



## 象鼻虫科昆虫二十三種の染色体研究

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A Further Investigation on the Chromosomes in Twenty-three  
Species of Weevils  
(Curculionidae, Coleoptera)

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Since the first interesting work (1940) of Suomalainen on polyploidy in parthenogenetic weevils, the chromosome survey of the Curculionidae (Coleoptera) has made extensive advance. Current knowledge mostly accumulated by Suomalainen (1940, 1945, 1947, 1949, 1950, 1954, 1955), Smith (1952, 1953, 1956a,b), Seiler (1947), Mikulska (1949, 1951, 1953), and Takenouchi (1953, 1954, 1955, 1957a,b, 1958a,b,) has established that all the parthenogenetic species so far studied cytologically belong to Adelognatha, and that the great majority of them are connected with polyploidy, while weevil showing bisexual reproduction are diploid and heterogametic in males mostly having an X-Y mechanism. Three Japanese species among more than 90 species studied by the present author are parthenogenetic and show a polyploid relation. In the present paper are reported the chromosomes of additional twenty-three species of the Japanese curculionid weevils.

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*Material and Methods*: The majority of the specimens used for study were collected in Hokkaido with a few obtained in several localities in Japan during a period from April to July, 1956 and 1959. The locations where the weevils obtained are noted in the description for each species. In Table 1 are given the chromosome-number and sex-constitution in twenty-three species dealt with in this paper. They represent thirteen subfamilies of the Curculionidae.

Mostly the testes from adult males provided the material for study. Ovarioles from adult females of *Catapionus viridimetallicus* and *Hylobius* sp. and eggs of the former species were also furnished the material. The gonads were fixed in modified Allen-Bouin's solution after Momma (1954), and the ordinary paraffin method was used to make microscopical preparations. Mature eggs preserved in Petrunkevitch's solution were sectioned according to Peterfi's

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celloidin-paraffin method. The gonads were sectioned at 7 micra, and the eggs at 10 micra. The preparations were stained with Heidenhain's iron-haematoxylin and light-green. For *Cryptorrhynchidius* sp. I and *Anthonomus bisignifer*, the squash method stained with 10% acetic gentian violet was applied. Both squashed and sectioned slides were prepared for the following species: *Rhynchites placidus*, *Trichalophus albonotatus*, *Curculio flavescens*, and *Dorytomus mongolicus*. Camera lucida drawings were made at approximately 3,600 times and reduced to about 2,500 times in reproduction.

### Results of Observations

#### 1. *Rhynchites placidus* (Figs. 1—4)

Numerous adult males were collected on leaves of *Elaeagnus multiflora* Thunb. in the plantation of Hokkaido University. The slides provided many metaphase plates of the first division. There are 19 chromosomes of different sizes in the first metaphase (Figs. 1—3), consisting of 18 autosomal bivalents and an X—Y complex of a typical parachute form (Fig. 4)

#### 2. *Rhynchites* sp. (Figs. 5—7)

The testes from a single male which was captured in Kuriyama-machi, Hokkaido, in July of 1959, fortunately provided the primary spermatocytes. The first metaphase plate shows 17 bivalents of varying sizes (Figs. 5—6). An X—Y complex is apparent by its heteromorphic structure at diakinesis (Fig. 7).

#### 3. *Apoderus jekeli* (Figs. 8—10)

In the previous papers the chromosome number of this species collected at Mt. Daisetsu, Hokkaido, was reported as eighteen (Takenouchi, 1954, 1955). Another form of this species having different chromosome numbers was obtained in the suburbs of Hachiôji, Tokyo, in the middle of June, 1956. A male material provided several metaphase plates of the primary spermatocyte available for investigation. The haploid chromosome number was clearly determined to be 19 consisting of 18 autosomal elements and an X—Y complex with heteromorphic structure (Figs. 8—9). At anaphase the X and Y chromosomes migrate to the opposite poles preceding the autosomes (Fig. 10).

#### 4. *Phymatapoderus flavimanus* (Figs. 11—13)

The haploid chromosomes of this species were noted preliminarily in the previous paper (Takenouchi, 1955). The present data supplement the former results. Several specimens collected on leaves of *Urtica Thunbergiana* Sieb. et Zucc at Misumai near Jôzankei in May of 1959 were available for the study. The spermatogonial metaphase plate shows 32 chromosomes of varying sizes which consists of 30 elements in 15 pairs and an unequal pair of X and Y (Fig. 11). At least one pair of the diploid complex is acrocentric and the remaining pairs are of metacentric or subtelomitic nature. After mating of homologous pairs the X is supposed to be one of the small-size group of metacentric shape, the Y is the smallest spherical body. There are two kinds of the secondary spermatocytes each of which has 16 chromosomes: one contains the X (Fig. 12), while the other the Y (Fig. 13).

#### 5. *Paroplapoderus (Gomadaranus) ulmi* (Figs. 14—19)

A single adult male obtained in Bankei in the suburbs of Sapporo showed a few dividing

figures in both spermatogonia and spermatocytes. The spermatogonial metaphases were found to show 30 chromosomes composed of seventeen V-shaped elements, twelve rod-shaped ones of different sizes and a minute spherical element (Fig. 14). Morphological analysis indicates that the X element is represented by one of the medium-sized metacentric chromosomes, while the Y is a minute spherical body. Every primary spermatocyte shows 15 chromosomes of different sizes and shapes (Figs. 15—16), consisting of 14 autosomal bivalents and an X—Y complex (Fig. 17). The metaphase of the second division shows two kinds of cells with 15 chromosomes in each, one containing the X-element (Fig. 18), whilst the other contains the Y (Fig. 19).

6. *Catapionus viridimetallicus* (Figs. 20—22)

The description on the chromosomes of males belonging to this species were given in the previous papers (Takenouchi, 1953, 1954, 1955). The present data were derived from the females obtained in Sapporo in the middle of April, 1958. The slides based on their ovarioles show numerous oogonial cells in mitotic division. The diploid complex consists of eight large V-shaped chromosomes, four medium sized V-shaped ones, two small V-shaped elements, two large rods and four small rods (Figs. 20—21). Those 20 univalents in the diploid complement completely paired in ten pairs. Presumably, the two large telomitic elements are the X chromosomes in comparison with the feature obtained in the male (Takenouchi, 1953, 1954, 1955). The primary oocyte at metaphase is observable in just deposited eggs. Fig. 22 shows the chromosomes of the primary oocyte at metaphase: ten bivalents of various sizes are clearly recognizable.

7. *Amystax fasciatus* (Fig. 23)

The primary and secondary spermatocytes of this species were studied in the previous paper (Takenouchi, 1958b). Fig. 23 is a spermatogonial metaphase in the animal from the same locality. Every spermatogonial metaphase clearly shows 22 chromosomes. This result confirms the haploid number determined in the previous study. The diploid chromosomes are classified into ten pairs of V-shaped chromosomes of different sizes, a smaller V-shaped chromosome, and a minute spherical one. By picking up the homologous mates it is evident that the smaller V-shaped element represents the X-chromosome and the minute spherical element is the Y. The X-chromosome is easily distinguishable by its particular outline from others.

8. *Meotiorhynchus querendus* (Figs. 24—29)

Three males were collected on leaves of *Lespedeza bicolor* on the cliff near Yobetsumachi at the tip of the Shakotan Peninsula, Hokkaido in July and August, 1958. From these materials were prepared the slides furnishing a number of spermatogonial cells together with numerous spermatocytes. The spermatogonial metaphase shows 22 chromosomes including an unequal pair formed by an X and a Y (Fig. 24). Except for a minute spherical element, all the elements are metacentric ones of varying sizes and shapes. It is apparent that the former minute element is the Y and the X element is represented by one of the small-sized chromosomes of metacentric nature. The primary spermatocyte at metaphase shows ten ordinary bivalents and an X—Y pair (Figs. 25—27). One of the secondary spermatocytes resulted from the first division contains the X-element (Fig. 28), whilst the other includes the Y (Fig. 29).

9. *Lixus impressiventris* (Fig. 30).

The chromosomes of the primary spermatocytes observed in this species were reported in the previous paper (Takenouchi, 1958a). Several individuals obtained on leaves of *Polygonum Reynoutria* Makino in Misumai in the suburbs of Sapporo in May, 1959, which showed spermatogonial chromosomes. The diploid chromosome number was 40 in the spermatogonial division (Fig. 30). These 40 elements are clearly mated into 19 homologous autosome pairs and a heteromorphic pair; the former are all metacentric in nature while the latter consists of a comparatively larger rod-shaped element (X) and a minute telomitic one (Y). Above data completely correspond to the results obtained in the previous study (Takenouchi, 1958).

10. *Hypera nigrirostris* (= *Phytonomus (Phytonomus) nigrirostris*) (Figs. 31—32)

In a previous paper (Takenouchi, 1958a) preliminary notes on the chromosomes of this species were given. Numerous young adult males collected at the foot of Mt. Moiwa in July, 1959, furnished the material. The slides rendered the observation of the spermatogonial chromosomes available. Every spermatogonial cell contains 22 chromosomes of varying sizes which consist of 20 elements in ten pairs and an unequal pair made up of an X and a Y (Figs. 31—32). All the autosomes and the X are metacentric in nature, whilst the Y is identified as a minute spherical body. The data obtained in this study fairly confirm the former results.

11. *Trichalophus albonotatus* (Figs. 33—44)

This is the first to record this species in Japan. Four males collected in Bankei in the suburbs of Sapporo on June of 1959 used as the material for study. Both squashed and sectioned preparations were made. The diploid number of chromosomes was constantly 28 in every spermatogonium at metaphase (Figs. 33—34). A careful examination shows that the diploid complex consists of eight large V-shaped elements, two V-shaped ones of medium size, two small V-shaped chromosomes, fourteen rod-shaped bodies, one comparatively large J-shaped element, and a single one which appears to be slightly curved telocentric. The latter two chromosomes are particular in appearance in the spermatogonial metaphase; they remain unpaired after homologous pairing while the remaining elements undoubtedly constitute homologous pairs. At first spermatocyte metaphase a pair of heteromorphic chromosomes, one of which is J-shaped and the other apparently telocentric, is outstanding among the autosomal bivalents. Thus, it is evident that the J-shaped element is the X-chromosome, while the telocentric element is the Y. It seems that the Y approximately corresponds in size to the longer arm of the X (Figs. 33—34). Every primary spermatocyte at metaphase shows 14 chromosomes (Figs. 35—37). The telocentric Y and the longer arm of the X come in contact end to end. In every stage there is no difference in stainability between the ordinary pairs and the sex-pair in both squashed and sectioned slides. In the first division a synchronous segregation occurs between the sex-chromosomes and the autosomes (Figs. 38—40). The first division produced two classes of secondary spermatocytes: the one contains 13 autosomal elements and an X (Figs. 41, 43), and the other includes a similar autosomal set and a Y (Figs. 42, 44).

12. *Curculio flavescens* (Figs. 45—50)

Three insects found on leaves of *Quercus dentata* Thunb. in the public cemetery at Toyohira-

machi in the suburbs of Sapporo in June, 1959, furnished several spermatogonial cells and a number of spermatocytes in process of division. Every spermatogonial metaphase contains 28 chromosomes of varying sizes which consist of 26 elements in 13 pairs and an unequal pair consisting of an X and a Y (Fig. 45). The majority of the autosomes and the X are of metacentric nature, while the Y is a minute spherical body. The Y chromosome is identified as one of the comparatively smaller chromosomes in the diploid complex. The primary spermatocyte shows 14 chromosomes both in the squashed and sectioned slides (Figs. 46—48). In the former preparation the X—Y complex is easily recognizable because it is characterized by a parachute form at metaphase. The first meiotic division results in the production of two sorts of secondary spermatocytes having 14 chromosomes in each: one of them contains an X (Fig. 49), while the other a Y (Fig. 50).

13. *Curculio quercivorus* (Figs. 51—54)

Three males were collected on the same tree as above in June and July, 1959. The spermatogonial cell clearly shows 32 chromosomes at metaphase (Fig. 51). The X and Y are members of the small-sized group; the Y is the smallest in the diploid complement. Most of the univalents are of metacentric nature of various sizes. Every first metaphase contains 15 autosomal bivalents and an X—Y complex (Figs. 52—53). In the lateral view the X—Y complex is easily observable because of its heteromorphic configuration (Fig. 54).

14. *Hylobius perforatus* (Figs. 55—59)

Many animals were collected in Izashiki, Satamachi, Kagoshima Prefecture, in April, 1959, and supplied by Mr. Katsumi Kawabata, and Dr. Michio Chûjô. Only one of the materials gave several slides with many spermatocytes in division. There are 18 bivalents of various sizes consisting of 17 autosomal bivalents and an X—Y complex in the first metaphase plate (Figs. 55—56). The latter is clearly distinguishable from the autosomes by its peculiar parachute form (Fig. 57). Two kinds of secondary spermatocytes are found: the one has an X-element and the other a Y (Figs. 58—59).

15. *Hylobius* sp. (Figs. 60—61)

A female specimen was obtained on a leaf of *Petasites japonicus* Miq. in Sapporo in April, 1959. It was stated by some curculionid taxonomists that this animal is new to science. Fortunately, oogonial chromosomes were studied in this material. The diploid chromosome number was determined to be 24 in every oogonial division (Figs. 60—61). At least, nine pairs in the complex are metacentric and the remaining ones are telomitic elements. All univalents are clearly mated into 12 homologous pairs, suggesting the presence of 2 X chromosomes.

16. *Niphades variegatus* (Fig. 62)

The primary spermatocyte chromosomes of this species were reported by the present author (Takenouchi, 1958a). The specimens obtained in the mountain regions near Jûhachigawa in the suburbs of Tosashimizu, Kôchi Prefecture, in May, 1956, furnished several clear metaphase figures sufficient for the study of spermatogonial division. The spermatogonial cell shows 34 chromosomes which confirm the haploid number determined in the previous study (Takenouchi, 1958a). With some exception most univalents in the diploid complex are rod shaped,

and the Y is a minute spherical body (Fig. 62). The X-chromosome is without doubt one of the smaller metacentric elements.

17. *Anthonomus bisignifer* (Figs. 63—68)

The squash slide prepared from a single male obtained in Sapporo in May, 1959, provided many metaphase plates of both mitotic and meiotic divisions available for study. The spermatogonium contains 19 univalents of various shapes and sizes (Fig. 63). Some of them are metacentric, while the others are telocentric in nature. Morphological analysis revealed that a smallest element in the complement is in all probability the X-chromosome. Every primary spermatocyte clearly shows at metaphase 10 chromosomes, consisting of 9 autosomal bivalents and a small-sized X-element which is easily distinguishable due to its weak affinity to stain (Figs. 64—65). At anaphase of the first division the X migrates towards one of the poles (Fig. 66). Thus, two kinds of secondary spermatocytes result from the first division, the one having 9 autosomal dyads only (Fig. 67), while the other includes a similar content plus an X-element (Fig. 68).

18. *Dorytomus mongolicus* (Figs. 69—77)

The collections covering the past three years were needed in order to get favorite materials for study. Numerous insects were collected on the trunk of *Populus nigra* Linn. var. *italica* Muenchh. in the public cemetery at Toyohira-machi and the Campus of Hokkaido University, during a period from May to November in 1957, 1958, and 1959. The animals secured in July of 1959, provided a number of slides with available figures for the study of both spermatogonial and spermatocyte chromosomes. Spermatogonial metaphase plate contains 28 chromosomes (Figs. 69—71). The diploid complement is composed of four pairs of rod-shaped chromosomes, nineteen V-shaped elements and a minute spherical one. Morphological analysis of the chromosomes made it clear that one of the smaller V-shaped chromosomes is the X and the minute spherical element is the Y. Every primary spermatocyte metaphase shows constantly 14 chromosomes as the haploid complex, which consists of 13 autosomal bivalents of various sizes, and an X—Y bivalent. The latter is very prominent due to its parachute configuration as seen in the squash preparation (Figs. 72—74)). In the side-view, the X—Y complex appears as a heteromorphic body (Fig. 75). In the first division the X and the Y migrate to opposite poles, so that two kinds of secondary spermatocytes are formed: the one contains 13 ordinary dyads plus an X (Fig. 76), and the other includes a similar autosomal complex and a Y (Fig. 77).

19. *Cryptorrhynchidus* sp. I. (Figs. 78—80)

A male was obtained in July 1959 in the vicinity of Lake Shikotsu. The diploid number of chromosomes was determined to be 38 in the spermatogonial metaphase (Fig. 78), consisting of 18 homologous pairs of autosomes and an unequal pair of the X and Y. Among them, 21 elements are provided with a clear constriction in each manifesting a metacentric structure, 16 elements are rod-shaped, and the remaining one is remarkably minute in size. By pairing the supposed homologous mates it is evident that the smallest V-shaped element is the X, while the minute spherical body is the Y. The primary spermatocyte metaphase shows 19 well-defined chromosomes, consisting of eighteen autosomal bivalents and a parachute bivalent

composed of an X and a Y (Figs. 79—80).

20. *Cryptorrhynchidius* sp. II. (Figs. 81—86)

An individual which was obtained in Sapporo in June, 1959, furnished the material for this investigation. Fortunately, a few dividing figures of the spermatogonia and numerous spermatocytes were found in the squash preparation. The spermatogonial division clearly shows that the diploid number of this species is 32 (Fig. 81). This number is different from that of the former species as well as from those of other ones belonging to the genus *Cryptorrhynchidius* (Takenouchi, 1955, 1958a). The majority of elements in the complex are generally of metacentric nature. Karyotype analysis revealed that one of the smaller metacentric element is the X-chromosome, while a small body is the Y. There are 16 chromosomes of different sizes in each primary spermatocyte at metaphase (Figs. 82—83). The X—Y complex is easily detectable by its parachute form. As a result of the first division (Fig. 84), two sorts of cells having 16 chromosomes in each are produced, one containing the X element (Fig. 85), while the other possesses the Y element (Fig. 86).

21. *Colobodes* sp. I. (Figs. 87—91)

Two males obtained in Nopporo in May, 1959, supplied the material for this study, which provided dividing figures available for the counts of both primary and secondary spermatocyte chromosomes. There are 24 chromosomes of different sizes in the first metaphase (Figs. 87—88), 23 of which are autosomal bivalents, and the remaining one is a sex-determining bivalent composed of X and Y. The X—Y complex is remarkable by its typical parachute form in the lateral-view of the first spindle (Fig. 89). Two kinds of secondary spermatocytes containing 24 chromosomes in each are observable, the one having the X (Fig. 90), while the other possesses the Y (Fig. 91).

22. *Colobodes* sp. II. (Figs. 92—94)

A male animal was obtained in the same place as above. The material provided several metaphase plates of the primary spermatocyte. The haploid chromosome number of this species is different from that in the other species belonging to the genus *Colobodes*; the primary spermatocyte metaphase shows 18 bivalents which consist of 17 autosomal bivalents and an X—Y complex (Figs. 92—93). The X—Y complex is characterized by the prominent parachute form in the side view of the first spindle (Fig. 94).

23. *Mecysmoderes* sp. (95—96)

This species is specially outstanding by its distinguishing chromosome complex. A male specimen collected in the vicinity of Lake Shikotsu in July, 1959, furnished the present material. The spermatogonial chromosomes were available to observe in this material. Spermatogonial cells show at metaphase 38 chromosomes containing a strikingly large metacentric element, together with 23 small metacentric elements, 20 comparatively small telocentric ones, and two minute spherical bodies (Figs. 95—96). After a morphological analysis, it becomes evident that the largest V-shaped element represents the X-chromosome, and one of the smaller V-shaped elements may presumably be the Y.

## Discussion

The chromosome-list newly revised by Makino (1956) and the recent papers published by Mikulska (1951, 1953), Suomalainen (1955, 1958), Smith (1956a,b) and Takenouchi (1958a,b) indicate that the chromosomes of the Curculionidae have so far been reported in 132 bisexual species, while 34 species and races of parthenogenetic weevils have been subjected to cytological studies (Suomalainen, 1954, 1955, 1958; Takenouchi, 1957a,b). Parthenogenesis is found to occur mostly in members of two subfamilies, Otiorrhynchinae, and Brachyderinae, and seldom in Leptopinae, Cylindrorrhinae, and Eremninae. Of the parthenogenetic weevil species and races, the great majority are polyploid, while several species are represented by a bisexual as well as by a parthenogenetic race: the former are always diploid, the latter generally polyploid. Generally, bisexual species are diploid, and show an X—Y sex-determining mechanism in males with the exception of *Strophosomus capitatus* having an X—O mechanism (Suomalainen, 1940 Smith, 1956b). All the bisexual weevils studied cytologically by Suomalainen (1940, 1947, 1955) and Smith (1953) have 22 chromosomes in diploid, whereas parthenogenetic species show multiples of the chromosome number of  $n=11$ . The chromosomes of the Japanese weevils have been investigated by the present author in 90 species, three of which propagate parthenogenetically and show 33, 44, and 44 chromosomes, respectively (Takenouchi, 1953, 1954, 1955, 1957a,b, 1958a,b). It was found that the chromosome number of 87 bisexual species studied by the author ranges from 9 to 27 in haploid, and 32 species among them have 11 haploid chromosomes (Takenouchi, 1958b).

The present paper has furnished the results of a chromosome study carried out in twenty three species of the Japanese curculionid weevils, with special concern to the morphology of chromosomes and the sex-determining mechanism. As shown in Table I, the chromosome number varies from 10 to 24 in haploid. All the species here under study are bisexual in reproduction. They show an X—Y sex-determining mechanism except *Anthonomus bisignifer* which carries a X—O complex. Generally the X and Y undergo a separation reductionally in the first division. *Trichalophus albonotatus* is distinguishable from others by a J-shaped X and a telocentric Y: the telocentric Y comes to associate with the longer arm of the X in an end-to-end manner at first metaphase. This configuration suggests the possibility of a multiple-sex chromosome as reported in some buprestids, chrysomelids, and tenebrionids (Asana, Makino, and Niiyama, 1942, Yosida, 1944, 1949, Smith, 1952a,b, Takenouchi, 1957).

Japanese curculionid weevils so far studied by the author show that the chromosome number varies from 9 to 27 in haploid, and that the species with  $n$ , 11 chromosomes are most frequent in occurrence, being 29.1% in frequency. Weevils with 16 and 18 chromosomes rank second in occurrence (8.2%) and those having 12, 15, and 19 chromosomes follow next (7.3%). Especially, it is remarkable that most species belonging to Adelognatha have  $n$ , 11 chromosomes being 68 per cent in occurrence, and that the remaining several members show different numbers of chromosomes. Further, it is noteworthy that there are two forms in *Apoderus jekeli*: the one possesses 18 chromosomes and the other 19 chromosomes. It is difficult to distinguish those two species by their external bodily characters. Similar evidence has been found to occur in several other species (Takenouchi, 1955, 1958a,b).

## Summary

The chromosomes of twenty-three species of the Japanese curculionid beetles were investigated in germ cells. The chromosome number of the species studied ranges from 10 to 24 in haploid. The results of observations are summarized in Table 1.

**Table 1.** Species of curculionid weevils (Curculionidae) under study and their chromosome numbers established.

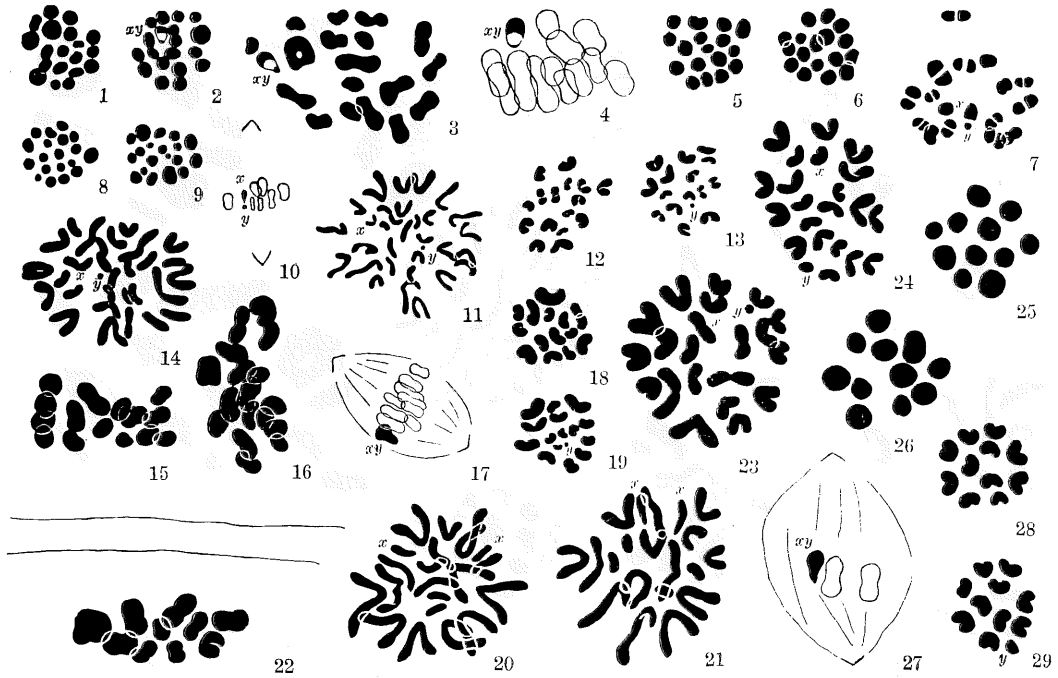
Species	Chromosome number		Sex-chr.
	2n	n	
Rhynchitinae			
1. <i>Rhynchites placidus</i> Sharp		19♂ (I)	X—Y ♂
2. <i>Rhynchites</i> sp.		17♂ (I)	X—Y ♂
Apoderinae			
3. <i>Apoderus jekeli</i> Roelofs		19♂ (I)	X—Y ♂
4. <i>Phymatopoderus flavimanus</i> Motschulsky	32s	16♂ (II)	X—Y ♂
5. <i>Paroplapoderus (Gomadaranus) ulmi</i> Kôno	30s	15♂ (I, II)	X—Y ♂
Brachyderinae			
6. <i>Catapionus viridimetallicus</i> Motschulsky	20o	10♀ (I)	X—X ♀
7. <i>Amystax fasciatus</i> Roelofs	22s		X—Y ♂
Tanymecinae			
8. <i>Meotiorhynchus querendus</i> Sharp	22s	11♂ (I, II)	X—Y ♂
Cleoninae			
9. <i>Lixus impressiventris</i> Roelofs	40s		X—Y ♂
Hyperinae			
10. <i>Hypera nigrirostris</i> (Fabricius) (= <i>Phytonomus (Phytonomus) nigrirostris</i> (Fab.))	22s		X—Y ♂
Alophinae			
11. <i>Trichalophus albonotatus</i> Motschulsky	28s	14♂ (I, II)	X—Y ♂
Curculioninae			
12. <i>Curculio flavescens</i> Roelofs	28s	14♂ (I, II)	X—Y ♂
13. <i>Curculio quercivorus</i> Kôno	32s	16♂ (I)	X—Y ♂
Hylobiinae			
14. <i>Hylobius perforatus</i> Roelofs		18♂ (I)	X—Y ♂
15. <i>Hylobius</i> sp.	24o		X—X ♀
16. <i>Niphades variegatus</i> Roelofs	34s		X—Y ♂
Anthonominae			
17. <i>Anthonomus bisignifer</i> Schenkling	19s	10♂ (I) 9, 10 (II)	X—O ♂
Notarinae			
18. <i>Dorytomus mongolicus</i> Zumpt	28s	14♂ (I, II)	X—Y ♂
Cryptorrhynchinae			
19. <i>Cryptorrhynchidius</i> sp. I	38s	19♂ (I)	X—Y ♂
20. <i>Cryptorrhynchidius</i> sp. II	32s	16♂ (I, II)	X—Y ♂
21. <i>Colobodes</i> sp. I		24♂ (I, II)	X—Y ♂
22. <i>Colobodes</i> sp. II		18♂ (I)	X—Y ♂
Ceuthorrhynchinae			

s: spermatogonium. o: oogonium. (I): Primary spermatocyte. (II): secondary spermatocyte.

In the species dealt with in this study there is no evidence for the presence of polyploidy. Except *Anthonomus bisignifer* which shows an X—O sex-determining mechanism, all the species under study are characterized by an X—Y mechanism in males.

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Figs. 1-4. Chromosomes of *Rhynchites placidus*. 1-2. First metaphases. 3. First pre-metaphase in the squash preparation. 4. Side view of the first meta-anaphase in the squash preparation.

Figs. 5-7. Chromosomes of *Rhynchites* sp. 5-6. First metaphases. 7. Diakinesis.

Figs. 8-10. Chromosomes of *Apoderus jekeli*. 8-9. First metaphases. 10. Side view of the first meta-anaphase.

Figs. 11-13. Chromosomes of *Phymatopoderus flavimanus*. 11. Spermatogonial metaphase. 12. Second metaphase. 12. Second metaphase, X-class. 13. The same, Y-class.

Figs. 14-19. Chromosomes of *Paroplapoderus (Gomadaranus) ulmi*. 14. Spermatogonial metaphase. 15-16. First metaphases. 17. Side view of the first meta-anaphase. 18. Second metaphase, X-class. 19. The same, Y-class.

Figs. 20-22. Chromosomes of *Catapionus viridimetallicus*. 20-21. Oogonial metaphases. 22. First metaphase.

Fig. 23. Spermatogonial metaphase of *Amystax fasciatus*.

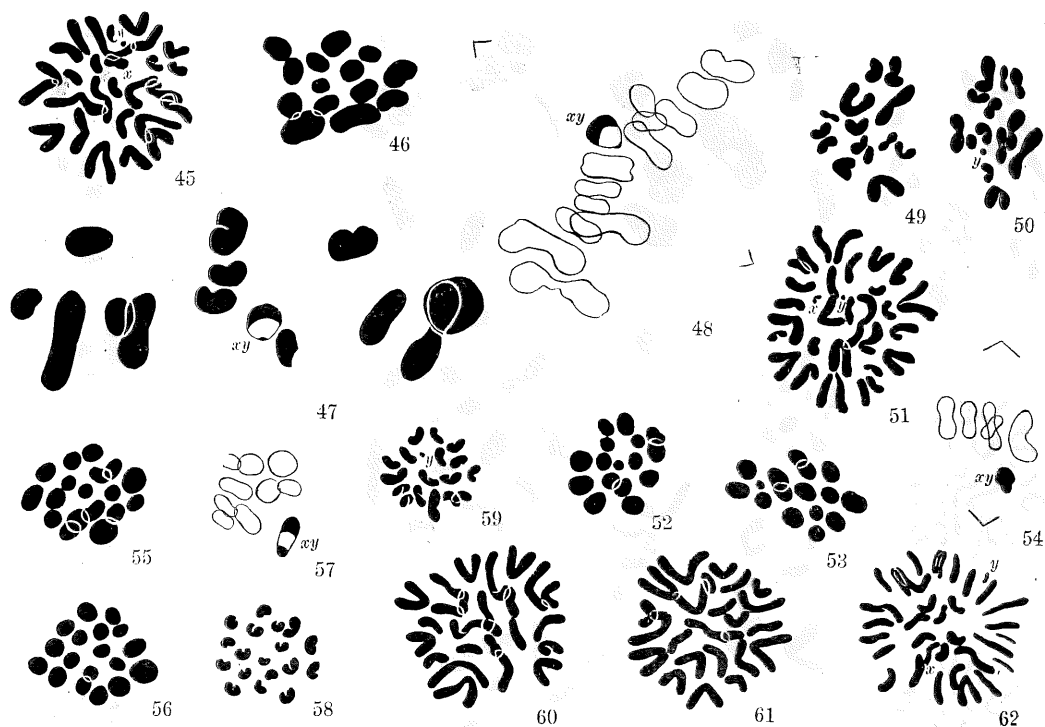
Figs. 24-29. Chromosomes of *Meotiorhynchus querendus*. 24. Spermatogonial metaphase. 25-26. First metaphases. 27. Side view of the first meta-anaphase. 28. Second metaphase, X-class. 29. The same, Y-class.



Fig. 30. Spermatogonial metaphase of *Lixus impressiventris*.

Figs. 31-32. Spermatogonial metaphases of *Hypera nigrostris*.

Figs. 33-44. Chromosomes of *Trichalophus albonotatus*. 33. Spermatogonial metaphase. 34. The same in the squash preparation. 35. First metaphase. 36-37. First metaphases in the squash preparations. 38-39. Side view of the first meta-anaphases. 40. The same in the squash preparation. 41, 43 (Squash preparation). Second metaphases, X-class. 42, 44 (Squash preparation). The same, Y-class.



Figs. 45-50. Chromosomes of *Curculio flavescens*. 45. Spermatogonial metaphase. 46. First metaphase. 47-48. First metaphases in the squash preparations. 49. Second metaphase, X-class. 50. The same, Y-class.

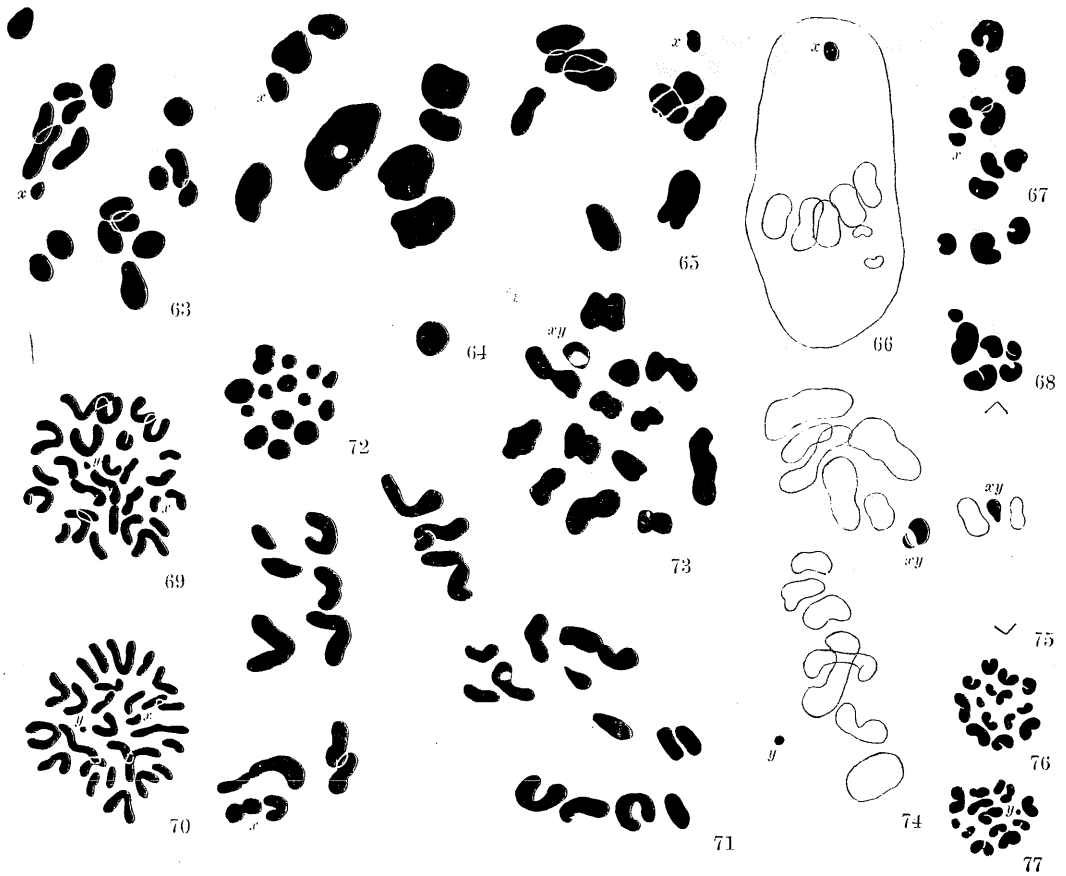
Figs. 51-54. Chromosomes of *Curculio quercivorus*. 51. Spermatogonial metaphase. 52-53. First metaphases. 54. Side view of the first meta-anaphase.

Figs. 55-59. Chromosomes of *Hylobius perforatus*. 55-56. First meta-phases. 57. Side view of the first meta-anaphase. 58. Second metaphase, X-class. 59. The same, Y-class.

Figs. 60-61. Oogonial metaphases of *Hylobius* sp.

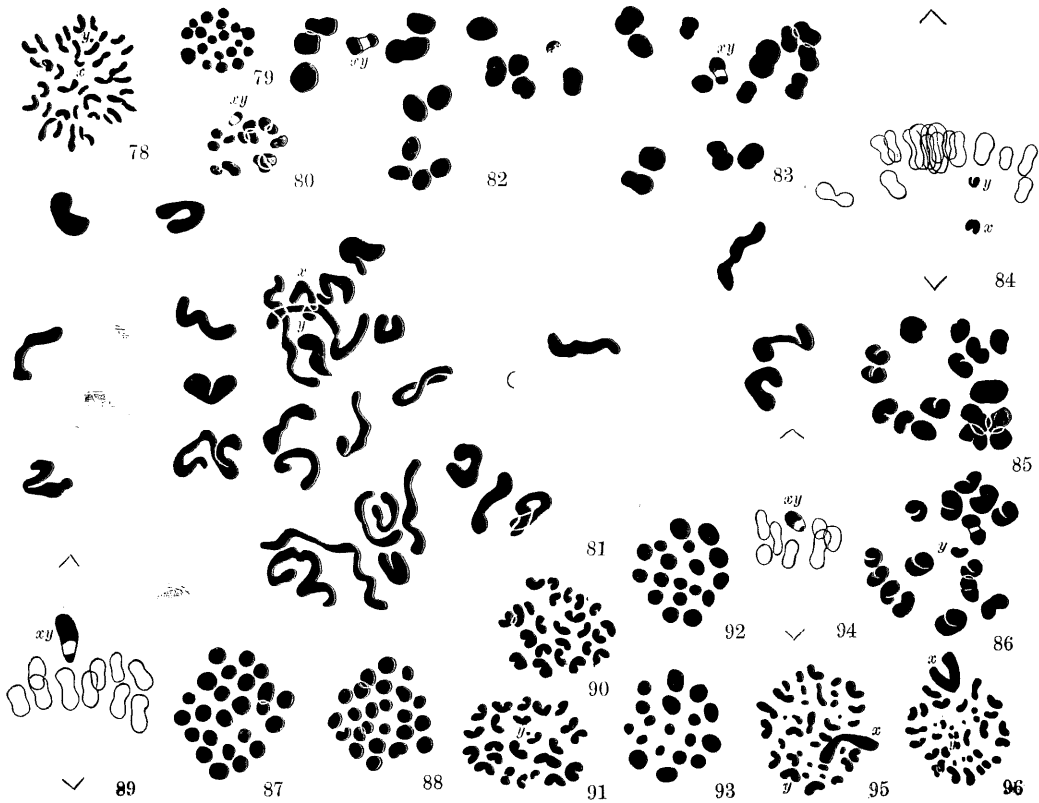
Fig. 62. Spermatogonial metaphase of *Niphades variegatus*.

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Figs. 63-68. Chromosomes of *Anthonomus bisignifer*. 63. Spermatogonial metaphase. 64-65. First metaphases. 66. Side view of the first meta-anaphase. 67. Second metaphase, X-class. 68. The Same, no X-class.

Figs. 69-77. Chromosomes of *Dorytomus mongolicus*. 69-70. Spermatogonial metaphases. 71. The same in the squash preparation. 72. First metaphase. 73-74. The same in the squash preparations. 75. Side view of the first meta-anaphase. 76. Second metaphase, X-class. 77. The same, Y-class.



Figs. 78-80. Chromosomes of *Cryptorrhynchidius* sp. I. 78. Spermatogonial metaphase. 79. First metaphase. 80. First metaphase, showing the X-Y complex.

Figs. 81-86. Chromosomes of *Cryptorrhynchidius* sp. II. 81. Spermatogonial metaphase. 82-83. First metaphases. 84. Side view of the first meta-anaphase. 85. Second metaphase, X-class. 86. The same, Y-class.

Figs. 87-91. Chromosomes of *Colobodes* sp. I. First metaphases. 89. Side view of the first meta-anaphase. 90. Second metaphase, X-class. 91. The same, Y-class.

Figs. 92-94. Chromosomes of *Colobodes* sp. II. 92-93. First metaphases. 94. Side view of the first meta-anaphase.

Figs. 95-96. Spermatogonial metaphases of *Mecysmoderes* sp.