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盛岡高等農林學校

學術報告

第拾壹號

THE BULLETIN

OF THE

MORIOKA IMPERIAL COLLEGE OF AGRICULTURE AND FORESTRY

MORIOKA,

JAPAN

No. XI

STUDIES ON THE GERM CELLS OF APHIDS

With Especial Reference to the Evolutional Significance of the Chromosomes.

BY

Orihay Shinji Ph. D.

昭和二年十二月

MORIOKA, DEC, 1927.

Chief Errors and Corrections

Page	Line	Error	Corrrection
	elsewhere	betulaecolens KALT	*betulae* KOCH
	"	*Melanothanthus*	*Melanoxantherium*
	"	*Acaudas*	*Acaudus*
	"	*Periphylus*	*Periphyllus*
	"	Thomas	(SCHRANK)
	"	*ribis*	*suguri*
	"	Neocalaphis	*Chromaphis*
	"	remainning	remaining
1	17	mammer	manner
2	23	Fleming's	Flemming's
8	14	trochancher	trochanter
83	33	fig. 33, 35	135 133
94	8	4+X=5	4+?=?
97	22	11 elements	10 elements
107	26	5 elements	at least 5
99	12	4 1 5	4 ? ?
15	15	5 1 6	6 1 7
19	(6)	(6) 1 (9)	6 1 7
21	21	*Euceraphis*	*Calaphis*
22	22	4 4 8	2 4 6
23	23	6 1 7	3 1 4
	31	10 1 11	3 1 4
	33	(10) 1 (11)	9 1 10

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Contents.

Introduction.

During the past decade the cytological studies of the germ cells of aphids have brought about many far-reaching important facts. In spite of the fact that nearly twenty species of aphids, including phylloxerans, have been investigated by several investigators, there still remain certain paramount questions regarding the chromosomal history of aphids to be solved. In order, therefore, to contribute as much as possible on this subject this paper is prepared. Although several important observations were made, the writer wishes to limit the scope of the present paper to only a few of them. One of such problems concerns with the number of the sex-chromosome or chromosomes that may be found in the germ cells of the aphids. Whether the number of sex-chromosomes is limited to two in the case of Aphids or it varies with the species or genus as in the case of Reduviids studied by Payne (1915) is of much importance and interest, for Morgan (1915), Doncaster (1920) and others all agree in stating that "there are only two sex-chromosomes in the Aphids", and that one X is the male and 2 X the the female chracteristics, etc.

Another problem that demands a definite solution is the mammer of synapsis and the nature of the "Double chromosomes" of Miss Stevens who thinks the double chromosomes to represent all of the chromosomes including the sex-chromosomes.

An especial consideration will, however, be given to the problem of evolution pertaining to the numbers of the sex-chromosomes as well as those of the autosomes, the differences and similarities of which may lead to the formulation of an idea as to the evolution of the genera and species, and in consequence of which a more satisfactory system of classifying aphids may be devised as Miss Stevens (1905) wished to have.

Before going further, I wish to express my hearty thanks to Professor

Long of the University of California, under whose untiring guidance the work was first began in July, 1913 and continued there until September 1915. My thanks are also due to Professor Lefever of the University of Missouri, with whom the work was continued for a year and who have kindly read a part of the manuscript. Last but not the least thanks are due to Professors Gates and Gould, both of whom have kindly given me their valuable suggestions and criticisms besides taking personal charge of my work during the absence on leave of Professor Long. I am also indebted to Professors Woodworth, Van Dyke and Essig of the University of California for many valuable informations and kind encouragements received during my stay in their rooms as a graduate student in the University of California.

Method of Study and Material.

A. Method of Study.

Most of the material studied was obtained from the individuals reared on the potted trees bought at nurseries and brought into the laboratory through the kindness of Professor Long of the University of California or by the aid granted to me from Saito Gratutude Funds, Sendai, Japan. For the study of the female germ cells, parthenogenetic and sexual, the ovaries of adults as well as the young of all ages were dissected out either directly in the fixing fluid or they were first dissected out in the Ringer's solution and then transferred into the fixing fluid.

One of the fixing reagents most generally used was Fleming's weak as well as strong solutions. Carnoy's aceto-alcohol-chroloform mixture was good for the fixation of winter eggs but in the study of the male cells it proved to have been far inferior to Tellensky's or Champy's, both of the last named gave as good a result as Fleming's. Sections of the testis were cut from 4 to 7 microns in thickness and stained mostly with Heidenhain's iron-alum-hematoxylin method followed by either orange G., acid fucsin or congo red. The tripple stain, safranin and gentian violet were also used with fairly good result. Phosphotungstic acid stain was used toward the end of the last

year's work. This stain was rather difficult to use with a great advantage, but in the specimens properly stainned with this dye I have found the very best and at the same time the most beautiful specimens.

B. Material:

Description of Species.

Stevens' (1905) statement that the present system of classifying aphids is unsatisfactory and therefore a new one based upon the cytological study should be devised led me to study a great many aphids cytologically as well as morphologically. Such investigations, however, contrary to her claim, convinced me that the present system of classification is better than the one that may be derived from cytological studies. Stevens bases her dissatisfaction on the ground that no less than three different forms or species of aphids infesting the rose are placed under the name of *Aphis rosae* L. Had she carefully gone through the literature on the rose aphids, she would have probably found out that there is no aphids at present that bears the name of *Aphis rosae*, and that several aphids infesting the rose are not indiscriminately called under the same name but that they are known as *Macrosiphun rosae, Myzaphis rosarum, Myzus persicae, Rhopalosiphum nervatum, Macrosiphum solanifoliae, Aphis gossypii* etc. The same is true in the case of the maple, birch etc. From what I have just said it will become clear that the system of naming the aphids according to their host plants as Stevens did is much more confusing and unsatisfactoy than the present system of classification based on the differences and similarities of external characters. This is the first reason for giving here the brief descriptions of the species, the germ cells of which have been investigated by me. Another reason why I have determined to give such descriptions lies in the fact that many of my material have not been described in English and that the sexual forms of even well known spscies are yet left undescribed. Last but not the least reason for giving so much space in describing the material is to present to the reader some of the more conspicuous features of each of the species investigated, so that when discussions on the corelation that may exist between various body characters and chromosomes of the germ

cell should be taken up, there would be no confusion as to the species in question.

1. *Dilachnus laricolus* MATSUMURA

Lachnus laricolus MATSUMURA, A list of Aphid, Japan., Jour. Coll. Agri. Tohoku Imp. Univ. Vo. VII, pt. 6, 1917.

Alate viviparous female (Fig. 1).

Body oval, hirsute, shining black in the living or dry specimens, but brick-red in the alcoholic ones. *Head* including the eyes not quite as broad as the prothorax, not divided, infuscation slight. *Proboscis* reaching the third leg, infuscated. *Eyes* dark red. *Antennae* arising directly from the sides of the head, 6-articulated, about half as long as the body, hirsute, infuscated except the basal portion of III, which part is concolourous with the body; I decidedly broader but not quite so long as II; II longer than broad, with a couple of hairs; III the longest, being longer than IV and V taken together, with about 10 circular senseria of somewhat smaller diameter than that of the joint and some 22 long hairs; IV decidedly shorter than V, with about 8 hairs and 3 circular sensoria; V longer than VI including the spur, with only one circular sensorium in addition to the one situating near the apex and about 10 long hairs; the base of VI more than twice as long as the spur, with the usual group of sensoria at its junction with the spur. *Thorax* and *abdomen* slightly infuscated. *Wings* moderately long with stigma long and radial sector almost atraight; media twice branched. *Legs* stout, hairy and infuscate with the exception of the base of the femur and the middle portion of the tibia. *Cornicles* situating on a pair of chitinous cones, conical, hairy, black. *Cauda* rounded, with a pair of tufts of long hairs, black.

Measurements in millimeters:

The length of the body 2.5	The length of the antennal articles:
The greatest breadth of the abdomen ... 3.4	III 0.4
The length of the fore wing 3.4	IV 0.2
The greatest breath of the fore wing ... 1.3	V 0.3

VI, base 0.15	hind 1.3
VII, spur 0.07	The length of the tibiae:
The length of the femur:	fore 1.1
fore 0.6	middle 1.1
middle 0.6	hind 2.1

Apterous Viviparous Female.

Ground colour brick-brown but owing to the presence of superficial maculae of black all over the body the living specimen looks black. *Body* oval, with a few long hairs in front. *Eyes* black. *Antennae* of 6 articles, a little longer than half the length of the body, hirsuite and infuscate; I shorter but broader than II; II longer than broad, III the longest with about 10 circular sensoria of two diferent sizes arranged on the entire length; IV shorter than V, with 3 circular sensoria; V longer than VI including the spur, with one sensorium besides the one usual subapical one; the spur of VI very much shorter than the base. *Proboscis* nearly as long as the body, infuscate for the most part. *Legs* short with many hairs, infuscated except the middle portions of the tibiae, which are concolourous with the body. *Cornicles* conical with a few hairs, black. *Cauda* round, with many long hairs.

Measurements in millimeters:

The length of the body 1.6	The length of the femora:
The greatest breadth of the abdomen ... 0.9	fore 0.4
The length of the antennal articles:	middle 0.4
III 0.40	hind 0.6
IV 0.20	The length of the tibiae:
V 0.30	fore 0.6
VI base 0.10	middle 0.8
VII spur 0.03	hind 1.4

Male

Alate. *Body* shining-black, except the abdomen, basal half of the antennal articles III, the basal half of the hind tibiae and the middle portions of the tibiae, all of which are infuscated but not so dark as the other parts mentioned. *Head* not divided in front, with rather short

hairs. *Eyes* large, dark red. *Antennae* arising directly from the side of the head, 6-articulated, decidedly shorter than the body, hirsute and infuscated throughout; I and II nearly as broad as long; III the longest but not quite so long as IV and V taken together, with about 12 short hairs and some 50 small circular sensoria irregularly arranged throughout the length; IV almost half as long as III, with about 12 circular sensoria and 6 or so of short hairs; V very much longer than IV, with about 8 short hairs and 16 circular sensoria in addition to the usual subapical one; VI about half as long as V, with a couple of short hairs and a group of sensoria at the place where the spur meets the base. *Proboscis* reaching the middle of the abdomen, slender, black. *Thorax* infuscated. *Wings* as in the viviparous winged female. *Legs* stout and hairy. *Abdomen* slightly infuscate, with black maculae on the dorsum. *Cornicles* subconical, with a few long hairs, infuscate. *Cauda* somewhat rounded, with long hairs.

Measurements in millimeters:

The length of the body 2.2	middle 0.6
The greatest breadth of the abdomen ... 0.8	hind 1.2
The length of the fore wing 3.2	The length of the tibiae:
The greatest breadth of the fore wing ... 1.1	fore 1.2
The length of the femora:	middle 1.2
fore 0.6	hind 2.0

Oviparous female.

Body oval and shining black in the living, but brick brown in the alcoholic specimen. It resembles in many respects the apterous viviparous female, the chief differences being:

1. *Body* much more plump.
2. *Legs* much more larger.
3. *Antennal* articles with less number of hairs and no sensorium on III and IV.
4. *Abdominal* maculation heavier.
5. *Proboscis* reaching nearly the tip of the abdomen.

Measurements in millimeters:

The length of the body 2.4	The length of the femora:
The greatest breadth of the abdomen ... 1.8	fore 0.6
The length of the antennal articles:	middle 0.4
III 0.4	hind 0.6
IV 0.2	The length of the tibiae:
V 0.3	fore 1.0
VI, base 0.1	middle 1.0
VI, spur 0.03	hind 1.7

2. *Pterochlorus tropicalis* van der Goot

Pterochlorus tropicalis v. d. GOOT, Zur. Syst. Aphid., Tijdschr. Ent. deel. LVI, 1913.

Alate viviparous female (Fig. 2).

Body elongate oval, shinging black, with numerous hairs. *Head* rather small, with some hairs. *Eyes* black. *Antenna* 6-articulated, nearly one-third as long as the body, hirsute, black; I and II not much longer than wide; III the longest with about 18 circular sensoria, IV shorter than V, with about 5 circular sensoria, V much longer than VI including the spurs, with about 2 circular sensoria in addition to the one situating near the apex, the spur of VI much shorter and narrower than the base, with a group of sensoria at the junctions of the two parts. *Thorax* and *abdomen* black, the latter with black superficial maculae on its dorsum. *Wings* rather broad, veins dark, the stigma very long with the radial sector arising almost at the tip of it, the media twice branched, almost black except the longitudinal band of white near the tip of the wing. *Legs* especially the hind pair long, hairy, black. *Corniele* subconical, arising from a chitinous conical base, without hair, black. *Cauda* rounded, with many pairs of long hairs.

Male

Body oblong, black. *Head* with many pairs of long bristle-like hairs in front, black. *Eyes* black. *Ocelli* prominent, not coloured. *Antennae* a little longer

than half the length of the body, 6-articulated, black, and hairy ; I as long as or a little longer than broad; II a little shorter than but nearly as broad as I, both with a couple of hairs; III the longest but not so long as IV and V taken together, armed with about 30 long hairs almost on one side and about 50 circular sensoria distributed throughout the length; IV much shorter than V, with about 18 long hairs in addition to about 24 small circular sensoria irregularly placed; V longer than VI including the spur, with about 14 hairs and some circular sensoria besides the usual apical one, VI with the usual group of sensoria at the junction of the spur and the base, the former being not quite half so long as the latter, armed with a few short hairs at the tip. *Wings* with the same colouration and venation as in the alate viviparous female, stigma long, the vein III twice branched, but all of them faintly indicated, the remainning veins dark-brownish. *Legs* stout and for the most part infuscated. Coxa, trochancher as well as the base and apex of the femur and tibia and the entire tarsi including the claws black. *Abdomen* and *thorax* black. *Cornicles* small. with many hairs, black. *Cauda* rounded, hairy black.

Measurements in millimeters:

The length of the body	3.5	IV	4
The greatest breadth of the abdomen	1.6	V	4
The lengths of the antennal articles :		VI, the base	2
III	7	VI, the spur	1

Oviparous female

Apterous. *Body* oval, shining black throughout. It differs from the apterous viviparous female in the following points:

1. Body smaller.
2. Legs more stout.
3. Hind tibiae very much flattened, with numerous secondary sensoria.

3. *Pterochrolus viminalis* (FONSCOLOMBE)

Aphis viminalis Boyer de FONSCOLOMBE, Ann. Soc. Ent. France, Vol. 10, 1841.
Lachnus viminalis BUCKTON, Monog. British Aphid., Vol. 3, 1880.
Tuberolachnus viminalis MORDWILKO, Ann. Mus. Zool. Acad. Imp. des Sc. tom. XIII, 1918.
Lachnus viminalis MATSUMURA, Jour. Col'. Agr. Tohoku Imp. Univ. Sapporo, Vol. VII, 1917.

Tuberolachnus viminalis ESSIG, Pomona Col'l. Jour. Ent. Vol. IV, 1912.
Tuberolachnus viminalis Das, Ind. Mus, Zool. Mus. Vo'. IV, 1918.
Tuberolachnus viminalis TAKAHASHI, Aphid. Formosa, No. 1, 1918.
Pterochlorus viminalis Baker, U. S. Dept. Agr. Bull. No. 826, 1920.

Alate viviparous female (Fig. 3).

This is the largest aphids found in this country. *Body* is covered with short fine hairs, dark brown with black maculae. *Head* narrower than the prothorax, black or dark brown. *Eyes* dark brown. *Rostrum* reaching beyond the third coxal cavity, apical joint black. *Antenna* short, 6-articulated, infuscated throughout; III the longest, almost subequal in length with the sum of IV and V, provided with about 15 circular sensoria arranged almost in a row; IV and V subequal in length, the former with 4 or 5 and the latter about 3 circular sensoria inclusive of the subapical one, VI slightly shorter than either IV or V, the base being nearly 5 times as long as the filament. *Thorax* black. *Legs* rather slender, with fine hairs; the basal portions of the femur and tibia concolourous with the body, the remainning portions being infuscated. *Wings* with veins brownish, stigma narrow and brownish, media once branched, radial sector almost straight. *Abdomen* brownish with black dorsal maculation and a large black tubercle between the cornicles. *Cornicles* conical, black. *Cauda* rounded, indistinct.

Measurements in millimeters:

The length of the body	4.1	IV	0.27
The greatest breadth of the abdomen	2.0	V	0.26
The length of the fore wing	5.0	VI, the base	0.23
The length of the antennal articles:		VI, the spur	0.04
III	0.55		

Apterous viviparous female

The largest of the aphids occuring in this country. *Body* conical, brownish. *Head* small, almost as wide as long with a few short hairs. *Eyes* dark brown. *Rostrum* reaching almost to the middle of the abdomen, only the apex dusky. *Antenna* short, one-third as long as the body, hairy and, for the most part, brownish; III the longest, IV a little longer than V or VI,

with a single sub-apical sensorium. *Thorax* rather small, well defined, concolourous with the body. *Abdomen* with short fine hairs, brownish with black spots and a large sub-conical tubercle arising between the cornicles. *Cornicles* conical, black. *Cauda* rounded, concolourous with the body.

Measurements in millimeters:

The length of the body 5.1	IV 0.30
The greatest breadth of the abdomen. ... 2.8	V 0.25
The lengths of the antennal articles:	VI, base 0.18
III 0.70	VI, spur 0.05

4. *Shivaphis celti* Das

Shivaphis celti Das, Mem. Ind. Mus., vol. 6, 1918.
Shivaphis Celticolens ESSIG and KUWANA, Proc. Cal. Acad. Sci., 4th series, vol. VIII, 1918.

Alate viviparous female (Fig. 4.)

Body elongate, covered with white floculence. *Head* including the eyes narrower than long, infuscated. *Eyes* red. *Proboscis* reaching the second leg, the apical portion infuscated, the remainning parts being concolourous with the body; I much broader but not much longer than II; III the longest with about 18 oblong sensoria situated for the most part on the middle portion; V slightly shorter than IV, with but a single circular sensorium near the apex; the spur of VI shorter than half the length of the base. *Eyes* red. *Ocelli* prominent, dark-margined. *Thorax* infuscated. *Wings* rather long; veins infuscated, with a smoky area near the tip of each; stigma also smoky. *Legs* rather short; coxae, apical parts of the femora, basal as well as the apical parts of the tibiae and the tarsi including the claws infuscated, the remainning parts concolourous with the body, *Abdomen* with the dorsal as well as the lateral black maculae. *Cornicles* almost pore-like, dark. *Cauda* deeply indented making U-shaped. *Cornicles* and cauda concolourous with the body.

Measurements in millimeters:

The length of the body 1.90	VI, the spur 0.04
The greatest breadth of the abdomen ... 0.70	The lengths of the femora:
The length of the fore wing 3.00	fore 0.40
The greatest breadth of the fore wing ... 0.90	middle 0.40
The lengths of the antennal articles:	hind 0.50
III 0.70	The lengths of the tibiae:
IV 0.40	fore 0.65
V 0.38	middle 0.65
VI, the base 0.28	hind 1.00

Male

Winged. *Body* elongate, without prominent hairs. *Ground colour* pale. *Head* including the eyes somewhat broader than the thorax, without prominent hairs in front, nor divided. *Antennae* arising from the sides of the head, very much longer than the body, infuscate. I and II subequal in length, both being not much broader than III; III the longest, with about 30 oblong sensoria arranged almost in a row; IV longer than V, with about 12 oblong sensoria arranged in a row; V as long as VI including the spur, with about 6 oblong sensoria in addition to a subapical one; the base of VI nearly 3 times as long as the spur, with about 6 oblong sensoria besides a group of them at the junction of the two parts. *Eyes* dark red, large. *Ocelli* with dark margin. *Proboscis* reaching the second caxal cavity, infuscate. *Thorax* without hairs, black. *Legs* moderately long, the femora entire, and the apical portions of the fore and the middle tibiae, and all of the hind tibiae including the tarsi and claws infuscate, the remainning parts concolourous with the body. *Abdomen* rather elongate, infuscate, with black dorsal maculation. *Fore wings* narrow, radial sector wanting, the media arising from the middle of the stigma, very much curved, running for a considerable distance pararell with the cubitus, then takes the direction pararell to the posterior margin of the wing; twice branched; all veins with smoky border, stigma smoky. *Hind wings* with both media and cubitus present, veins, especially the tips of them, smoky. *Cornicles* subtruncate, dusky. *Cauda* deeply indented so as to give a U-shape. *Anal plate* knobbed, dusky.

Apterous viviparous female.

Body oval, without any prominent hairs; ground colour is dark green but accompanied with slight infuscation. *Head* dusky, broader than long. *Eyes* red. *Proboscis* reaching beyond the second coxae, apical portion dusky. *Antennae* of 6 articles; nearly twice as long as the body; the apices of III, IV and V and the middle of VI infuscate; IV and V subequal in length, the latter with a single subapical sensorium; the base of VI much longer than the spur. *Thorax* infuscate. *Legs* short, sparingly hairy; the apical portion of the femur and the entire tarsi including the claws black, the remainning parts concolourous with the body. *Cornicles* subtruncate, broader at the base, infuscate. *Cauda* deeply indented making U-shape; slightly infuscate, with some hairs.

5. *Myzocallis castanae* FITCH

Callipterus castanae BUCKTON, Morg. British Aphid., Vol. 1888

Alate viviparous female.

A beautiful form. *Ground* colour of the body pale. Length of the body including the cauda 2.2 mm. *Head* dusky longer than broad, width including the eyes about 0.4 mm. *Antenna* 6-articulated, apices of III, IV, V, and VI including spur black and reticulate, the remainning parts being pale. There are about 8 circular sensoriae on III. This number varies with the species e. g., 9,8; 8,9; 7,7. etc. *Prothorax* broader than the head including the eyes, dusky with marginal trim of black. *Thorax* dusky with muscle lobes bright amber in color. *Abdomen* pale; usually, however, with one central broad transverse, two sides, and two marginal dorsal patches of black on each of the first seven segments. *Cauda* dusky. *Cornicles* black.

Measurements in millimeters:

The length of the body 2.2	III 0.6
The greatest breadth of the abdomen ... 0.8	IV 0.4
The length of the fore wing 2.7	V 0.3
The length of the hind wing 2.0	VI, the base 0.1
The lergths of the antennal articles:	VI, the spur 0.2

The lengths of the femora:	The lengths of the tibiae:
fore 0.6	fore 0.8
middle 0.6	middle 0.8
hind 0.9	hind 1.0

Male (Fig. 6).

Rather a small form. *General color* green or pale according to the nitche it infests. *Head* including the eyes slightly broader than the prothorax, width 0.4 mm. *Eyes* black, prominent. *Antennae* arising from a pair of frontal tubercles, dusky throughout their entire length, VI including the spur and the apical portions of the remainning articles almost black. *Rostrum* long, reaching beyond the third coxal cavity, the apical article black, the remainning ones dusky. *Prothorax* dusky, width 0.45 mm. Antennal sensoria are distributed as follows: III, about 25; IV, about 8, V, 6, VI, 3. The number, however, varies with the specimens. It also varies even with the left and right sides of the same individual. The following are some of the typical examples: 24, 8, 5, 2; 22, 6, 4: 18, 6, 6; 23, 8, 7, 3; 23, 8, 5, 3. *Mesothorax* black, width 6 mm. *Metathorax* black. Legs dusky to black. Cornicles black, strongly imbricated throughout its length, length 0.04 mm, Cauda dusky, triangular in form.

Measurements in millimeters:

The length of the body 1.8	The lengths of the femora:
The greatest breadth of the abdomen ... 0.5	fore 0.4
The length of the fore wing 2.8	middle 0.3
The length of the hind wing 1.8	hind 0.4
The lengths of the antennal articles:	The lengths of the tibia:
III 0.77	for: 0.7
IV 0.40	middle 0.5
V 0.30	hind 0.85
VI, the base 0.07	The length of the cornicle 0.04
VI, the spur 0.20	

Apterous oviparous female.

General color light orange to brown. *Head* the color of the body, width including the eyes. 0.35 mm. *Eyes* black. *Rostrum*, reaching beyond the

second coxal cavity, apical portion dusky, the remainning portion the color of the body. *Antennae* arising from the frontal tubercles, the rings of III, IV, V, and all of the sixth including the spur black, the remainning portions the color of the body. *Prothorax* the color of the body, 0.4 mm. wide. The muscle lobes are small, but strongly amber-colored. *Abdomen* the color of the body, with dorsal transverse rows of dark bands on each segment. Cornicles and cauda pale.

Measurements in millimeters:

The lergth of the body 1.7	IV 0.2
The greatest breadth of the abdomen ... 0.6	V 1.9
The lengths of the antennal articles:	VI, the base 0.1
III 0.3	VI, the spur 1.2

6. *Calaphis betulaecolens* FITCH.

Calaphis betulaecolens FITCH, Ist and 2nd Report on Nox. and Benef. Insects of the state of N. Y., 1856.

Alate viviparous female (Fig. 6).

General appearance black. *Head* between the eyes 0.3 mm. broad. *Beak* slender and long, second and third segments dusky, the first segment being pale. *Antennae* rather short and black. There are about eight circular sensoriae on III. *Eyes* black. *Simple eyes* distinct. *Prothorax* broader than long, width 0.45 mm. *Mesothorax* and *metathorax* black. *Legs* black. *Abdomen* pale with at least one transverse band of black. Occasionally in older forms two lateral and two marginal black patchs are seen on each of the first seven abdominal segments. *Cornicles* black, strongly imbricated. *Cauda* dusky.

Measurements in millimeters:

The length of the body 2.8	IV 0.35
The greatest breadth of the abdomen ... 0.8	V 0.2
The length of the fore wing 2.8	VI, base 0.1
The greatest breadth of the fore wing ... 2.8	VI, spur 0.2
The lengths of the antennal articles:	The lengths of the femora:
III 0.5	fore 0.4

middle 0.4	middle 0.7
hind 0.6	hind 1.0
The lengths of the tibiae:	The length of the cornicle 0.1
fore 0.7	

Alate Male.

Very much resembles the alate viviparous female, important distinguishing differences being:

1. Body slightly smaller,
2. Darker in coloration,
3. Penultimal segment of the abdomen has, on ventral side, a pair of cerci and a projecting pinis.

Apterous viviparous female.

Rather a small form. General appearance dusky. Length of the body including cauda 1.7 mm. The greatest width of the abdomen 0.9 mm. *Head* rather small, wider than long, width including the eyes 0.45 mm., pale. *Eyes* black. *Antenna* 6-articulated. There are about six circular sensoria on III. *Prothorax* broader than the head, width 0.55 mm. Meso-and metathorax with distinct muscle lobes. *Legs* from dusky to black. No pores on the hind tibia as seen in the case of the oviparous female. *Abdomen* with dark dorsal markings as in the oviparous female. *Cornicles* black. *Cauda* dusky.

Oviparous female.

Apterous. Very much resembles the apterous viviparous female. *Ground* colour pale. *Head* concolourous with the body. *Beak* rather stout, apices black, the remainning portion pale. *Eyes* black. *Antennae* 6-articulated, imbricated throughout, the apex of V and VI including the spur black, the remainning portions of the antennae pale. *Prothorax* wider than the head. *Legs* strongly chitinous and infuscated. *Abdomen* with one central, two lateral and two marginal black patches on each of the first seven abdominal segments. *Cornicles* black, strongly imbricated throughout the entire length. *Cauda* dusky. *Ovipositor* pale, long and telescopic.

The length of the body 1.7	IV 0.2
The greatest breadth of the abdomen ... 0.6	V 0.17
The lengths of the antennal articles:	VI, the base 0.1
III 0.4	VI, the spur 0.2

7. *Tuberculatus kashiwae* (MATSUMURA)

Myzocallis kashiwae MATSUMURA, A List of Aphid. Jap., Jour. Coll. Agr. Tohoku Imp. Univ. Vol. VII, pt. 6, 1917.

Alate viviparous female (Fig. 5).

Body greenish yellow. *Head* and *thorax* dusky to black. *Eyes* red. Simple eyes black with black margin. *Vertex* with a pair or two of tubercles bearing a long bristle. *Antennae* 6-articulated, shorter than the body; I and II throughout and the apices of I—VI black, the remainning parts concolourous with the body, without prominent long hairs; III subequal to the sum of IV and V taken together, with 1—8 circular sensoria; V shorter than IV, with an apical sensorium; the filamental portion of VI about 2 times as long as the base. *Wing venation* normal. *Stigma* along the subcosta with a crescentic black macula. Fore, mid, and hind *legs* concolourous with the body, *hind legs* black throughout, with the base of the femur pale. *Abdomen* with 3 pair of black tubercles and marginal large maculae. *Cornicles* black, concolourous with the body.

Host plant: Nara (Quercus dentata Thunb, Q. serrata Bl., Q. glandulifera, Bl.)

Measurements in millimeters:

The length of the body 1.2	The lengths the of femora:
The greatest breadth of the abdomen ... 0.6	fore 0.3
The length of the fore wing 2.2	middle 0.4
The greatest breadth of the fore wing ... 0.2	hind 0.4
The lengths of the antennal articles:	The lengths of the tibiae:
III 0.4	fore 0.6
IV 0.3	middle 0.6
V 0.3	hind 0.8
VI, the base 0.2	The length of the cornicle 0.1
VI, the spur 0.25	

Apterous viviparous female.

Body oval, with long hairs, green or light. *Head* between the eyes almost as broad as long, with some pairs of long hairs in front, dusky. *Antennae* arising from the sides of the head, 6-articulated, shorter than the body; I, and II entire, apices of III, IV, and V, and the middle portion of VI infuscate, the remainning parts concolourous with the body; I about twice as long and broad as II; II almost as broad as long; III the longest with 2 or 3 long hairs; IV slightly longer than V, with about 2 long hairs; V nearly twice as long as the base of VI, with a single subapical sensorium in addition to 2 or 3 hairs; the spur of VI more than twice as long as the base. *Eyes* red. *Thorax* infuscated. *Legs* moderately long, the apical portion of the tibia and the entire tarsi including claws infuscated, the remainning parts being concolourous with the body. *Abdomen* with black dorsal maculae. *Cornicles* subtruncate, wider at the base, black throughout. *Cauda* indent, hairy, concolourous with the body.

Measurements in millimeters:

The length of the body 1.2	The lengths of the femora:
The greatest breadth of the abdomen ... 0.7	fore 0.3
The lengths of the antennal articles:	middle 0.3
III 0.3	hind 0.3
IV 0.2	The lengths of the tibiae:
V 0.2	fore 0.5
VI, the base 0.1	middle 0.5
VI, the spur 0.13	hind 0.7

Male.

Body small, with a few long hairs, greenish. *Head* and *thorax* black. Compound eyes black. *Simple* eyes blackringed. *Antennae* of 6-articles, apices of III, IV and V, and VI including the spur black, the remainning parts concolourous with the body, III the longest, longer than VI; V shorter than IV; the filamental portion of VI about $1\frac{1}{2}$ times as long as the base. Number of antennal sensoria are as follows: III, 30, VI 14, V, 10. Fore and middle legs, with the exception of black tarsi including claws, green;

hind legs for the most part black, hairy. *Wing venation* normal but the stigmal vein is often obscure or faint. Stigma with black crescentic portion. *Abdomen* with black maculation and 3 pairs of tubercles. *Cornicles*, *cauda* and *cerci* black.

Measurements in millimeters:

The length of the body 1.2	VI, the spur 0.13
The greatest breadth of the abdomen ... 0.6	The lengths of the femora:
The length of the fore wing 2.2	fore 0.3
The greatest breadth of the fore wing ... 0.8	middle 0.35
The lengths of the antennal articles:	hind 0.6
III 0.3	The lengths of the tibiae:
IV 0.2	fore 0.7
V 0.2	middle 0.7
VI, the base 0.1	hind 1.2

Oviparous female.

Prevailing color light yellow with smoky superficial marking. *Eyes* black with red rim. Vertex with about 6 long hairs. *Antennae* 6-articulated, I, and II *slightly*, the apices of III, IV and V as well as the middle and the filamental parts of VI black, the remainning parts concolourous with the body. *Femur* and tarsus slightly dusky, the remainning parts green. *Cornicles* black. *Cauda* green or yellow.

Measurements in millimeters:

The length of the body 1.7	The lengths of the femora:
The greatest breadth of the abdomen ... 0.8	fore 0.3
The lengths of the antennal articles:	middle 0.2
III 0.4	hind 0.5
IV 0.2	The lengths of the tibiae:
V 0.2	fore 0.6
VI, the base 0.1	middle 0.6
VI, the spur 0.15	hind 1.0

8. *Tuberculatus quercicola* (MATSUMURA)

Acanthocallis quercicola MATSUMURA, Jour. Coll. Agri., Sapporo, Vol. VII, pt. 6, 1917.

Myzocallis quercicola TAKAHASHI, Aphid. of Formosa, pt. 2, 1923.

Alate viviparous female.

Body greenish. *Antennae* 6-articulated, much shorter than the body, with many slender hairs, the apices of III-VI infuscated, the remainning parts pale or yellowish; III the longest, with about 5 circular sensoria in a row; IV and V subequal in length, the latter with the usual apical sensoruim, VI as long as IV, the filamental portion and the base of VI subequal. *Head* and *thorax* slightly dusky. *Abdomen* with black maculae. *Cornicles* and *cauda* concolourous with the body. *Wings* normal with veins and stigma with narrow smoky areas. *Legs* for the most part pale, but in well matured forms the hind femur often infuscated.

Host plant: *Quercus serrata* BL.

Measurements in millimeters:

The length of the body 1.6	The lengths of the femora:
The greatest breadth of the abdomen ... 0.8	fore 0.3
The length of the fore wing 2.2	middle 0.2
The greatest breadth of the fore wing ... 0.7	hind 0.4
The lengths of the antennal articles:	The lengths of the tibiae:
III 0.50	fore 0.6
IV 0.30	middle 0.8
V 0.25	hind 1.0
VI, the base 0.11	The length of the cornicle 0.1
VI, the spur 0.22	

Alate Male.

Body greenish, with many long hairs. *Antennae* of 6 articles, longer than the body, with many long hairs, I and II black, III and V black only at the apex; III with about 20; IV about 14 and V with one apical and another basal sensoria; the filamental portion of VI about twice as long as the base. *Wing venation* as in the case of the viviparous female. *Legs* with the fore and the middle pairs green, the hind one being black. *Cornicles* truncate, black. *Cauda* trilobed, black. *Abdomen* with a dorsal black maculation.

9. *Tuberculatus querceus* KALTENBACH

Aphis querceus KALTENBACH, Mong. der Fam. Pflanzenlau e, 1843
Aphis querceus WALKER, The Zoologist, Vol. 5. 1870.
Callipterus querceus KOCH, Die Planzenlause Aphiden, 1855.

Alate viviparous female.

Head pale, width between the eyes 3 mm. *Eyes* prominet, black. *Beak* short, reaching only to the second coxae, tip slightly dusky. *Antennae* pale except dusky rings near the joints of III, IV, V, and VI including the spur. Article III is provided with about 6 large circular sensoria near the base. *Prothorax* pale, smallest width 4 mm; and the greatest width, which is nearer to mesothorax, 7 mm. *Mesothorax* pale, with muscle lobes orange, width 9 mm. *Legs* with dusky spot at the base of the tibia; tarsi dusky, the rest pale. *Abdomen* pale. *Cornicles* pale, slightly longer than wide at base, somewhat constricted at the middle, length about 0.1 mm. *Style* pale, tip rounded, with spines, about .25 mm. long. *Anal plate* pale, deeply bilobed, provided with long spines.

Nymphs. — As far as the writer's observations go, nymphs of this species were not shaded with green as in the case of related species.

Measurements in millimeters:

Length of the body	2.2	Wing expanse	3.0
The greatest width of abdomen	1.0	Length of the cornicle	1.0

10. *Callipterous kuricola* (MATSUMURA.)

Nippocallis kuricola MATSUMURA, A list of Aphid Japan, in: Jour. Coll. Agr. Tohoku Imp. Univ. Sapporo, Vol. VII, Pt. 6. 1917.
Callipterus kuricola Baker, Gen. Class. of Hemip. Fam. Aphid, in: U. S. Dept. Agr. Bull. No. 826. 1920.

Alate viviparous female. (Fig. 8).

Body pale with greenish shade, presenting a checkered appearance. *Head* and *thorax* somewhat infuscated. *Antennae* 6-articulated, apices of III-VI infuscated, the remainning parts concolourous with the body; III the longest but not so long as IV and V taken together, with a few hairs and about 6 circular sensoria; IV and V subequal, the latter with the

usual apical sensorium; the filamental portion and the base of VI subequal in length. *Legs* for the most part not infuscated. *Wings* lacking the radial sector in the fore wing, stigma and veins bordered with smoky areas. *Abdomen* with about 3 pairs of black tubercles but no maculation on the dorsum. *Cornicles* truncate, dark. *Cauda* bilobed, slightly dusky.

Host plant: Kuri (Castanea sativa Mill.)

Apterous viviparous female.

Body oval, with long hairs, infuscate or orange yellow. *Head* including the eyes somewhat broader than the prothorax, with about two pairs of long hairs on the vertex. *Eyes* red. *Antennae* of 6-articles shorter than the body; III the longest, with some 6 or 7 long hairs arranged mostly on one side; IV slightly longer than V, with two long hairs; V and VI including the spur subequal in length, the former with about 3 long hairs besides a single subapical sensorium and the latter a group of sensoria at the junction of the base and the spur; the spur much longer than the base. *Legs* with short hairs, the apical portions of the femora and the tibiae including the entire tarsi and claws infuscated, the remainning parts concolourous with the body. *Thorax* and *abdomen* infuscated. *Cornicles* subtruncate, black. *Cauda* indented, infuscated, with a few pairs of long hairs.

Male.

Ground colour of the body green with black superficial maculation. *Head* wider than long, the area between the eyes narrower than the prothorax, with a couple of long subcapitate hairs in front. *Eyes* dark red. *Ocelli* prominent, margin being black. *Antennae* 6-articulated, about as long as the body, imbricate and infuscate; I, the broadest; II longer than wide; III narrower in diameter than the two preceding articles but decidedly longer, provided with about 50 circular sensoria distributed irregularly throughout the length in addition to some long hairs, imbricated near the apex; IV very slightly longer than V, imbricated, with about 16 small circular sensoria irregularly located and 3 inwardly directed hairs; V

and VI entire subequal in length, both imbricated, the former with about 17 small sensoria beside a couple of hairs and the latter about 5 sensoria on the basal portion in addition to a regular group at the junction of the two parts. *Proboscis* short, not reaching the second coxae, terminal article infuscated. *Legs* moderately stout, apices of the femora, tibiae and tarsi including the claws infuscated, the remainning parts being concolourous with the body. *Wings* moderate in size; venation normal except the fact that the stigmal vein is usually absent; veins dusky with smoky borders; stigmata infuscated. *Abdomen* with dorsal, lateral and vental patches of black, from which subcapitate hairs arise. *Cornicles*, *cauda* and *anal plate* infuscate. Penis long, dusky, slightly imbricate. Craspers black, hairy and porous on the inner surface.

Measurements in millimeters:

The length of the body 1.0	VI, the spur 0.15
The greatest breadth of the abdomen ... 0.4	The lengths of the femora:
The length of the fore wing 2.2	fore 0.20
The greatest breadth of the fore wing ... 0.8	middle 0.20
The lengths of the antennal articles:	hind 0.25
III 0.45	The lengths of the tibia:
IV 0.15	fore 0.6
V 0.21	middle 0.5
VI, the base 0.10	hind 0.7

Apterous oviparous female.

Body oval, with long hairs, orange yellow, the only infuscated parts being the tip of the proboscis, antennal articles beginning from the apex of IV on to the tip of VI, apices of tibiae and the entire tarsi including the claws, and the cornicles. *Head*, *thorax* and *abdomen* with patches of infuscate maculae on the dorsum. *Antennae* very much shorter than the body, 6-articulated; III the longest, with about 3 long hairs; IV and V subequal in length, the latter with a couple of long hairs besides a single subapical sensorium, the spur of VI quite as long as the base, with a group of sensoria at the junction of the two parts. *Legs* short and stout; hind tibiae much flattened with numerous circular sensoria. *Cornicles* subtruncate, infuscate. *Cauda* indented, concolourous with the body.

Measurements in millimeters:

The length of the body 1.0	VI, the spur 0.08
The greatest breadth of the abdomen ... 0.7	The lengths of the femora:
The length of the fore wing 2.2	fore 0.15
The greatest breadth of the fore wing ... 0.9	middle 0.15
The lengths of the antennal articles:	hind 0.20
III 0.22	The lengths of the tibiae:
IV 0.11	fore 0.35
V 0.12	middle 0.35
VI, the base 0.06	hind 0.60

11. *Euceraphis betulifoliae* SHINJI.

Euceraphis betulifoliae SHINJI, Tokio Zool. Mag., vol. 34, p. 730.

Alate viviparous female (Fig. 9).

Body oblong, moderate in size, light green or yellowish, with head and thorax black or at least dusky. *Antennae* nearly one and half times as long as the body, 6-articulated, with very few short hairs; I nearly twice as long as and one and a half times as wide as II, with a couple of short hairs, from dusky to black; II longer than broad, with two or three hairs, the colour of I; III longer than either IV or V but not quite so long as VI including the spur, the basal as well as the apical portions black, the remainning parts the colour of the body, provided with about twenty oblong sensoria arranged in a row on the basal black portion; IV slightly shorter than V, imbricated, the apical half infuscated; V decidedly shorter than VI including the spur, imbricated, distal half black; VI imbricated and infuscated throughout; the spur nearly twice as long as the base, imbricated and black throughout, with a single group of sensoria at the junction of the two parts. *Eyes* dark red, almost black. *Proboscis* reaching beyond the second coxae, beyond the 2nd joint infuscated. *Thorax* wider than the first abdominal segment. *Wings* large, with veins dusky. Legs infuscated excepting the basal part of the femur, hairy. *Cornicles* subtruncated, more than twice as long as broad at the base, imbricated and black. *Cauda* trilobed, furnished with long hairs, the colour of the body.

Measurements in millimeters:

The length of the body	2.1	IV	0.4
The greatest breadth of the abdomen	0.8	V	0.3
The length of the fore wing	2.7	VI, the base	0.1
The lengths of the antennal articles:		VI, the spur	0.2
III	0.6		

Apterous viviparous female.

Body oblong, furnished with capitate hairs, light green. *Head* including the eyes as broad as the thorax. *Eyes* dark red, almost black. *Antennae* longer than the body, 6-articulated; the apical portions of all articles and the middle portion of VI infuscate, the remainning parts concolourous with the body; III, IV, V and the spur of VI subequal in length; the base of VI less than half the length of the spur. *Legs* stout with rather a few hairs the apices of the femur and the tibia as well as the tarsi and claws infuscate, the remainning parts concolourous with the body. *Abdomen* wanting dorsal black maculation. *Cornicles* subtruncate, wider at base and apex. *Cauda* slightly indented. *Anal plate* knobbed, concolourous with the body.

Measurements in millimeters:

The length of the body	1.6	VI, the spur	0.6
The greatest breadth of the abdomen	0.6	The lengths of the femora:	
The length of the fore wing	3.6	fore	0.6
The greatest breadth of the fore wing	1.3	middle	0.7
The lengths of the antennal articles:		hind	0.7
III	1.0	The lengths of the tibiae:	
IV	0.8	fore	1.3
V	0.6	middle	1.5
VI, the base	0.1	hind	2.0

Male.

Alate. *Body* elongate, from light green to almost yellowish. *Head* very wide, with ocular tubercles projecting backward, with some long hairs in front, infuscated. *Eyes* dark red, almost black. Three *ocelli* prominent. *Antennae* arising from a pair of slight frontal elevation, 6-articulated, very much longer than the body, imbricated with the exception of I, II and III;

without prominent hairs, infuscated throughout; I nearly twice as wide and long as III, with a long hair directed inward, greater in diameter than III; III the longest with the exception of VI including the spur, with about 44 oblong sensoria distributed throughout the length; IV and V subequal in length, or the former a little longer, the former without and the latter with a large oblong sensorium in place of the usual one; VI slender with the filamental portion nearly 3 times as long as the base, provided with the usual group of sensoria at the junction of the base with the filament. *Thorax* wider than the head or the abdomen. *Proboscis* reaching the second coxae, apical joint dusky. *Legs* long, hairy, infuscated for the most part. *Wings* long, with the venation normal, or often the basal portion of the third oblique obscure; veins dusky, at tips as well as the distal margin of stigmasmoky-bordered. *Abdomen* with a central band of black maculae. Lateral tubercles and *cornicles* black, the latter being imbricated, wide at base. *Cauda* and the *anal plate* dusky. Ventral craspers black, hairy and porous.

Measurements in millimeters:

The length of the body	1.6	The lengths of the femora:	
The greatest breadth of the abdomen	0.5	fore	1.2
The length of the fore wing	3.8	middle	0.8
The greatest breadth of the fore wing	1.1	hind	0.9
The lengths of the antennal articles:		The lengths of the tibiae:	
III	1.0	fore	1.2
IV	0.7	middle	1.3
V	0.5	hind	8.2
VI, the base	0.2	The length of the cornicle	1.15
VI, the spur	1.0		

Oviparous female.

Body oval, with a few bristles, light green or almost yellow. *Head* with a pair of long bristles in front, dusky. *Antennae* arising from a pair of prominent frontal tubercles, very much longer than the body, 6-articulated, imbricated excepting articles II and the basal part of III, infustated throughout, with but a few short hairs; I the broadest, broader than long; II

somewhat longer than broad; III the longest with the exception of VI including the spur; IV and V subequal in length, the former without, and the latter with a single apical sensorium near the apex; the spur of VI nearly 6 times as long as the base. *Eyes* black with a red margin. *Proboscis* reaching the second coxae, apical portion of II and the whole of III infuscated. *Legs* long, for the most part infuscated in the adult. *Abdomen* without dorsal marking. *Cornicles* subtruncated, widest at the base, reticulated and infuscated throughout. *Cauda* slightly dusky.

Measurements in millimeters:

The length of the body	1.8	The lengths of the femora:	
The breadth of the body	0.7	fore	0.7
The length of the fore wing	3.7	middle	0.8
The greatest breadth of the fore wing	1.0	hind	0.8
The lengths of the antennal articles:		The lengths of the tibiae:	
III	1.0	fore	1.0
IV	0.7	middle	1.0
V	0.5	hind	1.2
VI, the base	0.2	The length of the cornicle	0.2
VI, the spur	1.1		

12. *Enceraphis betulicola* KALTENBACH.

Aphis betulicola KALT. ♀, WALKER, Zoologist, 2000. 1842.
Callipterus betulae KOCH, Die Pflanzenlause Aphiden, 1855.
Callipterus betulicola BUCKTON, Mong. British Aphid. 1885.

Alate Viviparous Female (Fig. 10).

A beautiful form. The *ground colour* of the body pale. *Head* dusky, broader than long, width including the eyes about 0.4 mm. Beak rather stout. *Antennae* 6-articulated, apices of III, IV, V and VI including the entire spur black, the remainning parts pale. There are about 8 circular sensoria on III. This number varies with the species e. g., 8,8; 9,9; 8,8; 7,7; etc. *Prothorax* broader than the head including the eyes, dusky with marginal trim of black. *Thorax* dusky with muscle lobes bright amber in colour. *Abdomen* pale, usually, however, with one central broad transverse, two sides, and two marginal dorsal patches of black on each of the first

seven segments. *Cauda* dusky. *Cornicles* black.

Host plant: The paper birch.

Measurements in millimeters:

The length of the body	2.9	VI, the spur	0.2
The greatest breadth of the abdomen	0.9	The lengths of the femora:	
The length of the fore wing	4.2	fore	0.5
The length of the hind wing	2.7	middle	0.5
The lengths of the antennal articles:		hind	0.5
III	1.1	The lengths of the tibia:	
IV	0.8	fore	0.9
V	0.8	middle	0.9
VI, the base	0.2	hind	1.1

Male (Fig. 11).

Winged. *Body* long and slender. A beautiful specimen. Length of the body including the caude 2.6 mm. *Ground colour* of the body pale. *Head and thorax* black. *Eyes* prominent, black. *Beak* three-articulated, apical article black. The width of prothorax 0.6 mm. and that of mesothorax 0.7 mm. *Abdomen* with 6 median bands of black, one on either side of the abdominal segments 2-7 inclusive, the fourth being the largest. Legs dusky, apical half of the femur and entire tibia black. *Antennae* black throughout. There are about 62 sensoria on III, none on IV, 15 and a single terminal one on V, and a group of about 5 on the apical part of VI. *Cauda* and *cornicles* black. *Genital* protuberance pale. There is a pair of ventral cerci or claspers on the ventral side of the penultimal abdominal segment.

Measurements in millimeters:

The length of the body	2.6	VI, the base	0.3
The greatest breadth of the abdomen	0.7	VI, the spur	0.2
The length of the fore wing	3.8	The lengths of the femora:	
The greatest breadth of the fore wing	1.0	fore	0.5
The lengths of the antennal articles:		middle	0.5
III	1.1	hind	0.6
VI	0.6	The lengths of the tibiae:	
V	0.5	fore	0.9

middle ... ... 0.9 | hind 1.1

13. *Neocalaphis magnoliae* (ESSIG and KUWANA)

Calaphis magnoliae ESSIG and KUWANA, Aphid. Japan, Proc. Cal. Acad. Sci. 4th series, Vol. VIII, pt. 3, 1918.

Alate viviparous female.

Body green. *Head* and *thorax* slightly infuscated. *Antennae* of 6 articles; apices of III-VI, the middle part of III and the filamental portion of VI black; the remainning parts concolourous with the body; III the longest, but not quite so long as the filamental portion of VI, with about 14 circular sensoria on the basal half; IV and V subequal in length, the latter with the usual apical sensorium; the filamental portion of VI about 5 times as long as the base. *Fore wings* lacking the radial sector; veins and stigma bordered with smoky areas. *Abdomen* without black maculation on the dorsum. *Cornicles* and *cauda* concolourous with the body.

Host plant: Kobushi (Magnolia kobus THUNB.)

Measurements in millimeters:

The length of the body	1.5
The greatest breadth of the abdomen ...	0.6
The length of the fore wing	2.4
The greatest breadth of the fore wing ...	0.8
The lengths of the antennal articles:	
III	0.55
IV	0.40
V	0.30
VI, the base	0.06
VI, the spur	0.60
The lengths of the femora:	
fore	0.5
middle	0.5
hind	0.5
The lengths of the tibiae:	
fore	0.9
middle	0.8
hind	1.1
The length of the cornicle	0.15

Apterous viviparous female.

Light green or yellowish. *Body* elongate, with long capitate hairs. *Head* between the eyes almost as long as broad, with tuberculated hairs in front. *Antennae* 6-articulated, longer than the body, without prominent hairs; the apices of III, IV and V and the middle part of VI including the spur infuscate, the remainning parts concolourous with the body; I

almost twice as long and broad as I; II slightly broader than long; III the longest except the spur of VI; VI much shorter than V, the latter with a single circular sensorium near the apex and nearly twice as long as the base of VI which is but one-sixths as long as the spur. *Eyes* dark red. *Proboscis* reaching the second coxae, tip slightly dusky. *Legs* stout, concolourous with the body except the base and apex of the tibia and tarsi including the claws, all these parts being infuscate. Abdomen without any black maculation on dorsum. *Cornicles* subtruncate, concolourous with the body. *Cauda* indented, hirsute, concolourous with the body. *Anal plate* knobbed.

Oviparous female.

Apterous. *Body* elongate, spindle-shaped, with long subcapitate hairs, light green or almost yellow in the mature forms, with some pairs of long hairs in front, between the eyes nearly as wide as the prothorax. *Ocelli* three in number prominent. *Antennae* longer than the body, the apices of III, IV and V and the junction of the base and the filament of VI infuscated, the remainning parts being concolourous with the body; III longer than IV, without sensorium; IV and V subequal in length, latter being provided with the usual sensorium near the apex; spur of VI nearly 7 times as long as the base. *Legs* rather long, basal part of the tibia and tarsi including claws slightly infuscated, the remainning parts being concolourous with the body. *Abdomen* without any dorsal black macula. *Cornicles* subtruncate, light green. *Cauda* concolourous with the body, furnished with many hairs. *Ovipositor* telescopic, yellowish.

Measurements in millimeters:

The length of the body	1.7
The greatest breadth of the abdomen ...	0.8
The lengths of the antennal articles:	
III	0.55
IV	0.40
V	0.03
VI, the base	0.05
VI, the spur	0.60
The lengths of the femora:	
fore	0.4
middle	0.4
hind	0.5
The lengths of the tibiae:	
fore	0.7
middle	0.7
hind	0.9

14. *Neocalaphis magnolicolens* (TAKAHASHI)

Calaphis magnolicolens TAKAHASHI, Takahashi Chosaku Shu, No. 1, 1919.
Euceraphis magnolia SHINJI, Dobutsugakuzasshi Vol. 35, 1923.

Alate viviparous female (Fig. 12).

Body oblong, with a few hairs, green or pale. *Head* between the eyes almost as long as broad. *Eyes* red. *Antennae* arising from a pair of tubercles, nearly one and a half times as long as the body, apices of III, IV, and the base of VI infuscate, the remainning parts concolourous with the body; III very long, but not so long as VI including the spur, with about 14 circular sensoria situating mostly on the basal portion and arranged in a row; IV and V subequal in length, the latter with a single subapical sensoria; the spur of VI nearly 7 times as long as the base. *Proboscis* reaching the second leg, with a few short hairs, slightly dusky. *Prothorax* narrower than the head including the eyes, broader than long. All thoracic parts slightly infuscate. *Legs* long, with short hairs, the apices of the tibiae and tarsi including claws infuscated. *Wings* hyaline; fore wings with the media twice branched; the hind wings with both the media and cubitus present. *Abdomen* without any dorsal maculae. *Cornicles* subtruncate, *Cauda* indent, with some hairs. *Anal plate* knobbod, concolourous with the body.

Measurements in millimeters:

The length of the body	1.6	VI, the spur	0.8
The greatest breadth of the abdomen	0.6	The lengths of the femora:	
The length of the fore wing	2.8	fore	0.4
The greatest breadth of the fore wing	0.8	middle	0.4
The lengths of the antennal articles:		hind	0.6
III	0.65	The lengths of the tibia:	
IV	0.45	fore	0.9
V	0.42	middle	0.9
VI, the base	0.15	hind	1.2

Male.

Body elongate, with a few hairs, light green. *Head* wider than long, between the eyes being nearly as wide as the prothorax, furnished with

a pair or two of rather strong hairs in front, infuscared. *Eyes* dark red, almost black. Three *occelli* prominent. *Antennae* longer than the body, 6-articulated; I and II slightly infuscated; III longer than any of the two following articles but very much shorter than their sum, provided with about 14 large ovoid sensoria arranged in a row, imbricated near the apex; IV and V subequal in length or the former a little shorter, both imbricated throughout and infuscated at the bases as well as at the apices. There is a large oblong sensoria near the apex of V; VI imbricated and infuscated throughout, with a group of sensoria at the junction of the two parts; the filament about 6 times as long as the base. *Proboscis* reaching the second coxa, apex dusky. *Wings* rather long, hyaline with the stigma brownish. *Thorax* dusky. *Legs* rather stout, apical portions of femur and tibia, basal as well as the apical portions of the tibia, tarsi including the claws infuscated, the remainning parts being concolourous with the body. *Abdomen* elongate, light green with central patches of black on each segment. *Cauda* and *cornicles* light green. Ventral *craspers* infuscated, hairy and porous.

Measurements in millimeters:

The length of the body	1.5	VI, the spur	0.7
The greatest breadth of the abdomen	0.4	The lengths of the femora:	
The length of the fore wing	2.5	fore	0.4
The greatest breadth of the fore wing	0.7	middle	0.35
The lengths of the antenral articles:		hind	0.4
III	0.6	The lengths of the tibiae:	
IV	0.3	fore	0.7
V	0.3	middle	0.7
VI, the base	0.15	hind	0.9

Oviparous female.

Apterous. *Body* elongate, light green except the eyes which is red. *Head* between the eyes narrower than the prothorax, with a few hairs in front. *Antennae* longer than the body, 6-articulated; III large, longer than IV, but decidedly shorter than the sum of IV and V, without prominent hairs or sensorium; IV and V subequal in length or the latter slightly

longer and with a single apical sensorium; the base of VI about 4 times as long as the base, with a group of sensoria at the junction of the two parts. *Abdomen* without dorsal maculae. *Cornicles* subtruncate, concolourous with the body. *Cauda* and the *anal plate* light green.

Measurements in millimeters:

The length of the body 2.0	The lengths of the femora:
The greatest breadth of the abdomen ... 0.8	fore 0.40
The lengths of the antennal articles:	middle 0.25
III 0.4	hind 0.40
IV 0.3	The lengths of the tibiae:
V 0.35	fore 0.7
VI, the base 0.15	middle 0.7
VI, the spur 0.90	hind 1.1

15. *Therioaphis shinae* SHINJI

Therioaphis shinae SHINJI, Dobutsugakuzasshi, Vol. 36, 1924.

Alate viviparous female.

Body elongate, sides almost pararell. *Head* with a couple of short hairs in front, lateral margins black. *Eyes* red. *Ocelli* prominent with black rims. *Antennae* longer than the body, 6-articulated, I and II entire, the basal half of III and the apices of III, IV, V and the middle portion of VI black; the remainning parts concolourous with the body; III the longest with the exception of VI including the spur, provided with about 14 oblong sensoria arranged almost in a row on the basal half; I and V subequal in length, the former being without and the latter with but a single circular sensorium near the apex; the base of VI much shorter than V or the spur, with a group of sensoria at the junction of the two parts. *Prothorax* rather long, but not so long as it is wide, lateral quarters black. *Meso-*and *meta-thoracic* portions infuscated. *Legs* rather short, no part being infuscated. *Fore wings* stout, hyaline with no radial sector present; III but once branched; area between the costa and subcosta, lower half of the stigma and the apices of veins together with the wavy area between the veins smoky; veins infuscate. *Abdomen* without any dorsal macula of

black. *Cornicles* subtruncate, about twice as long as wide at base, concolourous with the body. *Cauda* deeply gulfed in U-shape. *Anal plate* knobbed, concolourous with the body.

Measurements in millimeters:

The length of the body 1.2	The lengths of the femora:
The greatest breadth of the abdomen ... 0.4	fore 0.20
The length of the fore wing 1.8	middle 0.20
The greatest breadth of the fore wing ... 0.6	hind 0.25
The lengths of the antennal articles:	The lengths of the tibiae:
III 0.40	fore 0.5
VI 0.25	middle 0.6
V 0.30	hind 0.5
VI, the base 0.20	The length of the cornicle 0.1
VI, the spur 0.30	

Male. (Fig. 13).

Body elongate. *Prevailing colour* light green. *Head* with a couple of short hairs in front; between the eyes broader than long, but not so long as the breadth of the prothorax, black all over except the posterior margin. *Eyes* red. *Ocelli* with black rim. *Antennae* 6-articulated, longer than the body; I and II entire, the apices of III, IV and V, and the middle portion of VI besides the basal half of III black, the remainning parts are of the same colour with the body; III the longest with the exception of VI including the spur, provided with about 16 oblong sensoria arranged in a row; IV and V subequal in length, the former with 4 and the latter with 4-6 sensoria besides the usual one situating near the apex; the base of VI shorter than either V or the spur, with about 2 oblong sensoria in addition to a single groupe at its junction with the spur. *Proboscis* reaching the second legs, apical joint infuscate. *Prothorax* long but not so long as wide, lateral margin black, the remainning portion being concolourous with the body. *Wings* rather short and broad; radial sector wanting; front margin beginning from the base to the stigma, apices of the veins and the wavy area between the veins smoky. *Hind wing* with both cubitus and media present. *Legs* short, no portion being infuscate. *Abdomen* without the dorsal

black maculae. *Craspers* hairy, porous and infuscated. *Cornicles* subtruncate, about twice as long as it is wide at the base, concolourous with the body. *Anal plate* knobbed, with a few pairs of bristles. *Cauda* cleft into U-shape, concolourous with the body.

Measurements in millimeters:

The length of the body 1.0	The lengths of the femora:
The greatest breadth of the abdomen ... 0.35	fore 0.20
The length of the fore wing 1.9	middle 1.15
The greatest breadth of the fore wing ... 0.7	hind 0.25
The lengths of the antennal articles:	The lengths of the tibiae:
III 0.40	fore 0.4
IV 0.25	middle 0.4
V 0.25	hind 0.5
VI, the base 0.20	The length of the cornicle 0.1
VI, the spur 0.25	

Apterous Oviparous female.

Prevailing colour light green. *Head* between the eyes narrower than the prothorax. *Eyes* dark red, almost black. *Ocelli* prominent. *Body* with strong somewhat capitate hairs. *Proboscis* reaching the base of the second legs, apex infuscate. *Antennae* slightly shorter than the body, light green in colour; III the longest with imbrication near the tip, V slightly shorter than the base of VI imbricated and the tip black, with an usual circular sensorium near the tip; VI imbricated and black throughout; filamental portion and the base subequal in length, both measuring 0.02 mm. *Legs* for the most part light green with the apex of the femur and tibia including tarsi black; *Hind tibia* incrassate and with numerous sensoria. *Abdomen* without black dorsal maculae. *Cauda* and *cornicles* concolourous with the body.

16. *Symydobius kabae* (MATSUMURA)

Vesocallis kabae MATSUMURA, A List of Aphid, Japan, Jour. Coll. Agr. Tohoku Imp. Univ. Sapporo, Vol. VII, pt. 6, 1917.
Eucraphis Japonica KUWANA and ESSIG, Aphid. Japan, Proc. Cal. Acad. Sci. 4th series, Vol. VIII, pt. 3, 1918.

Alate viviparous female (Fig. 14).

Body dark reddish brown. *Head* and *thorax* infuscated. *Antennae* of 6 articles, infuscated, much hairy; III the longest, as long as or slightly longer than IV and V taken together, with about 30 much-elongated subringed sensoria; V shorter than IV, with an apical sensorium; the spur of VI slightly shorter than the base. *Abdomen* with black dorsal markings. *Cornicles* subtruncate, black. *Cauda* somewhat rounded, black.

Measurements in millimeters:

The length of the body 2.4	VI, the spur 0.7
The greatest breadth of the abdomen ... 0.8	The lengths of the femora:
The length of the fore wing 4.0	fore 0.8
The greatest breadth of the fore wing ... 1.3	middle 0.9
The lengths of the antennal articles:	hind 0.4
III 1.4	The lengths of the tibiae:
IV 1.2	fore 1.6
V 1.0	middle 1.6
VI, the base 0.3	hind 2.3

Apterous viviparous female.

Body oval, hirsute, brick-brown. *Head* between the eyes broader than long. *Eyes* black, with many pairs of long hairs in front. *Antennae* arising from the sides of the head, nearly as long as the body, the apical half of III and IV and the entire length of V and VI infuscate; I almost twice as long and broad as II; II scarcely as long as broad; III the longest but not so long as IV and V taken together; IV and V subequal in length, the former without and the latter with a single subapical circular sensorium; the base of VI somewhat shorter than the base. *Proboscis* hardly reaching the hind coxae, stout and infuscated for the most part. *Thorax* and *abdomen* slightly infuscated, the latter with small patches of black on the dorsum. *Legs* stout, the basal half of the front and the middle tibiae concolourous with the body, the remainning parts black. *Cornicles* subtruncate, imbricate and infuscate. *Cauda* rounded, with some 12 pairs of long hairs, black.

Measurements in millimeters:

The length of the body	1.4	The lengths of the femora:	
The greatest breadth of the abdomen	0.8	fore	0.3
The lengths of the antennal articles:		middle	0.4
III	0.45	hind	0.5
IV	0.30	The lengths of the tibiae:	
V	0.20	fore	0.5
VI, the base	0.08	middle	0.6
VI, the spur	0.08	hind	1.0

Male.

Alate. *Body* elongate, sparingly hairy. *Prevailing colour* yellowish brown. *Head* wider than long. *Eyes* dark red, almost black. *Antennae* longer than the body, bristly and black; I slightly wider than long, with a few hairs; II longer than wide, narrower but not quite so narrow as I, with a few hairs; III the longest, nearly as long as IV and V taken together, with 9 or more long hairs and about 60 or more large, mostly oblong, sensoria distributed not in a row; IV decidedly longer than IV, with numerous long hairs (more than 5 visible from one side) but no prominent sensorium; IV and V subequal in length, imbricated, the former with many (about 24) long hairs and 20 small circular sensoria irregularly distributed; VI imbricated; the flagellate portion and the base subequal in length, with a group of sensoria at the junction of the two parts. *Proboscis* stout, moderately long, reaching the second acetabulum, infuscated throughout. *Legs* moderate in length, hairy, infuscated for the most part. *Thorax* and *abdomen* with patches of black. *Cornicles*, *cauda*, *anal plate* and *claspers* infuscate, very hairy.

Measurements in millimeters:

The length of the body	2.0	VI, the base	0.18
The greatest breadth of the abdomen	0.7	VI, the spur	0.18
The lengths of the antennal articles:		The lengths of the femora:	
III	1.50	fore	0.6
IV	0.50	middle	0.6
V	0.30	hind	0.9

The lengths of the tibiae:		middle	1.0
fore	1.0	hind	1.6

Oviparous female.

Very much like the apterous viviparous female, but it differs in:

1. The darker appearance due to the presence of black dorsal maculation, and
2. The hind tibia which is much more stout, enlarged and with numerous circular subsensoria.

Measurements in millimeters:

The length of the body	1.7	The greatest breadth of the abdomen	0.6

18. *Drepanaphis acerifoliae* THOMAS

Dreppanaphis acerifoliae THOMAS, 8th Report of Ent. Illinois, 1880.

Alate viviparous famale (Fig. 16).

This is one of the larger forms, beautiful with smoky stigma on the fore-wings and three pairs of large chitinous dorsal tubercles. *General colour* pale, with black dorsal markings. Head proper *i. e.*, *head* exclusive of the eyes narrower than the prothorax, width between the eyes 0.35 mm. *Eyes* prominent, dark red. *Beak* reaching beyond the second coxa, toward the tip dusky. Apices of III—IV and VI including the spur of the *antennae* black. There are about 9 circular sensoria on the basal half of III arranged in a row. There is also a single group of four sensoria at the junction of the base and the spur of VI. *Prothorax* wider than long, pale, width 0.5 mm. *Mesothorax* dusky. Dorsum of thorax appears intensely dark, being partly due to the presence of amber-colored muscle lobes below it. *Metathorax* dark, well defined. *Legs* rather short, dusky with the exception of those portions that are turned anteriorly. *Abdomen* pale. There are three pairs of blunt tubercles on the abdomen, the first pair of which is the longest, about 0.9 mm. long and dusky, the second being the smallest. These are generally pale but often black; the third pair dusky, 0.2 mm. long. *Cornicles* black. *Cauda* pale.

Measurements in millimeters:

The length of the body	2.1	The lengths of the femora:	
The greatest breadth of the abdomen	0.8	fore	0.6
The length of the fore wing	3.4	middle	0.4
The lengths of the antennal articles:		hind	0.6
III	0.90	The lengths of the tibiae:	
IV	0.55	fore	0.85
V	0.50	middle	0.90
VI, the base	0.10	hind	1.10
VI, the spur	0.90	The length of the cornicle	0.27

Male. (Fig. 17).

General appearance black. *Head* black, width including the compound eyes 0.5 mm. *Ocelli* prominent, black. *Rostrum* stout, dusky to black. *Prothorax* almost as broad as the head including the eyes, black. *Antennae* black. There are following numbers of antennal sensoria: III, 80; IV, 28; V, 11. *Thorax* black. *Abdomen* infuscated. There are one transverse band of black on ventral as well as the dorsal surfaces of each segments. *Femur* dusky. Tibia rather long, apical one-sixth part dusky to black, the remainning part being brown. On the ventral surface of the eighth abdominal segment, there are bifurcate, black, chitinous cerci. *Penis* which is surrounded by the cerci is pale and almost transparent. *Cauda* black.

Measurements in millimeters:

The length of the body	3.0	IV	0.80
The width of the abdomen	0.7	V	0.70
The lengths of the antennal articles:		VI, the base	0.13
III	1.15	VI, the spur	0.7

Host plant: *Acer saccharinus.*

Distribution: Europe, N. America, Japan and Korea.

18. *Drepanosiphum platanoides* SCHRANK

Aphis platanoides SCHRANK, Fauna Boic. Vol. II, 1801.
Aphis platanoides KALTE KALTENBACH, Mong. der Famil. Pflanzenlause 1843.
Aphis platanoides WALKER, Zoologist Vol. 5, (1870).
Drepanosiphum platanoides, KOCH, Die Pflanzenlause Aphiden, 1855.
Drepanosiphum platanoides KUCKTON, Monog. British Aphid.

Alate viviparous female (Fig. 18).

This is certainly one of the larger aphids. *Head* dusky, width including the eyes 0.6 mm. *Eyes* black. *Beak* stout, not reaching the second coxal cavity, the apex dusky. *Antennae* 6-jointed, longer than the body, infuscated for the most part. *Prothorax* dusky, width 0.6 mm. *Thorax* dusky, width 0.9 mm. Dorsal surface of femora and apical half of tibiae including the tarsi and claws black, the remainning parts of the leg pale. Cornicles 0.8 mm. long, apical one-half black, the remainning part pale. *Cauda* bifurcate, pale.

Measurements in millimeters:

The length of the body	2.9	IV	1.0
The greatest breadth of the abdomen	0.8	V	0.8
The length of the fore wing	4.6	VI, the base	0.1
The lengths of the antennal articles:		VI, the spur	0.9
III	1.2		

Oviparous Female.

Apterous. Although the ground color of the body is pale, general appearance of the adult form is dark to black on account of the presence of a black middle band and two marginal patches of the same colour on each abdominal segment. *Head* and *thorax* also black. *Eyes* as in the alate form, black. Filament or spur of the antenna very slender. No sensorium on either III or IV. *Cornicle* long, subcylindrical, suddenly constricted near the apex, apical half black, the remainning part pale. Length 0.4 mm.

Measurements in millimeters:

The length of the body	2.4	V	0.6
The greatest breadth of the abdomen	0.8	VI, the base	0.1
The lengths of the antennal articles:		VI, the spur	0.6
III	0.9	The length of the cornicle	0.4
IV	0.7		

19. *Chaitophorus sali-apterus* SHINJI

Chaitophorus sali-apterus SHINJI, Dobutsugakuzasshi, Vol. 36, 1924.

Alate viviparous female.

Pale or green. Very small form. *Antennae* shorter than the body, dusky to black; III longer than IV or V, with about 10 small sensoria besides 4-6 long hairs; IV and V subequal in length; the spur of VI almost twice as long as the base. *Legs* dusky throughout, with numerous hairs. *Abdomen* without any dorsal macula. *Cornicles* and *cauda* pale.

Measurements in millimeters:

The length of the body 0.9	fore 0.2
The greatest breadth of the abdomen ... 0.6	middle 0.2
The lengths of the antennal articles:	hind 0.25
III 0.25	The lengths of the tibiae:
IV 0.10	fore 0.25
V 0.10	middle 0.25
VI, the base 0.05	hind 0.35
VI, the spur	The length of the cornicle 0.30
The lengths of the femora:	

Male.

Apterous. *Body* light yellowish with head black. *Antennae* 6-articulated, with some long hairs; III the longest with about 14 circular sensoria; IV longer than V, with 8-10 small sensoria; V with about 6 sensoria; the spur of VI nearly 5 times as long as the base. *Legs* with the exception of a small portion of the femur black; hind tibiae much incrassiate, with numerous small sensoria. *Cornicles* truncate, black. *Cauda* also black, with some hairs.

Measurements in millimeters:

The length of the body 0.90	The lengths of the femora:
The greatest breadth of the abdomen ... 0.50	fore 0.25
The lengths of the antennal articles:	middle 0.25
III 0.30	hind 0.30
IV 0.15	The lengths of the tibiae:
V 0.15	fore 0.40
VI, the base 0.05	middle 0.60
VI, the spur 0.20	hind 0.60

Apterous viviparous female.

Body oval, with long hairs, light green or pale. *Head* narrower than the prothorax, with about 3 pairs of long hairs in front. *Eyes* red. *Antennae* of 6 articles, shorter than the body, from the apex of IV on to the tip of the spur infuscate, the remainning parts light green; I broader but as long as II; II longer than broad; III the longest with 3 or 4 long hairs; V a little longer than the base of VI, with a single subapical sensorium; IV slightly longer than V, with one long hair; the spur of VI, nearly twice as long as the base. *Proboscis* reaching the second coxa, slightly infuscated. *Thorax, abdomen* and *legs* with the exception of tarsi and claws not infuscated. *Cornicles* subtruncate, somewhat infuscate, broader at base. *Cauda* indented, hairy, colour of the body. *Anal plate* knobbed, hairy, concolourous with the body.

20. *Chaitophorus salicicolus* MATSUMURA(?)

Chaitophorus silicicolus MATSUMURA, A list. Aphid. Japan, Jour. Coll. Agr. Tohoku Imp. Univ. Sapporo, Vol. VII, pt. 6 (1917).

Alate viviparous female (Fig. 19).

Head and *thorax* infuscated. *Abdomen* pale or green with black dorsal maculation. *Antennae* of 6 articles, black throughout, imbricated; III with about 10 circular sensoria; VI and V subequal in length, the former with about 4 and the latter 2 sensoria in addition to the apical one; the filamental portion of VI about 2 times as long as the base. *Cornicles* and *cauda* black.

Apterous viviparous female.

Body oval, green, with checkered dorsal marking of dark and light green. *Antennal* articles I, II and the basal half of III green, the remainning portions being infuscated. *Cornicles* subtruncate, slightly dusky.

Host plant: *Salix Sieboldiana* BL. and S. Multinervis P. & S.

Locality: Morioka.

Male.

Winged. Somewhat smaller than the alate viviparous female. *Body* elongate, with some long hairs. *Prevailing colour* green. *Antennae* 6-articulated, with a few long hairs on each segment, basal half of III green, the

remainning parts black; III slightly shorter than the filamental portion of VI, but decidedly longer than any of the following articles, provided with about 60 small circular sensoria scattered all over the segment; IV longer than V, with about 10 small sensoria irregularly placed; V nearly twice as long as the base of VI, with about 8 small sensoria, the spur of VI about 4 times as long as the base. *Head* and *thorax* black. *Eyes* black. *Vertex* as well as the sides of the head with many long hairs. *Proboscis* reaching the second coxa, black throughout. *Thoracic lobes* with long hairs. *Legs* for the most part infuscated, infuscation being denser near the apex of the femur and the tibia as well as the basal half of the latter and tarsi. *Fore wings* with the basal portions of II, radial sector and III obscure; stigma dark. *Abdomen* with black dorsal maculation. *Cauda*, *cornicles* and *cerci* infuscated.

Alate viviparous female.

Body rather small, setose, green. *Head* black. *Ocelli* large, black. *Antennae* 6-articulated, black; I and II piceous; III shorter than V and IV taken together; V shorter than IV; the spur of VI about 5 times as long as the base. *Number of sensoria* are as follows: III, 20; IV, 4; V, I: VI, a group. *Legs* comparatively short, claws only black, the remainning parts green. *Wings* with veins and stigma smoky. *Cornicles* short, subtruncate, base 2 times as wide as the apex, infuscated, and imbricated throughout. *Cauda* concolourous with the body.

21. *Melanoxanthus sali-japonica* SHINJI.

Melanoxanthus sali-japonica, SHINJI Dobutsugakuzasshi, Vol. 36, 1924.

Alate viviparous female (Fig. 20).

Orange coloured, rather large aphid. *Antennae* long, reaching the middle part of the abdomen, III the longest, nearly as long as IV and V taken together, with about 18 circular sensoria in a row; IV slightly longer than V, with 3 small circular sensoria; V with but 1 sensorium near the apex; the filamental portion of VI a little longer than the base. *Head*, *thorax* and *ocelli* black. *Rostrum* reaching beyond the third coxal cavity, the last article black.

Abdomen with black transverse maculae and many long hairs. *Cornicles* small, somewhat inflated near the middle, concolourous with the body. *Cauda* black, with long hairs.

Apterous viviparous female.

Body orange or brown. *Antennae* shorter than the body, with a few hairs; article VI black, the remainning articles concolourous with the body; III the longest, without sensorium; IV and V with 1 sensorium each. The spur of VI longer than its base. Each of the *abdominal* segments with a pair of small tubercles. *Cornicles* concolourous with the body. *Cauda* black.

Host plant: *salix sp.*

Locality: Morioka.

Measurements in millimeters:

The length of the body	1.7	The lengths of the femora:	
The greatest breadth of the abdomen	0.8	fore	0.4
The lengths of the antennal articles:		middle	0.4
III	0.40	hind	0.4
IV	0.20	The lengths of the tibiae:	
V	0.20	fore	0.6
VI, the base	0.10	middle	0.7
VI, the spur	0.15	hind	1.2

Male.

Prevailing colour yellowish brown with black superficial markings. *Head* between the eyes slightly wider than the prothorax, infuscated, with about 2 pairs of hairs in front. *Eyes* dark red, almost black. *Ocelli* prominent, with margin black. *Antennae* of 6 articles, infuscated throughout; I wider than long, with a couple of hairs directed inward; II as wide as long with about 4 long hairs directed inwards; III the longest, with about 30 short hairs and 68 circular sensoria irregularly distributed on the entire length, IV shorter than V, imbricated throughout, with about 10 hairs and 20 or more circular sensoria; V nearly equal in length to VI including the filament, with about 4 hairs and 18 circular sensoria besides a subapical one; the base of VI slightly longer than the filament, with about 3 circular

sensoria besides a group at the junction of the two parts. *Proboscis* very long, reaching the middle portion of the abdomen, dusky throughout. *Thorax* narrower than the abdomen. *Legs* rather stout, both the tibia and the femur hirsute, infuscated with the exception of the middle part of the tibia, which is concolourous with the body. *Abdomen* with numerous dorsal and lateral maculae of black. *Cornicles*, *cauda* and *craspers* infuscated, hairy. *Penis* long, imbricated, dusky.

Oviparous female.

Body oblong, furnished with short hairs, brick-brown in colour, with slight infuscation throughout the body. *Eyes* black. *Head* including the eyes narrower than the prothorax. *Proboscis* reaching the third coxae, infuscate. *Antennae* wanting the frontal tubercles, 6-articulated, hirsute, apex of IV on to the tip of VI imbricate and infuscate; III the longest, being longer than VI including the spur; IV and V subequal in length, the latter with a single subapical sensorium; the base of VI decidedly longer than the base, with a group of sensoria at the junction of the two parts. *Thorax* infuscated. *Legs* rather short, the apices of femora and tibiae including tarsi and claws infuscate, the remainning parts being concolourous with the body. *Abdomen* with black patches on the dorsum. *Cornicles* cylindrical, about 5 times as long as the breadth at the apex, concolourous with the body. *Cauda* rounded, hirsute and infuscated.

Measurements in millimeters:

The length of the body	2.0
The greatest breadth of the abdomen	1.1
The lengths of the antennal articles:	
III	0.40
VI	0.20
V	0.15
VI, the base	0.15
VI, the spur	0.20
The lengths of the femora:	
fore	0.3
middle	0.4
hind	0.4
The lengths of the tibiae:	
fore	0.6
middle	0.9
hind	0.4
The length of the cornicle	0.1

22. *Periphyllus aceris* LINNAEUS

Aphis aceris LINNAEUS, System Nat., Ed. I, 1767.
Aphis aceris FABRICIUS, ENT. SYST. 17.
Aphis aceris KALTENBACH, Monog der Pflanzenlause Aphid. 1843.
Chaitophorus aceris KOCH, Die Pflanzenlause Aphid, 1855.
Chaitophorus aceris BUCKTON, Monog. British Aphid, Vol. II, 1879.
Chaitophorus aceris MATSUMURA, In: Jour. Coll. Agr. Sapporo Tohoku Imp. Univ. Bull. Vol. VII, pt. 6, 1917.
Chaitophorinella acerifoliae TAKAHASHI, Dobutsugakuzasshi No. 371, 19.
Chaitophorus japonica ESSIG and KUWANA, Proc. Cal. Acad. Sci. 4th. series, Vol. VIII, pt. 6, 1918.
Chaitophorinella aceris v. d. GOOT, Beitr. Zur Kentn. der Holland. 1915.

Alate viviparous female (Fig. 23).

Body with long hairs, brown with black superficial markings. *Head* and *thorax* black. *Antennae* of 6 articles, III the longest, with about 7 long hairs and 10-14 circular sensoria. V shorter than IV, with a single apical sensoria, the filamental portion of VI about twice as long as the base. *Cornicles* and *cauda* black.

Measurements in millimeters:

The length of the body	2.5
The greatest breadth of the abdomen	1.0
The length of the fore wing	3.6
The greatest breadth of the fore wing	1.2
The lengths of the antennal articles:	
III	0.5
IV	0.3
V	0.2
VI, the base	0.1
VI, the spur	0.08
The lengths of the femora:	
fore	0.8
middle	0.7
hind	1.4
The lengths of the tibiae:	
fore	1.3
middle	1.3
hind	1.9

Male.

Alate. Not much different from the alate viviparous female. The *Prevailing colour* of the body is light brown, but on account of the presence of the black dorsal maculation the form looks black. *Body* sparingly covered with long hairs. *Antennae* of 6 articles, each segment with some long hairs, black throughout; III the longest with about 100 small circular sensoria;

IV and V subequal, the former with about 50 and the latter some 14 small sensoria; the spur of VI nearly 3 times as long as the base. *Wing venation* normal. *Legs* for the most part black, hairy. *Cornicle* and *cauda* infuscated. *Craspers* horny, black.

Measurements in millimeters:

The length of the body 2.9	VI, the spur 0.4
The greatest breadth of the abdomen ... 1.3	The lengths of the femora:
The length of the fore wing 4.2	fore 0.7
The greatest breadth of the fore wing ... 1.5	middle 0.6
The lengths of the antennal articles:	hind 0.9
III 0.7	The lengths of the tibiae:
IV 0.4	fore 1.1
V 0.3	middle 1.2
VI, the base 0.1	hind 1.6

Oviparous female.

Apterous. *Body* green with black superficial maculation. *Antennae* almost as long as the body, 6-articulated; III and the basal half of IV concolourous with the body, the remainning parts black; III the longest, with about 16 long hairs; IV for the most part imbricated; V shorter than IV, with an apical sensorium besides 5 long hairs; the spur of VI nearly four times as long as the filament, with one long hair. *Head* black, vertex with 6 long hairs. *Eyes* black. *Thorax* and *abdomen* with some long hairs. *Cornicles* and *cauda* black.

23. *Periphyllus koelreuteriae* (TAKAHASHI)

Chaitophorinella koelreuteriae TAKAHASHI, Dobutsugakuzasshi, No. 371, 1921.

Alate viviparous female (Fig. 22).

Body dark yellow. *Head* and *thorax* black. *Antennae* 6-articulated, the basal half of III lightly and the remainning parts densely infuscated; III the longest, longer than VI including the filament, with about 20 hairs on the inner and 2 on the outer side, in addition to about 40 circular; sensoria; IV and V subequal, each with about 6 inner and 2 outer hairs; the

spur of VI about twice as long as the base. *Abdomen* with black maculation. *Stigma* smoky. *Legs* for the most part black. *Cornicles* and *cauda* black.

Host plant: Mokugenii. (*Koelreuteria paniculata* MAXM.)

Distribution: Tokio, Morioka, Aomori.

Measurements in millimeters:

The length of the body 2.6	VI, the spur 0.3
The greatest breadth of the abdomen ... 1.3	The lengths of the femora:
The length of the fore wing 3.8	fore 0.5
The greatest breadth of the fore wing ... 1.2	middle 0.7
The lengths of the antennal articles:	hind 0.5
III 0.8	The lengths of the tibiae:
IV 0.4	fore 1.0
V 0.3	middle 1.0
VI, the base 0.2	hind 1.5

Apterous viviparous female.

Body oval, with long hairs, infuscated. *Antennae* 6-articulated, longer than the body, III the longest, with about 12 long hairs; IV much longer than V, with about 5 long hairs and no sensorium; V and the spur of VI subequal in length, the former with 4 long hairs in addition to a single subapical sensorium and the latter, which is but one-third as long as the spur, with a group of sensoria at the apex where the spur begins. *Cornicles* subtruncate, broader at the base than at the apex, black. *Cauda* indented, hairy, black.

Measurements in millimeters:

The length of the body 2.2	fore 0.6
The greatest breadth of the abdomen ... 1.6	middle 0.5
The lengths of the antennal articles:	hind 0.9
III 0.4	The lengths of the tibiae:
IV 0.3	fore 1.1
V 0.3	middle 1.1
VI, the base 0.2	hind 1.6
VI, the spur 0.3	The length of the cornicle 1.1
The lengths of the femora:	The length of the cauda ... ...

24. *Dichaitophorus sali-niger* SHINJI.

Chaitophorus sali-niger SHINJI, Dobutsugakuzasshi Vol. 26, (1924)

Alate viviparous female (Fig. 22).

Body elongate, with many long hairs, infuscated. *Head* not divided, narrower than long, with about 3 pairs of long hairs in front. *Eyes* dark red, almost black. *Antennae* longer than half the length of the body, 6-articulated, beginning from the tip of III on to the tip of the spur infuscate; I and II subequal in size; III the longest, but not so long as the spur of VI, which is nearly 3 times as long as the base, with 3 circular sensoria and about the same number of long hairs; IV longer than V, with a single hair, the former with a subapical circular sensorium and the latter with a group of them at the junction of the two parts. *Proboscis* reaching the second coxae, infuscate. *Fore wing* with media usually once, but often twice, branched; hind wings with both media and cubitus present. *Legs* stout. *Cornicles* subtruncate, imbricate and infuscate. *Anal plate* somewhat knobbed. *Cauda* rounded, with a few long hairs.

Measurements in millimeters:

The length of the body 1.2	VI, the spur 0.15
The greatest breadth of the abdomen ... 0.35	The lengths of the femora:
The length of the fore wing 1.8	fore 0.25
The greatest breadth of the fore wing ... 0.6	middle 0.25
The lengths of the antennal articles:	hind 0.25
III 0.15	The lengths of the tibiae:
IV 0.10	fore 0.35
V 0.07	middle 0.35
VI, the base 0.08	hind 0.45

Apterous viviparous female.

Body oval, with long hairs. *Ground colour* yellowish-brown, but, owing to the superabundance of black maculae, the entire body looks black. *Head* not divided, narrower than long. *Proboscis* reaching only to the second coxae, infuscate. *Antennae* very much shorter than the body; I, II and the apical parts of III and the entire VI infuscate; III the longest except the

spur, with two long and one short hairs; IV longer than V; both IV and V with one short and another long hairs; V and the base of VI subequal in length, each with one long and another short hairs. Sensoria are located one subapical on V and a group at the junction of the base and the spur of VI. *Eyes* black. *Legs* very short, the entire femur and the apical half of tibia including the tarsi and claws infuscate, the remainning parts concolourous with the body. *Cornicles* subtruncate, imbricate and infuscate. *Cauda* almost round, with a few long hairs. *Anal plate* knobbed.

Measurements in millimeters:

The length of the body 1.2	IV 0.10
The greatest breadth of the abdomen ... 0.7	V 0.10
The lengths of the antennal articles:	VI, the base 0.07
III 0.15	VI, the spur 0.20

Male.

Apterous. *Ground colour* of the body yellowish. *Head* and *thorax* black. *Abdomen* with black maculae all over the body. *Vertex* as well as the body with some long hairs. *Eyes* black, with reddish rim. *Antennae* 6-articulated, imbricated, the basal portion of III concolourous with the body, the remainning parts black. *Legs* rather short, all parts, with the exception of the basal half of the tibia, black. *Cornicles* and *cauda* black. The number of antennal sensoria are as follows: on III, about 28; on IV, 16 on V 10 besides one somewhat larger apical one; on VI, one in the middle part of the base besides a single apical group.

Oviparous female.

Body larger than male, yellowish, with many long hairs. *Antennae* of 6 articles, I, II and VI black, the remainning parts concolourous with the body, every article with some long hairs. *Fore* and *middle* legs normal, the hind ones with much incrassate tibiae. This portion of the tibia is usually infuscated and with numerous small sensoria. *Cornicles* and *cauda* black.

Measurements in millimeters:

The length of the body 1.5	The lengths of the femora:
The greatest breadth of the abdomen ... 1.0	fore 0.15
The lengths of the antennal articles:	middle 0.20
III 0.22	hind 0.20
IV 0.15	The lengths of the tibiae:
V 0.15	fore 0.30
VI, the base 0.10	middle 0.45
VI, the spur 0.25	hind 0.60

25. *Aphis gossypii* GLOVER

Aphis gossypii GLOVER, Pat. Off. Report. 1854.
Aphis citrula ASHMEAD, Florida Dispatch, Vol. I, 1882.
Aphis cucumeris FORBES, 12th Rept. Ent. Illinois.
Aphis gossypii MATSUMURA, Jour. Coll. Agr. Tohoku Imp. Univ., Sapporo, Vol. VII, pt. 6. 1917.
Aphis gossypii ESSIG and KUWANA, Proc. Cal. Acad. Sci. 4th. series, Vol. VIII, pt. 3. 1918.
Aphis gossypii TAKAHASHI, Aphid. Formosa, pt. 1. 1921.

Apterous viviparous female apterous.

Body oval, with rather prominent lateral tubercles and short hairs, green or pale. *Head* including the eyes nearly as bread as the prothorax. *Antennae* lacking the frontal tubercles, 6-articulated, nearly as long as the body, imbricated throughout the length, the apices of IV and V and the entire VI infuscate, the remainning parts concolourous with the body; III the longest except the VI including the spur, subequal in length to the spur alone; V slightly shorter than IV, with a single subapical sensorium; the spur of VI nearly 3 times as long as the base, with a group of sensoria at the junction of the two parts. *Legs* with short hairs, the basal portions of the femora and tibiae concolourous with the body, the remainning parts infuscate. *Thorax* and *abdomen* not infuscated. *Cornicles* subcylindrical nearly 5 times as long as broad at the base, strongly imbricated and infuscated. *Cauda* rather long, with a couple of long hairs, infuscate.

Measurements in millimeters:

The length of the body 0.9	The lengths of the femora:
The greatest breadth of the abdomen ... 0.5	fore 0.10
The lengths of the antennal articles:	middle 0.15
III 0.20	hind 0.20
IV 0.15	The lengths of the tibiae:
V 0.10	fore 0.30
VI, the base 0.10	middle 0.30
VI, the spur 0.20	hind 0.40

Alate viviparous female.

Body rather small, green or light green. *Head* rather narrow, between the eyes much shorter than the prothorax, infuscated. *Eyes* dark red. *Ocelli* prominent. *Antennae* composed of 6-articles, imbricated with the exceptions of the whole of II and the basal half of III, the remainning parts being concolourous with the body; III much longer than either IV or V, provided with about 8 circular sensoria; IV longer than V, without sensorium; V with but one sensorium near the apex; VI with a group of sensoria at the junction of the two parts, the filamental portion being about 3 times as long as the base. *Thorax* infuscated. *Wings* hyaline with veins brownish. *Legs* stout, femur sparingly and tibia densely hairy; apices of the femur, tibia, and tarsi including the claws infuscated, the remainning parts concolourous with the body. *Abdomen* without dorsal black maculae. *Cornicles* cylindrical, nearly twice as wide at the base as at the apex, imbricated and infuscated throughout. *Cauda* subconical, with a few hairs, infuscated.

Measurements in millimeters:

The length of the body 1.3	The lengths of the femora:
The greatest breadth of the abdomen ... 0.6	fore 0.30
The length of the fore wing 2.5	middle 0.30
The greatest breadth of the fore wing ... 1.1	hind 0.35
The lengths of the antennal articles:	The lengths of the tibiae:
III 0.25	fore 0.6
IV 0.20	middle 0.6
V 0.20	hind 0.8
VI, the base 0.10	The length of the cornicle 0.2
VI, the spur 0.20	The length of the cauda 0.1

Oviparous female.

Apterous. *Body* ovoid, light green or yellowish. *Head* between the eyes narrower than the prothorax, without prominent hairs. *Eyes* dark red, almost black. *Antennae* of 6 articles, very much shorter than the body; I and II entire and the apical portions of III, IV and V and VI including the spur infuscated, the remainning portions being concolourous with the body; III longer than IV, without prominent hairs or sensorium; IV longer than V; V subequal in length to the spur of VI, with a single subapical sensorium; the spur of VI nearly 4 times as long as the base. *Thorax* and *abdomen* without dorsal infuscation. *Legs* short, the hind tibiae very much incrassated, with numerous rather large circular sensoria throughout the length. *Cornicles* subcylinderical, wider at the base than near the apex, being nearly 3 times as long as wide, imbricated and infuscated throughout. *Cauda* infuscated with a few long hairs.

Measurements in millimeters:

The length of the body 1.0	The lengths of the femora:
The greatest breadth of the abdomen ... 0.7	fore 0.1
The lengths of the antennal articles:	middle 0.1
III 0.15	hind 0.2
IV 0.10	The lengths of the tibiae:
V 0.10	fore 0.25
VI, the base 0.10	middle 0.25
VI, the spur 0.15	hind 0.10

Male.

Winged. *Body* rather small, elongate, orange yellow. *Head* without prominent hairs in front, between the eyes very much narrower than the prothorax. *Eyes* dark red. Three *ocelli* prominent. *Antennae* arising from a pair of small elevations, 6-articulated, longer than the body, infuscated and with the exception of I and II imbricated; I wider than II; II longer than wide; III longer than IV or V, with about 28 very small circular sensoria; IV slightly longer than V, with about 24 small circular sensoria; V nearly twice as long as the base of VI, with about 14 circular sensoria besides a single subapical one near the apex, the filamental portion of VI nearly

$2\frac{1}{2}$ times as long as the base. *Proboscis* reaching the second coxa, the basal half of I concolourous with the body, the remainning parts being infuscated. *Thorax* dusky to black. *Wings* moderately long, venation normal to the genus with veins dusky. *Legs* with the middle femur particularly short, femur sparingly and tibia abundantly hairy, apical parts of the femur and tibia and tarsi including the claws infuscated. *Abdomen* without dorsal infuscation. *Cornicles* subcylindrical, near the base nearly twice as wide as at the apex, imbricated and infuscated throughout. *Cauda* and *anal plate* black, both with a few long hairs. Ventral *craspers* hairy, porous and infuscated.

Measurements in millimeters:

The length of the body 1.1	VI, the spur 0.22
The greatest breadth of the abdomen ... 0.4	The lengths of the femora:
The length of the fore wing 2.4	fore 0.4
The greatest breadth of the fore wing ... 0.9	middle 0.3
The lengths of the antennal articles:	hind 0.4
III 0.30	The lengths of the tibiae:
IV 0.22	fore 0.5
V 0.20	middle 0.4
VI, the base 0.10	hind 0.8

26. *Acauda itadori* SHINJI

Neolaccinaphis itadori SHINJI, Dobutsugakuzasshi, Vol. 36, 1924.

Alate viviparous female (Fig. 24).

Head, thorax and *compound eyes* black. *Antenna* longer than the body, apical one-third part of III, apical one-half part of IV and the base as well as the positerior one-half parts of VI black, the remainning parts ferruginous; III with 26-28 circular sensoria, longer than any of the following two articles; IV shorter than III, with about 3 sensoria on the middle portion; V with one sensorium besides a single apical one; the filamental portion of VI about 6 times as long as the base. *Cornicles* long, imbricate, black.

Measurements in millimeters:

The length of the body 1.6	The lengths of the femora:
The greatest breadth of the abdomen ... 0.8	fore 0.6
The length of the fore wing 3.0	middle 0.5
The greatest breadth of the fore wing ... 1.1	hind 0.6
The lengths of the antennal articles:	The lengths of the tibiae:
III 0.5	fore 1.2
IV 0.4	middle 1.1
V 0.4	hind 1.4
VI, the base 0.1	The length of the cornicle 0.3
VI, the spur 0.6	

Apterous viviparous female.

Head and *thorax* black. *Ocelli* dark red. *Abdomen* ferrugineus with a large dorsal black patch. *Antennae* longer than the body, I and II entirely, III except the basal portion, apices of IV and V and the base of VI black, the remainning parts concolourous with the body.

Male.

Winged. *Prevailing colour* reddish orange. *Antennae* arising from a pair of prominent frontal tubercles, 6-articulated, very much longer than the body, imbricated, with a few short hairs, black throughout; III somewhat longer than IV, with about 100 small circular sensoria irregularly placed; IV decidedly longer than V, with 36 sensoria; V with about 16 small sensoria besides a single subapical one; the filamental portion of VI about 7 times as long as the base. *Eyes* dark red, almost black. *Proboscis* reaching beyond the third coxa, apical two articles dusky to black, with many short stout hairs. *Head* and *thorax* black. *Legs* normal. *Front wings* with their I and II obliques with smoky borders. *Abdomen* almost covered by a large patch of black macula. *Cornicles* subcylindrical, reaching beyond the caudal apex, imbricated, black. *Cauda* rounded, black.

Measurements in millimeters:

The length of the body 1.2	The lengths of the antennal articles:
The greatest breadth of the abdomen ... 0.5	III 0.50
The length of the fore wing 3.1	IV 0.50
The greatest breadth of the fore wing ... 1.2	V 0.40

VI, the base 0.10	The lengths of the tibiae:
VI, the spur 0.45	fore 0.8
The lengths of the femora:	middle 1.0
fore 0.4	hind 1.1
middle 0.5	The length of the cornicle 0.2
hind 0.7	

Apterous viviparous female (Fig. 25).

Head and *thorax* black. *Ocelli* dark red. *Abdomen* ferruginous, with a large dorsal black patch. *Antennae* longer than the body, I and II entirely, III except the basal portion, apices of IV and V and the base of VI black, the remainning parts concolourous with the body.

Host plant: Itadori (*Polygonum Reynoutria* MAKINO).

Locality: Morioka.

Date of collection: Oct. 20, 1923.

Measurements in millimeters:

The length of the body 1.3	The lengths of the femora:
The greatest breadth of the abdomen ... 1.0	fore 0.3
The lengths of the antennal articles:	middle 0.3
III 0.50	hind 0.4
IV 0.45	The lengths of the tibiae:
V 0.40	fore 0.9
VI, the base 0.10	middle 0.9
VI, the spur 0.08	hind 1.0

27. *Carolinaia tade* SHINJI, new species.

Alate viviparous female (Fig. 26).

Body elongate, without prominent hairs, green. *Head* including the eyes decidedly broader than the *prothorax*, infuscate. *Eyes* red. *Antenna* 6-articulated, without prominent antennal tubercle, imbricated and infuscated throughout; III slightly shorter than the spur of VI, with about 34 small circular sensoria irregularly arranged; IV much longer than V, with about 8 circular sensoria arranged almost in a row; V nearly twice as long as the base of VI, with about 4 circular sensoria in addition to the subapical one; the spur of VI nearly 4 times as long as the base, with a single group of sensoria at the junction of the two parts. *Proboscis* reaching beyond

the second leg, from the second articles down to the tip infuscate. *Thorax* black. *Legs* moderately long, apical portions of the femora, tibiae and the entire tarsi including the claws black. *Wings* hyaline, the venation normal and the veins dark brown. Hind wings with the cubitus lacking. *Abdomen* without any dorsal markings. *Cornicles* somewhat longer than the antennal article III, subcylindrical, near the apex swollen, apical half being infuscate. *Cauda*, subconical, rather small, infuscate for the most part.

Measurements in millimeters:

The length of the body 1.2	The lengths of the femora:
The greatest breadth of the abdomen ... 0.4	fore 0.4
The length of the fore wing 2.4	middle 0.3
The greatest breadth of the fore wing ... 0.9	hind 0.4
The lengths of the antennal articles:	The lengths of the tibiae:
III 0.45	fore 0.7
IV 0.25	middle 0.8
V 0.25	hind 0.9
VI, the base 0.21	The length of the cornicle 0.4
VI, the spur 0.55	The length of the cauda 0.1

Apterous viviparous female.

Body oval, without any prominent hair, green. *Head* broader than the thorax. *Eyes* red. *Antennae*, for the most part, 6-but often 5- articulated, imbricated and infuscated from the apical half of III on to the tip of the spur; about as long as the body; the relative length of each being similar with the case of the alate viviparous female. *Proboscis* reaching the second leg, apical articles infuscate. *Abdomen* without any dorsal macula. *Cornicles* subcylindrical, nearly twice as broad at the base as at the middle, apical portion somewhat swollen, imbricated and infuscated throughout the length. *Cauda* small, conical, with a few hairs, infuscated.

Measurements in millimeters:

The length of the body 1.6	IV 0.2
The greatest breadth of the abdomen ... 1.0	V 0.18
The lengths of the antennal articles:	VI, the base 0.2
III 0.4	VI, the spur 0.5

28. *Myzus suguri* SHINJI

Myzus ribis SHINJI, Dobutsugakuzasshi, Vol. 36, 1924.

Note: LINNAEUS, AMYOT, KOCH, PASSERINI, DAVIDSON, BUCKTON, v. d. GOOT and others all have described one or more aphids occuring on the currant or gooseberry or on both. One of such was called *Aphis ribis* by LINNAEUS. *Rhopalosiphum ribis* was, however, applied on the German species by KOCH while *Myzus ribis* was the name used by PASSERINI and BUCKTON. Those forms described and figured by such German writers as FOREL, KOCH and others are surely *Rhopalosiphum* for they are provided with a pair of prominent swollen cornicles. The one described under the same species name by BUCKTON, too, may have "at least very slightly clavate cornicles"—BUCKTON, Vol. I, p. 181. So his species, too, may be regarded as a near relatives of the German species. Since, however, the generic name of *Rhopalosiphum* has been recently clearly established to imply all of the forms above mentioned ···· even those that were regarded as *Rhopalosiphum* on account of the clavate cornicle, the forms or species I have described as *Myzus ribis*, I here-by propose to change the species name from *ribis* to *suguri* according to the rules governing the priority.

Alate viviparous female (Fig. 27).

General colour pale. *Head* including the eyes wider than the prothorax by 0.05 mm, dusky. *Rostrum* reaching beyond the second coxa, three jointed, the first and the second articles dusky, the third being black. *Antennae* arising from a pair of strongly tuberculated frontal processes, six-articulated, pretty dusky to black throughout the length. *Eyes* black. *Prothorax* dusky to black, width 0.45 mm. *Antennal* sensoria are scattered as follows: III, 27; IV, 11; V, 10; VI, a group of one large surrounded by about four small ones. Meso- and meta-thorax from dusky to black, according to the age. *Legs* also varies from dusky to black. *Abdomen* with a transverse row of dark dorsal markings on each of the segments. *Cornicle* dusky strongly imbricated. *Cauda* triangular in shape, dusky, with some bristles.

Measurements in millimeters:

The length of the body	1.9
The greatest breadth of the abdomen	0.8
The length of the fore wing	3.6
The length of the hind wing	2.0
The lengths of the antennal articles:	
III	0.62
IV	0.46
V	0.40
VI, the base	0.15
VI, the spur	1.10
The lengths of the femora:	
fore	0.7
middle	0.7
hind	0.8
The lengths of the tibiae:	
fore	1.3
middle	0.9
hind	1.6
The length of the cornicle	1.2

Male.

Body small. General appearance reddish. This red colour becomes green when treated with alcohol. *Head* dusky to black, width between the eyes 0.2 mm. *Compound eyes* large and red. *Simple eyes* prominent. *Prothorax* wider than long, width being 0.3 mm., dusky. *Rostrum* three jointed, slender, reaching beyond the third coxal cavity, the terminal joint dusky to black. *Antennae* arising from a pair of prominent frontal tubercles, longer than the body, for the most part black. Following number of sensoria are found: III, 34; IV, 15; V, 13; VI, 3. *Meso-* and *metathorax* black. *Abdomen* with dark chitinous markings on each of its segments. *Legs* rather slender, tibia gradually thickened toward the apex. *Cornicles* black, triangular in shape with some hairs.

Measurements in millimeters:

The length of the body	1.4
The greatest breadth of the fore wing	3.2
The lengths of the antennal articles:	
III	0.60
IV	0.45
V	0.40
VI, the base	0.13
VI, the spur	0.75
The lengths of the femora:	
fore	0.7
middle	0.7
hind	0.7
The lengths of the tibiae:	
fore	1.20
middle	1.20
hind	1.40
The length of the cornicle	3.5
The length of the cauda	1.5

Oviparous female.

Body pale with the exception of the dusky apex of the rostrum, black claws and also the terminal joint of antennae, all these parts being black.

Head between the eyes 0.3 mm. *Eyes* large, dark red. *Antennae* arising from a pair of prominent frontal tubercles, pale except VI including the filamental portion, subequal in length with the body, III is very slightly longer than IV, without sensoria, V much shorter than IV, the filamental portion of VI nearly 4 times as long as the base. *Prothorax* trapezoid on surface view, 0.3 mm. long, wide, black. *Cornicles* subcylindrical, pale. *Cauda* triangular, pale.

Measurements in millimeters:

The length of the body	2.0
The greatest breadth of the abdomen	9.0
The lengths of the antennal articles:	
III	0.032
IV	0.300
V	0.250
VI, the base	0.160
VI, the spur	0.700
The lengths of the femora:	
fore	0.7
middle	0.7
hind	0.7
The lengths of the tibiae:	
fore	1.2
middle	1.2
hind	1.4
The length of the cornicle	3.5
The length of the cauda	1.5

29. *Myzus lespedezae* (Essig and Kuwana)

Rhopalosiphum lespedezae ESSIG and KUWANA, Aphid. Japan, Proc. Calif. Acad. Sci. 4th series, Vol. 8, pt. 3, 1918.

Alate viviparous female.

Body green. *Head* and *thorax* dusky. *Eyes* dark red, with black rim. *Antennae* arising from a pair of prominent antennal tubercles, much longer than the body, black throughout; III slightly longer than IV, with a few long hairs and about 15 circular sensoria arranged mostly in a row; IV and V subequal, or in many cases the former decidedly longer, with a few long hairs and about 3 small circular sensoria in the middle part; V a little longer than twice the base of VI, with one apical sensorium; the filamental portion of VI about 6 times as long as the base, imbrication occurs on every segment. *Wing venation* normal, I and II obliques with smoky borders. *Legs* for the most part infuscated, corsely hairy. *Abdomen* with dorsal marginal black maculae. *Cornicles* not quite reaching the tip of

the cauda, beyond the middle somewhat infuscated, black. *Cauda* almost as long as the cornicle, with some hairs, concolourous with the body or very slightly dusky.

Apterous viviparous female.

Body green with a few long hairs especially on the vertex and caudal plate. *Head* infuscated. *Eyes* dark red. *Antennae* of 6 articles, black throughout; III, IV and V subequal or the fourth the longest; the filamental portion of VI about 6 times as long as the base. *Proboscis* reaching the second coxae, black. *Legs* for the most part infuscated. *Cornicles* not reaching the apex of the cauda, much bulged beyond the middle, black. *Cauda* long, concolourous with the body, or in some cases slightly dusky.

Male.

Alate. *Body* rather smaller, yellowish. *Head* and *thorax* slightly infuscated. *Eyes* black with their margin reddish. *Simple eye* with black rim. *Antennae* of 6 articles; III slightly longer than V; IV and V subequal in length; the filamental portion of VI about 6 times as long as the base. The number of sensoria are as follows: III, 50,; IV, 24; V, 20 besides one larger apical one. *Abdomen* with dusky marginal maculae. *Wings* normal in venation; I and II obliques with smoky border. *Legs* with the base of femur pale, the remainning portions black. *Cornicles* shorter than the cauda, beyond the middle bulged, black. *Cerci* and *penis* black. *Cauda* slightly dusky.

Measurements in millimeters:

The length of the body	1.2
The greatest breadth of the abdomen ...	0.6
The length of the fore wing	2.7
The greatest breadth of the fore wing ...	0.7
The lengths of the antennal articles:	
III	0.55
IV	0.55
V	0.45
VI, the base	0.15
VI, the spur	0.65
The lengths of the femora:	
fore	0.35
middle	0.35
hind	0.45
The lengths of the tibiae:	
fore	1.10
middle	1.10
hind	1.40
The length of the cornicle	0.35
The length of the cauda	0.20

Oviparous female.

Apterous. *Body* oval, yellowish brown. *Antennae* of 6 articles, longer than the body, black; III somewhat shorter than IV or V; IV and V subequal, or the former a little longer, the latter with an apical sensorium. *Eyes* very dark red. *Proboscis* almost reaching the third coxa, black. *Abdomen* with small marginal black spots on each segment. *Cornicles* not reaching the caudal apex, beyond the middle inflated, black. *Cauda* and ovipositor very slightly infuscated.

Host plant: Hagi (*Lespededa bicolor* TURCZ)

Distribution: From Hokkaido to Kiushu.

Measurements in millimeters:

The length of the body	2.0
The greatest breadth of the abdomen ...	1.2
The lengths of the antennal articles:	
III	1.55
IV	0.45
V	0.40
VI, the base	0.15
VI, the spur	0.55
The lengths of the femora:	
fore	0.40
middle	0.40
hind	0.55
The lengths of the tibiae:	
fore	0.90
middle	0.90
hind	1.20
The length of the cornicle	0.50
The length of the cauda	0.25

34. *Amphorophora ribicola* OESTLUND

Nectaroiphum ribicola OESTLUND, Synopsis Aphid. Minn. 1887.

Alate viviparous female.

General color, pale or green. *Head*, pale or green, broader than long, width between the eyes, 0.45 mm. *Beak*, reaching the second coxa, near the tip dusky. *Antennae* situating on a frontal tubercle, pale except dusky rings at the distal end of III, IV and V, and VI including the spur. Sensoria are about 14 on III, one each on IV and V. *Prothorax* wider than long, width, 0.6 mm., pale. *Mesothorax* slightly dusky, with muscle lobes amber, width, 1 mm. *Metathorax* slightly dusky. *Legs*, with distal one-fifth portion of tibia, and entire tarsi dusky, the remainning parts pale. *Abdomen*, pale, plump. *Cornicles* mostly dusky, often basal half pale. *Cauda* pale. Wings hyaline with smoky areas near the tips of the fore wings.

Measurements in millimeters:

The length of the body	3.8	The lengths of the femora:	
The greatest breadth of the abdomen	1.6	fore	1.0
The length of the fore wing	4.3	middle	1.0
The lengths of the antennal articles:		hind	1.0
III	1.10	The lengths of the tibiae:	
IV	0.70	fore	1.5
V	0.55	middle	1.5
VI, the base	0.30	hind	2.0
VI, the spur	0.80		

Apterous viviparous female.

General color, pale or green. *Head*, pale, broader than long. *Beak* reaching to the third coxa, pale except the apical half of the third joint, which is dusky. *Prothorax* pale. *Thorax* and *abdomen*, pale. *Tibia* dusky. The rest of the legs are the color of the body. *Cornicle* dark, slightly swollen as in the alate form. *Cauda* pale, longer than broad at the base.

Measurements in millimeters:

The length of the body	2.7	IV	0.06
The greatest breidth of the abdomen	1.3	V	0.55
The lengths of the antennal articles:		VI, the base	0.2
III	0.09	VI, the spur	1.0

Male.

Body rather small, reddish in appearance, but this reddish colour is lost when it is treated with alcohol. *Head* black or at least dusky, with a pair of prominent frontal tubercles. *Eyes* dark red. *Ocelli* with dark red margin. *Antenna* arising from a frontal tubercle, 6-articulated, about twice as long as the body, infuscated throughout and reticulated beyond the apical portion of III on to the tip of the filament of VI; I nearly twice as long but wider by one-third than II; II twice broader than III; III the longest except VI including the spur, with a few fine hairs and about 46 small circular sensoria irregularly placed along the entire length; IV much shorter than V, without prominent sensorium; V with about 24 small circular sensoria in addition to a subapical one which is much larger than the rest; the

filamental portion of VI nearly 3 times as long as the basal portion, with a group of sensoria at the base of the filament. *Thorax* dusky to black. *Legs* slender, the basal half of the tibia concolourous with the body, the remainning portions including the claws infuscated, with fine hairs. *Wings* very long, veins fulvous. *Abdomen* with dorsal, middle and lateral maculae of black. *Cornicle* slender, reaching beyond the tip of the *cauda*, not much swollen as in the case of the viviparous females, apical portion reticulated, black throughout. *Cauda* long, with a few long hairs, infuscated.

Measurements in millimeters:

The length of the body	1.6	fore	1.0
The greatest breadth of the abdomen	0.6	middle	1.0
The length of the fore wing	3.5	hind	1.0
The lengths of the antennal articles:		The lengths of the tibiae:	
III	0.7	fore	1.5
IV	0.6	middle	1.5
V	0.7	hind	2.0
VI, the base	0.2	The length of the cornicle	0.6
VI, the spur	1.2	The length of the cauda	0.2
The lengths of the femora:			

31. *Macrosiphum cornifoliae* SHINJI

Macrosiphum cornifoliae SHINJI, Dobutsugakuzasshi Vol. 36, 1924.

Alate viviparous female (Fig. 29).

Allied to *Macrosiphum linderae* SHINJI. *Head* and *thorax* slightly dusky. *Abdomen* pale. *Antennae* arising from a pair of prominent frontal tubercles, longer than the body, pale throughout; III slightly longer than IV, provided with about 6 circular sensoria in a row, IV and V subequal in length, the filamental portion of VI about 5 times as long as the base. *Head* wider than long. *Ocelli* dark red, often blackish. Simple eyes prominent. *Abdomen* elongate, without black macula. *Cornicles* reaching beyond the caudal end, wider at base and gradually narrows down toward the apex, pale throughout. *Cauda* long, with many long hairs, pale. *Legs* with the dark claws, pale with the exception of the dark claws.

Male.

Alate. *Body* elongate, light green or yellow. *Head* nearly twice as broad as long, including the eyes being wider than the prothorax, infuscated. *Eyes* dark red, almost black. *Antennae* arising from a pair of prominent frontal tubercles, 6-articulated, very much longer than the body, infuscated throughout and imbricated beyond the apical portion of III on; I longer and broader than II; II longer than wide, with a couple of very short hairs; III somewhat longer than IV, with more than 56 circular sensoria irregularly distributed throughout the length; IV and V subequal in length, the former with about 26, and the latter about 20 circular sensoria besides the usual apical one, both being arranged nearly in a row; the filament of VI very slender and nearly 6 times as long as the base. *Proboscis* long, reaching beyond II, the apex only black. *Legs* slender, with some short hairs, coxa, trochanter and the basal part of the femur concolourous with the body, the remainning parts being infuscated. *Abdomen* without black dorsal maculae. *Cornicles* very long, being more than half as long as the hind femur, slightly wider at the base than near the apex, basal half imbricated, and the apical half reticulated, dusky throughout the length. *Cauda* long, with some hairs, dusky. *Craspers* black, hairy and porous.

Measurements in millimeters.

The length of the body 1.3	The lengths of the femora:
The greatest breadth of the abdomen ... 0.5	fore 0.7
The length of the fore wing 3.0	middle 0.7
The greatest breadth of the fore wing ... 1.1	hind 0.8
The lengths of the antennal articles:	The lengths of the tibiae:
III 0.6	fore 1.2
IV 0.5	middle 1.3
V 0.4	hind 1.5
VI, the base 0.2	The length of the cornicle 0.3
VI, the spur 0.5	The length of the cauda 0.1

Apterous viviparous female.

Body oval, without prominent hair. Pale with the exception of slightly dusky claws and apices of antennal articles III, IV, V and VI entirely.

Cornicles and *cauda* concolourous with the body. *Head* between the eyes narrower than the prothorax. *Antennae* arising from a pair of prominent frontal tubercles, 6-articulated, longer than the body, with a few short hairs, beginning from the apex of III on to the tip of the spur infuscated, the remainning parts concolourous with the body; I and II concolourous with the body; III long, longer than any of the following articles except the spur of VI which is much longer; IV and V subequal in length; both imbricated, the latter with a single subapical sensorium; the base of VI shorter than any of the preceding articles, with a group of sensoria at the apex; the spur nearly 5 times as long as the base. *Thorax* and the *abdomen* not infuscated. *Legs* moderately long, femur and the hind tibia very much thick, the latter having many circular sensoria, tarsi and claws infuscate, the remainning parts concolourous with the body. *Cornicles* subcylindrical, tapering gradually toward the apex, very slightly dusky. *Cauda* conical, with a few short hairs, concolourous with the body.

Measurements in millimeters:

The length of the body 1.8	fore 0.6
The greatest breadth of the abdomen ... 1.0	middle 0.7
The lengths of the antennal articles:	hind 0.7
III 0.5	The lengths of the tibiae:
IV 0.4	fore 1.1
V 0.4	middle 0.9
VI, the base 0.3	hind 1.2
VI, the spur 0.8	The length of the cornicle 0.3
The lengths of the femora:	The length of the cauda 0.15

Oviparous female.

Body oval, light green or almost yellow. Very much like the apterous viviparous female, chief differences being:

1. *Antennae* imbricated and infuscated from the apical half of III on to the apex of VI.

2. Hind femora incrassate, with numerous circular sensoria on the entire length.

3. The presence of a telescopic ovipositor.

Measurements in millimeters:

The length of the body	1.1
The greatest breadth of the abdomen ...	0.5
The lengths of the antennal articles:	
III	0.6
IV	0.3
V	0.4
VI, the base	0.3
VI, the spur	0.8
The lengths of the femora:	
fore	0.6
middle	0.7
hind	0.7
The lengths of the tibiae:	
fore	0.8
middle	0.9
hind	1.0
The lehgth of the cornicle	0.4
The length of the cauda	0.2

32. *Macrosiphum gobonis* MATSUMURA

Macrosiphum gobonis MATSUMURA, A List of Aphid. Japan, Coll. Jour. Agr. Sapporo, Vol. 7, pt. 6, 1917.
Macrosiphum solidaginis MAKI, Agr. Expt. St. Formosa, Bull. No. 103, 1917.
Macrosiphum gobonis TAKAHASHI, Aphid. Formosa, I, 1921.

Alate viviparous female (Fig. 28).

General appearance shiny black. *Head* and *thorax* black. The ground colour of the abdomen dark brown with superificial bands of black. *Antennae* black throughout; III with about 90 circular sensoria; V shorter than IV, with a single apical sensorium; the filamental portion of VI about 4 times as long as the body. *Legs* with the apical half of femur, and tibiae and tarsi including the claws black. *Cornicles* almost 2 times as long as the cauda, wider near the base than at the apex, reticulated and black throughout. *Cauda* long, black.

Measurements in millimeters:

The length of the body	2.1
The greatest breadth of the abdomen ...	1.2
The lengths of the antennal articles:	
III	0.9
IV	0.6
V	0.4
VI, the base	0.2
VI, the spur	0.7
The lengths of the femora:	
fore	0.9
middle	0.8
hind	0.10
The lengths of the tibiae:	
fore	1.6
middle	1.5
hind	2.2
The length of the cornicle	0.9
The length of the cauda	0.5

Apterous viviparous female.

Body oval, with some short hairs, shining black. *Head* small, including the eyes not much broader than the prothorax. *Eyes* red. *Ocelli* prominent. *Antennae* arising from a pair of prominent frontal tubercles, 6-articulated, longer than the body, with a few short hairs, infuscated; II nearly twice as long as II; II scarcely longer than broad; III the longest except VI including the spur, provided with about 14 small circular sensoria; V shorter than IV, with a single subapical sensorium; the spur of VI about 5 times as long as the base. *Proboscis* reaching beyond the third legs, infuscated. *Thorax* black. *Legs* moderately long, apical half of the tibia, and femur and tarsi including the claws infuscate, the remainning parts concolourous with the body. *Abdomen* infuscate with black dorsal maculae. *Cornicles* subcylindrical, the basal part imbricated and the apical portion reticulated, black throughout, nearly twice as broad at the base as at the apex. *Cauda* slender, with about 4 pairs of long hairs, infuscated.

Measurements in millimeters:

The length of the body	1.6
The greatest width of the abdomen ...	0.7
The lengths of the antennal articles:	
III	0.7
IV	0.4
V	0.4
VI, the base	0.1
VI, the spur	0.7
The lengths of the femora:	
fore	0.4
middle	
hind	

Apterous oviparous female.

Body oval, with short hairs, shining black. *Head* between the eyes narrower than the prothorax, black. *Antennae* arising from a pair of prominent frontal tubercles, nearly one and a half times as long as the body, 6-articulated, with a few spine-like short hairs, black throughout; I almost twice as broad and long as II; II a little longer than broad; III the longest with the exception of VI including the spur, with about 100 small circular sensoria situated irregularly and much protruding; VI a little longer than V, with about 2 pairs of short hairs; V about 3 times as long as the base of VI, with a single subapical circular sensorium and about 3 pairs of short

hairs, the spur of VI about 5 times as long as the base. *Proboscis* reaching somewhat beyond the hind legs, infuscate. *Thorax* black. *Legs* rather long, the basal half of the femur and the middle portion of the tibia concolourous with the body, the remainning portions being infuscated. *Abdomen* infuscate, with black maculae. *Cornicles* reaching beyond the tip of the cauda, longer than the antennal articles III, wider at the base and gradually tapering toward the apex, the basal half imbricated and the apical half strongly reticulated, black. *Cauda* long, with about 4 pairs of long hairs, black.

Measurements in millimeters:

The length of the body 2.4	fore 0.7
The greatest width of the abdomen ... 1.3	middle 0.8
The lengths of the antennal articles:	hind 0.8
III 0.9	The lengths of the tibiae:
IV 0.6	fore 0.9
V 0.4	middle 0.7
VI, the base 0.1	hind 1.2
VI, the spur 0.7	The length of the cornicle 0.6
The lengths of the femora:	The length of the cauda 0.25

Alate male.

General colour yellowish black. *Head* including the eyes somewhat wider than long, black. *Eyes* large, black. *Ocelli* prominent. *Antennae* arising from a pair of prominent frontal tubercles, 6-articulated, I slightly narrower than the tubercle but decidedly longer than the tubercle, entirely black; II about half as wide as but decidedly shorter than I, black throughout, III the longest except VI including the spur, black except the greenish basal portion, provided with about 84 small circular sensoria irregularly disposed throughout the entire length, not much imbricated, without prominent hair; IV shorter than V, imbricated throughout the length, with a few hairs and some 40 or more small circular sensoria, apical half infuscated; V slightly longer than IV, strongly imbricated throughout, provided with more than 30 small circular sensoria in addition to a single one near the apex; VI imbricated throughout; spur nearly 6 times as long as the base. *Prothorax* wider than the head including the eyes, black. *Front legs* slender, with short

hairs, the apical half of the tibia, femur and tarsi including the claws infuscated, the remainning parts concolourous with the body. *Mesothorax* and *metathorax* wider than the prothorax, black. *Wings* long, hyaline, veins brownish, humuli prominent. The colouration of the middle and the hind legs is the same with that of the front legs. *Abdomen* without dorsal and lateral superficial marking. *Cornicles* very long, imbricated near the base and reticulated towards the apex. *Cauda* rather long, with a few long hairs. *Crasper* large, black.

Host plant: Gobo (*Arctium Lappa* L.)

Distribution: Formosa, Naha, Miyakonojo, Hiroshima, Shizuoka, Tokio, Sendai, Morioka, Aomori, Hakodate, Suigen.

Measurements in millimeters:

The length of the body 1.50	The lengths of the femora:
The greatest breadth of the abdomen ... 0.55	fore 0.6
The length of the fore wing 2.60	middle 0.6
The greatest breadth of the fore wing ... 0.80	hind 0.7
The lengths of the antennal articles:	The lengths of the tibiae:
III 0.60	fore 1.2
IV 0.50	middle 1.3
V 0.30	hind 0.7
VI, the base 0.15	The length of the cornicle 0.6
VI, the spur 0.80	The length of the cauda 0.2

Macrosiphum ligustrumae ESSIG and KUWANA.

Mac. Ligustrumae, ESSIG and KUWANA, Proc. Cal. Acad. Science. 1918.

Oviparous female.

Apterous. *Prevailing colour* green. *Length* of the body excluding the cauda 1.3 mm., *the greatest width* of abdomen 0.7 mm. *Eyes* dark red. Three *ocelli* prominent. *Antennae* arising from a pair of prominent frontal tubercles, 6-articulated, nearly twice as long as the body, for the most part concolourous with the body except the apices of II, III, IV and V as well as VI including the spur, all these parts being infuscated; III the longest except VI, somewhat imbricated near the apex, with a few hairs directed both

inward and outward besides about 4 small circular sensoria on the basal half; IV and V subequal in length; the filament of VI nearly 6 times as long as the base. *Proboscis* reaching beyond the second coxae, strong, 3-articulated, apex dusky. *Legs* moderately long, concolourous with the body except the apices of the femur, tibia and tarsi including unguis, all of these being infuscated; bristles on tibia much more numerous than those on the femur. *Cornicles* reaching beyond the tip of the cauda, imbricated throughout, nearly twice as broad at base as at the apex, black. *Cauda* long, concolourous with the body, provided with about 3 pairs of long hairs.

Measurements in millimeters:

The length of the body 1.6	The lengths of the femora:
The greatest breadth of the abdomen ... 0.7	fore 0.4
The greatest breadth of the fore wing ...	middle 0.4
The lengths of the antennal articles:	hind 0.5
III 0.7	The lengths of the tibiae:
IV 0.5	fore 1.0
V 0.4	middle 0.8
VI, the base 0.15	hind 0.5
VI, the spur 0.7	

Viviparous female.

Body oval, with a few short hairs, green. *Head* between the eyes narrower than the prothorax. *Eyes* dark red. *Antennae* arising from a pair of prominent frontal tubercles, 6-articulated, nearly one and a half times as long as the body, provided with a few short hairs, not much infuscated, the apices of III, IV, V and the entire VI infuscate, the remainning parts concolourous with the body; III the longest with the exception of VI including the spur, with about 10 small circular sensoria arranged almost in a row; IV and V subequal in length, or the latter a little shorter; V with a single circular subapical sensorium; the spur of VI about 5 times as long as the base. *Proboscis* reaching the second coxal cavity, tip dusky. *Thorax* and *abdomen* without dorsal maculation. *Legs* long, the apical portions of the femora and tibiae and the entire tarsi including the claws infuscate, the remainning parts concolourous with the body. *Cornicles* subsylindrical, at

the base almost twice as broad as at the apex, black. *Cauda* elongate, with about 3 pairs of long hairs, infuscate.

Male.

Winged. *Body* moderately large, light green. *Head* including the eyes wider than the prothorax, infuscated. *Proboscis* reaching the second coxae, II on infuscated, I being concolourous with the body. *Antennae* arising from a pair of prominent frontal tubercles, 6-articulated, very much longer than the body, infuscated except the basal one-eighth part of III, I the largest in diameter; II slightly longer than wide; III the longest, provided with a few hairs and some 24 small circular sensoria irregularly distributed throughout the length, imbricated near the apex; IV somewhat longer than V, imbricated, provided with a few hairs and some 10 circular sensoria situating on the apical half and arranged in a row; V imbricated, with a few hairs and 30 or more small circular sensoria irregularly disposed; VI imbricated throughout, with a group of sensoria at the junction of the two parts, the flagellated portion nearly 9 times as long as the base. *Thorax* black. *Wings* for the most part normal in venation. *Veins* black brown. *Cornicles* and *cauda* black, the former being imbricated throughout, wider at the base. *Abdomen* with black maculation. *Craspers* black, hairy, and porous on the concave side.

Measurements in millimeters:

The length of the body 1.4	The lengths of the femora:
The greatest breadth of the abdomen ... 0.6	fore 0.7
The lengths of the antennal articles:	middle 0.6
III 0.8	hind 0.7
IV 0.4	The lengths of the tibiae:
V 0.4	fore 1.2
VI, the base 0.2	middle 1.2
VI, the spur 0.8	hind 1.4

Macrosiphum sonchi (LINNAEUS)

Aphis sonchi LINNAEUS, System. Nat. Bd. I, 1767.

Aphis sonchi FABRICIUS, Ent. Syst.

Aphis sonchi SCHRANK, Ent. Boi. Fauna Boica, Bd. II, 1801.
Aphis sonchi KALTENBACH, Mong. der Fam. Pflanzenlause, 1843.
Aphis campanulae KALTENBACH, Mong. der Fam. Pflanzenlause, 1843.
Siphonophora aliariae no. I, KOCH, Die Pflanzenlause Aphid. 1855.
Siphenophora Lactucae KOCH, Die Pflanzenlause Aphid. 1855.
Macrosiphum sonchi MATSUMURA, A list of Aphid. Japan, in:
Jour. Coll. Agr. Tohoku Imp. Univ. Sapporo. Vol. VII, pt. 6, 1917.
Macrosiphum sonchi v. d. GOOT, Beitr. zur Kenntnis der Hollands.
Blattlause, 1915.
Macrsiphum formosanus TAKAHASHI, Aphid. Formosa, 1921. (?)

Alate viviparous female.

Body elongate, reddish brown. *Head* and *thorax* dusky. *Antennae* 6-articulated, longer than the body, with a few stout hairs, infuscated throughout; III somewhat shorter than IV and V combined, with about 60 elevated circular sensoria; IV shorter than V, without sensorium; V more than twice as long as the base of VI, with a subapical sensorium, the filamental portion of VI about 5 times as long as the base. *Proboscis* reaching the third coxae, terminal 2 articles black. *Legs* and *wings* normal. *Abdomen* with small dusky maculae on the dorsum. *Cornicles* as long or longer than the cauda, at the base about twice as wide as it is at the apex, reticulated, black throughout. *Cauda* long, constricted much, concolourous with the body.

Measurements in millimeters:

The length of the body	1.5
The greatest breadth of the abdomen	0.6
The length of the fore wing	2.6
The greatest breadth of the fore wing	0.9
The lengths of the antennal articles:	
III	0.9
IV	0.3
V	0.3
VI, the base	0.2
VI, the spur	2.6
The lengths of the femora:	
fore	0.6
middle	0.5
hind	0.6
The lengths of the tibiae:	
fore	1.2
middle	1.3
hind	1.6
The length of the cornicle	0.4
The length of the cauda	0.2

Apterous viviparous female.

Body oval, with a few short hairs, dark-brown. *Head* narrower than the prothorax. *Eyes* dark red, almost black. *Ocelli* large, with black margin. *Antennae* arising from a pair of prominent frontal tubercles, longer than the body, with some short hairs, infuscated; I twice as long and broad as II; II longer than broad; III the longest, with the exception of VI including the spur, with about 100 small protruding circular sensoria arranged all along the joint; IV and V subequal in length or the latter a little short, the former without and the latter with a single subapical sensorium; the spur of VI nearly 5 times as long as the base. *Proboscis* reaching beyond the middle coxae, infuscate. *Thorax* and *abdomen* infuscate. *Legs* with some short hairs, infuscate except the basal portion of the femur, which are concolourous with the body. *Cornicles* subcylindrical, wider at the base, black. *Cauda* long, with a few pairs of long hairs, infuscated.

Host plant: Nogeshi (*Sonchus sps.*)

Distribution: Kiushu-Hokkaido.

Measurements in millimeters:

The length of the body	1.6
The greatest breadth of the abdomen	0.9
The lengths of the antennal articles:	
III	1.3
IV	0.4
V	0.3
VI, the base	0.2
VI, the spur	0.6
The lengths of the femora:	
fore	0.9
middle	0.9
hind	1.10
The lengths of the tibiae:	
fore	1.4
middle	1.5
hind	1.5
The length of the cornicle	0.6
The length of the cauda	0.3

Male.

Alate. *Body* elongate, reddish yellow, provided with some hairs. *Head* wider than long, width of which between the eyes narrower than the prothorax. *Eyes* dark red. Three *ocelli* prominent, black-margined. *Antennae* arising from a pair of prominent frontal tubercles, 6-articulated, infuscated throughout the length, I as wide as but much longer than the tubercles, provided with a few hairs; I nearly as long and about half as broad as II, with a few hairs; III decidedly narrower than any of the preceding articles, with about 10 hairs, more than half as long as the body, with about

10 circular sensoria irregularly placed throughout the length; IV longer than V, imbricated, with a few hairs and about 28 small circular sensoria irregularly distributed besides a rather large usual one near the apex; V imbricated throughout, with a few hairs and about 24 small circular sensoria irregularly placed besides the regular one near the apex, VI imbricated throughout, the spur being nearly 6 times as long as the base. *Proboscis* stout, reaching the second coxae, infuscate throughout the length. *Thorax* black, wider than the head. *Wings* rather large; venation normal with veins brownish. *Legs* with femora, tarsi including the unguis and distal as well as the proximal portions of the tibiae black, the remainning parts being concolourous with the body. *Abdomen* rather slender, with middle and lateral maculae of black. *Cornicles* reaching beyond the apex of the cauda. *Pinis* wider and imbricated at the base, and narrower and reticulate near the apex. *Cauda* long, with a few long hairs, black. *Craspers* dusky, with numerous hairs and pores on the concave surface.

Measurements in millimeters:

The length of the body	1.6	The lengths of the femora:	
The greatest breadth of the abdomen	0.6	fore	0.8
The length of the fore wing	2.8	middle	0.8
The greatest breadth of the fore wing	1.0	hind	0.9
The lengths of the antennal articles:		The lengths of the tibiae:	
III	1.4	fore	1.4
IV	0.4	middle	1.5
V	0.3	hind	2.0
VI, the base	0.2	The length of the cornicle	0.7
VI, the spur	0.6	The length of the cauda	0.4

Apterous oviparous female.

Very much like the apterous viviparous female, the chief differences being:

1. Antennal articles with some 100 small circular sensoria of the protruding type.
2. Hind tibiae much thickened and with numerous small sensoria.

The following tabulation will show some of the more important differences obvious among several species and genera of the aphids, the descriptions of which have already been given:

Body:

1. Shape:— oval (*Dilachnus*), elongate (*Euceraphis*), etc.
2. Size:— small (*Chaitophorus*), large (*Pterochlorus*), etc.
3. Colouration:— light (*Euceraphis*), with maculae (*Calaphis* etc.,) etc.

Antennae:

1. Length:— Shorter than (*Lachni*), as long as (*Callipherina*), longer (*Macrosiphina*) than the body.
2. Sensoria:
   - A. of male:— on III only (*Calaphis*), on all segments (*Macrosiphum*), on III and V (*Euceraphis*) etc.
   - B. of apterous viviparous female: on III (*Acauda itadori*), non (*Chaitophorini*) etc.
   - C. of alate viviparous female: on III (Common to many), on all segments (*Myzus ribis*) etc.

Cauda:

1. Shape:— round (*Pterochlous* etc.), bifurcate (*Myzocallis* etc.), entire and elongate (*Macrosiphum* etc.).

Wing:

1. Fore wing: with III once branched (*Dichaitophorus*), III twice branched (*Aphis* etc.).
2. Hind wing: with cubitus (most of the species), without cubitus (*Carolinaia*) etc.
3. Colouration: with cloudy area (*Callipterus* etc.), without cloudy area (most of the species) etc.

To correlate these characters with the chromosomes would be of much interest, but a few of them will be discussed in the present paper leaving the rest for a future work.

In closing this part of the work, a list of the species studied according to the genera, and those portions of the keys for the identification of the

genera recently prepared by Baker (1920) will be quoted for a comparison with the keys prepared as the result of the study of the chromosomes.

Family APHIDIDAE
Subfamily APHIDINAE
Tribe Lachnini
Subtribe LACHNINA
Genus DILACHNUS
1. Dilachnus piniformosanus TAKAHASHI.
2. Dilachnus laricolus MATSUMURA.
Subtribe Pterochlorina
Genus Pterochlorus
3. Pterochlorus (Tuberolachnus) viminalis FONSCOLOMBE.
4. Pterochlorus tropicalis van der GOOT.
Tribe CALLIPTERINI
Subtribe Phyllaphidina
Genus Shivaphis
5. Shivaphis celti DAS.
Subtribe CALLIPTERINI
Genus Callaphis
6. Calaphis betulaecolens FITCH.
7. (Calaphis) magnolicolens TAKAHASHI.
Genus Callipterus
8. Call. kuricola MATSUMURA.
Genus Tuberculatus
9. Tuberculatus quercus KALT.
10. Tuberculatus quercicola MATSUMURA.
11. T. (Myzocallis) Kashiwae MATSUMURA.
Genus Chromaphis
12. CH. Magnoliae KUWANA et ESSIG.
Genus THERIOAPHIS
13. T. shinae SHINJI.
Genus Euceraphis
14. Euceraphis betulae KALTENBACH.
Genus Myzocallis
15. Myzocallis castanae FITCH.
Genus Symydobius
16. Sy. (Euceraphis) japonica KUWANA et ESSIG.
Subtribe Drepanosiphina
Genus Drepanaphis
17. Dr. acerifoliae THOMAS.
Genus Drepanosiphum
17. Drep. platanoides SCHRANK.
Genus Chaitophorus
18. Chaitophorus sali-apterus SHINJI.
19. Chaitophorus salicola MATSUMURA.
Genus Dichaitophorus G. N.
20. Dic. (Chaitophorus) sali niger SHINJI.
Genus Periphyllus Aceris L.

21. Periphyllus aceris Linne'
22. Periphyllus koelreuteria TAKAHASHI.
Subtribe PTEROCOMMINA
Genus Melanoxantherium
23. Melanoxantherium sali-japonica SHINJI.
Tribe APHIDINI
Subtribe Aphidina
Genus Acaudus
24. Acaudus itadori SHINJI.
Genus Carolinaia
25. Carol. tade SHINJI.
Genus Rhopalosiphum
26. Rhop. lespedezae KUWANA et ESSIG.
Subtribe Macrosiphinia
Genus Amphorophora
27. Amph. ribicola OESTLUND
Genus Myzus
28. Myzus ribis SHINJI (Linne' ?)
Genus Macrosiphum
29. Macrosiphum gobonis MATSUMURA.
30. Macrosiphum cornifoliae SHINJI.
31. Macrosiphum ligustrumae KUWANA et ESSIG.
32. Macrosiphum sonchi KALTENBACH.

A recent synopsis of the aphids described above according to Mr. Baker, who is one of the best authority on the subject is as follows:

KEY TO THE TRIBES OF THE SUBFAMILY APHIDINAE.

1. Cornicles situated on broad flat cones..... Lachnini
Cornicles truncate, or more or less elongate..... 3
2. Thorax of alate form with the lobes not prominently developed; oviparous form small. Large wax plates present (*Shivaphis celti*)..... Thelaxini.
Thorax of alate form with the lobes prominently developed. Wax plates usually absent..... 3
3. Cornicles truncate or elongate; when elongate the cauda knobbed, and the anal plate bilobed, or the antennae prominently hairy..... Callipterini
Cornicles not truncate, usually elongate. Cauda never knobbed. Antennae with only a few spine-like hairs..... Aphidini

KEY TO THE SUBTRIBE OF THE LACHNINI

1. Radial sector of fore wings curved and of moderate length. Stigma elongate..... Pterochlorina
Radial sector of fore wings short and straight situated near the tip of the wing. Cornicles on hairy cones (*Dilachnus*)..... Lachnina

KEY TO THE SUBTRIBES OF THE CALLIPTERINI

1. Antennae armed with rather long, prominent hairs..... 2
Antennae usually with minute, sometimes stout bristles..... 3
2. Cornicles cylindrical or vasiform..... Pterocommina
Cornicles truncate, enlarged at base..... Chaitophorina

3. Cornicles variable, often, long and somewhat swollen .... Drepanaphidina
   Cornicles never long; always short and truncate; .... Callipterina

KEY TO THE GENERA OF THE CALLIPTERINA

1. Cauda distinctly knobbed, anal plate usually bilobed or sometimes deeply divided. 3
   Cauda not distinctly knobbed, anal plate entire or almost so 2
2. Antennae minutely setose, sensorium at base of unguis oval or somewhat rounded .... Symydobius
   Antennae not minutely setose, sensorium at base of unguis long and narrow, etc, ... Euceraphis
3. Anal plate deeply divided with U—shaped cleft so that the lobe appear as distinct; cauda knobbed .... Thericaphis
   Anal plate bilobed, not deeply divided; cauda very markedly knobbed 4
4. Antennae and often the cauda with prominent hairs .... Callipterus
   Cornicles and antennae without such hairs 5
5. More or less distinct antennal tubercles present .... Calaphis
   No distinct antennal tubercles present .... Myzocallis

KEY TO THE GENERA OF THE DREPANOSIPHINA

1. Cornicles extremely long and swollen in the middle .... Drepanosiphum
   Cornicles not reaching the tip of the abdomen .... Drepanaphis

KEY TO THE GENERA OF CHAITOPHORINA

1. Cauda quite distinctly knobbed .... Chaitophorus
   Cauda not knobbed but rounded .... Periphyllus

KEY TO THE GENERA OF THE PTEROCOMMINA

1. Cornicles somewhat swollen .... Pterocomma
   Cornicles cylindrical .... Melanoxantherium

KEY TO THE GENERA OF THE APHIDINA

1. Cornicles swollen, not subcylindrical or trapering ..... Rhopalosiphum
2. Cauda aparently absent, or a mere rounded plate-like structure .... Acaudus
   Head with prominent antennal tubercles .... Macrosiphina

KEY TO THE GENERA OF THE MACROSIPHINA

1. Cornicles swollen .... Amphorophora
   Cornicles cylindrical or tapering, scarcely swollen 2
2. Tubercles strongly converging .... Myzus
   Tubercles distinctly diverging .... Macrosiphum

The above keys are quoted here for the use in comparing this with the one that will be suffixed at the end of this thesis.

The descriptions of germ cells

A. Germ cells of *Euceraphis betulaecolens* KALTENBACH.

This is a larg form. The stem mother hatches late in February from the egg laid in the fall by the oviparous female. The newly hatched nymph is dark orange at first on account of the presence of the yolk substances in the body. At about the time when the yolk contents of the nymph become exhausted, buds of the host plant, the birch, break out, and the insect migrates and feeds on young leaves. When a twig infested with eggs is brought into the room and left to dry, the buds, of course, do not open, and consequently the newly hatched young die of starvation, but if such twigs were placed in a tumbler containing water, or planted in a moist soil, buds would open in the next Spring and consequently the young hatch, mature, and reproduce. The larvae or nymphs become mature in from 18 to 24 days depending on the condition of the host plant and temperature, and commence to deposite young viviparous larvae, which in turn, after a lapse of about 20 days, give rise to numerous young viviparous females and so on. Yet this condition of parthenogenesis does not last very long. In California, New York and Missouri, U. S. A., where I have had actual observations, the male and female forms appeared sooner or later.

For the purpose of determining the sequence of the germ cells of males, several methods of experimentation were adopted. The one suggested to me by Dr. Long was the best so far as mortality is concerned. The method is briefly as follows: by means of a hot needle a tiny drop of melted wax was placed between the wings of the adult as soon as they had emerged from the final molting skin, and the insect was transferred to a fresh clean leaf and then the whole was enclosed within a small lamp-chimney of one inch in diameter with cotton plugs at both ends. The chimneys were then tied by means of a string to boughs. As soon as an adult female deposites the young, the former is transferred to another chimney until she gives birth to another larva, and so on. By this method, a complete life history of the

young from the time of its birth to its maturity could be worked out. In general, it may be said that an adult female deposits, at the temperature of 70°—80°, one young every two hours. Since there are 8 ovarioles in this species, it means that at least sixteen hours are required to empty one embryo out of the first egg-chambers, and since the nineth or the first embryo in the second egg-chamber follows with an intermission of two hours also, in ordinary purposes it may be said that the depositing cycle of ovarioles in this form is eighteen hours. Similarly it follows that the period spent by an egg to mature, or in other words, the growth period of the oocyte, is also about sixteen hours. Thus it is comparatively an easy matter to determine the sequence of the maturation figures found in different egg chambers or sperm cysts of the same or different ovarioles or testis as the case may be. It is, however, a difficult task to know difinitely this time factor in different individuals for the reason that the development of the germ cells depends, like individuals, largely on temperature and other environmental conditions.

The chromosome numbers of the somatic as well as the germ cells of the male and female have already been given in my brief communication entitled the chromosomes of a certain aphid, *Euceraphis betulae* Kalt. (1918). In this paper an attempt will be made to analyse a probable method, by which the reduction in the number of chromosomes of this species may be brought about.

I. Spermatogenesis.

The male sexual organ develops in general like that of the female, the only difference being the relative size, shape and number of the germ cells contained. There are exactly the same number of testis as the female ovarioles at least in the case of *Euceraphis betulae* Kalt., i. e., one on each side of the main axis of the body. The testes on each sides are, however, open at the same point forming a radial structure. Consequently the pedicels or the sperm ducts are all very short. Another difference observable between the sexual organs of the male and the female is the number of epithelial cells that invest the germ cells within. As has been stated, the follicular epithelial cells of the female organ increase in size with the growth of the egg, while in the male cells this is not the case. Each one of the eight testes or testicular lobes is divided into compartments, and the cells in each compartment are approximately of the same size and stage or phase of development, suggesting that they are probably all derived from a single primodial germ cell.

A. Spermatogonium.

The spermatogonia of *Euceraphis betulae* Kaltenbach are, as a rule, found in the testis of a still unborn young larva. They are also found in or near the free end of testicular lobes of the nymphs until an early part of the third larval stage, but the cases where they are found in the testis of the winged adult is very rare. Since the chromosomal history of the spermatogonium is essentially the same as that of the somatic cell or with that of other animals, only a brief account will be given here.

The resting spermatogonia are rather numerous, indicating that this stage occupies quite a considerable duration. The size of the cell at this stage is slightly ovoid than to be a perfect sphere. There are two membranes: the outer cell membrane and the inner nuclear membrane. The latter is not only very distinct but also sharper and heavier than the former in all the sectioned materials. The cytoplasmic area of the spermatogonial cell stains decidedly darker than that of the cells of the later generation i. e., the spermatocytes. No centrosome could be detected in this or the succeeding stages. The nucleus contains within it a large nucleolus or the karyosphere of Blackman (1905) and others. This nucleolus or the true karyosome is sphaerical in outline, and locates at one pole and not in the exact center of the nucleus. It appears black and homogeneous in the specimens stained with Heidenhein's haematoxylin at the stage of an ordinary colouration. When, however, the extraction of the stain continued long enough, or the triple stain is used, or better still when it is stained with the phosphotongastic acid, it presents a vacuolated appearance (Fig. 120), showing often within it a granular chromosome-like bodies, the number of which corresponding to that of the accessory chromosomes. A greater portion of the nucleus near the karyosome is occupied by granules which easily take up

such acid dyes as orange G, acid fucsin, or Congo red. These are usually arranged in a radiating manner out of the nucleolus toward the opposite direction. No visible substance was found toward the other pole of the cell.

Following the stage described, both the cytoplasm and karyosome or nucleolus become clearer. The karyospher disappears gradually and the chromatin granules derived mostly from it become scattered on an achromatic network, the gradual disappearance of which, coupled with the shortening of the fibers, causes the appearance of fine threads. In favourable specimens a groupe of 4 long beads-like threads are recognizable as late a time as the Fig. **122** represents. Thus there is no question about the karyosomal origin of the chromosomes. When the beads-like chromosomal threads became recognizable as a fore-runner of the definitive autosomes (chromosomes), there still can be seen a group of lessor 4 of rather compacted chromatic bodies, the later history of which shows them to be the so-called sex- or X-chromosomes. Thus it is clear that the so-called X-chromosomes in this species are nothing but a part of the karyosome. These beaded chromosomes gradually shorten and finally give rise to a definitive number of chromosomes, i. e., two longer pairs in addition to a group of shorter 4.

Conditions of a spermatogonium when all of the chromosomes made their appearance with no nucleolus are illustrated in such prophase figures as are represented by Fig. **125** and **126**. There are, in each one of them, two pairs of long chromosomes, the later history of which proves them to be the autosomes, and 4 smaller (shorter) chromosomes of verying sizes. These chromosomes, including the sex-chromosomes, become soon arranged on an achromatic spindle which then appears —Metaphase. Fig. **128** represents a subpolar view and Fig. **127** a lateral view of such a metaphase figure. Fig. **129** and **130** illustrating two anaphase figures show that there is no such an extraordinary phenomenon as the extrusion or lagging behind of any of the chromosomal parts indicating that the last spermatogonial division is similar to that of an ordinary somatic mitosis so far as the chromosomal behavior is concerned. After the last spermatogonial division the chromosomes gradually fade away, and at the same time achromatic substance increases so much that only a smaller part of the nucleus is occupied by

chromatic substance during the late telophase of the last spermatogonial stage and the spermatocyte of the first order in an early growth period.

B. Spermatocyte

The first remarkable change observed in an early growth period of the spermatocyte I is the appearance on the achromatic matrix of several chromatic granules, the number of which seems to correspond with that of the definitive chromosome threads. As the chromatin granules increase, the nucleus begins to appear dark and continues so until the late prophase of the first maturation division. In the following stage, a clear space becomes noticeable in each of the threads or chromosomes. Thus at this stage each chromosome presents a doubled appearance. Although in Fig. 33 and 35 there seem to exist four small solid chromosomes besides four large paired ones, I take this condition of the smaller ones as due to different orientations, and that if they were seen from another angle, they might have, no doubt, appeared as doubled. That my interpretation is probably correct is shown by Fig. **134** which clearly indicates the existence of a paired or doubled condition in all of the chromosomes.

Now, if we regard each of the pairing chromosomes as representing a single spermatogonial chromosome, we should have half as many chromosomes as we see here. Thus, there is no other alternative than to regard the pairs as due to a longitudinal splitting of each of the spermatogonial chromosomes. In this respect, then, my interpretation agrees with MORGAN's (1915) suggestion, namely, that the chromosomes here apparently split longitudinally in anticipation of the second maturation division, which closely follows the first without an intermission of a resting stage.

Now let us go back to the spermatocytal stage of the birch aphid. In Fig. **139** there are two pairs of large chromosomes besides four small apparently solid chromosomes. Thus the total number of chromosomes is now eight. This change in the chromosome number is due to two factors: in the first place the clear space between each one of the chromosomes became obliterated, and the second that this obliteration is followed by a side-by-side conjugation of larger or ordinary chromosomes to form two pairs.

As the maturation division progresses, each part of the paired autoso-

mes goes to the opposite poles, but the heterochromosomes are first drawn out to form the *lagging chromosomes* and then all are suddenly withdrawn into a single daughter cell. Those daughter cells which received two autosomes besides four heterochromosomes undergo another mitosis before they are transformed into spermatozoa, while those that received two autosomes and no heterochromosome degenerate *in situ* (Fig. 146). Thus, all the spermatocytes of the second order have six chromosomes as is illustrated by Fig. 147.

Such is a general accounts of the maturation phenomenon in *Eucera-phis betulae*. As in the case of other animals certain advantages and handicaps are evident in this species. Descriptions and discussions on certain phases of chromosomal history are, therefore, left untouched in this particular sections, leaving a fuller account to the time when the most favourable species will be taken up.

2. Oogenesis.

A. Parthenogenetic ovum.

Since, as we shall soon state, both the nurse and the oocytal cells arise from the oogonial cells by differentiation, and since the oocytes are formed after the differentiation of the nurse cells became definitely established as such, strictly speaking, there is no oogonium. Besides, the mitosis of the primodial germ cells, from which both the nurse cells and the oocytes arise, is, whatever their future history may be, essentially the same as that of the ordinary cell division. Dismissing, therefore, the accounts of the oogonia, we shall directly proceed to take up the account of the oocyte.

Growth period: —Fig. 150 represents a condition of one of the earlieast oocytes during the growth period. The cell boundary is still indefinite but its nuclear membrane is very distinct. The cytoplasmic area surrounding the nucleus is dense and homogenous. In the nucleus itself there is a large body which is basic in reaction but is surrounded by achromatic alveolar plasma. In the material which is slightly younger than the one shown here this densely stainning body is much larger and much more compact, but in the one illustrated here, the nucleolus or karyosphere of Blackman (1905)

has already become smaller and presents a kind of vacuolation. In fact the remains of the former large nucleolus is now represented by this vacuolated structure. This vacuolation, it must be noted here, has produced now definitely recognisable four smaller chromosomes, or it is more probable that the disappearance of the nucleolar structure brought to view the said chromosomal structures. Beyond this quadruple chromatic area, there have come into view some beaded threads, the number of which it was often difficult to ascertain.

With the growth of the egg, however, these granular beads-like threads of the chromatic granules above mentioned became enlarged and the threads at the same time thickened (Fig. 152—153) until heavy threads are formed of the granular chromatic body, or chromatins. Although the presence at the place of the origin of the chromatic threads of a more or less compact accessory quadruple prevents, to a certain degree, a clearer investigation into the nature of the chromosomal threads at this period, the fact that there are at least 4 separate pieces which are approximately of the shape and size of the ordinary chromosomes that immediately form at this stage, favours the view of the non-existence of a single spireme in this Aphid (Fig. 154). In the next older egg the formation of the threads into a definitive number of chromosomes is evident. At this stage two pairs of autosomes so characteristic of the spermatocyte are very clearly seem. They are of about the same size and shape, both being of rod-shape. In this and even in the next older eggs the sex-chromosomes are still found close together forming a closely associated quadruple.

With a further growth of the egg, however, a dispersion of the chromosomes including the sex-chromosomes and the shortenning of the autosomes take place (Fig. 155—156). This change, however, does not disturb the relative size and position of the chromosomes. The shortenned chromosomes appear spherical but, in reality, they form rings with a clear area in the center of each one of them. The exact meaning of this ring formation is not very clear, but is not entirely without a guess that it may have been brought about by a wounding or curling of the chromosomes and probably not due to a contraction as one might suppose. It may also be taken as

due to a precocious splitting of the chromosomes in an anticipation of the polar body formation. On this point a further study is necessary.

Metaphase — The ring-shaped chromosomes seen last becomes gradually elongate or rather straightens out at the beginning of this stage. Meanwhile an achromatic spindle fibers make their appearance on the equatorial plate, on which the now-elongated chromosomes become arranged. The number of chromosomes seen on the equatorial plate is 8; 4 very long and 4 much smaller ones. Thus, the sex-chromosomes, the number of which theoretically ought to be 8, seem to keep on a state of fusion in most of the eggs parthenogenetically develop. As the figures 161 and 162 show, every one of the chromosomes, including the sex-chromosomes, is attached to a fiber that runs from one pole of the oocyte to the equator. This fact shows, contrary to the maturation of the spermatocyte, that all the chromosomes do equally divide.

Anaphase — There is no difference observable between the anaphase of the pseudomitosis of the parthenogenetic egg and that of an ordinary mitosis so far as the chromosomal behavior is concerned. Each of the eight chromosomes including the accessories becomes somewhat shorter and more ovoid as they recede each from the other toward the opposite pole. As the spindle fibers contract, each half of the chromosomes becomes more and more appart. There is no visible difference between the chromosomes that are destined to be cut off from the egg nucleus to become the polar body and those that go to form the first cleavage nucleus later. The cytoplasm, however, behaves differently from the case of the ordinary mitosis: instead of aggregating equally around the two daughter cells, or rather chromosomal groups, it still fills a greater portion of the egg with, of course, the exception of those parts that becomes vacuolate on account of the growth in size of the oocyte. The daughter chromosomes-group that becomes pulled out, so-to-speak, to the periphery of the egg constitutes the polar body.

Telophase — By the time when one of the chromosome-groups becomes pulled, so-to-speak, to the periphery of the egg, a sort of nuclear membrane is formed around each of the daughter cell or more correctly a chromosome-group. After this is done, one of the daughter nucleus that

happened to lie on the periphery begins to degenerate whereas the other that remained deep in the cytoplasm begins to migrate toward the center of the egg, all this while its contents becoming disorganized. This nucleus, which is now the first cleavage nucleus, then goes into a resting stage. That the polar body remains for a considerable time without disappearing may be learned from such figures as Fig. 164, which illustrates a condition of the parthenogenetic egg in the metaphase of the first cleavage. The same figure also illustrates the fact that the first cleavage spindle of the parthenogenetic egg lies in the center of the egg.

2. Sexual ovum.

The study of the so-called winter egg was undertaken not so much for its maturation process as its bearing to the determination of the sex of the individual. Although a great many eggs have been fixed and studied, specimens representing some stages of the maturation divisions are yet to be found. The facts that the polar body formation probably takes place simultaneous with, or a short time after, the deposition of the egg and that the eggs at this time become peculiarly brittle make the sectioning rather difficult, giving only a very few specimens showing the female pronucleus.

The ovaries or rather ovarioles that produce the so-called winter eggs are originally the same as those that produce the parthenogenetic ova so far as the origin and subsequent differentiation are concerned, the most noticeable differences existing between these two kinds of ovaries being their relative rate of growth and differenciation of their contents, nurse cells and the oocytes: in those ovarioles that produce the sexual ova the growth of the nurse cells above are more rapid than those of the ovarioles producing the parthenogenetic eggs whereas the growth and the change in the appearance of the chromosomes are just the opposite of this, i. e., they are faster in the case of the parthenogenetic eggs than in the case of the sexual ova (Fig. 175 B). Consequently it happens that, by the time when the sexual ova reach their ultimate size and their nuclei, now the germinal vesicles, begin to undergo a division to produce the first polar body, the parthenogenetically developing eggs had already undergone a complete embryological deve-

lopment and are ready to be deposited.

One of the most remarkable features observable during the growth period of the oocyte of the first order is the contraction to one of the poles i. e. the pole opposite of the oviduct, of all the chromosomal threads (Fig. 165). In favourable specimen representing a similar stage there is often found a furrow running lengthwise of some of the chromosomes. So, I can not but consider such furrows as due to a longitudinal splitting of the autosomes, and the contraction of the chromosomes to represent a true contraction stage so common in the case of other insects and animals. In this connection, it must be mentioned that the oocytes are not produced by a peculiar division of follicular cells that enclose the nurse cells and ova as TANNREUTHER (1906) declares, but all are the products of the oogonia, which are in turn derived from nothing but undifferentiated primodial germ cells. In Fig. 175 A almost all of the oocytes are found in the contraction stage and each of them is connected to nurse cells above with nutritive strings of Tannreuther secreted by the nurse cells.

From this time on the appearance of the chromosomal threads gradually changes and by the time when an oocytal chamber is formed, the chromosomal threads become shortened and at the same time all appear to have radiated from a single mass of plasmosome-like structure which is often vacuolated. The fact that the number of the visible chromosomes at this stage is usually limitted to four, some of which may show a longitudinal furrow that runs through each one of them suggest that the threads may, in reality, represent the autosomes and that the sex-chromosomes have, by this time, condensed to form a plasmosome-like structure (Fig. 168-172).

In the next older egg, the chromosomal threads seen last have, in all probability, formed a single large thread with a mass of sex-chromosomes at one of its ends. The next step in the chromosomal change is not very clear as yet, but the presence of such a figure as Fig. 169 suggests that the single thread seen last must have divided transversely to form a characteristic number of chromosomes, which in turn conjugated to form tetrad-like structures, one of which being the sex-chromosomes. All this while, it must be mentioned, the nucleus or the so-called germinal vasicle moves out from the center

toward the periphery of the egg. During this migration the tetrad-like chromosomes come together and form again a nucleolus-like structure, from which three or probably four chromosomes radiate out. By the time, however, when the germinal vesicle reaches the periphery of the egg, those radiating chromosomes become broken into numerous small pieces which soon becoming darkly staining bodies escape into the cytoplasm through the nuclear wall. A careful observation on the nucleolus-like body remained in the nucleus discloses the fact that within this apparently solid body there are embedded two pairs of chromosome-like treads besides a round body. This is just the condition, I think, BLACKMAN (1905) found in the case of the maturation of the egg of a Myriapoda.

The next change in the nucleus is the disappearance of the nucleolus-body and the formation of about 6 oval bodies instead. I can not but take this stage as representing a late prophase comparable to Fig. 159 in the case of the parthenogenetic egg. The change just described takes place during the migration of the germinal vesicle to the periphery of the egg. On reaching the periphery, the germinal vesicle contracts and becomes smaller, at the same time causing a vacuole to appear between the periphery of the egg and the nuclear membrane. That the formation of the first polar body will be the next change, which phenomenon I have not been able to observe, can be learned from such a figure as Fig. 174 which shows two nuclei arranged almost in a row. One of these nuclei situating near the periphery of the egg will probably represent the first polar body, while one of the daughter nuclei of now-dividing one will become the second polar body. Should this assumption turn out to be true, then, we would expect at least two and probably three polar bodies in this case as against one in the case of the parthenogenetic egg. Of the chromosomal distribution among the polar bodies and the female pronucleus nothing definite could be detected on account of a dark appearance of the nuclei. On this point a further study is necessary.

3. The Origin and Differentiation of the Germ Cell.

The origin and subsequent history of the germ cells of aphids have been

already investigated by several investigators such, for example, as HUXLEY (1894), LEUCKART (1864), CLAUSE (1864), MECZNIKOW (1866), BALBIANI (1868), WITLACZIL (1884), WILL (1888), STEVENS (1905) and TANNREUTHER (1907). Several views have been advanced to account for the origin and subsequent history of the germ cell of aphids. Most striking of these are the follicular epithelial origin of the oocytes (TANNREUTHER) and the existence of two kinds of oocytes corresponding the summer and winter eggs in a single ovary (STEVENS). In order to investigate whether these phenomena are more common occurence or they are limited to a certain species or they are due to misinterpretation by the investigators, the study of the germ cells in *Euceraphis betulae* KALT. was began under the guidance of Professor Long of the University of California in 1913, and the work was continued under Professor LeFevre, at the University of Missouri, during the seasons of September, 1917—May, 1918.

The lateral view of the anaphase of the first cleavage cell is shown in Fig. 177. The chromosomes of two daughter cells are found very much appart. There is neither lagging chromosome or chromosomes, nor are there any indication that may suggest the casting out of chromatin substance in this or the stages previous to this. Soon a nuclear membrane is formed around each of the two daughter cells while all the so-called yolk which is, in this case, nothing more than a kind of cytoplasm, is divided equally into the posterior and anterior halves. Thus apparently the first cleavage is equational as regard the amount of chromosomes as well as that of the surrounding substances, the protoplasm and yolk, if any.

The second cleavage spindle is directed obliquely and not parallel to the antero-posterior axis of the egg, but the division is here again equational; the resulting four cells each receives apparently an equal amount of the nuclear as well as the protoplasmic material. There is neither lagging chromosome nor the casting out of chromatin. The same is true in the case of the third cleavage (Fig. 178). The condition of this or that of the figure that shows the dividing cells slightly before the completion of the blastoderm are also to the effect that, at least up to this stage, all cleavage cells equally divides and must, therefore, be regarded as equally potential.

At the next stage, however, an interesting phenomenon occurs. A large, much more clearer cell than the rest of the blastodermic ones, makes its sudden appearance (Fig. 180). Besides the two distinctive features just mentioned, this large clear cell is reticular and represents an appearance of distinct and definite chromosomal character as against a more glanular appearance exhibited by the rest of the blastodermic cells. The exact manner and time of the appearance of this single large cell could not be made out. Other evidences, however, indicate that this differentiated cell must have occured simultaneously with the completion of the blastoderm and the subsequent beginning of gastrulation and also of the migration of a certain colony of symbiotic organisms at the posterior end of the egg. This single large cell is, as its later history shows, the primodial germ cell. By subsequent multiplication and differentiation it forms the two of the three ovarian elements, namely, the nurse cells and the true egg cells or the oocytes as they are often called.

Somewhat later conditions of the germ rudiments are shown by Fig. 182 and 183. The germ cells have been greatly increased in number by successive divisions since we described them last, but each one of them still presents its characteristic appearance. One of the most interesting and at the same time the most important things is the fact that all the germ cells are completely immersed in, or more correctly speaking, surrounded by a colony of symbiotic organisms, mycetomia or the secondary yolk of many investigators. The nurse cells and oocytes are, however, derived from the same undifferentiated primodial germ cell, the former being the first to develop followed by the latter.

Still later on, when the oocytes became differentiated as such, there are in each ovariole from 8 to 16 nurse cells and about the same number of oocytes besides several follicular epithelial cells that surround them.

Epithelial cells multiply, and at the same time extend postero-dorsally untill they meet with the vaginal invagination that has occured near the posterior end of the embryo. Meanwhile the growth of the nurse cells continue not only in number but also in volume. In the case of the ovariole of the parthenogenetic eggs the nuclei of the nurse cells undergo little change as

the comparison of Fig. 184 and Fig. 185 indicates. Soon a kind of nutritive material similar to the protoplasm begins to be secreted by the nurse cells. At first the secretion accumulates uniformly around the nucleus of the nurse cell in a form of a ring. Silmultaneous with this the ring elongates postero-ventrally and at the same time converges toward the center of the ovariole where the nutritive material assumes an appearance of threads. Each one of these connects with one of the oocytes situating in the distal portion of the ovarian chamber. The oocyte that is found in the center of the chamber receives, by reason of its central position, more of the nutritive material than any other, and consequently grows faster than the remainning oocytes, all of which get nearly an equal amount of the nutritive substance.

As the central oocyte grows in size, it becomes constricted off from the rest of the oocytes to form a new chamber, which is, it must be mentioned, formed by the multiplication of the epithelial cells. It is in this newly-formed egg chamber that a greater part of the maturation process takes place.

When the oocyte locating centrally becomes constricted off to form a separate egg chamber, another oocyte in the upper chamber assumes the central position, and by reason already mentioned begins to grow suddenly and is, in turn, constricted off to form another egg chamber, so that at this time an ovariole consists of a string of three chambers. I have seen many strings of four chambers but not one containing more than this number. I am, therefore, of an opinion that in all probabilities the embryos will have passed into an empty chambers after the formation of the fourth chamber. In many cases only four larvae are deposited from each ovariole. Usually a majority of the oocytes and embryos developed, seem to have no chance of being laid. The foregoing accounts hold true also in the case of the oviparous female and her eggs.

I have been unable to observe any indication that may suggest the origin of the oocytes by the division of the follicular epithelial cell as Tannreuther (1907) describes and figures. All my specimens of transverse sections through the ovariole show the condition as illustrated in Fig. 186 and Fig. 187. A clear demarkation of the epithelial layer from the oocytes and the direction of the dividing epithelial cells are found, not towards the

interior of the chamber, but tangential to it.

It must also be mentioned here that in the species I have studied there were only one kind of oocytes and not two as Miss Stevens claims to have found in her specimen.

The origin of the three ovarian elements in aphids has been differently described by different writers.

Lubbock (1849) claims that the egg and nurse cells are modified epithelial cells of the end chamber.

Balbiani (1868) states that the germ rudiments of parthenogenetic aphids undergo a process of budding previous to their differentiation into the nurse cells and oocytes.

Metchnikow (1866) derived the end chamber from a mass of cells "Die am untersten Pole des Endfaches liegenden Zelle sich bedeutend vergrossert, wobei sie in ein, aus dem Endfachepithel entstandes Follikel eingeschlossen wird und hier ihre weitere Entwicklung vollzieht."

Stevens (1905) insists that the content of the end chamber is of two kinds possibly corresponding to the summer and winter eggs, and that those situated on the lower portion of the end chamber degenerate in the ovaries that produce the agamic eggs.

Tannreuther's (1906) recent observation is no better than that of Lubbock, for he declares that the egg cells do not originate from the inner mass in common with the nurse cells or ovarian glands but grow out of the follicular epithelial cells situating at the base of the end chamber.

In insects other than aphids, the result of several investigators differ with the species with which they have worked. It would be of interest to go into the literatures on this problem, but since such a resume has already been given in my previous work (Shinji, 1922), I shall not attempt to repeat it here.

B. The Number of Chromosomes in Representative Species.

1. The subtribe Lachnina.

Material No. I.—*Dilachnus laricolus* (Figs. 189–193). This is one of the large forms, being nearly as large as *Pterochlorus tropicalis*, to which

it is closely related. The equatorial plate of the first spermatocyte mitosis (Fig. 189) shows 5 elements: 4 bivalent and one univalent chronosomes. It is this univalent element that becomes drawn out in anaphase and finally withdrawn into one of the two daughter spermatocytes of the second order.

2. The subtribe PTEROCHLORINA.

Material No. 2.—*Pterochlorus tropicalis* (Fig. 194–196). In the number of elements there is no difference between this and the preceeding species, both having 5 elements or $4_{II}+X=5(♂)$. One of the distinguishing features of the equatorial plate of this species is the triangulate shape of the sex or univalent element with a clear space in its center.

Material No.—3.—*Tuberolachnus viminalis* (197–198). BAKER placed the present species in the same genus with *tropicalis*, but the examination of the chromosome elements in this species does not favour this determination. For in this case there are unmistakably 4 elements or $3_{II}+X=4$ (♂), X being the largest. It is, therefore, thought wise to call this species by its older name of *Tuberolachnus viminalis* in spite of BAKER's opinion.

3. The subtribe PHYLLAPHIDINA.

Material No. 4.—*Shivaphis celti* (Fig. 199–200). The subtribe PHYLLAPHIDINA, to which the present species as well as *Tamalia* (*Phyllaphis*) *coweni* studied by MORGAN (1916) belong, was regarded by BAKER (1920) to constitute the phylogenetic link between the subtribes CALLIPTERINA and CHAITOPHORINA on the one hand and such other subtribes as MACROSIPHINA, APHIDINA, LACHNINA and others on the other. The number, shape and size of the chromosomes found in this species are in strict accordance with the views just stated, for two elongate elements representing 4 autosomes besides one small sex-chromosome or 5 in diploid number is the smallest number conceivable in the germ cells of the aphids and, thus, it must be regarded as to represent a primitive character in the evolutional scale.

4. The subtribe CALLIPTERINA.

Material No. 5.—*Myzocallis castanae* (Figs. 201 and 202). The polar views of the equatorial plates of the first spermatocyte mitosis show 6 elements. The largest of these alone is univalent, the rest being bivalent (Fig. 202).

Material No. 6.—*Calaphis betulaecolens* (Fig. 203). Camera Lucida drawings of equatorial plates made at the University of California suggest the probable identity of this species with the paper birch aphid studied by STEVENS (1905).

Material No. 7.—*Tuberculatus kashiwae*. A great many specimens of this species were collected, but all were too old to show any good chromosome plate. In one specimen 7 elements were observed.

Material No. 8.—*Tuberculatus quercicola* (Figs. 204–206). Figure 204 is an equatorial plate of the first spermatocyte mitosis. There are 7 elements of different sizes and shapes, and figure 205 shows all but one double. Thus the diploid chromosomes of this species can be represented by $12+X=13$. Thus in the number of chromosomes alone this species differs from *Myzocallis castanae*. Hence a different genus name of *Tuberculatus*.

Material No. 9.—*Tuberculatus querceus* (Figs. 207 and 208). The specimens of this species were collected in the United State of America. Unlike our *Tuberculatus*, this material has two extra tiny elements, making 9 elements in all. Of the significance of these tiny elements we shall discuss later on.

Material No. 10.—*Callipterus kuricola* (Figs. 209 and 210). The equatorial plate of the first spermatocyte mitosis shows 7 elements, the largest one being univalent. Thus there is no difficulty in distinguishing this species from *Tuberculatus quercicola*, in which the univalent element is surely not the largest one.

Material No. 11—*Euceraphis betulifoliae* (Fig. 211). Morphologically this species is very closely related to both *Euceraphis betulae* and *Symydobius kabae* in the possession of elongated sensoria on the third antennal articles, but it differs from the former in the lack of glands that secrete flocculent substance. It also differs from the latter in its habits of feeding on the leaf instead of barks. The chromosome complex of this species, however, shows more affinity to the genus *Calaphis* than *Euceraphis* represented

by *betulae* Koch, for there are 10 bivalent elements besides a single univalent one in the equatorial plate of the first spermatocyte mitosis (Fig. 211).

Material No. 12.—*Euceraphis betulae* (Figs. 1—148). This is the species, the spermatogenesis and ovogenesis of which have been described in some details in Part A of this thesis.

Material No. 13.—*Chromaphis magnoliae* (Figs. 212 and 213). In the figure 214 which represents an equatorial plate of the first spermatocyte mitosis there are 4 elements, the largest of which being univalent. This fact points to the primitiveness of this species as compared with the rest of the genera belonging to the subtribe Callipterina.

Material No. 14.—*Calaphis magnolicolens* (Figs. 214 and 215). The equatorial plate of the first spermatocyte mitosis shows 10 elements including an unpaired one (Fig. 214).

Material No. 15.—*Therioaphis shinae* (Fig. 216). This is one of the beautiful forms resembling in many respect a *Callipterus*, and so does the number of chromosome elements. The sex-chromosome or the univalent element in the equatorial plate seems, however, not to be the largest of 7 although our material is too scanty to decide on this point.

Material No. 16.—*Symydobius kabae* (Figs. 217 and 218). Figure 217 is an equatorial plate of the first spermatocyte mitosis. There are 13 elements of varying sizes and shapes, and Figure 218 shows that all of them except the largest one are bivalent.

5. The subtribe Drepanosiphina.

Material No. 17.—*Drepanaphis acerifoliae* (Figs. 219 and 220). A polar view of the equatorial plate of the first spermatocyte mitosis is shown by Fig. 219. In this figure there are 19 elements, 16 of which being almost similar in shapes and sizes. Which of these is univalent can not be told.

Material No. 18.—*Drepanosiphum platanoides* (Figs. 221 and 222). One of the polar views of the equatorial plate of the first spermatocyte mitosis shows 15 elements, a few of them being much smaller than the rest which are of nearly the same sizes and shapes. The lateral view of a similar plate brings out the existence of a single univalent chromosome, but the

exact identity of which is rather difficult to be made. Stevens (1906) presents a few figures illustrating the presence of a hetero-chromosome in a maple aphid. Although she did not mention the scientific name of the species studied or the number of the two sets of chromosomes, her explanation of the figures and also her figure 48 in her 1906 paper, which shows eight and seven division of the elements of the first spermatocyte, suggest the identity of her species with mine, namely, *Drepanosiphum platanoides* Schrank.

6. The subtribe Chaitophorina.

Material No. 19.—*Chaitophorus sali-apterous* (Figs. 223 and 224).

Material No. 20.—*Chaitophorus salicicolus* (Figs. 225 and 226).

The number of chromosomes in these two species are the same, both having 7 elements or $6_{\text{II}}+X=7$ (♀). In this regard, these two species may well be said to resemble a *Callipterus*. The Univalent (sex) element in the case of these two species is, however, not so large as that found in *Callipterus*.

Material No. 22.—*Periphyllus aceris* (Figs. 229 and 230).

Material No. 23.—*Periphyllus Koelreuteriae* (Figs. 231 and 232).

These two species are very closely related, and so is the general appearance of their equatorial plate. The sex chromosome or the univalent element in the equatorial plate is also similar in that it represents the largest one. These two species, however, differ in their total number of chromosomes: in *P. koelreuteriae* there are at least 11 elements, one of them being univalent, while in *P. aceris* the number of elements is 10 and that of the somatic-chromosomes $18+X=19$ (♀).

Material No. 24.—*Dichaitophorus sali-niger* (Figs. 233). The polar view of the equatorial plates of the first spermatocyte mitosis shows 7 elements. This indicates a close similarity of this species to the genus *Chaitophorus*.

7. The subtribe Pterocommina.

Material No. 21.—*Melanoxantherium sali-japonica* (Figs. 227 and 228). In Fig. 227, which shows a polar view of an equatorial plate of the first spermatocyte mitosis, there are eleven elements including a large univalent

one. Thus the result of our investigation into the number of chromosomes is strictly in accordance with the views of BAKER (1920) in placing the subtribe PTEROCOMMINA above the CHAITOPHORINA branch in his phyllogenetic tree.

8. The subtribe APHIDINA.

Material No. 25. *Aphis gossypii*. All the material of this species examined were infected with parasitic organisms. In such ones we usually met with spermatocytes with 4 elements. It is, however, with much reservation that we take such a cell as a normal one, for in another *Aphis*, *Aphis sambuci*, we found 6 elements including one univalent chromosome in the equatorial plate of the first spermatocyte mitosis (Fig. 255).

Material No. 26.—*Acaudus itadori* (Figs. 234 and 235). Unlike that of the preceeding species, the equatorial plate of the first spermatocyte division of this species shows 6 elements, one of which being univalent (Fig. 234).

Material No. 27.—*Carolinaia tade* (Figs. 236 and 237). The number of elements found in the equatorial plate of the first spermatocyte mitosis is 5. In this respect the present species resembles *Aphis oenotherae*, *Aphis* of star cucumber and *Aphis* of salanae willow studied and reported by STEVENS (1906).

9. The subtribe MACROSIPHINA.

Material No. 28.—*Myzus suguri* (Figs. 238—242).

Material No. 29.—*Amphorophora lespedezae* (Figs. 243 and 244).

Material No. 30.—*Amphorophora ribicola* (Figs. 245 and 246).

The number of elements or chromosomes found in the first spermatocyte mitosis of these three species is the same, each having 6 elements including one univalent chromosome. This univalent chromosome is, in the case of *Myzus suguri*, the largest of all elements, but in the case of the remaining species it is not so prominent.

Material No. 31.—*Macrosiphum cornifoliae* (Figs. 247 and 248).

Material No. 32.—*Macrosiphum gobonis*.

Material No. 33.—*Macrosiphum ligustrumae* (Fig. 249).

Material No. 34—*Macrosophum sonchi* (Fig. 250).

These four species exactly agree in the number of chromosomes. The equatorial plates of all show 7 elements or $6_{\text{♀}}+X=7(\overset{\text{♀}}{\text{♂}})$.

The following list prepaired in the order of the number of elements found in the aphids so far investigated and reported in this paper is of interst in showing a relative position each of the species holds:

A List of Chromosome Elements in Aphids.

Material No.	Name of species	Number of elements in spermatocyte I. Bivalent.	Univalent.	Total.
1.	*Dilachnus laricolus*	4	1	5
2.	*Pterochlorus tropicalis*	4	1	5
3.	*Tuberolachnus viminalis*	3	1	4
4.	*Shivaphis celti*	2	1	3
5.	*Myzocallis castanae*	5	1	6
6.	*Calaphis betulaecolens*	(8)*	1	
7.	*Tuberculatus kashiwae*	(6)*	1	7
8.	*Tuberculatus quercicola*	6	1	7
9.	*Tuberculatus querceus*	(6)×	1	(9)×
10.	*Callipterus kuricola*	6	1	7
11.	*Euceraphis betulifoliae*	(10)*	1	11
12.	*Euceraphis betulae*	4	(4)*	8
13.	*Chromaphis magnoliae*	6	1	7
14.	*Calaphis magnolicolens*	9	1	10
15.	*Therioaphis shinae*	6	1	7
16.	*Symydobius kabae*	12	1	13
17.	*Drepanaphis acerifoliae*	(18)*	(1)*	(19)*
18.	*Drepanosiphum platanoides*	14	1	15
19.	*Chaitophorous sali-apterous*	6	1	7
20.	*Chaitophorus salicicolus*	6	1	7
21.	*Melanoxantherium sali-japonica*	10	1	11
22.	*Periphyllus aceris*	9	1	10
23.	*Periphyllus koelreuteriae*	(10)*	1	(11)*

24.	*Dichaitophorus sali-niger*	(6)*	(1)*	(7)*
25.	*Aphis gossypii*	5	1	6
26.	*Acaudus itadori*	4	1	5
27.	*Carolinaia tade*	5	1	6
28.	*Myzus suguri*	5	1	6
29.	*Amphorophora lespedezae*	5	1	6
30.	*Amphorophora ribicola*	6	1	7
31.	*Macrosiphum cornifoliae*	6	1	7
32.	*Macrosiphum gobonis*	6	1	7
33.	*Macrosiphum ligustrumae*	(6)*	1	(7)*
34.	*Macrosiphum sonchi*			

To this list the following may also be added:

Name of species	name of authority	Diplo'd number of chromosomes in male.	Number of elements
Aphis saliceti	Von Baehr (1906)	4+X= 5	3
Aphis salicis	Tannreuther (1906)	6 = 6	3
(*Melanoxantherium*) *salicis*	"	6 = 6	3
(*Tamalia*) *coweni*	Morgam (1906)	4+X= 5	3
(*Liosomaphis*) *berberides*	Morgan (1906)	4+X= 5	3
(*Aphis*?) *oenotherae*	Stevens (1906)	8+X= 9	5
Aphis on golden rod	"	10+X=11	6
Aphis of star cucumber	"	8+X= 9	5
Aphis of salanac willow	"	8+X= 9	5
(*Macrosiphum*?) on milkweed	"	7 or 8	(4)
(*Macrosiphum*?) *Aphis* on rose, green.	"	12+X=13	7

The Chromosome number of the following species have been studied since the present thesis was sent to press:

Name of species	Diploid no. in male cell.	Total no. of elements.
Phyllaphis fagi (Linnaeus) (Fig. 251)	24+X=25	13

* The numbers enclosed in the parentheses are those that were found in rather a few cells.

Eulachnus piniformosanus Takahashi (Figs. 252 and 253).	12+X=13	7
Aphis sambuci Linnaeus (Fig. 254)	10+X=11	6
Amphorophora yomenae Shinji (Fig. 255).	10+X=11	6
Amphorophora indicum Van der Goot (Fig. 256)	10+X=11	6
Akkaia polygonae Takahashi (Fig. 257)	10+X=11	6
Cavariella sericola Shinji (Fig. 258)	6+X= 7	4

General Considerations and Conclusions.

I. The sex chromosome and sex.

Much of the recent cytological literature have, in some way or other, to do with the so-called sex-chromosome. This peculiar chromosome has been known as "Chromatin nucleolus" (Montgomery, '8, '06, '11); "Accessory chromosome" (Mcclung '02, Stevens '05); "Odds-chromosome" (Stevens '09); "Idio-chromosome" (Wilson '00, '01, '02, '03); "X-chromosome" (Morgan '09); "Sex-chromosome" (Hegner '15; Morgan '15 and others). It was first discovered by Henking ('90) in the spermatocytes of a hemiteron insect, *Pyrrochoris apterus*. He states that in his material one of the chromosomes passed undivided into one of the daughter cells during the second maturation disivion, so that there resulted two kinds of spermatids with respect to the number of chromosomes, one receiving one more chromosome than its sister cell.

The discovery of this chromosome peculiar in its behavior is of much importance, at least, in two ways; in the first place it revolutionized then the prevalent idea that the number of chromosomes in the cells of an individual of a species would be constant; and in the second place, it paved the way for the solution of the problem of the sex determination. Henkings' observation was confirmed by Paulmier in the case of *Anasa*, another heteropteron insect. The significance or the function of this chromosome was, however, remained in question until three years later when Mcclung ('02), who had also found a similar body in the spermatocytes of *Ziphidium*, an orthopteron insect, came forward with a suggestion that this might be a kind of sex determinant. Since then, one or more of odds-

chromosomes have been discovered in a large number of animals belonging to various phyla. In all of these cases it has fully demonstrated that they are intimately associated with the phenomenom of sex.

The presence in aphids of the hetero-chromosome was denied by TANNREUTHER (1906) in the case of *Aphis saliceti* and *Melanothantherium* (*Melanoxanthus*) *salicis*, and by STEVENS in *Aphis oenotherae* (1905). STEVENS (1906) in her later paper as well as MORGAN (1906, 1909) and VON BAEHR (1909), however, all recognise the hetero-chromosome in many aphids. In every species they have studied, the number of hetero-chromosme was found to be only one in the male germ cell. So, MORGAN, STURTEVANT, MÜLLER and BRIDGES (1915), DONCASTER (1924) and others were right in stating that "There are only two sex-chromosomes in the aphids",…MORGAN etc., p. 103, and "In the aphids, however, as in other parthenogenetic forms, only females arise from fertilized eggs, and since the male has only one X-chromosome, one would expect that two kinds of spermatozoa would be formed"…DONCASTER, p. 165. Since, however, our *Euceraphis betulae* possessing more than one (4 in the male cell) sex-chromosomes has been found, their statements can no longer hold true, and consequently a modification in the wording becomes necessary.

2. Correlations between the shape and size of chromosomes and the body characters.

The present study of chromosomes was mostly confined to the number of chromosomes, and consequently nothing definite can be said as yet as regard the relation that may exist between the chromosomal elements on the one hand and the body characters on the other. This much may, however, be said that, in general, the longer the shape of the autosomes the longer or more elongate will be the body shape. Another example of what seems to be a correlation existing between chromosomes and body characters is found in the case of the maculation of the body and the sex-chromosome. To state the same thing in another words, this means that larger the sex-chromosome is as compared with the largest of autosomes, the heavier will be the maculation of the body. Thus, it was fonnd out that

in the genera *Callipterus*, *Calaphis Dichaitophorus* and *Symydobius*, where there is a large sex-chromosome almost all forms, namely, the male, viviparous as wells as oviparous females have black dorsal maculation; whereas in the cases where the sex-chromosome is very small as compared with any of the autosomes, as in the case of *Macrosiphum cornifoliae*, *Chaitophorus sali-apterous* etc., the black maculation appears only on the male, and that to a very small extent.

3. On the evolutional significance of chromosome numbers.

BAKER (1920), whom we regard as the best authority on the classification of aphids, recognizes 6 tribes or branches in the subfamily APHIDINAE. The result of our cytological investigation into the number of chromosomes so far carried out is in accord with his views, for we have seen at least one or two species possessing the primitive number of chromosomes, 5, in each of three main branches we have studied. This conclusion might, however, be regared as merely an accidental coincidence should the data obtained through the cytological work be of such a nature that they can not be extended to the cases in the evolution of genera as well. So, let us now see how far the variation in the numbers and sizes of chromosome elements correspond with the generic characters of the genera.

To begin with, BAKER considers the evolution of the tribe LACHNINI in the following order, the first mentioned being the most primitive:

1. *Pterochlorus* ($4_{II}+X=5$), including
   Tuberolachnus ($3_{II}+X=4$)
2. *Dilachnus* ($4_{II}+X=5$)
3. *Eulachnus* ($6_{II}+X=7$)

The numbers enclosed in parenthesis show the numbers of elements found in the male germ cells. It will be of interest to note that these numbers run also in numerical order in these genera. So far as this tribe is concerned, then, the number of elements may well be said to represent the evolutional scale.

According to BAKER. the subtribe PHYLLAPHIDINA is thought to have branched out of the main trunk, the tribe CALLTPTERINI, much earlier than

the subtribes CHAITOPHORINA and CALLIPTERINA. The same conclusion may also be reached from the cytological data, for we have already shown that at least two species of this subtribe, namely, *Shivaphis celti* and *Tamalia coweni*, have the least conceivable number for aphids, namely, 3 elements or one less than the smallest number of elements found in either of the subtribes CHAITOPHORINA and CALLIPTERINA.

Again, the coincidence is found in the case of the subtribes CHAITOPHORINA and PTEROCOMMINA. Our representative of the last named of these two subtribes is *Melanoxantherium* with $10_{\text{II}}+X=11$ elements, and so this must be regarded higher than *Chaitophorus* with $6_{\text{II}}+X=7$ ($\hat{\delta}$) elements.

In another large branch of the subtribe, too, it was found that BAKER's placing the subtribe DREPANOSIPHINA higher in the evolutional scale than the subtribe CALLIPTERINA is in strict accord with our views arrived at from the numerical data, for the number of elements in the former subtribe runs as high as 19 represented by *Drepanaphis acerifoliae*, while the highest number attained by CALLIPTERINA is but 13 which is the number found in *Symydobius*.

A phylogenetic tree of APHIDINAE

In the last large tribe of APHIDINI, the subtribes APHIDINA and MACROSIPHINA are thought to have arisen from the same main trunk at just about the same point. This opinion, too, can, for the most part, be justified, for we found genera having 6 elements in both of these subtribes. But, as the table of elements given on page 100 shows, the existence of species having 3 elements in the subtribe APHIDINA is a conclusive proof that this subtribe has, in all probabilities, branched out of the subfamily APHIDINAE long before the subtribe MACROSIPHINA with 6 or

7 elements has made its appearance. This is the only point, on which the cytological data are somewhat at variance with the conclusion reached through a morphological study by BAKER (1920).

The phylogenetic tree inserted here will be of much interest when compared with a similar one found on the third page of BAKER's (1920) work.

4. On the evolution of chromosomes.

Since, as stated above, the evolution of the genera and species of aphids is in strict accordance with the increase in number of elements or chromosomes, and since the genera and species with the least number of chromosomes represent the most primitive ones considered from the morphological point of view, no objection will be raised against the assumption that the most primitive number of chromosomes is $4+X=5$ (diploid in male), and that all the other numbers are but the products of this primitive set. On the subject of such a multiplication of chromosomes WILSON (1905, 1909, 1924) states that the supernumerous cases of X elements may be the product of successive divisions of a single X element. The existence of those 4 X-elements in the male cells of our *Euceraphis betulae*, may, we believe, be explained in this manner.

Question arises: how, then, the autosomes multiply? To this our answer is that they will, in all probability, multiply by a transverse division or divisions of primitive elements so far as our material is concerned. At least one example of such a transverse division of a chromosome has been found and reported by KAWAGUCHI (1923) in the case of *Bombyx mori* and its wild variety *Bombyx mori* var *mandarina*. He states that there are 27 chromosomes (haploid) in *Bombyx mori* var *mandarina*, but this number is found increased to 28 in *Bombyx mori*, and that in crosses between these two forms 2 of the 28 chromosomes of the latter behaved as though they were homologue of a single large one found in the former, showing their probable identity. Examples of this kind are also found in plants, the most prominent case being that found in varieties of *Zea mays*

KAWAGUCHI, E. Cotological Studies on the Hybrids between *Bombyx mori* and *Bombyx mor.* var. *mandarina*, (in Japanese). Dobutsugakuzasshi, Vol. 35, pp. 247–249, 1923.

first reported by KUWADA.×

So much for cases of transverse division of chromosomes in other animals and plants. Let us now take up the evidences afforded by the chromosomes sets of aphids. The existence of 11 elements in *Periphyllus koelreuteriae* and 10 in *Periphyllus aceris* is one of the most interesting cases that suggests the probable segmentation of a chromosome. The equatorial plates of these two species are almost similar with the exceptions of the fact that in that of the former there are 11 elements as against 10 in that of the latter, and that the place occupied by a single element in one species is given over to two smaller ones in the other species. Again, it must be mentioned that the smaller of the two elements in the case of *Periphyllus koelreuteriae* is found either closely attached to, or in connection with, the larger one. These facts, I believe, strongly suggest that one of the chromosome elements in the case of *Periphyllus koelreuteriae* has recently divided or still is in process of division. Another instructive example of what seems to be the division of elements is found in the case of *Drepanosiphum platanoides* and *Drepanaphis acerifoliae*. In the former there are 15 elements including some larger elements, whereas the latter shows 19 elements of smaller type. So we can but think that these larger elements of *Drepanosiphum* have underwent a division to produce smaller ones of *Drepanaphis*.

In short, in this hypothesis of division of the chromosome element alone we find the explanation for the existence of gradation in number of elements in each of three main tribes of the same subfamily.

The case of *Dilachnus laricolus* or *Pterochlorus tropicalis* where there are 5 elements seems to be due to a division that took place in one of the 4 elements found in such a species as *Tuberolachnus viminalis* with 4 elements. Should this view turn out to be correct, then, it follows that the genera *Dilachnus* and *Pterochlorus* are both more recent than the genus *Tuberolachnus*. If, again, two of the 5 elements of *Dilachnus* should divide to become 4, *Eulachnus* would result. In like manner, *Macrosiphum* with

× KUWADA, Y., Journ. Coll. Scie. Tokio, vol. 39, Art. 10, 1905, pp. 1–148.

7 elements may be explained to have been produced when one of the 6 elements found in such a genera as *Myzus* or *Amphorophora* has divided transversely once to become two.

5. On the importance of the chromosome number for systematic works.

Miss STEVENS (1906) once entertained an opinion that the system of classifying aphids at that time was unsatisfactory and that a new one based upon the cytological investigation should be devised. My investigation into the numbers and sizes of nearly fifty species representing some 28 genera has shown the fact that, in general, the present taxonomy of the family Aphididae as revised by BAKER (1920) is in accord with the data obtained through cytological researches.

Since, as already stated, the number, the relative sizes and shapes etc. of the chromosome elements are nearly constant in most of the species of the same genus, these chromosome characters may well be applied for the determination of doubtful genera. The following are some of the examples, in which such doubtful genera may so be given their proper positions.

A. The genera *Tuberolachnus* and *Pterochlorus*.

The genera *Tuberolachnus* was erected in 1908 by MORDWILKO with *Lachnus viminalis* FONSCOLOMBE as type. This genus is distinguished from other genera of the tribe LACHNI by the possession on the dorsum of its abdomen a very large tubercle, but BAKER thinks that this character is insufficient for a distinction and, therefore, it ought to be placed in the same genus with *Pterochlorus tropicalis*. The result of my cytological work reported in this paper is to the effect that the sole representative of the genus *Tuberolachnus* in this country possesses 4 elements as against 5 in *Pterochlorus tropicalis*. So, I am of the opinion that our *viminalis* shall once more be placed under its old genus name of *Tuberolachnus*.

B. The genera *Myzocallis*, *Callipterus* and *Tuberculatus*.

BAKER (1924) has recently reported the following list of synonyms for

these three genera:

a. The genus *Myzocallis*.

Myzocallis PASSERINI……1860
Pterocallis PASSERINI……1860
Subcallipterus MORDWILKO……1894
Tuberculatus MORDWILKO……1894
Callipterus VAN DER GOOT……1913
Tuberculoides VAN DER GOOT……1915
Acanthocallis MATSUMURA……1917
Takecallis MATSUMURA…1917

b. The genera *Callipterus*.

Callipterus KOCH……1855
Callaphis WALKER……1870
Ptychodes BUCKTON……1881
Panaphis KIRKALDAY……1904
Nippocallis MATSUMURA……1917

The result of my cytological work reported in this paper is, in some respects, contrary to the above determination of BAKER. The species belonging to the genera listed above and their chromosome numbers being known are as follow:

Name of species	Number of chromosome elements
Myzocallis castanae FITCH.	$5_{II}+X=6$ ($\hat{\varphi}$).
Tuberculatus kashiwae MATS.	$(6_{II})+X=(7)$ ($\hat{\varphi}$).
Tuberculatus (*Acanthocallis*) quercicola MATS.	$6_{II}+X=7$ ($\hat{\varphi}$).
Callipterus kuricola MATSUMURA.	$6_{II}+X=7$ ($\hat{\varphi}$).

Thus, the cytological investigation points to the fact that the so-called *Myzocallis* of BAKER contains at least two different groups of aphids: one possessing 6 and the other 7 elements. A question arises: what shall be done with them? My answer is this only that group which has 6 elements be called *Myzocallis*, while that which is represented by *kashiwae* and (*Acanthocallis*) *quercicola* be placed in a separate genus. Morpho logically, then, the presence on the abdomen of three pairs of large tubercles in the species of the genus *Tuberculatus* must be considered as

great a character as that found in the genus *Tuberolachnus* above mentioned.

In this connection it must be mentioned that the genus *Callipterus* represented by our (*Nippocallis*) *kuricola* is distinct from the genus *Myzocallis* of BAKER in its morphological and chromosome characters.

C. The genera *Euceraphis, Calaphis, Symydobius and Yezocallis.*

The following tabulation brings out the differences and similarities existing among the species belonging to four supposed-to-be different genera:

Name of species	number of elements
Euceraphis betulae	$4_{II}+4X=8$ ($\hat{\varphi}$)
Calaphis betulaecolens	$10_{II}+X=11$ ($\hat{\varphi}$)
Calaphis magnolicolens	$10_{II}+X=11$ ($\hat{\varphi}$)
Symydobius (*Euceraphis*) *japonica*	$12_{II}+X=13$ ($\hat{\varphi}$)
Symydobiues (*Yezocallis*) *kabae*	$12_{II}+X=13$ ($\hat{\varphi}$)

The table clearly shows that ESSIG and KUWANA's *Euceraphis* is not an *Euceraphis*. Cytologically, again, at least no difference can be detected between *Euceraphis japonica* and *Yezocallis kabae* which is according to BAKER a *Symydobius*.

D. The genera *Chaitophorus and Periphyllus.*

The chromosomal characters of the following 4 species formerly listed under the genera *Chaitophorus* will be made the basis of the present discussion:

Name of species	Number of elements
Periphyllus (*Chaitophorinella*) *koelreuteriae*	11 ($\hat{\varphi}$)
Periphyllus (*Chaitophorinella*) *aceris*	10 ($\hat{\varphi}$)
Chaitophorus salicicolus	7 ($\hat{\varphi}$)
Chaitophorus sali- apterous	7 ($\hat{\varphi}$)

The investigation into the chromosome number of these species has clearly brought out the existence of two well defined groups: one possessing

$10_{II}+X=11$ elements or more and the other $6_{II}+X=7$ or more. So, my views of the classification of these genera are in strict accordance with those of BAKER (1920).

E. The genera *Myzus* and *Amphorophora*.

As the following partial list of these two genera will show, there has been a considerable confusion among systematists as regard the exact standing of these genera:

The genus *Myzus* PASSERINI (1860).

Rhopalosiphum PASSERINI-1860; ESSIG (1912, 1917).

The genus *Amphrophora* BUCKTON (1876).

Rhopalosiphum, VAN DER GOOT (1915); ESSIG (1917).

So far as the number of chromosome elements is concerned, there is no difference between *Myzus* and *Amphorophora*, both having 6 elements. When, however, their equatorial plates are compared, it becomes clear that in the genus *Myzus* represented by *Myzus suguri* the sex chromosome or the univalent element is found to be the largest one, while in two species of *Amphorophora* it is no larger than the largest of the autosomes. Thus it may be said that the cytological differences between these two genera lies, not in the number of chromosomes or elements, but in the relative size of the sex element as compared with the autosomes.

Summary

1. There is in an early period of the spermatocyte of the first order a stage in which the so-called splitting of chromosomes takes place. This phenomenon of splitting seems to be nothing more than a side-by-side conjugation of the homologous chromomeres of each chromosome including the sex-chromosome or chromosomes.

2, Synapsis, which is of parasynaptic type, occurs at a later part of the growth period. All the autosomes conjugate in a side-by-side method, resulting in the formation of bivalent chromosomes.

3. There is but one sex-chromosome in all but one species, in which 4 sex-chromosomes are found. That exceptional species is *Enceraphis betulae*.

4. The sex-chromosome or chromosomes become drawn out during the anaphase to form the "lagging chromosome" of STEVENS. Finally, however, they are all withdrawn in their entirety into one of the two second spermatocytes. As a result of this peculiar behavior of the sex-chromosome, two kinds of the second spermatocytes are formed; one with and the other without the sex-chromosome. The latter degenerates *in situ* while the former becomes the functional spermatozoa after another division.

5. Only one polar body is formed in the maturation of the parthenogenetic egg. It remains in the cytoplasm and later degenerates without taking any active part in the development of the egg.

6. The shapes and sizes of chromosomes seem to be correlated with those of the body and its maculation: in general, the longer the autosomes are the longer the body will be, and the larger the sex-chromosome is as compared with the autosomes, the greater the number of black maculae found on the dorsum of the individual will be.

7. The number of the chromosomes and body characters are so closely correlated that we can safely judge the evolutional scale of any aphid by its number of chromosomes.

8. The increase in number of chromosomes seems to have been made by a transverse division or divisions of one or more of primitive chromosme or chromosomes.

9. The number as well as the relative sizes and shapes of chromosomes are constant within a genus, and so these characters may be used in the determination of genera to a certain extent.

10. The genus *Myzocallis* of BAKER includes, at least, two distinct genera of *Myzocallis* and *Tuberculatus*,

12. The genus *Tuberolachnus* with $3_{II}+X=4$ ($\hat{\varphi}$) elements shall be separated from the genus *Pterochlorus* with $4_{II}+X=5$ ($\hat{\varphi}$) elements, and called again by its former generic name of *Tuberolachnus*.

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EXPLANATION OF THE FIGURES.

1. *Dilachnus laricolus* (MATSUMURA), alate viviparous female.
2. *Pterochlorus tropicalis* van der GOOT, alate viviparous female.
3. *Pterochlorus viminalis* FONSCOLOMBE, , alate viviparous female,
4. *Shivaphis celti* DAS, alate viviparous female.
5. *Tuberculatus kashivae* (MATSUMURA), alate viviparous female.
6. *Calaphis betulaecolens* FITCH, male.
7. *Taberculatus quercicola* (MATSUMURA), alate viviparous female.
8. *Callipterus kuricola* (MATSUMURA), oviparous female.
9. *Euceraphis betulaefoliae* SHINJI, alate viviparous female.
10. *Euceraphis betulae* KALT, alate viviparous female,
11. *Enteraphis betuloe* KALT, male,
12. *Neocalaphis magnoliae* (TAKAHASHI), alate viviparous female.
13. *Therioaphis shinae* SHINJI, male.
14. *Symydobius japonica* (KUWANA et ESSING), alate viviparous female.
15. *Drepanaphis acerifoliae* THOMAS, oviparous female.
16. *Drepanaphis acerifoliae* THOMAS, alate viviparous,
17. *Drepanaphis acerifoliae* THOMAS, male.
18. *Drepanosiphum platanoides* SCHRAEK, alate viviparous female.
19. *Chaitophorus salicola* MATSUMURA, alate viviparous female.
20. *Melanoxanthus sali-japanica* SHINJI, alate viviparous female.
21. *Dichaitophorus sali-niger* SHINJI, alate viviparous female.
22. *Periphyllus koelreuteriae* TAKAHASHI, alate viviparous female.
23. *Periphyllus aceris* LINNAEUS, male.
24. *Acauda itadori* SHINJI, alate viviparous female.
25. *Acauda itadori* SHINJI, apterous viviparous female.
26. *Carolinaia tade* SHINJI, alate viviparous female.
27. *Myzus suguri* SHINJI, alate viviparous female.
28. *Macrosiphum gobonis* MATSUMURA, alate viviparous female.
29. *Macrosiphum cornifoliae* SHINJI, alate viviparous female.
30. *Dilachnus laricolus*, antenna of the oviparous female.
31. *Dilachnus laricolus*, antenna of the apterous viviparous female.
32. *Dilachnus laricolus*, antenna of the alate viviparous female.
33. *Dilachnus laricolus*, antenna of the male.
34. *Pterochlorus tropicalis*, antenna of the male.
35. *Pterochlorus tropicalis*, antenna of the apterous viviparous female.
36. *Shivaphis celti*, antenna of the alate viviparous female.
37. *Tuberculatus quercicola*, autenna of the oviparous female.
38. *Tuberculatus quercicola*, antenna of the alate viviparous female.
39. *Tuberculatus quercicola*, antenna of the apterous female.
40. *Myzocallis castanae*, antenna of the alate viviparous female.
41. *Myzocallis castanae*, antenna of the male.
42. *Tuberculatus kashiwae*, antenna of the oviparous female.
43. *Teberculatus kashiwae*, antenna of the apterous viviparous female.

44. *Tuberculatus kashiwae*, antenna of the apterous viviparous female.
45. *Symydobius kobae*, antennal article III of the male.
46. *Symydobius kobae*, antennal articles IV, V, VI of the male.
47. *Drepanosiphum platanoides*, antenna of the alate viviparous female.
48. *Drepanosiphum platanoides*, antenna of the male.
49. *Chaitophorus sali-apterus*, antenna of the apterous viviparous female.
50. *Chaitophorus sali-apterus* antenna of the alate viviparous female.
51. *Chaitophorus salicola*, antenna of the alate viviparous female.
52. *Chaitophorus salicola*. antenna of the male.
53. *Euceraphis betulaefoliae* the third antennal article of the male.
54. *Euceraphis betulaefoliae* the third antennal article of the alate viviparous female.
55. *Euceraphis betulaefoliae* the third antennal article of the apterous viviparous female.
56. *Dichaitophorus sali-niger*, the antenna of the male.
57. *Dichaitophorus sali-niger*, the antenna of the apterous viviparous female.
58. *Neocalaphis magnoliae*, the antenna of the alate viviparous female.
59. *Neocalaphis magnoliae*, the antenna of the apterous viviparous female.
60. *Therioraphis shinae*, the antenna of the alate viviparous female.
61. *Calaphis betulaecolens*, antenna of the alate viviparous female. (above).
    Calaphis betulaecolens, antenna of the male. (below).
62. *Periphyllus aceris*, the antenna of the apterous viviparous female.
63. *Periphyllus aceris*, the antenna of the male.
64. *Aphis gossypii*, antenna of the alate viviparous female.
65. *Aphis gossypii*, antenna of the male.
66. *Carolinaia, tade*, antenna of the male.
67. *Acauda itadori*, antenna of the alate viviparous female.
68. *Acauda itadori*, antenna of the male.
69. *Acauda itadori*, antenna of the apterous viviparous female.
70. *Rhopalosiphum, lespedezae* antenna of the apterous viviparous female.
71. *Macrosiphum cornifoliae*, antenna of the apterous viviparous female.
72. *Macrosiphum cornifoliae*, antenna of the male.
73. *Macrosiphum zonchi*, antenna of the male.
74. *Macrosiphum ligerstrumae*, antenna of the male.
75. *Myzus tuguri*, antenna of the alate viviparous female.
76. *Myzus tuguri*, antenna of the male.
77. *Macrosiphum gobonis*, antenna of the apterous viviparous female.
78. *Macrosiphum gobonis*, antenna of the male.
79. *Dilachnus laricolus*, cornicle of the male.
80. *Dilachnus laricicolus*, cauda of the same.
81. *Pterochlorus tropicalis*, cauda of the male.
82. *Shivaphis celti*, cauda of the alate viviparous female.
83. *Shivaphis celti*, cornicle of the same.
84. *Tuberculatus quercicola*, cornicle of the alate viviparous female.
85. *Tuberculatus quercacola*, cauda of the alate viviparous female.
86. *Callipterus kuricola*, cauda of the male.
87. *Euceraphis betulae*, cauda of the alate viviparous famale.
88. *Euceraphis betulae*, cauda of the same.
89. *Euceraphis betulae*, cornicles of the same.
90. *Euteraphis betulaefoliae*, cauda of the alate viviparous female
91. *Euceraphis betulaefoliae*, cornicle of the same.
92. *Necalaphis magnolicolens*, cauda of the alate viviparous female.

93. *Neocalaphis magnoliecolens*, cornicle of the same.
94. *Myzocallis castanae*, cauda of the alate viviparous female.
95. *Myzocallis castanae*, cornicle of the same.
96. *Therioaphis shinae* cornicle of the alate viviparous female.
97. *Therioaphis shinae*, cauda of the same.
98. *Symydobius kobae*, cauda of the vapterous viviparous famale.
99. *Symydobius kobae*, cauda of the alate viviparous female.
100. *Symydobius kobae*, cauda of the cauda of the male.
101. *Drepanosiphum acerifoliae*, cornicle of the alate viviparous female.
102. *Drepanosiphum acerifoliae*, cauda of the same.
103. *Periphyllus aceris*, cornicls of the alate viviparous female.
104. *Periphyllus aceris*, cauda of the same.
105. *Melanoxanthus sali japonica*, cauda of the apterous viviparous female.
106. *Melanoxanthus sali-japonica*, cornicle of the same.
107. *Melanoxanthus sali-japonica*, cornicle of the alate viviparous female.
108. *Acauda itadori*, cornicle of the alate viviparous female.
109. *Acauda itadori*, cauda of the same.
110. *Aphis gossypii*, cauda of the alate viviparous female.
111. *Aphis gossypii*, cornicle of the same.
112. *Macrosiphum gobonis*, cornicle of the alate viviparous female.
113. *Myzus lespedeae* cornicle of the same.
114. *Carolinaia tade*, cornicle of the alate viviparous female.
115. *Macrosiphum gobonis*, cauda of the alate viviparous female.
116. *Amphorophora ribicola*, cauda of the alate female.
117. *Macrosiphum gobonis*, cornicle of the alate viviparous female.
118. *Amphorophora ribicola*, cornicle of the same.

Spermatogonia of *Euceraphis betulae* (Fig. 119–130).

119. Spermatogonium in resting stage.
120. A little later stage showing the beginning of the appearance of basic chromosomal granules.
121–122. Still later stage. In these the autosomes can be detected but the sex-chromosomes are still in the state of a nucleolus.
123–124. Prophase. In Fig. 123 the autosomes have already assumed the shape recognizable as such, but the sex-chromosomes are found congregated in the form of a nucleolus, from which sex-chromosomes appear in the next figures.
125–126. All the chromosomes have already emerged, and in Fig. 125 they are forming a thread almost continuous.
127. A somewhat later metaphase. Chromosomes have already begun their migration toward the opposite poles.
128. A polar view of the equatorial plate.
129–130. Anaphase. Chromosome-plates are still seen advanced to the opposite poles.

Spermatocytes I of *Euceraphis betulae* (Fig. 131–146).

131–138. Various stages in the growth period.
139–141. Prophase figures showing parasynapsis.
142–143. Metaphase, lateral views.
144. Anaphase, showing the lagging chromosomes.
145–146. Telophase, showing two kinds of daughter nuclei.

Spermatocytes II of *Euceraphis betulae* (Fig. 147–149).

147. Metaphase, a polar view.
148. Anaphase, a lateral view.
149. Equatorial plate, a lateral view.

Parthenogenetic ova of *Euceraphis betulae* (Fig. 150–164).

150–154. Growth period, various stages.
155–159. Prophase, various stages.
160. The first clearage cell (the female pronucleus).
161–162. Metaphase, lateral views.
163. Anaphase, a lateral view.
164. First cleavage spindle.

Sexual or winter ova of *Euceraphis betulae* (Fig. 165–174).

165–169. Growth period.
165. Polarization stage.
166–167. Early growth period.
168. Diplotine stage
169. Spireme stage
170. Synizesis stage
171–173 Prophase
174. Metaphase of the second maturation division

Euceraphis betulae (Fig 175–188).

175. A. Ovailes, B. Ovarioles.
176. A. Anaphase of the reduction division. B. A famale with male (upper) and famale (lower) embryoes.
177. Parthenogenetic egg. Anaphase of the first cleavage division.
178. Parthenogenetic egg. Anaphase of the third cleavage division.
179. Parthenogenetic egg. Anaphase of the fourth cleavage.
180. Parthenogenetic egg. Longitudinal section prior to the completion of the blastoderm.
181. Parthenogenetic egg. A section through the lower pole of the egg, showing the pole cells at about the completion of the blastoderm.
182. Parthenogenetic egg. A transverse section through the posterior part of the egg.
183. Parthenogenetic egg. A section through the ovary, in which the lower cell mass, the oogonia, is in their last division.
184. Sexual egg. Section through an ovariole.
185. Parthenogenetic egg. Section through the lower half of the egg.
186. Parthenogenetic egg. Section through the middle part of the egg, showing the difference in nurse and oocytal cells.
187. Parthenogenetic egg. A longitudinal section through an ovariole. Small cells with clear-cut chromosomes are oocytes.
188. Parthenogenetic egg. One of the sagital sections of the abdomen, showing 8 ovarioles surrounded by a mass of symbiotic organisms.

Dilachnus laricolus (189–193).

189. A spermatocyte of the first order in a late prophase.
190–191. Lateral views of the spermatocyte of the first order in anaphase.
192. Polar view of the equatorial plate of the second maturation division.
193. Anaphase of the second maturation division.

Pterochlorus tropicalis. (194–196).

194. Late prophase of the spermatocyte of the first order.

195. Polar view of the equatorial plate of the first spermatocyte mitosis.
196. Lateral view of the same.

Tuberolachnus viminalis.

197. Polar view of the equatorial plate of the first spermatocyte mitosis.
198. Lateral view of the same.

Shivophis celti.

199. Polar view of the equatorial plate of the first spermatocyte mitosis.
200. Lateral view of a similar spermatocyte.

Myzocallis castanae.

201. Polar view of the equatorial plate of the first spermatocyte mitosis.
202. Lateral view of a similar spermatocyte.

Calaphis betulaecolens.

203. Polar view of the equatorial plate of the first spermatocyte mitosis

Tuberculatus quercicola.

204. Polar view of the equatorial plate of the first spermatocyte mitosis.
205. Lateral view of a similar spermatocyte.
206. One of the second spermatocytes receiving the lagging chromosome.

Tuberculatus quercus.

207. Polar view of the first spermatocyte mitosis.
208. Lateral view of a similar spermatocyte.

Callipterus kuricola.

209. Polar view of the equatorial plate of the first spermatocyte mitosis.
210. Lateral view of a similar spermatocyte.

Euceraphis betulifoliae.

211. Polar view of the equatorial plate of the first spermatocyte mitosis.

Chromaphis magnoliae.

212. Polar view of equaterial plate of the first spermatocyte mitosis.
213. Lateral view of a similar spermatocyte.

Calaphis magnolicolens.

214. Polar view of the metaphase plate of the first permatocyte mitosis.
215. Lateral view of a similar spermatocyte.

Therioaphis shinae.

216. Polar view of the first maturation division.

Symydobius kabae.

217. Polar view of the first maturation division.
218. Lateral view of a similar spermatocyte.

Drepanaphis acerifoliae.

219. Polar view of the equatorial plate of the first spermatocyte mitosis.
220. Lateral view of a similar spermatocyte.

Drepanosiphum platanoides.

221. Polar view of equatorial plate of the first maturation division.
222. Lateral view of a similar spermatocyte.

Chaitophorus sali-apterous.

223. Polar view of equatorial plate of the first spermatocyte mitosis.
224. Lateral view of a similar spermatocyte.

Chaitophorus salicicolus.

225. Polar view of the metaphase plate of the first maturation division.
226. Lateral view of a similar spermatocyte.

Melanoxantherium sali-japonica.

227. Polar view of equatorial plate of the first spermatocyte mitosis.
228. Lateral view of a similar spermatocyte.

Periphyllus aceris.

229. Polar view of equatorial plate of the first spermatocyte mitosis.
230. Lateral view of a similar spermatocyte.

Periphyllus koelreuteriae.

231. Polar view of the metaphase of the first maturation division.
232. Lateral view of the same stage.

Dichaitophorus sali-niger.

233. Polar view of the metaphase of the first maturation division.

Acaudus itadori.

234. Polar view of the mataphase of the first maturation division.
235. Lateral view of the same stage.

Carolinaia tade.

236. Polar view of equatorial plate of the first spermatocyte mitosis.
237. Lateral view of the same stage.

Myzus suguri.

238. Polar view of metaphase of the first spermatocyte mitosis.
239. Lateral view of the same stage.
240–242. Various phases in the anaphase of the first spermatocyte mitosis showing the behavior of the univalent element.

Amphorophora lespedezae.

243. Polar view of equatorial plate of the first spermatocyte mitosis.
244. Lateral view of a similar spermatocyte.

Amphoroph'ora ribicola.

245. Polar view of the metaphase of the first maturation division.
246. Lateral view of the same stage.

Macrosiphum cornifoliae.

247. Polar view of the metaphase of the first spermatocyte division.

248. Lateral view of the same.

Macrosiphum ligustrumae.

249. Polar view of equatorial plate of the first spermatocyte mitosis.

Macrosiphum sonchi.

250. Polar view of the metaphase of the first maturation division.

Phyllaphis fagi.

251. Polar view of the metaphase of the first maturation division.

Eulachnus piniformosanus.

252. Polar view of equatorial plate of the first spermatocyte mitosis.
253. Lateral view of a similar spermatocyte.

Aphis sambuci.

254. Polar view of the metaphase of the first maturation division.

Amphorophora vomenae.

255. Polar view of equatorial plate of the first spermatocyte mitosis.

Amphorophora indicum.

256. Polar view of the equatorial plate of the first spermatocyte mitosis.

Akkaia polygonae.

257. Polar view of the equatorial plate of the first spermatocyte mitosis.

Cavariella sericola.

258. Polar view of the equatorial plate of the first spermatocyte mitosis.

(Notes: The drawings were made with the aid of a camera lucida. All drawings except Figs 1–188 were originally magnified 3040 times using a 20X objective, N. A. 30. They were afterwards reduced to 1520 in reproduction.)

Plate I.

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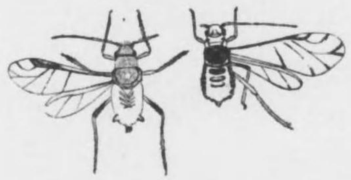

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Plate II.

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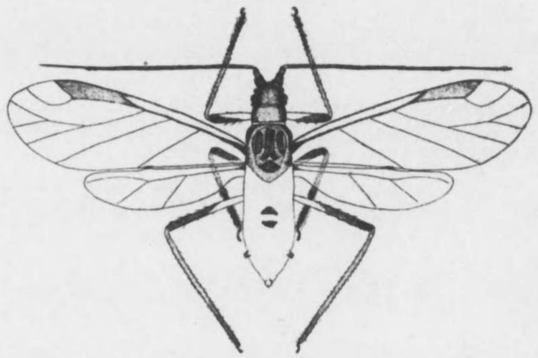

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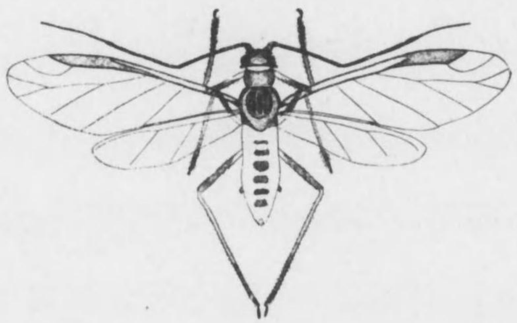

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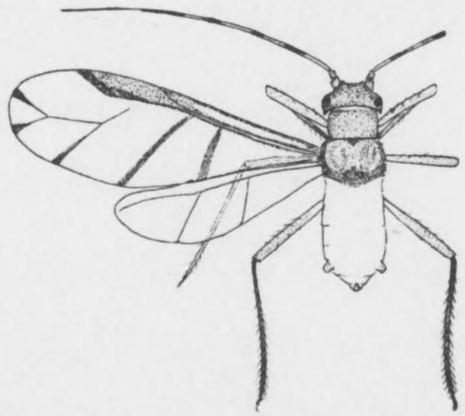

Plate III.

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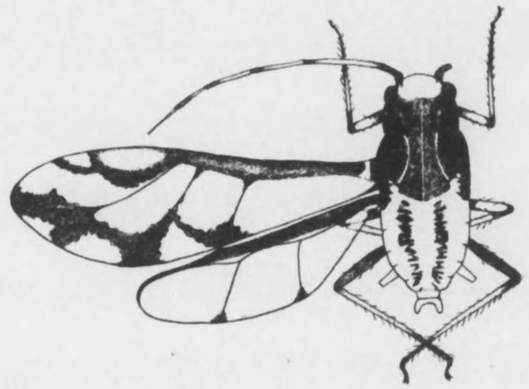

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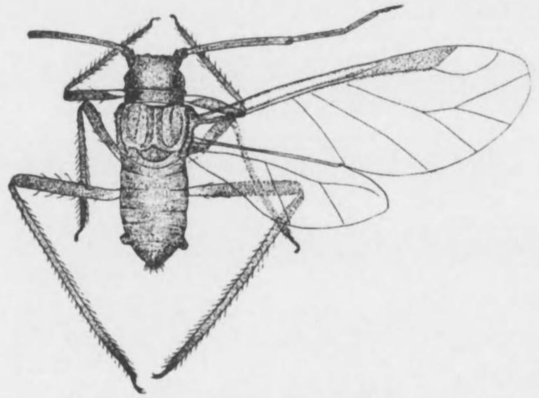

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Plate IV.

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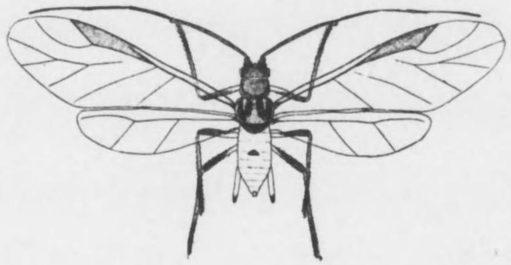

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Plate V.

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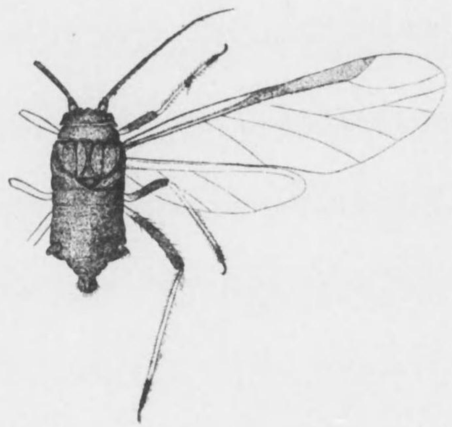

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Plate VI.

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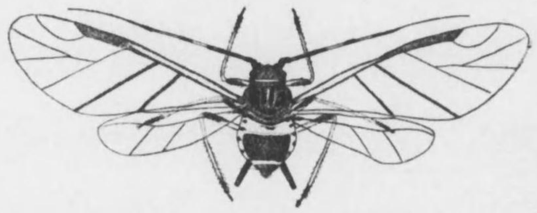

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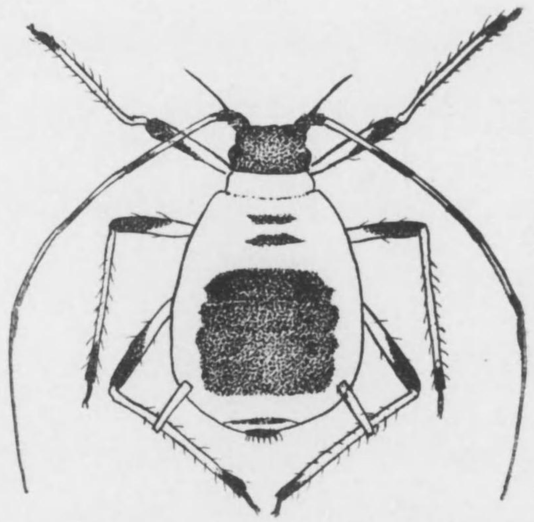

Plate VII.

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Plate VIII.

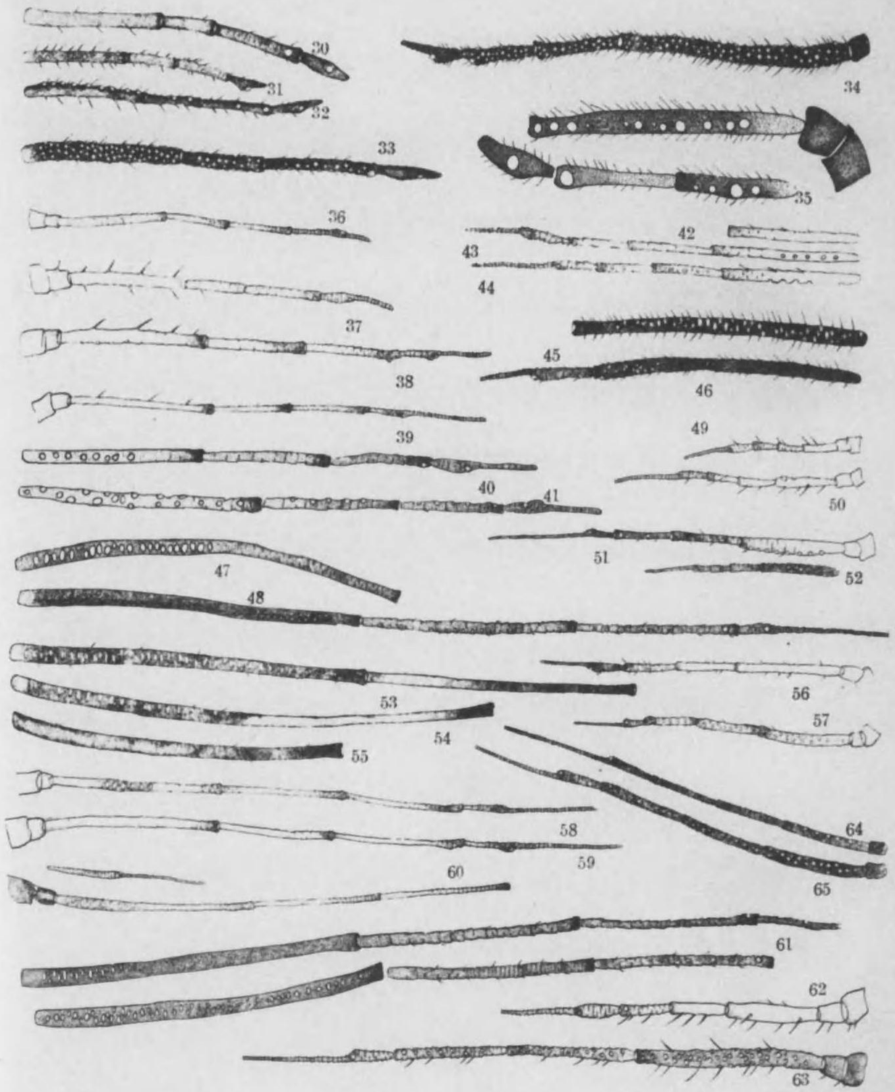
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Plate IX.

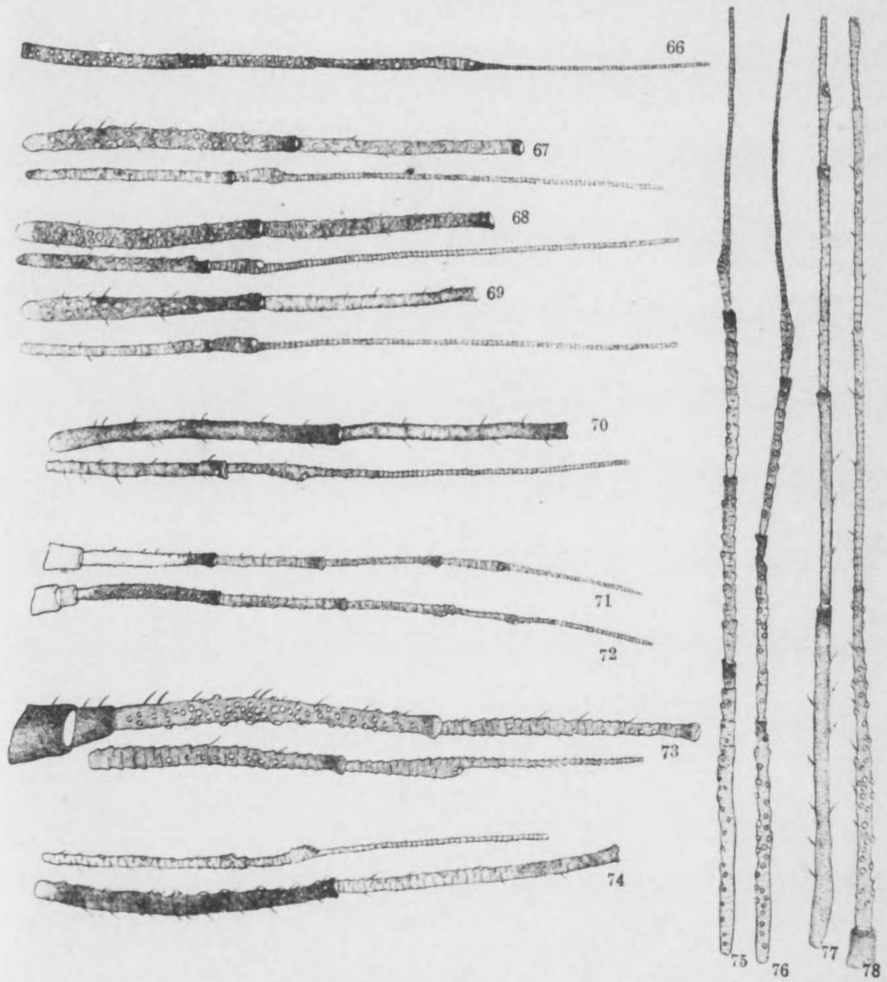

Plate X.

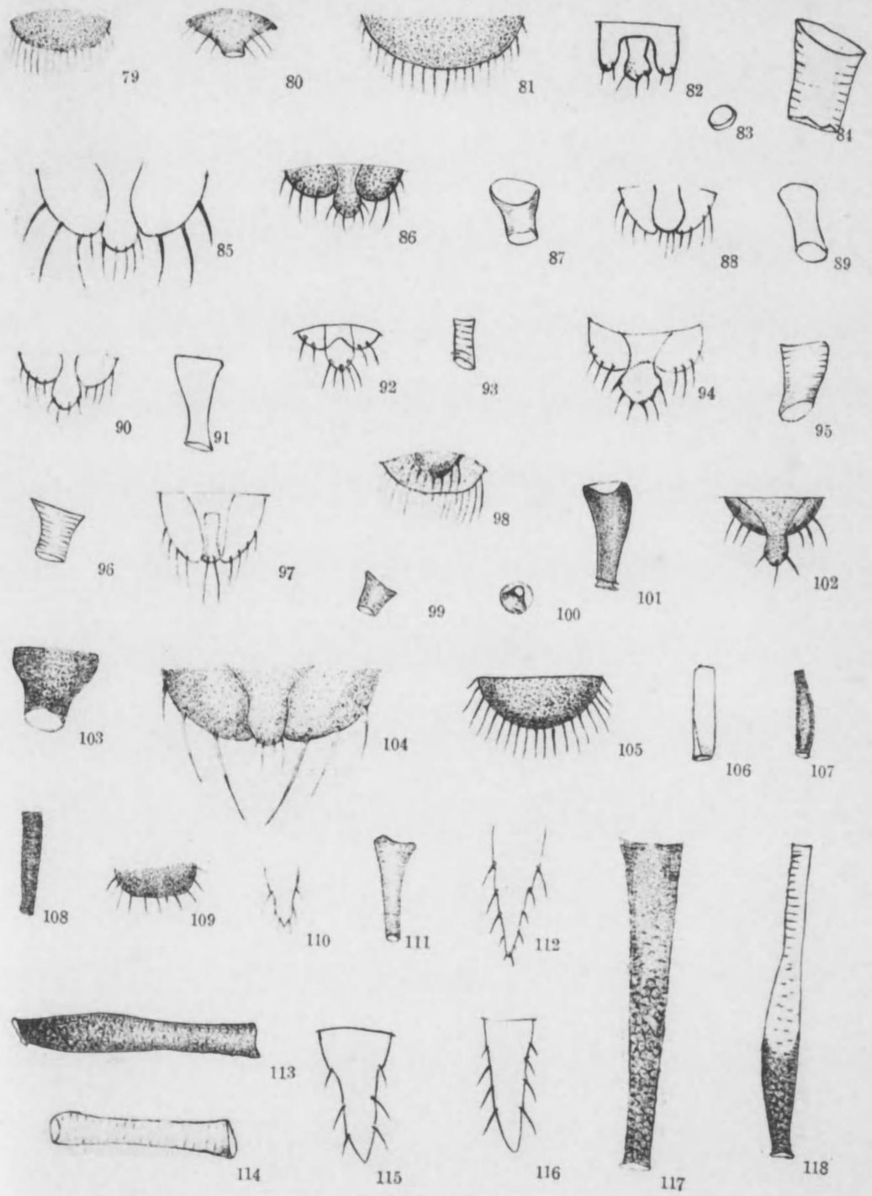
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Plate XI.

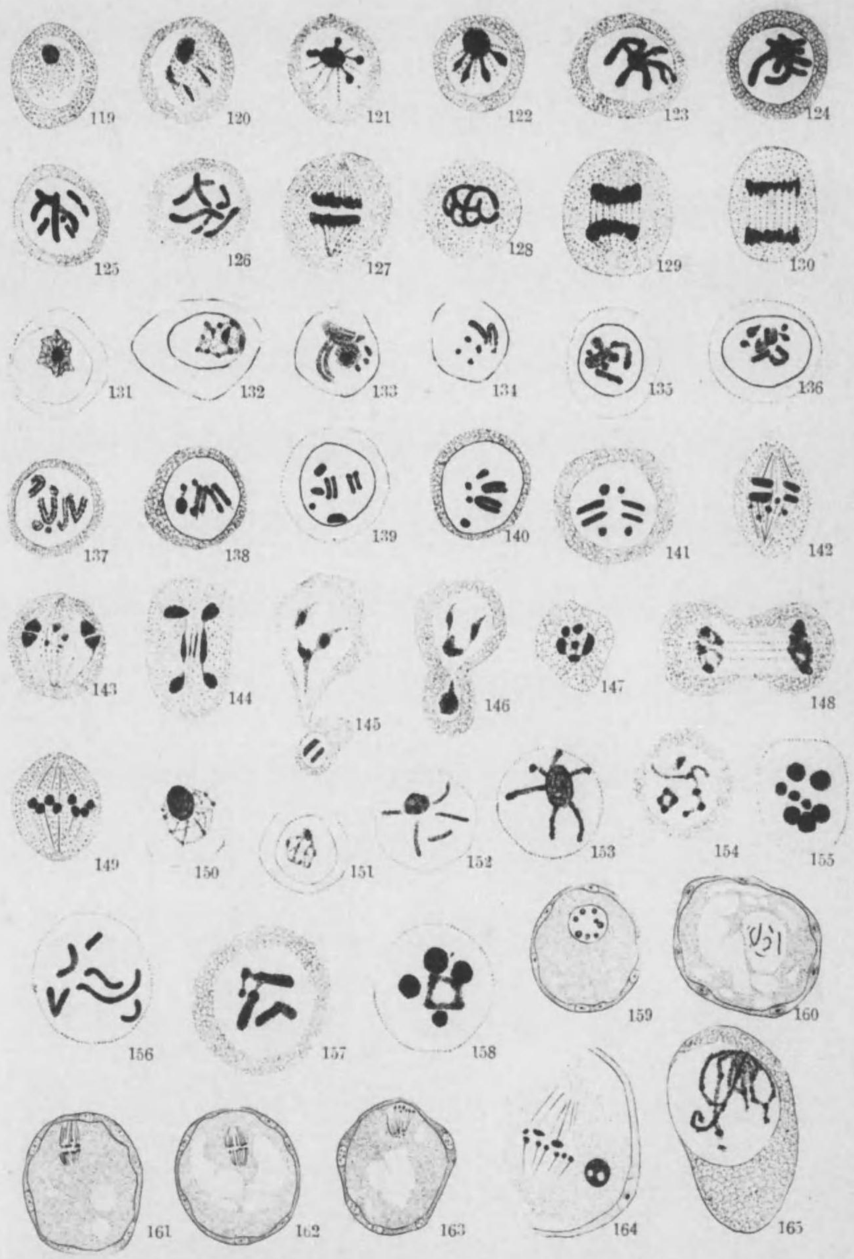
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Plate XII.

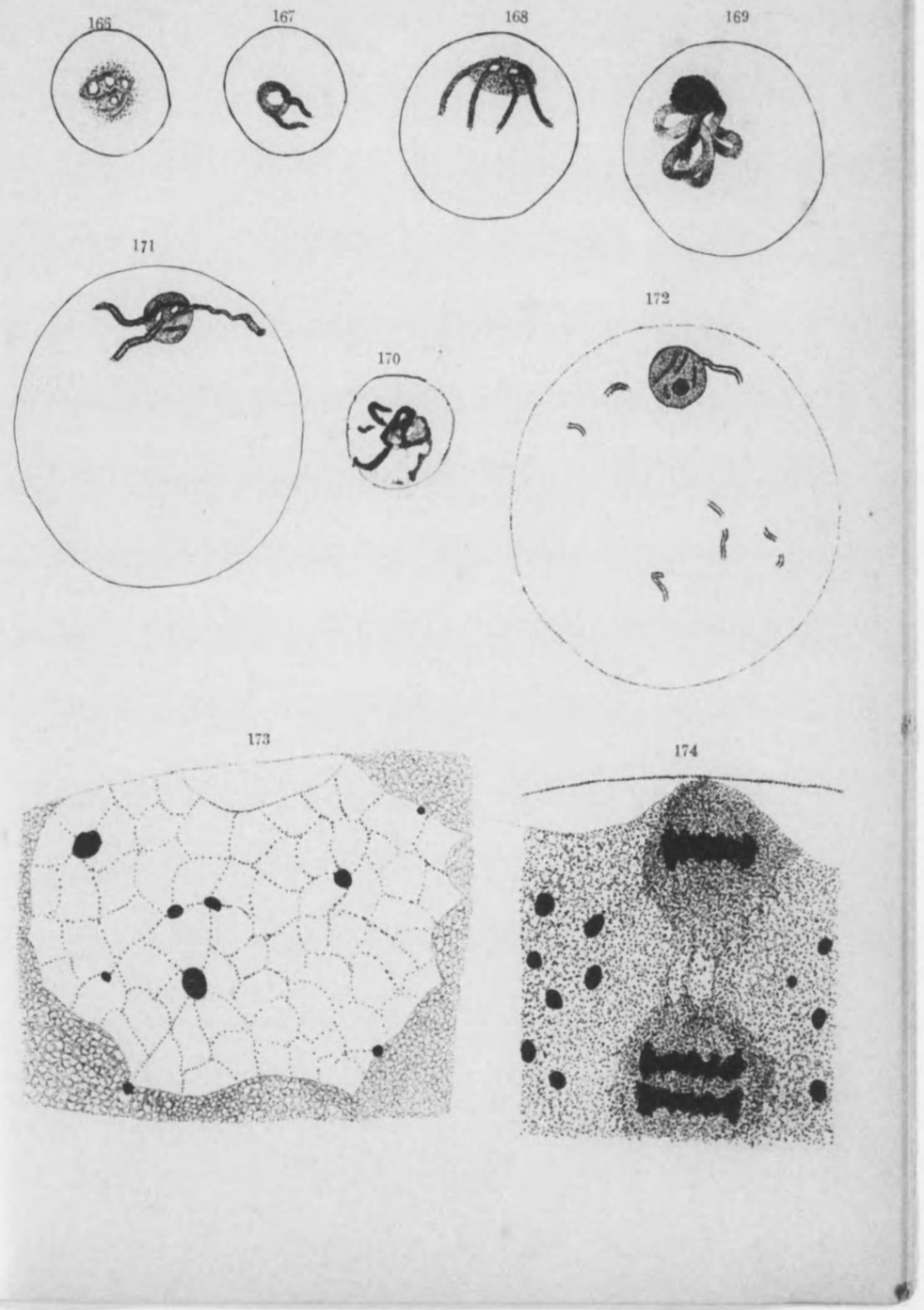

Plate XIII.

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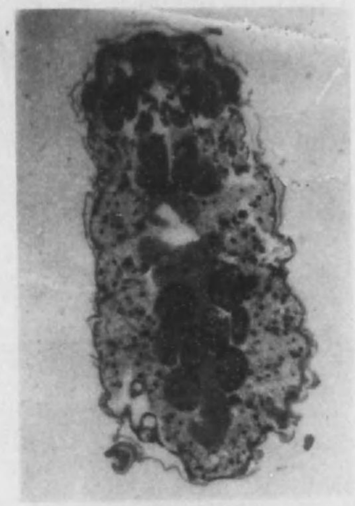

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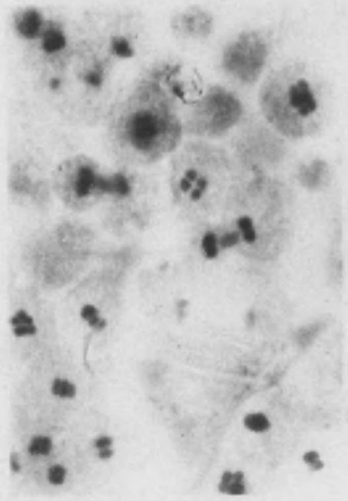

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Plate XIV.

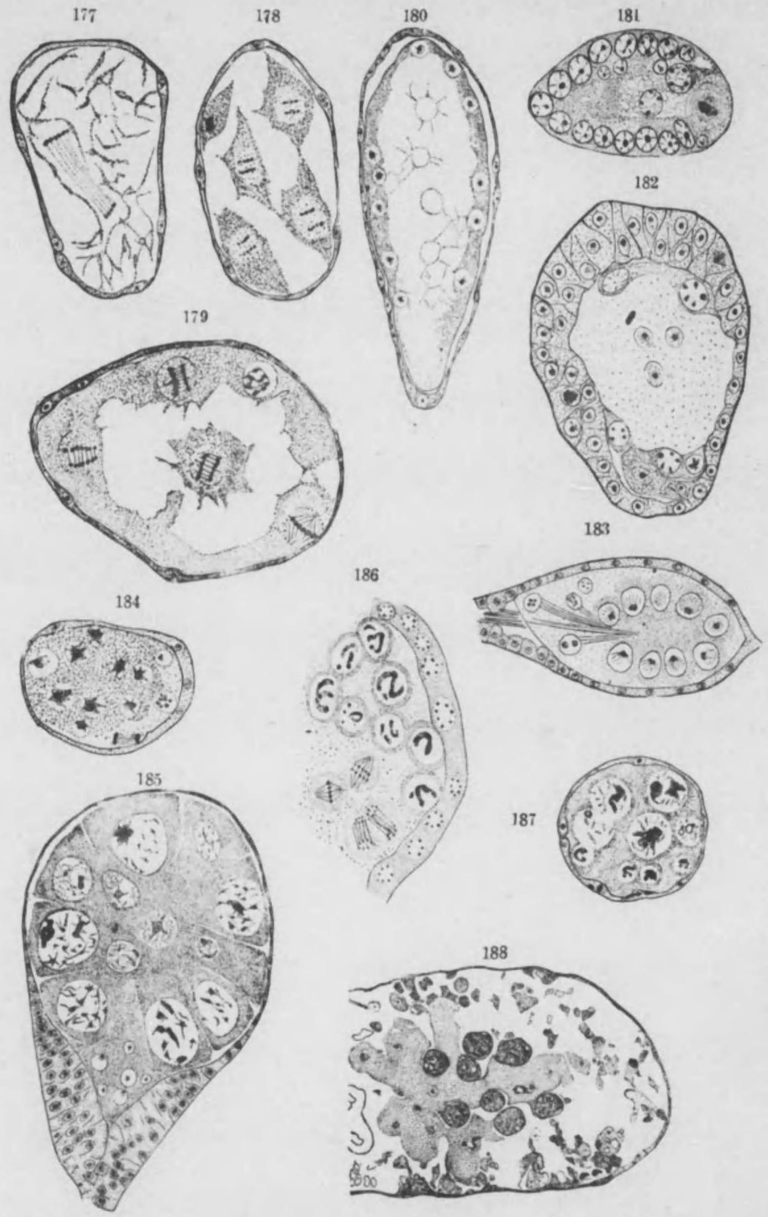

Plate XV.


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