

The Taxonomy of the Grylloblattodea and their Distribution in Korea

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I . Introduction

The notopteran insect is originally alpine and subterranean. Therefore, it is not easily found in the open air. In the Korean Peninsula, it has been found rarely because of this reason and the paucity of interested entomologists.

The first specimen was believed to have been collected near Chang beak (Ch'ang Pai) fall in Mt . Baektu-san (White head) on the frontier of Korea and Manchuria in the 1930's, but this was not reported to the scientific world and the specimen is probably missing. Subsequently the author found a young male at Simbog-gul Cave, Yeonpung-myeon, Koesan-gun, Chungcheon buk-do Province in 1963. This is the real first record in Korea. He also collected various samples from many different limestone caves in the Taebeak and Sobeak mountain ranges in the middle part of the Korean Peninsula. All these were of nymphal stages.

In 1966 a mature adult male was collected by him from Biryong donggul Cave at Jeongseon-gun in the upper branch of the Southern Han River. Other specimens of male and female adults were collected from Kosu donggul Cave at Danyang-gun along the middle reaches of the Southern Han

River in 1973. By close examination the author was able to identify them as new species. They were described under the names of *Galloisiana biryongensis* and *G. kosuensis*. Although the author also collected three adult female specimens, one from Shimbog-gul cave at Koesan-gun, one from Yongsugol-gul Cave at Jeongseon-gun, and one from Kwangcheon-seongul Cave at Pyeongchang-gun, he has yet to obtain the adult male specimen needed for the precise identification.

A number of other notopteran individuals have been collected inside caves like these, but a few were found outside the caves; their known localities were Mt. Sokri-san at Boeun-gun and Mt. Buyong-san at Eumseong-gun, Chungcheong buk-do Province. In view of the fact that many specimens have been found in extensive areas in the Japanese Islands such as Hokkaido, Honshu, and Kyushu, there is a good possibility of finding the species on the mountains of Korea when 30 energetic efforts are made to search for the Notoptera.

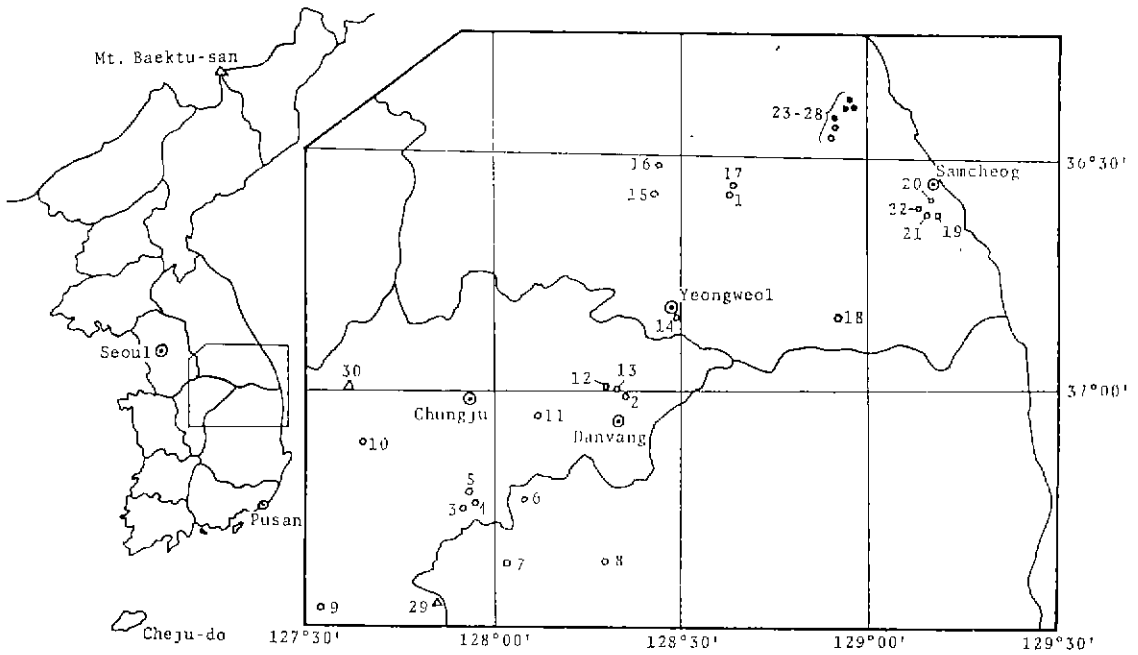
A proper taxonomical study has still to be made, and comprehensive studies on the morphology, genetics, and ecology of the Korean *Galloisiana* have not yet been carried out. This paper summarizes the collection data, the characteristic of the species and the habitats known in Korea.

II. List of Localities and the Species Obtained

(LIMESTONE CAVES)

- No. 1. Biryong-gul Cave, Yongtan-ri, Jeongseon-myeon, Jeongseon-gun, Kangweon-do: Galloisiana biryongensis.
- No. 2. Kosu-gul Cave, Kosu-ri, Daegang-myeon, Danyang-gun, Chungcheon-buk-do: Galloisiana kosuensis.
- No. 3. Simbog-gul Cave, Keumdae-ri, Yeonpung-myeon, Koesan-gun, Chungcheong-buk-do: Galloisiana sp.
- No. 4. Suyeo-gul Cave, Yuha-ri, Yeonpung-myeon, Koesan-gun, Chungcheong-buk-do: Galloisiana sp.
- No. 5. Keunlgangddeul-gul Cave, Haengchon-ri, Yeonpung-myeon, Koesan-gun, Chungcheong-buk-do: Galloisiana sp.
- No. 6. Gung'gol-gul Cave, Kwan'eum-ri, Mun'gyeong-myeon, Mun'gyeong-gun, Kyeong sang-buk-do: Galloisiana sp.
- No. 7. Mosan-gul Cave, Sungjeo-ri, Ka'eum-ri, Mun'gyeong-gun, Kyeong sang-buk-do: Galloisiana sp.
- No. 8. Gulibawi-gul Cave, Beolbang-ri, Gampo-myeon, Yecheon-gun, Kyeong sang-buk-do: Galloisiana sp.
- No. 9. Daeryong-gul Cave, Nuhyeon-ri, Kadeog-myeon, Cheongweon-gun, Chungcheong-buk-do: Galloisiana sp.
- No. 10. Baegma-san-gul Cave, Pocheon-ri, Hansu-myeon, Jecheon-gun, Chungcheong-buk-do: Galloisiana sp.
- No. 11. Bodeog'am-gul Cave, Bogpyeong-ri, Hansu-myeon, Jecheon-gun, Chungcheong-buk-do: Galloisiana sp.
- No. 12. Hago-gul Cave, Hago-ri, Maepo-myeon, Danyang-gun, Chungcheong-buk-do: Galloisiana sp.
- No. 13. Besil'ap-gul Cave, Dodam-ri, Maepo-myeon, Danyang-gun, Kangweon-do: Galloisiana sp.
- No. 14. Gossi-gul Cave, Jinbyeol-ri, Hadong-myeon, Yeongweol-gun, Kangweon-do: Galloisiana sp.
- No. 15. Jangbawi-gul Cave, Jujin-ri, Pyeongchang-myeon, Pyeongchang-gun, Kangweon-do: Galloisiana sp.

- No. 16. Kwangcheon-seon-gul Cave, Daewha-ri, Daewha-myeon, Pyeongchang-gun, Kangweon-do: Galloisiana sp.
- No. 17. Yongsugol-gul Cave, Yongtan-ri, Jeongseon-myeon, Jeongseong-gun, Kwangweon-do: Galloisiana sp.
- No. 18. Yongyeon-gul Cave, Hwageon-ri, Hwangji-eub, Samcheog-gun, Kangweon-do: Galloisiana sp.
- No. 19. Chodang-gul Cave, Keumgye-ri, Keundeog-myeon, Samcheog-gun, Kangweon-do: Galloisiana sp.
- No. 20. Jobi-gul Cave, Jobi-ri, Samcheog-eub, Samcheog-gun, Kangweon-do: Galloisiana sp.
- No. 21. Jungsoegari-gul Cave, Yeosam-ri, Nogog-myeon, Samcheog-gun, Kangweon-do: Galloisiana sp.
- No. 22. Chilbatsjae-gul Cave, Sang-keoro-ri, Miro-myeon, Samcheog-gun, Kangweon-do: Galloisiana sp.
- No. 23. Munbang'u-gul Cave, San'gye-ri, Oggye-myeon, Myeongju-gun, Kangweon-do: Galloisiana sp.
- No. 24. Namsan'gol-gul Cave, San'gye-ri, Oggye-myeon, Myeongju-gun, Kangweon-do: Galloisiana sp.



[Fig. 1] Map showing the localities of *Galloisiana* spp. in Korea

III. The Species of the genus *Galloisiana* in Korea

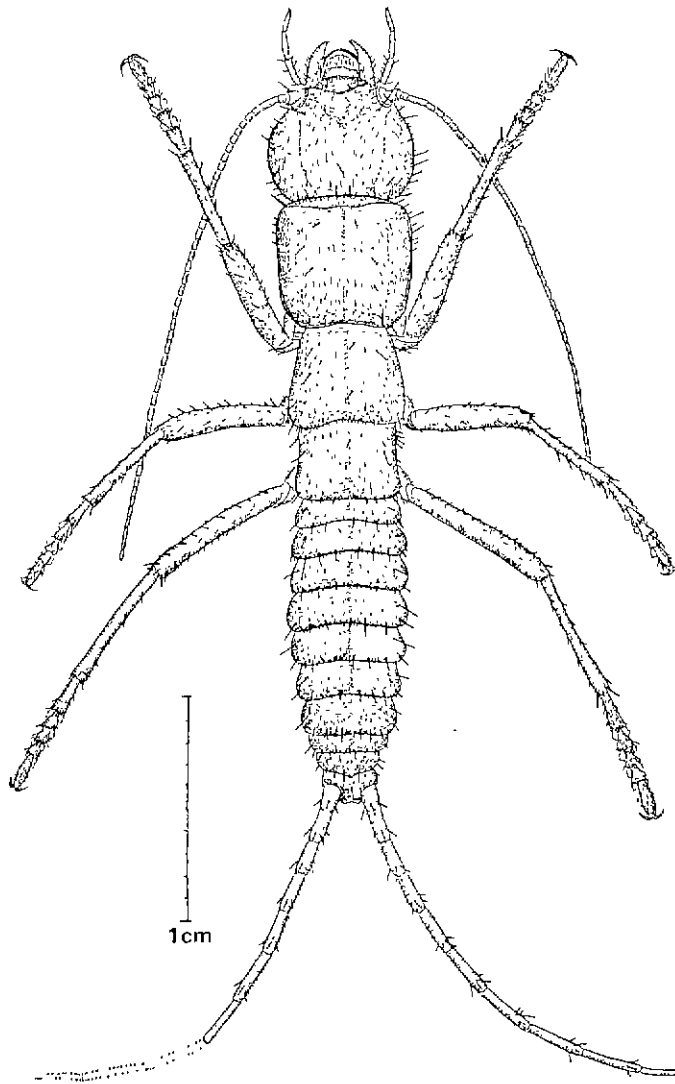
Galloisiana specimens collected so far in Korea are conspicuously larger (22-34mm) in body size than the specimens found in Japan (17-24mm) (Caudell and King, 1924; Asahina, 1959, 1961) and the Maritime Provinces of Siberia (Bey-Bienko, 1951; Pravdin et al., 1977).

The pronotum of Korean specimens is of square shape and the posterior margin straight or slightly incurved. The Japanese specimens show that the sides are of slightly narrowed and rounded shape, and the specimens from the Maritimes have a short projection in the middle of the posterior margin.

The first cervical sclerites bear spine-like setae arranged in a regular pattern (Korean specimens), whereas those of the specimens from Japan and the Maritimes are arranged irregularly or weakly developed.

The third segment of antenna of Korean specimens is three times as long compared to the second segment. The preapical teeth of the lacinia are widely separated. White pulvilli are present on the tarsal segments. The cerci have nine segments; their shape is similar to those of the Japanese specimens.

The male supra-anal plate is important as a character for identification of the species. The male genital organ is developed in a complicated way. The author has assumed that the Korean and Japanese species belong to the same genus as they have common features on various points in morphology, but it is necessary for these to be compared with the specimens from the Maritimes.



[Fig. 2] *Galloisiana biryongensis*, male

Synopsis of the species known from Korea is as follows:

1. *Galloisiana biryongensis* Namkung, 1974

(Korean name: Biryong-galleuwa beolle)

Male:

Size large for the genus; body length, 34mm; antenna, 25mm; cercus, ca. 20mm. General coloration grayish brown; head and pronotum noticeably darker.

Head wide and flat, chestnut-like but rounded; width, 6.1 and length, 5.7mm; its smooth brown surface with yellowish-white fine hairs. Seven or eight setae at the parietal margin, two or three near the antennal socket, and one or two along the epicranial suture. The suture is clearly seen from the base of the antenna to the occiput. Eyes are externally reduced, but under close microscopic scanning, a light coloured spot of narrow oval shape and a pair of setae on the eye area are observed.

Antenna with 48 segments on the left in the case of the holotype; the third segment is about three times longer than the second.

Pronotum slightly longer (6.4mm) than its width (6.2mm), gently narrowed from the anterior to the posterior. Seven setae on the anterior margin, seven on the lateral one and three at the middle of the posterior part.

Mesonotum trapezoid; the anterior margin (6.4mm) narrower than the posterior (5.3mm), The width of the posterior margin shorter than that of the pronotum. Three brown setae on the left side, two on the right, four or five on the lateral lower margins, and two irregular ones on the middle.

Metanotum rectangular; the anterior margin (4.7mm) slightly narrower than the posterior (5.0mm), two setae on the left side and four on the right of the promargin, two in the midline, three on the left and five on the right of the retromargin, all of them irregular.

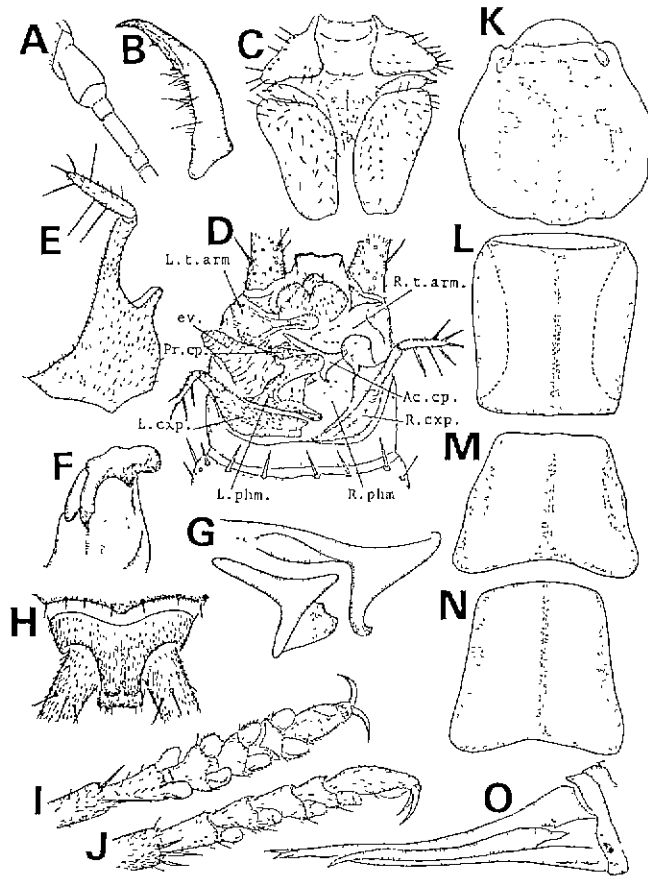
The first cervical sclerite with heavy spine-like setae, distinctly borne along the lateral margin; number of setae, 10 on the left and 9 in the right. The basisternum triangular, posterior part sclerotized.

Abdominal tergite with 7 to 8 large setae on each side of the posterior margins and one pair of setae on each of the lateral margins. The supra-anal plate like a dull point of a fountain pen in shape; this differs distinctly from other species.

Abdominal sternite with numerous setae which are arranged rather irregularly.

The cerci 9 segmented; the total length is five times as long as the hind femora; each segment with three or four large setae at the end and with long, white and fine hairs. Coxopodites asymmetrical; the left coxopodite scoop-shaped and its width of basal part is about 2.5 times wider than the right coxopodite, and the right coxopodite acutely triangular with a short thumb-like process which is situated on the dorsal margin and bent inwardly.

The stylus cylindrical, five times longer than its width, and with outstanding long setae; four on the apex and two at the inferior side of the right one, and four on the apex and three at the inferior side of the left one.



[Fig. 3] *Galloisiana biryongensis*

A. Antenna of male, segments 1 to 5. B. Left lacinia of male, ventral view. C. Prosternum of male, ventral view. D. End of abdomen of male, ventral view. E. Right coxopodites and stylus of male. F. Principal copulatory sclerite of male, ventral view. G. Accessory copulatory sclerite of male, ventral view. H. Supraanal plate of male, dorsal view. I. Tarsus of Leg II of male, ventral view. J. Tarsus of Leg III of male, lateral view. K. Head of female (exuvia), dorsal view. L. Pronotum of female (exuvia), dorsal view. M. Metanotum of female (exuvia), dorsal view. N. Mesonotum of female (exuvia), dorsal view. O. Ovipositor (exuvia), lateral view.

The left phallomere supported by the sclerotized skin with long white eversible sac, and almost entirely membranous and wrinkled. The right phallomere nearly membranous and transparent.

The principal copulatory sclerite covered with a sclerotized skin and two accessory copulatory sclerites seen in the intersternal area.

Note:

The holotype specimen of *Galloisiana biryongensis* was found at a limestone cave called "Biryong dong-gul" at Biryong-dong of Yongtan-ri in Jeongseon-myeon of Jeongseon-gun, Kangweon-do Province. The cave is situated at the upstream of the Southern Han River, 500km north-east of Seoul. The narrow entrance of the cave is found under a rock half way up Mt. Subiryong-bong. Entering the cave, an S-shaped gallery is discovered. The length of gallery is 50m, the width 5m, and the height 2 to 5m. The floor is covered with debris and gravels, under which is a thin layer of organic clay material. There is no pool nor underground stream. The mean air temperature is 9°C, and the humidity ranges between 80-88%.

The cave system extends for more than 1500m with the main gallery of about 600m in length. This cave leads in all directions into small branches, and there are many side galleries and small and large pools, but no subterranean stream. The floor near the entrance was covered with leaves wind-blown from outside. The thin clay layer was mixed with organic matter such as wood chips.

Galloisiana was found under gravels about 20m inside the entrance. The

condition of this spot was rather comfortable without interference of outside air. Some Diplopoda, Araneae, blind beetles and other important cavernicoles were also found, but not in quantity. These cavernicoles are mainly found around 20m range from the entrance, and become rare far from the entrance.

This cave is nominated and preserved as the culture properties of Kangweon-do.

2. *Galloisiana kosuensis* Namkung, 1974

(Korean name: Kosu-galleuwa beolle)

Male:

Size medium for the genus; body length, 22mm; antenna, 15mm; cercus, ca. 13mm. General coloration reddish-brown; head and pronotum noticeably darker.

Head rounded, flat and somewhat wider than its length (4.0 to 3.7mm); it smooth surface with fine yellowish-white hairs; four setae on the left side, six on the right, three each at the attachment of the antennae, seven irregularly arranged along the hind margin. The epicranial suture is not clear. Eyes small, each containing an ocular setae in the center.

Antennae with 46 segments on the left and 45 segments on the right. The third segment is approximately three times longer than the second one.

Pronotum gently narrowing from the anterior to the posterior and longer than its width (anterior margin, 4.0mm, posterior margin, 3.6mm, length, 4.3mm). Seven setae on the promargin, with one pair of large spines on each

side. Three setae on the lateral margins, five or six weak setae irregularly arranged in the middle.

Mesonotum trapezoid; the anterior margin narrower than the posterior margin (anterior margin, 2.7mm, posterior margin, 3.6mm, length, 2.7mm). There are three setae on the left side, four on the right, five on the posterior margin, and five irregularly arranged in the center.

Metanotum rectangular; the anterior margin slightly shorter than the posterior margin (anterior margin, 3.1mm, posterior margin, 3.3mm, length, 2.2mm). One setae on the left side, one seta on the right side of the posterior margin, and seven setae on the anterior half.

The first cervical sclerite with four pairs of spine-like setae regularly aligned along the outer margin.

Abdominal tergites with eight large setae on each side of the posterior margins and one pair of setae on each of their lateral sides. The supra-anal plate forms an asymmetric triangle; the left side is shrunken, the stylet is bluntly pointed and inclined to the left. This is a character that distinguished this species from the closely related *Galloisiana nipponensis* in which stylus is long, narrow, and pointed.

Abdominal sternites with numerous setae rather irregularly arranged on each of the plates.

The cerci 9-segmented with yellowish-white color and fine hairs. The second segment is the shortest and the 6th or 7th segment is the longest.

The left coxopodite wider than its length (13:8); the stylus bears

exceptionally long setae, two on the apex and two large ones at the ventral side. The right coxopodite acutely triangular, longer than its width (7:5). A short thumb-like process sandwiched and bent inwardly near the base of the dorsal margin; this process is hardly visible.

The left phallomere is supported by sclerotized skin and is attached with a weak, white, eversible sac, which is nearly entirely membranous and multi-wrinkled in appearance. The right phallomere almost completely membranous and transparent.

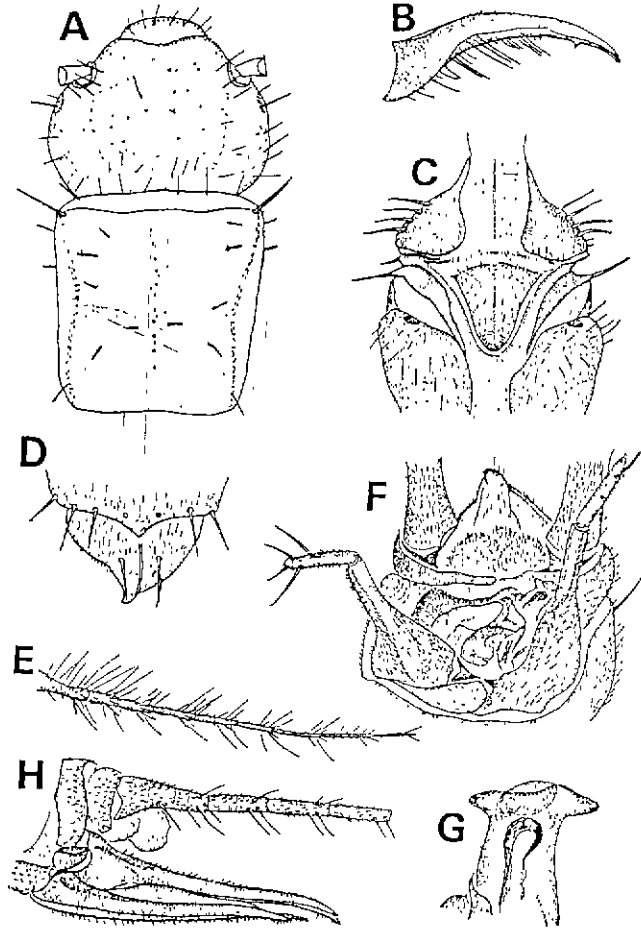
The principal copulatory sclerite differs from *Galloisiana biryongensis* in that it has a pick-shaped apical lip of the copulatory process and a stouter hook-like process on the dorsolateral side.

Female:

The general form similar to the male. Body length, 23mm. Antenna 47-segmented on the right. Cerci broken into five segments. The dorsal valve (4.5mm) of the ovipositor reaching to 3/4 of 4th cerci segment, middle valve (2.18mm) attached basally to dorsal valve at 2/15 the distance from the base of the latter.

Note:

The holotype specimen of *Galloisiana kosuensis* was found in a limestone cave called "Kosudong-gul" at Kosu-ri in Daegang-myeon, Danyang-gun, Chung cheong-buk-do Province, on the middle reach of the Southern Han River, 480km southeast of Seoul.



[Fig. 4] *Galloisiana kosuensis*

A. Head and prothoracic tergum of male, dorsal view. B. Right lacinia of male, ventral view. C. Prosternum of male, ventral view. D. Supraanal plate of male, dorsal view. E. Right cercus of male. F. end of abdomen of male, posterior view. G. Principal copulatory sclerite of male, ventral view. H. Ovipositor, lateral view.

The entrance to the cave is on the slope of Mt. Gachisan, behind a village. The cave was used as a mine-storage for a long period, and was greatly damaged. An underground stream is always flowing from inside towards the entrance and then becomes subterranean (50m inside), with a small branch leading upward on the right side. A clay layer piled with detritus maintains relatively comfortable circumstances (mean temperature, 15°C, humidity, 87%). The habitat of *Galloisiana* was under gravels. Diplopoda, Collembola etc., were found but other animals were rare. The main gallery extends northward in zigzag shape and is about 400m in length (600m including other passages).

This cave has been open to the public since 1976, and the spectacular scene has attracted many people. The narrow space in the cave is always crowded with visitors and various environmental changes occur, and cavernicoles are in serious danger of disappearance as it is too destructive for the type-locality of *Galloisiana kosuensis*. It is a difficult problem whether they can survive under the present conditions.

This cave has been designated as No. 256 of the natural monument.

Ecological note:

The following data are not the results of preplanned experiment and examination; they are only a record of observation of the insects at the time they were collected.

The localities of collections are mostly limestone caves, and the habitats are as follows:

Mountain-ranges; 13 examples in the Taebeaks, 12 in the Sobeaks, 5 in the Charyeongs.

Altitude; 8 examples under 200m, 8 under 300m, 5 under 400m, 6 under 500m, 3 over 500 to 900m. Notoptera seem to be relatively rich under 500m in altitude.

The component of zone; 17 examples in mountain, 9 in the foot of mountains, 4 in open field.

The distances from cave entrances where specimens were collected are 10m from the entrance in 7 examples, 20m in 14, 30m in 6, over 50 to 200m in 3. The majority of the specimens came from the vicinity of the entrance.

Mean air temperatures of the habitat are 10°C in 17 examples, 12°C in 9, and 15°C in 4. Comfortable temperature for habitat seems to range under 10°C.

The humidities of habitat are 75% in 3 examples, 80% in 9, 85% in 8, 90% in 7, and 95% in 4. The comfortable humidity seems to range from 80 to 85%.

The times of year of the habitat records were 23% in May, 29% in June, and 21% in July. This shows that the insects frequently appear from spring to summer and seldom during the cold season from December to March.

The author collected 8 specimens crawling, while 130 specimens were under stones. This shows that the insects have the tendency to be positive in concealment. When they were found, aged ones were sluggish whereas young ones were quick in activity. None was found crawling up on the rock

wall.

Of 138 collections, 15 specimens had with reduced eyes and 123 with compound eyes.

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