NOTES ON THE ALPINE CORDYCEPS OF CHINA
AND NEARBY NATIONS

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ABSTRACT

This paper gives an account of 33 species of the genus *Cordyceps* collected from
the alpine areas of China and Nepal of these, *Cordyceps kangdingensis*, *C. multiaxialis*
and *C. nepalensis* are described and illustrated as new species, while *C. sinensis*, *C.
crassispora*, *C. aspera*, *C. canadensis* etc. are also reported from China and a few taxa
from nearby nations. A key to 33 alpine species of *Cordyceps* from these areas is given.

Key words Alpine *Cordyceps*, *C. kangdingensis*, *C. multiaxialis*, *C. nepalensis*.

Traditional Chinese medicinal alpine caterpillar fungi appear to be endemic
to the alpine regions of Southwestern and Northwestern China, etc. Some of them
are famous in Chinese medicine as a tonic and beneficial to gonadal activity (Liu,
1980; Pegler et al., 1994). The alpine *Cordyceps* are generally regarded as rare spe-
cies, such as *Cordyceps sinensis* (Berk.) Sacc., (Tai, 1979, Teng, 1996), *C. aspera*
Pat. (Patouillard, 1893, Tai, 1979), and *C. crassispora* Zang, Yang et Li (Zang et
als., 1990). Recently, the authors made numerous mycological explorations to
Deqin region of Yunnan, Kongding region of Sichuan, and some specimens were
collected from Guizhou, Tibet and Nepal. Among them there are 3 taxa with
morphological features which do not correspond with any of the hitherto described
taxa. After detailed study, the authors now describe them as new, *Cordyceps
nepalensis*, *C. kangdingensis* and *C. multiaxialis*.

TAXONOMY

*Cordyceps* (Fr.) Link, Handbuch 3: 347. 1833.


The alpine species of the genus *Cordyceps* from China, especially in
southwestern China, are treated here according to host biomes and vertical distribution.

Stromata single or rarely branched above, or several in a cluster, caespitose,
arising from underground. Fresh fruitbodies composed of fertile part and stalk,
carnose or rather coriaceous, stuffed, externally brown—purpuraeous, reddish brown,
brown—olivaceous, brown—black, internal part whitish or whitish yellow.
Fertile part terminal, cylindric clavate or capitulate, sometimes sub—compressed, sur-
face mammilate, punctate with the ostioles of totally embedded or subembedded perithecia, sometimes with separated raphe, longitudinal, thread-like, or nearly smooth. Cortex composed of prosenchymatous or pseudoparenchymatous tissue, usually consisting of one layer of closely interwoven hyphae in section, whitish, yellowish brown to pigmented, covered with a deep brown palisade-like layer. Perithecia mostly ovoid, free to embedded in the stroma. Asci cylindrical, narrowing below, with hemispherical thickening of the wall at the apex. Ascospores hyaline, filiform, multiseptate, breaking into 1- or more-celled, cylindric, linear or subfusoid segments. Secondary spores present or not seen (Mains, 1958; Kobayasi et al. 1960).

Type species: Cordyceps militaris (Fr.) Link.

KEY TO THE KNOWN ALPINE SPECIES OF CORDYCEPS

1. Growing on fruit bodies of the genus Elaphomyces (Fungi) ................................................................. 2
2. Growing on insects ......................................................................................................................................... 3
3. Head ellipsoid to clavate, dark brown to black. Stipe smooth, with longitudinal striae, attached to the host usually by whitish-yellow branching root-like fibers. Secondary spores 3-4 x 2-3 μm ................................................................. 23. Cordyceps ophioglossoides
4. Head globose to ellipsoid, yellow-brown to vinaceous fawn. Stipe with a thin layer of loosely interwoven brown hyphae covering the upper part, smooth at the base ................................. 3
5. Growing on the bodies of Lepidoptera or other insects, distributed below 4000 m alt. ............................. 13
6. Head surface rough, ostioles with mammillar projections on the upper portions of stromata 7
7. Stromata narrow clavate, rough or punctate with the ostioles of the perithecia. Stipe usually forming tomentose tufts ................................................................. 8
8. Stromata broad clavate, asperate with the ostioles of the perithecia. Stipe glabrous, on Limnigetis ................................................................. 9. Cordyceps falcata
9. Stromata small and gracile, 2.5-4 cm long, stipe whitish, tomentose at the base, asci short cylindric, 150-200 x 4-5 μm, secondary ascospores 3-5 x 1-1.5 μm, on Coleoptera. ................................................................. 1. Cordyceps aspera
10. Stromata usually yellowish brown to vinaceous brown, perithecia ovate to flask-shaped, 900-1100 x 340-430 μm. Asci 500-550 x 12-15 μm, secondary ascospores spindle-shaped, 18-27 x 2.5-3 μm .................................................................................. 5. C. capitata
11. Perithecia mostly ovoid, free to embedded in the stroma. Asci cylindric, narrowing below, with hemispherical thickening of the wall at the apex. Ascospores hyaline, filiform, multiseptate, breaking into 1- or more-celled, cylindric, linear or subfusoid segments. Secondary spores present or not seen (Mains, 1958; Kobayasi et al. 1960).

Type species: Cordyceps militaris (Fr.) Link.
OF CORDYCEPS

- 10. Stromata usually clustered, occasionally 2,3, or 4 from host, asci with 8-10 μm thickening of the wall at the apex and a long narrow base, secondary ascospores 8-20 x 0.6-1.2 μm on larvae of Lepidoptera
- 11. Perithecia ovoid, 320-350 x 270-300 μm, secondary ascospores oblong, 7.7-14 x 8.4-13.3 μm, on Hepialus latius, found only in NW China
- 12. Perithecia 150-550 x 110-240 μm, ascospores linear, filamentous, obscurely multi-septate, 120-190 x 0.6-1.3 μm, secondary ascospora not common, on larvae of Hepialus armoricus
- 13. Stroma simple, cylindrical with 5-7 μm thickening of the wall at the apex and gradually narrowed at the base, secondary ascospores 14-33 x 2-2.6 μm, on larvae of Thitarodes
- 14. Stromata simple, cylindrical with 5-7 μm thickening of the wall at the apex and gradually narrowed at the base, secondary ascospores 14-33 x 2-2.6 μm, on larvae of Thitarodes
- 15. C. kandengensis
- 16. Stromata 110-260 x 100-250 μm, ascospores filamentous, closely multi-septate, 20-70 x 0.5-13 μm, breaking into 1-celled secondary ascospores 15-35 x 0.5-1.3 μm, on larvae of Hepialus nebulosus
- 17. Stromata always simple, unbranched
- 18. Stromata usually cespitose or branched
- 19. Stromata clavate or obovoid, light vinaceous drab when fresh, stipe slender, usually with cylindrical branches, perithecia conoid, 600-950 x 230-400 μm, asci cylindrical, 300-600 x 4-6 μm, with a 2.5-3 μm thick cap, ascospores multi-septate, secondary spores 6-10 x 1.5 μm, on larvae of Coleoptera
- 20. Stromata slender, cylindrical or clavate, not light vinaceous drab when fresh, stipe cylindrical, tufted or branched
- 21. Stromata several from various parts of the host
- 22. Stromata gregarious from the head of the host
- 23. Stromata with deep shades of color when fresh, usually dark brown, head globose, perithecia 750-800 x 200-230 μm, flask shaped, asci cylindrical, 200-250 x 10-12 μm, secondary ascospores 8-10 x 3-4 μm and rounded at the top, on Hepialus altaicola and other larvae of Lepidoptera
- 24. Stromata yellowish in color
- 25. Stromata reddish to orange color
- 26. Stromata with intense colors, asci cylindric, fiiform, multiseptate, finally breaking into l-celled fragments
- 27. Stromata pale brown to chestnut color, asci somewhat fusoid, 150-180 x 5-8 μm, ascospores 85-100 x 1.9-2.2 μm, multiseptate, not breaking into fragments, on larvae of Coleoptera
- 28. Stromata with yellow, reddish or orange colors
- 29. Stromata with intense colors, asci cylindric, filiform, multiseptate, finally breaking into l-celled fragments
- 30. Stromata with deep shades of color when fresh, usually dark brown, head globose, perithecia 750-800 x 200-230 μm, flask shaped, asci cylindrical, 200-250 x 10-12 μm, secondary ascospores 8-10 x 3-4 μm and rounded at the top, on Hepialus altaicola and other larvae of Lepidoptera
- 31. Stromata with deep shades of color when fresh, usually dark brown, head globose, perithecia 750-800 x 200-230 μm, flask shaped, asci cylindrical, 200-250 x 10-12 μm, secondary ascospores 8-10 x 3-4 μm and rounded at the top, on Hepialus altaicola and other larvae of Lepidoptera
- 32. Stromata with deep shades of color when fresh, usually dark brown, head globose, perithecia 750-800 x 200-230 μm, flask shaped, asci cylindrical, 200-250 x 10-12 μm, secondary ascospores 8-10 x 3-4 μm and rounded at the top, on Hepialus altaicola and other larvae of Lepidoptera
- 33. C. tabesculata
- 34. Stromata with deep shades of color when fresh, usually dark brown, head globose, perithecia 750-800 x 200-230 μm, flask shaped, asci cylindrical, 200-250 x 10-12 μm, secondary ascospores 8-10 x 3-4 μm and rounded at the top, on Hepialus altaicola and other larvae of Lepidoptera
- 35. C. sinensis
- 36. Stromata large, usually 20-30 cm long, 1.5-2.3 mm thick, blackish-brown, on larvae of Coleoptera
- 37. Stromata clavate or obovoid, light vinaceous drab when fresh, stipe slender, usually with cylindrical branches, perithecia conoid, 600-950 x 230-400 μm, asci cylindrical, 300-600 x 4-6 μm, with a 2.5-3 μm thick cap, ascospores multi-septate, secondary spores 6-10 x 1.5 μm, on larvae of Coleoptera
- 38. Stromata usually cespitose or branched
- 39. Stromata pale brown to chestnut color, asci somewhat fusoid, 150-180 x 5-8 μm, ascospores 85-100 x 1.9-2.2 μm, multiseptate, not breaking into fragments, on larvae of Coleoptera
- 40. Stromata with deep shades of color when fresh, usually dark brown, head globose, perithecia 750-800 x 200-230 μm, flask shaped, asci cylindrical, 200-250 x 10-12 μm, secondary ascospores 8-10 x 3-4 μm and rounded at the top, on Hepialus altaicola and other larvae of Lepidoptera
- 41. C. gracilis
- 42. Stromata with deep shades of color when fresh, usually dark brown, head globose, perithecia 750-800 x 200-230 μm, flask shaped, asci cylindrical, 200-250 x 10-12 μm, secondary ascospores 8-10 x 3-4 μm and rounded at the top, on Hepialus altaicola and other larvae of Lepidoptera
- 43. Stromata with deep shades of color when fresh, usually dark brown, head globose, perithecia 750-800 x 200-230 μm, flask shaped, asci cylindrical, 200-250 x 10-12 μm, secondary ascospores 8-10 x 3-4 μm and rounded at the top, on Hepialus altaicola and other larvae of Lepidoptera
- 44. Stromata with deep shades of color when fresh, usually dark brown, head globose, perithecia 750-800 x 200-230 μm, flask shaped, asci cylindrical, 200-250 x 10-12 μm, secondary ascospores 8-10 x 3-4 μm and rounded at the top, on Hepialus altaicola and other larvae of Lepidoptera
- 45. Stromata with deep shades of color when fresh, usually dark brown, head globose, perithecia 750-800 x 200-230 μm, flask shaped, asci cylindrical, 200-250 x 10-12 μm, secondary ascospores 8-10 x 3-4 μm and rounded at the top, on Hepialus altaicola and other larvae of Lepidoptera
- 46. Stromata with deep shades of color when fresh, usually dark brown, head globose, perithecia 750-800 x 200-230 μm, flask shaped, asci cylindrical, 200-250 x 10-12 μm, secondary ascospores 8-10 x 3-4 μm and rounded at the top, on Hepialus altaicola and other larvae of Lepidoptera
- 47. Stromata with deep shades of color when fresh, usually dark brown, head globose, perithecia 750-800 x 200-230 μm, flask shaped, asci cylindrical, 200-250 x 10-12 μm, secondary ascospores 8-10 x 3-4 μm and rounded at the top, on Hepialus altaicola and other larvae of Lepidoptera
- 48. Stromata with deep shades of color when fresh, usually dark brown, head globose, perithecia 750-800 x 200-230 μm, flask shaped, asci cylindrical, 200-250 x 10-12 μm, secondary ascospores 8-10 x 3-4 μm and rounded at the top, on Hepialus altaicola and other larvae of Lepidoptera
- 49. Stromata with deep shades of color when fresh, usually dark brown, head globose, perithecia 750-800 x 200-230 μm, flask shaped, asci cylindrical, 200-250 x 10-12 μm, secondary ascospores 8-10 x 3-4 μm and rounded at the top, on Hepialus altaicola and other larvae of Lepidoptera
24. Head yellowish

25. Head 1-1.5 mm diam., yellowish, perithecia ovoid, 450-550 x 300-350 μm, secondary ascospores 7-8 x 1.5-1.7 μm, on Formicidae

26. Head roundish, reddish orange or orange brown, perithecia flask shaped or narrowly oblong

27. Head clavate, orange buff to Mikado orange, perithecia ovoid, 500-630 x 150-200 μm, asci capitate, 500-520 μm x 6-8 μm, secondary ascospores filiform, 1-1.5 μm thick, multi-septate, secondary ascospores not seen, on adults of Pentatomidae, Coreidae, etc

28. Perithecia superficial and free

29. Head golden or reddish yellow, perithecia ovate, 290-320 x 158-180 μm, ascospores cylindric, 140-145 x 6-7.5 μm, multi-septate, breaking into 1-celled fragments 10-11 x 1.5-1.7 μm, on Coleoptera

30. Stromata with deep shades of color, blackish brown to blackish, perithecia completely embedded, oblong, 300-350 x 135-150 μm, asci cylindric 100-120 x 6-8 μm, secondary ascospores 4-5 x 1.5-1.7 μm, on larvae of Oxyanus and Trictens, Lepidoptera

31. Stromata large, stout or slender, usually more than 5 cm long

32. Stromata 10-15 cm long, 5-7 mm thick, clavate, perithecia flask shaped, 830-1100 x 300-400 μm, asci 201-250 x 7-10 μm, secondary ascospores 5-7 x 3-3.2 μm, on Lepidoptera, etc

33. Stromata 5-7 cm long, 2-5 mm thick, clavate, reddish orange, perithecia long flask shaped, 650-750 x 280-300 μm, asci 320-350 x 3-4 μm, secondary ascospores 5-7 x 1-1.2 μm, on Coleoptera and Lepidoptera

Fig. 1. 1-4, Cordy of the stroma. 3. Asci i Typus! 5-8, Cordy stroma. 6. Asci and as Typus!)
<table>
<thead>
<tr>
<th>No.</th>
<th>Species</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C. militaris</td>
<td>Blackish, perithecia completely blackish</td>
</tr>
<tr>
<td>2</td>
<td>C. aurantia</td>
<td>Ascospores 5-7 x 3-3.2 μm, on</td>
</tr>
<tr>
<td>3</td>
<td>C. barnesii</td>
<td>Ascospores 5-7 x 3-3.2 μm, on</td>
</tr>
<tr>
<td>4</td>
<td>C. gunnii</td>
<td>Ascospores 5-7 x 3-3.2 μm, on</td>
</tr>
<tr>
<td>5</td>
<td>C. oxycephala</td>
<td>Ascospores 5-7 x 3-3.2 μm, on</td>
</tr>
<tr>
<td>6</td>
<td>C. tricentri</td>
<td>Ascospores 5-7 x 3-3.2 μm, on</td>
</tr>
<tr>
<td>7</td>
<td>C. myrmecophila</td>
<td>Ascospores 5-7 x 3-3.2 μm, on</td>
</tr>
<tr>
<td>8</td>
<td>C. tricentri</td>
<td>Ascospores 5-7 x 3-3.2 μm, on</td>
</tr>
</tbody>
</table>

Fig. 1, 1-4, Cordyceps kangdingensis Zang et N. Kinjo 1. Ascocarps. 2. Fertile part of the stroma. 3. Asci and ascospores. 4. Part of a section through the stroma. (HKAS 30255, Typus) 5-8, Cordyceps multiaxialis Zang et N. Kinjo 5. Part of a section through the stroma. 6. Asci and ascospores. 7. Fertile part of the stroma. 8. Ascocarps. (HKAS 30258, Typus)
   Specimens examined. Sichuan: the original label is Tibet. 1893. R. P. Farges 6633. Type in F. Songpan, Hwanglong Mts. 4300m. 15 V. 1989. Zang & Xia. 11572 (HKAS 21981; Songpan, Dunala, 4100 m. 5 VII 1981. Zang 11613 (HKAS 21982).)

   Specimen examined. Yunnan, Jingdong, Eilo Mts. under evergreen forest, on rotten wood, 2330 m. 23 VIII 1994. Zang 12362 (HKAS 29635).


Specimen examined. Yunnan, Kunming, Western Mts. 16 VIII 1938. J. Z. Chou. (no number)

Specimen examined. Hainan Island, Tan County, on adult of Cicadidae. 8 XI 1939. S. C. Teng 6179, 4141 (Typus! BPI)

7. Cordyceps crassislora Zang, Yang et Li, Mycotaxon 37: 58. 1990. (Fig. III: 1)
Specimen examined. Yunnan, Deqin, Bai Ma Snow Mts. 4300 m. 18 V 1996. Zang 12747. (HKAS 30203)

Specimen examined. Yunnan, Jingdong, Xiu Jia Ba, 2500 m. on larvae of Diabrotica. 25 VIII 1994. Zang 12418 (HKAS 29638)

Specimen examined. Tibet, lower Yalongzangbu (River), on larva of Coleoptera. (Wang & Zang, 1983)

Specimens examined. Gansu, Maqu County, Dashui, 3600–3800 m. C. Wang 11888; Jishi Shan, 4000 m. Wang 11816. (Shimizu, 1994)


Specimen examined. Hainan Island, Yen County, 13 VI 1934. S. C. Teng 3243 Typus! in BPI


Sphaeria hawkesii Gray, Notices Insects Fungi 2: 10. 1858.
Specimens examined. Hunan, Anhwa County, Zijiang, on larvae of Oxyconus, Trictens. 6 VI 1989. F. L. Xong 1 (HKAS 21945); Jiangxi, Xing Guo County, on larvae of Trictens. 5 V 1987. Y. C. Jiang 1 (HKAS 20257); Guangdong, Dinghuo Mts. 30 III 1981. Bi (no number)

15. Cordyceps kandingensis Zang et N. Kinjo, sp. nov. (Fig. I: 1–4; III: 2)
Stromatibus clavatis, singularibus, 6.2 – 7.5 cm longis, 2 – 4 mm crassis, capitulis cylindricis, 3.2 – 3.5 cm longis, 3 – 4 mm crassis, porphyro–brunneis, atro–violaceis; apis acerosis sterileibus; cortice pseudoparenchymato; perithecis
Cordyceps multiaxialis Zang et N. Kinjo, sp. nov. (Fig. I: 5–8; III: 3)

Stromatibus clavatis, multiaxialis, 4–5.2 cm longis, 1.5–3 mm crassis, capitulis cylindricis, gracilibus, 1.3–2 cm longis, 1–2 mm crassis, porphyro–brunneis vel atro–brunneis, apis acerosis sterilibus; cortice pseudo–parenchymato; peritheciis globoideis, 100–300 × 100–320 μm. Ostiola densa, 4 ostiola / 1 mm., superficialibus excelsis. Stipitibus 2–2.5 cm longis, 1.2–2.2 mm crassis, aequalis, levigatis. Asci clavuli, cylindracei, ad basin sensim angustati, 25–52 (104) × 7.8–9.1 μm, 8–sporis. Ascosporis hyalinis, filiformis, multisepatatis, 7.8–20 × 0.6–1.2 μm.

In larvis aff. Thitarodetis.

Cordyceps myrmecophila Cesati, Boto Zeit. 4: 877. 1846.


23. Cordyceps nepalensis Zang et N. Kinjo, sp. nov. (Fig. II: 1–5; III: 4)

Stromatibus clavatis, singularibus, 4.1–4.5 cm longis, 2–3.5 mm crassis, capitulis cylindricis 2.2–2.5 cm longis, 2–3 mm crassis, porphyro–brunneis vel atro–brunneis, apis acerosis sterilibus; cortice pseudoparenchymato; peritheciis globoides vel ovoideae, superficialibus, levigatis, segmentatis, 102–multisepatatis, 2

In larvis Hej


Specimens examined. Hainan Island, Zang 11618 (HKAS 39213).
Cunning, Western Mts. 2000 m. 20
Jiang area, 3600 m. on larvae of
(696); Tibet, Motou. 10 XI 1982. Y.

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Cordyceps chinensis (Berk.) Sacco, in Hooker, Jourm. Decad. n. 480. t. 8. fo 3. 1854;
Sacc., Syllo Fung. 2: 576. 1883
Specimen examined. Tibet, Motou, on Elaphomyces. (Wang & Zang, 1983)

\[ \text{sp. novo (Fig. I: 5 – 8; III: 3 )} \]

Specimens examined. Guizhou, Fanjing Mts., 1700 m. 10 VI 1987. X. L. Wu 2926 a, (HKAS 18512); Yunnan, Jinghong, Nabang River area 1000 m. on adult of Pentatomidae. 16 VIII 1995. Zang 12598 (HKAS 29532); Yongshan County, Kuixi, 1700 m. 4 IX 1985. L. X. Yang 850013 (HKAS 16965)

Cordyceps ophioglossoides (Ehrh.) Fr., Summa Veg. Scand. p. 381. 1849.


Specimen examined. Sichuan, Rue Er Gai, 3000 m. 24 III 1986. R. Q. Huang 1 (HKAS 18204)

Cordyceps racemosa Berk., in Hooker, Journ. Decad. n.480. t. 8. f. 3. 1854;
Specimen examined. Tibet, Motou, on Elaphomyces. (Wang & Zang, 1983)
Specimens examined. Yunnan, Pingbian, Da Wei Mts. 2100 m. 7 X 1995. Zang 12665 (HKAS 30140); Wenshan County, Malipo, Lao Jun Mts. 1500 m. 1 X 1995. Zang 12605 (HKAS 30178)


Specimens examined. China, Herb Berkley, 1879, (Typus ! in K); Sichuan, Muli, Donglang, 4600 m. 14 V 1983. S. Wang 1 (HKAS 11796); Sichuan, Herb N. Patouillard 1878 (F); Xiojin County, Congde, 3900 m. 3 VI 1996. Zang 12740 (HKAS 30253); Kongding, Xindu, 3950 m. 4 VI 1996. Zang 12741 (HKAS 30254); Kangding, Tagong, 3900 m. 5 VI 1996. Zang 12746 (HKAS 30252); Gansu, Gannan, Maqou, 3700 m. V. 1980. Li 4. (HKAS 17019); Xinjiang, Tian Shan, Uta Mts. (Zhao Mao, 1985); Yunnan, Lijiang, Yulong Mts. 4100 m. 2 VI 1981. L. S. Wang 815 (HKAS 7494); Qinghai, Yushu, 4000 m. 14 VI 1976. Huang 12; Tibet, Ridong, Mengyong, 14 V 1995, Shi 1 (HKAS 29365).

Specimen examined. Tibet, Yaluzang Bo (River), on Polistes, Trachytes and Vespa etc. (Wang & Zang, 1983)

Specimen examined. Guizhou, Du Yun, on Pieris rapae Linn. and Metarhizium anisopliae, 30 VIII 1980. Liang (SGAC 2905)


Specimen examined. Yunnan, Mengga County, Caiping Mts. 800 m. on adult moths, Lepidoptera, Sphingidae, Coccytus etc. 10 VII 1995 m. Zang 12687 (HKAS 29640)

GEOPHIC DISTRIBUTION

The alpine region generally includes the Hengduan Mountains, Eastern Himalayas, and certain alpine areas of China and nearby nations. In these zones all the wet and moist alpine vegetations are to be found. Polygonum, and Astragalus are widely distributed, preferring sunny sites, steep slopes and drier areas,
Hengduan Mountains, Eastern nearby nations. In these zones all nd. *Polygonum*, and *Astragalus* are steep slopes and drier areas,
Rhododendron, Fritillaria delavayi Franch, and Meconopsis ferretil Prain occur almost everywhere but more abundantly in the wetter parts of alpine mountains.

The typical inhabitants of higher altitudes above 4000 m are, however, bio-diverse types of insects, especially Lepidoptera, Thitarodes, Heptalitis etc., which represent a rare type of animal life that can live as high up as 4000 - 4500 m. alt. Most species of the genus Cordyceps are parasitic on the larvae of Lepidoptera as carnivores or parasites, a mass of mycelium filling the host bodies. Insects such as Thitarodes armoricanus (Oberthuer) Ueda, T. kandingoides (Chu et Wang) Ueda, T. danieli Viette, T. eberti Viette (K. Ueda, 1996), Heptalitis baimaensis Liang, etc., all are common in Hengduan Mountains and Himalayas. Cordyceps ascocarps usually develop and come to maturity in April to June, only a few in July, and arise from buried mummified larvae of Lepidoptera, on infection from secondary ascospores, which multiply by budding (Fig. III: 1, C). Hyphal bodies develop in the haemocoel of the larvae.

Certain members of the genus Cordyceps, e.g., Cordyceps kandingensis and C. multiaxialis occur in Kangding, Sichuan; C. crassispora in Deqin in Yunnan, and C. nepalensis in Nepal, and probably also in Tibet. They are all found in the Hengduan Mts and Himalayas (Fig. IV). Cordyceps sinensis is known to be widely distributed in Gansu, Qinghai, Sichuan, Yunnan and the Himalayas, all well known for enormous adaptation on such alpine mycotaxa. The alpine Cordyceps members often associate with Polygonum viviparum L., P. affine D. Don, P. macrophyllum D. Don (Fig. III: 1, b), P. glaciale (Meisn.) Hook. f., Astragalus balfourianus Simpson, A. craibianus Simpson, etc.

Most of the species are able to spread widely in China when environmental conditions are favorable. For example, Cordyceps canadensis is scattered along the Chang Bai Mountains, 1400 - 1800 m., Jilin, and over wide areas in Yamagata, Japan and Canada proper. C. gansuensis is found in Maqu County, Gansu, 3600 - 3800 m. (Shimizu, 1994). Each fungus has evolved its own distinctive assemblage of plants and insects. Moreover, the alpine caterpillar fungi generally inhabit different kinds of insect hosts and plants, which have converged in their ecological association with more or less separated outposts in southern regions of China, e.g., Cordyceps barnesii, C. oxycephala, and C. myrmecophila. They are recorded in Dinghu Mountains, Kongdong (Bi et als., 1994) and Jianfengling (Mts.), Hainan Island, the type locality of Cordyceps cicadicola and C. grilii, only recorded from Hainan Island. Most of the other species, e.g., Cordyceps liangshanensis, distributed only in Sichuan, Guizhou, Yunnan (1500 - 2600 m. alt.) (Fig. IV), C. gunnii, C. hawkesii have a wide distribution range in Central and Eastern China.

The Cordyceps fungi are not only parasitic on insects, but also on fungi, especially on the subterranean ascocarps of the genus Elaphomyces, e.g., Cordyceps racemosa in Tibet, C. ophioglossoides and C. captiata in Yunnan, and C. canadensis in Jilin.
id *Meconopsis lèrrestii* Prain occur al-
wetter parts of alpine mountains.

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996 ), *Hepialus baimaensis* Liang, etc.,

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III: 1, C ). Hyphal bodies develop in

, e. g., *Cordyceps* kangdingensis and *C.

rassispora* in Deqin in Yunnan, and C.

st. They are all found in the Hengduan

ensis* is known to be widely distributed

e Himalayas, all well known for enor-

he alpine *Cordyceps* members often as-

line D. Don, *P. macrophyllum* D. Don f.,

*Astragalus halfliriamus* Simpson, A.

widely in China when environmental

*lyceae canadensis* is scattered along the

n, and over wide areas in Yamagata,

ound in Maqu County, Gansu, 3600 –

olved its own distinctive assemblage of

pillar fungi generally inhabit different

converged in their ecological associa-

sional regions of China, e. g.,

*myrmecophila*. They are recorded in

994 ) and Jianfenging (Mt.), Hainan

cola and *C. gryilli*, only recorded from

; *Cordyceps langshanensis*, distributed

2600 m. alt.) ( Fig. IV ), *C. gunnii*, C.

tral and Eastern China.

tic on insects, but also on fungi, espec-

: genus *Elaphomyces*, e. g. *Cordyceps*

*capitata* in Yunnan, and *C. canadensis

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