the group of *S. ochroleuca* L. and occurs on the whole Balkan Peninsula. This is the first record for Albanian plants, they show the same chromosome number $2n = 16$ as given in literature (KACHIDZE, 1929; FREY, 1969; VERLAQUE, 1975; STRID & FRANZEN, 1981; STRID, 1986b).

**Tremastelma palaestinum** (L.) Janchen ( = *Callistemma brachiatum* Boiss., = *Scabiosa brachiata* (Boiss.) Sibth. & Sm.) ($2n = 14$).

Dry rocky place near Erindi, 10 km N of Gjirokastra, district Gjirokastra, 400 m, 5.8.1989 (cult. No. *12120*);

*T. palaestinum* is an annual species of the eastern Mediterranean area. The chromosome number $2n = 14$ of the Albanian plants confirms earlier indications for plants from other countries (KACHIDZE, 1929; EHRENDORFER, 1964; VERLAQUE, 1977a, b, 1978, 1980, 1982, 1986b; STRID & FRANZEN, 1981; BALTISBERGER, 1991b). The only deviating number was found by STRID (1971) in plants from Albania with $2n = 16$.

The seeds from Albania were sown in the greenhouse in summer 1989. They germinated within some weeks. The seedlings formed leaf rosettes, but remained in this stage and did not flower until the spring of 1990. The plants are therefore biennials and showed the same behavior as was demonstrated in plants from Manthirea, Greece (BALTISBERGER, 1991b). The two sites (Erindi, Albania; Manthirea, Greece) present about the same ecology (dry, open vegetation).

Two varieties of *T. palaestinum* are known (VERLAQUE, 1986b): var. *palaestinum* (slender plants with undivided basal leaves and middle sized capitula) and var. *lyratum* (Vis.) Hayek (robust plants with pinnatisect or lyrate basal leaves and big capitula). But, at least in cultivation, the

morphology of the plants investigated here and in BALTISBERGER (1991b) does not correspond with these varieties. The biennials from Manthirea (Greece, No. *11674*) are slender plants up to 30 cm, with lyrate basal leaves and small capitula, while the real annuals from Gythion (Greece, No. *11735*) are robust plants up to 1 m with undivided basal leaves and large capitula (BALTISBERGER, 1991b). The biennial plants from Erindi (Albania, No. *12120*) show a new combination with medium sized plants up to 60 cm, with slightly divided basal leaves and large capitula.

*Euphorbiaceae*

**Euphorbia falcata** L. ($2n = 36$).

Weed in cultivated field, near Gjerbës, E of Mali i Tomorit, 25 km ESE of Berat, district Skrapar, 1250 m, 10.8.1989, No. *11959* (cult. No. *12055*).

*E. falcata* is an annual with Mediterranean and Westasiatic origin, but now, as weed and ruderal, it can also be found elsewhere. Three different chromosome numbers are given in literature: $2n = 14$ (STRID & FRANZEN, 1981), $2n = 16$ (POLYA, 1950; GARCIA & VALDES, 1981), and $2n = 36$ (D'AMATO, 1939; GUINOCHET & LEFRANC, 1981). The Albanian plants, with $2n = 36$ have the same number as given in the last two indications, this is the first record for Albanian plants.

**Euphorbia myrsinites** L. ($2n = 20$).

Rocky meadow, Livadhet-e-Dajtit, W-side of Mali i Dajtit, 10 km E of Tirana, district Tirana, 1050 m, 16.8.1989 (cult. No. *12388*).

*E. myrsinites* is a variable complex (SMITH & TUTIN, 1968), and several taxa have been described (GREUTER, 1965). The Albanian plants belong to *E. myrsinites* s.str. (ALDEN, 1986), and no counts from this country have been published to date. With $2n = 20$, they have the same chromosome number as given in literature (PERRY, 1943; STRID & FRANZEN, 1981; FRANZEN & GUSTAVSSSON, 1983; STRID & ANDERSSON, 1985).

*Geraniaceae*

**Geranium macrorrhizum** L. ($2n = 92$).

Rocky slope, Mali i Melesinit, W of Leskoviku, district Kolonja, 900-1000 m, 4.8.1989, No. *11921* (cult. No. *12529*).

*G. macrorrhizum* belongs to *Geranium* subgenus *Robertium* section *Unguiculata* (YEO, 1984). It occurs in southeast Europe and is often cultivated elsewhere for ornament. The chromosome number is $2n = 46$ (WARBURG, 1938; STRID & FRANZEN, 1981; STRID & ANDERSSON, 1985; BALTISBERGER, 1991b).

The number $2n = 46$ suggests a basic chromosome number $x = 23$ (VAN LOON, 1984), which is confirmed by the chromosome number $2n = 46$ of the closely related *G. dalmaticum* (G. Beck) Rech. fil. (BALTISBERGER, 1984; YEO, 1984). The Albanian plants of *G. macrorrhizum* are therefore tetraploids with $2n = 4x = 92$ (Fig. 6). GAUGER (1937) and VAN LOON (1984) indicate the chromosome number $2n = 87$-$93$, they probably also had tetraploid plants.

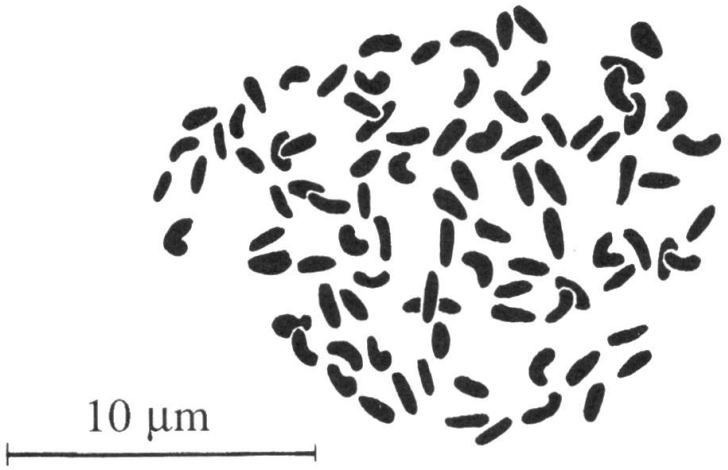


Fig. 6. — Somatic metaphase of *Geranium macrorrhizum* ($2n = 4x = 92$).

*Gramineae*

**Festucopsis serpentini** (C. E. Hubbard) Melderis (= *Brachypodium serpentini* C. E. Hubbard) ($2n = 14$).

Rocky slope on serpentine, Qafa e Buallit, W of Bulqiza, on the road from Burreli to Peshkopia, district Mati/Dibra, 700 m, 29.7.1991, No. *12476* (cult. No. *12891*).

*F. serpentini* is an endemic species of Albania and grows only on serpentine soils and rocks (MELDERIS, 1978; GUTH, 1990; SEBERG & al., 1991). The chromosome number of $2n = 14$ corresponds with the indications by JONES (in DARLINGTON & WYLIE, 1955) and BALTISBERGER & LEUCHTMANN (1991).

The chromosomes of *F. serpentini* are rather large and meta- to submetacentric (Fig. 7) as previously reported by BALTISBERGER & LEUCHTMANN (1991). The related *F. sancta* (Janka) Melderis has similar chromosomes (number, sizes and types) (KOZUHAROV & PETROVA, 1975, 1981; STRID & FRANZEN, 1983; GUTH, 1990; SEBERG & al., 1991).

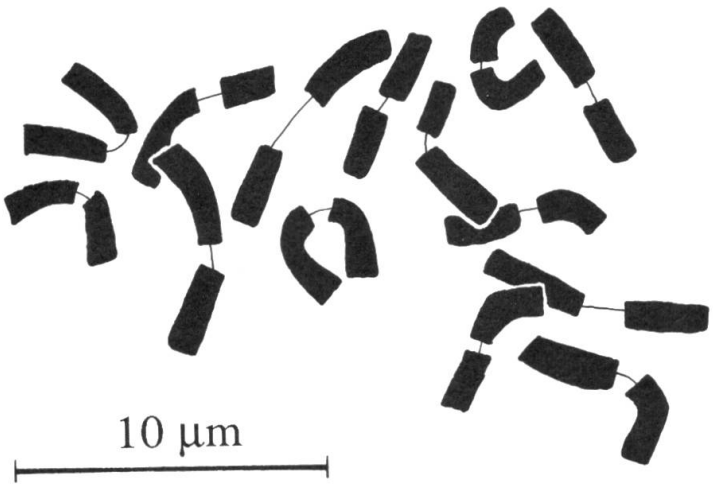


Fig. 7. — Somatic metaphase of *Festucopsis serpentini* ($2n = 14$).

*Labiatae*

**Ajuga chamaepitys** (L.) Schreber ($2n = 28$).

Rocky place between Bukova and Barmashi, on the road from Erseka to Leskoviku, district Kolonja, 850 m, 4.8.1989, No. *11916* (cult. No. *12377*).

*A. chamaepitys* is a Mediterranean annual extending northwards to Belgium, Germany and Poland. This is the first record for Albanian material, but only one Albanian plant could be investigated. It has the same chromosome number, $2n = 28$, as given in numerous indications in literature (compilations see FEDEROV, 1974; GOLDBLATT, 1981, 1985, 1988; VAN LOON, 1987).

**Betonica scardica** Griseb. (= *Stachys scardica* (Griseb.) Hayek) ($2n = 16$).

Rocky slope on serpentine, Qafa e Buallit, W of Bulqiza, on the road from Burreli to Peshkopia, district Mati/Dibra, 700 m, 29.7.1991 (cult. No. *12479*).

*B. scardica* is a Balkan endemic occuring in Albania, south Jugoslavia (Macedonia and probably Serbia), western Bulgaria and northern Greece. The chromosome number, $2n = 16$, corresponds with indications in literature (LANG, 1940; KOEVA, 1977; BALTISBERGER, 1984, 1987, 1989, 1991a; FRANZEN in BADEN, 1991a; BALTISBERGER & HUBER, 1993).

*B. scardica* belongs to a group of species which is treated as a section (GAMS, 1964; BALL, 1972b; PIGNATTI, 1982) or a subgenus (BHATTACHARJEE, 1980, 1982) of the genus *Stachys,* or as a separate genus, *Betonica,* (DE CANDOLLE, 1848; HALACSY, 1902; EHRENDORFER, 1973; KNORRING, 1977; HESS & al., 1980). Beside morphological features, all taxa of the genus *Betonica* with its basic chromosome number $x = 8$ and large chromosomes with easily visible centromers (Fig. 8A) are cytologically clearly separated from *Stachys* which has many different basic chromosome numbers and small chromosomes (BALTISBERGER, 1989).

**Lamium longiflorum** Ten. (= *L. garganicum* L. subsp. *laevigatum* Arcangeli) ($2n = 18$).

Between calcareous rocks, W-side of Mali i Thatë, NE of Bletas, 15 km ESE of Pogradec, district Pogradec, 1850-1900 m, 16.8.1993 (cult. No. *12985*).

*L. longiflorum* is a mountain species of southern Europe from southern France to Turkey and Iran. Till now, no Albanian material has ever been investigated. The Albanian plants show $2n = 18$ chromosomes as given in JÖRGENSEN (1927) and VAN LOON (1980).

**Marrubium peregrinum** L. ($2n = 32$).

Rocky slope near Gollomboç at lake Prespa, 30 km NNE of Korça, district Korça, 860-900 m, 11.8.1993 (cult. No. *12806*).

*M. peregrinum* occurs in the eastern part of Central Europe, on the Balkans and in western Turkey. Two chromosome numbers are given in literature: $2n = 32$ (MARKOVA & IVANOVA, 1971; BALTISBERGER, 1994) and $2n = 34$ (MURIN & UHRIKOVA in MAJOVSKY & al., 1970; MARGULAEV, 1984). This is the first record for Albanian plants. They show $2n = 32$ chromosomes and so confirm the number given in the first two papers on material from Bulgaria and Greece.

**Marrubium thessalum** Boiss. & Heldr. ($2n = 20$).

Rocky slope on limestone, W-side of Mali i Thatë, NE of Bletas, 15 km ESE of Pogradec, district Pogradec, 1400-1500 m, 16.8.1993 (cult. No. *12821*).

*M. thessalum* is an endemic of north Greece (Macedonia, Thessalia) and south Albania. The chromosome number of the Albanian plants is $2n = 20$ and confirms therefore the counts on Greek material by STRID & FRANZEN (1981), FRANZEN (in BADEN, 1991b) and BALTISBERGER (1994).

**Marrubium vulgare** L. ($2n = 34$).

Rocky slope near Gollomboç at lake Prespa, 30 km NNE of Korça, district Korça, 860-900 m, 11.8.1993 (cult. No. *12805*).

*M. vulgare* is a widespread species in Eurasia and North Africa and introduced in America, in earlier times it was cultivated as a medicinal plant (HESS & al., 1980). The chromosome number, $2n = 34$, found in the Albanian plants corresponds with most indications in literature (MOORE, 1973, 1974, 1977; FEDEROV, 1974; GOLDBLATT, 1984, 1985; VAN LOON, 1987; GOLDBLATT & JOHNSON, 1990, 1991, 1994).

The plants of the site investigated here show calyces with about 10 equal teeth. The closely related (and probably conspecific) *M. alternidens* Rech. fil. differs from *M. vulgare* in its calyx teeth (5 large alternating with 5 small). *M. alternidens* was described from the "Flora Iranica" area (RECHINGER, 1952), but later was also recorded from Asia Minor, Greece and Albania (STRID, 1971; BALTISBERGER & LENHERR, 1984).

**Salvia officinalis** L. ($2n = 14$).

Rocky place near Raps, 35 km N of Shkodër, district Shkodër, 400-450 m, 13.8.1989 (cult. No. *12386*). Rocky slope, Mali i Çikes, 35 km SSE of Vlora, district Vlora, 1300-1400 m, 9.8.1989 (cult. No. *12382*). Rocky place on the road from Elbasan to Librazhdi, 16 km after Elbasan, district Librazhdi, 220 m, 2.8.1989 (cult. No. *12387*).

*S. officinalis* is a rather variable species which grows in Spain, southern France and the western part of the Balkan Peninsula; it is widely cultivated as a pot-herb and naturalized in southern and Central Europe. All plants of the 3 Albanian sites showed the same chromosome number, $2n = 14$, as given in numerous indications in literature (compilations see LÖVE & LÖVE, 1974; GOLDBLATT, 1981, 1984, 1988; GOLDBLATT & JOHNSON, 1990); this is the first record for Albanian material.

**Salvia verbenaca** L. (= *S. clandestina* L., = *S. horminoides* Pourret) ($2n = 56$).

Rocks near the coast, S of Sarandë, district Sarandë, 10-30 m, 7.8.1989 (cult. No. *12796*).

*S. verbenaca* is a very polymorphic species with many local variants (HEDGE, 1972; AFZAL-RAFII, 1979). This fact may also be an explanation for the many different chromosome numbers given in literature: $2n = 14, 16, 32, 40, 42, 44, 48, 54, 56, 58, 59, 60, 62, 64, 72$ (compilations in MOORE, 1973, 1974, 1977; FEDEROV, 1974; LÖVE & LÖVE, 1974; GOLDBLATT & JOHNSON, 1990, 1994). No Albanian material has been investigated before. The Albanian plants show $2n = 56$ chromosomes (Fig. 8B), the same number was indicated by AFZAL-RAFII (1979) and MARKOVA & IVANOVA (1982).

**Sideritis roeseri** Boiss. & Heldr. ($2n = 32$).

Rocky slope on limestone, W-side of Mali i Thatë, NE of Bletas, 15 km ESE of Pogradec, district Pogradec, 1400-1500 m, 16.8.1993 (cult. No. *12822*). Rocky slope, W-side of Mali i Gramosit, E of Erseka, district Kolonja, 1700 m, 12.8.1993, No. *12809* (cult. No. *12912*).


Fig. 8. — Somatic metaphases. **A,** *Betonica scardica* ($2n = 16$); **B,** *Salvia verbenaca* ($2n = 56$); **C,** *Teucrium chamaedrys* ($2n = 62$).

*S. roeseri* belongs to the section *Empedoclia* which is taxonomically very difficult and insufficiently known. The taxa of this section are widely used for making "mountain tea". For Greece, *S. roeseri* was divided into three subspecies (PAPANICOLAOU & KOKKINI, 1982), Albanian and Macedonian material was not investigated. The Albanian plants correspond fairly well with *S. roeseri* subsp. *roeseri* which is distributed in the Greek Pindus from Mr. Parnassos northwards to the Albanian border (PAPANICOLAOU & KOKKINI, 1982). The chromosome number in section *Empedoclia* is homogeneously $2n = 32$ as in *S. roeseri* subsp. *roeseri,* in literature (CONTANDRIOPOULOS, 1978; BALTISBERGER, 1991a, 1994) as well as in the plants investigated here.

**Stachys germanica** group

The group of *S. germanica* L. comprises in Europe about 10 species (BALL, 1972b), and some species were divided into several subspecies (e.g. HAYEK, 1928-1931; RECHINGER, 1937, 1941a; LANG, 1940). With the exception of *S. alpina* L., the only taxon with glandular hairs on stems, all taxa are systematically very difficult, and many intermediates are known. The *S. germanica* group belongs to section *Eriostomum* which is cytologically uniform, all taxa have the same chromosome number, $2n = 30$.

Three taxa of this group were investigated as follows:

**Stachys cretica** L. ($2n = 30$).

Voskopoja, 15 km W of Korça, district Korça, 1100 m, 3.8.1989 (cult. No. *12392*).

*S. cretica* occurs in Crete, the Aegean Islands, and Greece northwards to the Ionian Islands (Kephalonia, Zakynthos) and Mount Tymphrestos (RECHINGER, 1937), but it also grows in southern Albania (districts Vlora and Kolonja; BALTISBERGER & LENHERR, 1984). The site in Voskopoja is about 50 km northwards of the known site near Leskoviku (district Kolonja). The chromosome number, $2n = 30$, corresponds with the previous indication (BALTISBERGER, 1987) and with the number of all taxa within the section *Eriostomum.*

**Stachys germanica** L. ($2n = 30$).

Rocky meadow, Livadhet-e-Dajtit, W-side of Mali i Dajtit, 10 km E of Tirana, district Tirana, 1050 m, 16.8.1989 (cult. No. *12394*). Rocky slope, W-side of Mali i Gramosit, E of Erseka, district Kolonja, 1900 m, 12.8.1993, No. *12811* (cult. No. *12913*).

*S. germanica* has a wide distribution in western, central and southern Europe. It was divided into several subspecies (e.g. BALL, 1972b; BHATTACHARJEE, 1982; BADEN, 1991a), but the delimitations are obscure, and many intermediates occur. The chromosome number of the Albanian plants corresponds with the numerous indications in literature (compilations e.g. FEDEROV, 1974; VAN LOON, 1987; GOLDBLATT & JOHNSON, 1994).

**Stachys salviifolia** Ten. ($2n = 30$).

Dry place, Kalidhet e vllejve near Borova, on the road from Erseka to Leskoviku, district Kolonja, 1000 m, 4.8.1989 (cult. No. *12532*).

*S. salviifolia* is morphologically intermediate between *S. cretica* L. and *S. germanica* L. Therefore it was also treated as *S. cretica* subsp. *salviifolia* (Ten.) Rech. fil. (RECHINGER, 1937; BALL, 1972b) or *S. germanica* subsp. *salviifolia* (Ten.) Gams (GAMS, 1964). It occurs in the Mediterranean area. As all taxa of section *Eriostomum, S. salviifolia* has $2n = 30$ chromosomes (BALTISBERGER, 1988) which was confirmed by the Albanian plants.

**Teucrium chamaedrys** L. ($2n = 62$).

Rocky slope on limestone, W-side of Mali i Thatë, NE of Bletas, 15 km ESE of Pogradec, district Pogradec, 1400-1500 m, 16.8.1993 (cult. No. *12915*). Rocky slope near Gollomboç at lake Prespa, 30 km NNE of Korça, district Korça, 860-900 m, 11.8.1993 (cult. No. *12911*).

*T. chamaedrys* grows on dry places in southern and central Europe, southwest Asia and northern Africa. It is a very variable taxon which was separated into several infraspecific taxa (e.g. RECHINGER, 1941b), but these are mostly not recognized. Many different chromosome numbers are given for *T. chamaedrys* s.l.: $2n = 32, 58, 60, 62, 64, 65, 72, 80, 96$ (compilations see MOORE, 1973, 1974, 1977; FEDEROV, 1974; GOLDBLATT, 1981, 1985, 1988; VAN LOON, 1987; GOLDBLATT & JOHNSON, 1990, 1991). The chromosome number is given for the first time for Albanian plants. With $2n = 62$ (Fig. 8C) it corresponds with other counts from the Balkans (MARKOVA, 1982, from Bulgaria; BALTISBERGER, 1993b, from Kosovo and northern Greece), but this number was also found in other countries of the Mediterranean area (compilation see BALTISBERGER, 1993b). Nevertheless there is no apparent correlation between morphology, chromosome number and geographical distribution (Fig. 9).

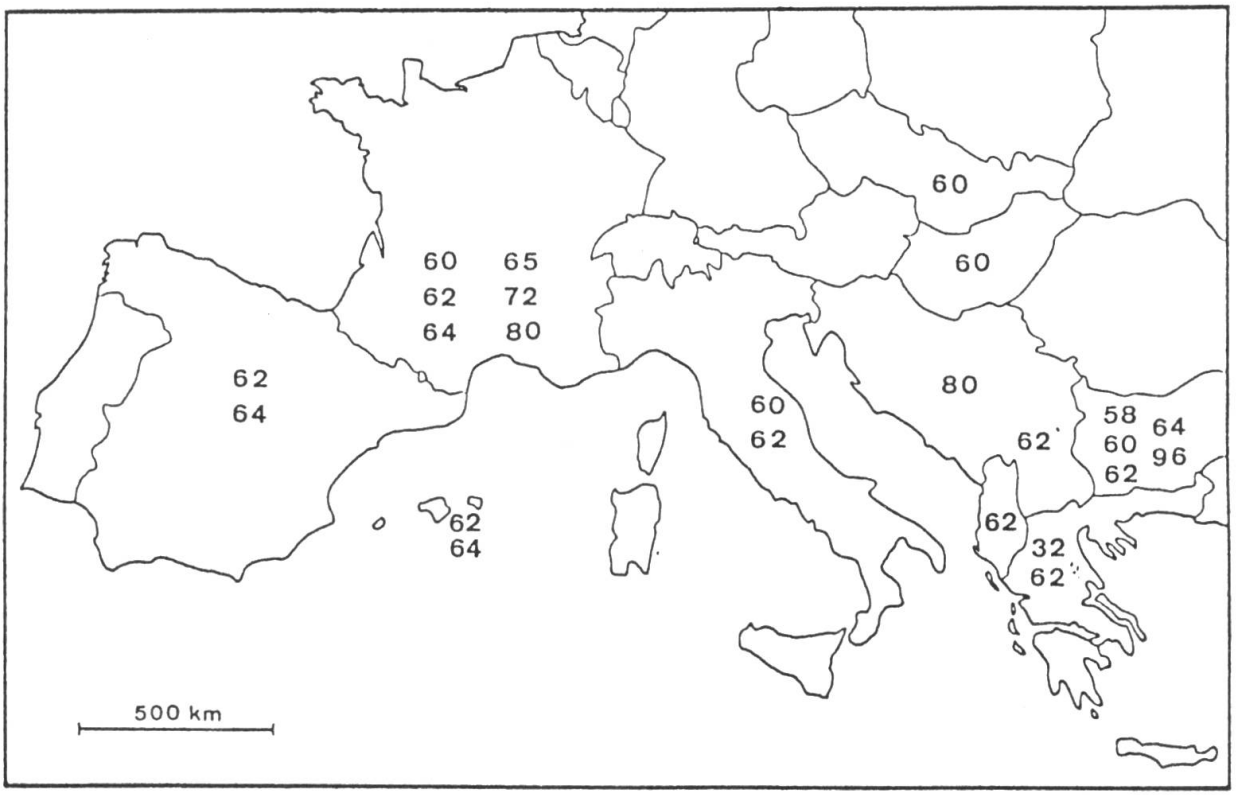


Fig. 9. — Geographical occurence of chromosome numbers of *Teucrium chamaedrys* (from BALTISBERGER, 1993b, modified).

## *Liliaceae*

**Allium flavum** L. ($2n = 16 + 1B$).

Calcareous rocks, W-side of Mali i Thatë, NE of Bletas, 15 km ESE of Pogradec, district Pogradec, 1650-1750 m, 16.8.1993, No. *12826* (cult. No. *12919*).

*A. flavum* is a variable species occuring on dry, rocky places in southern Europe and Turkey. Two subspecies are recognized (STEARN, 1980; ANDERSSON, 1991a): subsp. *flavum* (throughout

the range of the species) and subsp. *tauricum* (Besser ex Reichenb.) Stearn (southeast Europe). The Albanian plants belong to subsp. *flavum* (det. D. Tzanoudakis, Patras, Greece). Most of the indications in literature give $2n = 16$ for both subspecies (see MOORE, 1973, 1977; FEDEROV, 1974; GOLDBLATT & JOHNSON, 1991, 1994), which is confirmed by this first record for Albanian plants.

The karyotype consists of 16 meta- to submetacentric chromosomes, two pairs with satellites (Fig. 10A). All the Albanian plants have, in addition, one B-chromosome, which is subtelocentric and so belongs to type 1, according to the classification of VON BOTHMER (1970). The same karyotype is given by CHESHMEDZHIEV (1971a), CAPINERI & al. (1978) and WITTMANN (1984). CHESHMEDZHIEV (1971a) observed two to three pairs of chromosomes with satellites, but no B-chromosomes. CAPINERI & al. (1978) give no indication about satellites, but observed 0-2B-chromosomes of the same type as given for the Albanian plants. On the other hand, WITTMANN (1984) indicates only one pair of chromosomes with small satellites and observed no B-chromosomes. It seems that either the partially very small satellites are not always visible, or *A. flavum* is variable concerning satellites.

**Allium moschatum** L. (det. D. Tzanoudakis, Patras, Greece) ($2n = 16$).

Calcareous rocks, W-side of Mali i Thatë, NE of Bletas, 15 km ESE of Pogradec, district Pogradec, 1650-1750 m, 16.8.1993, No. *12825* (cult. No. *12918*).

*A. moschatum* grows on dry, rocky places in southern Europe, from Spain to Turkey. No counts exist on Albanian *A. moschatum*. The Albanian plants show the same chromosome number, $2n = 16$, as indicated in literature (see MOORE, 1973; FEDEROV, 1974; GOLDBLATT, 1981, 1984, 1985, 1988; GOLDBLATT & JOHNSON, 1990, 1991, 1994).

The karyotype consists of 14 meta- to submetacentric and 2 acrocentric chromosomes, the acrocentric ones show a secondary constriction (Fig. 10B). Similar karyotypes are presented in BILLERI (1954), CHESHMEDZHIEV (1971b), GARBARI & SENATORI (1975), TORNADORE (1982) and TZANOUDAKIS (1983). They all indicate acrocentric chromosomes with satellites, but mention, in addition, 1 to 2 meta- to submetacentric pairs with small to minute satellites. The occurence of these satellites seems to be variable (see comment above under *A. flavum*).

**Lilium albanicum** Griseb. ($2n = 24$).

Meadow, W of Kula Ziberit, northern part of Mali i Korabit, 20 km NE of Peshkopia, district Dibra, 2000-2100 m, 26.7.1991, No. *12451* (cult. No. *12890*).

*L. albanicum* belongs to the difficult group of *L. carniolicum* Bernh. ex Koch; it is a local taxon in Albania, southwest Jugoslavia (probably Macedonia) and west and northcentral Greece (HAYEK, 1933; MATTHEWS, 1980; ANDERSSON, 1991b). The chromosome number for *L. albanicum* was unknown for Albanian plants. It is $2n = 24$, as published in LOVKA & al. (1971) and SOPOVA (1971). The chromosomes are rather large (up to 15 µm). Based on the investigations of 48 taxa of the genus *Lilium* (but without *L. carniolicum* s.l.), STEWART (1947) concluded that there are no large variations in chromosome morphology within the genus. All taxa have 2 pairs of large meta- to submetacentric and 10 pairs of subtelo- to acrocentric chromosomes which is confirmed for *L. albanicum* (Fig. 11).

*Papilionaceae*

**Medicago prostrata** Jacq. (det. A. Strid & K. Tan, Copenhagen, Denmark) ($2n = 16$).

Rocky meadow near the frontier station on the road from Shkodër to Tamarë, 40 km N of Shkodër, district Shkodër, 750 m, 13.8.1989, No. *11969* (cult. No. *12152*).

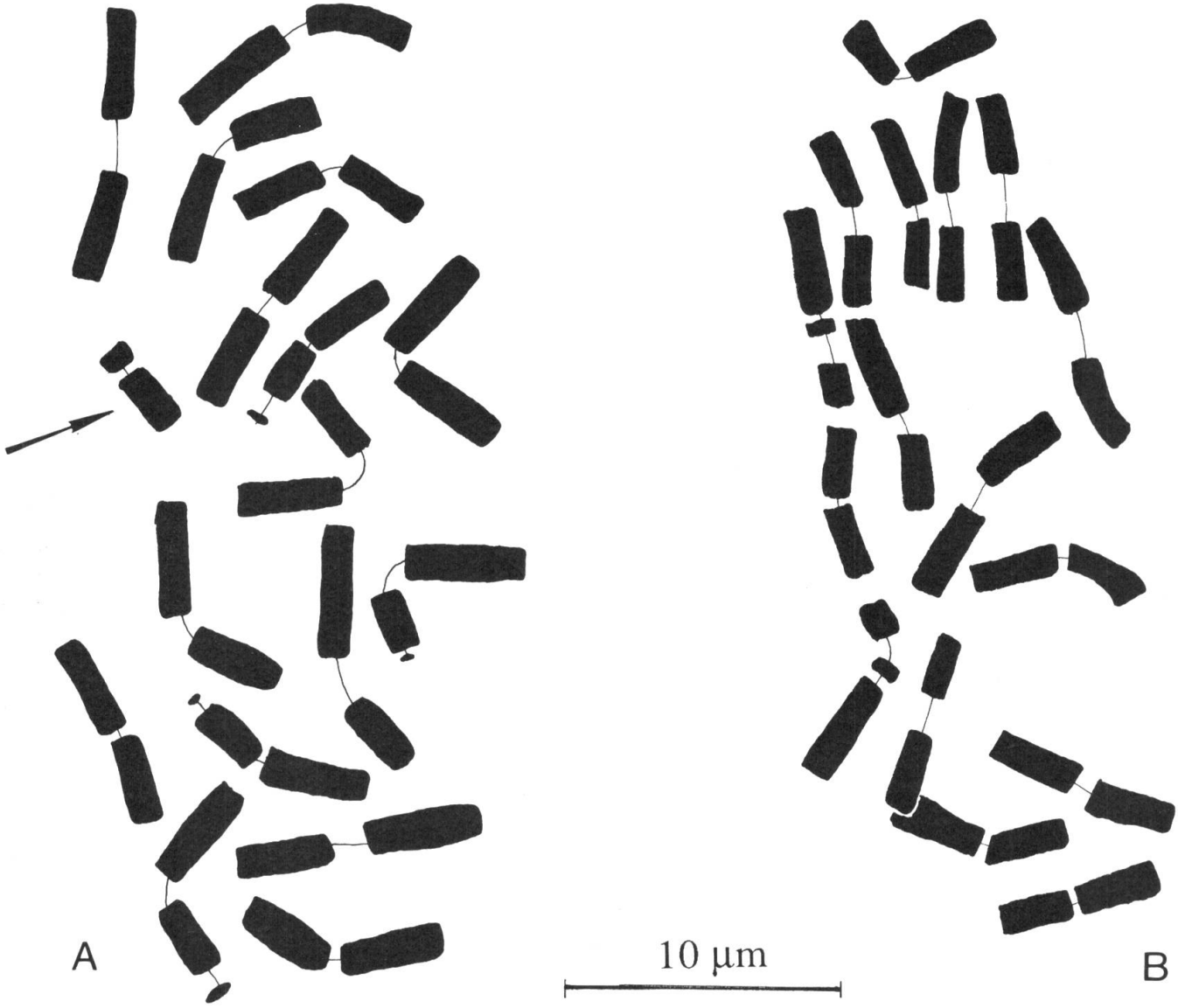


Fig. 10. — Somatic metaphases. **A,** *Allium flavum* ($2n = 16 + 1B$; **B**-chromosome arrowed); **B,** *Allium moschatum* ($2n = 16$).

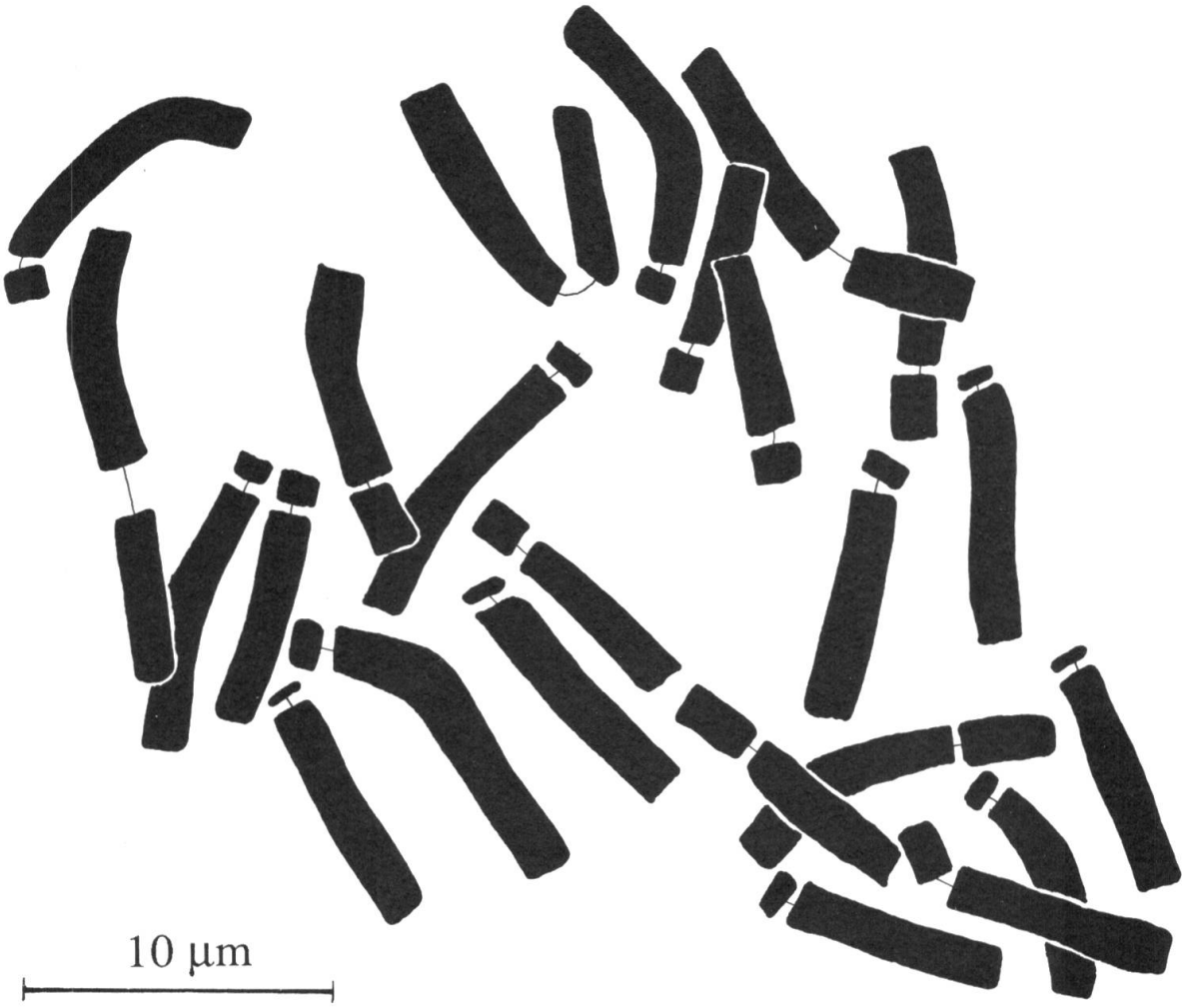


Fig. 11. — Somatic metaphase of *Lilium albanicum* ($2n = 24$).

*M. prostrata* is a variable species growing from eastern Austria and Italy to the Black Sea (LESINS & LESINS, 1979), southwards it is distributed as far north as Greece (Mt. Vourinos; PRESTON & STRID, 1986). The recognized subspecies (HAYEK, 1927; MICEVSKI, 1973) are not clearly separated, the Albanian plants are probably best placed under subsp. *prostrata.*

For *M. prostrata,* the diploid ($2n = 2x = 16$) and the tetraploid ($2n = 4x = 32$) chromosome numbers are given in literature (compilations see MOORE, 1973, 1977; FEDEROV, 1974), there are no counts from Albanian material. The Albanian plants have 16 chromosomes and are therefore diploid.

**Psoralea bituminosa** L. ($2n = 20$).

Roadside, Syri ë Kaltër near Muzinë, on the road from Gjirokastra to Sarandë, district Sarandë, 150 m, 6.8.1989 (cult. No. *12090*).

*P. bituminosa* is widespread in southern Europe. No counts from Albanian plants are known. The Albanian plants, with $2n = 20$ chromosomes, confirm earlier indications (compilations in MOORE, 1973, 1977; FEDEROV, 1974; GOLDBLATT, 1981, 1984, 1988; VAN LOON, 1987; GOLDBLATT & JOHNSON, 1991). The only deviating number, $2n = 22$, was published by AFZAL-RAFII & al. (1986).

**Trifolium arvense** L. ($2n = 14$).

Rocky slope, NW of Mali i Çajupit, Mali i Lunxhërisë, 12 km NNE of Gjirokastra, district Gjirokastra, 1400-1450 m, 5.8.1989, No. *11931* (cult. No. *12353*).

*T. arvense* is a very variable, originally Mediterranean species, which has been spread nearly all over the world as a weed. With $2n = 14$ chromosomes, the Albanian plants confirm the very numerous counts given in literature (compilations see MOORE, 1973, 1974, 1977; FEDEROV, 1974; GOLDBLATT, 1981, 1984, 1985, 1988; VAN LOON, 1987; GOLDBLATT & JOHNSON, 1990, 1991, 1994).

*Ranunculaceae*

**Nigella damascena** L. ($2n = 12$).

Rocky slope, Mali i Melesinit, W of Leskoviku, district Kolonja, 900-1000 m, 4.8.1989 (cult. No. *12115*). Rocky place, ancient castle of Gjirokastra, district Gjirokastra, 370 m, 6.8.1989 (cult. No. *12091*).

*N. damascena* originates from the Mediterranean area, but is cultivated for ornamental use elsewhere. It is (as all taxa of the genus *Nigella*) diploid with $2n = 12$ chromosomes (compilations of the numerous counts see MOORE, 1973; FEDEROV, 1974; GOLDBLATT, 1981, 1984, 1988; VAN LOON, 1987; GOLDBLATT & JOHNSON, 1990, 1994). This is confirmed by the plants from the two Albanian sites. The karyotype is rather asymmetric with 10 metacentric and 2 acrocentric chromosomes (Fig. 12). Only one pair of the metacentric chromosomes was observed to bear a rather large satellite; contrarily, BHATTACHARYYA (1958), GILOT-DELHALLE (1970) and CAPINERI & al. (1978) report more pairs with satellites.

**Ranunculus acris** L. ($2n = 14$).

Wet place near Voskopoja, 15 km W of Korça, district Korça, 1200 m, 3.8.1989 (cult. No. *12565*).


Fig. 12. — Somatic metaphase of *Nigella damascena* (No. *12115*) ($2n = 12$).

*R. acris* is widespread in Europe. It is part of a very variable complex consisting of about 6 taxa (COLES, 1971). All taxa of this group have a basic chromosome number, $x = 7$, which is uncommon in the genus *Ranunculus* with mostly $x = 8$. *R. acris* s.str. is diploid with $2n = 14$ chromosomes (compilations of the very numerous indications see MOORE, 1973, 1974, 1977; FEDEROV, 1974; GOLDBLATT, 1981, 1984, 1985, 1988; VAN LOON, 1987; GOLDBLATT & JOHNSON, 1990, 1991), no Albanian plants were included in the investigations. The same number is shown by the Albanian plants.

The karyotype consists of 4 large and 2 medium sized metacentric and 8 submeta- to subtelocentric chromosomes; one pair of the latter bears satellites (Fig. 13A). The same karyotype for *R. acris* was found by GREGSON (1965), GOEPFERT (1974) and MARCHI & al. (1975).

**Ranunculus arvensis** L. ($2n = 32$).

Weed in cultivated field, Voskopoja, 15 km W of Korça, district Korça, 1200 m, 3.8.1989, No. *11909* (cult. No. *12113*).

*R. arvensis* is a Mediterranean species, and as a weed and ruderal, it also grows elsewhere. This is the first record for Albanian material. With $2n = 32$ chromosomes, the Albanian plants are tetraploid which agrees with indications in literature (MOORE, 1973, 1974, 1977; FEDEROV, 1974; GOLDBLATT, 1981, 1984; GOLDBLATT & JOHNSON, 1990, 1991, 1994).

**Ranunculus bevifolius** Ten. ($2n = 16$).

Calcareous scree, E-side of Mali i Tomorit, W of Gjerbës, 20 km ESE of Berat, district Skrapar, 2000-2100 m, 10.8.1989, No. *11948* (cult. No. *12383*).

*R. brevifolius* is the southern taxon of *Ranunculus* sect. *Thora* (with *R. hybridus* Biria and *R. thora* L.). It occurs in the Abruzzi Mountains and in mountains of the Balkan Peninsula, Crete, and southwestern Turkey. *R. brevifolius* is diploid with $2n = 16$ chromosomes (GREGSON, 1965 [as *R. hybridus*]; MARCHI, 1968, 1971; FAVARGER, 1973; STRID & FRANZEN, 1981; BALTISBERGER, 1990, 1994). No previous counts of Albanian plants are known. They are also diploid with $2n = 16$.

**Ranunculus bulbosus** L. ($2n$ = 16).

Rocky meadow near the frontier station on the road from Shkodër to Tamarë, 40 km N of Shkodër, district Shkodër, 750 m, 13.8.1989 (cult. No. *12054*).

*R. bulbosus* is a widespread European taxon. It is polymorphic, and several subspecies have been described. Only 2 subspecies are recognized by COLES (1973; subp. *bulbosus* and subsp. *adscendens* [Brot.] Neves). A third local subspecies (subsp. *castellanus* [Freyn] P. W. Ball & Heywood; northwest Spain) is accepted by TUTIN & AKEROYD (1993). the plants of Albania show conspicuously swollen stocks and thus represent subsp. *bulbosus*. Their chromosome number, $2n$ = 16, is the first record for Albanian plants and confirms the numerous counts in literature (compilation see BALTISBERGER, 1981).

**Ranunculus marginatus** D'Urv. ($2n$ = 16).

Wet place in Voskopoja, 15 km W of Korça, district Korça, 1200 m, 3.8.1989, No. *11911* (cult. No. *12030*).

*R. marginatus* occurs in wet places in southeastern Europe and Sicilia. Typical *R. marginatus* has smooth achenes, whereas plants with strongly tuberculate achenes are called var. *trachycarpus* (TUTIN & AKEROYD, 1993). It seems that there is a correlation between morphology and ploidy level: typical *R. marginatus* is diploid with $2n$ = 16 chromosomes (STRID & FRANZEN, 1981; BALTISBERGER & al., 1993), *R. marginatus* var. *trachycarpus* is tetraploid with $2n$ = 32 chromosomes (GREGSON, 1965; GOEPFERT, 1974). The Albanian plants investigated here are diploid and have smooth achenes, confirming this correlation.

The karyotype consists of 2 pairs of metacentric chromosomes, 1 pair of submetacentric, 4 pairs of subtelo- to acrocentric, and 1 pair of telocentric chromosomes, the latter with satellites (Fig. 13B). A similar karyotype is published for tetraploid *R. marginatus* var. *trachycarpus* by GOEPFERT (1974).

**Ranunculus nemorosus** DC. ($2n$ = 16).

Roadside in forest of *Fagus silvatica,* S-side of Mali i Polisit, 15 km SSE of Librazhdi, district Librazhdi, 1350 m, 2.8.1989, No. *11907* (cult. No. *12062*).

*R. nemorosus* is a widespread species in Europe, on the Balkan Peninsula reaching southwards to Albaynia, Serbia and Bulgaria (BALTISBERGER & HESS, 1986). No chromosome count from Albanian *R. nemorosus* is known. The Albanian plants are diploid with $2n$ = 16 chromosomes as given in literature (compilations of the numerous counts see BALTISBERGER, 1980; DIOSDADO & PASTOR, 1992; GOLDBLATT & JOHNSON, 1994).

**Ranunculus repens** L. ($2n$ = 32).

Roadside in forest of *Fagus silvatica,* S-side of Mali i Polisit, 15 km SSE of Librazhdi, district Librazhdi, 1350 m, 2.8.1989 (cult. No. *12047*).

*R. repens* is a very frequent and widespread species which originated in Eurasia and was introduced as a neophyte in other continents. Most of the indications in literature give the tetraploid number of $2n$ = 32 chromosomes (compilations in BALTISBERGER, 1981; DIOSDADO & PASTOR, 1992; GOLDBLATT & JOHNSON, 1994), the same number was established for the first time in Albanian plants.

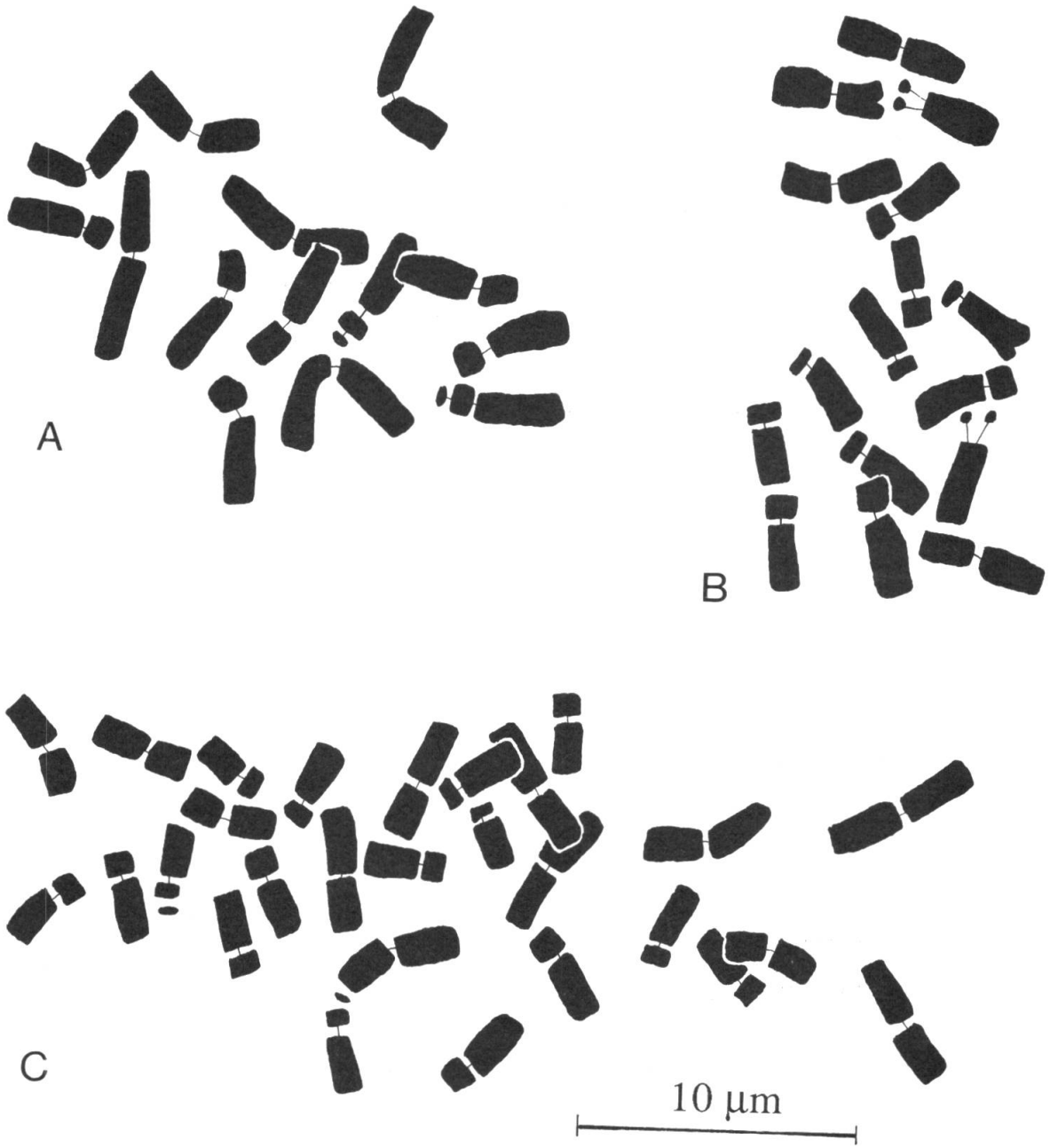


Fig. 13. — Somatic metaphases. **A,** *Ranunculus acris* ($2n = 14$); **B,** *Ranunculus marginatus* ($2n = 16$); **C,** *Ranunculus serbicus* ($2n = 28$).

**Ranunculus serbicus** Vis. ($2n = 28$).

Roadside in forest of *Fagus silvatica,* S-side of Mali i Polisit, 15 km SSE of Librazhdi, district Librazhdi, 1350 m, 2.8.1989, No. *11908* (cult. No. *12097*).

*R. serbicus* grows in shaddy and wet places in the southern part of the Balkan peninsula and in southwestern Italy (Calabria). It belongs to the same group as *R. acris* (see above) but *R. serbicus* is tetraploid with $2n = 28$ chromosomes. No record for Albanian *R. serbicus* is known. With $2n = 28$, the Albanian plants are tetraploid as well. The same number was reported by LARTER (1932), LANGLET (1936), SZ.-BORSOS (1971), GOEPFERT (1974), MARCHI & al. (1975) and STRID & ANDERSSON (1985). The only deviating number, $2n = 14$, is given by TSCHERMAK-WOESS & DELEZAL (1953), and is probably caused by misidentified plants (the origin of the plant material is not indicated).

The karyotype consists of 8 large and 4 medium sized metacentric and 16 submeta- to subtelocentric chromosomes (Fig. 13C). A similar karyotype is given by GOEPFERT (1974) and MARCHI & al. (1975). *R. acris* has (on the diploid ploidy level) the same chromosome types (see above), confirming the relationship of the two taxa.

*Rosaceae*

**Potentilla speciosa** Willd. ($2n = 14$).

Calcareous rocks, W-side of Mali i Thatë, NE of Bletas, 15 km ESE of Pogradec, district Pogradec, 1650-1750 m, 16.8.1993, No. *12824* (cult. No. *12984*). Rocky slope, summit area of Mali i Çajupit, Mali i Lunxhërisë, 12 km NNE of Gjirokastra, district Gjirokastra, 1650-1700 m, 5.8.1989 (cult. No. *11940*).

*P. speciosa* occurs in crevices of limestone rocks and in stabilized calcareous screes from the western and southern parts of the Balkan Peninsula, eastwards through Turkey to Syria and Iraq. It has $2n = 14$ chromosomes (SHIMOTOMAI, 1930a, b; DE MONTMOLLIN, 1984; FRANZEN & GUSTAVSSON in STRID, 1986a; BALTISBERGER & HUBER, 1993; BALTISBERGER, 1994), which is confirmed for the first time in Albanian plants.

*Rubiaceae*

**Asperula arvensis** L. (conf. F. Krendl, Vienna, Austria) ($2n = 22$).

Weed in cultivated field, Voskopoja, 15 km W of Korça, district Korça, 1200 m, 3.8.1989 (cult. No. *12031*).

Originally *A. arvensis* is a Mediterranean species, naturalized in Central Europe and casual in the north. No Albanian plants have been investigated before; they have $2n = 22$ chromosomes, confirming the counts given in literature (compilations in FEDEROV, 1974; GOLDBLATT & JOHNSON, 1990, 1991; REYNAUD & al., 1992).

**Galium tricornutum** Dandy (conf. F. Krendl, Vienna, Austria) ($2n = 44$).

Weed in cultivated field, Voskopoja, 15 km W of Korça, district Korça, 1200 m, 3.8.1989 (cult. No. *12033*).

*G. tricornutum* grows as weed and ruderal in open dry habitats, it occurs in central and southern Europe and is casual elsewhere. Albanian plants are investigated here for the first time, with their tetraploid chromosome number, $2n = 44$, they agree with indications in literature

(compilations see FEDEROV, 1974; MOORE, 1977; GOLDBLATT, 1981; GOLDBLATT & JOHNSON, 1990). In GOLDBLATT (1985), ANCHEV (1982) is cited with the diploid number, $2n = 22$, for *G. tricornutum,* but ANCHEV (1982) gives no chromosome number for this species.

### *Saxifragaceae*

**Saxifraga adscendens** L. ($2n = 22$).

Calcareous scree, Shuttan i Radomirës, N-side of Mal i Korabit, NE of Peshkopia, district Dibra, 2300 m, 27.7.1991, No. *12464*.

*S. adscendens* is a widespread arctic-alpine species growing in the mountains of Europe eastwards to the Caucasus as well as in North America. It belongs to the *S. tridactylites* group (WEBB, 1993) which contains several taxa that are not always placed at the same taxonomic level (ALDEN & STRID, 1986; WEBB, 1993). Especially on the Balkan Peninsula, the taxa are rather variable. The Albanian plants probably are best placed under *S. adscendens* subsp. *adscendens.* No Albanian material has been investigated up till now. The only single Albanian plant investigated shows $2n = 22$ chromosomes, confirming earlier indications in literature (compilations see FEDEROV, 1974; HESS & al., 1977; MOORE, 1977; GOLDBLATT, 1981, 1984, 1985; GOLDBLATT & JOHNSON, 1994).

**Saxifraga rotundifolia** L. ($2n = 22$).

Shaddy place in the gorge of river Cem, 40 km N of Shkodër, district Shkodër, 250 m, 13.8.1989 (cult. No. *12041*).

*S. rotundifolia* is a plant of central and southern European mountains reaching eastwards through Turkey to Iran and the Caucasus. Its chromosome number is uniformly $2n = 22$ (see MOORE, 1973; FEDEROV, 1974; GOLDBLATT, 1981, 1985; GOLDBLATT & JOHNSON, 1990) which was also established in Albanian plants for the first time.

### *Scrophulariaceae*

**Linaria peloponnesiaca** Boiss. & Heldr. ($2n = 12$).

Rocky place on the road from Elbasan to Librazhdi, 22 km after Elbasan, district Librazhdi, 250 m, 2.8.1989 (cult. No. *12186*).

*L. peloponnesiaca* is a Balkan endemic (Albania, Macedonia and Greece). The Albanian plants have $2n = 12$ chromosomes confirming earlier indications (STRID & FRANZEN, 1981; BALTISBERGER, 1987; FRANZEN in STRID & TAN, 1991).

### *Umbelliferae*

**Bupleurum veronense** Turra (= *B. baldense* Turra subsp. *gussonei* (Archangeli) Tutin) ($2n = 16$).

Rocky place in the gorge of river Cem, 40 km N of Shkodër, district Shkodër, 250 m, 13.8.1989, No. *11965* (cult. No. *12056*).

*B. veronese* is an annual species of dry open habitats which occurs in Italy and in the Balkans. No chromosome counts on Albanian material have ever been carried out till now. The chromosome number, $2n = 16$, confirms the earlier indication by VAN LOON & KIEFT (1980).

**Caucalis platycarpos** L. (= *C. lappula* Grande) (2*n* = 20).

Weed in cultivated field, near Gjerbës, E-side of Mali i Tomorit, 25 km ESE of Berat, district Skrapar, 1250 m, 10.8.1989, No. *11960* (cult. No. *12109*). Weed in cultivated field, Voskopoja, 15 km W of Korça, district Korça, 1200 m, 3.8.1989 (cult. No. *12057*).

*C. platycarpos* is a widespread species in dry, open habitats, originating from the Mediterranean area but distributed as a weed now through most of Europe. No Albanian plants have been investigated till now. Plants of both sites show the same chromosome number, 2*n* = 20, confirming the indications in literature (compilations in FEDEROV, 1974; GOLDBLATT, 1981; GOLDBLATT & JOHNSON, 1990; BALTISBERGER, 1991c).

**Orlaya daucorlaya** Murb. (2*n* = 14).

Rocky place between Bukova and Barmashi, on the road from Erseka to Leskoviku, district Kolonja, 850 m, 4.8.1989 (cult. No. *12110*). Dry rocky place near Erindi, 10 km N of Gjirokastra, district Gjirokastra, 400 m, 5.8.1989 (cult. No. *12067*).

*O. daucorlaya* grows on rocky, dry places in the Balkans and in Italy (only in the Abruzzi Mountains; PIGNATTI, 1982). The chromosome number of all plants of both Albanian sites is 2*n* = 14, which also agrees with the number given by STRID (1971) for Albanian plants. All chromosomes are meta- to submetacentric (Fig. 14A) as indicated in STRID (1971), one pair bears small satellites.

The plants from district Kolonja (cult. No. *12110*) match with typical *O. daucorlaya.* But the plants from district Gjirokastra (cult. No. *12067*) show somewhat different spines on the fruits. These spines on secondary dorsal ridges are not compressed and not confluent at the base. They are thus similar to those of *O. grandiflora* (L.) Hoffm. (see below), but the uniseriate arrangement of the spines and especially the chromosome number, 2*n* = 14, clearly indicate that it is neither *O. grandiflora* nor of hybridogene origin between *O. daucorlaya* and *O. grandiflora,* but probably a special race of *O. daucorlaya.*

**Orlaya grandiflora** (L.) Hoffm. (2*n* = 20).

Rocky roadside on the road from Elbasan to Librazhdi, 16 km after Elbasan, district Librazhdi, 220 m, 2.8.1989 (cult. No. *12096*).

*O. grandiflora* is widespread on dry places in southern and estern Europe. No chromosome counts for Albanian plants have been carried out till now. The chromosome number, 2*n* = 20, of the Albanian plants confirms the numerous indications in literature (compilations see MOORE, 1973, 1974, 1977; FEDEROV, 1974; GOLDBLATT, 1984, 1985; VAN LOON, 1987).

**Tordylium maximum** L. (2*n* = 20).

Rocky slope, Mali i Melesinit, W of Leskoviku, district Kolonja, 900-1000 m, 4.8.1989 (cult. No. *12189*).

*T. maximum* is a widespread ruderal on warm places in south and Central Europe. The Albanian plants show the same chromosome number as given in literature (compilations in MOORE, 1973, 1974; FEDEROV, 1974; GOLDBLATT, 1981, 1984, 1985; VAN LOON, 1987; GOLDBLATT & JOHNSON, 1990).

**Torilis arvensis** (Hudson) Link (2*n* = 12).

Rocks in the gorge of river Cem, 40 km N of Shkodër, district Shkodër, 250 m, 13.8.1989 (cult. No. *12169*). Roadside neaar Mushqeta, on the road from Tirana to Elbasan, district Tirana, 400 m,

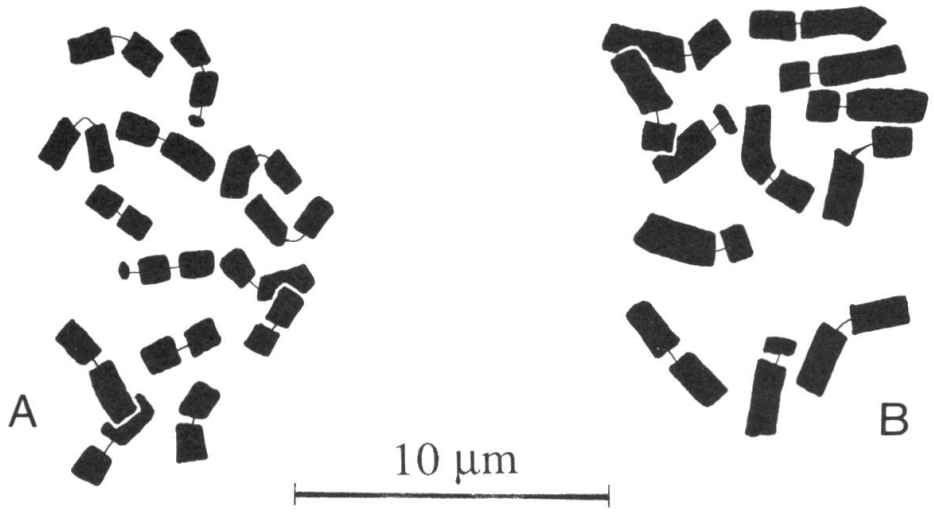


Fig. 14. — Somatic mataphases. **A**, *Orlaya daucorlaya* (No. *12110*) ($2n = 14$); **B**, *Torilis arvensis* (No. *12169*) ($2n = 12$).

8.1989 (cult. No. *12341*). Rocky place, ancient castle of Gjirokastra, district Gjirokastra, 370 m, 6.8.1989 (cult. No. *12107*). Roadside, Syri ë Kaltër near Muzinë, on the road from Gjirokastra to Sarandë, district Sarandë, 150 m, 6.8.1989 (cult. No. *12095*).

*T. arvensis* s.l. is a difficult complex of taxa, growing in dry, open habitats, originally in the Mediterranean area but now northwards to Great Britain and northern Germany. The taxa within the group are usually treated as subspecies, sometimes as species. The distinguishing morphological characters are weak, and the variability rather high. The plants of Mushqeta (cult. No. *12341*) match partly with *T. arvensis* subsp. *neglecta* (Schultess) Thell. (= *T. radiata* Moench), the other three are *T. arvensis* subsp. *arvensis*.

Numerous indications of the chromosome number $2n = 12$ are given in literature for *T. arvensis* s.l. (compilations see MOORE, 1973, 1977; FEDEROV, 1974; GOLDBLATT, 1981, 1984, 1985; BALTISBERGER, 1987; VAN LOON, 1987; GOLDBLATT & JOHNSON, 1990, 1991). The Albanian plants from all four sites have the same chromosome number.

The karyotype consists of 2 metacentric, 8 submetacentric and 2 subtelocentric chromosomes (Fig. 14B). A similar karyotype is given by HAMAL & KOUL (1988) for *T. arvensis*. In addition, they indicate minute satellites in one pair of submetacentric chromosomes, but no satellites were observed in the Albanian plants.

ACKNOWLEDGEMENTS

Thanks for confirmation or determination of specimens are due to Dr. F. Krendl, Vienna, Austria *(Rubiaceae)*, Prof. Dr. A. Strid and Dr. K. Tan, Copenhagen, Denmark *(Medicago)*, Prof. Dr. H. Teppner, Graz, Austria *(Onosma)* and Dr. D. Tzanoudakis, Patras, Greece *(Allium)*. Mr. M. Fotsch looked for the cultivated plants, Mrs. A. Siegwolf took care of our English, and Mrs. S. von Vivis typed the manuscript, for which we are grateful.

REFERENCES

AESCHIMANN, D. (1984). Etude biosystématique du Silene vulgaris s.l. (Caryophyllaceae) dans le domaine alpin. Traitement numérique des populations des Alpes et de quelques chaînes voisines. *Candollea* 39: 399-415.

AFZAL-RAFII, Z. (1979). Contribution à l'étude cytotaxonomique du groupe Salvia verbenaca L. *Bull. Soc. Bot. France* 126: 79-86.

AFZAL-RAFII, Z., M. P. BOSC & J. VIANO (1986). Investigation cytogénétique de quelques plantes médicinales des Massifs du Lubéron, de Lure et du Mont-Ventoux. *Rev. Cytol. Biol. Vég., Bot.* 9: 251-262.

ALDEN, B. (1986). Euphorbia L. *In:* STRID, A. (ed.), *Mountain flora of Greece*. 1: 566-576. Cambridge University Press.

ALDEN, B. & A. STRID (1986). Saxifraga L. *In:* STRID, A. (ed.), *Mountain flora of Greece.* 1: 359-380. Cambridge University Press.

ANCHEV, M. E. (1982). Taxonomic study of Galium L. in Bulgaria. II. Karyological and pollen structural investigation. *Fitologija (Sofia)* 19: 43-68.

ANDERSSON, I. A. (1991a). Allium L. *In:* STRID, A. & K. TAN (eds.), *Mountain flora of Greece.* 2: 701-714. Edinburgh University Press.

ANDERSSON, I. A. (1991b). Lilium L. *In:* STRID, A. & K. TAN (eds.), *Mountain flora of Greece.* 2: 683-686. Edinburgh University Press.

ANDERSSON, I. A., A. CARLSTRÖM, R. FRANZEN, T. KARLEN & H. NYBOM (1983). A revision of the Aethionema saxatile complex (Brassicaceae). *Willdenowia* 13: 3-42.

BADEN, C. (1991a). Stachys L. *In:* STRID, A. & K. TAN (eds.), *Mountain flora of Greece.* 2: 97-107. Edinburgh University Press.

BADEN, C. (1991b). Marrubium L. *In:* STRID, A. & K. TAN (eds.), *Mountain flora of Greece.* 2: 82-84. Edinburgh University Press.

BALL, P. W. (1972a). Onosma L. *In:* TUTIN, T. G. & al. (eds.), *Flora Europaea.* 3: 89-94. Cambridge University Press.

BALL, P. W. (1972b). Stachys L. *In:* TUTIN, T. G. & al. (eds.), *Flora Europaea.* 3: 151-157. Cambridge University Press.

BALTISBERGER, M. (1980). Die Artengruppe des Ranunculus polyanthemos L. in Europa. *Ber. Schweiz. Bot. Ges.* 90: 143-188.

BALTISBERGER, M. (1981). Verwandtschaftsbeziehungen zwischen der Gruppe des Ranunculus polyanthemos L. und R. repens L. sowie Arten der Gruppen des R. acris L. und des R. bulbosus L. *Bot. Helv.* 91: 61-74.

BALTISBERGER, M. (1984). Zytologische Untersuchungen an einigen Pflanzen aus Albanien. *Ber. Geobot. Inst. ETH, Stiftung Rübel, Zürich* 51: 63-77.

BALTISBERGER, M. (1987). Chromosomenzahlen einiger Pflanzen aus Albanien. *Ber. Geobot. Inst. ETH, Stiftung Rübel, Zürich* 53: 47-63.

BALTISBERGER, M. (1988). Chromosomenzahlen einiger Pflanzen aus Albanien. II. *Ber. Geobot. Inst. ETH, Stiftung Rübel, Zürich* 54: 42-50.

BALTISBERGER, M. (1989). Etudes biosystématiques du genre Betonica. Nombres chromosomiques. *Biocosme Mésogéen, Nice* 6: 1-19.

BALTISBERGER, M. (1990). Zytologische Untersuchungen an einigen Arten aus Italien. *Arch. Bot. Ital.* 66: 153-165.

BALTISBERGER, M. (1991a). Chromosomenzahlen einiger Labiaten aus Albanien. *Ber. Geobot. Inst. ETH, Stiftung Rübel, Zürich* 57: 165-181.

BALTISBERGER, M. (1991b). Cytological investigations of some Greek plants. *Fl. Medit.* 1: 157-173.

BALTISBERGER, M. (1991c). Chromosome numbers. *In:* STACE, C. A. (ed.), *IOPB chromosome data 3. IOPB Newsletter* 17: 5-13.

BALTISBERGER, M. (1992). Botanische Notizen und zytologische Untersuchungen an einigen Pflanzen (insbesondere aus den Gattungen Ranunculus und Achillea) aus dem albanisch-jugoslawischen Grenzgebiet (Korab, Sar Planina). *Ber. Geobot. Inst. ETH, Stiftung Rübel, Zürich* 58: 192-211.

BALTISBERGER, M. (1993a). Zytologische Untersuchungen an Compositen aus Albanien. *Candollea* 48: 437-448.

BALTISBERGER, M. (1993b). Two interesting chromosome numbers from the Balkans. *IOPB Newsletter* 20: 12-15.

BALTISBERGER, M. (1994). Chromosome numbers in some species from Greece. *Bot. Chron.* 11: 15-29.

BALTISBERGER, M. & D. AESCHIMANN (1988). Die Chromosomenzahlen der Silene-Arten der Sektion Inflatae (Caryophyllaceae). *Ber. Geobot. Inst. ETH, Stiftung Rübel, Zürich* 54: 51-60.

BALTISBERGER, M. & H. HESS (1986). Zur Verbreitung von Ranunculus polyanthemoides Bor. und R. nemorosus DC. *Veröff. Geobot. Inst. ETH, Stiftung Rübel, Zürich* 87: 79-90.

BALTISBERGER, M. & W. HUBER (1993). Chromosome numbers. *In:* STACE, C. A. (ed.), *IOPB chromosome data 5. IOPB Newsletter* 20: 4-9.

BALTISBERGER, M. & A. LENHERR (1984). Labiaten aus Albanien. *Candollea* 39: 423-439.

BALTISBERGER, M. & A. LEUCHTMANN (1991). Investigations on some Gramineae from Albania and Greece. *Ber. Geobot. Inst. ETH, Stiftung Rübel, Zürich* 57: 182-192.

BALTISBERGER, M., A. MULLAJ & V. TARTARI (1993). Mediterranean chromosome number reports 3 (185-203). *Fl. Medit.* 3: 348-353.

BHATTACHARJEE, R. (1980). Taxonomic studies in Stachys: II. A new infrageneric classification of Stachys L. *Notes Roy. Bot. Gard. Edinburgh* 38: 65-96.

BHATTACHARJEE, R. (1982). Stachys L. *In:* DAVIS, P. H. (ed.), *Flora of Turkey.* 7: 199-262. Edinburgh University Press.

BHATTACHARYYA, N. K. (1958). Cytology of two species of Nigella. *Genetica Iberica* 10: 179-191.

BILLERI, G. (1954). Osservazioni sul cariogramma di Allium moschatum L. (Liliaceae). *Caryologia* 6: 45-51.

BRITTON, D. M. (1951). Cytogenetic studies on the Boraginaceae. *Brittonia* 7: 233-266.

CAPINERI, R., G. D'AMATO & P. MARCHI (1978). Numeri cromosomici per la Flora Italiana: 534-583. *Inform. Bot. Ital.* 10: 421-465.

CHATER, A. O., S. M. WALTERS & J. R. AKEROYD (1993). Silene L. *In:* TUTIN, T. G. & al. (eds.), *Flora Europaea.* 1: 191-218. Cambridge University Press.

CHESHMEDZHIEV, I. V. (1971a). A contribution to the cytotaxonomy of certain species of Allium L. *Bot. Žurn.* 56: 662-670.

CHESHMEDZHIEV, I. V. (1971b). Cytosystematic study of some species from genera Allium L. and Nectaroscordum Lindl. *Bot. Žurn.* 56: 1644-1657.

COLES, S. M. (1971). The Ranunculus acris L. complex in Europe. *Watsonia* 8: 237-261.

COLES, S. M. (1973). Ranunculus bulbosus L. in Europe. *Watsonia* 9: 207-228.

CONTANDRIOPOULOS, J. (1978). Contribution à l'étude cytotaxinomique des Sideritis section Empedoclea (Labiatae). *Pl. Syst. Evol.* 129: 277-289.

CONTANDRIOPOULOS, J. & D. MARTIN (1967). Contribution à l'étude cytotaxinomique des Achillea de Grèce. Irrégularités de la méiose. *Bull. Soc. Bot. France* 114: 257-275.

CONTANDRIOPOULOS, J. & P. QUÉZEL (1973). Deux Dipsacacées nouvelles de Grèce. *Biol. Gallo-Hellen.* 5: 131-137.

D'AMATO, F. (1939). Ricerche embriologiche e cariologiche sul genere Euphorbia. *Nuovo Giorn. Bot. Ital. N.S.* 46: 470-509.

DAMBOLDT, J., G. GRAUMANN, D. PHITOS & V. MELZHEIMER (1981). Beiträge zur Flora Ionica. VII. Der Formenkreis von Scabiosa crenata (Dipsacaceae). *Phyton* 21: 85-102.

DARLINGTON, C. D. & A. P. WYLIE (1955). *Chromosome atlas of flowering plants.* George Allen & Unwin Ltd., London. 519 pp.

DE CANDOLLE, A. (1848). *Prodromus systematis naturalis regni vegetabilis. XII.* Masson, Paris. 707 pp.

DE MONTMOLLIN, B. (1984). Etude cytotaxonomique de la flore de la Crète. II. Nombres chromosomiques. *Bot. Helv.* 94: 261-267.

DIOSDADO, J. C. & J. E. PASTOR (1992). Citotaxonomía de las especies vivaces del género Ranunculus L. sect. Chrysanthe (Spach) L. Benson en la Península Ibérica. *Candollea* 47: 555-576.

DOMAC, R. (1972). Cerinthe L. *In:* TUTIN, T. G. & al. (eds.), *Flora Europea.* 3: 94-95. Cambridge University Press.

DYER, A. F. (1963). The use of lacto-propionic orcein in rapid squash methods for chromosome preparations. *Stain Techn.* 38: 85-90.

EHRENDORFER, F. (1959). Spontane Chromosomenaberrationen und andere Meiosestörungen bei diploiden Sippen des Achillea millefolium-Komplexes. *Chromosoma* 10: 365-406.

EHRENDORFER, F. (1964). Über stammesgeschichtliche Differenzierungsmuster bei den Dipsacaceen. *Ber. Deutsch. Bot. Ges.* 78: 83-94.

EHRENDORFER, F. (1973). *Liste der Gefässpflanzen Mitteleuropas.* Gustav Fischer Verlag, Stuttgart. 318 pp.

FAVARGER, C. (1946). Recherches caryologiques sur la sous-famille des Silénoïdées. *Ber. Schweiz. Bot. Ges.* 56: 364-466.

FAVARGER, C. (1973). Cytotaxonomie de quelques orophytes des Abruzzes. *Acta Bot. Acad. Sci. Hung.* 19: 81-92.

FEDEROV, A. (1974). *Chromosome numbers of flowering plants.* Koeltz, Königstein. 926 pp.

FRANZEN, R. (1986a). Taxonomy of the Achillea clavenae group and the A. ageratifolia group (Asteraceae, Anthemideae) on the Balkan Peninsula. *Willdenowia* 16: 13-33.

FRANZEN, R. (1986b). Anthemis cretica (Asteraceae) and related species in Greece. *Willdenowia* 16: 35-45.

FRANZEN, R. (1991a). Achillea L. *In:* STRID, A. & K. TAN (eds.), *Mountain flora of Greece.* 2: 431-450. Edinburgh University Press.

FRANZEN, R. (1991b). Anthemis L. *In:* STRID, A. & K. TAN (eds.), *Mountain flora of Greece.* 2: 420-431. Edinburgh University Press.

FRANZEN, R. & L.-A. GUSTAVSSON (1983). Chromosome numbers in flowering plants from the high mountains of Sterea Ellas, Greece. *Willdenowia* 13: 101-106.

FREY, L. (1969). Chromosome numbers in the genus Scabiosa L. *Fragm. Florist. Geobot.* 15: 179-184.

GAMS, H. (1964). Labiatae. *In:* HEGI, G., *Illustrierte Flora von Mitteleuropa. 2. Aufl.* 5/4: 2255-2548. C. Hanser, München.

GARBARI, F. & E. SENATORI (1975). Il genere Allium L. in Italia. VI. Contributo alla citosistematica di alcune specie. *Atti Soc. Tosc. Sci. Nat. Mem.,* Ser. B, 82: 1-23.

GARCIA, I. & B. VALDES (1981). Numeros cromosomicos para la flora española, 225-239. *Lagascalia* 10: 241-247.

GAUGER, W. (1937). Ergebnisse einer zytologischen Untersuchung der Familie der Geraniaceae. I. *Planta* 26: 529-531.

GILOT-DELHALLE, J. (1970). Contribution à l'étude cytotaxonomique du genre Nigella L. *Caryologia* 23: 211-223.

GOEPFERT, D. (1974). Caryotypes and DNA content in species of Ranunculus L. and related genera. *Bot. Not.* 237: 464-489.

GOLDBLATT, P. (1981). Index to plant chromosome numbers 1975-1978. *Monogr. Syst. Bot. Missouri Bot. Gard.* 5: 1-533.

GOLDBLATT, P. (1984). Index to plant chromosome numbers 1979-1981. *Monogr. Syst. Bot. Missouri Bot. Gard.* 8: 1-427.

GOLDBLATT, P. (1985). Index to plant chromosome numbers 1982-1983. *Monogr. Syst. Bot. Missouri Bot. Gard.* 13: 1-224.

GOLDBLATT, P. (1988). Index to plant chromosome numbers 1984-1985. *Monogr. Syst. Bot. Missouri Bot. Gard.* 23: 1-264.

GOLDBLATT, P. & D. E. JOHNSON (1990). Index to plant chromosome numbers 1986-1987. *Monogr. Syst. Bot. Missouri Bot. Gard.* 30: 1-243.

GOLDBLATT, P. & D. E. JOHNSON (1991). Index to plant chromosome numbers 1988-1989. *Monogr. Syst. Bot. Missouri Bot. Gard.* 40: 1-238.

GOLDBLATT, P. & D. E. JOHNSON (1994). Index to plant chromosome numbers 1990-1991. *Monogr. Syst. Bot. Missouri Bot. Gard.* 51: 1-267.

GRAU, J. (1966). Unterschiede in der Chromosomengestalt bei Moltkia und Lithospermum. *Ber. Deutsch. Bot. Ges.* 79: 182-187.

GREGSON, N. M. (1965). *Chromosome morphology and cytogenetics in the genus Ranunculus L.* Ph. D. Thesis, Univ. Liverpool. 349 pp.

GREUTER, W. (1965). Beiträge zur Flora der Südägäis 1-7. *Candollea* 20: 167-218.

GREUTER, W., H. M. BURDET & G. LONG (1984). *Med-Checklist 1.* Conservatoire et Jardin botaniques de la Ville de Genève. 330 pp.

GUINOCHET, M. & M. LEFRANC (1981). Chromosome numbers. *In:* LÖVE, A. (ed.), *Chromosome number reports LXXIII. Taxon* 30: 829-861.

GUTH, S. (1990). *Zur Taxonomie der Gattung Festucopsis (Hubbard) Melderis (Poaceae).* Diplomarbeit, Fachbereich Biologie, J. W. Goethe-Universität, Frankfurt a.M. (Manuscript, 96 pp.).

HALACSY, E. (1902). *Conspectus Florae Graecae.* Vol. II, 612 pp. Engelmann, Lipsia.

HAMAL, I. A. & A. K. KOUL (1988). Cytotaxonomic analysis of the Himalayan species of the genus Torilis (Apiaceae). *Pl. Syst. Evol.* 159: 185-192.

HAYEK, A. (1927). *Prodromus Florae Peninsulae Balcanicae.* Vol. 1, 1193 pp. Verlag des Repertoriums, Dahlem bei Berlin.

HAYEK, A. (1928-1931). *Prodromus Florae Peninsulae Balcanicae.* Vol. 2, 1152 pp. Verlag des Repertoriums, Dahlem bei Berlin.

HAYEK, A. (1933). *Prodromus Florae Peninsulae Balcanicae.* Vol. 3, 472 pp. Verlag des Repertoriums, Dahlem bei Berlin.

HEDGE, I. C. (1972). Salvia L. *In:* TUTIN, T. G. & al. (eds.), *Flora Europaea.* 3: 188-192. Cambridge University Press.

HESS, H. E., E. LANDOLT & R. HIRZEL (1977). *Flora der Schweiz. Band 2: Nymphaeaceae bis Primulaceae. 2., durchgesehene Aufl.* Birkhäuser Verlag, Basel und Stuttgart. 956 pp.

HESS, H. E., E. LANDOLT & R. HIRZEL (1980). *Flora der Schweiz. Band 3: Plumbaginaceae bis Compositae. 2., durchgesehene Aufl.* Birkhäuser Verlag, Basel, Boston und Stuttgart. 876 pp.

HUBER, W. & M. BALTISBERGER (1992). Chromosome numbers: Asteraceae. *In:* STACE, C. A. (ed.), *IOPB chromosome data 4. IOPB Newsletter* 18/19: 6-8.

HUBER-MORATH, A. (1975). Achillea L. *In:* DAVIS, P. H. (ed.), *Flora of Turkey.* 5: 224-252. Edinburgh University Press.

JALAS, J. & J. SUOMINEN (eds.) (1986). *Atlas Florae Europaeae. 7. Caryophyllaceae (Silenoideae).* Helsinki. 229 pp.

JARETZKY, R. (1928). Untersuchungen über Chromosomen und Phylogenie bei einigen Cruciferen. *Jahrb. Wiss. Bot.* 68: 1-45 (cited from Federov, 1974).

JÖRGENSEN, C. A. (1927). Cytological and experimental studies in the genus Lamium. *Hereditas* 9: 126-136.

KACHIDZE, N. (1929). Karyologische Studien über die Familie der Dipsacaceae. *Planta* 7: 482-502.

KNORRING, O. E. (1977). BetonicaL. *In:* SHISHKIN, B. K. (ed.), *Flora of the U.S.S.R. Labiatae.* 11: 172-176. Israel Program for Scientific Translations, Jerusalem.

KOEVA, J. (1977). Cytotaxonomical study of some Balkan endemic taxa of genus Stachys L. *Phytology (Sofia)* 6: 38-46.

KOKKINI, S. (1991). Pterocephalus Vaill. ex Adanson. *In:* STRID, A. & K. TAN (eds.), *Mountain flora of Greece.* 2: 358-359. Edinburgh University Press.

KOZUHAROV, S. I. & A. V. PETROVA (1975). Chromosome numbers. *In:* LÖVE, A. (ed.), *IOPB chromosome number reports XLVIII. Taxon* 24: 367-372.

KOZUHAROV, S. I. & A. V. PETROVA (1981). The caryotype of a relic grass species and some notes on its relations. *Bol. Soc. Brot., Ser. 2,* 53: 1177-1181.

KUZMANOV, B. & S. KOZUHAROV (1970). Chromosome numbers. *In:* LÖVE, A. (ed.), *IOPB chromosome number reports XXVI. Taxon* 19: 264-269.

KUZMANOV, B. & S. KOZUHAROV (1973). Karyological study of Bulgarian Compositae. 2. *Izv. Bot. Inst. (Sofia)* 24: 125-137.

LANG, A. (1940). Untersuchungen über einige Verwandtschafts- und Abstammungsfragen in der Gattung Stachys L. auf cytogenetischer Grundlage. *Bibl. Bot.* 118: 1-94.

LANGLET, O. (1936). Nagra bidrag till kännedomen om kromosomtalen inom Nymphaeaceae, Ranunculaceae, Polemoniaceae och Compositae. *Sv. Bot. Tidskr.* 30: 288-294.

LARTER, L. N. H. (1932). Chromosome variation and behaviour in Ranunculus L. *J. Genet.* 26: 255-283.

LESINS, K. A. & I. LESINS (1979). *Genus Medicago (Leguminosae) — a taxogenetic study.* Junk, the Hague. 228 pp.

LEVAN, A., K. FREDGA & A. A. SANDBERG (1964). Nomenclature for centromeric position on chromosomes. *Hereditas* 52: 201-220.

LÖVE, A. & D. LÖVE (1974). *Cytotaxonomical atlas of the Slovenian flora.* J. Cramer, Lehre. 1241 pp.

LOVKA, M., F. SUSNIK, A. LÖVE & D. LÖVE (1971). Chromosome numbers. *In:* LÖVE, A. (ed.), *IOPB chromosome number reports XXXIV. Taxon* 20: 785-797.

LOVKA, M., F. SUSNIK, A. LÖVE & D. LÖVE (1972). Chromosome numbers. *In:* LÖVE, A. (ed.), *IOPB chromosome number reports XXXVI. Taxon* 21: 333-346.

MAGULAEV, A. Y. (1984). Cytotaxonomic study in some flowering plants of the North Caucasus. *Bot. Žurn.* 69: 511-517.

MAJOVSKY, J. & al. (1970). Index of chromosome numbers of Slovakian flora. *Acta Fac. Rer. Nat. Univ. Comenianae Bot.* 16: 1-26.

MARCHI, P. (1968). Sulla utilita di due indici ricavati dalla elaborazione biometrica dei cariotipi. *Giorn. Bot. Ital.* 102: 569-570.

MARCHI, P. (1971). Numeri cromosomici per la Flora Italiana: 45-56. *Inform. Bot. Ital.* 3: 82-94.

MARCHI, P., R. CAPINERI & G. D'AMATO (1975). Numeri cromosomici per la Flora Italiana: 208-218. *Inform. Bot. Ital.* 7: 377-389.

MARKOVA, M. (1982). Chromosome numbers. *In:* LÖVE, A. (ed.), *IOPB chromosome number reports LXXVII. Taxon* 31: 761-777.

MARKOVA, M. & P. IVANOVA (1971). Karyologische Untersuchungen der Vertreter der Familien Boraninaceae, Labiatae und Scrophulariaceae in Bulgarien. II. *Mitt. Bot. Inst. Bulg. Akad. Wiss.* 21: 123-131.

MARKOVA, M. L. & P. S. IVANOVA (1982). Caryological investigation of the genus Salvia L. in Bulgaria I. *Phytology (Sofia)* 19: 24-42.

MATTHEWS, V. A. (1980). Lilium L. *In:* TUTIN, T. G. & al. (eds.), *Flora Europaea.* 5: 34-35. Cambridge University Press.

MELDERIS, A. (1978). Taxonomic notes on the genus Festucopsis (C. E. Hubbard) Melderis. *Bot. J. Linn. Soc.* 76: 316-320.

MELZHEIMER, V. (1986). Silene L. *In:* STRID, A. (ed.), *Mountain flora of Greece.* 1: 135-170. Cambridge University Press.

MICEVSKI, K. (1973). Beitrag zur Taxonomie und Chorologie des Medicago prostrata-agg. in Mazedonien. *God. Sborn. Prirod.-Mat. Fak. Univ. Skopje, Biol.* 25: 137-147.

MOORE, R. J. (1973). Index to plant chromosome numbers 1967-1971. *Regnum Vegetabile* 90: 1-539.

MOORE, R. J. (1974). Index to plant chromosome numbers for 1972. *Regnum Vegetabile* 91: 1-108.

MOORE, R. J. (1977). Index to plant chromosome numbers for 1973/74. *Regnum Vegetabile* 96: 1-257.

PAPANICOLAOU, K. & S. KOKKINI (1982). A taxonomic revision of Sideritis L. section Empedoclia (Rafin.) Bentham (Labiatae) in Greece *In:* MARGARIS, N., A. KOEDAM & D. VOKOU (eds.), *Aromatic plants: basic and applied aspects:* 101-128. Martinus Nijhoff Publishers, The Hague.

PERRY, B. A. (1943). Chromosome number and phylogenetic relationships in the Euphorbiaceae. *Am. J. Bot.* 30: 527-543.

PIGNATTI, S. (1982). *Flora d'Italia.* 2: 732 pp. Edagricole, Bologna.

POLYA, L. (1950). Chromosome numbers of Hungarian plants. II. *Ann. Biol. Univ. Debrecen.* 1: 46-56 (cited from Federov, 1974).

PRESTON, C. D. & A. STRID (1986). Medicago L. *In:* STRID, A. (ed.), *Mountain flora of Greece.* 1: 493-497. Cambridge University Press.

RECHINGER, K. H. (1937). Revision des Formenkreises der Stachys cretica. *Ann. Naturh. Mus. Wien* 48: 167-178.

RECHINGER, K. H. (1941a). Neue und kritische Labiaten aus dem Orient und Mittelmeergebiet. *Bot. Jahrb. Syst.* 71: 526-546.

RECHINGER, K. H. (1941b). Monographische Studie über Teucrium Sect. Chamaedrys. *Bot. Arch.* 42: 335-420.

RECHINGER, K. H. (1952). Labiatae novae orientales. *Österr. Bot. Z.* 99: 37-64.

REYNAUD, C., D. FILOSA & R. VERLAQUE (1992). Mediterranean chromosome number reports 2: 98-106. *Fl. Medit.* 2: 258-264.

SEBERG, O., S. FREDERIKSEN, C. BADEN & I. LINDE-LAURSEN (1991). Peridictyon, a new genus from the Balkan peninsula, and its relationship with Festucopsis (Poaceae). *Willdenowia* 21: 87-104.

SHIMOTOMAI, N. (1930a). Chromosomenzahlen und Phylogenie bei der Gattung Potentilla. *J. Sci. Hiroshima Univ. Ser. B, Div. 2 (Bot.)* 1: 1-11.

SHIMOTOMAI, N. (1930b). Über die Chromosomenzahlen und die Phylogenie bei der Gattung Potentilla. *Bot. Mag. (Tokyo)* 44: 490-498.

SLÁVIK, B., V. JAROLIMOVA & J. CHRTEK (1993). Chromosome counts of some plants from Cyprus. *Candollea* 48: 221-230.

SMITH, A. R. & T. G. TUTIN (1968). Euphorbia L. *In:* TUTIN, T. G. & al. (eds.), *Flora Europaea* 2: 213-226. Cambridge University Press.

SOPOVA, M. (1971). The karyology of three Macedonian Liliums. *God. Sborn. Prirod-Mat. Fak. Univ. Skopje, Biol.* 23: 151-161.

STEARN, W. T. (1980). Allium L. *In:* TUTIN, T. G. & al. (eds.), *Flora Europaea* 5: 49-69. Cambridge University Press.

STEWART, R. N. (1947). The morphology of somatic chromosomes in Lilium. *Am. J. Bot.* 34: 9-26.

STREY, M. (1931). Karyologische Studien an Borraginoideae. *Planta* 14: 682-730.

STRID, A. (1971). Chromosome numbers in some Albanian angiosperms. *Bot. Not.* 124: 490-496.

STRID, A. (ed.) (1986a). *Mountain flora of Greece.* 1: 822 pp. Cambridge University Press.

STRID, A. (1986b). Chromosome numbers. *In:* LÖVE, A. (ed.), *Chromosome number reports XCIII. Taxon* 35: 897-903.

STRID, A. & I. A. ANDERSSON (1985). Chromosome numbers of Greek mountain plants. An annotated list of 115 species. *Bot. Jahrb. Syst.* 107: 203-228.

STRID, A. & R. FRANZEN (1981). Chromosome numbers. *In:* LÖVE, A. (ed.), *Chromosome number reports LXXIII. Taxon* 30: 829-861.

STRID, A. & R. FRANZEN (1983). Chromosome numbers. *In:* LÖVE, A. (ed.), *IOPB chromosome number reports LXXVIII. Taxon* 32: 138-141.

STRID, A. & K. TAN (eds.) (1991). *Mountain flora of Greece.* 2: 974 pp. Edinburgh University Press.

SZ.-BORSOS, O. (1970). Contributions to the knowledge on the chromosome numbers of Phanerogams growing in Hungary and southeastern Europe. *Acta Bot. Acad. Sci. Hung.* 16: 255-265.

SZ.-BORSOS, O. (1971). Contributions to the knowledge on the chromosome numbers of Phanerogams growing in Hungary and southeastern Europe. II. *Acta Bot. Acad. Sci. Hung.* 17: 37-46.

TEPPNER, H. (1971a). Cytosystematik, bimodale Chromosomensätze und permanente Anorthoploidie bei Onosma (Boraginaceae). *Österr. Bot. Z.* 119: 196-223.

TEPPNER, H. (1971b). Cytosystematische Studien an Onosma (Boraginaceae). Die Formenkreise von O. echioides, O. helveticum und O. arenarium. *Ber. Deutsch. Bot. Ges.* 84: 691-696.

TEPPNER, H. (1991a). Onosma L. *In:* STRID, A. & K. TAN (eds.), *Mountain flora of Greece* 2: 26-39. Edinburgh University Press.

TEPPNER, H. (1991b). Karyology of some Greek Onosma species (Boraginaceae). *Bot. Chron.* 10: 271-292.

THOMAS, S. M. (1983). A taxonomic clarification of Petrorhagia section Kohlrauschia (Caryophyllaceae). *Bot. J. Linn. Soc.* 87: 55-75.

THOMAS, S. M. & B. G. MURRAY (1981). Breeding systems and hybridization in Petrorhagia sect. Kohlrauschia (Caryophyllaceae). *Pl. Syst. Evol.* 139: 77-94.

THOMAS, S. M. & B. G. MURRAY (1983). Chromosome studies in species and hybrids of Petrorhagia sect. Kohlrauschia (Caryophyllaceae). *Pl. Syst. Evol.* 141: 243-255.

TORNADORE, N. (1982). Contributo alla conoscenza citotassonomica di "Allium moschatum" L. *Webbia* 35: 283-293.

TSCHERMAK-WOESS, E. & R. DOLEZAL (1953). Durch Seitenwurzelbildung induzierte und spontane Mitosen in den Dauergeweben der Wurzel. *Österr. Bot. Z.* 100: 358-405.

TUTIN, T. G. & J. R. AKEROYD (1993). Ranunculus L. *In:* TUTIN, T. G. & al. (eds.), *Flora Europaea* 1(second ed.): 269-286. Cambridge University Press.

TZANOUDAKIS, D. (1983). Karyotypes of ten taxa of Allium section Scorodon from Greece. *Caryologia* 36: 259-284.

TZANOUDAKIS, D. & G. IATROU (1981). New combinations for two endemic taxa of the Greek flora. *Bot. Chron.* 1: 22-28.

VAN LOON, J. C. (1980). Chromosome numbers. *In:* LÖVE, A. (ed.), *IOPB chromosome number reports LXIX. Taxon* 29: 703-730.

VAN LOON, J. C. (1984). Chromosome numbers in Geranium from Europe. I. The perennial species. *Proc. Kon. Ned. Akad. Wetensch. Ser. C.* 87: 263-277.

VAN LOON, J. C. (1987). *A cytotaxonomical atlas of the Balkan flora.* J. Cramer, Berlin/Stuttgart. 416 pp.

VAN LOON, J. C. & B. KIEFT (1980). Chromosome numbers. *In:* LÖVE, A. (ed.), *IOPB chromosome number reports LXVIII. Taxon* 29: 533-547.

VAN LOON, J. C. & H. M. SNELDERS (1979). Chromosome numbers. *In:* LÖVE, A. (ed.), *IOPB chromosome number reports LXV. Taxon* 28: 627-637.

VERLAQUE, R. (1975). Contribution à l'étude caryologique des Dipsacaceae de la Méditerranée orientale. *Biol. Gallo-Hellen.* 6: 75-100.

VERLAQUE, R. (1977a). Chromosome numbers. *In:* LÖVE, A. (ed.), *IOPB chromosome number reports LVI. Taxon* 26: 257-274.

VERLAQUE, R. (1977b). Validité et position systématique du genre Tremastelma Rafin. (Dipsacaceae). *Rev. Biol. Ecol. Médit.* 4: 105-115.

VERLAQUE, R. (1978). Etude cytotaxinomique de quelques Dipsacaceae et Morinaceae du nord de la Grèce. *Rev. Biol. Ecol. Med.* 5(1): 15-30.

VERLAQUE, R. (1980). Chromosome numbers. *In:* LÖVE, A. (ed.), *IOPB chromosome number reports LXVII. Taxon* 29: 347-367.

VERLAQUE, R. (1982). Chromosome numbers. *In:* LÖVE, A. (ed.), *IOPB chromosome number reports LXXVII. Taxon* 31: 761-777.

VERLAQUE, R. (1986a). Etude biosystématique et phylogénétique des Dipsacaceae. IV. Tribu des Scabioseae (phylum n° 1, 2, 3). *Rev. Cytol. Biol. Végét. Bot.* 9: 5-72.

VERLAQUE, R. (1986b). Etude biosystématique et phylogénétique des Dipsacaceae. V. Tribu des Scabioseae (phylum n° 4) et conclusion. *Rev. Cytol. Biol. Végét. Bot.* 9: 97-176.

VON BOTHMER, R. (1970). Cytological studies in Allium. I. Chromosome numbers and morphology in Allium sect. Allium from Greece. *Bot. Not.* 123: 518-550.

WARBURG, E. F. (1938). Taxonomy and relationship in the Geraniales in the light of their cytology. *New Phytol.* 37: 130-159.

WEBB, D. A. (1993). Saxifraga L. *In:* TUTIN, T. G. & al. (eds.), *Flora Europaea* 1 (second ed.): 437-458. Cambridge University Press.

WITTMANN, H. (1984). Beiträge zur Karyologie der Gattung Allium und zur Verbreitung der Arten im Bundesland Salzburg (Österreich). *Linzer Biol. Beitr.* 16: 83-104.

WRIGLEY, F. (1986). Taxonomy and chorology of Silene section Otites (Caryophyllaceae). *Ann. Bot. Fennici* 23: 69-81.

YEO, P. F. (1984). Fruit-discharge-type in Geranium (Geraniaceae): its use in classification and its evolutionary implications. *Bot. J. Linn. Soc.* 89: 1-36.

Address of the authors: Geobotanisches Institut ETH, Zollikerstrasse 107, CH-8008 Zürich, Switzerland.