ACTA SOCIETATIS
BOTANICORUM POLONIAE
vol. XXXVI — nr 3
1967

Chromosomes of some *Trollius* species

A. DOROSZEWSKA

Studies conducted so far indicate that species of the genus *Trollius* do not differ in chromosome numbers. Their characteristic diploid chromosome number is 2n = 16 (Langlet 1927, 1936; Lewitsky 1931; Żukowa 1961; Doroszewska 1965, and others). This constant chromosome number does not exclude the possibility of differences in their morphology, and it can be supposed that karyotypes of individual taxa are not identical. This problem is interesting from the point of view of phylogeny of the *Trollius* species and it may throw some light on the taxonomic problems within the genus. For this reason the author, who conducts observations and experiments on the genus *Trollius*, has found it necessary to study these karyotypes in greater detail.

Very little is known so far about the morphology of *Trollius* chromosomes. Kurita (1957, 1959, 1960, 1965) in his study of chromosomes within the family *Ranunculaceae* has described the karoytypes for six species of *Trollius*. The material described in the present paper contains data for 7 taxa, of which *T. altaicus*, *T. europaeus* and *T. Ledebouri* have been previously described by Kurita. Kurita has conducted studies on plants which he has received from Botanical Gardens whreas the specimens of *T. altaicus* and *T. europaeus* used by the author of this paper came from natural stands. Thus a study of this material and comparison of results seems in order.

MATERIALS AND METHODS

The observations were conducted on the following material. *Trollius altaicus* C.A.M. (No. 20) — seeds collected from a natural stand in the Altai Mts.
Trollius chinensis Bge. (No. 25) — from the Warsaw Botanic Garden
Trollius europaeus L. (No. 55) — from natural stands in the Białowieża Forest.
Trollius europaeus var. *transsilvanicus* (Schur) Bł. (No. 27) — from a natural stand in the Bieszczady Mts.
Trollius Ledebouri Rchb. (No. 4) — from the Warsaw Botanic Garden.
Trollius pumilus Don. (No. 10) — „ „ „ „ „
Trollius yunnanensis Ulbr. (No. 90) — seeds obtained from the Botanic Garden in Greifswald in the year 1959.

The plants mentioned above have been cultivated in identical conditions on plots in the Warsaw Botanic Garden. Squash preparations have been made from root tips by the Dyer (1963) method somewhat modified and adjusted to the material. The chromosomes have been measured on fresh preparations. For each taxon 5—10 metaphase plates have been measured. Mean chromosome lengths have been calculated as well as the mean lengths of the arms and the ratio of the short arm length to the long arm length (index). Results of the measurements and calculations are presented in tables.

OBSERVATIONS

Trollius plants have relatively long chromosomes with two arms. Usually one arm is shorter than the other. The centromere can be situated more or less subterminally or somewhat closer towards the centre of the chromosome. In most chromosomes one arm is more or less twice as long as the other. On the basis of chromosome size and the location of the centromere the author was able to distinguish 4 basic classes of chromosomes in the studied karyotypes of *Trollius*:

A — longer chromosomes, with the arm ratio more or less 1 : 2 (index 0,47—0,52). In some the ratio of the arms is more or less 2 : 3 (index 0.64) and such chromosomes have been marked as A_1.

B — longer chromosomes with a subterminal centromere. The arm ratio is approximately 1 : 3 (index 0.30—0.35) or 1 : 4 (index 0,24—0.25).

C — shorter chromosomes. Arm ratio more or less 1 : 2 (index 0,48—0.52): chromosomes with index of 0.62 have been described as C_1.

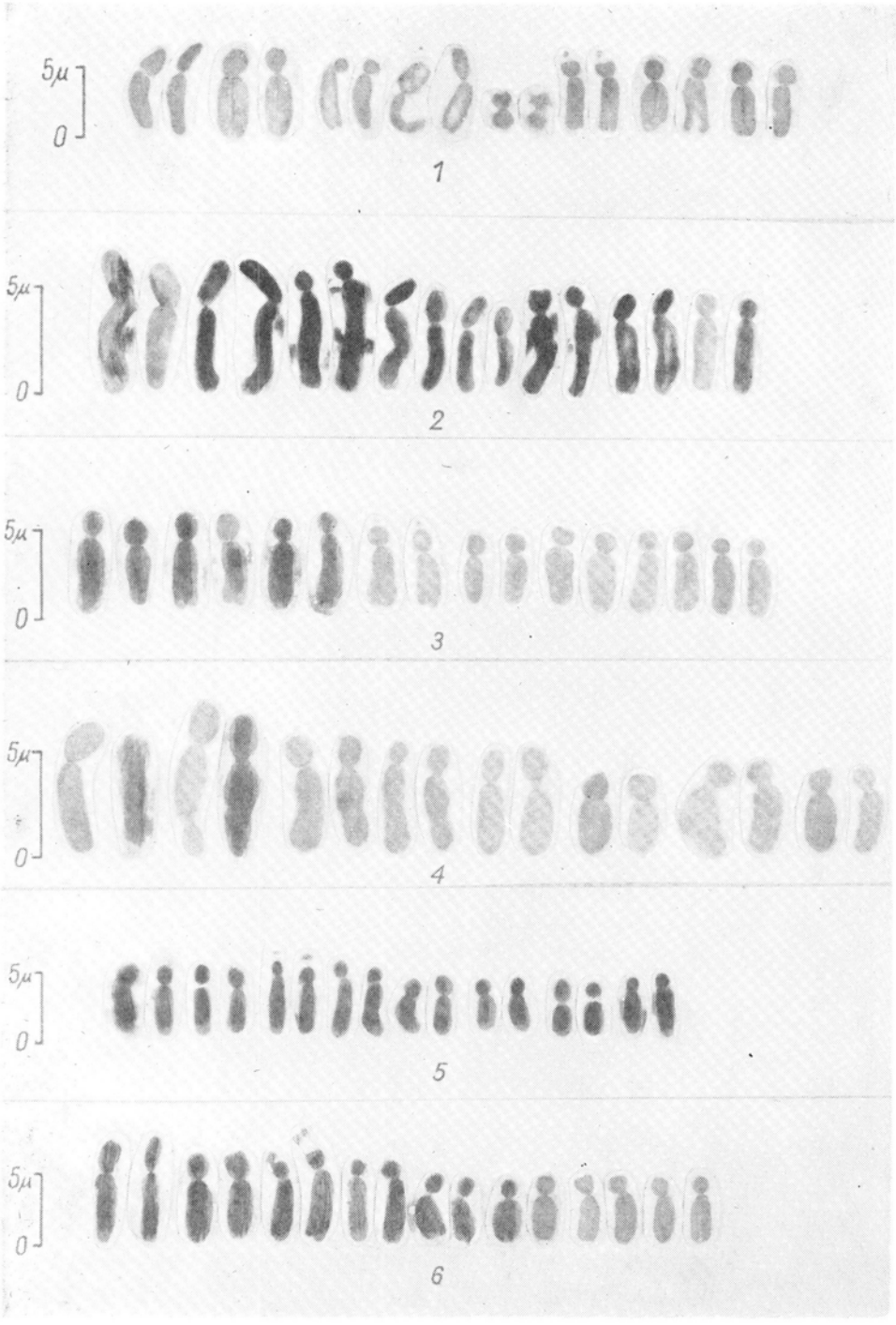
D — shorter chromosomes with a subterminal centromere. Their ratio is 1 : 3 (index 0.31—0.35) or 1 : 4 (index 0.24—0.25).

Chromosomes of the class C and D are in some taxa of more or less the same length and sometimes their differentiation has caused some difficulties. In chromosomes with a satellite, it is always attached to the shorter arm. The presence of the satellite has been marked by the letters Sat.

Trollius altaicus

The karyotype of *T. altaicus* has been described on the basis of measurements on 8 metaphase plates in two plants. Data presented in table I contains the mean lengths calculated for 16 chromosomes. In this species the longest chromosomes have been found (Table I, Plate II). The karyotype of *T. altaicus* contains three pairs of longer chromosomes and 5 pairs of shorter chromosomes. The first two pairs are longest and their arm ratios are 0.48 and 0.49 respectively, thus these are two similar chromosomes of class A. The third pair is somewhat shorter, and its centromere is positioned more terminally. It is a pair of class B and its arm ratio (index) is 0.31. On the longer arm of this chromosome a secondary constriction has been found positioned along about 1/3 of the arm's length (Plate II, fig. *1, B*). Following two chromosome pairs are of class C one of which however is considerably shorter than

Plate I



Photomicrograph of *Trollius* chromosomes

1 — *T. altaicus*, 2 — *T. chinensis*, 3 — *T. europaeus* var. *transsilvanicus*. 4 — *T. Ledebouri*, 5 — *T. pumilus*, 6 — *T. yunnanensis*

Table 1

The mean chromosome lengths

	Pair	Class	Length of chromosomes μ	Length of arms in μ	Index
T. altaicus	1	A	7,9	2,6 : 5,3	0,49±0,006
	2	A	7,7	2,5 : 5,2	0,48±0,008
	3	B	6,3	1,5 : 4,8	0,31±0,015
	4	C	5,5	1,8 : 3,7	0,49±0,009
	5	C	4,4	1,5 : 2,9	0,52±0,006
	6	D+Sat	5,5	1,1 : 4,4	0,24±0,017
	7	D	5,5	1,1 : 4,4	0,25±0,012
	8	D	5,4	1,1 : 4,3	0,25±0,009
T. chinensis	1	A	6,0	2,0 : 4,0	0,50±0,013
	2	A	5,8	2,0 : 3,8	0,52±0,013
	3	B	5,2	1,0 : 4,2	0,25±0,006
	4	C	4,1	1,4 : 2,7	0,52±0,020
	5	C	4,1	1,4 : 2,7	0,52±0,053
	6	D	4,4	1,1 : 3,3	0,33±0,004
	7	D	4,4	1,1 : 3,3	0,33±0,008
	8	D	4,2	1,0 : 3,2	0,31±0,013
T. europaeus var. *transsilvanicus*	1	A	6,4	2,2 : 4,2	0,52±0,007
	2	A	5,6	1,8 : 3,8	0,49±0,012
	3	B	5,6	1,3 : 4,3	0,30±0,006
	4	C+Sat	4,5	1,5 : 3,0	0,50±0,003
	5	C	4,3	1,4 : 2,9	0,52±0,020
	6	D	4,6	1,2 : 3,4	0,35±0,003
	7	D	4 6	1,1 : 3,5	0,31±0,004
	8	D	4,2	1,0 : 3,2	0,31±0,004
T. europaeus	1	A	4,7	1,6 : 3,1	0,51±0,012
	2	A	4,6	1,5 : 3,1	0,48±0,011
	3	B	4,4	1,1 : 3,3	0,33±0,000
	4	C+Sat	3,4	1,1 : 2,3	0,48±0,005
	5	C	3,4	1,1 : 2,3	0,49±0,020
	6	C	3,3	1,1 : 2,2	0,50±0,017
	7	D	3,5	0,9 : 2,6	0,34±0,007
	8	D	3,3	0,8 : 2,5	0,32±0,004

the other. It is the shortest chromosome pair in the karyotype. On the photomirograph (Plate I, fig. 1) this fifth chromosome pair appears to be even shorter than in reality. According to measurements its mean length is 4.4 μ, which is more than half of the length of chromosomes A. The last three chromosome pairs belong to class D. The sixth pair has a small satellite on the shorter arm and its arm ratio is 0.24. The seventh and eight pair are impossible to differentiate. Their index is identical namely 0.25. The karyotype of *T. altaicus* can be described by the formula $2A+B+2C+D_{Sat}+2D$.

Trollius chinensis

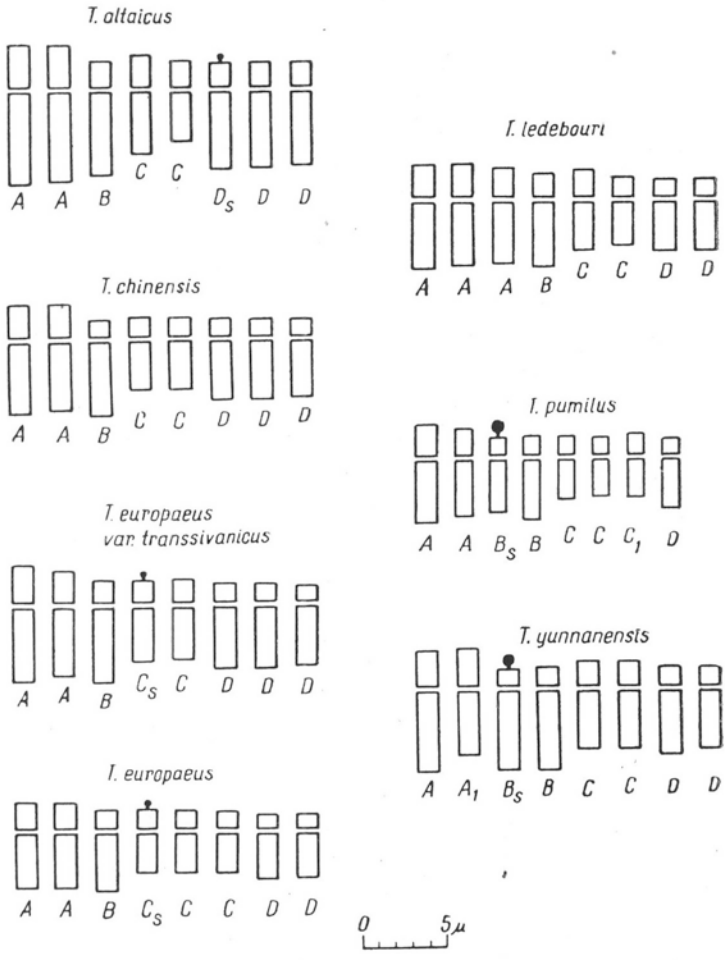
The karyotype of *T. chinensis*, similarly as that of *T. altaicus* contains three pairs of longer chromosomes and 5 pairs of shorter chromosomes. Measurements were made on five mataphase plates of one plant. *T. chinensis* has chromosomes of medium length. In its karyotype very distinctly two pairs of chromosomes of class A can be found. They are of more or less equal length, and even though their index is respectively 0.50 and 0.52 they are not possible to distinguish from one another. The third pair of chromosomes, of class B is the most asymmetrical one in the karyotype, since its index is 0.25, i.e. the arms are in the ratio 1 : 4. The fourth and fifth chromosome pairs are identical, belong to class C and their index is 0.52. The last three chromosomes pairs belong to class D. It is practically impossible to distinguish between them even though the last one is somewhat smaller. A satellite has not been found in this karyotype, and if it does exist it must be very closely appressed to a chromosome arm. The formula for the *T. chinensis* karyotype is 2A+B+2C+3D.

Trollius europaeus and *T. auropaeus* var. *transsilvanicus*

Measurements of chromosomes of *T. europaeus* and *T. europaeus var. transsilvanicus* has been performed on 10 metaphase plates of one plant for each of these taxa. As can be seen from the listings (Table 1, Plate II, fig. 3, fig. 4), the chromosomes of T. *europaeus* are smaller than those of *T. europaeus var. transsilvanicus*. In spite of applying the same cytological method in both cases, the chromosomes of *T. europaeus var. transsilvanicus* had a weaker spiral and were less compact than the chromosomes of *T. europaeus*. This is probably the reason for certain small differences in the karyotypes of the taxa. Plants of *T. europaeus var. transsilvanicus* coming from the Bieszczady grew very luxuriantly, and were bigger than the specimens of *T. europaeus* from Białowieża. If *T. europaeus* var. *transsilvanicus* has somewhat longer chromosomes, then certainly that difference is not as large as would appear from table 1. The first three pairs of *T. europaeus* chromosomes are of equal length, two of which belong to class A and one to class B. Of the 5 pairs of shorter chromosomes, three have been classified as C and two as D. One of the pairs of class C contains a small satelite on the shorter arm, and the remaining two do not differ from each other. Also the two pairs of D chromosomes are impossible to distinguish in spite of the fact that their indices are 0.34 and 0.32 respectively.

The karyotype of *T. europaeus* var. *transsilvanicus* is generally speaking the same as that of *T. europaeus*. The observed differences are not large. One pair of the class C chromosomes has a satelite similarly as in *T. europaeus*, however in contrast to *T. europaeus* among the shorter chromosomes two pairs were classed as C three as D. One pair of D chromosomes has index 0.35. The centromere of these chromosomes is positioned slightly more medially and it is probably this pair of chromosomes that was classed as C in *T. europaeus*. The main difference therefore concerns one pair of C chromosomes. As has been mentioned at the onset, the distinction between C and D chromosomes was often not very clear and in the case of these taxa these difficulties were present. For this reason it can be considered that differences

Plate II



Diagrams of *Trollius* karyotypes

between these two taxa are not significant and could have been caused by an uneven shrinking of the two chromosome arms.

Karyotypes of these two taxa can be compared by the formulae:

T. europaeus $2A+B+C_{Sat}+2C+2D$

T. europaeus var. *transsilvanicus* $2A+B+C_{Sat}+C+3D$.

Trollius Ledebouri

The karyotype of *T. Ledebouri* is somewhat different from those described so far. It consists of four pairs of longer chromosomes and 4 pairs of shorter chromosomes. Ammong the longer ones three pairs were of class A with arm ratios 0.50, 0,51 and 0.47 respectively (Table 2; Plate II, fig. 5). The first two pairs are identical and the third is somewhat shorter. Also on the second chromosome pair of class A a secondary constriction has been found on the longer arm (Plate 1. fig. 4). The pair of B chromosomes is more or less of the same length as the third A pair of chromosomes. Its index is 0.34. Ammong the four pairs of shorter chromosomes two pairs have been classified as C and two as D chromosomes. One pair of C chromosomes is somewhat shorter than the other while both pairs of the D chromosomes are of equal length. No satellite has been found. Only five metaphase plates have been measured from one plant, but they contained chromosomes with a distinct morphology. The karyotype of *T. Ledebouri* can be described by the formula $3A+B+2C+2D$.

Trollius pumilus

The koryotype of *T. pumilus* similarly as that of *T. Ledebouri* has four pairs of longer chromosomes and four pairs of shorter chromosomes. The first pair of chromosomes of class A is the longest in the karyotype. These chromosomes are not only longer but are markedly broader than the rest. Table 2, Plate I, fig. 5, Plate II fig. 6). The second pair of chromosomes is also of class A, whereas the following two pairs are of class B and their indices are respectively 0.35 and 0.32. One pair of the B chromosomes has a large satellite attached to the shorter arm and is easy therefore to distinguish. The next two pairs of chromosomes that is the fifth and the sixth are identical and belong to class C. The seventh pair has its arm ratio 0.62 and therefore is of class C_1. The last pair of chromosomes belongs to class D and has somewhat greater dimetions than chromosomes C.

Measurements of the karyotype of *T. pumilus* have been made on 10 metaphase plates of two plants. The chromosomes of *T. pumilus* appear somewhat smaller than those of other species. In length the dimentions are about what they are in other species but since they are narrower they appear to be smaller. Only the first pair of chromosomes is of the same thickness as in other taxa. The karyotypic formula for *T. pumilus* is $2A+B_{Sat}+B+2C+C_1+D$.

Trollius yunnanensis

The karyotype of *T. yunnanensis* has been described on the basis of 6 metaphase plates of one plant. Similarly as in last two species *Trollius yunnanensis* has half of

Table 2

The mean chromosome lengths

	Pair	Class	Length of chromosomes in μ	Length of arms in μ	Index
T. Ledebouri	1	A	5,7	1,9 : 3,8	0,50±0,000
	2	A	5,6	1,9 : 3,7	0,51±0,007
	3	A	5,3	1,7 : 3,6	0,47±0,013
	4	B	5,1	1,3 : 3,8	0,34±0,003
	5	C	4,3	1,5 : 2,8	0,50±0,014
	6	C	3,7	1,2 : 2,5	0,48±0,021
	7	D	3,9	1,0 : 2,9	0,34±0,008
	8	D	3,9	1,0 : 2,9	0,34±0,004
T. yunnanensis	1	A	6,7	2,2 : 4,5	0,49±0,004
	2	A_1	5,9	2,3 : 3,6	0,64±0,018
	3	B+Sat	5,5	1,1 : 4,4	0,25±0,017
	4	B	5,6	1,1 : 4,5	0,24±0,003
	5	C	4,9	1,6 : 3,3	0,48±0,007
	6	C	4,9	1,6 : 3,3	0,48±0,008
	7	D	4,8	1,2 : 3,6	0,33±0,005
	8	D	4,4	1,1 : 3,3	0,33±0,000
T. pumilus	1	A	5,3	1,8 : 3,5	0,51±0,015
	2	A	4,8	1,6 : 3,2	0,50±0,019
	3	B+Sat	4,2	1,1 : 3,1	0,35±0,009
	4	B	4,5	1,1 : 3,4	0,32±0,004
	5	C	3,3	1,1 : 2,2	0,50±0,018
	6	C	3,2	1,1 : 2,1	0,52±0,014
	7	C_1	3,4	1,3 : 2,1	0,62±0,024
	8	D	3,6	0,9 : 2,7	0,33±0,005

its chromosomes longer and half shorter. The karyotype contains two pairs of A class of chromosomes, the first one having the longest chromosomes with an arm ratio of 0.49, and the other having somewhat smaller chromosomes with a 0.64 arm ratio. Thus this latter pair was classified as A_1. The following two pairs of chromosomes, that is the third and the fourth, belong to class B. The third pair has large satellites on the shorter arms and the arm ratio is 0.25. The fourth pair is similar with an arm ratio of 0.24.

These are the most asymmetrical chromosomes in the karyotype. In *T. yunnanensis* similarly as in *T. pumilus* the satelilte occurs on the chromosomes of class B.

The karyotype of *T. yunnanensis* consists further of two identical pairs of chromosomes of class C and of two pairs of chromosomes D. As can be seen from the measurements, one of the D pair is somewhat shorter, but for practical purposes the last two pairs are indistinguishable (Table 2, Plate I. fig. 6, Plate II, fig. 7). The karyotype of T. *yunnanensis* can be described by the formula $A+A_1+B_{Sat}+B+2C+$ $+2D$.

DISCUSSION

Langlet (1932) has divided the chromosomes of the *Ranunculaceae* family into two groups one of which contains small chromosomes of type T and the other contains large chromosomes of type R. *Trollius* has large chromosomes all of which belong to the R type of Langlet.

The classification into longer and shorter chromosomes was made by the author in order to facilitate the differentiation of various chromosomes pairs in the karyotypes of *Trollius*. As has been observed from the measurements made in the group of the longer chromosomes the greatest lenghts were found in *T. altaicus* (7.9 μ) and the shortest in *T. pumilus* (4.2 μ). In the group of shorter chromosomes the longest ones were in *T. altaicus* (5.5 μ) and the shortest in *T. pumilus* (3.2 μ). Thus it can be seen that the division into longer and shorter chromosomes is only a relative concept yet it has practical value.

Asymmetrical positioning of the centromere is typical for *Trollius*. The centromere can be either subterminal or somewhat more centrally located. The most assymmetrically positioned centromere has been found in the chromosomes of class D in *T. altaicus* and in chromosomes of class B in *T. yunnanensis*. Their arm ratio was 0.24 to 0.25 (Tables 1, 2). The remaining chromosomes to class B and D have indices varying between 0.30 and 0.35. In the chromosomes of class A and C the arm ratio was approximately 1 : 2. The lowest index was found in *T. Ledebouri*, 0.47 and the highest was 0.52 in *T. altaicus* , *T. chinensis*, *T. europaeus var. transsilvanicus* and in *T. pumilus*. Chromosomes with a more medial positioning of the centromere were present in T. *yunnanensis* in the A_1 type of chromosomes (index 0.64) and in *T. pumilus* in the C_1 type of chromosomes (index 0.62).

Thus over the whole observation the arm ratio of the chromosomes varied from 0.24 to 0.64.

Comparing the numerical results of Kurita for the species *T. altaicus* (1965), *T. dschungaricus* (1959), *T. Ledebouri* (1960) and *T. pulcher* (1957) with those of the author it can be stated that so far the most terminal centromere has been reported in *T. pulcher* with an index of 0.22 and the most medial centromere in *T. dschungaricus* with an index of 0.79 and *T. altaicus* with an index of 0.78. Thus the index for the chromosomes studied by Kurita has a wider range, however the extermal values were found in the species *T. pulcher* and *T. dschungaricus* which I have not studied.

Comparing the karyotype of *T. altaicus* as observed by the author and by Kurita small differences can be seen. They concern in particular one pair of chromosomes (Kurita 1965 table 4, pair e), the index of which was 0.71 and 0.78. Such chromosomes have not been found by the author in the *T. altaicus* plants studied. Instead one pair of class C chromosomes has been found with very short arms (Table 1, Plate II, fig. 1). The remaining pairs of chromosomes in the karyotype are identical or almost so in the two studies. Kurita's first two pairs of chromosomes correspond to mine class A, and the third to class B. Of the shorter chromosomes three pairs correspond to class D and on one of them there is a small satellite on the shorter arm. The differences in the karyotype morphology of *T. altaicus* con-

cerning one pair of chromosomes C were probably caused by the difference in the experimental material. The plants of *T. altaicus* from the Altai Mts. have differed somewhat from specimens of the species obtained from other sources. The former were much larger, more luxuriant, and their flower morphology was also somewhat different. Chromosome dimensions of the Altai plants were larger than those of other specimens of the species (authors own observations).

For *T. europaeus* Kurita (1959) presents only drawings of chromosomes, but he does not give the numerical data. Thus it is difficult to compare these karyotypes accurately. In the authov's material a chromosome pair with a median centromere and one chromosome larger than the other has not been found . (Kurita 1959, fig. 6 pair d). Apart from that the author's results agree with the drawings of Kurita.

In the case of *T. Ledebouri* the karyotype observed by the author diverges substancially from Kurita's (1960) data for that species. The author has not found a satellite on any of the chromosomes, whereas in Kurita's material a satellite is distinct on one of the shorter chromosome pairs. Kurita presents only two pairs of chromosomes with an index close to 0.50 whereas the author has found 5 such pairs. These discrepancies in the observations must come from differences in the material at the disposal of the two authors.

From the observations made it is clear that in taxa of *Trollius* there are differences not in chromosome numbers but in their morphology. These differences are relatively not great and the similarities between the karyotypes are more striking. In all the karyotypes (Plate II) the following pairs of chromosomes are present: one pair of A chromosomes, one pair of B chromosomes, one pair of C chromosomes and one pair of D chromosomes. This of course does not mean that the same chromosome pairs repeat themselves in all the karyotypes. It only implies that these pairs are similar to each other in their morphology. The remaining four pairs of chromosomes occur in various numbers in the different taxa. Chromosomes C and D occur from one to three pairs in different taxa. In *T. Ledebouri* there are three pairs of A chromosomes; two pairs of B chromosomes can be found in *T.* pumilus and *T. yunnanensis.* Karyotypes of these two species are very much alike and they differ markedly from the karyotypes of the remaining taxa.

The karyotypes of *T. pumilus* and *T. yunnanensis* contain four pairs of longer chromosomes and four pairs of shorter chromosomes. Of the longer chromosomes they have two pairs of class A chromosomes and two of class B. In both species one of the B pairs has a large satelite on the shorter arm. Of the shorter chromosomes *T. pumilus* and *T. yunnanensis* have in common two pairs of C chromosomes and one pair of chromosomes D. These two karyotypes differ only in one pair of chromosomes which in *T. pumilus* has been described as C_1 and in *T. yunnanensis* as a second pair of D chromosomes. Also one pair of A chromosomes has been classified in *T. yunnanensis* as A_1. One would have expected that the karyotypes of *T. pumilus* and *T. yunnanensis* would be dislike since these two species differ markedly in their overall morphology, however the similarity of karyotypes is obvious. On none of the other taxa a satellite has not been found on chromosomes B. They

were usually situated on a pair of shorter chromosomes of type C or D. In other taxa the satellites are small, not visible on all preparations, whereas in *T. pumilus* and *T. yunnanensis* the satellites are large and distinct. The distinctiveness of these two karyotypes is all the more interesting since they both belong to a group of the oldest species of *Trollius*. They are isolated form the remaining taxa since they give with them sterile hybrids. On the other hand an F_1 *T. yunnanensis* × *T. pumilus* hybrid is partially fertile (author's own observations). Their geographical ranges coincide to a large extent, since *T. pumilus* occurs in south China and in the western Himalayas whereas *T. yunnanensis* occurs in southern China and in the Yunnan province. The similarity in the karyotypes is a further indication of their close affinity.

The karyotype of *T. chinensis* is very similar to that of *T. europaeus var. transsilvanicus*, with the difference that in *T. chinensis* no satellite has been found. However only plants from natural stands can be considered as completely certain as well as those of *T. pumilus* and *T. yunnanensis*. These two species as mentioned above give sterile progeny with other species and therefore are isolated. The remaining species of *Trollius* cross very easily with each other and give fertile progeny. Thus the material of *Trollius* obtained from Botanical Gardens may not be quite pure. This concerns *T. chinensis* and *T. Ledebouri* in particular.

SUMMARY

1. The author has described the karyotypes of the following taxa: *Trollius altaicus, chinensis, europaeus, europaeus var. transsilvanicus, Ledebouri, pumilus* and *yunnanensis*. For each taxon 5—10 metaphase plates have been analysed for the length of mitotic chromosomes. Mean chromosome lengths, and the lengths of their arms have been calculated as well as the ratio of the shorter to the longer arm (index).

2. The karyotypes of individual taxa differed from one another in the chromosome morphology, however some chromosome pairs were similar in different taxa.

3. The largest satellites were found in *T. pumilus* and *T. yunnanensis*, whereas in the karyotypes of *T. chinensis* and *T. Ledebouri* satellites have not been found.

4. The karyotypes of *T. pumilus* and *T. yunnanensis* demonstrated similarities and at the same time differed substancially from the karyotypes of the remaining taxa. These observations confirm the distinctiveness of these two taxa from other species and their close mutual affinity.

Department of Plant Systematics and Geography
University of Warsaw, Poland

(Entered: 30.I.1967.)

REFERENCES

Doroszewska A., 1965, Observations on the *Trollius chinensis* x. *T. europaeus* hybrids, Acta Soc. Bot. Pol. 34: 451—469.

Dyer A. F., 1963, The use of lacto-propionic orcein in rapid squash methods for chromosome preparations, Stain Tecn. 38: 85—90.

Kurita M., 1957, Chromosome studies in *Ranunculaceae* VI. Karyotypes of six genera, Rep. Biol. Inst. Ehime Univ. 3: 9—15.

Kurita M., 1959, Chromosome studies in *Ranunculaceae* XIV. Karyotypes of several genera, Mem. Ehime Univ. Sect. II, 3: 25—32.
Kurita M., 1960, Chromosome studies in *Ranunculaceae* XVII. Karyotypes of some species, Mem. Ehime Univ. Sect. II, 4: 59—66.
Kurita M., 1965, Chromosome studies in *Ranunculaceae* XXIII, Mem. Ehime Univ. Sect. II, 5: 11—17.
Langlet O., 1927, Beiträge zur Zytologie der Ranunculazeen, Svensk Bot. Tidskrift 21: 1—17.
Langlet O., 1932, Über Chromosomenverhältnisse und Systematik der *Ranunculaceae*, Svensk Bot. Tidskrift 26: 381—400.
Levitsky G. A., 1931, The "karyotype" in systematics, Bull Appl. Bot. 27: 187—218.
Zhukova P. G., 1961, Kariologija niekotorych widow *Ranunculaceae* w poliarno-alpijskim Botaniczeskom Sadu, Bot. Zur. 46: 421—42.

Kariotypy niektórych gatunków Trollius

Streszczenie

Opracowano kariotypy dla następujących gatunków *Trollius*: *altaicus*, *chinensis*, *europaeus*, *europaeus* var. *transsilvanicus*, *Ledebouri*, *pumilus i yunnanensis*. Dla każdego taksonu zmierzono 5—10 płytek metafazalnych chromosomów mitotycznych, wyliczono średnie długości chromosomów i ich ramion oraz stosunek długości ramienia krótszego do dłuższego, tj. index. Znaleziono różnice między kariotypami poszczególnych taksonów, chociaż niektóre pary chromosomów w różnych taksonach wykazywały wielkie podobieństwo. Wszystkie badane rośliny były diploidami, zawierającymi po 16 chromosomów. Z przeprowadzonych obserwacji wynika, że różnice występujące między kariotypami poszczególnych taksonów *Trollius*, dotyczą morfologii chromosomów a nie ich ilości.

Duże podobieństwo znalezione między kariotypami *T. pumilus* i *T. yunnanensis* wskazuje na pewną odrębność tych gatunków i ich wzajemne bliskie pokrewieństwo.