

(26) *Lycosa pseudoannulatus*

(Figs. 169-170)

The present material matures in autumn. The favourable specimens could not be obtained at ease. The observation was carried out on the preparations of testes from three adult individuals preserved by CAROTHER's solution in September. The testes were too old to observe spermatogenesis, in which only some of the maturation division figures were found. The haploid chromosome number of the first metaphase is 15, 13 of which are autosomes and the remaining two are X-elements. The bivalents are of medium size, which are considerably condensed and of globular or short rod shape; V-formed elements are found very rarely. The two X-elements are always distinguishable in the first division. Here also they stand on the different level from the equatorial plane, apart from the autosome group. The two elements seem to be of almost similar size. -

(27) *Lycosa* sp.

(Figs. 171-177)

Two male individuals were collected in March in Iwakuni city, but unfortunately the name of the species was not determined. The testes from these were fixed by modified NAVASHIN's solution. In the preparations no good gonial metaphase was obtained, and the following description was compelled to be limited within the observation of meiotic divisions.

First division (Figs. 171-174): The nuclear plates of the primary spermatocytes are large and favourable for cytological study. The chromosomes are highly condensed at metaphase I, most of which are of simple appearance. In Fig. 172 all bivalents are arranged in orderly manner on the plate, they are condensed short rods, some of which are constricted medially, assuming somewhat dumb-bell-shape. The number of bivalents is 13, besides these exist two univalent X's in the metaphase I. In many cases the 2 X's situate on the accessory plate, lie parallel with very short distance to each other. Between the both elements no size difference can be found. The X's are regarded as to be the largest elements in the complements.

In some maturation division figures several particular elements can be observed. Fig. 171 is a polar aspect of metaphase I (prometaphase), in which two minute elements are present on the outermost circle of the spindle, near the periphery. They are very minute spherical bodies and seem to be less intensely stained with hematoxylin than usual chromosome elements. In the lateral view of metaphase I shown in Fig. 174 the 2 X's stand on the outer side of the spindle somewhat near one

pole, while the autosome bivalents remain on the equatorial plane. In addition to these, two pairs of minute bodies are found on the periphery of the spindle, both pairs are symmetrical to the equatorial plane. Although it is not determined whether such minute elements possess individual spindle fibre or not, it looks as if they had finished the division and each pair removed precociously towards the respective poles.

The presence of such elements could not always be proved in the first division, but even if they are not seen, we can not deny their presence. It is likely to happen that owing to the smallness and less intense staining they are liable to be out of sight. It is highly probable that they are usually present in all primary spermatocytes and divide equationally in the first division. The elements of the question are distinguishable in the second division also. In the second metaphase plate shown in Fig. 177 two minute elements are found on the outer circle of the spindle, here also they probably divide equationally again.

Concerning the existence of such aberrant bodies in spiders some reports have been published by PAINTER ('14), HACKMAN ('48) and SUZUKI ('52a). PAINTER described "planosomes" and "ctetosomes" in many species he studied, of which the "ctetosomes" are of strange characteristics and seem to be considerably different from the bodies mentioned above. On the other hand, the "planosomes" are of much interest. He observed in *Lycosa communis* that at first metaphase at least one of the very small chromosomes may pass early to one pole, but it was not determined whether or not it divides at that time. The small element (chromosome) pictured by PAINTER (PAINTER's Pl. 33: Fig. 112, marked "P") resembles very much those found in the present material. It differs only in number, namely, it is only one in the former, but two in the latter. By him the similar feature was observed further in *Dolomedes fontanus* (Pisauridae), *Xysticus triguttatus* (Thomisidae) and *Anyphaena saltibunda* (Anyphaenidae). He called such a body "very small chromosome" in some cases but "planosome" in other cases. Summarizing his statements it may be said that the planosomes divide in the first division; in the second division they do not divide but lag in the spindle; their ultimate distribution may be irregular and apparently a simple matter of chance; except the irregular distribution the planosomes show close resemblance to microchromosomes; and that probably they are regarded as degenerating m-chromosome.

Recently HACKMAN ('48) reported on the planosome and m-chromosomes in Lycosidae. He found one or two small bodies in the spermatogonia and second maturation division of *Trochosa rulicola*, which are basophilic and negative for FEULGEN's reaction, and he regarded them as planosomes of PAINTER. Besides, he found an occurrence of one true microchromosome in the metaphase I of *Lycosa tarsalis*.

The small bodies found in the present material show similarities not only to the planosome of PAINTER but also to microchromosomes of HACKMAN. Especially the comparison of the present material with HACKMAN's *Lycosa tarsalis* reveals close resemblance between them. Although it can not be proved conclusively whether planosomes and microchromosomes are quite different or not, in my opinion, there exists some relationship between the both elements. At any rate the occurrence of planosome- or microchromosome-like elements suggests that they would play some roles in the evolution of chromosome number. On this point full description will be given in the later pages.

Second division (Figs. 175-177): The second metaphase chromosomes are highly condensed, which are of spherical or short rod shape. Here also two kinds of metaphase plates are obtained. One bears 15 elements and the other 13 ones. The microchromosomes are stated above.

10. Family Pisauridae

In this family one species of *Pisaura* and two species of *Dolomedes* were so far studied cytologically by PAINTER ('14) and HACKMAN ('48). The materials employed in the present study are the following five Japanese species, *Pisaura lama*, *Dolomedes angustivirgatus*, *D. pallitarsis*, *D. saganus* and *D. sulfureus*.

The results obtained in the present paper show that all the species possess an XXO system and the same chromosome number, $2n=28$. The chromosome number of *Dolomedes* species differs from that reported by previous authors. The X-elements of the species studied are regarded as to be the smallest pair in the complements contrary to those of other families. No mitotic chromosomes have so far been reported by previous authors, but in the present study they have been obtained in all the species, furthermore in *Pisaura lama*, *Dolomedes pallitarsis* and *D. sulfureus* the chromosomes of the females have been clearly observed.

Subfamily Pisaurinae

(28) *Pisaura lama*

(Figs. 178-189)

The materials used in the present investigation are gonads from many individuals captured in March and April. Both male and female gonads were fixed mainly by modified NAVASHIN's solution and partly by CAROTHER's solution.

Spermatogonia (Figs. 178-181): The testes fixed in March are suitable for the observation of spermatogonial chromosomes, those preserved

in May also contain some gonial metaphases, but in which the plates and chromosomes are relatively small in size and not so favourable for study. The gonial metaphase plates show always $2n=28$. All the chromosomes are of acrocentric type, which assume simple rods of smooth outline. They are relatively short ($1.3-2.2 \mu$ in length), only a slight size difference can be found in the complements. In some plates all elements are more or less larger and show slightly curved rod-shape. At any stage of the gonial division the sex-chromosomes can not be distinguishable.

First division (Figs. 183-187): Numerous excellent first metaphase plates are obtained, in which 15 elements are present, 13 of which are autosome bivalents and the remaining two univalents representing X's. The bivalents are of V- or horse-shoe-shaped, some others are of such form as two segments or spherical bodies are attached at their apices. In Fig. 184 some bivalents show median transversal slit. At metaphase I the 2 X's situate on the intermediate position between the equatorial plane and one pole, sometimes lie near one pole as in many species with 2 X's. Both elements may lie with short distance or apart with considerable distance. In the polar aspect they always stand on the outermost circle of the spindle, they are essentially rod-shaped, but at metaphase I they are longitudinally split and sometimes showing typical V-form. Usually they lie parallel to spindle fibre, but in other figures show some irregular arrangement. At any stage of the first division each of the two X's is of about similar length. It is particularly worthwhile noting that the 2 X's of the present species are regarded as to be the smallest pair in the complements. Careful observation of polar and profile views of the first division reveals that the 2 X-elements are always smaller than any other bivalents. The similar conditions are demonstrated in other species of this family studied by me. PAINTER ('14) and HACKMAN ('48) who studied the chromosomes of the present family described nothing on such condition, but the 2 X's pictured by HACKMAN ('48) are clearly the smallest ones in the complements. (See HACKMAN's Taf. V Figs. 83 and 84).

At first anaphase autosomal bivalents divide equationally and each half removes to respective pole in a usual manner, but in this separation some abnormal features are observed. In some figures one or two bivalents precociously divide and remove to the opposite poles, sometimes they go to the same pole. In such figures one or two univalents are coexisting with true X-elements near one pole. Similar features have been reported in many species by PATAU ('48), HACKMAN ('48), SUZUKI ('51a, '52a and this paper) and BOLE-GOWDA ('52).

Second division (Figs. 188-189): In the secondary spermatocyte metaphases two classes are distinguishable, one contains 13 autosomes plus

2 X's, and the other 13 autosomes alone. The chromosomes are condensed. They are small spherical bodies or short rods of slightly pointed end. In the secondary metaphase the X's are not clearly distinguishable from autosomes.

Chromosomes in females (Fig. 182): In the gonad from subadult female fixed in March could be found many mitotic figures. In the oogonial metaphase plates the chromosomes are crowded so closely that it is difficult to count their number. In the stalk cells which carry the growing cells, however, good mitotic figures are obtained, in which 30 chromosomes are fairly counted. Although the chromosomes are more or less smaller than those of spermatogonia, considerable similarity can be found in the chromosome shape between the both gonia. The comparison of diploid numbers in both sexes suggests that 4 out of 30 elements in the female are representatives of sex-chromosomes. The sex-chromosome mechanism XX:XXXX in the present species is thus surely proved. But it is difficult to identify the 4 X's in the oogonial complements.

Subfamily Thaumasiinae

(29) *Dolomedes angustivirgatus*

(Figs. 190-197)

The material was secured in April and May, which was fixed by NAVASHIN's solution and CAROTHER's fluid. The chromosomes are of considerable size and favourable for observation. By PAINTER ('14) the chromosome number of *Dolomedes fontanus* is 15 in haploid, one of which is microchromosome, on the other hand, *Dolomedes fimbriatus* published by HACKMAN ('48) with $n=13$. The present species together with the other three *Dolomedes* species possesses the haploid number of 15, which includes no microchromosome. The occurrence of different chromosome number in Japanese *Dolomedes* species is very interesting.

Spermatogonia (Fig. 190): Numerous metaphase plates are obtain, all good figures always contain 28 chromosomes. The chromosomes are of acrocentric type without exception. Most of them are long rods of smooth outline, several pairs lying in the inner circle are slightly small. The largest one is 3.1μ and the smallest one 1.7μ long. Some larger elements are slightly curved, particularly one or two more or less acutely bent near the middle. All the elements are arranged in orderly manner on the equatorial plate. The X-chromosomes can not be clearly detected in the complements.

First division (Figs. 191-195): The metaphase plate I shows invariably 15 haploid number, here also thirteen autosome bivalents and two X-chromosomes are easily distinguishable. The bivalents are large, their shape is almost equal to that mentioned in the previous species. In

many plates exist a few very large V-shaped bivalents. At metaphase I the 2 X's are always recognized on the peripheral portion of the spindle, in many figures each of the X's is separated with some distance, sometimes apart with considerable distance. Only rarely are they closely attached to each other. In spite of separate arrangement, both elements go unexceptionally to a single pole at anaphase I. Between the two X's no size difference can be found. At metaphase the X's are completely split, so that they usually assume V-shape. The X's often show such a feature as two small segments are attached with their terminal thin thread; when viewed from different angle each of such X's assumes two small dots attached closely. As is well observed in many figures, the X-elements are smaller than any other bivalents; probably they are the smallest elements in the complements.

Second division (Figs. 196-197): The chromosomes of the metaphase II are very small in size, but they are arranged well apart, so that the number is accurately counted. One half of figures bears 15 and the other 13 elements. The chromosomes are short rods or small spherical bodies with more or less pointed end.

Oogonia: Some metaphase plates were obtained in the ovary fixed at the end of March. Of course the oogonial chromosomes are all acrocentrics and the shape of which resembles that of spermatogonial ones. About 28 to 30 elements are counted in the metaphase plate.

(30) *Dolomedes pallitarsis*

(Figs. 198-205)

The chromosome study of this species was carried out by the preparations of testes fixed between March and May. As fixatives modified NAVASHIN's solution and ALLEN-BOUIN's fluid were employed. The general feature of chromosomes is approximately similar between the present species and the previous one; namely, the chromosome number and sex-chromosome mechanism are equal between them; however, some differences can be found in the chromosome morphology.

Spermatogonia (Figs. 198-200): In the metaphase plate there exist 28 chromosomes. The chromosome shape varies in different figures. In Fig. 198 many irregular shaped rod elements are present closely within nuclear cavity. In which the elements are deeply stained with hematoxylin, they are essentially of acrocentric type, but typical rod elements are few, most of them are slightly or somewhat acutely curved. Some are very acutely bent and of remarkably irregular outline. The elements, especially those arranged within the inner circle of the spindle possess a large knob-like thickening at their end, and which are so acutely bent that they exhibit extremely bizarre configuration. One chromosome

situated in the inner circle is acutely bent twice, and therefore it appears as if it bore an accessory segment at apex. The gonial chromosomes of this kind resemble rather that of *Lycosa cinereofusca* of Lycosidae than that of the allied forms of the present family. The chromosome complements shown in Fig. 199 are much slender and mostly are of thin, long rod shape, their outline smooth, in the complements are only a few bizarre elements. In Fig. 200 the chromosomes are smaller in size and most of them showing typical rod-shape. In this case also two out of 28 elements are regarded as X-elements. Although some characteristic chromosomes are found in Fig. 198 as stated above, it is difficult to select true X-elements in the gonial complements.

First division (Figs. 201-204): The first metaphase chromosomes are not so highly condensed, they are rather smart compared with *Dolomedes angustivirgatus*. All metaphase plates show 13 bivalents and 2 univalent X's. Most of the bivalents are of V-form of varying size, some assuming more or less dumb-bell-shape, which look as if two segments were connected with pointed end. In Fig. 203 one very long bivalent is found, which is considered to be of a proximal chiasma. In many metaphases the 2 X's stand on the spindle completely apart from the autosomal group. At this stage they show longitudinal split, in some plates they assume V-shape, but in others show two rods. Here also the two X's are alike in size and regarded as the smallest units in the complements.

Second division (Fig. 205): Some metaphase plates show $n=15$ and others with $n=13$. The chromosomes are condensed short rods.

(31) *Dolomedes saganus*

(Figs. 206-210)

The material used was one pair of testes from adult specimen captured in July, which was fixed by CAROTHER's solution. In the same testis all stages of spermatogenesis were observed.

Spermatogonia (Fig. 206): In the testis a few spermatogonial dividing figures were found. As shown in Fig. 206 28 chromosomes are counted in the metaphase plates. The chromosomes are comparatively short rods of little size difference, which are straight or slightly curved, and of smooth outline. No particular chromosomes can be distinguished in the complements.

First division (Figs. 207-209): The metaphase plate is somewhat smaller than that of other *Dolomedes* species, but the number and shape of chromosomes are nearly equal to others. That is to say, in the present case also 13 autosome bivalents and two X-elements are clearly

recognized at first metaphase. The two X's stay on the eccentric position of the spindle, but they are always closely attached; no separated X's are found. Contrary to the allied forms these X's assume rod-shape through the first division. In this material also no size difference exists between the both X's, which are smaller than any other bivalents.

Second division (Fig. 210): The metaphase chromosomes are 15 in some plates and 13 in others. The elements are rod-shape, some are short and others slightly long. The sex-chromosomes can not be distinctly identified in the plates.

(32) *Dolomedes sulfureus*

(Figs. 211-217)

The coloration of the body strikingly varies in different individuals and the species is polymorphic. Numerous individuals were studied cytologically, but no difference was perceived in such polymorphic individuals. The material was gathered during spring and summer and the gonads were fixed mainly by modified NAVASHIN's solution.

Spermatogonia (Figs. 211-213): Many excellent metaphase spindles are obtained, in which the diploid chromosome number of 28 is clearly counted. The chromosomes are short rods of very smooth outline. The largest element is about 2.2μ long and the smallest one 1.3μ , the remainings ranging between the both extremes, thus only a slight size difference is seen in the complements. Most chromosomes are straight, only a few slightly curved. All the elements show very beautiful radial arrangement on the plate. So far as the shape and arrangement are concerned, remarkable similarity can be found between the present species and *Pisaura lama*. (Compare Figs. 211-213 with Fig. 178). As shown in Figs. 211-213 all chromosomes show similar appearances, so that no sex-chromosomes can be clearly distinguished in the complements.

First division (Figs. 215 and 217): On the metaphase plate I exist 13 autosome bivalents and two sex-chromosome univalents well apart to each other. When differentiated in favourable degree the bivalents show fine smart appearance, which remarkably resemble those of *Dolomedes pallitarsis*. In Fig. 215 about one half of the bivalents are of V or horse-shoe-shape, the other of short dumb-bell-shape. The two X-elements are smaller and at metaphase exhibiting a longitudinal split. At this stage they usually lie parallel with some distance, sometimes they are completely separated; in Fig. 217 each of the both elements stands on the opposite side of the axis connecting both poles.

Second division (Fig. 216): In this species also the 2 X's undividedly go to a single pole in the previous division, consequently so far as

the X's are concerned, two classes of secondary spermatocytes are formed. One possesses 13 autosomes and two X's and the other only 13 autosomes. The chromosomes are small, which resemble those of *Dolomedes angustivirgatus* and *D. pallitarsis*.

Oogonia (Fig. 214): In the female gonads fixed at the end of April were obtained a number of metaphase plates. The chromosome number was determined in some plates, which is $2n=30$ without exception. The nuclear plate and chromosomes of Fig. 214 are smaller than those of spermatogonia, which are slender and of typical rod-shape with tapering end. The largest element is about 2μ long and the smallest one ca. 1.0μ . The diploid chromosome number in the female is two more than that of the male, 4 out of 30 elements are regarded as X-elements. In the oogonial complements, however, they are not distinguishable.

11. Family Agelenidae

The chromosomes of the present family were studied by WALLACE ('00, '05, '09), SOKOLSKA ('25), REVELL ('47) and HACKMAN ('48), and five species of *Agelena*, *Tegenaria* and *Hahnia* are known cytologically. The previous studies show that the spiders of this family are of characteristic chromosomal features, that is to say, the chromosomes are considerably high in number and two kinds of sex-determining mechanisms of XXO- and XXXO-type are found.

In the present paper the chromosomes of three Japanese species *Agelena limbata*, *A. opulenta* and *Tegenaria corasides*, and one Finnish species *Cryphoea silvicola* have been researched. The results obtained are similar in general with those so far reported. Namely all the species studied bear high chromosome number, and the sex-chromosome mechanism is XXO-type in *Agelena* and *Tegenaria* and XXXO-type in *Cryphoea*.

Subfamily Ageleninae

(33) *Agelena limbata*

(Figs. 218-221)

This species inhabits usually in gardens and fields, numerous specimens of different growing stages were fixed during May and September. The gonads from them were preserved by CAROTHER's solution and modified NAVASHIN's solution. The testes fixed in May and June largely contain spermatogonia, those preserved in July and August are most favourable for meiotic chromosome study.

Spermatogonia (Fig. 218): The nuclear plate of spermatogonial metaphase is considerably large in size, as large as that reported in *Sparassidae*, and probably the largest, in Araneomorphae. On the large plate

there are many chromosomes, all of which are of acrocentric type. The largest pair is about 3.4μ long and the smallest one about 1.4μ . Between the both extremes the remaining chromosomes vary gradually. As shown in Fig. 218 all the elements are typical rods with tapering ends, most of them are slightly and others acutely curved. The number of chromosomes are relatively high, so the determination of the number is not easy; in many metaphases 42 to 44 elements are counted. The true diploid number may probably be 44. Two out of 44 chromosomes are regarded as sex-chromosomes, but the identification of them in the complements is difficult. Judging from the meiotic division the two X's might be the largest pair in the gonial complements.

WALLACE ('09) reported in the study of *Agelena naevia* that at gonial anaphase and telophase two pairs of largest elements remove to each pole behind other autosomal group, and she regarded such elements as two sex-chromosomes. In the present material no such figures were obtained, though numerous slides were observed.

First division (Figs. 219-221): In the slides fixed in July a number of good dividing figures were obtained. The metaphase I invariably shows the haploid number of 23, of which 21 are autosomal bivalents and the remaining two univalents representing sex-chromosomes. In good slides all the elements are arranged in orderly manner, which exhibit beautiful appearance. The form of bivalents varies more or less by different degree of differentiation, but in many plates about one half of bivalents assume V-form, the other half dumb-bell-shape. In the present material both X's are not closely arranged but lie with some distance, sometimes quite separated X's are found. They assume typical rods in some plates, in others are longitudinally split and exhibiting more or less V-form. In the first division they undividedly go to one pole and no irregularity is found.

The favourable secondary metaphase plates could not be obtained.

(34) *Agelena opulenta*

(Figs. 222-225)

The present species are found in the similar habitats with the previous species and the two species seem to be closely related systematically to each other. The material used was collected in August and fixed by the same fixatives as in the previous case. In the same testis both spermatogonial and meiotic division figures were observed.

The chromosomal feature of this species shows remarkable resemblance to that of *Agelena limbata* in accordance with their systematic relationship. Namely, in the present species males also the chromosome number is $2n=44$, $n=22$ and the sex-determining mechanism is XXO-type.

Regarding the 2 X's similarities are found between the both *Agelena* species.

(35) *Tegenaria corasides*

(Figs. 226-227)

Three European species of *Tegenaria* have already been studied cytologically. Although there exist some questions in these reports, two kinds of sex-determining mechanisms of XXO- and XXXO-type are known in the present genus, so the study of Japanese species is very intriguing. The material used was secured during April and August, the testes of which were fixed by CAROTHER's fluid and modified NAVASHIN's solution. The individuals were too young to observe the meiotic figures, only spermatogonial division and some early stages of meiotic prophase were obtained in the slides.

Spermatogonia (Figs. 226-227): The cell plate is as large as the *Agelena*, in which many chromosome elements are present. In many cases some elements are overlapped, in particular smaller ones staying in the inner region are liable to be arranged irregularly, which prevent the counting of chromosome number. Two good metaphase plates were obtained, in which 42 chromosomes were counted. The chromosomes are all acrocentrics. The size and shape are generally similar to those of *Agelena limbata*. Some larger rod-elements are acutely curved and with more or less irregular contour. Some pairs situating in the central position of Fig. 227 are distinctly smaller than others, but the appearances pictured are not their whole bodies, probably nothing but a part of the bodies. The chromosome complements shown in Fig. 226 are somewhat smaller than those of Fig. 227 and many have more irregular contour, two elements stand at 4 and 5 o'clock with a slight but clear constriction near apex.

In the present material no meiotic divisions were observed, so that the sex-determining mechanism could not be clearly proved. Earlier stages of meiotic prophase, however, exhibit the presence of two heteropycnotic elements in every nucleus. This and the presence of even number of chromosomes in the male suggest the probable occurrence of two sex-chromosomes in the male sex. Such X's can never be distinguished in the gonial metaphase, but presumably the largest one pair may correspond to X's.

The autosome number of this species is equal to that of three European species of *Tegenaria* published by REVELL ('47). SOKOLSKA ('25) and HACKMAN ('48) reported 18 and 16 pairs of autosomes respectively in one *Tegenaria* species which is regarded to be conspecific as one of the species studied by REVELL ('47). It is very strange that the same species

possesses unequal chromosome numbers by different authors, it must be reinvestigated. But the numbers reported by SOKOLSKA and HACKMAN may be probable ones, and the number of 20 by REVELL might be more accurate. If so, 20 pairs of autosomes are regarded as to be typical of all the *Tegenaria* species so far studied.

(36) *Cryphoea silvicola*

(Figs. 228-236)

The present material was fixed by HACKMAN in Finland, the paraffin block of which was present to me. The block was labelled as follows: Locality: Helsingfors; Date: VIII '49; Fixative: BOUIN-DUBOSCQ-BRASIL. The material was a single male and entire abdomen was embedded. The block was re-embedded and sectioned by the present author. The testis was fixed in excellent condition.

No spermatogonial division figures were found in the slides.

First division (Figs. 228-233): The nuclear plate is very large, as large as that of *Agelena*. On that plate exist many chromosome elements. A careful observation reveals that the haploid number is 23, 20 out of which are autosome bivalents and the remaining three X-chromosomes. In the excellent figures the autosome bivalents stand apart to each other. The shape of bivalents differs somewhat in different figures. In Fig. 228 are found many V-formed bivalents, which seem as if two chromosome segments were connected at tapering end. In Fig. 230 all elements (except two) assume large V-shape, in which two elongated limbs are connected to each other with terminal very thin chromosome thread. The bivalents pictured in Fig. 229 are of more or less different appearance, where except some V- or horse-shoe-shaped ones most are of such appearance as two spherical bodies that are attached closely with thin slit, assuming somewhat dumb-bell-shape, and most of the globules have one more clear slit which is perpendicular to the previous one. In the profile view these bivalents assume very long bodies which are of terminal or subterminal chiasma.

The existence of 3 X-elements is clearly demonstrated at any stage of the meiotic division. At meiotic prophase they are recognized as three heteropycnotic elements at a certain position near the nuclear membrane. But they are most clearly distinguishable in the first maturation division. At metaphase I three particular elements are identified on the outermost of the spindle, in slightly different level from the equatorial plane. They are very elongated, large rod-shaped and lie parallel to the spindle fibre, each of which is not alike in length: one is strikingly larger than others, the remaining 2 X's may be equal in length, but in some figures they are a little different. As the degree

of condensation of chromosomes is variable in different figures, it is not always easy to find out absolute size difference between the two smaller X's. At any rate of the 3 X's one is distinctly larger than others. Usually the X's are elongated and in the profile assume large rod shape, sometimes with a longitudinal split; when completely split, the X's exhibit large V-form of very elongated limbs. In the first division all the three X's are heteropycnotic to some degree, usually less intensely stained with iron hematoxylin than autosome bivalents. When viewed from the lateral the elongated X's are not smooth in outline, mostly showing coarse contour (Figs. 232-233), so that as a whole they are easily distinguished from autosomes. The 3 X's lie parallel to each other with short distance, but the arrangement, in particular, that of larger one is variable in figures. At first anaphase and telophase the X's go undividedly towards one pole, during such stages they are distinctly identified from others by their characteristic appearance.

Second division (Figs. 234-236): Numerous secondary metaphases are found in the preparations. The cell plates are considerably large and favourable for observation. In the profile view the chromosomes show such figures as two elements are attached at apices and their arms being stretched freely in the nuclear cavity, so that in the polar aspect each of them show twofold structure of similar bodies. Some plates show 20 elements and others 23 ones, 3 of which are regarded as X-elements, but they can not be clearly identified in the figure.

12. Family Urocteidae

The present family comprises only a single genus *Uroctea*, which is extremely different in habit and structure from others. No cytological study has been published, so the chromosomal investigation of this family is very intriguing. In this paper one Japanese *Uroctea* species was used as material.

(37) *Uroctea compactilis*

(Figs. 237-242)

A number of specimens from juvenile to adult were collected in Iwakuni and near Hiroshima during March and June. Most of the testes were fixed by modified NAVASHIN's solution and the remainings by FLEMMING's weak solution. The testes fixed between March and May showed spermatogonial dividing figures. For the study of meiotic divisions those fixed in and after June are suitable. It is very strange that meiotic chromosomes are unfixable, though gonial chromosomes are preserved in good condition by usual fixatives.

Spermatogonia (Figs. 237-240): The cell plates are very large in size, on which many acrocentric chromosomes are found. The chromosomes fixed by modified NAVASHIN's solution are stained deeply and usually show stout appearance. They are rather short stout rods of pointed end, the outline smooth, straight or slightly curved. Only a slight size difference can be found in the complements. In the slides fixed by FLEMMING's weak solution the chromosomes are fine, which assume typical rod-shape. In the metaphase plates 42 elements are counted, of which two are considered to be sex-chromosomes. It is, however, difficult to find them out in the gonial metaphase.

First division (Figs. 241-242): As mentined above the meiotic chromosomes are unfixable, and it is very difficult to observe. In the slides fixed by the above mentioned solutions the chromosome elements are considerably deformed or many of them are fused to each other, and most elements are distributed in irregular manner, thus it is never easy to obtain good metaphase spindles. Somewhat similar condition are found in *Heptathela kimurai* and *Atypus karschi*, but it is not evident at present why such condition is caused. Contrary to metaphase I, some good figures of early meiotic prophase stages are obtained. At leptotene and pachytene two intensely stained heteropycnotic elements are recognized in the nucleus, which lie close to a certain locus of nuclear membrane. Probably the two elements correspond to X-elements. It is rather difficult to count meiotic chromosomes; in some plates, however, about 20 or more elements are counted.

In the second division metaphase also the chromosomes are unfixable, and impossible to examine.

13. Family Theridiidae

In this family the chromosomes of two species of *Theridium* and *Steatoda* have already been published by MONTGOMERY ('07) and HACKMAN ('48). By them both species bear 10 pairs of autosomes and an XXO-system. The materials employed in this paper are the following seven-species: *Crustulina guttata*, *Enoplognatha foliicola*, *Lithyphantes dubius*, *Ariamnes cylindrogaster*, *Theridium sterninotatum*, *Theridium tepidariorum* and *Nesticus* sp. One of them, *Crustulina guttata* is a Finnish species, all the rest are Japanese spiders.

No mitotic figures had so far been reported, but the present study succeeded using all the materials. The chromosome number of *Lithyphantes* and *Nesticus* is $n=13$, while the remaining five species possess $n=12$, which is similar to that reported by previous authors. In spite of the variation of chromosome numbers all the species show the same sex-determining mechanism of an XXO-type.

Subfamily Asageninae

(38) *Crustulina guttata*

(Figs. 243-246)

The present material is a Finnish species, which was fixed by HACKMAN. In the label noted as follows: Locality: Tvärminne; Date: V '48; Fixative: SANFELICE's solution. As the block was so small that it was re-embedded by me. All stages of spermatogenesis were obtained in the same slide. The cell plates and chromosomes are very small and are not suitable for observation.

Spermatogonia (Fig. 243): The size of gonial metaphase plate is extremely small; in some plate it is only $8.6\mu \times 6\mu$ in diameter; the chromosomes also very small, the length ranges from the smallest 0.8μ to the longest 1.2μ . The elements are short, simple rods with pointed ends, which show slight size difference, no characteristic feature can be found. The chromosome number is counted in some metaphases, which is 22 undoubtedly. The two X-elements are never distinguishable in the gonial complements.

First division (Figs. 244-246): Although a number of first metaphase plates are obtained, the chromosome elements are so small and some are united or overlapped each other, that it is rather difficult to count the number. But careful observation reveals the haploid number is 12, which consists of 10 autosome bivalents and 2 X-elements. The bivalents assume more or less dumb-bell-shape or condensed spherical bodies. The 2 X's are always distinguishable in the first division. Usually both the elements stand close on the eccentric position of the spindle, and appear as two short rods of about the same size. Of course in the first division they remove undividedly to one pole.

No good secondary metaphase plate was obtained.

(39) *Enoplognatha foliicola*

(Figs. 247-248)

The materials used are gonads of male individuals which were captured in April and May. The testes were preserved by modified NAVASHIN's solution, partly by ALLEN-BOUIN's solution. Here also the chromosomes are so small that the material is not favourable for chromosomal study.

Spermatogonia (Figs. 247-248): Some good gonial metaphase plates are obtained, in which the diploid number of 22 is clearly counted. All chromosomes are of acrocentric type, which show slender rod-shape. The chromosome shape resembles not only to the previous species but also to the *Linyphia* and *Tetragnatha* mentioned in the following pages.

In the spermatogonial complements the identification of particular elements is impossible.

First division: As in the foregoing species *Crustulina guttata*, the chromosomes (bivalents) are so small, which renders the observation difficult. But the X-elements are almost always distinguishable from autosome bivalents in the first division. Here also two multiple X's are present. At metaphase I they are observed as two condensed rods of nearly equal size. Each of the 2 X's lies with a short distance to each other on the eccentric position of the spindle, sometimes they stay near one pole. The autosome bivalents are highly condensed and of more or less globular forms. In some plates about 10 bivalents are counted.

The secondary metaphase plates could not be clearly observed.

(40) *Lithyphantes dubius*

(Figs. 249-259)

The following description is based on the observation of the preparations of testes from male individuals which were collected in April and May. Most of the materials were fixed by modified NAVASHIN's fluid and partly by ALLEN-BOUIN's solution. Contrary to many allied species of the family, the chromosomes of the present species are of medium size and preserved in good condition by any of the common mixtures. In the testes fixed in the middle of May all stages of spermatogenesis were present.

Spermatogonia (Figs. 249-251): The spermatogonial metaphase plates show invariably the diploid chromosomes of 24. The number is two more than that typical to the family. The chromosomes are typical rods of smooth outline with tapering ends. Many of them are slightly and others, especially larger elements, are irregularly curved. The largest one pair are about $2.9\ \mu$ long and the smallest one $1.3\ \mu$. One pair of chromosomes situated at 7 o'clock of Fig. 249 are surely the largest in the complements and somewhere near the submedian they are clearly constricted, and at that position bent acutely. Such elements make us recall the particular chromosomes in some species of Argiopidae and Clubionidae, etc. (Suzuki, '51a, '52a). Very probably the two elements represent sex-chromosomes.

Except the size, the chromosomes of the present material show remarkable resemblance to those of the previous species.

First division (Figs. 252-257): In the first division the chromosomes are condensed and stained very deeply with iron hematoxylin. In any of the first metaphase plates the haploid number is 13, 11 of which are autosome bivalents and the rest two sex-chromosomes. Some of the bivalents show such form as two chromosome segments are attached at

their apices, assuming somewhat V-shape, others, short rod or globular shape. The two X-elements are always recognizable from autosome group by particular situation. In some figures they stay very close to one pole. In lateral view of the metaphase I they assume stout rods or oval shape of similar length. At that stage they often exhibit a longitudinal split, so that in some cases they are recognized as dot-like elements. At telophase of Fig. 254 the 2 X's stand very close to one pole, and, being of typical rod, are easily distinguishable from autosomal group.

Second division (Figs. 258-259): In the second metaphase the chromosomes are condensed and of small oval or spherical bodies. Regarding the number two classes are formed, one bears 11 and the other 13 elements. In the plate X's are indistinguishable.

Subfamily Argyrorodinae

(41) *Ariamnes cylindrogaster*

(Figs. 260-265)

This subfamily has never been studied cytologically. The present spider possesses an extremely elongated body and beautiful coloration, which are very characteristic for the species. The testes from two individuals secured in August and September were fixed by NAVASHIN's solution and CAROTHER's fluid. In the same testis both mitotic and meiotic division figures were obtained. The cell plate and chromosomes are distinctly larger than any of the allied forms studied, which make the observation favourable.

Spermatogonia (Fig. 260): The spermatogonial chromosomes are very large, the largest one is 4μ in length, even the smallest one 2.2μ long. Among the numerous spiders examined the present species possesses the second largest chromosomes, next to the *Thelcticopis* of Sparassidae or *Plexippus* of Salticidae. The chromosomes are essentially of acrocentric type and assume large rod of pointed ends. As shown in Fig. 260 most elements are slightly curved. The diploid number is undoubtedly 22, two of which are regarded as multiple sex-chromosomes, but the identification of them is impossible in the complements.

First division (Figs. 261-265): On the first metaphase plate the haploid number of 12 is clearly counted. The bivalents are cross-shaped, which in the polar aspect show stout rods, and some of which have a slight median constriction. Some V-shaped bivalents which are of proximal chiasma are also found in the plate. The feature of such bivalents resembles very much that of *Steatoda bipunctata* of the same family reported by HACKMAN ('48). For example, the size and shape of bivalents seem to be almost equal between the two species. At meta-

phase I the 2 X's are short stout rods of similar size.

The favourable secondary spermatocytes could not be obtained in the slides.

Subfamily Theridiinae

(42) *Theridium tepidariorum*

(Figs. 266-268)

This species is one of the most common house spiders and most widespread of all spiders. Its chromosomes have already been studied by MONTGOMERY ('07) and HACKMAN ('48). The same has been reinvestigated in this paper. The materials used were individuals in different growing stages, which were captured in spring. As fixatives CAROTHER's solution and modified NAVASHIN's fluid were used, which did not give so favourable results, because in many slides the chromosomes are crowded closely or clumped and render the observation difficult. It seems that the similar condition commonly occurs in many of the present family. Therefore most species of the family are not favourable for chromosome study except a few materials.

Spermatogonia (Fig. 266): Among numerous slides only a few spermatogonial division figures are obtained, in which 22 diploid chromosomes can be counted with certainty. As shown in Fig. 266 the chromosomes are typical rod of varying size; some are straight, and others slightly bent. The chromosome complements resemble those of *Enoplognatha* and the following *Theridium sterninotatum*, etc. The two sex-chromosomes can not be clearly identified in the gonial complements.

First division (Figs. 267-268): As stated above the chromosomes are liable to fuse each other, so that it is rather difficult to obtain good dividing figures. In some metaphases, however, ten bivalents are barely counted. The bivalents when viewed from the pole assume short rod or globular form. The X-elements are easily distinguished from autosome group, which are condensed rods of approximately equal size, stand in the accessory plate, and sometimes stay very close to one pole. Usually each of the 2 X's lies with some distance. The chromosome feature of this kind is almost equal to that reported by HACKMAN in Finnish material.

The second metaphase plate could not be clearly observed in my material.

(43) *Theridium sterninotatum*

(Figs. 269-271)

The testes from two subadult individuals collected in May were

fixed by modified NAVASHIN's solution. General feature of chromosomes very much resembles that of the previous species. Here also the chromosomes are small and the preservation is very difficult.

Spermatogonia (Fig. 269): One excellent metaphase plate is obtained, which show the diploid number 22. All elements are typical rods of tapering end, which are of little size difference. The metaphase plate shown in Fig. 269 exhibits similarity to the previous species, and besides, it very much resembles *Araneus saganus* and *Meta yunohamensis* of the Argiopidae described in the following pages. Here also the 2 X's can never be distinguished in the gonial complements.

First division (Figs. 270-271): The haploid number is always 12, 10 of which are autosome bivalents and the rest two X-elements. The shape and size of them are equal to the *Theridium tepidariorum*. In this case also 2 X's stand at metaphase I very close to one extremity of the nucleus.

The chromosomes of the second division could not be clearly observed.

Subfamily Nesticinae

(44) *Nesticus* sp.

(Figs. 272-274)

Some authors, for example CASTON ('48), regard the present subfamily as separate family Nesticidae. On the other hand PETRUNKEVITCH ('28) and others do not recognize such separation. The material used in the present paper is two males captured in October, but to my regret the species name has not yet been determined. The testes were fixed by modified NAVASHIN's solution. In the slides some spermatogonial metaphases and meiotic division figures were obtained.

Spermatogonia (Fig. 272): In the small spermatogonial metaphase are found short but more or less stout rod chromosomes arranged close to each other. Even the largest pair is 1.7μ long, only a slight size difference exists in the complements. Their appearance differs somewhat from that of the near relatives of the family. The metaphase plate pictured in Fig. 272 shows the diploid chromosome number-24.

First division (Figs. 273-274): The first metaphase figures always show $n=13$, 2 of which are univalents representing sex-chromosomes. The bivalents assume cross-shape, in which the bivalents are of interstitial chiasma, when viewed from the pole they exhibit rod-form. Some bivalents are oval to globular shape, V-shaped ones being rarely. At any stage of the first division the 2 X's are clearly found, as in many allied forms at metaphase I they stay on the intermediate position between the pole and equatorial plane, sometimes situated very close to one pole. In such figures they look almost immovable during anaphase

and telophase. The 2 X's are usually of short, stout rods with more or less pointed ends. In Fig. 274 they are slightly constricted near median.

The second division figures could not be obtained in the slides.

14. Family Linyphiidae

In this family PAINTER ('14) first reported the occurrence of XXO-system in *Linyphia marginata*, recently the chromosome of some species belonging to *Leptyphanthes*, *Drapetisca* and *Linyphia* were studied by HACKMAN ('48), and he found that all the species possess the haploid number of 13 and an XXO-system of sex-determining mechanism.

The materials investigated by me are '4 species belonging to the *Linyphia*, one of which is the same as that reported by PAINTER. Except one species, *Linyphia montana*, all the materials show similar chromosomal results to those so far published. On the other hand, *Linyphia montana* bears twice the autosome number of the allied species; the chromosome condition of *montana* is regarded to be analogous to *Araneus ventricosus* of Argiopidae already reported by me (SUZUKI, '51a).

Subfamily Linyphiinae

(45) *Linyphia albolimbata*

(Figs. 275-281)

The present species occurs in early spring. The testes from adult individuals were fixed by modified NAVASHIN's solution in March and May. Such testes contained all stages of spermatogenesis.

Spermatogonia (Figs. 275-276): In the metaphase plate of spermatogonia there invariably exist 24 acrocentric chromosomes. The chromosomes are small in size and very thin with tapering ends. Some are simple, straight rods, others slightly curved. In some figures all the elements are elongated, which are of somewhat irregular contour, and in particular, one or two elements are distinctly constricted near the median.

First division (Figs. 277-279): Some excellent metaphase plates are obtained, in which the haploid number of 13 is clearly counted, 11 of which are autosomal bivalents and the remaining two are multiple sex-chromosomes. The bivalents are small but of distinct appearance, which are arranged well apart on the equatorial plane. In the polar view they are of dumb-bell-shape, some of V-form; short rod or dot-like bivalents which are of terminal chiasma exist very seldom. At first metaphase the 2 X's always situate on the different level from the autosome group; lying parallel close to each other, no size difference exists between the both elements. Of course they are prereducational and go undividedly

to one pole in the first division.

Second division (Figs. 280-281): Due to the non-separation of X's in the previous division two kinds of second metaphase plates are formed. One half contains 11 autosomes and two X's, the other half 11 autosomes only. The chromosomes are very small and are dot-like or short rod-shape. In the complements the X's are indistinguishable.

(46) *Linyphia* sp.

(Fig. 282)

The present material is found during the same season as the previous one. Both species are allied closely, but to my regret the name of the species has not yet been determined. The materials employed are the testes from adult males captured during March to May. They were fixed by modified NAVASHIN's solution.

All the stages of spermatogenesis were obtained in the preparations. The chromosomes of this species strikingly resemble those of the previous *L. albolimbata*. Namely the chromosome number is 24 in diploid, 13 in haploid and the sex-chromosome mechanism XXO-type. The morphological character of both mitotic and meiotic chromosomes also are almost equal to that of *albolimbata*.

(47) *Linyphia marginata*

(Figs. 283-285)

The present species is the same as that studied by PAINTER ('14). He published that during pachytene stage the accessory chromosome elements appear as two rods taking the stain very deeply. Basing upon such observation he concluded the presence of 2 X's in this species. As regards the number of chromosomes no definite count was made.

The materials used in the present study are the testes from the two individuals secured in August and September. The fixatives used are NAVASHIN's solution and ALLEN-BOUIN's solution.

The spermatogonial metaphase plate invariably show $2n=24$. The chromosomes are acrocentrics and resemble those of *Linyphia albolimbata*. No particular elements are distinguished in the gonial complements. In the first maturation division 13 haploid number is clearly counted. Of course two of which are X-elements and the remaining 11 autosome bivalents. The bivalents are condensed to a considerable degree, and their shape generally resembles that of *L. albolimbata*. At metaphase I the two X-elements are always recognized somewhere in the intermediate between the equatorial plane and one pole. Here also each of the X's is of nearly equal length.

(48) *Linyphia montana*

(Fig. 286)

The present spider matures in autumn as the previous one. The material used is one adult male captured on October 30, 1949 in Showa village, near Hiroshima. The specimen was found in the shrubs on the mountain of that village. The spider is very small in size, and the testes were preserved with some entrails by NAVASHIN's solution.

So far as external characters are concerned, the present material shows close resemblance to the allied species studied in this paper, but differs strikingly in chromosomes. Namely the haploid number is 24 instead of 13 which is typical to the most of *Linyphia*. It is thus of much interest that the autosome number is twice that of the near relatives.

In the slides of testes are observed a number of sperms, some maturation divisions and a few spermatogonial figures.

The spermatogonial chromosomes are of acrocentric type. Owing to the absence of excellent figures the chromosome number could not be determined, but in some plates at least 40 or more elements were counted.

First division (Fig. 286): Many metaphase plates were obtained. The cell plates are much larger than those of the allied forms. On the metaphase plate exist many bivalents and two X-elements. As regards the 2 X's similar condition is found between the present material and its relatives. Namely at first metaphase both X's stand on the accessory plate, which exhibit in the profile two rods of similar length, in most cases both X's lie with some distance. The number of autosome bivalents are 22 undoubtedly. The bivalents standing in outer circle of the plate are V-shaped and those in inner circle typical dumb-bell-shaped.

Some secondary metaphase plates were obtained but the chromosome number could not be clearly counted.

It is worthwhile noting that the chromosomes of the present species greatly differs in number from its near relatives, the autosomes of the former are just twice those of the latter, and it seems that the cell plates of *montana* become larger in size as the number of chromosomes is duplicated. Apparently the present species looks like polyploidy, but probably it would not so, I think. The present case is regarded as to be analogous to the *Araneus ventricosus* of Argiopidae. In my previous report (SUZUKI, '51a) I concluded that the chromosomes of *A. ventricosus* are old and presumably they exhibit ancestral form of most of the common argiopid spiders. The chromosomes of *Linyphia montana* would be a further proof of such interpretation.

15. Family Tetragnathidae

Some authors regard the present group as separate family, but some others do not agree with this separation, treating it as one subfamily of the Argiopidae. In the present family two species of *Tetragnatha* were studied cytologically by HACKMAN ('48). The materials used in my study are three Japanese species, *Tetragnatha japonica*, *T. squamata* and *Leucauge blanda*. By HACKMAN two Finnish *Tetragnatha* species show $n=12$, on the other hand, the Japanese species with $n=13$, which is typical to most of Argiopidae. The presence of such difference is of much interest. I wonder, however, whether the difference is real or not. The haploid number of 12 may probably be mistaken by HACKMAN due to the smallness of chromosomes. General feature of chromosomes in the present family is very similar to that of Argiopidae.

(49) *Tetragnatha japonica*

(Figs. 287-294)

This spider is very commonly encountered in fields, and numerous fresh materials were captured during spring and early summer. The testes were fixed by normal and modified NAVASHIN's solution, and ALLEN-BOUIN's solution. The material fixed in March and April is suitable for the observation of spermatogonia; that fixed in April and May contains numerous maturation division spindles.

Spermatogonia (Figs. 287-288): The chromosomes are very small and are of acrocentric type. In many plates such elements are arranged close to each other, and some of them are overlapped, which render the counting difficult. In order to determine the chromosome number numerous slides have been observed. Careful observation in excellent slides reveals that the diploid number is 24 without exception. As mentioned above HACKMAN reported $2n=22$ in Finnish *Tetragnatha extensa*, which is fewer by two than that of the present species. He states in his paper that the chromosomes of *Tetragnatha* are small in size and some of them are overlapped, therefore the chromosome numbers of both diploidal and haploidal set counted are probable numbers. It seems that he overlooked one pair of autosomes in the complements.

In the metaphase plates of Figs. 287-288 all 24 chromosomes are arranged well apart on the equatorial plane. The largest element pictured is about 1.7μ long. They are small, slender rods with tapering ends; some are slightly, others irregularly curved. The X-elements which are recognizable in the maturation division cannot be distinguished in the spermatogonial complements.

First division (Fig. 289-292): On the first metaphase plate 11 auto-

some bivalents and two univalents representing sex-chromosomes are found. Most of the bivalents are V-shaped and others are of small dumb-bell-shape or rod-shape. At metaphase I the two X-chromosomes are always distinguishable on the different level from the autosomal group. They assume two rods, and sometimes when condensed intensely exhibit two globular bodies of nearly similar size. Both elements lie parallel with short distance, but sometimes stand close. In the first division they do not divide but go to a single pole and divide equationally in the second division.

Second division (Figs. 293-294): The chromosomes of the second metaphase plate are very small and are condensed and of dot-like or short rod-shape. Some plates bear 11 elements and others 13 ones, 2 of which are X-elements.

(50) *Tetragnatha squamata*

(Figs. 295-298)

Systematically the present material is allied very closely to the previous species. The material was collected during March and May. The testes preserved in the middle of April show numerous spermatogonial metaphases and meiotic division figures. The mixtures are equal to those of the previous species. In accordance with systematic relationship close resemblance exists between the chromosomes of the present species and *T. japonica*.

Spermatogonia (Figs. 295-297): The diploid number of chromosomes is always 24. The shape and arrangement of mitotic chromosomes very much resemble those of *Tetragnatha japonica*. In the present material such figure as shown in Figs. 295-297 was obtained, in which the chromosomes are short rods of smooth outline with slight size difference. Here also the identification of 2 X's is not possible.

First division (Fig. 298): The metaphase plate I shows the haploid number of 13, 11 of which are autosome bivalents and the remaining two are X-elements. Concerning the autosome bivalents and X-elements nearly similar feature can be found between the both *Tetragnatha* species.

Second division: Two classes of the secondary spermatocytes are observed, one of which possesses 11 autosomes and two X's, the other 11 autosomes only.

(51) *Leucauge blanda* *

(Figs. 299-305)

The spiders of this species are mountain habitants. A number of

* The present material has been commonly known as *Leucauge blanda*, but by YAGINUMA's recent report ('54) it is not true *L. blanda* but a quite new species, *L. magnifica*.

individuals from juvenile to adult were gathered during March to June. Their testes were fixed largely by modified NAVASHIN's solution, and partly by FLEMMING's weak solution. As in the previous two species the chromosomes are somewhat unfixable. In many cases they are liable to fuse or clump to each other, and it is not always easy to obtain good preparations. The spermatogonial figures are obtained in the gonads from comparatively young individuals fixed in March, while the gonads fixed in May or June contain maturation division figures.

Spermatogonia (Figs. 299-301): As shown in Figs. 299-301 the appearance of gonial plates varies in different slides. But in the chromosome number no variation is present, all the gonial metaphases possess $2n=24$. The chromosomes are always of acrocentric type, in some plates the appearance of which resembles that of *Tetragnatha*. The chromosomes of Fig. 299 are very slender rods, most of which with irregular outline, where the largest element is about 3μ long, even the smallest one ca. 1.3μ long, which are distinctly larger than those of *Tetragnatha*. Each of the homologous pairs lie parallel close to each other. The elements shown in Fig. 300 are considerably condensed, which are reduced in length, but increased in width, thus most of them show short stout rods with pointed ends, and smooth contour. Furthermore, some of them are longitudinally split and very stout in appearance. In Fig. 302 the chromosomes are more intensely condensed, all of them assume rather globular bodies or very stout, short rods of more or less pointed ends. One might be astonished at such a remarkable difference in gonial metaphases. A similar condition has been published in *Aranea reaumuri* and *Cyclosa octotuberculata* belonging to the related family Argiopidae by PÄTAU ('48) and SUZUKI ('51a) respectively, furthermore, more or less similar phenomena are found in *Icius magister* and *Lycosa pallitarsis* mentioned in the present report. In any plate of spermatogonia the 2 X's can not be distinguished.

First division (Figs. 303-304): The first metaphase plate is very small in size, which always contains 11 autosome bivalents and two sex-chromosomes. The shape of bivalents is about equal to that of above mentioned *Tetragnatha* species. At metaphase the 2 X's stand on the intermediate situation between one pole and equatorial plane, usually they lie apart with some distance, and when longitudinally split they assume more or less V-form in the profile. No size difference exists between both X's.

Second division (Fig. 305): In the present case also the X's remove undividedly toward a single pole, and thus two kinds of secondary metaphase plates are formed. One bears 13 elements and the other 11 ones. The univalents are condensed small bodies as shown in Fig. 305.

16. Family Argiopidae

The chromosomes of this family were so far investigated by many workers such as BERRY ('06), PAINTER ('14), HARD ('39), PÄTAU ('48) and HACKMAN ('48). The present author also reported in the first paper of this series the chromosomal features of the Japanese argiopid species (SUZUKI, '51a). Of these authors HACKMAN and SUZUKI found interesting occurrence of so-called centric fusion in some *Araneus* species, and an abnormal, very high chromosome number was discovered in *Araneus ventricosus* by myself. With the aim to know whether such or other kinds of interesting facts can be detected in further observation or not, cytological survey has been undertaken again in the following five species: *Araneus fuscocoloratus*, *Araneus saganus*, *Cyclosa sedeculata*, *Larinia punctifera* and *Meta yunohamensis*. The results obtained, however, reveal that the general feature of chromosomes in these spiders is nearly equal to that found in many of the family.

Subfamily Araneinae

(52) *Araneus fuscocoloratus*

(Figs. 306-308)

The present species is devoid of dorsal tubercles on the abdomen, and thus belongs to the '*Epeira*' in the strict sense. The materials used are the testes from two individuals captured in March and April, which were fixed by modified NAVASHIN's solution. In the slides no spermatogonial metaphase was observed but found meiotic division figures.

The chromosome number and sex-chromosomes of this species are equal to those reported in many allied forms of the same family, namely in the first metaphase plates present eleven autosomes and two accessory elements. The bivalents are cross-shaped, which show dumb-bell-shape or more or less rod-shape in the polar view. Typical V-formed elements with a proximal chiasma are very few. The X-elements are distinguished at metaphase I as two univalents on the accessory plate of the spindle, which are short stout rods in the profile, and of nearly equal length. Each of the elements stays parallel to each other with short distance, sometimes they lie closely. At anaphase when autosome bivalents divide the X's are already removed near one pole. As they are pre-reductional, two sorts of secondary metaphase plates are found. One of them possesses 11 autosome univalents and the other 11 autosomes plus 2 X's.

(53) *Araneus saganus*

(Figs. 309-311)

The present spider is provided with one pair of dorsal tubercles on

the abdomen, which belongs to the '*Aranea*' in strict sense. In spite of painstaking efforts no male individual was secured, accordingly the study was limited to the female sex. The gonads of three subadult females captured in Iwakuni in April were dissected out and preserved by modified NAVASHIN's solution.

Oogonia (Figs. 309-311): In slides of female gonads a number of oogonial metaphase plates were obtained. Some of them are so excellent that the chromosomes are counted with certainty. As shown in Figs. 309-311 the oogonial plates possess 26 diploid chromosomes. The nuclear plate and chromosomes are of medium size. All the elements are of typical rod-shape of varying size. They show smooth outline, some are straight, others slightly curved. The chromosome complements of Fig. 311 are smaller in size than those of Figs. 309-310, which are short rods with pointed ends. Only a slight size difference can be found in that plate.

When the diploid number of the present female is compared with that of the allied species male, 4 out of 26 are regarded as to be multiple X-elements, but they exhibit no peculiarities and indistinguishable in the oogonial complements.

As stated in my previous report (SUZUKI, '51a) the genus "*Aranea*" is divided into two groups '*Aranea*' and '*Epeira*' by some authors, according to the presence or the absence of dorsal tubercles. In '*Aranea*' (in strict sense) two Finnish species and two Japanese ones have been studied cytologically by HACKMAN and SUZUKI respectively. Except one of the Japanese species, *A. ventricosus*, the remaining three species males possess $n=13$, which is common to many of the '*Epeira*' studied. The chromosomes of *A. ventricosus* is regarded as to be aberrant, therefore no cytological difference can be found between the '*Epeira*' and '*Aranea*.'

(54) *Cyclosa sedeculata*

(Figs. 312-314)

The present study was carried out based on the preparations of testes from adult males collected in spring. The material was too old to observe the gonial metaphase.

First division (Figs. 312-313): Many metaphase plates are obtained, which show the haploid number 13. Here also 11 of them are autosomal bivalents and the remaining two sex-chromosome univalents. The autosome bivalents are relatively large and favourable for observation. They assume V or dumb-bell-shape, which very much resemble those of *Cyclosa octotuberculata* reported in the previous paper (SUZUKI, '51a). The 2 X's stand on the outside of autosomal group, forming an accessory plate, and lie closely side by side, and in the polar aspect appear as

two spherical bodies closely attached. Of course in the first division both X's go to a single pole.

Second division (Fig. 314): The chromosomes are intensely condensed, showing globular form. One half of the secondary spermatocytes possesses 13 elements and the other 11 ones.

(55) *Larinia punctifera*
(Figs. 315-317)

The present genus is a quite new material for cytology. The materials used are 4 male individuals collected in April, the testes of which were fixed by modified NAVASHIN's mixture. Both mitotic and meiotic division figures were obtained in the same gonad. The chromosomes are stained very deeply with iron hematoxylin, which can not be easily decoloured by usual degree of differentiation, moreover some elements are liable to fuse to each other, so the chromosome study is rather difficult.

Spermatogonia (Fig. 315): The gonial chromosomes are rod-shaped, which are rather short; some elements bear knob-like thickening at distal end, and somewhat irregular contour. As mentioned just above excellent metaphase figures are not obtained, but in some plates 24 chromosomes are counted. The sex-chromosomes can not be clearly identified in the complements.

First division (Figs. 316-317): The first metaphase plate is relatively large, on which the bivalents are found more or less close together. Some are overlapped to each other, which make the observation difficult. Careful examination reveals, however, that the haploid number is 13. Some bivalents are of large V-form, which are of a proximal chiasma, some others are cross-shaped, and one or two small bivalents are rod-like. Contrary to the autosome bivalents 2 X's are always clearly identified in this division. Each of the X's may be closely arranged, sometimes apart with very short distance. In profile view of metaphase I they appear as two stout rods of slightly pointed end, standing on the periphery, intermediate between one pole and autosomal group. The two elements seem to be quite equal in length. Of course they are prereductional.

The good secondary metaphase plates could not be obtained in the material.

Subfamily Metinae

(56) *Meta yunohamensis*

(Figs. 318-320)

The spiders of this species inhabit usually above brooks and seem to prefer cooler habitat. Many individuals from juvenile to adult were preserved during April and June. As fixatives modified NAVASHIN's solution and FLEMMING's weak solution were employed. When the latter fixative was used the chromosomes showed very sharp contour. The chromosomes are so small that unless good fixatives are used favourable results will not be obtained.

Spermatogonia (Figs. 318-319): The chromosomes are of acrocentric type and are very small in size. Even the largest one is 1.9μ long. The size is probably the smallest one among the argiopid species studied, in this respect the species shows close resemblance to *Tetragnatha* (Tetragnathidae), *Enoplognatha*, *Theridium* (Theridiidae) and *Linyphia* (Linyphiidae). In all metaphase plates the diploid number of 24 is clearly counted. The elements are small rods, straight or slightly bent. All elements show similar shape, no particular elements representing sex-chromosomes are distinguishable in the gonial complements.

First division (Fig. 320): The metaphase plate I shows always $n=13$, 11 of which are autosomal bivalents and the remaining two, sex-chromosomes. The bivalents are arranged well apart with equal distance on the equatorial plane, the 2 X's form an accessory plate. In the polar aspect the bivalents show V-form, which appear as two small rod segments attached at apices to each other. The two X's are invariably distinguishable from autosome bivalents, usually they are of rod-shape, lying parallel with short distance on the eccentric position of spindle.

Second division: Two kinds of secondary metaphase plates are obtained. One has 11 elements and the other 13 ones.

The chromosome number and sex-chromosome mechanism of the present species are equal to those of many others of the Argiopidae, but as mentioned above the shape and size of chromosomes show rather closer resemblance to *Tetragnatha*, *Linyphia*, *Theridium* than to the allied forms of the family.

17. Family Mimetidae

No species has been studied cytologically in this family. As a representative *Ero japonica* was investigated.

(57) *Ero japonica*

(Figs. 321-324)

The material employed in the present study was the testes from four specimens which were gathered in May. The testes were fixed by modified NAVASHIN's solution.

Spermatogonia (Fig. 321): In the spermatogonial metaphase plate very stout chromosomes are arranged somewhat closely. The chromosomes are so deeply stained that it is relatively difficult to obtain good preparation, in which chromosomes can be easily counted. As shown in Fig. 321 all the elements are of acrocentric type, extremely thickened and appear to be very strong. The larger stout rod elements are straight or slightly arched, with pointed ends, some are acutely bent somewhere near apex and assume irregular contour. The smaller elements exhibit more or less scale-form. In the Fig. 321 24 elements are counted exactly, two of which are regarded as X-elements, but their identification in the complements is difficult.

First division (Figs. 322-324): It is rather difficult to obtain the excellent first metaphase plates in which all elements are arranged in orderly manner on the same plane. In many plates the bivalents show somewhat irregular arrangement, so that in spite of their large shape their observation is not easy. In Fig. 322 13 elements are counted, 11 of which are autosomal and the remaining two correspond to X's. The bivalents are of very large form and are stained deeply by iron hematoxylin, most of which are stout rods slightly constricted in the median, others are short rods or spherical bodies. The 2 X's stand on the periphery of the spindle, forming accessory plate. In polar view they assume two globular or oval bodies of about equal size, lying parallel with short distance. At metaphase I the 2 X's often stay near one pole as shown in Fig. 323.

As stated above at metaphase I the bivalents show some irregularities in arrangement. In many spindles some bivalents stand on somewhat different level from the equatorial plane. In one spindle three elements lie near one pole (Fig. 323), while others are on the equatorial plane; two of the former correspond to the X-elements, the remaining one is regarded as autosomal univalent, which failed to form bivalent and precociously moved near the pole. In Fig. 324 two such univalents are found near both poles.

Table II. Chromosome numbers in cytologically studied spiders.

Species	Sex	2N	N (I)	N (II)	Author
Subord. Liphistiomorphae					
Fam. Liphistiidae					
<i>Heptathela kimurai</i>	♂	±94	46? + X ₁ X ₂	— —	SUZUKI
Subord. Mygalomorphae					
Fam. Aviculariidae					
<i>Dugesiella hentzi</i>	♂	—	21 + X ₁ X ₂	— —	PAINTER '14
Fam. Atypidae					
<i>Atypus karschi</i>	♂	±44	21? + X ₁ X ₂	— —	SUZUKI
Subord. Arachnomorphae					
Div. Cribellatae					
Fam. Uloboridae					
Subfam. Miagrammopinae					
<i>Miagrammopes orientalis</i>	♂	22	10 + X ₁ X ₂	10 12	SUZUKI
♂	♀	24	—	—	♂
Subfam. Uloborinae					
<i>Uloborus varians</i>	♂	22	10 + X ₁ X ₂	10 12	♂
Fam. Dictynidae					
<i>Dictyna arundinacea</i>	♂	±24	11? + X ₁ X ₂	11 13?(12)	HACKMAN '48
♂ <i>foliicola</i>	♂	24	11 + X ₁ X ₂	— —	SUZUKI
Fam. Amaurobiidae					
<i>Amaurobius sylvestris</i>	♂	—	16 + X ₁ X ₂	16 18	PAINTER '14
Div. Ecribellatae					
Fam. Dysderidae					
Subfam. Segestriinae					
<i>Ariadna lateralis</i>	♂	—	3 + X	3 4	SUZUKI
Fam. Pholcidae					
<i>Spermaphora meridionalis</i>	♂	—	? + X ₁ X ₂	— —	PAINTER '14
<i>Pholcus crypticolens</i>	♂	23	11 + X ₁ X ₂	— —	SUZUKI
Fam. Drassidae					
<i>Callilepis nocturna</i>	♂	—	10 + X ₁ X ₂	10 12	HACKMAN '48
♂ <i>imbecilla</i>	♂	—	10 + X ₁ X ₂	10 12	PAINTER '14
<i>Berlandina cinerea</i>	♂	±22	10 + X ₁ X ₂	10 12	HACKMAN '48
<i>Drassodes lapidosus</i>	♂	—	10 + X ₁ X ₂	10 —	♂
♂ sp.	♂	22	—	— —	SUZUKI
<i>Haplodrassus cognatus</i>	♂	—	10 + X ₁ X ₂	— —	HACKMAN '48

Species	Sex	2N	N (I)	N (II)	Author
<i>Gnaphosa muscorum</i>	♂	—	10+X ₁ X ₂	10 12	HACKMAN '48
<i>Zelotes subterraneus</i>	♂	—	10+X ₁ X ₂	10 12	♂ ♂
<i>Poecilochroa variana</i>	♂	—	10+X ₁ X ₂	10 12	♂ ♂
Fam. Clubionidae					
Subfam. Clubioninae					
<i>Chiracanthium japonicum</i>	♂	26	12+X ₁ X ₂	12 14	SUZUKI '52a
♂ <i>kompiricola</i>	♂	26	12+X ₁ X ₂	12 14	♂ ♂
♂ <i>unieum</i>	♂	26	12+X ₁ X ₂	12 14	♂ ♂
<i>Clubiona</i> sp.	♂	—	22-26	— —	CARNOY '85
♂ <i>holosericea</i>	♂	—	10+X ₁ X ₂	— —	HACKMAN '48
♂ <i>subsultans</i>	♂	—	10+X ₁ X ₂	— 12	♂ ♂
♂ <i>phragmitidis</i>	♂	—	10+X ₁ X ₂	10 12	♂ ♂
♂ <i>japonicola</i>	♂	22	10+X ₁ X ₂	10 12	SUZUKI '52a
♂ <i>lena</i>	♂	24	11+X ₁ X ₂	— —	♂ ♂
Subfam. Micariinae					
<i>Micaria decorata</i>	♂	—	10+X ₁ X ₂	10 12	HACKMAN '48
♂ <i>unifascigera</i>	♂	—	10+X ₁ X ₂	— —	SUZUKI '52a
Subfam. Corinninae					
<i>Trachelas japonicus</i>	♂	—	10+X ₁ X ₂	— 12	SUZUKI '52a
Fam. Anyphaenidae					
<i>Anyphaena accentuata</i>	♂	—	12+X ₁ X ₂	— —	HACKMAN '48
♂ ♂	♀	—	14	—	♂ ♂
♂ <i>saltibunda</i>	♂	—	9+X ₁ X ₂	9 11	PAINTER '14
Fam. Sparassidae					
Subfam. Micrommatinae					
<i>Micrommata viridissima</i>	♂	±35	16?+X ₁ X ₂ X ₃ ?	— —	HACKMAN '48
Subfam. Sparianthidinae					
<i>Thelcticopis severa</i>	♂	43	—	— —	SUZUKI '52a
Subfam. Heteropodinae					
<i>Heteropoda venatoria</i>	♂	41	19+X ₁ X ₂ X ₃	19 22	SUZUKI & OKADA '50
♂ ♂	♀	44	—	—	♂ ♂ ♂
♂ ♂	♂	41	19+X ₁ X ₂ X ₃	19 22	BOLE-GOWDA '52
♂ <i>forcipata</i>	♂	41	19+X ₁ X ₂ X ₃	19 22	SUZUKI '52a
♂ <i>sexpunctata</i>	♂	21	10+X	10 11	BOLE-GOWDA '52
<i>Spariolenus tigris</i>	♂	41	19+X ₁ X ₂ X ₃	19 22	♂ ♂ ♂
Subfam. Deleneinae					
<i>Olios lamarki</i>	♂	42	20+X ₁ X ₂	20 22	♂ ♂ ♂
Fam. Thomisidae					

Species	Sex	2N	N (I)	N (II)	Author
Subfam. Misumeninae					
<i>Misumena vatia</i>	♂	—	11+X	11 —	HACKMAN '48
" <i>tricuspidata</i>	♂	23	11+X	11 12	SUZUKI '52a
<i>Xysticus triguttatus</i>	♂	—	11+X ₁ X ₂ (probably 11+X)	11 13(?)	PAINTER '14
" <i>viaticus</i>	♂	23	11+X	11 —	HACKMAN '48
" <i>ulmi</i>	♂	—	11+X	11 —	" "
" "	♀	—	12	—	" "
" <i>insulicola</i>	♂	23	11+X	11 12	SUZUKI '52a
" <i>ephippiatus</i>	♂	23	11+X	11 12	" "
<i>Coriarachne fulvipes</i>	♂	23	—	— —	" "
<i>Oxyptila decorata</i>	♂	—	11+X	11 12	" "
<i>Oxytate setosa</i>	♂	—	11+X ₁ X ₂	11 13	" "
" "	♀	26	—	—	" "
<i>Diaea subadulta</i>	♂	—	13+X	— —	" "
Subfam. Philodrominae					
<i>Philodromus laevipes</i>	♂	—	13+X ₁ X ₂	— —	HACKMAN '48
" <i>emarginatus</i>	♂	—	13+X ₁ X ₂	13 15	" "
" <i>aureolus</i>	♂	—	13+X ₁ X ₂	13 15	" "
" <i>aureolus japonicola</i>	♂	27	13+X	13 14	SUZUKI '52a
" <i>histrio</i>	♂	—	13+X ₁ X ₂	— —	HACKMAN '48
" <i>roseus</i>	♂	28	13+X ₁ X ₂	13 15	SUZUKI '52a
" <i>nigrostriatipes</i>	♂	—	13+X ₁ X ₂	13 15	" "
<i>Thanatus formicinus</i>	♂	—	13+X ₁ X ₂	13 15	HACKMAN '48
<i>Tibellus oblongus</i>	♂	—	11+X ₁ X ₂	11 13	" "
" <i>tenellus</i>	♂	28	13+X ₁ X ₂	13 15	SUZUKI '52a
Fam. Salticidae					
Subfam. Myrmarachninae					
<i>Myrmarachne formicaria</i>	♂	—	11+X	— —	HACKMAN '48
" <i>japonica</i>	♂	28	13+X ₁ X ₂	13 15	SUZUKI
" "	♀	30	15	—	" "
Subfam. Hasariinae					
<i>Hasarius albarius</i>	♂	28	13+X ₁ X ₂	13 15	" "
" "	♀	30	—	—	" "
" <i>adansoni</i>	♂	28	13+X ₁ X ₂	13 15	" "
Subfam. Maeviinae					
<i>Maevia vittata</i>	♂	28	13+X ₁ X ₂	13 15	PAINTER '14
" "	♀	30(29)	—	—	" "
Subfam. Hyllinae					
<i>Evarcha falcata</i>	♂	—	13+X ₁ X ₂	13 15	HACKMAN '48

Species	Sex	2N	N (I)	N (II)	Author
Subfam. Plexippinae					
<i>Plexippus paykulli</i>	♂	28	13+X ₁ X ₂	13 15	SUZUKI
♂	♂	—	? +X ₁ X ₂	— —	SHARMA '50
♂ <i>setipes</i>	♂	28	13+X ₁ X ₂	— —	SUZUKI
♂ <i>crassipes</i>	♂	28	13+X ₁ X ₂	13 15	♂
<i>Jous linea</i>	♂	28	13+X ₁ X ₂	13 15	♂
Subfam. Pelleninae					
<i>Aelurillus dimorphus</i>	♂	28	13+X ₁ X ₂	13 15	♂
Subfam. Heliophaninae					
<i>Evophrys aninotatus</i>	♂	28	13+X ₁ X ₂	13 15	♂
Subfam. Dendryphantinae					
<i>Dendryphantès rudis</i>	♂	—	13+X ₁ X ₂	— —	HACKMAN '48
<i>Pseudicius encarpatus</i>	♂	—	13+X ₁ X ₂	— —	♂
<i>Icius magister</i>	♂	28	13+X ₁ X ₂	13 15	SUZUKI
♂ <i>elongatus</i>	♂	28	13+X ₁ X ₂	13 15	♂
<i>Icidella vittata</i>	♂	28	13+X ₁ X ₂	13 15	♂
<i>Rhene atrata</i>	♂	28	13+X ₁ X ₂	— —	♂
Subfam. Sitticinae					
<i>Sitticus terebratus</i>	♂	—	13+X ₁ X ₂	13 15	HACKMAN '48
♂ <i>liitoralis</i>	♂	—	13+X ₁ X ₂	— —	SUZUKI
Subfam. Marpissinae					
<i>Salticus scenicus</i>	♂	—	13+X ₁ X ₂	— —	HACKMAN '48
Fam. Oxyopidae					
Subfam. Oxyopinae					
<i>Oxyopes salticus</i>	♂	—	10+X ₁ X ₂ (probably 10+X)	— —	PAINTER '14
♂ <i>ramosus</i>	♂	21	10+X	10 11	HACKMAN '48
♂ <i>hindustanicus</i>	♂	21	10+X	10 11	BOLE-GOWDA '50
♂ <i>sertatus</i>	♂	21	10+X	10 11	SUZUKI '52a
♂	♀	22	—	—	♂
<i>Nishina generosa</i>	♂	21	10+X	10 11	♂
<i>Peucetia viridana</i>	♂	28	13+X ₁ X ₂	13 15	BOLE-GOWDA '50
Fam. Lycosidae					
Subfam. Lycosinae					
<i>Arctosa leopardus</i>	♂	—	12+X ₁ X ₂	12 14	HACKMAN '48
♂ <i>alpigena</i>	♂	—	12+X ₁ X ₂	— —	♂
<i>Lycosa insopita</i>	♂	28(?)	13(?) +X ₁ X ₂	13-15 (?)	MONTGOMERY '05
♂ <i>communis</i>	♂	—	10+X ₁ X ₂	— —	PAINTER '14
♂ <i>saccata</i>	♂	±28	13+X ₁ X ₂	13 15	HACKMAN '48
♂ <i>paludicola</i>	♂	—	13+X ₁ X ₂	13 15	♂

Species	Sex	2N	N (I)	N (II)	Author
<i>Lycosa monticola</i>	♂	—	13+X ₁ X ₂	13 15	HACKMAN '48
<i>fluviatilis</i>	♂	—	13+X ₁ X ₂	13 15	" "
"	♀	—	—	15	" "
<i>pullata</i>	♂	—	13+X ₁ X ₂	— —	" "
<i>tarsalis</i>	♂	—	12+m+X ₁ X ₂	— —	" "
<i>T-insignita</i>	♂	28	13+X ₁ X ₂	13 15	SUZUKI
<i>cinereofusca</i>	♂	28	13+X ₁ X ₂	13 15	"
<i>coelestis</i>	♂	26	12+X ₁ X ₂	12 14	"
<i>pseudoannulata</i>	♂	—	13+X ₁ X ₂	— —	"
sp.	♂	28	13+X ₁ X ₂	13 15	"
<i>Pirata piraticus</i>	♂	—	12+X ₁ X ₂	12 14	HACKMAN '48
<i>uliginosus</i>	♂	—	11+X ₁ X ₂	— —	" "
<i>Schizocosa crassipes</i>	♂	22	10+X ₁ X ₂	10 12	HARD '39
<i>Tarentula pulverulenta</i>	♂	—	13+X ₁ X ₂	13 15	HACKMAN '48
<i>aculeata</i>	♂	—	13+X ₁ X ₂	13 15	" "
<i>Trochosa ruricola</i>	♂	26	12+X ₁ X ₂	12 14	" "
"	♀	28	14	14	" "
<i>spinipalpis</i>	♂	—	12+X ₁ X ₂	— —	" "
<i>Xerolycosa nemoralis</i>	♂	—	12+X ₁ X ₂	— —	" "
<i>miniata</i>	♂	—	10+X ₁ X ₂	10 12	" "
Fam. Pisauridae					
Subfam. Pisaurinae					
<i>Pisaura listeri</i>	♂	—	13+X ₁ X ₂	13 15	HACKMAN '48
" <i>lama</i>	♂	28	13+X ₁ X ₂	13 15	SUZUKI
"	♀	30	—	—	"
Subfam. Thaumasiinae					
<i>Dolomedes fontanus</i>	♂	—	12+m+X ₁ X ₂	— —	PAINTER '14
" <i>fimbriatus</i>	♂	—	11+X ₁ X ₂	11 —	HACKMAN '48
" <i>angustivirgatus</i>	♂	28	13+X ₁ X ₂	13 15	SUZUKI
" "	♀	ca. 30	—	—	"
" <i>pallitarsis</i>	♂	28	13+X ₁ X ₂	13 15	"
" <i>saganus</i>	♂	28	13+X ₁ X ₂	13 15	"
" <i>sulfureus</i>	♂	28	13+X ₁ X ₂	13 15	"
" "	♀	30	—	—	"
Fam. Agelenidae					
Subfam. Ageleninae					
<i>Agelena naevia</i>	♂	ca. 52	25?+X ₁ X ₂	— —	WALLACE '09
" "	♂	—	ca. 15	— —	PAINTER '14
" <i>limbata</i>	♂	44	21+X ₁ X ₂	— —	SUZUKI

Species	Sex	2N	N (I)	N (II)	Author
<i>Agelena opulenta</i>	♂	44	21+X ₁ X ₂	— —	SUZUKI
<i>Cryphoea silvicola</i>	♂	—	20+X ₁ X ₂ X ₃	20 23	"
<i>Tegenaria domestica</i>	♂	—	18(?) + X ₁ X ₂ X ₃	18(?) 19	SOKOLSKA '25
"	♂	43	20+X ₁ X ₂ X ₃	— —	REVELL '47
"	♀	46	—	—	" "
" <i>derhami</i>	♂	43	20+X ₁ X ₂ X ₃	— —	" "
"	♂	—	16? + X ₁ X ₂ X ₃	16? 19?	HACKMAN '48
" <i>atrica</i>	♂	42	20+X ₁ X ₂	— —	REVELL '47
"	♂	—	18-24	— —	CARNOY '85
" <i>corasides</i>	♂	42	—	— —	SUZUKI
" sp.	♂	—	6-12	— —	CARNOY '85
Subfam. Hahniinae					
<i>Hahnina nava</i>	♂	—	16+X ₁ X ₂	— —	HACKMAN '48
"	♀	—	18	—	" "
Fam. Argyronetidae					
<i>Argyroneta aquatica</i>	♂	—	11? + X ₁ X ₂	— —	" "
Fam. Uroctidae					
<i>Uroctea compactilis</i>	♂	42	20? + X ₁ X ₂	— —	SUZUKI
Fam. Theridiidae					
Subfam. Asageninae					
<i>Steatoda bipunctata</i>	♂	—	10+X ₁ X ₂	— —	HACKMAN '48
<i>Crustulina guttata</i>	♂	22	10+X ₁ X ₂	— —	SUZUKI
<i>Enoplognatha foliicola</i>	♂	22	10+X ₁ X ₂	— —	"
<i>Lithyphantes dubius</i>	♂	24	11+X ₁ X ₂	11 13	"
Subfam. Agyroclinae					
<i>Ariamnes cylindrogaster</i>	♂	22	10+X ₁ X ₂	— —	"
Subfam. Theridiinae					
<i>Theridium tepidariorum</i>	♂	—	10+X ₁ X ₂	10 12	HACKMAN '48
"	♀	24	12	—	MONTGOMERY '07
"	♂	22	10+X ₁ X ₂	— —	SUZUKI
" <i>sterninotatum</i>	♂	22	10+X ₁ X ₂	— —	"
Subfam. Nesticinae					
<i>Nesticus</i> sp.	♂	24	11+X ₁ X ₂	— —	"
Fam. Linyphiidae					
Subfam. Linyphiinae					
<i>Leptyphanthes minutus</i>	♂	—	11+X ₁ X ₂	— —	HACKMAN '48
<i>Drapetisca socialis</i>	♂	24	11+X ₁ X ₂	— —	" "
<i>Linyphia marginata</i>	♂	—	10? + X ₁ X ₂	— —	PAINTER '14

Species	Sex	2N	N (I)	N (II)	Author
<i>Linyphia marginata</i>	♂	24	11+X ₁ X ₂	11 13	SUZUKI
♂ <i>resupina domestica</i>	♂	—	11?+X ₁ X ₂	— —	HACKMAN '48
♂ sp. (<i>triangularis</i>)	♂	—	11+X ₁ X ₂	— —	♂ ♂
♂ <i>albolimbata</i>	♂	24	11+X ₁ X ₂	11 13	SUZUKI
♂ <i>montana</i>	♂	—	22+X ₁ X ₂	— —	♂
♂ sp.	♂	—	11+X ₁ X ₂	11 13	♂
Fam. Micryphantidae					
<i>Gongylidium rufipes</i>	♂	—	10+X ₁ X ₂	— —	HACKMAN '48
Fam. Tetragnathidae					
Subfam. Tetragnathinae					
<i>Tetragnatha extensa</i>	♂	±22	10+X ₁ X ₂	10 12	♂ ♂
♂ sp. (<i>obtusa</i> ?)	♂	—	10+X ₁ X ₂	— 12	♂ ♂
♂ <i>japonica</i>	♂	24	11+X ₁ X ₂	11 13	SUZUKI
♂ <i>squamata</i>	♂	24	11+X ₁ X ₂	11 13	♂
<i>Leucauge blanda</i>	♂	24	11+X ₁ X ₂	11 13	♂
Fam. Argiopidae					
Subfam. Metinae					
<i>Meta reticulata</i>	♂	—	11+X ₁ X ₂	— —	HACKMAN '48
♂ <i>yunohamensis</i>	♂	24	11+X ₁ X ₂	11 13	SUZUKI
Subfam. Argiopinae					
<i>Argiope amoena</i>	♂	24	11+X ₁ X ₂	11 13	SUZUKI '51a
Subfam. Nephilinae					
<i>Nephila clavata</i>	♂	—	11+X ₁ X ₂	11 13	♂ ♂
Subfam. Epeirinae					
<i>Cyclosa octotuberculata</i>	♂	24	11+X ₁ X ₂	11 13	♂ ♂
♂ ♂	♀	26	—	—	♂ ♂
♂ <i>atrata</i>	♂	—	11+X ₁ X ₂	11 13	♂ ♂
♂ <i>sedeculata</i>	♂	—	11+X ₁ X ₂	11 13	♂
<i>Aranea sericata</i>	♂	23	11+X (probably 11+X ₁ X ₂)	11 12	BERRY '06
♂ <i>reaumuri</i>	♂	24	11+X ₁ X ₂	11 13	PÄTAU '48
♂ ♂	♀	26	13	—	♂ ♂
♂ <i>angulata</i> ?	♂	—	11+X ₁ X ₂	11 13	HACKMAN '48
♂ <i>cucurbitina</i>	♂	—	11+X ₁ X ₂	— —	♂ ♂
♂ <i>diademata</i>	♂	—	11+X ₁ X ₂	11 13	♂ ♂
♂ ♂	♀	—	13	—	♂ ♂
♂ <i>dumetorum</i>	♂	14	6+X ₁ X ₂	6 8	♂ ♂
♂ ♂	♀	—	8?	—	♂ ♂
♂ <i>foliata</i>	♂	24	11+X ₁ X ₂	— —	♂ ♂

Species	Sex	2N	N (I)	N (II)	Author
<i>Aranea sexpunctata</i>	♂	—	11+X ₁ X ₂	— —	HACKMAN '48
♂ <i>japonicus</i>	♂	—	11+X ₁ X ₂	11 13	SUZUKI '51a
♂ <i>mitificus</i>	♂	—	11+X ₁ X ₂	11 13	♂ ♂
♂ <i>opima</i>	♂	24	11+X ₁ X ₂	11 13	♂ ♂
♂ <i>scylla</i>	♂	14	6+X ₁ X ₂	6 8	♂ ♂
♂ sp.	♂	24	11+X ₁ X ₂	11 13	♂ ♂
♂ <i>ventricosus</i>	♂	46	22+X ₁ X ₂	— —	♂ ♂
♂ <i>fuscocoloratus</i>	♂	—	11+X ₁ X ₂	11 13	♂
♂ <i>saganus</i>	♀	26	—	—	♂
<i>Larinia punctifera</i>	♂	24	11+X ₁ X ₂	— —	♂
<i>Zilla stroemi</i>	♂	—	11+X ₁ X ₂	— —	HACKMAN '48
Fam. Mimetidae					
Subfam. Mimetinae					
<i>Ero japonica</i>	♂	24	11+X ₁ X ₂	— —	SUZUKI

DISCUSSION

I. Number of spiders species studied cytologically

The cytological studies of spiders have been carried out by many workers, among which the earlier investigations were reported by CARNOY (1885), WAGNER (1896 a,b), WALLACE ('00, '05, '09), BÖSENBERG ('04), MONTGOMERY ('05, '07) and BERRY ('06). Following these authors PAINTER ('14), SOKOLSKA ('25), WARREN ('25, '26, '28, '29, '30) and HARD ('39) contributed to this field. Recently remarkable reports have been published by many workers such as REVELL ('47), PÄTAU ('48), HACKMAN ('48), SUZUKI ('49, '50 a,b, '51 a,b, '52 a,b,c, '53, '54 and present paper), SUZUKI and OKADA ('50), SHARMA ('50) and BOLE-GOWDA ('50, '52). In particular HACKMAN and the present author studied the chromosomes of vast number of spiders. The total number of species studied cytologically by these workers amounts to 181 species of 90 genera belonging to 26 different families of all three suborders. The number of species and families studied are shown in the following table.