

Biological Surveys in the Sør Rondane Mountains, Dronning Maud Land, in 1989 and 1990 Seasons

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セールロンダーネ山地における生物調査

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要旨: 第 27-31 次南極地域観測隊 (1986-1990) において、「陸上生態系構造の研究」計画を実施した。これは国際的な BIOTAS 計画に関連した研究計画であった。第 27-29 次観測隊では越冬観測により、昭和基地周辺の沿岸露岩域、特にラングホブデ雪鳥沢の生態系を調査し、第 30-31 次観測隊は夏隊によりセールロンダーネ山地の内陸露岩域における生物調査を実施した。前者についてはすでに報告されているので、ここでは後者について報告する。第 30 次観測隊には 2 名の隊員が参加し、陸上のルートをたどり、同山地の西部露岩域において土壌動物および地衣類を中心とした調査を行った。また第 31 次観測隊は 1 名の隊員のみであったが、ヘリコプターを夏季オペレーションに導入したことにより、同山地を広く調査することができた。前次隊同様、土壌動物を中心に調査し、植物の採取にも努めた。詳細な研究は今後につが、地衣類や節足動物に新たな知見がもたらされている。

Abstract: From 1986 to 1990, a survey of terrestrial biology was carried out as one of the main projects of the Japanese Antarctic Research Expedition, corresponding to the international BIOTAS program. The terrestrial ecology was studied by wintering personnel during the first three years. For this research the SSSI of the Yukidori Valley was used as a main research field. Since the main research activities at that time were already reported by H. KANDA *et al.* (Nankyoku Shiryô, 34, 76, 1990), the present report deals with the research activities conducted in the Sør Rondane Mountains, Dronning Maud Land, during the last two summer seasons. The 1989 survey was made in the western part of the Mountains by means of snow vehicles, and the 1990 survey covered the entire area of the Mountains by using helicopters. Lichens were widely distributed in the Mountains, but well-developed communities of mosses and algae were restricted to the western part of the Mountains. One springtail and several mite species were also found in these western areas and Mefjell which is located in the central part of the Mountains.

1. Introduction

From 1986 to 1990, a survey of terrestrial biology was conducted as one of the

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main projects of the Japanese Antarctic Research Expedition (JARE), corresponding to the international BIOTAS (Biological Investigations of Terrestrial Antarctic Systems) program. The project comprises two programs; that is 1) the studies on the terrestrial ecosystems of the coastal ice-free areas around Syowa Station during three wintering seasons of 1986 to 1988 (JARE-27 to -29), and 2) faunal and floral surveys with some ecological researches on the inland nunataks of the Sør Rondane Mountains, Dronning Maud Land, during two summer seasons of 1989 and 1990 (JARE-30 and -31). The former includes biological meteorology as well as ecological observation at the newly designated SSSI (Site of Special Scientific Interest) of the Yukidori Valley in Langhovde.

The progress of the first program was already reported by KANDA *et al.* (1990).

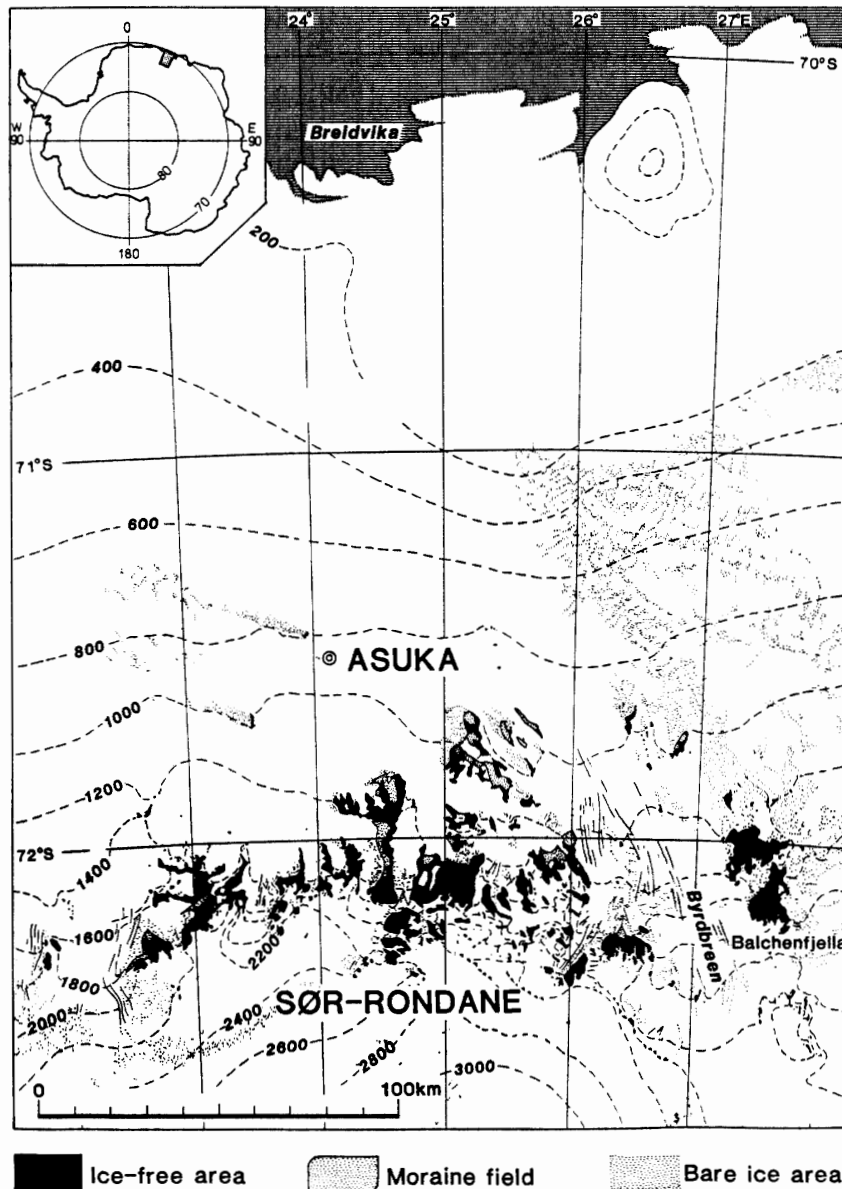


Fig. 1. Sør Rondane Mountains, Asuka Station and Breid Bay (Breidvika).

Then, this paper deals with the progress of the second program carried out in the Sør Rondane which remains almost unexplored biologically.

2. Outline of the Sør Rondane Mountains

The Sør Rondane Mountains is situated in the eastern part of Dronning Maud Land, East Antarctica, and runs along 72°S parallel from 22° to 28°E (Fig. 1). The mountain range is about 150 km apart from the nearest coast and consists of many nunataks of various size. Some nunataks are aggregated with each other but the others are isolated far apart. While the altitude of the northern foot is about 1000 m above sea level, the southern foot come up to the elevation above 2000 m by the mountains which dam up the continental ice sheet.

Although no meteorological observation has systematically been made in the Sør Rondane Mountains area, the wintering observations have commenced in February 1987 at Asuka Station (71°32'S, 24°08'E, 930 m asl) about 30 km north of the Mountains (YAMANOUCHI *et al.*, 1988; AOKI, 1989; AYUKAWA, 1989). In 1987, for instance, the annual mean was -19.7°C in air temperature and 13.1 m/s in the velocity of wind which mostly blew from ESE. Especially in winter blizzards occurred frequently. However, the Sør Rondane seemed usually less windy particularly in its northwestern part than Asuka Station (AYUKAWA, 1989).

From the Sør Rondane Mountains, DODGE (1962) reported ten species of lichens collected by the Belgian Antarctic Expedition in 1959–1961. VAN AUTENBOER (1964) found nesting sea birds such as snow petrels, Antarctic skuas, Wilson's storm petrels and Antarctic petrels. Nevertheless, the biological survey of this range remains incomplete. For instance, no survey of soil animals has been made in the Sør Rondane, whereas several arthropods and lichens were already reported from the inland nunataks in the western part of Dronning Maud Land (DALENIUS and WILSON, 1958; BOWRA *et al.*, 1966; LINDSAY, 1972; SØMME, 1986a). Recently, some ecological surveys were carried out there by Norwegian scientists (ENGELSKJON, 1986; SØMME, 1986b). Since the Sør Rondane Mountains is in the similar geographical condition to the nunataks of these western Dronning Maud Land, some invertebrates and mosses were expected so that the present survey was planned.

3. Short History

The Sør Rondane Mountains was found in 1937 by the Norwegian Expedition which was led by Lars CHRISTENSEN. Thereafter, the operation "Highjump" of U. S. Navy made an air survey in 1946–1947, and on the basis of those photographs taken by the operation a map of the Sør Rondane Mountains was published in 1957 by the Norsk Polarinstitut.

On the occasion of the International Geophysical Year, the Belgian Expedition settled the Base Roi Baudouin (70°26'S, 24°29'E, 36 m asl) on an ice shelf of Breid Bay in 1957. The observation at this base was once ceased in 1961, but resumed in 1964 as the Belgian-Netherlands Antarctic Expedition which lasted for three years. Those expeditions surveyed the Sør Rondane Mountains mainly on its geological and glaciological aspects (VAN AUTENBOER, 1964).

Since a reconnoitering flight made from Syowa Station to the Sør Rondane Mountains via the Yamato Mountains in December 1980 (KAWAGUCHI, 1983), JARE has frequently dispatched parties to the Sør Rondane Mountains. In November and December, 1983, a party conducted the glaciological traverse of the Yamato Mountains, and finally reached an eastern part of Balchenfjella (MAE, 1990). Shortly prior to it, another party landed from Breid Bay to search the approaching route to the Sør Rondane in February 1983 (OHYAMA, 1984). They concluded that a direct route should be taken from Breid Bay to the Mountains along the meridian 24°E. Since then JARE has dispatched many geoscience parties to the Mountains along this route (MORIWAKI *et al.*, 1985, 1986, 1989; HIRAKAWA *et al.*, 1987; ASAMI *et al.*, 1988). In 1987, wintering observations have started at Asuka Station (AYUKAWA, 1989).

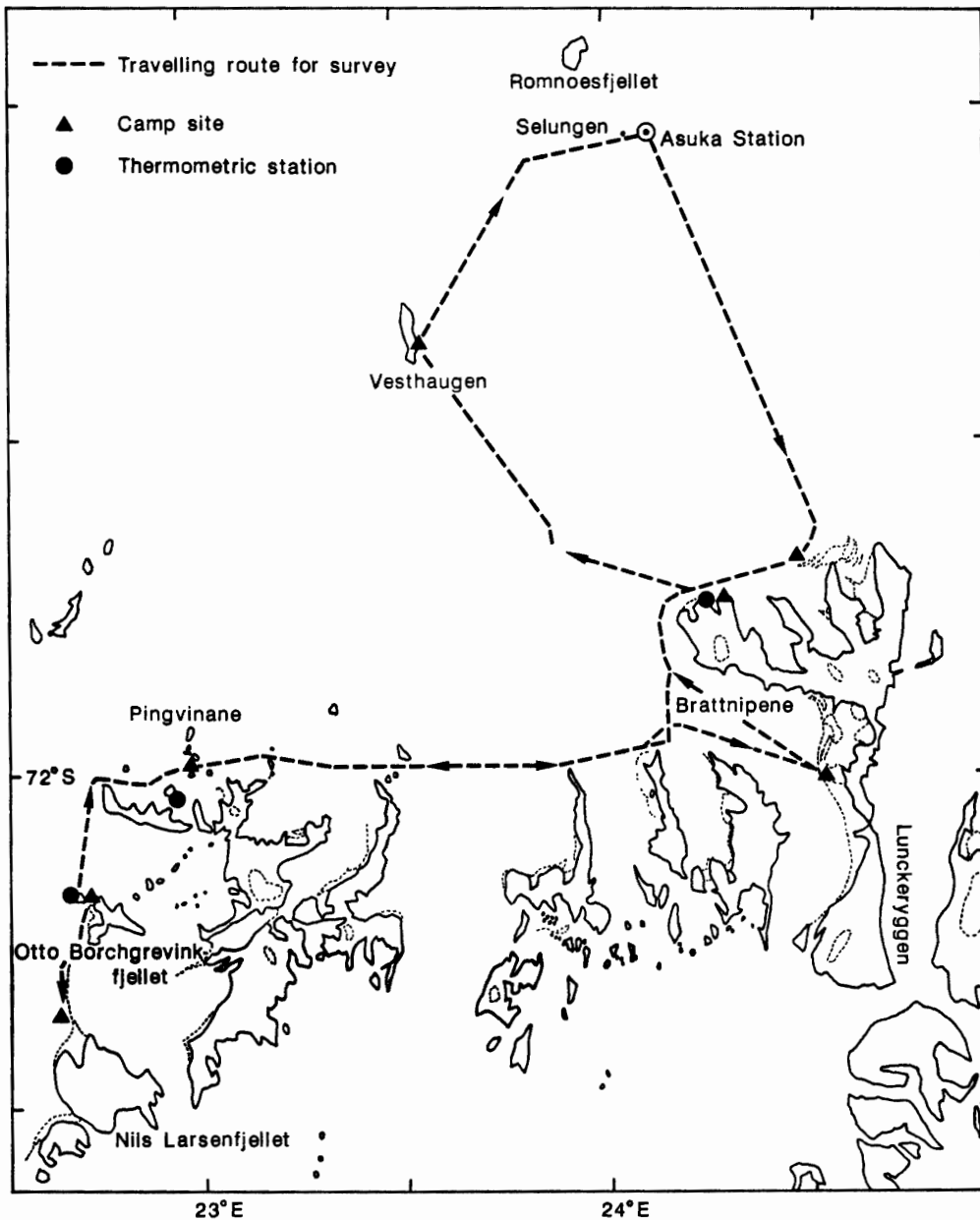


Fig. 2. Western part of the Sør Rondane Mountains surveyed by JARE-30.

4. Outline of the Present Program

As a first step of the biological survey by JARE, the present program includes the faunal and floral surveys of this area, with special reference to the soil animals, bryophytes, lichens and algae. In addition to the biological surveys, this program will make pedological and micrometeorological surveys which will provide much information for discussing the distribution of plants and soil animals in this area.

Consequently, two biologists (zoologist and/or botanist) are to be dispatched during successive two summer seasons. The field parties are to be accompanied by geoscientists. The biologists and geoscientists will make their own research plans but the other field activities will be conducted in cooperation with each other. The field works will entirely be given for the sampling, and the analyses of samples and data are to be undertaken in Japan.

5. Field Activity and Biological Survey of JARE-30

The field survey of JARE-30 was carried out in the western part of the Mountains, ranging from Brattnipene to Nils Larsenfjellet (Fig. 2). The party consisted of seven scientists: two geomorphologists, two paleomagnetists, one geodetic surveyor, and two biologists (HIGASHI and MIYAWAKI among the authors). Three snow vehicles of SM40S type, seven snow mobiles, some sledges and one caboose were used for approaching the research fields. The party left the Asuka Station on December 29, 1988 and returned to the Station on February 1, 1989.

The survey was carried out at the following eight nunataks of the western part of the Mountains: Brattnipene, Otto Borchgrevinkfjellet, Nils Larsenfjellet, Pingvinane, Lunckeryggen, Vesthaugen, Selungen and Romnaesfjellet (Fig. 2). Soil samples were collected from the following microhabitats on each nunatak: bare ground, under boulder, under snow patch, nest of snow petrel, guano of snow petrel, lichen community, algal community and moss community (Table 1). From each microhabitat

Table 1. Microhabitats for soil sampling.

| | Bratt- nipene | Otto Borchgrevink- fjellet | Nils Larsen- fjellet | Pingvinane | Luncke- ryggen | Vest- haugen | Selungen (Seal) | Romnaes- fjellet |
|-------------------------|------------------|----------------------------------|----------------------------|------------|-------------------|-----------------|--------------------|---------------------|
| Bare ground | * | * | * | * | * | * | * | * |
| Under boulder | * | * | * | * | * | * | * | * |
| Under snow patch | * | * | * | * | * | * | * | * |
| Nest of snow petrel | * | * | * | * | * | | | |
| Guano of snow petrel | * | * | * | * | * | | | |
| Lichen community | * | * | | * | * | * | * | * |
| Algal community | * | * | | * | | | | |
| Moss community | | * | | * | | | | |

three sorts of soil samples were taken as follows: about 200 g for soil analysis, five blocks of 125 ml for extracting xerophylic animals and three blocks of 125 ml for extracting hygrophylic animals. Xerophyles were extracted immediately after sampling by the Tullgren apparatus installed in the snow vehicle. The samples for soil analysis were weighed soon after sampling and stored in frozen state. The samples for hygrophyles were stored in the insulated boxes to maintain the temperature around 0°C during the transportation to Japan as far as possible.

The samplings of plants were made at various locations including rock surface, crevices in a rock and so on. Additionally, some plant communities were phytosociologically surveyed at eleven sites by the belt transect method. Moreover, some quadrats for long term monitoring of the plant community were set up at two nunataks, Pingvinane and Selungen.

Temperatures of air and microhabitats were recorded at three nunataks by using the data loggers (Table 2).

Table 2. Microhabitats for temperature measurement.

| | Otto Borchgrevinkfjellet (Jan. 5–10) | Pingvinane (Jan. 13–19) | Brattnipene (Jan. 25–29) |
|----------------------|---|----------------------------|-----------------------------|
| Air temperature | * | * | * |
| Bare ground | * | | * |
| Under snow patch | | * | * |
| Nest of snow petrel | * | * | |
| Guano of snow petrel | * | | |
| Lichen community | | * | |
| Algal community | | | * |

6. Field Activity and Biological Survey of JARE-31

Helicopters introduced to the summer operation enable the field survey of JARE-31 to cover an extensive area of the Mountains including some places to which overland approach was obstructed by the presence of many crevasses. This party was composed of six scientists: four geologists, one geodetic surveyor and one zoologist (HIRUTA, one of the authors). They often left the air base of Asuka Station for one-day or a few-day surveys. This flight operation was carried out from January 5 to 30, 1990 after the air base was established and pilots experienced some flights and landing to the mountainous areas. Prior to the flight operation, some biological surveys were conducted in a nunatak near the Station (OSANAI *et al.*, 1990).

The survey was carried out at the following ten nunataks extending over entire area of the Mountains: Austkampane, Balchenfjella Nord, Balchenfjella Sør, Austkampane (SE), Tanngarden, Vengen, Menipa, Dufekfjellet, Mefjell and Bergersenfjellet (Fig. 3). Soil samples for xerophyles, hygrophyles and soil analysis were taken by the core sampler (20 cm² × 5 cm) at almost the same microhabitats as in JARE-30. Each sample was 1200 ml (12 cores). Xerophyles were extracted by the Tullgren apparatus installed at Asuka Station, and the other samples were transported to Japan in frozen state. Thermometry of microhabitat was attempted at each nunatak, but the stay at each nunatak was too short to take long term records. Since the formation

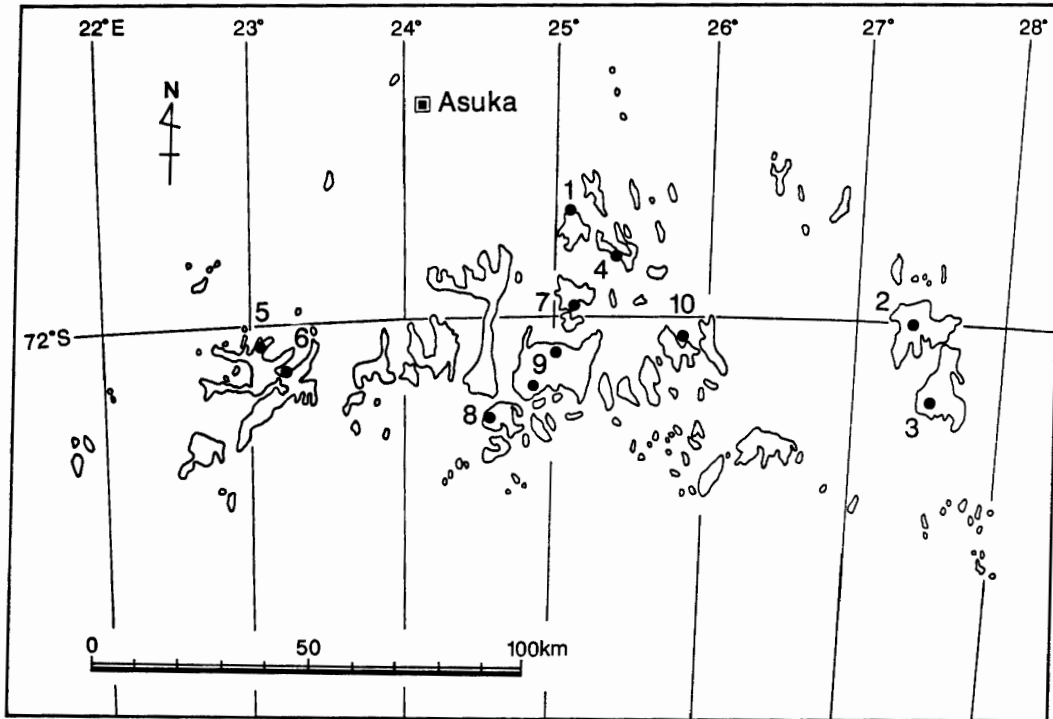


Fig. 3. Nunataks surveyed by JARE-31. 1. Austkampane, 2. Balchenfjella Nord, 3. Balchenfjella Sør, 4. Austkampane (SE), 5. Tanngarden, 6. Vengen, 7. Menipa, 8. Dufekfjellet, 9. Mefjell, 10. Bergersenfjellet.

of personnel restricted the number of biologists to only one (zoologist), the phytosociological survey was not undertaken in this expedition. However, the plant specimens were collected from as many sites as possible and were transported to Japan in frozen state.

7. Summary of the Results

The identification of specimens and the analyses of soil and meteorological data are still in progress, and most of the results will be published in due time. In this paper general information obtained in the field is represented as follows.

1) Except in Balchenfjella Nord, lichens were widespread over the Sør Rondane area including the small nunatak, Bamsefjell which is isolated far from the southwestern edge of the Mountains. At least two genera of lichens will be newly added to the floral list from this area reported by DODGE (1962). No discovery of lichens in Balchenfjella Nord is probably attributed to the short stay and the insufficient survey.

2) Developed communities of algae and mosses were often found in the northwestern part of the Mountains such as Vengen and Tanngarden. Sea birds were more frequently observed nesting and/or foraging in the western area than in other areas of the Mountains. Their activities seemed to be considerably controlled by meteorological factors such as katabatic wind.

3) Since several authors (DALENIUS and WILSON, 1958; BOWRA *et al.*, 1966; SOMME, 1980, 1986a) reported the several species of arthropods from the western part

of Dronning Maud Land, the occurrence of some arthropods has been predicted even in the Sør Rondane. According to our expedition, the present survey found one springtail and several mite species in Mefjell and the northwestern part of the Mountains. This presents a striking contrast to no discovery of springtails in the coastal area around Syowa Station, whereas the environmental condition is less severe and faunal surveys have been made more frequently around Syowa Station. This problem requires that the colonization of arthropods should be researched in relation to the history of retreat of the continental ice sheet.

References

- AOKI, T. (1989): Meteorological data at Asuka Station, Antarctica in 1988. *JARE Data Rep.*, **150** (Meteorology 23), 110 p.
- ASAMI, M., MAKIMOTO, H., ANIYA, M., HAYASHI, M., IIMURA, Y., HAYASHI, T., NARAOKA, H., YONEZAWA, Y., FUJITA, S. and GREW, E. S. (1988): Sêru Rondâne Sanchi chigaku chôsatai hôkoku 1988 (JARE-29) (Report on the geological, geomorphological and geodetic field work and meteorite search in the Sør Rondane Mountains, 1988 (JARE-29)). *Nankyoku Shiryô (Antarct. Rec.)*, **32**, 334–363.
- AYUKAWA, M. (1989): Dai-28-ji Nankyoku Chiiki Kansokutai Asuka Kansoku Kyoten ettô hôkoku 1987 (Activities of the first wintering party at Asuka Station by the 28th Japanese Antarctic Research Expedition in 1987). *Nankyoku Shiryô (Antarct. Rec.)*, **33**, 234–268.
- BOWRA, G. T., HOLDGATE, M. W. and TILBROOK, P. J. (1966): Biological investigations in Tottanfjella and central Heimefrontfjella. *Br. Antarct. Surv. Bull.*, **9**, 63–70.
- DALENIUS, P. and WILSON, O. (1958): On the soil fauna of the Antarctic and of subantarctic islands. The Oribatidae (Acari). *Arkiv. Zool.*, **11**, 393–425.
- DODGE, C. W. (1962): Expedition Antarctique Belge: Lichens. *Bull. Jard. Bot. Etat, Bruxelles*, **32**, 301–308.
- ENGELSKJON, T. (1986): Botany of two Antarctic mountain ranges: Gjelsvikfjella and Muhlig-hofmannfjella, Dronning Maud Land. I. General ecology and development of the Antarctic cold desert cryptogam formation. *Polar Res.*, **4**, 205–224.
- HIRAKAWA, K., MATSUOKA, N., TAKAHASHI, Y., SAKIYAMA, T., OSANAI, Y. and TANAKA, K. (1987): Sêru Rondâne Sanchi chigaku chôsatai hôkoku 1987 (JARE-28) (Report on the geological, geomorphological and geodetic field party in the Sør Rondane Mountains, 1987 (JARE-28)). *Nankyoku Shiryô (Antarct. Rec.)*, **31**, 206–229.
- KANDA, H., INOUE, M., MOCHIDA, Y., SUGAWARA, H., INO, Y., OHTANI, S. and OHYAMA, Y. (1990): Biological studies on ecosystems in the Yukidori Valley, Langhovde, East Antarctica. *Nankyoku Shiryô (Antarct. Rec.)*, **34**, 76–93.
- KAWAGUCHI, S. (1983): Dai-21-ji Nankyoku Chiiki Kansokutai ettôtai hôkoku 1980–1981 (Activities of the wintering party of the 21st Japanese Antarctic Research Expedition in 1980–1981). *Nankyoku Shiryô (Antarct. Rec.)*, **77**, 69–92.
- LINDSAY, D. C. (1972): Lichens from Vestfjella, Dronning Maud Land. *Norsk Polarinst. Medd.*, **101**, 21 p.
- MAE, S. (1990): Dai-24-ji Nankyoku Chiiki Kansokutai ettôtai hôkoku 1983–1984 (Activities of the wintering party of the 24th Japanese Antarctic Research Expedition in 1983–1984). *Nankyoku Shiryô (Antarct. Rec.)*, **34**, 363–380.
- MORIWAKI, K., SHIRAIISHI, K., IWATA, S., KOJIMA, S., SUZUKI, A., TERAJ, K., YAMADA, S. and SANÔ, M. (1985): Sêru Rondâne Sanchi chigaku chosatai hôkoku 1985 (JARE-26) (Report on the geological, geomorphological and geodetic field work in the Sør Rondane Mountains, 1985 (JARE-26)). *Nankyoku Shiryô (Antarct. Rec.)*, **86**, 36–107.
- MORIWAKI, K., KOJIMA, H., ISHIZUKA, H., MATSUOKA, N., KOMETANI, T., SHIGA, S., MORITA, T. and KURIKI, S. (1986): Sêru Rondâne Sanchi chigaku chosatai hôkoku 1986 (JARE-27) (Report on the geological, geomorphological and geodetic field party in the Sør Rondane Mountains, 1986 (JARE-27)). *Nankyoku Shiryô (Antarct. Rec.)*, **30**, 246–281.

- MORIWAKI, K., FUNAKI, M., HIRAKAWA, K., TOKIEDA, K., ABE, H., HIGASHI, S. and MIYAWAKI, H. (1989): Sêru Rondâne Sanchi chigaku, seibutsu chosatai hôkoku (Report on the geomorphological, paleomagnetic, geodetic, zoological and botanical field work in the Sør Rondane Mountains, 1988–89 summer season (JARE-30)). *Nankyoku Shiryô (Antarct. Rec.)*, **33**, 293–319.
- OHYAMA, Y. (1984): Dai-24-ji Nankyoku Chiiki Kansokutai natsutai hôkoku 1982–1983 (Activities of the summer party of the 24th Japanese Antarctic Research Expedition in 1982–1983). *Nankyoku Shiryô (Antarct. Rec.)*, **82**, 30–45.
- OSANAI, Y., TAKAHASHI, Y., TAINOSHO, Y., TSUCHIYA, N., HAYASHI, T. and HIRUTA, S. (1990): Sêru Rondâne Sanchi chigaku, seibutsu chosatai hôkoku 1990 (JARE-31) (Report on the geological, geodetic and biological field work in the Sør Rondane Mountains, 1990 (JARE-31)). *Nankyoku Shiryô (Antarct. Rec.)*, **34**, 445–481.
- SOMME, L. (1980): Terrestrial arthropods from Vestfjella, Dronning Maud Land (Acari, Collembola), with notes on their taxonomy. *Entomol. Scand.*, **11**, 61–64.
- SOMME, L. (1986a): New records of terrestrial arthropods from Dronning Maud Land, Antarctica. *Polar Res.*, **4**, 225–229.
- SOMME, L. (1986b): Ecology of *Cryptopygus sverdrupi* (Insecta: Collembola) from Dronning Maud Land, Antarctica. *Polar Biol.*, **6**, 179–184.
- VAN AUTENBOER, T. (1964): The geomorphology and glacial geology of Sør-Rondane, Dronning Maud Land, Antarctica. *Vlaam. Acad. Wetenschap., Lett. Schoone Kunsten Belg., Kl. Wet., Meded.*, **26**(8), 91 p.
- YAMANOUCHI, T., SHIBUYA, K. and SAKAI, R. (1988): Meteorological data at Asuka Camp, Antarctica in 1987. *JARE Data Rep.*, **140** (Meteorology 21), 104 p.

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