

MEDICAL ENTOMOLOGY

A REVISION OF THE ADULT ANOPHELINE MOSQUITOES OF JAPAN :

SYSTEMATIC DESCRIPTIONS, THEIR HABITS AND THEIR
RELATIONS TO HUMAN DISEASES, TOGETHER
WITH AN ACCOUNT OF THREE NEW SPECIES.

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Among the Anopheline mosquitoes of Japan the first recorded species was *Anopheles hyrcanus* (Pallas) var. *sinensis* Wiedemann. It was reported under two different names from two different localities nearly at the same time; one as *A. funestus*? by Kinoshita from Formosa in September, 1901 and the other as a new species *A. yesoensis* by Tsuzuki from Hokkaido in October of the same year. In 1903 Miyajima described a species of *Anopheles* from Honshu identifying it with *A. sinensis* Wiedemann and considering *A. yesoensis* Tsuzuki as a synonym of it.

Thenceforth no more species had been reported from the entire Japan except Formosa until two new species were described in 1918; *A. japonicus* from Hokkaido by the writer and *A. koreicus* from Korea by the writer and Watanabe. Though later Edwards (1921) recorded *A. lindesaii* Giles from Nagasaki and a new species *A. punctibasis* from Nagasaki and Yokohama, it seems there is a duplication of the nomenclature between the two species given by Edwards and the two species mentioned just above.

From Formosa, however, many species have been recorded by several authors, especially by Tsuzuki, Kinoshita, Hatori and Koidzumi. Their opinions in the nomenclature of the Formosan species, however, have not been in accordance with one another and accordingly rather a great confusion has been brought about.

It seems therefore to be necessary to give a revision to the Anopheline mosquitoes of Japan. With this intension the writer has collected materials from Japan proper and sent Mr. Hirayama to Formosa and Korea for the same purpose. The materials thus collected consisted of mostly adult specimens and a very few larval forms. Under the circumstances the present work is confined to the study of the adult specimens only.

With regard to the classification employed a few words are required here. Since the genus *Anopheles* established by Meigen (1818) the classification of the

Anopheline group of the Culicidae has undergone great many changes. On the one hand the group of the Culicidae was given such a high value as subfamily by Theobald (1901) and others, and accordingly many new genera were introduced into the group so that their number reached to 35 or more in a comparatively short space of time.

On the other hand the group was considered not as a high one, but relatively homogeneous. From this point of view Dyar & Knab (1907) discarded almost all genera established by then placing them as synonyms with the single genus *Anopheles*. Their idea was adopted first by Williston (1908) and then by Edwards (1911). In the next year Edwards published a classification of the Culicidae dividing the subfamily Culicinae into four tribes and giving one position (Tribe Anophelini) among them to the Anopheline group. This is followed by many authors up to the present.

After that an important research in the classification of the Anophelini was made by Christophers (1915). After a precise study of the male hypopygium of the Anophelini he divided the tribe into three genera, e. i. *Anopheles*, *Myzomyia* and *Nyssorhynchus*. Edwards (1921) considered, however, it is convenient in the nomenclature to recognise two divisions *Anopheles* and *Myzomyia* proposed by Christophers as subgenera of the genus *Anopheles*. Recently Christophers (1924) agreed with the view of Edwards treating his three divisions mentioned above and two more divisions *Chagasia* and *Bironella* as subgenera of the genus *Anopheles*. But the writer can not help but feels it more advisable if Christophers had retained his original idea. As he says the five divisions are clearly determinable by the male hypopygium so that no intermediate forms are recognisable and have a distinct distribution such as is found in genera of mammals. Moreover according to Root (1922) two divisions (*Anopheles* and *Nyssorhynchus*) among them are respectively divisible into two distinct subdivisions which may have a value of subgenera. It would be therefore reasonable to raise the five divisions to the rank of genera.

The Anophelini of Japan is represented by thirteen species including three new ones, all belonging to two divisions *Anopheles* and *Myzomyia*, five to the former and the remaining eight to the latter and these two divisions will be treated as genera in the following.

It is noteworthy that the two genera have a distinct distribution also in this country. While the genus *Anopheles* is distributed all over Japan extending from the Oriental to the Palaearctic region, the other genus *Myzomyia* is entirely confined to Formosa and Ryukyu Is., warmer parts of the Oriental region, not a single species of the genus having been recorded from Japan proper and from Korea. To say more exactly the distribution of *Myzomyia* is bounded by the frost line as it is seen in *Aedes argenteus* (Poiret).

It was very fortunate that I was sent to inspect Medical Entomology in Europe and America by order of the Government through the good offices of

Prof. Nagayo, Prof. Watase and Prof. Hayashi of the Tokyo Imperial University, and had an opportunity of examining many important type-specimens of the Culicidae especially those in the British Museum. I express here my sincere thanks to the professors mentioned above for their kindness and to the authorities of the British Museum for permission to work on the Culicidae there. I must also extend my cordial thanks to Mr. Edwards for his kind help and many important informations given in the course of my work.

To the closing of the introductory words a table will be added as a summary of the present work, which shows valid specific names and synonyms of the Anopheline mosquitoes of Japan as well as their distribution and their relations to human diseases.

The Anopheline Mosquitoes of Japan.

Valid names.	Synonyms.	Distribution.	Relation to human diseases.
1. <i>Anopheles japonicus</i> Yamada (1918).	<i>A. plecau</i> Koidzumi (1920). <i>A. lindesaii</i> of Edwards from Nagasaki (1921).	Hokkaido, Honshu, Shikoku, Kyushu & Formosa.	No evidence.
2. <i>A. hyrcanus</i> (Pallas) var. <i>sinensis</i> Wiedemann (1828).	<i>A. plumiger</i> Dönitz (1901). <i>A. funestus</i> ? of Kinoshita (1901). <i>A. yesoensis</i> Tsuzuki (1901). <i>A. sinensis</i> subspecies <i>indiensis</i> Theobald (1901). <i>A. sp.</i> Miyajima (1902). <i>A. pseudopictus</i> of Kinoshita (1903).	Hokkaido, Honshu, Shikoku, Kyushu, Korea & Formosa.	Important carrier of the tertian malaria (Tsuzuki, Miyajima & Kinoshita). The sporocyst of the quartan parasite was experimentally formed in one female out of eight (Kinoshita). Succeeded in infecting the malignant parasite experimentally (Tsuzuki). Failed to infect the malignant parasite experimentally (Miyajima & Kinoshita). May serve as an intermediate host for <i>Filaria bancrofti</i> , but not important carrier (Taniguchi, Mochizuki, Yamada & Komori).
3. <i>A. sineroides</i> , n. sp.		Hokkaido & Honshu.	Failed to infect the larva of <i>Filaria bancrofti</i> experimentally (Yamada & Komori).
4. <i>A. koreicus</i> Yamada & Watanabe (1918).	<i>A. punctibasis</i> Edwards (1921).	Korea, Kyushu & Honshu.	No evidence.
5. <i>A. edwardsi</i> , n. sp.		Honshu.	No evidence.
6. <i>Myzomyia minima</i> (Theobald) (1901).	<i>A. sp.</i> from Tamsui Hatori (1901). <i>A. christophersi</i> Theobald (1902). <i>A. formosanaensis</i> I Tsuzuki (1902).	Formosa & Ryukyu Is.	Important carrier of the malignant parasite (Tsuzuki & Kinoshita).

	<p><i>A. aconitus</i> var. <i>cohaesa</i> Dönitz (1903). <i>A. sp. a.</i> Kinoshita (1903). <i>A. listoni</i> of Kinoshita (1904). <i>M. christophersi</i> var. <i>alhoapicalis</i> Theobald (1910). <i>M. listoni</i> of Hatori (1912).</p>		
7. <i>M. formosaensis</i> II (Tsuzuki) (Feb. 1902).	<p><i>A. vagus</i> Dönitz (Sep. 1902). <i>A. sp. b.</i> Kinoshita (1903). <i>A. rossi</i> of Kinoshita (1904). <i>M. rossi</i> var. <i>indefinita</i> Ludlow (1904). <i>M. rossi</i> of Hatori (1913). <i>A. rossi</i> var. <i>vagus</i> of Christophers (1916).</p>	Formosa.	Succeeded in infecting the malignant parasite experimentally (Tsuzuki). Failed to infect the same parasite experimentally (Kinoshita).
8. <i>M. hatorii</i> (Koidzumi) (1920).	<p>Daito-<i>Anopheles</i> Hatori (1910). <i>M. ludlowi</i> of Hatori (1911). <i>A. ludlowi</i> var. <i>formosaensis</i> Koidzumi (1917). <i>A. hatorii</i>, sp. nov. (?) Koidzumi (1920).</p>	Formosa.	No evidence.
9. <i>M. fuliginosus</i> ^a (Giles) (1900).	<p><i>A. leucopus</i> Dönitz (1901). <i>A. jamesii</i> Liston (1901). <i>A. nagpori</i> James & Liston (1904). <i>Pyretophorus freerae</i> Banks (1906). <i>Nyssorhynchus fuliginosus</i> var. <i>adie</i> James & Liston (1911). <i>Nyssorhynchus fuliginosus</i> var. <i>nagpori</i> James & Liston (1911).</p>	Formosa.	Carries the quartan parasite experimentally (Stephens & Christophers). Carries the malignant parasite experimentally (Stanton). Sporozoites in nature (Adie & Fry).
10. <i>M. hanabusai</i> , n. sp.	<p><i>A. maculatus</i> of Hanabusa (1903). <i>Neorellia willmori</i> of Hatori (1913). <i>A. maculatus</i> var. nov. (?) Koidzumi (1920).</p>	Formosa.	No evidence.
11. <i>M. indiensis</i> (Theobald) (1903).	<p><i>Nyssorhynchus maculipalpis</i> var. <i>indiensis</i> Theobald (1903). <i>A. jamesii</i> Stephens & Christophers (1902). <i>Nyssorhynchus maculipalpis</i> of James & Liston (1911). <i>Nyssorhynchus maculipalpis</i> of Hatori (1913). <i>A. splendidus</i> Koidzumi (1920).</p>	Formosa.	Carries the malignant parasite experimentally (Stephens & Christophers).
12. <i>M. tessellatus</i> ^a (Theobald) (1901).	<p><i>A. punctulatus</i> Theobald (1901). <i>A. formosae</i> Hatori (1901). <i>A. deceptor</i> Dönitz (1902). <i>A. annulipes</i> of Kinoshita (1904).</p>	Formosa.	Succeeded in infecting the malignant parasite experimentally (Kinoshita).

	<i>M. thorntonii</i> Ludlow (1904). <i>Dactylomyia ceylonica</i> New- stead & Carter (1910). <i>Nyssomyzomyia punctulata</i> of Hatori (1912). <i>A. thorntonii</i> of Koidzumi (1917). (?) <i>A. kinoshitai</i> Koidzumi (1917). <i>A. taiwanensis</i> Koidzumi (1917).		
13. <i>M. kochi</i> (Dönitz) (1901).	<i>A. ocellatus</i> Theobald (1901). <i>Cellia flava</i> Ludlow (1908). <i>Christophersia holli</i> James (1910).	Formosa.	No evidence.

Tribe **ANOPHELINI.**

Edwards, Bull. Ent. Res. iii, p. 2 (1912).

Genus **ANOPHELES** Meigen.

Meigen, Syst. Besch., i, p. 10 (1818).

1. **Anopheles japonicus** Yamada.

(Jap. name. — Yamato-hamadaraka).

Anopheles japonicus Yamada, Eiseigaku Densenbyogaku Zasshi xiii, p. 689 (1918).*Anopheles pleccau* Koidzumi, Daiwan Kenkyujo Hokoku viii, pp. 17, 28 & 34 (1920).*Anopheles lindesaii* of Edwards, Bull. Ent. Res. xii, p. 273 (1921).

DESCRIPTION. — *Female*. Head: Occiput with a median groove, brownish black, clothed with erect cuneiform black scales except for a patch on the vertex in front, where a group of lanceolate white scales appears and is followed by another group of erect cuneiform white to yellowish scales; intra-orbital space narrow, cuneiform, with a row of long hair-like twisted white scales projecting forwards and another row of lanceolate white scales along each orbital margin; vertical bristles golden, orbital bristles blackish. Proboscis straight, uniform, clothed with spatulate black scales, those at the base longer and outstanding; labellae rather long, brownish black. Palpi nearly as long as the proboscis, roughly clothed with spatulate black scales, those on the basal joint longer and rougher. Antennae filiform, about two-thirds as long as the proboscis; torus small, deep reddish brown, nude; flagellar joints rugose, blackish brown, with whitish piles; first joint with many small spatulate black scales; whorl-hairs

moderately long, black. Clypeus brownish black, without scales.

Thorax: Prothoracic lobes blackish brown, clothed with a patch of broad-lanceolate black scales at the apex and some black bristles. Mesonotum elongate, narrow, distinctly divided into one central and two lateral longitudinal bands all broad; the central band ashy grey, with a median narrow dark stripe extending along the whole length of the disc, two submedian broad bare greyish brown lines on the anterior half and two sublateral similar lines on the posterior half; each lateral band blackish brown in front of the suture, deep black behind; sparse pale golden to blackish hairs on the central band, somewhat darker hairs on each lateral band; a group of narrow sharp-pointed yellowish white scales medianly on the anterior margin, a group of black scales of similar form at each shoulder; marginal and dorsal bristles rather short, pale golden to blackish. Scutellum collar-like, ashy grey, with a dark central spot, clothed with hairs similar to those on the central band of the mesonotum; marginal bristles pale golden and sparse in the middle, black and dense tending to form a tuft at each side. Postnotum blackish brown, nude. Pleurae grey, with three broad longitudinal blackish brown stripes which are better seen to the naked eye; spiracular bristles absent; pre-alar, stenopleural and upper mesepimeral bristles well developed, golden brown; stenopleural bristles being divided into two (upper and lower) groups.

Abdomen: Form slightly depressed, truncate at the tip; dorsum brownish black, basal areas and apical margins of segments being somewhat greyish, entirely clothed with hairs golden brown or blackish according to the light; venter hardly paler; cerci sickle-shaped, about three times as long as wide, clothed with small setae.

Wings: Petiole of the second marginal cell nearly one-half the length of its cell, that of the second posterior cell a little less than two-thirds as long as its cell: basal cross-vein distant slightly more than its own length from the anterior cross-vein; outstanding scales of veins broad-lanceolate; all scales of veins brownish black and pale yellowish, the light scales forming many interruptions or patches as follows: one yellowish patch at the tip of the costa, extending on to the first vein and the anterior branch of the second vein, one very small patch consisting of a few yellowish scales on the first vein at the junction of the humeral cross-vein, one in the middle of the posterior branch of the second vein, two on the third vein one of them lying near the base, the other at the tip, one in the middle of the anterior branch of the fourth vein and another at the tip of the posterior branch of the vein, one at the bifurcation of the fifth vein, three on the anterior branch of the vein, one of them lying at the tip of the branch, one at the tip of the posterior branch of the fifth vein, and one at the tip of the sixth vein; the pale patch at the tip of the third vein, that at the tip of the posterior branch of the fourth vein and that at the tip of the anterior branch of the fifth vein may or may not appear according to the specimen; fringe dark

brown, according to the specimen there may be seen one pale patch opposite the tip of the posterior branch of the fourth vein, one opposite the tip of the anterior branch of the fifth vein and another opposite the tip of the posterior branch of the same vein.

Legs: Femora black above, hardly paler beneath, with yellowish white knee-spots and rather broad basal bands of similar colour, the basal band on the hind femora extending on the ventral surface about basal one-sixth the length of the joint; hind femora with a broad yellowish white band about the middle; tibiae brownish black, with apical yellowish white spots; tarsi entirely brownish black. Claws all equal and without tooth.

Length in mm.: Head 0.55; thorax 1.70; abdomen 3.20; proboscis 3.00; wing 5.30.

Male. Differences from the female: Proboscis relatively long and thinner. Palpi long; long joint slightly more than two-thirds the length of the proboscis, slender, gradually thickened towards the tip, with a bare pale constriction about the middle, clothed with black scales and bearing a few blackish setae at the tip; penultimate joint enlarged and compressed laterally, brownish black, bearing on the inner surface a few scattered pale scales and dark brown ones and pale golden setae; last joint being lost. Antennae vertically plumose, nearly seven-ninths as long as the proboscis; torus large, pale brown, slightly pruinose, nude; last two flagellar joints long, rugose, black, with whitish piles; the remaining flagellar joints short, pale, with blackish rings bearing long hairs smoky brown or blackish according to the light. Wings narrower; petiole of the second marginal cell nearly five-ninths as long as its cell, that of the second posterior cell nearly as long as its cell; basal cross-vein distant a little more than its own length from the anterior cross-vein; scales of veins sparser; pale patches except that at the tip of the costa which is nearly the same in size as in the female, showing a greater extension than in the female, especially the pale patch lying near the base of the third vein becomes here a very long, pale line extending about one-half the length of the vein; brownish black scales tending to aggregate at the base of the second vein and at the junction of the cross-veins. Claws of the fore tarsi unequal, the larger claw one-toothed, the smaller without tooth; those of the mid and hind tarsi equal, having no teeth.

Length in mm.: Head 0.45; thorax 1.35; abdomen 2.62; proboscis 2.70; wing 3.56

DISTRIBUTION. — Rare in Hokkaido, Honshu, Shikoku, Kyushu and Formosa. In Honshu and Formosa the species has been found at high altitudes.

Kanayama, Hokkaido (23. viii. 1917); Rubeshibe (28. viii. 1917); Mt. Myogi (about 3000 feet) (4. viii. 1918, I. Omori); Murotosaki, Shikoku (15. viii. 1921, S. Hirayama); Nagasaki (v. 1921, W. A. Lamborn); Musha (3750 feet), Formosa (xi. 1917, M. Koidzumi).

HABITS. — At Kanayama & Rubeshibe females of the species were caught

when they came to bite the writer among bushes in the evening. According to Dr. Koidzumi *A. pleccau* which is considered here as a synonym of the species, breeds in springs at mountainous districts in Formosa.

RELATION TO DISEASES. — No evidenc.

TYPE. — The syntype (No. 4) consists of three females from Kanayama. One male from Mt. Myogi is taken as the idio.

NOTE. — I had formerly described this species in Japanese referring to the original description of *A. lindesaii* Giles (Gnats, 1st ed. p, 166, 1900) and giving the following note; "This is a large black species resembling *A. lindesaii* Giles from India, but it differs from this in the markings of the legs and wings. Both species have a broad white band in the middle of the hind femora, but the Indian species has no other markings on the legs, while the present species bears yellowish white spots at the tips of the femora and tibiae. Wing-markings of both species are very much alike, but the apical white spot on the costa in *A. lindesaii* shows a greater extension than in the present species, involving the tips of all veins outside the anterior branch of the fourth vein, and the white spot at the tip of the posterior branch of the fifth vein is absent in the Indian species, which appears always in the Japanese species (translation)."

Thenceforth I have had an opportunity of examining the female type and homotype of both sexes of *A. lindesaii* which are preserved in the British Museum. In comparison of the Japanese specimens with the type of the Indian species I have not been able to detect any difference in leg-markings except that in the Japanese species the basal yellowish white band on the hind femora is apparently narrower than in the Indian species; in the former the band extends on the ventral surface about one-sixth the length of the femora, while in the latter it runs about one-third. In the wing of the Indian species a white spot appears at the tip of the posterior branch of the second vein, which is not seen in the Japanese species. A white spot at the tip of the posterior branch of the fifth vein which was not described by Giles is seen also in the Indian species as in the Japanese. In the Indian species a white spot does not appear at the tip of the anterior branch of the fifth vein, which may appear in the Japanese species. A more decisive difference is seen in the form of the outstanding scales of the wing-veins; in the Indian species the scales are narrow-lanceolate, while in the Japanese species they are much broader. Another morphological difference is observed in the male hypopygium, two parbasal spines in the Japanese species being much more slender than those in the Indian species.

The paratype of *A. pleccau* Koidzumi is in B. M. This Formosan form differs from the typical form merely in the small white spot on the first vein at the junction of the humeral cross-vein; in the former it is somewhat larger, consisting of about seven white scales while in the latter it consists of from one to five scales. As far as the adult only is concerned, no one will intend to separate the Formosan form from the typical form by such a trifle difference as this.

2. *Anopheles hyrcanus* (Pallas) var. *sinensis* Wiedemann.

(Jap. name. — Shina-hamadaraka).

Culex hyrcanus Pallas, Reise durch russischen Reichs i, p. 475 (1771).*Anopheles sinensis* Wiedemann, Auss. Zweifl. Ins. i, p. 547 (1828).

Giles, Gnats, 1st ed. p. 160 (1900); 2nd ed. p. 305 (1902).

Theobald, Mon. Cul. i, p. 137 (1901).

Miyajima, Chugai Ijishimpo (1903) No. 547, p. 1; No. 548, p. 17; No. 549, p. 11.

Kinoshita, Nikusaka Hokoku, No. 3, p. 81 (1904); Arch. für Schiff. X, p. 622 (1906).

Matsumura, Thousand Insects of Japan, ii, p. 123 (1905).

Nawa, Konchu Sekai xiv, p. 468 (1910).

Hatori, Daiwan Igakkai Zas. No. 90, p. 832 (1912).

Koidzumi, Daiwan Kenkyujo Hokoku, No. 8, p. 16, 28 & 34 (1920);

Dobutsu. Zas. xxxvii, p. 99 & 149 (1925).

Anopheles plumiger Dönitz, Insektenborse, xviii, p. 37 (Jan. 1901).*Anopheles sinensis* sub-species *indiensis* Theobald, Mon. Cul. i, p. 145 (1901).*Anopheles funestus*? of Kinoshita, Nikusaka Hokoku, No. 1 (Tokyo Igakkai Zas. xvi, p. 53, Sep. 1901).*Anopheles yesoensis* Tsuzuki, Gunigakkai Zas. No. 123, Suppl. (yesoensis), (Oct. 1901); Saikingaku Zas. No. 71, p. 1 (Oct. 1901); Saikingaku Zas. No. 75, p. 93 & 95 (jesoensis) (Feb. 1902); Centralbl. für Bak. xxxi, 763 p. (jesoensis) (1902); Arch. für Schiff. vi, p. 286 (jesoensis) (1902). Dönitz, Zeitschr. für Hyg. xiii, p. 231 (jesoensis) (1903).*Anopheles* sp. Miyajima, Tokyo Igakkai Zas. xvi, p. 262 (March, 1902).*Anopheles pseudopictus* of Kinoshita, Tokyo Igakkai Zas. xvii, p. 754 (Aug. 1903).*Myzorrhynchus sinensis* Theobald, Mon. Cul. iii, p. 89 (1903); iv, p. 86 (1907); v, p. 51 (1910).

Hatori, Daiwan Igakkai Zas. Nos. 114 & 115, p. 279 (1912); Nisshin Igaku, iii, p. 35 (1913).

Mochizuki, Fukuoka Ika Zas. vii, p. 53 (1913).

Matsumura, Dainippon Gaichu. ii, p. 45 (1915); Konchubunrui. ii, p. 58 (1915).

Anopheles (*Anopheles*) *hyrcanus* of Edwards, Ann. & Mag. N. Hist. viii, p. 629 (1921).*Anopheles* (*Anopheles*) *hyrcanus* var. *sinensis* of Christophers, Ind. Med. Res. Memois, No. 3, p. 28 & 86, (1924).

DESCRIPTION. — *Female*. Head: Occiput with a median groove, dark greyish brown, slightly pruinose, clothed with erect cuneiform dark brown scales except for a patch on the vertex in front, which consists of lanceolate to cuneiform

white scales; intra-orbital space narrow, cuneiform, with a row of long hair-like white scales projecting forwards, and another row of lanceolate white scales along each orbital margin; vertical bristles pale golden, orbital bristles blackish. Proboscis straight, a little thickened at the base, clothed with spatulate brownish black scales which become longer and rougher towards the base; labellae elongate, dark brown. Palpi about as long as the proboscis, uniform, roughly clothed with long spatulate brownish black scales, roughest on the basal third, with a band of yellowish white scales and a group of setae of similar colour at the apex and a band of white scales at each of three preceding articulations which involves both ends of the joints; apical whitish band nearly as broad as the penultimate one, sometimes the former slightly broader than the latter, the last two bands well separated in most cases, but very rarely they are united with each other; some pale scales being intermixed on the inner-dorsal side along the whole length of the palpi or sometimes along the basal joint only. Antennae filiform, nearly four-fifths as long as the proboscis; torus small, dark brown, clothed with small lingulate whitish scales on the posterior side; flagellar joints rather stout, rugose, blackish, clothed densely with whitish piles; first five or six flagellar joints clothed with lanceolate to spatulate white scales; whorl-hairs short, dark brown. Clypeus brownish black, slightly pruinose, bearing a patch of broad lingulate brownish black scales on each side.

Thorax: Prothoracic lobes dark brown, pruinose, with a patch of erect spatulate to lingulate dark brown scales. Proepimera without scales. Mesonotum elongate, narrow, chestnut brown on both sides in front of the sutures, dark grey pruinose on the remaining area; a median narrow dark stripe extending along the whole length of the disc; two submedian broad bare dark lines on the anterior half, and two broader bare dark lines sublaterally on the posterior two-thirds; a velvet-black spot in front of the scutellum and a pair of similar spots each lying at the anterior end of the posterior sublateral line; sparse pale golden hairs all over the dorsum; a patch of long linear-lanceolate yellowish white scales medianly on the anterior margin; a patch of lanceolate to lingulate pale brown scales at each shoulder; dorsal and marginal bristles pale golden to dark brown. Scutellum collar-like, grey pruinose, clothed with pale golden hairs; marginal bristles pale golden and sparse in the middle, dark brown and rather dense tending to form a tuft at each side. Postnotum brownish black, pruinose, nude. Pleurae grey pruinose, with three broad, but ill-defined blackish brown stripes which are rather well seen to the naked-eye; spiracular bristles small, about ten in number, pale golden; pre-alar, and stenopleural bristles short, whitish, a few of these bristles being transformed into lingulate or linear scales; upper mesepimeral bristles long and whitish.

Abdomen: Form slightly depressed, truncate at the tip; dorsum and venter brownish black, entirely clothed with golden hairs; seventh sternite with a patch of erect lingulate scales in the middle towards the posterior margin, most of the

scales black, but some in front whitish; cerci sickle-shaped, about three times as long as wide, bearing small setae.

Wings: Petiole of the second marginal cell about one-half as long as its cell, that of the second posterior cell nearly five-sevenths the length of its cell; basal cross-vein distant less than its own length from the anterior cross-vein; outstanding scales of veins broad-lanceolate; all scales of veins coloured brownish black and yellowish white, forming rather ill-defined markings as follows: Costa black, with two distinct white patches on the apical half, the first of which is about one-twentieth as long as the costa, lying at the junction of the subcosta, the second nearly as long as or sometimes two-thirds as long as the first, lying close to the apex, and moreover having scattered pale scales towards the base of the vein along the posterior surface, which are always intermixed with black scales and never form any distinct spot, though they extend along the whole length of the costa in some specimens; first vein with three white patches, the first of them lying just before the origin of the second vein and the other two corresponding to the first and second costal patches, and in addition bearing some white scales which are intermixed with black ones along the basal part inwards the first white patch and on both sides of the second white patch; second vein white-scaled along its stem except for a black patch at the base; each branch of the second vein black, with a white patch in the middle, the white patch on the anterior branch corresponding to the second costal patch and lying just outside the white patch on the posterior branch; third vein with a small black patch at the base and another at the apex, and the remaining area of the vein mottled with a large amount of white scales and a few black ones, but in rare cases the area is entirely white-scaled; fourth vein clothed usually with white scales on its stem, but in some cases a few black scales are intermixed there; each branch of the fourth vein with a small black patch at the base and another at the apex, the middle area being mottled with the two kinds of scales; fifth vein with some black scales at the base and a black patch near the base, four black patches on the anterior branch and one at the tip of the posterior branch; sixth vein with two black patches, one lying about the middle, the other at the tip; fringe dark brown, with a distinct yellowish white patch extending from the apex of the anterior branch of the second vein to a point between the apex of the third vein and that of the anterior branch of the fourth vein, and another pale patch opposite the apex of the posterior branch of the fifth vein, which extends on fifteen or sixteen scales in highly developed cases, but in opposite cases it consists of five or six scales.

Legs: Femora and tibiae dark brown above, dark yellowish beneath; femora with distinct yellowish white knee-spots; tibiae with rather indistinct apical spots of similar colour; all tarsi blackish, except for the underside of the first joint, where it is dark yellowish; fore tarsi with narrow distinct apical yellowish white bands on the first three joints; mid tarsi with similar, but slightly narrower

bands on the first three joints, and in some cases a narrow apical band also on the fourth joint; hind tarsi with similar, but broader bands on the first four joints and with traces of basal whitish bands on the fourth and fifth joints. Claws equal, having no teeth.

Length in mm.: Head 0.50; thorax 1.75; abdomen 3.50; proboscis 2.50; wing 5.10.

Male. Differences from the female: Proboscis longer and thinner. Palpi nearly as long as the proboscis; long joint enlarged at the tip, with a bare pale constriction slightly below the middle, clothed with dark brown scales and white ones on the outside, the white scales forming a longitudinal stripe along the dorsal margin, the scales on the basal one-fourth of the long joint longer and rougher; last two joints enlarged and compressed laterally, forming a distinct club together with the enlarged tip of the long joint, clothed with dark brown scales on the outside and having white-scaled bands at their bases and tips; last joint with scattered pale scales on the inner side; dense, long, pale golden hairs along the dorsal and ventral margins of the penultimate joint and at the tip of the long joint; sparse, rather short hairs of similar colour on the last joint. Antennae vertically plumose, nearly four-fifths as long as the proboscis; torus large, pale brown, darkened on the inner side, pruinose, without scales; last two flagellar joints long and slender, rugose, pilose, blackish, the last joint nearly two-thirds as long as the penultimate joint and slightly thicker than the latter; the remaining joints short, pale yellowish, pubescent, with dark brown enlarged rings beyond the middle; first joint with some rather small lingulate dark brown scales; whorl-hairs long, pale or dark brown according to the light. Abdomen elongate, depressed; seventh sternite without scales; side-pieces of the hypopygium clothed with spatulate pale scales on the dorsum and dark brown ones on the outside. Wings narrower; petiole of the second marginal cell two-thirds as long as its cell, that of the second posterior cell nine-tenths as long as its cell; basal cross-vein distant a little more than its own length from the anterior cross-vein; scales of veins sparser; costa with less amount of white scales towards the base than in the female; third vein usually clothed with white scales in the middle, but in rare cases it bears a few black scales intermixed there; each branch of the fourth vein clothed with white scales in the middle, but without black ones there; fifth and sixth veins with less extensive black patches than in the female, especially the third patch on the anterior branch of the fifth vein is small consisting of several black scales, but in some cases it does not appear at all; the black patch at the apex of the sixth vein also small, represented by from one to three black scales. Claws of the fore tarsi very unequal, the larger claw with one tooth, the smaller without tooth; those of the mid and hind tarsi equal and not-toothed.

Length in mm.: Head 0.38; thorax 1.60; abdomen 4.00; proboscis 3.00; wing 4.50.

DISTRIBUTION. — *A. lycanus* in general is distributed throughout the Orient.

tal region and the southern part of the Palaearctic region. In the British Museum I have seen specimens of var. *sinensis* from East & South China, Tongking and Cochin China.

In this country, the variety is distributed all over the main islands from Formosa to Hokkaido and also over Korea, chiefly in plains along large rivers and lakes. But it has not been yet caught from Sakhalin.

Tamsui (16. vi. 1899, G. Mackay); Daihoku (7. v.); Hokuto (8. v.); Nanto (8. iv.); Hokuzanko (11. iv.); Dainan (5. iv. 1917, F. Shishido); Kanteibyō (19. iv.); Takao (1914, H. Sauter); Anping (1914, H. Sauter); Hozan (21. iv.); Heito (21. iv.); Boryo (22. iv.); Koshun (23. iv.); Daito (24. iv.); Toyen (1914, H. Sauter); Riran (29. iv.); Kompo (30. iv.); Toyota (2. v.); Kotobuki (2. v.); Yoshinomura (3. v.); Karenko (4. v.); Kagoshima (27. vii. 1916); Kumamoto (24. vii. 1916); Omura (23. vii. 1916); Nagasaki (26. v. 1921, W. A. Lamborn); Fukuoka (18. vii. 1916); Matsuyama (1903), Miyajima (15. vii. 1916, Komatsuzaki); Himimura, Iyo (27. vii. 1916, T. Kaburagi); Kochi (10. vii. 1921, S. Hirayama); Murotozaki (15. viii. 1921, S. Hirayama); Ogori (16. vii. 1916); Hiroshima (31. vii. 1916); Okayama (15. vii. 1916); Kobe (5. x. 1915) (1. vi. 1921, W. A. Lamborn); Osaka (13. vii. 1916); Yodo, Yamashiro (1903, Miyajima); Tanabe (2. viii. 1921, S. Hirayama); Kushimoto (8. viii. 1921); Kyoto (6. x. 1915); Fukui (11. vii. 1916); Kanazawa (8. x. 1915); Gifu (4. viii. 1916); Nagoya (3. x. 1915); Yokohama (1. x. 1915) (7. vi. 1921, W. A. Lamborn); Tokyo ix. 1915); Ajiki, Kazusa (1903, Miyajima); Mito (1903, Miyajima); Karuizawa (25. vii. 1902, C. E. Cornford); Nagaoka (28. viii. 1916); Higashiyama, Iwashiro (4. ix. 1916); Kaminoyama (2. ix. 1917); Sendai (11. viii. 1917); Aomori (13. viii. 1917); Hakodate (15. viii. 1917); Sapporo (19. viii. 1917); Jozankei (21. viii. 1917); Kanayama (23. viii. 1917); Yengarū (25. viii. 1917); Fusan (22. viii.); Jinsen (30. viii.); Eitoho (24. viii.); Keijo (2. ix.); Heijo (12. ix.); Kanko (6. ix.). I have also examined specimens of the variety in Watanabe's collection from the following localities in Korea, which was made in the summer, 1916: Fusan; Chinkaiwan; Taiko; Suigen; Risen; Shunsen; Chushu; Genshu; Kinka; Heisho; Kanko; Heijo; Anto; Rhuzan.

For collection S. Hirayama was sent by the writer to Korea in 1920 and to Formosa in 1921. In the above list the collector's name and the year are omitted to save repetition in the localities in Formosa and Korea from where Hirayama has gotten specimens. The collections in Kyushu, Honshu and Hokkaido in the above list in which the collector's name is not given have been made by the writer.

HABITS.—The female of this mosquito bites human beings at night and in darkness. Its bite is severe and painful.

Both sexes enter houses. In Tokyo, however, merely a small number of this variety is seen in houses. In a sitting room of an official residence of the Institute I collected indoor mosquitoes by a trap using alcohol and sugar as attracting substance during four months from June 21st to October 20th, 1919. All mosquitoes thus collected were 11112 in number and 152 (1.4%) out of them

were specimens of the variety. But in some localities, the variety occurs rather abundantly. For instance, the variety composed of 50.7% in number among a collection of indoor mosquitoes which was made in a bed room every morning from July 1st to September 30th, 1919 by Mr. S. Abe in a village near the Lake Fukushima, Echigo; the actual number of all the indoor mosquitoes being 830 and that of this variety 421.

It is only the female that hibernates in this variety. I found five females hibernating in a small cave on a slope near the Institute on December 13th, 1916 and in the same place one female on January 26th of the next year and three females on February 20th. When the female hibernates it takes a rather stable attitude which differs entirely from the ordinary resting position, stretching all its legs and bringing its body very close to the surface. On March 5th, I caught one female flying in my house and on March 8th two females about the cave mentioned above. In Tokyo the resurrection of the hibernating females seems to begin at the early spring.

It is well known that this mosquito breeds usually in large accumulations of water. I have found larvae of the mosquito in somewhat large ponds, fosses of ancient castles, permanent pools, marshes, watered rice-fields, water-reservoirs for irrigation and displacement, ditches having a slow current, and temporary pools in deltas of large rivers. They were found, however, in a small concrete basin in the back garden of my house, which has only four square feet in surface and also in a wooden water-barrel having one and a half feet in diameter.

The variety seems to breed continuously from spring to autumn and to repeat at least five or six generation during the warm season. The number of adults reaches the maximum in July. Out of 152 adults of this variety collected from June 21st to October 20th as mentioned above, 111 (73%) were the sum of those captured in July and 99 (89%) out of 111 in the last decade of that month.

Towards the end of autumn the breeding activity decreases gradually, though larvae, pupae and adults of both sexes are seen even in November. I captured one female near the front door of my house on November 10th and it bit me easily at that time when it was 10°C in air-temperature. On 21st of that month I caught three pupae and five larvae from a pond lying just in front of my laboratory and tried to keep them alive outdoors. Two of the pupae hatched out on December 1st and the remaining one on 4th. But one of the larvae had been dying on December 10th and the rest four were killed by a heavy frost on 27th of that month.

With regard to the longevity of this mosquito in warm season I observed that four females which were kept in a mosquito cage lived respectively 18, 35, 37 and 44 days. But it was not successful for me to keep adults of this mosquito in test-tubes for long time. The average longevity of ten females one by one in test-tubes was only 16 days and that of ten males 13 days. It is noteworthy

that I was able to keep alive one female in a cage for 12 days after it laid eggs and another female for 11 days.

RELATION TO DISEASES. — According to many authors this variety seems to be a suitable host for the tertian parasite *Plasmodium vivax* Grassi & Feletti. Tsuzuki (1901) in Fukagawa, Hokkaido succeeded in experimentally transmitting the tertian malaria from a patient to a healthy man by the female of *A. yesoensis* which is considered here as a synonym of this variety. After that, Dr. Miyajima (1903) in Yodo near Kyoto and Kinoshita (1904) in Formosa proved *A. sinensis* is a good transmitter of the tertian malaria. In fact this variety is an important carrier of the tertian malaria in this country and responsible for the prevalence of the fever within the village life throughout the country from Formosa to Hokkaido and also in Korea.

In relation to the quartan parasite, *Plasmodium malariae* (Laveran), Kinoshita (1904) in Formosa found that the sporocyst was formed within one female of *A. sinensis* out of eight specimens which were fed on the quartan malarial blood.

Miyajima and Kinoshita both in Formosa found simultaneously (1904) but independently that the subtertian or malignant parasite, *Laverania falciparum* Welch was incapable of development within *A. sinensis*.

Dr. Taniguchi (1905) gave an evidence that *A. sinensis* is capable of acting as an intermediate host for *Filaria bancrofti* Cobbold, while Dr. Mochizuki (1910) observed only one larva of the filaria out of 166 which were found within the body of twenty-three infected females of this mosquito showed normal development.

The writer and Komori fed sixteen females of this mosquito on the filarial blood and dissected them after twelve to nineteen days. Then 261 larvae of the filaria were found in all the mosquitoes. Among these larvae twelve individuals (4.6%) accomplished their development, one of those being found in the labium of the proboscis. Some of the remaining larvae were dying within the general body space of the abdomen and never showed any sign of development, but some of them were living or dying in the thoracic muscles and showed development to more or less extent. Though this mosquito is capable to a certain extent of acting as an intermediate host for *Filaria bancrofti*, it is not such an important carrier of the filaria as *Culex pipiens* var. *pallens* and *Aedes togoi*.

TYPE. — The type of *A. sinensis* Wiedemann from Canton, China in the Vienna Museum. The writer's plesiosyntype (No. 6) consists of ten females and ten males caught at Shiba, Tokyo.

NOTE. — Through kindness of Dr. H. Zerny of the Vienna Museum I have gotten facility of examining the type of *sinensis*. Though it has been much damaged, I have been able satisfactorily to identify the Japanese specimens with it.

Edwards (Bull. Ent. Res. x, p. 129, 1919) has discussed *Anopheles sinensis* Wiedemann should be identical with *Culex hyrcanus* Pallas from the North

Caspian region and accordingly the name *sinensis* will have to be sunk under *hyrcanus*. The location of the type of *Culex hyrcanus* is unknown and therefore it is not possible in the now to know whether *sinensis* is entirely identical with *hyrcanus* or not. As many authors consider, *A. sinensis* in a wide sense is, however, a variable species. If so, it is unlikely that these two forms from the different localities are entirely or variably identical, though they are specifically synonymous. It is rather natural to consider some varietal differences might have been existed between these two. What form of several varieties of *A. sinensis* the Pallas' specimen was close to or identical with is not deducible from his description. It is, however, very fortunate that there is preserved a female of *sinensis*-group in the British Museum, which came from nearly the same region as that of Pallas' specimen, being labelled as "Baku district, Caspian: v. 1919, In train: Pres. by C. M. Wenyon: 1920-63". I should like to consider this is rather the typical form of *A. hyrcanus* and will treat it as the topotype of the species.

The topotype of *hyrcanus* is distinguishable from *sinensis* in a narrow sense by many particulars as follows: Some very narrow lingulate pale scales are seen over each wing-root, while in *sinensis* such scales are hardly distinguishable from ordinary hairs. White bands at three articulations of the palpi much broader than those in *sinensis*, and the apical white band on the palpi is narrower than the preceding one whilst in *sinensis* the former is nearly the same in width as the latter or sometimes rather broader. Costa having no pale scales scattered along the posterior border. First vein with one more distinct white patch in addition to three, which extends from the extreme base to a point slightly beyond the humeral cross-vein. Fourth vein with a black-scaled patch extending along the basal third of its stem and a small black spot at the junction of the cross-veins. Fourth hind tarsal joint entirely pale-scaled.

The characteristics enumerated above seem to be sufficient to separate these two forms variably from each other, and I will call the typical or Caspian form *Anopheles hyrcanus* var. *hyrcanus* (Pallas) and the Chinese form *A. hyrcanus* var. *sinensis* Wiedemann.

A. Pseudopictus Grassi (Atti. R. Acc. Lincei, Rendic. viii, 1, p. 102, 1899) is here considered as synonymous with the typical form var. *hyrcanus*.

Many authors consider *A. plumiger* Dönitz from Hong Kong is identical with *A. sinensis*. I have come to agree with them when I examined the type of *plumiger* through kindness of Dr. G. Enderlein of Zoologisches Museum in Berlin. It has been thoroughly identical with var. *sinensis*.

A. yesoensis Tsuzuki was formerly considered by Christophers and others as close to or identical with *A. barbistrostris* Van der Wulp (Notes Leyd. Mus. VI, p. 248, 1884), while Theobald & Miyajima placed it as a synonym of *A. sinensis*. To resolve this doubt I will give first Tsuzuki's original description below. "Ich traf am 21. Juli 1901 in Sapporo der Hauptstadt von Hokkaido oder Jeso, ein, wo ich am 23. Juli ein Weibchen einer *Anopheles*-Art fand. Ich kam sodann

am 25. Juli nach Fukagawa, wo ich noch mehrere *Anopheles* fing. Am 4. August fing ich einige Exemplare derselben in Asahigawa. Alle *Anopheles*, welche ich in Hokkaido fand, waren von einer Art, welche am vorderen Rande des Flügels zwei grosse, am äusseren Rande einen kleine Flecken hat. Fühler, Taster und Körperhaltung sind ganz charakteristisch und machen die Unterscheidung von *Culex*-Arten leicht. Da bis jetzt in Japan diese Art der Mücken noch von niemand beachtet worden ist, fehlt natürlich ein besonderer japanischer Name. Es ist klar dass sie mit *Anopheles claviger* der in Europa verbreiten Art, nicht identisch ist, denn sie hat andere Zeichnung auf dem Flügel. Zweifelhaft ist mir ob es sich um eine neue Art handelt oder ob dieselbe mit einer schon anderwärts gefundenen identisch ist. Bis dieses entschieden nenne ich sie einfach: *Anopheles jesoensis* (Centralbl. für Bak. xxxi, p. 763, 1902). Judging from this description, there is no evidence to acknowledge that *A. jesoensis* is identical with *A. barbirostris*.

Subsequently Tsuzuki gave a new description of *A. jesoensis* and added Formosa & Hondo (=Honshu) as new localities to its distribution (Arch. für Schiff. vi, p. 286, 1902). A point of dispute in his second description is that "Der Taster des Weibchens ist ganz mit schwarzen Schüppchen bedeckt, welche nach der Tasterspitze hin immer kürzer werden", and this led many readers to consider *A. jesoensis* is as close to or identical with *A. barbirostris*. But his description of the wing explanates undoubtedly that of var. *sinensis*. A figure of the wing of *A. jesoensis* drawn by Eysell (Arch. für Schiff. vi, p. 297) also illustrates apparently that of var. *sinensis* showing characteristics which differ from those in *A. barbirostris* as follows: Two white patches on the apical half of the costa much longer than those in *barbirostris*. Second white patch on the first vein nearly equal to the first costal white patch in length and in position, while in *barbirostris* the former is always shorter than the latter or sometimes it is entirely suppressed. Stems of the second and fourth veins not entirely black-scaled. Anterior branch of the second vein with a small black spot at the tip, and posterior branch of the vein with only one white patch in the middle.

Another description of *A. jesoensis* was given by Dönitz who studied the Tsuzuki's specimen. (Zeitschr. für Hyg. xiv, p. 231). "Die Taster des ♀ kein weisses Band haben" is Dönitz's description about the palpi. In the next page, however, he writes as follows: "Auf den Tastern kann man vereinzelt weisse Schuppen auf dem 1. Gliede und an den Spitzen der folgenden Glieder erkennen, doch kommt dadurch weder eine Ringelung noch überhaupt ein heller Fleck zu Stande". If so, it is not right to identify *A. jesoensis* with *A. barbirostris*, because the latter has no pale isolated scales on the palpi.

As far as I know, *A. barbirostris* has not hitherto been found throughout Japan including Hokkaido, Honshu and Formosa where *A. jesoensis* had been taken from. By these reasons I should prefer to refrain myself from placing *A. jesoensis* as a synonym of *A. barbirostris*.

I have collected three species of *Anopheles* throughout Japan, which have the entirely black-scaled palpi. They are *A. japonicus*, *A. koreicus* and *A. edwardsi*. All of them are, however, rather rare and differ respectively from *A. yesoensis* in many particulars. According to Tsuzuki *A. yesoensis* seems to be rather a common species in Japan. So any of these three species does not answer to Tsuzuki's species.

The only one species of *Anopheles* which is commonly distributed all over Japan is *A. hyrcanus* var. *sinensis* and this only corresponds well to *A. yesoensis* in the distribution and the description except the palpal markings. Therefore I will say in conclusion that Tsuzuki's actual specimen of *Anopheles* might have been that of *A. hyrcanus* var. *sinensis* having the palpi more or less denuded towards the tip.

A. sinensis sub-species *indiensis* Theobald (Mon. Cul. i, p. 145, 1901) seems to be an intermediate form between var. *sinensis* and var. *peditaeniatus*. The wing-markings of *indiensis* are almost identical with those in *sinensis* except that costa has pale scales scattered along the anterior border as well as the posterior. Tarsal white bands, however, resemble those in *peditaeniatus* being very broad, though there are not seen basal white bands on the third and fourth joints of the fore and mid tarsi and on the third joint of the hind tarsi. But I am also inclined to place *indiensis* under var. *sinensis* as many authors did rather than to put it under var. *peditaeniatus* or to consider it as a distinct variety.

Myzorrhynchus peditaeniatus Leicester (Cul. Malaya. p. 31, 1908) is considered here as a distinct Malayan variety of *A. hyrcanus*. The cotype of *peditaeniatus* is in the British Museum and it differs from other varieties in the following particulars: All of the apical white tarsal bands are exceedingly broad (e. g. the band on the first fore tarsal joint nearly one-seventh as long as the joint and those on the second and third fore tarsal joints extending a little more than the apical half of the joints). Fore and mid tarsi with narrow basal white bands on the third and fourth joints and hind tarsi with similar bands on the last three joints. Stems of the second and fourth veins mottled with nearly equal amount of black and white scales.

An Indian form of *A. hyrcanus* has been called var. *vanus* Walker by some authors. But the type of *A. vanus* Walker (Jour. Proc. Linn. Soc. Lond. iv, p. 91, 1860) is entirely identical with *A. barbirostris* Van der Wulp (Notes Leyd. Mus. vi, p. 248. 1884) (This fact has been told by Edwards and I also acknowledged it having examined the type of *A. vanus*). The Indian form therefore will have to be called var. *nigerrimus* (*A. nigerrimus* Giles, Gnats, 1st ed. p. 171, 1900). The var. *nigerrimus* has the following characteristics distinguishable from other varieties. Second vein almost all black-scaled along the whole length of its stem or sometimes having only a few pale scales intermixed there. Fourth vein black-scaled along the whole length of its stem or at least along the basal half of it. Sixth vein black-scaled on the apical half or sometimes the

black-scaled area being divided into two patches which are always much longer than those in other varieties. Fore and mid tarsi having apparently narrower apical white bands. With the exception of the above differences the var. *nigerrimus* is rather allied to var. *peditaeniatus* in having smaller size (wing of the type of *nigerrimus* measuring 4.10 mm. in length and that of the type of *peditaeniatus* 3.60 mm.) and darker coloration and in lacking pale fringe spot opposite the tip of the posterior branch of the fifth vein. These resemblances between the Indian and Malayan forms are, however, characters which distinguish both forms from var. *hyrcanus* and *sinensis*. The Indian and Malayan forms are, moreover, distinguished from var. *sinensis* by having no pale scales scattered along the posterior border of the costa.

A. minutus Theobald (Mon. Cul. iii, p. 91, 1903) is placed by many authors as a synonym of *A. nigerrimus*. The types of the two species in the British Museum have not showed any differences between them.

A. sinensis var. *mesopotamiae* Christophers (Ind. Med. Res. iii, p. 196, 1916) is another distinct form of varieties. The specimens of var. *mesopotamiae* which I studied in the British Museum were a female labelled as "Mesopotamia: Amara: Maj. S. R. Christophers: 1920-194", and nine females having a label of "Mesopotamia: Barraha: Barraud: 22. xii. 1918." From these specimens I have been able to enumerate the following characters which will make this variety distinct from all others. Proboscis with pale scales on the underside towards the tip, generally extending on the apical half. Tibiae with apical white bands much broader than those in others. Costa and first vein having the largest amount of pale scattered scales among all the varieties. Fourth vein with two white patches on each of the branches. Border scales of the wing dark-coloured in the middle, pale at either end. General coloration most blurred among all the varieties. Besides these, the var. *mesopotamiae* differs from var. *hyrcanus* and *sinensis* in having a mottled area extending the basal third of the stem of the fourth vein, and from *sinensis* in having a black spot on the fourth vein at the junction of the cross-veins.

3. *Anopheles sineroides*, n. sp.

(Jap. name.—Yeseshina-hamadaraka).

DESCRIPTION.—This species is very closely allied to *A. korcicus* Yamada & Watanabe and more closely to *A. hyrcanus* (Pallas) var. *sinensis* Wiedemann, so much that its full description does not seem necessary and therefore only differences between the species and those two allied species are given here.

The species differs from *A. hyrcanus* var. *sinensis* in having (a) four white patches on the costa, the first and second of them small lying near the base, the third long, lying at the junction of the subcosta, nearly one-tenth as long as the costa and about twice the length of the corresponding patch in *sinensis*, the fourth

patch nearly the same as the apical patch in *sinensis* in length and in position; (b) six well-defined white patches on the first vein, the first of them extending from the extreme base to the junction of the humeral cross-vein, the fifth and sixth patches corresponding to the third and fourth costal white patches; (c) two ill-defined white patches on each branch of the fourth vein; (d) three black patches on the sixth vein, the first of those nearly one-sixth as long as the vein and distant slightly more than its own length from the base, the second patch one half as long as the first and distant its own length from the first, the third nearly as long as the first, lying at the tip; in the male, the black patches on the sixth vein less extensive than in the female, the third patch especially so, being represented by only one or two black scales.

From *A. koreicus*, the species is distinguishable by bearing (a) pale bands on the palpi; (b) a small patch of scales on each side of the clypeus; (c) three black patches on the sixth vein which differ from those in *koreicus* in size and in position; (d) and having no basal pale bands on the femora, tibiae and first three joints of all tarsi.

Length in mm.: Female.—Head 0.50; thorax 1.70; abdomen 3.12; proboscis 2.75; wing 5.50. Male.—Head 0.40; thorax 1.50; abdomen 3.30; proboscis 2.80; wing 4.25.

DISTRIBUTION.—Rare in Hokkaido and very rare in Honshu.

Tokyo (2♀, 15. viii. 1915; 1♀, 22. ix. 1916; 1♀, 30. ix. 1920); Yokohama (1♀, 9. vi. 1921, W. A. Lamborn); Bibai (11♀ & 4♂, 21. viii. 1919); Asibetsu (1♀, 22. viii. 1919).

HABITS.—Females of the species have been caught in houses in Tokyo and in Bibai. They feed on the human blood.

RELATION TO DISEASES.—The writer and K. Komori have fed seven females of the species on the blood of a patient infected with *Filaria bancrofti* Cobbold and dissected them after eleven to seventeen days. Then 30 larvae of the filaria have been found in the general body space of the abdomen of the mosquitoes and 25 larvae in the thoracic muscles. All larvae of the filaria have, however, been dying, changing into black colour and never showed any sign of development. There is no evidence in relation to malaria.

TYPE.—The syntype (No.7) consists of two females and two males from Bibai.

NOTE.—Edwards (Bull. Ent. Res. xii, p. 274, 1921) has pointed out a female of *A. punctibasis* from Yokohama has narrow white rings at the articulations of the palpi and a distinct white tip to the last joint. I have been permitted to examine the Yokohama specimen and unable to distinguish it from the type of *A. sineroides*.

4. *Anopheles koreicus* Yamada & Watanabe.

(Jap. name.—Chosen-hamadaraka).

Anopheles koreicus Yamada & Watanabe, Jikken Igaku Zasshi ii, p. 206 (1918).
Anopheles (Anopheles) punctibasis Edwards, Bull. Ent. Res. xii, p. 274 (1921).

DESCRIPTION.—*Female*. Head: Occiput with a median groove, brownish black, slightly pruinose, clothed densely with erect cuneiform dark brown scales at the back and sides, and with a large patch on the vertex in front, which consists of lanceolate to cuneiform white scales; intra-orbital space rather narrow, cuneiform, with a row of long hair-like white scales projecting forwards, and another row of lanceolate white scales along each orbital margin; vertical bristles yellowish white, orbital bristles black. Proboscis straight, slightly thickened towards the base, rather roughly clothed with broad-lanceolate black scales, those at the base being especially roughened; labellae elongate, brownish black. Palpi nearly as long as the proboscis, clothed entirely and roughly with long lanceolate to narrow-spatulate black scales, those on the basal joint longer and more outstanding; some short black setae at the tip. Antennae filiform, about three-fourths as long as the proboscis: torus small, deep brown, pruinose, clothed with small lingulate pale brown scales on the posterior side; flagellar joints rather slender, rugose, brownish black, bearing sparse whitish piles; first joint thickened, clothed densely with spatulate pale brown scales; second joint with a few of similar scales; whorl-hairs short, blackish. Clypeus brownish black, pruinose, without scales.

Thorax: Prothoracic lobes grey pruinose, with ill-defined blackish areas, clothed with a patch of erect lingulate black scales extending for the apical third, and short blackish bristles. Proepimera without scales. Mesonotum elongate, narrow, grey pruinose on a broad central band, dark brown to black pruinose on both sides; the central band with a median narrow dark stripe extending the entire length of the disc, two submedian broad bare dark lines on the anterior half, two broader similar lines sublaterally on the posterior two-thirds, a distinct dark line running near the inner side of each posterior sublateral line and an indistinct dark bare spot in front of the scutellum; sparse pale golden hairs all over the dorsum; a patch of linear-lanceolate to lingulate yellowish white scales medianly on the anterior margin; a patch of lingulate yellowish white to blackish scales at each shoulder; dorsal and marginal bristles rather short, pale golden to dark brown. Scutellum collar-like, grey pruinose, with a dark spot at the centre, clothed with pale golden hairs and marginal dark brown bristles. Postnotum brownish black, nude. Pleurae grey pruinose, with three broad, but ill-defined blackish brown stripes; spiracular bristles small, about twelve in number, pale golden; pre-alar, stenopleural, and upper mesepimeral bristles well-developed, a few of these bristles being sometimes transformed into linear-lanceolate scales.

Abdomen: Form depressed, truncate at the tip; dorsum and venter brownish black thoroughly clothed with dark golden to blackish hairs; seventh sternite with a patch of spatulate black scales in the middle towards the posterior margin; cerci sickle-shaped, about three-times as long as wide, brownish black, clothed with small setae.

Wings: Petiole of the second marginal cell nearly one-third as long as its cell, that of the second posterior cell slightly more than one half the length of its cell; basal cross-vein distant a little more than its own length from the anterior cross-vein; outstanding scales of veins broad-lanceolate to spatulate; all scales coloured yellowish white and black, forming sharply defined markings as follows: Costa black, with four white patches, the first of them small, lying at the extreme base, the second also small, lying just beyond the humeral cross-vein, the third about one-fifteenth as long as the costa, lying at the junction of the subcosta, the fourth nearly one-twelfth as long as the costa, situated at the tip; first vein white, with a small black spot on the basal part inwards the humeral cross-vein, and black, having six white patches on the remaining part, the first, fifth and sixth patches corresponding respectively to the second, third and fourth costal patches, the remaining three lying between the first and fifth patches, the third being always longest among them and situated just before the origin of second vein, the second and fourth small; second vein black, with a white patch near the tip of the anterior branch, which corresponds to the fourth costal patch, and another about the middle of the posterior branch; in some specimens, second vein with an ill-developed whitish patch just before the supra-numeral cross-vein and another before the bifurcation of the vein; third vein with a black patch at the base and another at the tip, and clothed with white scales in the middle in company with some black ones intermixed; fourth vein black, with an ill-defined white patch on its stem corresponding to the third white patch on the first vein, and two white patches on each of the branches; fifth vein white, with a prominent black patch about the middle of the stem, four small black patches on the anterior branch, and a small one close to the tip of the posterior branch; sixth vein white, with three black patches, the first of them small, lying at the extreme base, the second about one-fifth as long as the vein, lying about the middle of the vein, the third a little shorter than the second, lying at the tip; fringe dark brown with a large pale patch extending from the tip of anterior branch of the second vein to that of the anterior branch of fourth vein, and another patch opposite the tip of the posterior branch of the fifth vein.

Legs: Femora, tibiae and tarsi brownish black except for the underside of the femora and tibiae where it is dark yellowish, with rather broad yellowish white bands at their bases and tips, but the bands at the tips of all last tarsal joints and those at the last two articulations of the fore and mid tarsi rather inconspicuous, generally represented by a few yellowish white scales. Claws all equal and without tooth.

Length in mm.: Head 0.50; thorax 1.80; abdomen 3.20; proboscis 2.60; wing 4.80.

MALE.—Differences from the female: Proboscis longer and thinner. Palpi nearly as long as the proboscis; long joint slender, enlarged at the tip, with a bare pale constriction a little below the middle, clothed with black scales on the outer side; last joint about nine-tenths as long as the penultimate joint; the last two joints enlarged and compressed laterally, forming a distinct club together with the enlarged tip of the long joint, clothed with black scales on the outer side, those at the base of each joint being slightly paler; dense moderately long dark yellowish to blackish hairs along the dorsal and ventral margins of the penultimate joint and at the tip of the long joint; sparse short hairs of similar colour on the last joint. Antenne vertically plumose, about five-sixths as long as the proboscis; torus large, reddish brown, pruinose, nude; last two flagellar joints long and slender, rugose, pilose, dark brown, the last joint nearly one half as long as the penultimate joint and distinctly thicker than the latter; the remaining joints short, pubescent, with brown enlarged rings beyond the middle, pale yellowish below the ring, slightly darker above; first joint with many large linguulate black scales; whorl-hairs dense, long, greyish or blackish according to the light. Abdomen elongate, depressed, ornamented as in the female, but having no scales on the seventh sternite; side-pieces of the hypopygium clothed with long spatulate black scales on the dorsal aspect. Wings narrower; petiole of the second marginal cell about five-twelfths as long as its cell, that of the second posterior cell about seven-ninths the length of its cell; basal cross-vein distant one and a half times its own length from the anterior cross-vein: markings entirely similar to those in the female. Legs ornamented as in the female. Claws of the fore tarsi unequal, the larger claw one-toothed, the smaller without tooth; those of the mid and hind tarsi equal, having no teeth.

Length in mm.: Head 0.35; thorax 1.70; abdomen 3.60; proboscis 3.00; wing 4.80.

DISTRIBUTION.—Rather rare in Korea, Kyushu and Honshu.

Heisho, Korea (8♀, vii. 1916, S. Watanabe); Nagasaki (5♀ & 2♂ v. 1921, W. A. Lamborn); Inokashira near Tokyo (2♀ & 2♂, 7. vi. 1921, S. Hirayama).

HABITS.—Heisho specimens have been caught in barracks. Dr. Lamborn has reared adults in Nagasaki from pupae found in a muddy shaded pool in company with *Culex hayashii* Yamada.

RELATION TO DISEASES.—No evidence.

TYPE.—The syntype (No. 8) consists of three females from Heisho, Korea. Two males from Inokashira are taken as the idio-type.

NOTE.—The writer and Watanabe had described *A. koreicus* from Heisho, Korea in Japanese in 1918 and pointed out several differences between that and two allied species, *A. hyrcanus* var. *sinensis* Wiedemann and *A. barbirostris* Van der Wulp. Later Edwards (1921) has described a new species *A. punctibasis*

from Nagasaki, Japan and given several important characters which differ from those of *A. hyrcanus*. Compared the type of *A. punctibasis* with that of *A. koreicus* I have come to conclude the former is entirely identical with the latter.

From both of the allied species *A. hyrcanus* var. *sinensis* and *A. barbirostris*, the present species differs in the following points: • Wings more sharply mottled in naked-eye appearance than in the most distinctly-marked specimens of the two allied species, no intermixture of white and black scales except to a slight extent on the third vein. Costa with a small white spot at the extreme base and another immediately beyond the humeral cross-vein. Sixth vein with three black patches. Femora, tibiae and first three joints of all tarsi with basal yellowish white bands, as well as apical ones. It is distinguished moreover from *A. hyrcanus* var. *sinensis* by the particulars as follows: Palpi without white bands at the articulations. Clypeus having no scales. Flagellar joints of the antennae more slender, with sparser piles and scales being confined to the first two joints. Processes of ninth tergite of male hypopygium very short and broad, almost semicircular in form. It differs again from *A. barbirostris* in having less outstanding scales on the proboscis and palpi, narrower scales on the veins of the wing (in *A. koreicus* the scales are broad-lanceolate to spatulate in form, while in *A. barbirostris* they are ovate), and in having no scales on from the second to sixth abdominal sternites.

5. *Anopheles edwardsi*, n. sp.

(Jap. name. — Edwards-hamadaraka).

DESCRIPTION. — *Female*. Head: Occiput with a median groove, dark brown; clothed with erect cuneiform brown scales except for a large median patch on the vertex in front, consisting of lanceolate yellowish white scales which become gradually cuneiform in shape and pale brown in colour towards the back; intra-orbital space narrow, cuneiform, with a row of long hair-like yellowish white scales projecting forwards and another row of lanceolate yellowish white scales along each orbital margin; vertical bristles pale golden, orbital bristles dark brown. Proboscis straight, thicker towards the base, clothed with long spatulate brownish black scales, those at the base longer and outstanding; labellae elongate, blackish brown. Palpi shorter than the proboscis by the length of the labellae, clothed entirely and roughly with long spatulate brownish black scales, roughest on the basal joint. Antennae filiform, nearly five-sixths as long as the proboscis; torus small, dark brown, clothed with flat brownish white scales along the outer and posterior sides; flagellar joints rugose, blackish, with whitish piles; first joint thickened, long, nearly twice as long as the second joint, clothed densely with spatulate brownish white scales; second joint with a few of similar scales; whorl-hairs rather short, blackish. Clypeus dark brown, without scales.

Thorax: Prothoracic lobes blackish brown, pruinose, clothed with a patch

of spatulate to lingulate pale brown scales towards the tip and with short golden bristles. Proepimera without scales. Mesonotum elongate, narrow, dark greyish pruinose on a broad central band, blackish brown anteriorly on both sides; the central band with a median narrow blackish stripe extending the whole length of the disc, two submedian bare dark brown lines on the anterior half, two sublateral broader bare lines of similar colour on the posterior two-thirds, a narrow blackish line running along near the inner side of each posterior sublateral bare line, and a blackish bare spot in front of the scutellum; sparse pale golden hairs all over the dorsum; a patch of lanceolate brownish white scales and lingulate ones of similar colour medianly on the anterior margin; a group of lanceolate pale brown scales and broad lingulate ones of similar colour at each shoulder; dorsal and marginal bristles rather short, pale golden to dark brown. Scutellum collar-like, dark grey, with a blackish spot at the centre, clothed with pale golden hairs, and marginal pale golden to dark brown bristles. Postnotum dark brown, slightly pruinose, nude. Pleurae greyish pruinose, with three broad blackish brown stripes; spiracular bristles about ten in number, small, golden; pre-alar, stenopleural, and upper mesepimeral bristles all numerous, rather short, pale golden, being accompanied with a few lanceolate pale scales.

Abdomen: Form depressed, truncate at the tip; dorsum brownish black, entirely clothed with pale golden hairs; venter clothed with similar hairs, and bearing a few linear-lanceolate pale golden scales along the median longitudinal line, seventh sternite with a patch of lingulate to spatulate scales in the middle towards the posterior margin, most of the scales blackish, but some in front pale golden; cerci sickle-shaped, nearly three times as long as wide, blackish, covered with small setae.

Wings: Petiole of the second marginal cell a little less than one-third as long as its cell, that of the second posterior cell about one-half as long as its cell; basal cross-vein distant about its own length from the anterior cross-vein; outstanding scales of veins broad-lanceolate, narrower and more pointed than those in *A. hyrocanus* var. *sinensis*, coloured yellowish white and black; costa with four black patches, the first of them small, lying just before the junction of the humeral cross-vein, the second about one-tenth as long as the costa, distant about one-third its own length from the first, the third nearly one-sixth as long as the costa, lying apart by its own length from the second, the fourth nearly one-fifth as long as the costa or sometimes as long as the third, distant about two-thirds its own length from the third; subcosta with a long black patch which corresponds to the third costal patch; first vein with five black patches, the first of them corresponding to the second costal patch, the second small about one-third as long as the first, distant nearly its own length from the first, the third nearly as long as the first, the fourth just as long as the second, the third and fourth lying below the third costal patch, the fifth corresponding to the fourth costal patch in length and in situation; second vein with two black patches on its stem,

one at the base and the other about the middle, and also two patches on each of its branches, one at the base and the other at the tip; third vein with three black patches, one at the base, one about the middle and another at the tip, the middle and apical ones in some specimens being ill-defined by intermixture of white scales; fourth vein with two black patches on its stem one lying towards the base and corresponding to the second costal patch; the other very long, taking up about the distal half of the stem; each branch of fourth vein with a black patch at the middle and another at the tip, these two black patches are sometimes connected with each other as there appear black scales between them; fifth vein with a black patch about the middle of its stem, four on the anterior branch, the first lying at the base and the fourth at the tip, and one small patch close to the tip of the posterior branch; sixth vein with three black patches, the first of them small, lying at the base, the second and third rather long, the former lying about the middle, the latter at the tip; fringe dark brown, with two yellowish white patches, one extending from the tip of the anterior branch of the second vein to the tip of the third vein, the other very prominent, lying opposite the tip of the posterior branch of the fifth vein.

Legs: Femora and tibiae brownish-black above, pale yellowish brown beneath, with yellowish white bands at their bases and tips: fore and mid tarsi brownish black, with rather broad yellowish white bands at the bases of first three joints and at the tips of first two joints and in some specimens, narrow inconspicuous bands at the tips of the third and fourth joints; all joints of the hind tarsi with rather broad yellowish white bands at their bases and tips except for the tip of the last joint. Claws all equal and without tooth.

Length in mm.: Head 0.50; thorax 1.83; abdomen 3.60; proboscis 2.80; wing 5.60.

DISTRIBUTION. — Inokashira near Tokyo (9. iii. 1921, S. Hirayama).

HABITS. — In early spring the collector has brought to me twenty living females of the species. Most of them were found under the roof of a cottage where they seemed to have passed over the winter there. They bited readily my hand in darkness.

RELATION TO DISEASES. — No evidence.

TYPE. — The syntype (No. 9) consists of five females.

NOTE. — This is a large species, a little larger than *A. hyrcanus* var. *sinensis* and comes near two Indian species *A. gigas* Giles (Ent. Month. Mag. Ser. 2. No. 140, p. 196, 1901) and *A. simlensis* (James) (Anop. Mosq. of India, 2nd ed. p. 66, 1911; Patagiamyia simlensis). In consulting with the types of the two Indian species in the British Museum, I could easily distinguish the Japanese species from both of them. They differ from the Japanese species in having narrow pale bands at the articulation of the palpi and bearing no scales on the seventh abdominal sternite. Moreover *A. gigas* has four black patches on the costa which differ from those of the Japanese in size and in position and the

sixth vein clothed with black scales on about basal two-thirds and on the apical one-sixth. *A. simlensis* is furthermore distinguished from the Japanese by having five black patches on the costa, the entirely black-scaled sixth vein and the mid femora with a broader white patch extending about apical one-eighth. These differences enumerated above seem to be sufficient to consider this mosquito as a distinct species.

I dedicate this species to Mr. Edwards to express my cordial thanks for his kindness extended to me when I was studying the Culicidae in the British Museum.

(To be continued).
