Studies on the Calypterate Muscoid Flies from Japan.V.Revision of the Tribe Luciliini(Diptera,Calliphoridae)

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Studies on the Calypterate Muscoid Flies from Japan
V. Revision of the Tribe Luciliini
(Diptera, Calliphoridae)

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The tribe Luciliini consist of three genera, *Lucilia*, *Hemipyrellia* and *Francilia*, containing a large number of closely allied species of similar appearance which are called the green-bottle flies. Many species of the *Lucilia* are of economic and medical importance through their range, sometimes in cosmopolitan extent. The genus *Hemipyrellia*, whose distribution is restricted to the tropical and temparate zone of the Old World, is also medically important. The genus *Francilia* is known from Alaska and Scandinavia and not yet found in Japan. Nine species of Luciliini have been already fully redescribed by Hori (1950, 1955) in Japanese. In the present paper, eleven species of *Lucilia* and one of *Hemipyrellia* are dealt with, including the following three species besides Hori's records : *Lucilia bazini* Séguy, *L. snyderi* James and *L. silvarum* (Meigen).

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Tribe Luciliini

Lucilia Rob.-Desvoidy

(1830, Ess. Myod. 2, p. 452)

Syn. : *Somomyia* Rondani, 1861 (p. part)
Phaenicia Rob.-Desvoidy, 1863
Phumonesia Villeneuve, 1914
Bufolucilia Townsend, 1919

Roubaudiella Séguy, 1925
Dasylucilia Rohdendorf, 1925
Caesariceps Rohdendorf, 1925
Luciliella Malloch, 1926
Viridinsula Shannon, 1926
Chaetophaenia Enderlein, 1936
Acrophagella Ringdahl, 1942

Type-species : *Musca caesar* Linné

Length 5–12 mm, colour metallic green to blue, sometimes with coppery or purple reflection, and entirely black in a few cases.

Head : eyes bare, usually more or less approximated in male, separated in female, but dichoptic in male of *Lucilia bufonivora*, *L. sericata*, *L. cuprina*, etc., subholoptic in male of *L. papuensis*, *L. illustris*, etc. ; parafrontalia and parafacialia covered with silver or golden pollinosity ; arista long-plumose ; jowls one-third of eye-height ; vibrissae ascend almost half-way up to facialia ; facialia inconspicuous. Thorax : parasquamal and tympanic tufts present on suprasquamal ridge; squamae bare. Abdomen : second visible tergite with or without erect marginal bristles ; discal bristles only on last tergite. Wings : third longitudinal vein bristly both above and below as far as anterior cross-vein. Legs : brown to black ; *ad* on mid tibia usually 1, but 2–3 in some cases.

Distribution : cosmopolitan.

The problem of the subdivision of the *Lucilia*

It has been said that within the *Lucilia* s. lat., there are certain groups which might be well given subgeneric or generic rank. Some American authors prefered to subdivide this genus into three groups, "*Bufolucilia*", "*Phaenicia*" and "*Lucilia* s. str.", recognizing them as subgenera or distinct genera (Malloch, 1926 ; Hall, 1948 ; James, 1962). Aubertin (1933), Waterhouse & Paramonov (1950), and Zumpt (1956), however, have not regarded this treatment as adequate. Thus, the taxonomy of this group is still different among dipterists and attempts based upon rigourously phylogenetic principles may be required to clarify the classification of the group. From this point of view, some of the characters of the *Lucilia* s. lat. are analysed below to establish which views are suitable.

The comparative morphology of phallosomes indicates that *Lucilia* s. lat. can be clearly divided into three main natural groups, "*richardsi*-group", "*cluvia*-group" and "*fumicosta*-group". The members of these three groups are shown in Table 1. Each group has a definite type of phallosomes, which gradually developes in the same group as other external characters do so (Figs. 1 & 2). The phallosomes of Type-1 have a deep indentation near the corn on the vesica and a long juxta, which can be seen in the *fumicosta*-group. Type-2 represents the slender phallosomes with many small

indentations on the margin of vesica and with a long juxta. This type is concerned with the *cluvia*-group. Type-3 is reprsentative of the stout phallosomes having the vesica with a broad shallow indentation and a short juxta. The last type is found in many members of the *richardsi*-group. Phallosomes of these three types, however, are essentially common in the ground plan of the structure: vesica well developed; paired harpes separated distinctly; base of harpes or harpesbasis on either side united with each other anteriorly; juxta developed; ventral sclerotization between vesicae strong, united with harpesbasis; the posterior process of theca or spinus long.

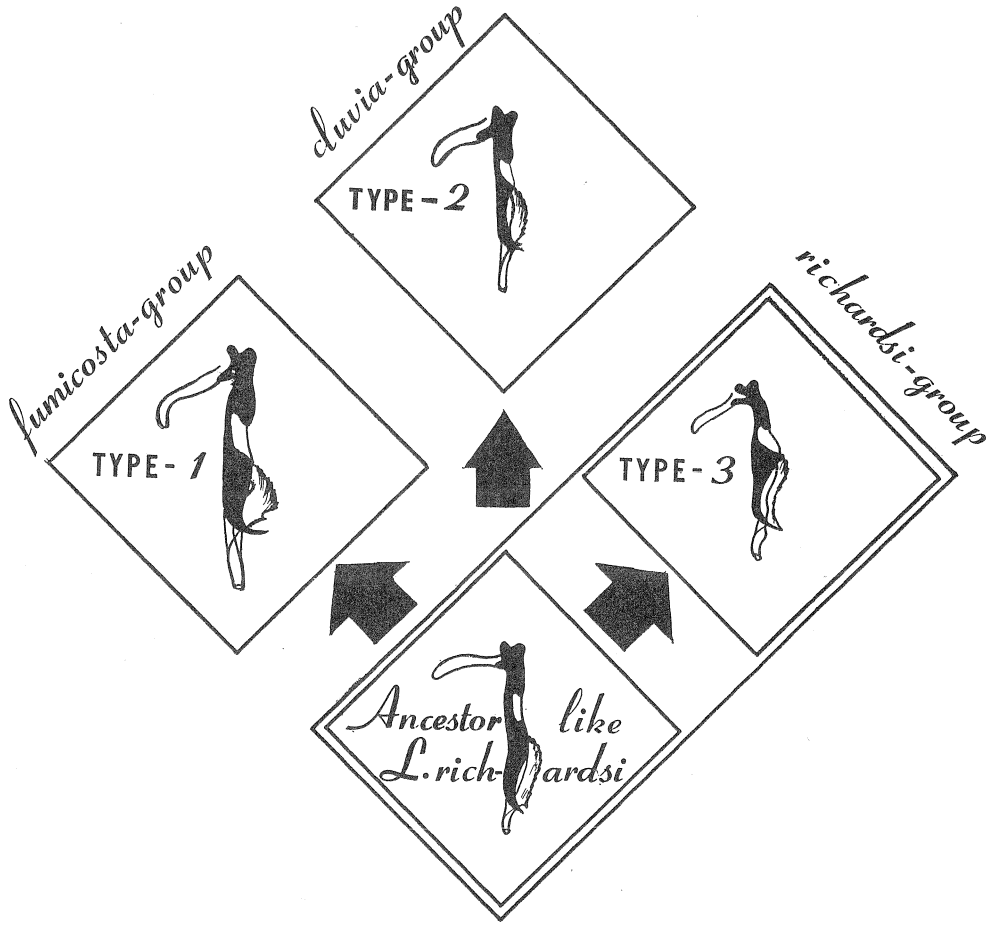

Fig. 1. Four phallosomes of the postulated ancestral and advanced types.

Accordingly the three phallosomal types seen in these blowflies can be easily derived from a common ancestral type which resembles the phallosome of *L. richardsi* belonging to the *richardsi*-group. In other words the sister-group relationship exisits among these three groups. Also from the other external morphology of the adult, the characters which are useful for the phylogeny are derived. The dichoptic eyes of males may be considered to be plesiomorph in these blowflies. This feature is found

Table 1. Data matrix

Groups and species	Character states			
	Eyes	Subcostal sclerite	Basicosta	Phallosome
***richardsi*-group**				Ancestral type
Lucilia richardsi Collin, 1926	−	+	−	−
L. regalis (Meigen, 1826)	−	+	−	+
L. pilosiventris Kramer, 1910	−	−	−	++
L. pilosa Baranov, 1926	−	−	−	?
				Type-3
L. cuprina (Wiedemann, 1830)	−	−	−	+++
L. pallescens Shannon, 1924	−	−	−	++++
L. sericata (Meigen, 1826)	−	−	−	+++++
L. bufonivora Moniez, 1876 (? =*L. elongata* Shannon, 1924)	−	−	++	+++
L. silvarum (Meigen, 1826)	−	−	++	++++
L. thatuna Shannon, 1926	+	−	−	++++++
***cluvia*-group**				Type-2
L. cluvia (Walker, 1849) (? = *L. problematica* Johnson, 1913)	−	−	−	+
L. eximia (Wiedemann, 1819)	+	−	+	++
L. caeruleiviridis Macquart, 1855	++	−	−, +	+++
L. ibis Shannon, 1926	++	−	+	?
L. rica Shannon, 1926	++	−	−	?
L. mexicana Macquart, 1843	+	−	++	+++
L. purpurescens (Walker. 1837)	++	−	++	++++
L. ochricornis (Wiedemann, 1830)	+	−	++	?
L. japuhybensis (Mello, 1961)	?	?	?	++++
L. illustris (Meigen, 1826)	+	++	++	++++
L. caesar (Linné, 1758)	++	+	++	+++++
? *L. pionia* (Walker, 1849)	−	−	−	?
***fumicosta*-group**				Type-1
L. fumicosta Malloch, 1926	+	+	++	+
L. papuensis Macquart, 1842	+	++	++	++
L. bazini Séguy, 1934	++	++	++	+++
L. sinensis Aubertin, 1933	++	++	++	++++
L. graphita Shannon, 1926	++	++	+	+++++
L. snyderi James, 1962	++	++	++	+++++
L. porphyrina (Walker, 1857)	++	++	++	++++++
L. ampullacea Villeneuve, 1922	++	++	++	++++++
? *L. andrewi* Senior-White, 1940	++	?	++	?
?? *L. infernalis* (Villeneuve, 1914)	++	++	++	?
Evolutional trend of characters − Plesiomorph +, ++ Apomorph	++ holoptic ↑ + subholoptic ↑ − dichoptic	++ hairly (black hairs) ↑ + hairly (brown hairs) ↑ − pubescent	++ black ↑ + dark brown ↑ − yellow	++++++ ↑ ++ ↑ −

in restricted forms of calypterate flies while it occurs in the majority of acalypterate flies generally regarded to be more primitive than the former. In process of evolution, eyes seem to become from dichoptic to holoptic according to the increase of their size. Black basicosta may be apomorph, and can be considered to be derived from the yellow one. In young adults just emerged from pupae, basicostal sclerites are always yellow, and subsequently darkened. Black hairs on the subcostal sclerites may be an apomorph feature of this group, while brown short hairs on the sclerites may be less advanced. In the present study the latter feature, which can be seen in *L. richardsi* and *L. regalis*, is regarded as plesiomorph for purpose of convenience. The pubescence on subcostal sclerites may be plesiomorph. The transitional condition of this character can be seen in *L. illustris*, whose subcostal sclerites have a few inconspicuous wiry black hairs among thick dark brown decumbent pubescence. This is regarded as an apomorph feature in the present paper. The characters in transitional condition are treated as apomorph or plesiomorph in some cases for convenience' sake when the dendrogram is constructed. The progressive change in the shapes of phallosomes is more or less parallel to that in these external characters given above, as shown in Fig. 2. In Fig. 2, is illustrated a probable phylogeny of the genus *Lucilia*, which is based upon the continuous range in phallosomal forms and the other external morphology. It indicates that the *richardsi*-group is most primitive among these three groups.

Another important evidence of the evolution may come from a study of the geographical distribution, which shows more or less clear patterns in each group, as illustrated in Figs. 3, 4 & 5. The *fumicosta*-group is certainly indigenous in the Combined Oriental and Australian Region. Two species of this group, *Lucilia graphita* and *L. snyderi* are found only on the Hawaiian and Bonin Islands at present. They may have been isolated on these islands of the Pacific Ocean and differentiated from the ancestoral population of Indo-Malayan origin to the new endemic form in the respective Islands. Such long distance migration of a fraction of the population from the Indo-Malayan region to these Islands may be possible by chance by means of ocean current, wind as well as flight. If an endemic form, *Lucilia andrewi* Sen.-White, on Christmas Island of the Indian Ocean certainly belongs to this group, the same process of differentiation may be explained. The *cluvia*-group is fundamentally an inhabitant in the New World. Of this group, *Lucilia illustris* and *L. caesar*, however, show somewhat different distributions from the other members of this group, as shown in Fig. 4. It can be interpreted that *L. illustris* was originally established in North America and may have later appeared to the Palearctic, Oriental and Australian Regions. *L. caesar* which have a teritory in the Palearctic Region seems to be an aberrant member of this group. This species might be recently differentiated there from such an ancestral form as *L. illustris*. *Lucilia richardsi*, *L. regalis* and *L. pilosiventris* of the *richardsi*-group, which are most primitive in morphology, are endemic in southern Eurasia, often in older mountain chains from

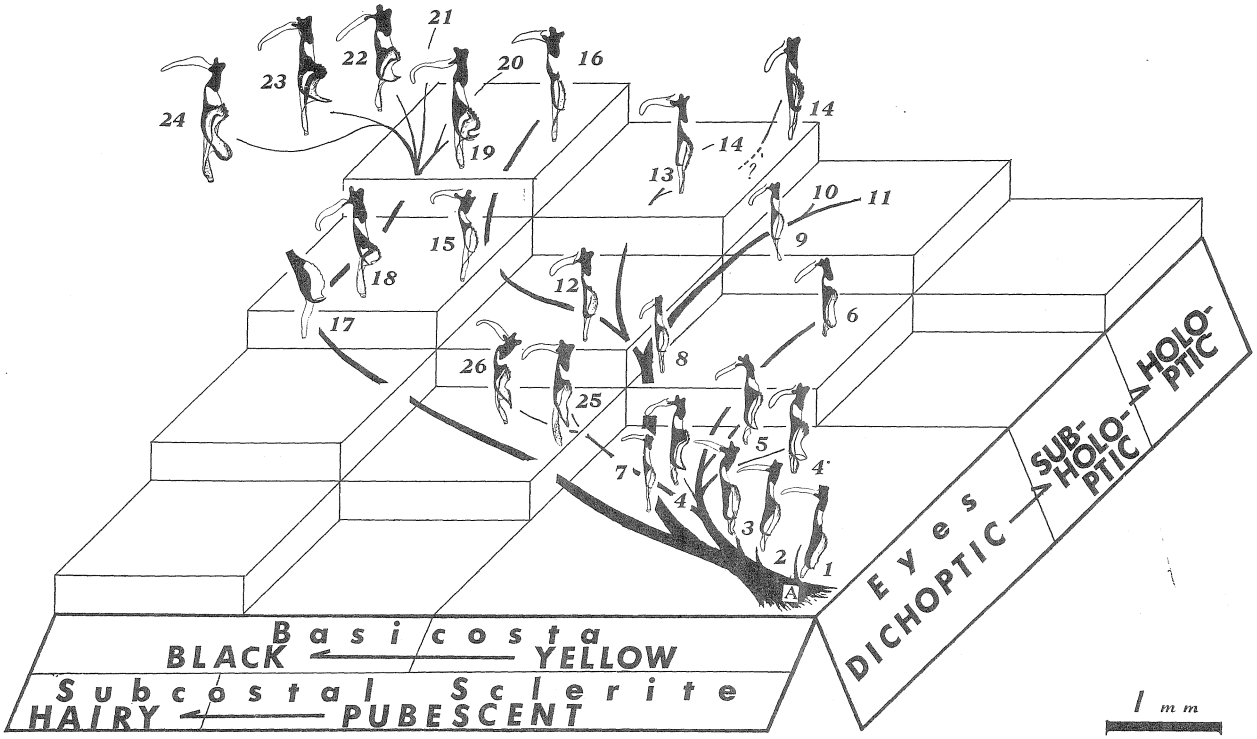

Fig. 2. Pictorial phylogeny of *Lucilia* on the basis of the phallosomes. 1–6, 25–26 : *richardsi*-group, 7–16 : *cluvia*-group, 17–24 : *fumicosta*-group, A : Probable ancestor, 1 : *L. richardsi*, 2 : *L. regalis*, 3 : *L. pilosiventris*, 4 : *L. cuprina*, 4' : *L. pallescens*, 5: *L. sericata*, 6: *L. thatuna*, 7: *L. cluvia*, 8: *L. eximia*, 9: *L. caeruliviridis*, 10: *L. ibis*, 11 : *L. rica*, 12 : *L. mexicana*, 13 : *L. purpurascens*, 14 : *L. ochiricornis*, 14' : *L. japuhybensis*, 15 : *L. illustris*, 16 : *L. caesar*, 17: *L. fumicosta*, 18: *L. papuensis*, 19: *L. bazini*, 20: *L. sinensis*, 21: *L. graphita*, 22: *L. snyderi*, 23 : *L. porphyrina*, 24: *L. ampullacea*, 25: *L. silvarum*, 26: *L. bufonivora*.

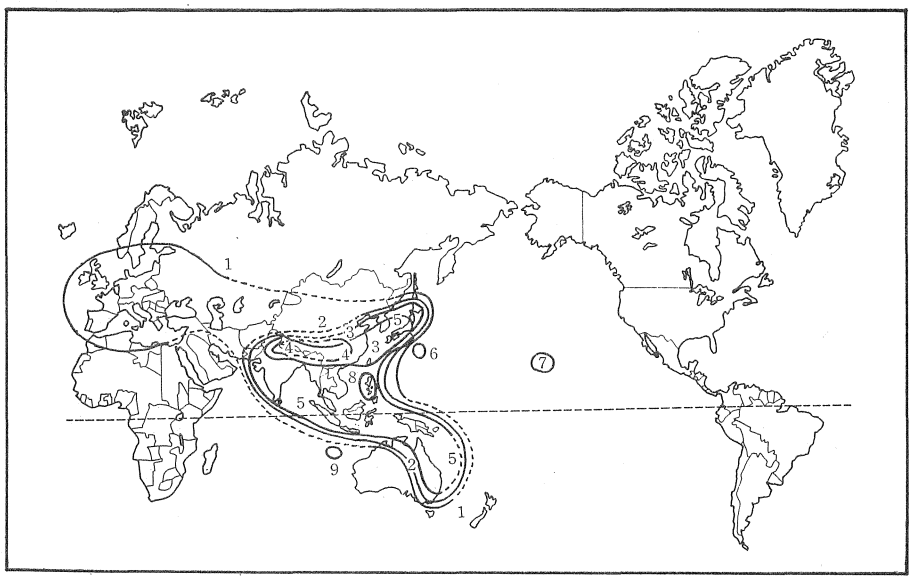

Fig. 3. Approximate limits of distributions of members belonging to the *fumicosta*-group. 1: *L. ampullacea*, 2: *L. papuensis*, 3: *L. bazini*, 4: *L. sinensis*, 5: *L. porphyrina*, 6: *L. snyderi*, 7: *L. graphita*, 8: *L. fumicosta*, 9: *L. andrewi*.

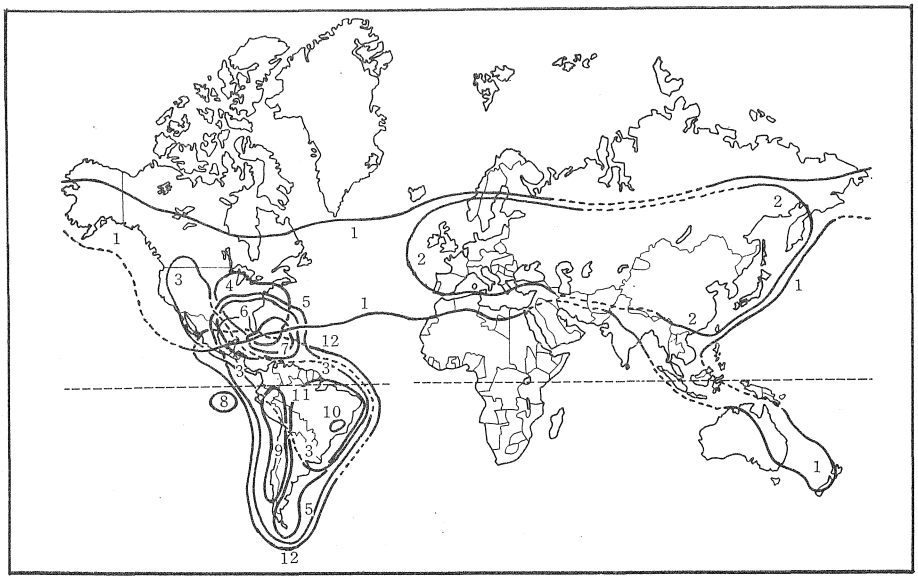

Fig. 4. Approximate limits of distributions of members belonging to the *cluvia*-group. 1: *L. illustris*, 2: *L. caesar*, 3: *L. mexicana*, 4: *L. caeruliviridis*, 5: *L. eximia*, 6: *L. cluvia*, 7: *L. rica*, 8: *L. pionia*, 9: *L. ibis*, 10: *L. japuhybensis*, 11: *L. ochiricornis*, 12: *L. purpuracens*.

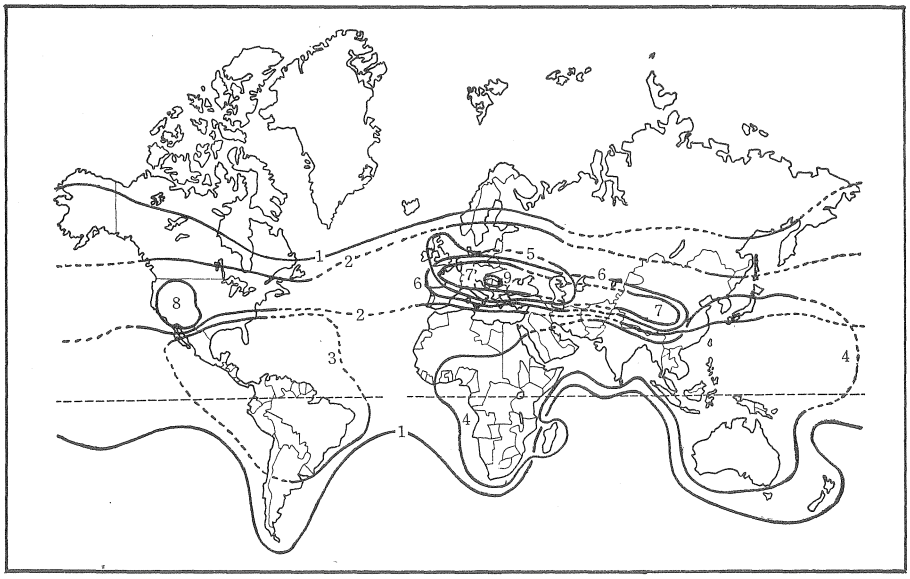

Fig. 5. Approximate limits of distributions of members belonging to the *richardsi*-group. 1: *L. sericata*, 2: *L. bufonivora* & *L. silvarum*, 3: *L. pallescens*, 4: *L. cuprina*, 5: *L. richardsi*, 6: *L. pilosiventris*, 7: *L. regalis*, 8: *L. thatuna*, 9: *L. pilosa*.

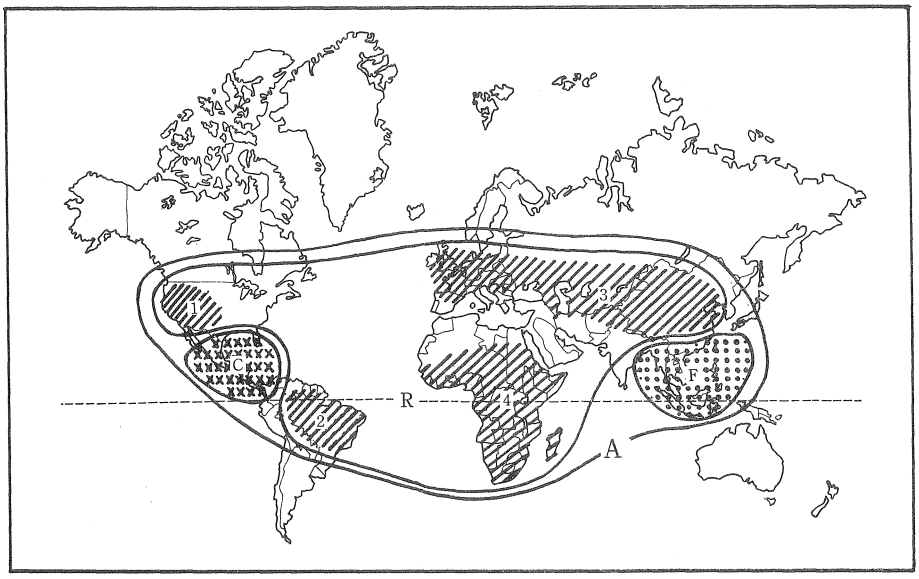

Fig. 6. Probable extent of ancestor and centre of distributions of three groups now existing. A: Extent of ancestor, C: Centre of *cluvia*-group, F: Centre of *fumicosta*-group, R: Centre of *richardsi*-group, 1: Area of *L. thatuna*, 2: Area of *L. pallescens*, 3: Area of *L. richardsi*, *L. regalis*, *L. pilosiventris* and *L. pilosa*, 4: Area where *L. cuprina* inhabited originally.

Tibet to Europe. *Lucilia thatuna* is preserved in western parts of the United States of America, as James has recorded from Colorado, Montana, Idaho, Washington and California. *Lucilia pallescens*, which is very closely related to *Lucilia cuprina*, is distributed in southern United States and Brazil. *Lucilia silvarum*, *L. bufonivora* and *L. sericata* are considered to inhabit originally in the Palearctic Region, or widely in Holarctic Region, and have been long preserved there. *Lucilia cuprina* is also considered to be of African origin. At present, however, *L. sericata* and *L. cuprina* become more or less cosmopolitan. It is most probable that they have been recently transported by man from their older habitats to other new parts of the world, as suggested by Aubertin (1933), Zumpt (1956) and Mello (1961).

From the view point of the distribution and the facts mentioned below, the *richardsi*-group can be considered as an older group. According to Kolbe (1913), the extensive region of Central Asia should be considered as the centre of all palearctic faunas. The present-day animals of this area belong predominantly to an ancient extensive endemic element, being preserved for a long time. For example, Mani (1962) said that the closest relatives of the mountain authochthone endemic elements in the Himalayan fauna are found on Central Asiatic mountains, often extending over older mountain chains from Asia to Alaska, Canada and north-western parts of the United States of America. The striking similarity of the Nearctic and the Central Asiatic, Tibetan and Himalayan species has been stressed by a number of workers like van Dyke (1929). van Dayke is of the view that, at least in the case of Carabidae, Central Asia must be considered as the main centre of distribution of the entire Holarctic fauna. He believes that the fundamental elements of highlands of Asia have spread to north Asia, Europe and America. These peculiarities in fauna seem to be characteristic not only of insects but also of other taxonomically wholly unrelated groups such as triclad Turbellaria. Hyman (1934) has, for example, recently drawn attention to the fact that the fresh-water Planarians from the Himalaya and from Tibet are remarkably similar to those from the United States and in some cases almost indistinguishable from them. We may also recall here that the distributions of the species belonging to the *richardsi*-group were restricted to the limited areas of the older mountain chains from Africa to north-western parts of the United States. Therefore, a probable ancestor of *richardsi*-group, which may be also considered to be that of the *Lucilia* s. lat., seems to have been widely distributed in the continents of Africa, Eurasia, and North and South America (Fig. 6 A). Each member of the *richardsi*-group was later differentiated from the ancestral form in each respective continent, remaining up to relatively recent ages in a limited area of North and South America, Southern Eurasia and Africa, respectively (Fig. 6 1–4). The centre of distribution of *fumicosta*- and *cluvia*-group can be seen in the East and West Indies, respectively, lying to east and west peripheries of the hypothetical extent of ancestor (Fig. 6 C, F). This may suggest that the earlier isolation from the ancestral form occurs in these areas, resulting in differentiation of two new groups.

Three natural groups of the *Lucilia* s. lat. seem to be differentiated from a probable ancestor, which is closely related to the most primitive form in each group, namely *Lucilia richardsi*, *L. cluvia* and *L. fumicosta*. There is no evident gap to segregate from each other in external characters among three groups. These facts led the present author to consider the *Lucilia* s. lat. as a monophyletic generic taxon. According to the present study, subdivision of *Lucilia* s. lat. into "*Phaenicia*" and "*Lucilia* s. str." seems to result in that each of them includes heterogeneous members of the phylogeny, and not to be suitable to new systematics. In the present paper, therefore, the author erects three new "groups" with the indipendent names, *richardsi*-, *cluvia*- and *fumicosta*-group to avoid taxonomical confusion.

Key to the species of *Lucilia*

1. Body entirely black or purple, without typical green tinge. *Bonin and Izu-shichito Isls.* ..... (2)
— Body blue to green, sometimes with coppery or purple tinge partly ..... (4)
2. Antennae and tibiae brownish ; postsutural *ac* 3, sometimes 2 in female.....*L. porphyrina*
— Antennae and tibiae black; postsutural *ac* always 2 ..... (3)
3. Second visible tergite of male with well-developed marginal bristles. *Bonin Isls.* ..... *L. snyderi*
— Second visible tergite of male without marginal bristles. *Izu-shichito Isls.* ...*L. ampullacea*
4. Basicosta light brown ..... (14)
— Basicosta black ..... (5)
5. Second visible tergite with strong erect median marginal bristles ; subcostal sclerite pubescent ..... (6)
— Second visible tergite without marginal bristles ; subcostal sclerite with upstanding black hairs ..... (7)
6. Postsutural *ac* 2 .....*L. bufonivora*
— Postsutural *ac* 3 .....*L. silvarum*
7. Anterior pair of postsutural *ac* usually more advanced than the second pair of postsutural *dc* ; second and third visible tergites without dark marginal bands posteriorly ; in both sexes only one *ad* present on mid tibia ..... (8)
— Anterior pair of postsutural *ac* level with, or slightly posterior to second pair of postsutural *dc*; second and third visible tergites with dark marginal bands posteriorly; in male one, in female two *ad* present on mid tibia ..... (13)
8. Tibiae brown; upper squama infuscated, with a tuft of blackish brown hairs on inner lower margin ..... *L. porphyrina*
— Tibiae black ; upper squama whitish, with a tuft of yellowish white or brown hairs on inner lower margin ..... (9)
9. ♂ ..... (10)
— ♀ ..... (12)
10. Eyes dichoptic, separated by the width of third antennal segment .....*L. illustris*
— Eyes holoptic, closely approximated ..... (11)
11. Hypopygium shining green, rather prominent.....*L. caesar*
— Hypopygium black, inconspicuous or invisible ..... *L. ampullacea*
12. Frons broad, at bases of antennae conspicuously broader than the length of third antennal

segment (Fig. 7 a) ; lower squama white ; sixth tergite balck, straight in profile, with complete series of marginal bristles (Fig. 8 A) ..... *L. illustris*

— Frons about as same as length of third antennal segment (Fig. 7 b); sixth tergite metallic green, slightly inflatted, with only one or two pairs of very short marginal bristles in the mid-line (Fig. 8 B) ..... *L. caesar*

-- Frons smaller in width than the length of third antennal segment (Fig. 7 c) ; sixth tergite black, straight in profile, with complete series of marginal bristles (Fig. 8 C)..... ..... *L. ampullacea*

13. ♂: upper squama with a tuft of yellowish brown hairs on inner lower margin ; posterior margins of second and third visible tergites narrowly darkened. ♀ : upper and lower squamae having same brightness ..... *L. bazini*

— ♂: upper squama with a tuft of blackish brown hairs on inner lower margin ; posterior margins of second and third visible tergites broadly darkened. ♀ : upper and lower squamae having different brightness ..... *L. papuensis*

14. ♂: abdomen elongate, somewhat arched in profile ; sternites with tufts of long hairs ; hypopygium prominent. ♀ : body coppery, with dense pruinosity; cerebrale bearing only one occipital hairs on each side (Fig. 10 A) ..... *L. cuprina*

— ♂ : abdomen more or less oval, not arched in profile, sternites without tuft of long hairs ; hypopygium inconspicuous. ♀ : body green, sometimes golden, with sparse pruinosity ; cerebrale bearing 5–8 hairs on each side (Fig. 10 B) ..... *L. sericata*

1. *cluvia*-group

Lucilia caesar (Linné)

(Japanese name: Kinbaë)

(1758, Syst. Nat. 10, p. 595; Löw, 1858, Wien. Ent. Mon. 2, pp. 100–112; Coquillett, 1898, Proc. U. S. Nat. Mus. 21, p. 334; Lundbeck, 1927, Dip. Dan. 7, p. 147; Shiraki, 1932, Icon. Ins. Jap. p. 21; 1958, Sanit. Ins., p. 997; Aubertin, 1933, Linn. Soc. J. Zool. 38, p. 400; James, 1947, Flies that cause Myiasis Man, p. 84; Hori, 1950, Misc. Rep. Res. Inst. Nat. Reso. 16, p. 16; Takano, 1950, Icon. Ins. Jap. revised edit. p. 1693; Kano & Sato, 1951d, Jap. J. Exp. Med. 21, p. 233; Kano, 1954, Nippon no Hae, p. 18; 1965, Icon. Ins. Jap. Colore Naturali Edita 3, p. 234; Takeuchi, 1955, Gensyoku Nippon Konchu Zukan, p. 154; Zumpt, 1956, Lind. Fliegen pal. Reg. 64i, p. 45; Park, 1960, Stud. Flies Korea 1, p.46)

Syn.: *Somomyia jeddensis* Bigot (1877, Ann. Soc. Ent. France, vol. 5, no. 7, p. 255).

This palearctic species is commonly found on fields in spring and fall in Japan.

Length: 6–10 mm.

Bionomics: No description of the larval stage has hitherto be given. The biology and the pathogenesis are briefly reported by James (1947).

Geographical distribution: Japan (Hokkaido, Honshu, Kyushu, Shikoku), Korea, Manchuria, China, Siberia, Europe, Morocco, Libia, Madeira, and Canary Isls,

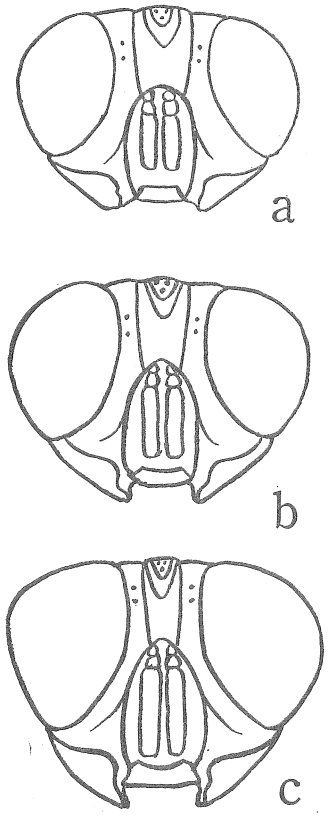

Fig. 7. Anterior view of heads, females. a: *Lucilia illustris*, b: *L. caesar*, c: *L. ampullacea* (after T. Spence).

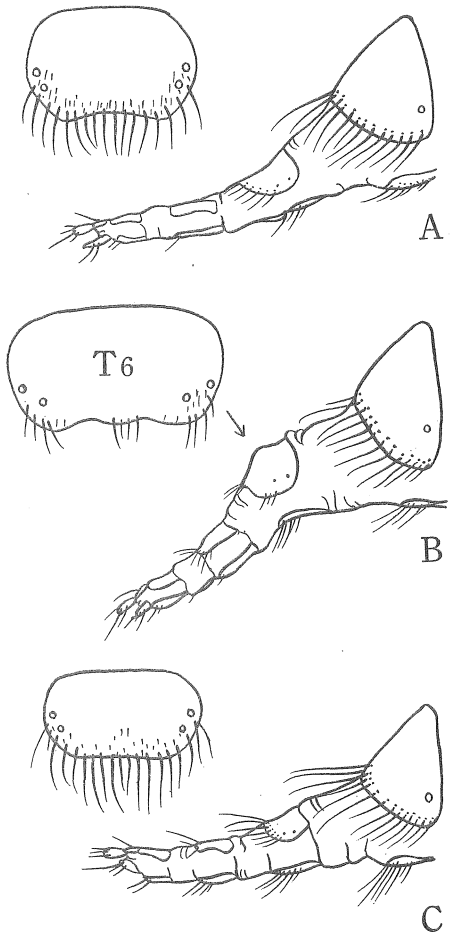

Fig. 8. Profiles of ovipositors. A: *Lucilia illustris*, B: *L. caesar*, C: *L. ampullacea*, T_6: Sixth tergites, dorsal view. (after T. Spence, slightly modified).

Lucilia illustris (Meigen)

(Japanese name: Midori-kinbaë)

(1826, Syst. Beschr. 5, p. 54; Aubertin, 1933, Linn. Soc. J. Zool. 38, p. 402; James, 1947, Flies that cause Myiasis Man, p. 85; Hori, 1950, Misc. Rep. Res. Inst. Nat. Reso. 16, p. 17; Takano, 1950, Icon. Ins. Jap. revised edit., p. 1693; Kano & Sato, 1951d, Jap. J. Exp. Med. 21, p. 233; Kano, 1951e, Ill. Pocket Book Ins. Larv., p. 310; Kano & Sato, 1952, Jap. J. Exp. Med. 22, p. 34; Kano, 1954, Nippon no Hae, p. 18; 1959, Ill. Ins. Larv. Jap., p. 697; 1965, Icon. Ins. Jap. Colore Naturali Edita 3, p. 234; Zumpt, 1956, Lind. Fliegen pal. Reg. 64i, p. 48; Shiraki, 1958, Sanit. Ins., p. 1000; Park, 1960, Stud. Flies Korea 1, p. 47)

This is the commonest form among Japanese fauna of *Lucilia*, usually lives out-of-doors, especially around the houses. The female cannot be easily distinguished from it of *L. caesar* by the external appearance, but may differ from it by the more broader and parallel-sided frons (Fig. 7 a). The male also has a somewhat broader frons as compared with *L. caesar*, *L. ampullacea* and *L. porphyrina*.

Length: 6–10 mm.

Bionomics : Adults are oviparous, most frequently on garbage and grasses around the houses in Japan. The habits of adult flies were reported by R. A. Wardle (1930) and D. C. Hall (1947). The larva is normally a scavenger, most frequently occurs in carrion and garbage, but it occasionally becomes parasitic. Cases of myiasis of human open wound and ulcer (James, 1947), subdermal myiasis of young foxes (Kingscote, 1932; Hall, 1947), and parasitism in a larva of a moth *Dictyoploca japonica*, (Mizukami, 1964) were reported. The descriptions and figures of larval stage were given by D. C. Hall (1947) and R. Kano (1951e, 1952, 1954 & 1959).

Geographical distribution: Japan, Korea, Manchuria, China, Siberia, Central Asia, Burma, India, Europe, North America, Australia, and New Zealand.

2. *fumicosta*-group

Lucilia porphyrina (Walker)

(Japanese name: Suneaka-kinbaë)

(1857, J. Proc. Soc. 1, p. 24; Aubertin, 1933, Linn. Soc. J. Zool. 38, p. 408; S.-White, Aubertin & Smart, 1940, Fa. Brit. India, Dipt. 6, p. 53; Hori, 1955, Bull. Biogeog. Soc. Jap. 6–19, p. 231; Zumpt, 1956, Lind. Fliegen pal. Reg. 64i, p. 50; Kano, 1959, Ill. Ins. Larv. Jap., p. 697; 1965, Icon. Ins. Jap. Colore Naturali Edita 3, p. 234; Park, 1960, Stud. Flies. Korea 1, p. 48)

Syn.: *Somomyia japonica* Bigot (1877, Ann. Soc. Ent. France, vol. 5, no. 7, p. 254).

This species seems to be widely distributed in the southern parts of Japan. The adults usually have metallic green to blue body, brown tibiae, very dark brown squamae and wings tinged with brown smoke at bases. But, materials collected from Izu-shichito Isls. have different appearance from typical *L. porphyrina*. The colouration of body is purple to black. Postsutural acrostichal bristles are usually three pairs, sometimes two in female. Genitalic evidence shows that the materials exactly agree with *L. porphyrina*.

Length: 8–11 mm.

Bionomics: Adults occur out-of-doors in early spring and late fall, and will spend winter in a small hole under ground solitarily or in a group (Ôkawa, 1966). Larvae breed in the carcases of birds and other animals. Only one case of myiasis of toads, *Bufo melanostictus*, was reported from India (Dasgupta, 1962). The description and figures of the larval stage were given by R. Kano (1959).

Specimens examined: 1♂, 2♀, Torishima Is., Tokyo, 18–22. iv. 1959 (H. Yamamoto leg.); 1♂, 1♀, 14–16. i. 1961 (K. Shirai leg.); 2♀♀, Miyake Is., Tokyo, 17–23. ix. 1963 (K. Miyamoto & S. Maeda leg.); 1♀, Izu-Oshima Is., Tokyo, 28. iv. 1964 (H. Kurahashi leg.).

Geographical distribution: Japan (southern parts of Honshu, Izu-Hachijojima Is., Torishima Is., Shikoku, Kyushu, Amami-Oshima Isls., Tsushima Is.), Korea, China, Malay, India, Ceylon, Sumatra, Krakatoa Is., Java, Philippines, and Australia.

Lucilia snyderi James

(Japanese name: Ogasawara-kinbaë)

(1962, Ins. Micronesia vol. 13, no. 4, p. 115)

One paratype-specimen is examined by the author. This species is closely related to *L. porphyrina*, especially to the form found in Izu-shichito Isls., and also to *Lucilia graphita* Shannon from Hawaii Isls. *L. snyderi* however differs from them in the entirely black legs, the erect median marginal bristles on the second visible tergite of the male and the shape of the male genitalia.

♂.–Head: eyes bare, closely approximated; frontal stripe black, narrow, reduced to a line posteriorly; parafacialia almost parallel-sided, narrow, silver-dusted; face and jowls usually black, dark-grey dusted; jowls with fine black bristles, scmetimes reddish towards facialia; facialia setulose on their lower two-fifths; antennae black, the third segment slightly reddish at bases; arista long-plumose; palpi yellow to brown.

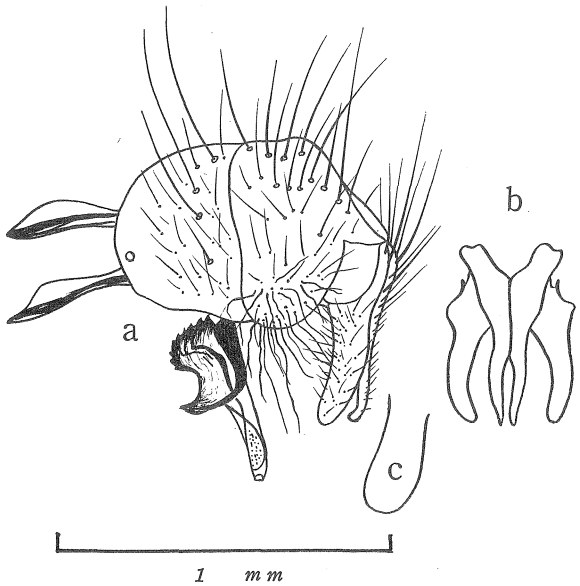

Fig. 9. *Lucilia snyderi* James. a: Lateral view of postabdomen, b: Posterior view of forceps, c: Lateral view of outer forceps of *L. porphyrina*.

Thorax: black, with a purple tinge reflection in certain lights, slightly white-dusted; thoracic spiracles black. Caetotaxy of one paratype examined; *ac* 2−3+2, *dc* 2−3+3, *ia* 1+2, *prs* 1, *ph* 3, *h* 3, *n* 2, *sa* 2, *pa* 2, *st* 1−2+1, *sc* 3+1.

Wings: hyaline, light-brown tinged basally; basicosta and epaulet black; subcostal sclerite yellow, with black setulae; third longitudinal vein setulose half or more distance to anterior cross-vein; lower squama black, upper one paler. Halteres brown.

Legs: black; mid tibia with

a long *ad*, a short *ad*, 2 *p* and 1 *pd*; hind tibia with 2 *av*, 2–3 *ad* and 2 *pd*.

Abdomen: black, with coppery to purplish reflection in certain lights, thinly but distinctly whitish-dusted; second visible tergite with a row of marginal bristles, a few of them erected. Male genitalia small, shown in Fig. 9.

According to the original description——

♀: frons about three-fourths as wide as long; frontal stripe approximately parallel-sided; parafrontalia and parafacialia wider than in male, parafacialia about one-third as wide as distance between vibrissae; upper proclinate fronto-orbital bristles much weaker and not much more than one-half as long as the lower; frontal rows ending between the two fronto-orbital bristles; front tibiae and tarsi black-haired below. Abdomen without erect median marginal bristles on the second visible tergite. Otherwise as described for male.

Length: 5.5–9 mm.

Bionomics: unknown.

Specimen examined: 1♂, paratype, Okimura, Hahajima, Bonin Isls., 26. iv.—9. vi. 1958 (F. M. Snyder leg.).

Geographical distribution: Bonin Isls. (Hahajima).

Lucilia ampullacea Villeneuve

(Japanese name: Kogane-kinbaë)

(1922, Bull. Mus. Paris 28, p. 515; Aubertin, 1933, Linn. Soc. J. Zool. 38, p. 403; S.-White, Aubertin, Smart, 1940, Fa. Brit. India, Dipt. 6, p. 50; Hori, 1950, Misc. Rep. Res. Inst. Nat. Reso. 16, p. 18; Takano, 1950, Icon. Ins. Jap., revised edit., p. 1693; Kano & Sato, 1951d, Jap. J. Exp. Med. 21, p. 233; 1952, Jap. J. Exp. Med. 22, p. 33; Kano, 1954, Nippon no Hae, p. 19; Zumpt, 1956, Lind. Fliegen pal. Reg. 64i, p.44; Park, 1960, Stud. Flies Korea 1, p. 46)

Syn.: *Lucilia laoshanensis* Quo (1952, Acta Ent. Sinica, vol. 2, no. 2, p. 116), **syn. nov.**

The exteral appearance of this species resembles of that of *L. caesar* so closely that it is difficult to be differentiated from it without examining the genitalia. The males of *L. ampullacea* have not such a mettalic green and prominent hypopygium as in males of *L. caesar*. The phallosomes and forcepes are quite different from those of *L. caesar*. The females also are similar to those of *L. caesar* and *L. illustris*, but the frons of *L. ampullacea* is usually narrower than the width of facialia (Fig. 7 c).

The body-colouration of this form shows such conspicuous regional changes as observed in *L. porphyrina*, being bluish green in Hokkaido, Honshu, Shikoku, and Kyushu, and purple to black only in Izu-shichito Isls.

L. laoshaensis Quo described by the unique type from Laoshan, Shantug, China seems to be an abnormal form of *L. ampullacea* with three postsutural *ac* because the

male genitalia and the other external characters agree with those of *L. ampullacea*. Such abnormal forms sometimes are seen among Japanese materials.

Geographical distribution: Japan, Korea, China, India, Europe, Algeria and Australia.

Lucilia bazini Séguy

(Japanese name: Nise-miyamakinbaë)

(1934, Encycl. Ent. B 2, Dipt. 7, p. 15)

Syn.: *Lucilia papuensis*: Park (1962, Korean J. Zool., vol. 5, no. 2, p. 2), **syn. nov.**

This species as well as *L. sinensis* Aubertin is placed as a synonym of *L. porphyrina* by Zumpt (1956). According to the author's examination of a number of Japanese specimens which agree perfectly with Séguy's original description of *L. bazini*, they are different from *L. porphyrina* and other allied species in the male genitalia and the colouration of squamae. The present author prefers to consider them not as a synonym of *L. porphyrina*, but as a separate species. The main characteristics are as follows: eyes closely approximated in male; two pairs of postsutural *ac* inserted at level of two posterior pairs of *dc*; abdomen with narrow dark marginal bands on second and third visible tergites; upper squama white, lower one yellowish brown; female with 2 *ad* on mid tibia; male genitalia shown in Fig. 2 *19*.

Length: 9–13 mm.

Bionomics: *L. bazini* is much more common than *L. porphyrina* and *L. papuensis*, and occurs in mountainous regions.

Geographical distribution: Japan (Hokkaido. Honshu. Kyushu), Korea, and China.

Lucilia papuensis Macquart

(Japanese name: Miyama-kinbaë)

(1842, Mém. Soc. Roy. Agric. Arts Lille, p. 298; Kano & Sato, 1951d, Jap. J. Exp. Med. 21, p. 232; 1954, Nippon no Hae, p. 19; Hori, 1955, Bull. Biogeogr. Soc. Jap. 6–19, p. 231; Zumpt, 1956, Lind. Fliegen pal. Reg. 64i, p. 49)

This species is similar to *L. bazini*, but can be easily distinguished from it by the characteristics which are illustrated by the key. The male genitalia is shown in Fig. 2. *18*, and compared with that of *L. bazini*.

Length: 8–13 mm.

Bionomics: *L. papuensis* is commonly found in mountainous regions. Adults like the animal matters, especially dead earth worms and carcases of other small animals. No description on the larval stage has hitherto been given.

Geographical distribution: Japan, China, Thailand, Malay, Ceylon, India, Philippines, Java, Lombok, Borneo, Celebes, Aru Is., New Guinea, Australia, and Melanesia (New Hebrides).

3. *richardsi*-group

Lucilia bufonivora (Moniez)

(Japanese name: Kaëru-kinbaë)

(1876, Bull. Dep. Nord. Lille 8, p 25; Hori, 1955, Bull. Biogeogr. Soc. Jap. 6-19, p. 230)

Japanese population of this species usually has two pairs of postsutural *ac*, strong median marginal bristles on the second visible tergite and black hairs on the subcostal sclerites. The male abdomen is elongated oval.

Length: 5-10 mm.

Bionomics: *L. bufonivora* may have two generations each year in Japan. Adults are commonly found on foliage in the paddy-fields and on banks of streams in early summer and late fall. The larva is known to be parasitic upon such amphibians as toads and frogs in Europe (Moniez, 1876, 1878; Brumpt, 1934; Balzac, 1937). The general biology was given by Kryger (1926) and Brumpt (1934).

Specimens examined: 8♂♂, 3♀♀, Terai, Ishikawa Pref., ?. viii. 1952 (Hori leg.); 19♂♂, 16♀♀, Kanaiwa, Kanazawa City, Ishikawa Pref., 29. v. 1963, 15. v. 1964, 7. x. 1962 (Kurahashi leg.); 2♂♂, 1♀, Kasumigaura, Ibaragi Pref., 9. v. 1965 (S. Shinonaga leg.).

Geographical distribution: Japan (Honshu), China, Europe, and N. America.

Lucilia silvarum (Meigen)

(1826, Syst. Beschr. 5, p. 53; Aubertin, 1933, Linn. Soc. J. Zool. 38, p. 419; Zumpt, 1956, Lind. Fliegen pal. Reg. 64i, p. 44)

The record of this species from Japan is first found in Aubertin's work (1933). Zumpt (1956) mentioned that he examined materials labelled with a Japanese locality which had been sent to him from one of the European museums. Unfortunately the author has never seen any specimen of *L. silvarum* from Japan.

Length: 6-10 mm.

Geographical distribution: Japan (?), Europe and N. America.

Bionomics: the larva is probably parasitic, or saprophagous (?). Only one case of parasitic habit is observed in North America, and the description and figures of larval stage were given (Hall, 1947).

Lucilia sericata (Meigen)

(Japanese name: Hirozu-kinbaë)

(1826, Syst. Beschr. 53; Lundbeck, 1927, Dipt. Dan. 7, p. 145; Séguy, 1928, Encycl. Ent. A 9, p. 157; 1933-34, Encycl. Ent. B 2, Dipt. 7, p. 16; Wainwright, 1928, Trans. Ent. Soc. Lond. 76, p. 238; Aubertin, 1933, Linn. Soc. J. Zool. 38, p. 411; Davies, 1934, Ann. Appl. Biology 21, p. 267; S.-White, Aubertin & Smart, 1940, Fa. Brit.

India, Dipt. 6, p. 54; James, 1947, Flies that cause Myiasis Man, p. 86; Hall, 1947, Blowflies N. America, p. 259; Waterhouse & Paramonov, 1950, Austral. J. Soc. Res. B 3, p. 310; Hori, 1950, Misc. Rep. Res. Inst. Nat. Reso. 16, p. 19; Takano, 1950, Icon. Ins. Jap. revised edit., p. 1693; Thomas, 1951, Proc. Zool. Soc. Lond. 121, p. 170; Kano & Sato, 1951d, Jap. J. Exp. Med. 21, p. 232; 1952, Jap. J. Exp. Med. 22, p. 35; Kano, 1954, Nippon no Hae, p. 19; 1959, Ill. Ins. Larv. Jap., p. 698; Spence, 1954, Proc. R. Ent. Soc. B 23, p. 34; van Emden, 1954, Handb. Brit. Ins. x 4 (a), p 122; Shiraki, 1958, Sanit. Ins., p. 1002; Park, 1960, Stud. Flies Korea 1, p. 49)

This species is widely distributed in the world and commonly found in Japan, especially on the fish spread out to dry at fishing villages.

Length: 5–10 mm.

Bionomics: *L. sericata* is one of the species most intimately connected with the blowing of wool, and is a very serious pest in Africa and Australia, but in temperate climate zones this fly is comparatively harmless. Many investigations have been made on its habit of blowing sheep, the physico-chemical ecology, and the general biology (Séguy, 1928; Aubertin, 1933; Yasuda, 1939b, c, d, e; Hall, 1947; James, 1947; Waterhouse & Paramonov, 1950; Zumpt, 1956). The detailed descriptions and figures of the larval stage were given by the following authors: Yasuda (1939a), Hall (1947), James (1947), Waterhouse & Paramonov (1950), Kano & Sato (1952), Kano (1954, 1959) and Shiraki (1958).

Geographical distribution: cosmopolitan.

Lucilia cuprina (Wiedemann)

(Japanese name: Hitsuzi-kinbaë)

(1830, Auß. Zweifl. Ins. 2, p. 654; Aubertin, 1933, Linn. Soc. J. Zool. 38, p. 412; Hori, 1950, Misc. Rep. Res. Inst. Nat. Reso. 16, p. 20; Takano, 1950, Icon. Ins. Jap. revised edit., p. 1694; Kano & Sato, 1951d, Jap. J. Exp. Med. 21, p. 232; 1952, Jap. J. Exp. Med. 22, p. 36; Kano, 1954, Nippon no Hae, p. 19; 1959, Ill. Ins. Larv. Jap., p. 698; 1965, Icon. Ins. Jap. Colore Naturali Edita 3, p. 234; Zumpt, 1956, Lind. Fliegen pal. Reg. 64i, p. 46; Shiraki, 1958, Sanit. Ins., p. 1001; James, 1962, Ins. Micronesia vol. 13, no. 4, p. 117)

This species is very closely allied to *L. sericata*, especially in these females, but can be easily distinguished from it by the specific differences of adults and

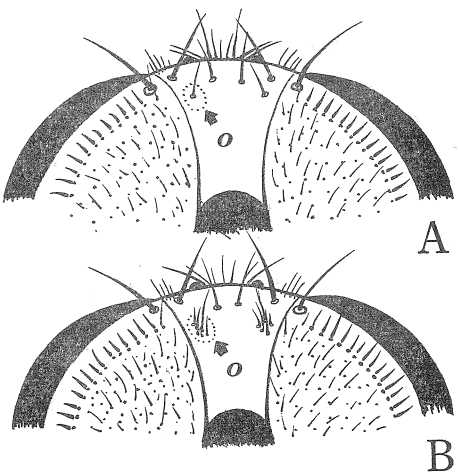

Fig. 10. Posterior view of heads, upper half. A: *Lucilia cuprina*, B: *L. sericata*, *o*: Occipital hairs useful in distinguishing two species.

larvae discovered by Waterhouse & Paramonov (1950) (Fig. 10).

Length: 5–10 mm.

Bionomics: *L. cuprina* is essentially a southern inhabitant. Although *L. cuprina* and *L. sericata* may often occur together throughout the southern parts of Japan. In Hokkaido only the latter is found abundantly. The adults are most numerous in late summer in market sections of towns in central Japan, where they may be easily collected upon decaying matter. Many investigatory works have been done on its habit of blowing sheep and the general biology (Séguy, 1928; Aubertin, 1933; Hall, 1947; James, 1947; Waterhouse & Paramonov, 1950; Zumpt, 1956). The larva is primarily a scavenger, although in some parts of the world such as Australia and South Africa, the parasitic habit becomes strongly developed (James, 1947). The descriptions and figures of larval stage were given by Hall (1947), Waterhouse & Paramonov (1950), Kano & Sato (1952), and Kano (1954, 1959).

Geographical distribution: Japan except Hokkaido, and temparate and tropical zones of the world.

Hemipyrellia Townsend

(1918, Ins. Mens. 6, p.154)

Type-species: *Hemipyrellia curriei* Townsend

This genus *Hemipyrellia* closely allied to the *Lucilia* in general appearance, and has been treated as the subgenus of the *Lucilia* by early workers. The main characteristics are as in the following: supraspiracular convexity with long erect fine hairs; hypopygium more or less prominent; second genital segment with long lateral lobes.

Geographical distribution: a part of Palearctic Region, Oriental, Australian and Ethiopian Regions.

Hemipyrellia ligurriens (Wiedemann)

(Japanese name: Tokyo-kinbaë)

(1830, Auß. Zweifl. Ins. 2, p. 655; S.-White, Aubertin & Smart, 1940, Fa. Brit. India, Dipt. 6, p. 42; Hori, 1951, Sci. Rep. Kanazawa Univ., vol. 1, no. 2, p. 9; Kano & Sato, 1951d, Jap. J. Exp. Med. 21, p. 233; 1952, Jap. J. Exp. Med. 22, p. 35; Kano, 1954, Nippon no Hae, p. 19; 1959, Ill. Ins. Larv. Jap., p. 699; 1965, Icon. Ins. Jap. Colore Naturali Edita 3, p. 233; Zumpt, 1956, Lind. Fliegen pal. Reg. 64i, p. 56; Park, 1960, Stud. Flies Korea 1, p. 53; 1962, Korean J. Zool., vol. 5, no. 1, p. 5; James, 1962, Ins. Micronesia, vol. 13, no. 4, p.112)

Length: 6–10 mm.

Bionomics: *H. ligurriens* is very common in market sections of Japanese towns. The adults are most abundant in late summer in central Japan. The rearing method, the descriptions and figures of larvae were given by Kano (1951a, b, 1952, 1954, 1959).

Geographical distribution: Japan (Honshu, Izu-Hachijojima Is. Bonin Isls., Shikoku, Kyushu and Amami-Oshima Isls.), Korea, China, India, Ceylon, Thailand, Malay, Java, Celebes, Philippines, New Britain, and Australia.