

SVERIGES GEOLOGISKA UNDERSÖKNING

SER. C.

Avhandlingar och uppsatser.

N:o 492.

ÅRSBOK 42 (1948) N:o 1.

INTERGLACIAL INSECT
REMAINS FROM SWEDEN

BY

CARL H. LINDROTH

With 2 Plates

Pris 2 kronor

STOCKHOLM 1948
KUNGL. BOKTRYCKERIET. P. A. NORSTEDT & SÖNER
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Introduction.

Owing to the practically total glaciation of Sweden during the Last Glaciation Period (Würm) strata of an interglacial or even older age are not likely to be discovered *in situ*. They were partly swept away by the Würm-ice and partly covered with moraines or other glacial deposits. It is thus easily understood that the presence of interglacial stages in Fennoscandia on the whole was long doubted or completely denied.

Apart from some fossiliferous layers in Skåne (vide Holmström 1912, p. 443; Henriksen 1933, p. 283 a. f.), which are considered as partially interglacial, the following five finds have hitherto been made in Sweden which are, for good reasons, almost unanimously regarded by geologists as being interglacial:

A. Jämtland, Frösön (Högbom 1893).

B. Ångermanland, Härnön (Munthe 1890, 1904, 1906, 1909 a, 1909 b, 1910, 1946). This find has been the subject of a very hot discussion (vide further e. g. Holst 1895, 1906, 1909) but its true age seems now to be quite clear, not least because of the enclosed insect remains.

C. Hälsingland, Bollnäs (Halden 1915).

D. Jämtland, Pilgrimstad (Kulling 1945).¹

E. Ångermanland, Långsele (Sandegren 1945).

At the four last-mentioned of these localities, marked on the adjoining map (fig. 1), the interglacial strata also proved to contain insect remains, which were placed at my disposition for determination. Also the material from Härnön previously treated by Mjöberg (1904, 1905, 1916) proved to require a close revision. The entire material belongs to »Sveriges Geologiska Undersökning» (Geological Survey of Sweden), and I wish to express my thanks to the officials of that institution, Director Professor P. Geijer, Dr. O. Kulling, Dr. R. Sandegren and Dr. P. Thorslund, for having highly facilitated my work. The remains from Härnön and Bollnäs were forwarded to me by Professor H. Munthe and Dr. B. Halden respectively, for which I am very much indebted.

¹ A locality with similar stratification, as yet not fully investigated, was detected by Thorslund (1939) at Vålbacken, Jämtland.

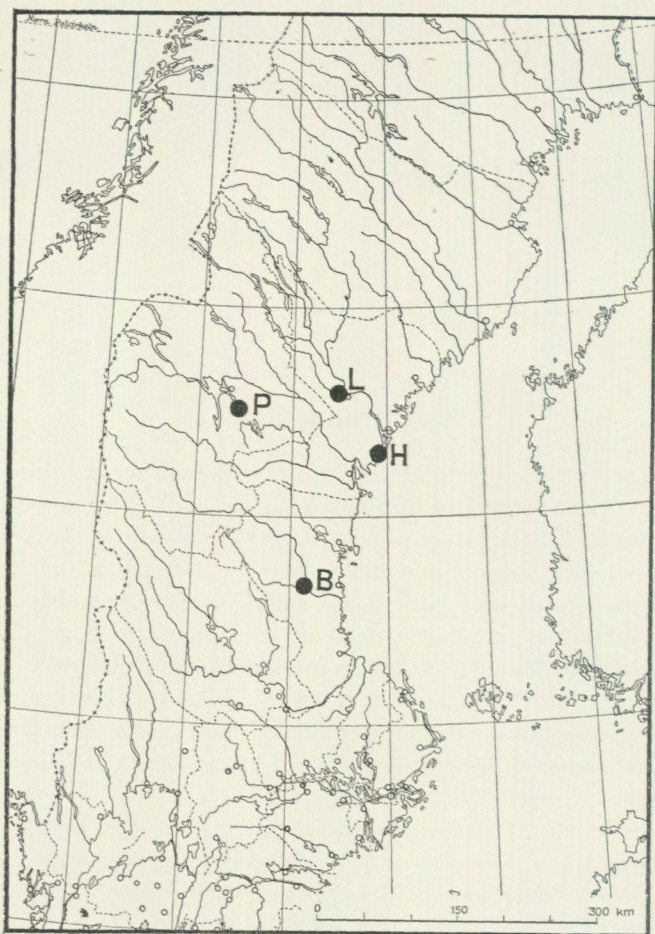


Fig. 1. Swedish localities of interglacial insect remains. B = Bollnäs, H = Härnön, L = Långele, P = Pilgrimstad.

Mjöberg, in his above-mentioned papers, names four Coleoptera from the Härnö-gyttja determined as to species, two of them described as new, extinct species, and adds several other forms determined as to genus only. Among these as well as among the remaining unnamed fragments he suggested many extinct species: »Überhaupt machen diese Reste einen fremden Eindruck und dürften auch meistens von alten, allem Anschein nach ausgestorbenen Arten herkommen» (1916, p. 5).

The present revision of the Härnö material has shown that Mjöberg's opinion was extremely weakly founded. His two *novae species*, *Gyrinus sculpturatus* (1905) and *Olophrum interglaciale* (1904), shortly after their description were examined by Kolbe (Holst 1909, p. 116) who declared them to be *G. Paykulli* OCHS (*bicolor* PAYK.) and *O. rotundicolle* C. R. SAHLB. respectively. Dr. Anton Jansson (Örebro), who studied the Härnö material before I took it over, expressed

as his opinion that it was a question of *G. opacus* C. R. SAHLB. and *O. consimile* GYLL. (Munthe 1946, p. 4—5). In the first case I agree with him. As to the *Olophrum*, however, a closer study of the recent species has taught me that the determination of an *Olophrum* from the elytra only (and other parts are not preserved in the material) must be regarded as hopeless. Their puncture within each species is subject to the most surprising variation, the species-limits in this genus being on the whole unusually little decided (vide Munster 1935—36). Above all there is no satisfactory reason for describing an *Olophrum*-elytron as belonging to an extinct species.

The two remaining Coleoptera specifically named by Mjöberg are *Agonum* (*Anchomenus*) *moestum* DFT. and *Oodes helopioides* FBR. The first one is no *Agonum* but a clear *Pterostichus*, though it is impossible to decide the species; especially the microsculpture is quite different. No specimen labelled as *Oodes* and no remains of that genus were present in the material. As the occurrence in the Härnö-gyttja, however, of this southern beetle, the continuous area of which reaches into the province of Gästrikland only, would be completely in contrast with the rest of the fauna, the determination must undoubtedly be incorrect. Thus all the species-names of Coleoptera in the Härnö material given by Mjöberg have to fall.

The following determinations made by Mjöberg (l. c.) are also incorrect: »*Anchomenus* sp.» (p. 7) is a *Pterostichus* (there is no *Agonum* in the material); »*Loricera* (?) sp.» (p. 8) is probably *Diachila arctica* (vide below), at any rate no *Loricera*; »*Boreaphilus*? *Eudectes*? sp.» is *Arpedium brunnescens* (vide below); »*Geodromicus* (?) sp.» is an *Olophrum*.

It is not difficult to understand how the Härnö material could make so strange an impression on Mjöberg that he suggested it to be the remains of a partly extinct fauna. He had met with the manifestation of a fact, the difficulty of which could be expressed in the form of the following question: To what extent do fossils and subfossils change by postmortal processes?

In fact this question has already once been raised on the basis of subfossil insects from Sweden. Henriksen (1933, p. III) described a *Notiophilus coriaceus* from late glacial beds in Skåne and regarded it as an extinct species. The same year, at the IV Nordic Entomological Congress at Oslo, where Henriksen gave an account of his investigations, Munster stated in the following discussion that by treating *Notiophilus aquaticus* with NaOH he had succeeded in giving its elytra just the same rugulose microsculpture which was said to be characteristic for *N. coriaceus* (Norsk Ent. Tidsskr. 3. Oslo 1934, p. 295). This is also applicable to the Härnö material, where 3 elytra of *Notiophilus* are present, two of them being typical *aquaticus*, whereas the third has just the *coriaceus*-structure mentioned. I am unable to interpret this except as a postmortal change.

In the Härnö material the matter is complicated by the common and highly striking appearance of great, \pm regularly formed and arranged punctulae on the interstices of elytra or on the disc of the prothorax of many Carabids,

especially of the genus *Pterostichus*, also for instance on a prothorax of *Amara alpina*. Mjöberg (1916, p. 13) rejects the idea that this sculpturation might be postmortal, and at first sight I was of the same opinion (Munthe 1946, p. 4) so deep and regular are these punctulae. The opposite interpretation, however, can be based upon the following facts:

1. Also the normal punctulae of many species (Carabids, Staphylinids, *Simplocaria* etc.) are evidently strengthened in the interglacial material (especially from Härnön).

2. Except for these punctulae the remains often completely agree with recent material (e. g. *Pterostichus diligens*).

3. Quite minute rudiments of such punctulae can sometimes be seen also on other, better preserved subfossil material though apparently absent in the living insect (e. g. elytra and prothorax of *Pterostichus diligens*, elytron of *Harpalus nigritarsis*, prothorax of *Amara alpina*, all from Långsele; elytron of *Amara alpina* from Pilgrimstad).

I tried in vain to bring about such punctulae on dried recent specimens of several *Pterostichus* by treating them in different concentrations of HCl, H₂SO₄, HNO₃, H₂S, H₄NOH and NaOH. On the other hand the rugulose »coriaceus-microsculpture» mentioned above was produced not only by NaOH but also by the ammonia and especially by the sulphuric acid.

In spite of this failure I am highly inclined to suggest the structural peculiarities mentioned as postmortal changes. Whether their common occurrence just in the Härnön material is due to the possible higher age of these deposits or to the action of special chemical substances, I am unable to decide. It is evident, however, that the insect remains of this bed have also mechanically been subject to extreme changes, resulting in outflattening, foldings and other deformations. Also the colour of the Härnön-insects is badly preserved, its metallic lustre having almost totally disappeared; brown or yellow parts being so darkened that they hardly contrast. Thus the far-reaching conclusions drawn by Mjöberg (1904, p. 495—496) on the basis of the supposed extraordinarily dark colour of *Olophrum »interglaciales»* have no real ground.

The most useful taxonomical characters of subfossil remains of Coleoptera, especially when consisting merely of single or fragmentary elytra, lie in the microsculpture, i. e. the fine surface structure not clearly visible in an enlargement less than 100 × or a little more. Usually each species possesses its quite peculiar system of punctuation, reticulated or parallel winding lines etc. Especially indispensable are these characters for beetles (e. g. many Curculionids) which when living have their elytra covered with dense hairs or scales the removal of which gives the subfossils a quite unfamiliar appearance. Regard must be paid to the fact, however, that rather essential differences of microsculpture sometimes exist between male and female of the same species.

In the following taxonomic survey the insect remains of all the samples are treated together. With the exception of the *Aphalara* and the *Cryobius* only those insects are listed which could be determined as to species. Thus the numerous elytra of *Olophrum* from Härnön and Långsele were left out. The

majority of the Härnö-material as well as several specimens from Långsele proved completely undeterminable. A comparison of the fauna of the four localities connected with some general conclusions follows. Some determinations or controls, accounted of at each species, were made by Professor Harald Lindberg (Helsingfors), Assistent F. Ossiannilsson (Stockholm) and Assistent Per Brinck (Lund) to whom I herewith express my sincere gratitude.

Nomenclature according to *C a t a l o g u s* 1939.

List of Species.

Hemiptera (1 species).

Fam. Psyllidae.

1. *Aphalara* cf. *calthae* L., possibly *affinis* Zett., the specific value of which is not quite clear (det. Ossiannilsson). Långsele, 1 right forewing. — Both forms are widely distributed in Sweden (vide Wahlgren, Ent. Tidskr. 55. Stockholm 1934, p. 86) but *affinis* has not yet been found south of Östergötland.

Coleoptera (41 species).

Fam. Carabidae.

1. *Nebria Gyllenhali* SCHÖNH. Pilgrimstad, 1 left elytron, only the extreme apex wanting; the striae with unusually fine puncture, otherwise typical. At the apex clear traces of rufinismus.

Other fossil finds. Denmark, Sjælland, late glacial (Henriksen 1933, p. 125). Iceland, interglacial (Thorkelsson 1935, p. 5).

Distribution. Circumpolar. In Europe boreoalpine. In Scandinavia south to Dalsland, Värmland, Västmanland, further at the shores of Lakes Vänern and Vättern and on Gotland. In Balticum south to Curland. Maps: Holdhaus & Lindroth 1939 (p. 269; Taf. VI); Lindroth 1945.

Ecology. Within the *regio alpina* almost ubiquitous in not too dry places, at lower niveaus a stenotopic riparian insect, especially by rivers but also by the sea and cold-water lakes. It ascends in the fjelds regularly into the middle alpine step but occasionally to considerably higher altitudes (Jämtland, 1370 metres).

2. *Notiophilus aquaticus* L. (*Notiophilus* sp., Mjöberg 1916, p. 8). Härnön, 3 defect elytra, all without apical part, one of pronounced «*coriaceus*» type (Henriksen 1933, p. 111). Pilgrimstad, elytron without apical part.

Other fossil finds. Skåne, Svedala and Mossby, late glacial («*coriaceus*», Henriksen l. c.). England, late glacial, determined with some doubt (Blair 1924, p. 558). Dogger Bank, postglacial moor-log (Bell 1922).

Distribution. Circumpolar. The whole of Fennoscandia, but more frequently in the north. Map: Lindroth 1945.

Ecology. Eurytopic, prefers gravelly ground with moderate moisture

and open meadow-vegetation. Of all the Fennoscandian Carabids this is the only species inhabiting all vertical zones, incl. the *regio alpina superior*.

3. *Diachila arctica* GYLL. (*Diachila* sp., Mjöberg 1916, p. 5, Taf. I, fig. 1). Härnön, a complete prothorax (vide Munthe 1946, p. 4). The elytral fragment named by Mjöberg (l. c.) »*Loricera* (?) sp.» probably also belongs here. Pl. I, fig. a.

Other fossil finds. Galicia, early glacial (Lomnicki 1894, p. 24).

Distribution. Circumpolar. In Europe only in the extreme north (fig. 4), not farther west than Abisko in Swed. Lapland. Map: Lindroth 1945.

Ecology. A swamp species ecologically related with *Elaphrus lapponicus*. From the lower parts of the *regio alpina* (incl. the tundra) to the higher parts of the conifer belt.

4. *Diachila polita* FALD. (*Diachila*, 2 spp., Mjöberg 1916, p. 6, Taf. I, figg. 3, 5). Härnön, left half of prothorax, fragments of two left elytra (vide Munthe 1946, p. 4). Pl. I, fig. b.

Distribution. Eurasiatic. From Kamtschatka to the east of the Kola Peninsula (fig. 5). Map: Lindroth 1945.

Ecology. A tundra species but in NE Russia and Siberia also in the northernmost parts of the taiga. On rather dry ground.

5. *Elaphrus lapponicus* GYLL. Långsele, left elytron without apical third. Pl. I, fig. c.

Other fossil finds. Denmark, Jutland, late glacial (Henriksen 1933, p. 126).

Distribution. Eurasiatic (possibly circumpolar). In Europe boreobritish, outside Fennoscandia (and one locality in Latvia) in the British Isles only. In Scandinavia apparently a bicentric fjeld species. Maps: Lindroth 1935, p. 585; 1945.

Ecology. On the moss-pillows (e. g. *Paludella squarrosa*) of small fens, especially at springs on mountain slopes. In the *regio alpina inferior*, *regio betulina* and the upper parts of the conifer belt, isolated (in Finland and Latvia) farther south.

6. *Bembidion (Plataphus) prasinum* DFT. Pilgrimstad, 2 defect elytra, apparently of the same specimen; clear traces of rufinismus (»ab. *Kolströmi* C. R. SAHLB.»).

Distribution. Eurasiatic. In Europe boreomontan. In Sweden south to the river Dalälven, in Norway to the extreme south. Maps: Netolitzky 1913; Lindroth 1945.

Ecology. A stenotopic riparian species living on coarse sterile gravel close to the water, quite prevalent at running water. A member of the conifer belt fauna it extends regularly into the *regio betulina* but only seldom into the lower parts of *regio alpina*; in Siberia, however; also on the tundra.

7. *Bembidion (Plataphus) Hasti* C. R. SAHLB. Pilgrimstad, 4 elytra belonging to at least 3 specimens.

Other fossil finds. Skåne, Bara, late glacial (Henriksen 1933, p. 128).

Distribution. Eurasiatic. In Europe in the extreme north but along the Scandinavian fjelds to S Norway; isolated on the eastern shores of the Gulf of Bothnia. Map: Lindroth 1945.

Ecology. As in *B. prasinum* but also on \pm sandy shores. It is a more pronounced fjeld species reaching its maximum in the *regio betulina* and regularly extending to the *regio alpina media*.

8. *Patrobus septentrionis* DEJ. Långsele, a complete prothorax. Pl. 1, fig. e.

Other fossil finds. Skåne and Denmark, late glacial (Kolbe 1932; Henriksen 1933, p. 129). Jämtland, late postglacial (Sandegren 1924, p. 45). Iceland, interglacial (Thorkelsson 1935, p. 5).

Distribution. Circumpolar. In Europe (excl. the sbsp. *australis* J. SAHLB. s. l.) boreoalpine, in the central parts inhabiting the Alps only; also in the British Isles. In Sweden south to northern Dalarna, in Norway along the fjelds into the south. Map: Lindroth 1945.

Ecology. In the *regio alpina* very eurytopic, also on rather dry moor-ground, extending to the higher parts (in Swed. Lapland to 1300 metres). In the forest region a distinctly hygrophilous insect living on river banks or in Sphagnum. In the conifer belt rare and local.

9. *Patrobus assimilis* CHAUD. Långsele, a complete prothorax. Pl. 1, fig. d.

Distribution. Only found in Europe but extending eastward to the Urals. Boreoalpine, but with little pronounced »Auslöschungszone». In Fennoscandia generally distributed but rare in the southern part of Sweden. Maps: Holdhaus & Lindroth 1939; Lindroth 1945.

Ecology. In the north extremely eurytopic, also on dry ground, toward the south gradually more hygrophilous, in S Sweden exclusively in forest fens, e. g. among Sphagnum. In the fjelds ascending to the *regio alpina inferior*.

10. *Harpalus nigritarsis* C. R. SAHLB. (vide Lindroth, Ent. Tidskr. 64. Stockholm 1943, p. 26). Långsele, left elytron of ♂, only the extreme apex wanting. The microsculpture also in the apical part is weaker than in any *latus* L. seen by me but agrees completely with that of the single known Swedish specimen (♂) of *nigritarsis*. Also the feeble shoulder tooth is characteristic. Pl. 1, fig. h.

Distribution. This extremely rare species has not been collected in Fennoscandia within the last century. Only old specimens without exact locality exist. It has moreover been reported from Siberia. Vide Lindroth 1945 (p. 492). — Its ecology is unknown.

†1—474103. S. G. U. Ser. C. N:o 492. Lindroth.

11. *Amara alpina* FBR. Härnön, right half of prothorax. Långsele, 3 halves of prothorax, 2 fragments of the shoulder region of elytra. Pilgrimstad, 2 fragments forming a nearly complete right elytron. Pl. 1, fig. f.

Other fossil finds. Skåne and Denmark (Jutland), late glacial (Henriksen 1933, p. 140).

Distribution. Eurasiatic. In Europe boreo-british, found also in Scotland. In Fennoscandia, excl. a single specimen at the river Dalälven, in fjeld districts only. Maps: Lindroth 1935, p. 590; 1945.

Ecology. The most characteristic Carabid beetle of our *regio alpina* where it especially frequents the moderately dry dwarfshrub moor but also occurs in meadows, on boulder ground, at the margin of snowfields etc. In the *regio betulina* local and less frequent, in the *regio coniferina* a single spontaneous occurrence known (Norway, Femundsenden).

12. *Pterostichus (Lyperophorus) vermiculosus* MÉN. Härnön, fragment of the shoulder region of right elytron (vide Munthe 1946, p. 4). The sculpture is extremely characteristic. Pl. 1, fig. g.

Other fossil finds. Finland, Karelian Isthmus, late glacial (Poppius 1911).

Distribution. Eurasiatic. In Siberia and N Russia, toward the west to the Petschora only.

Ecology. A true tundra form not found in the taiga. It is said to live in dry places.

13. *Pterostichus (Cryobius) sp.* Härnön, 2 right prothorax halves. One of them has a left elytron (excl. apical part) fixed to the same label, thus surely found together. Other fragments of elytra in the material probably belong to the same species. Characteristic is the peculiar punctuation of both prothorax and the elytral interstices mentioned above and considered to be postmortal. Apart from that the prothorax shows a great resemblance to that of *P. laeviusculus* J. SAHLB. and *P. despectus* J. SAHLB., the elytron to that of *P. sulcipennis* J. SAHLB. All these species are known exclusively from the Siberian tundra. The taxonomy of *Cryobius*, however, in spite of the revision by Poppius (1906), is quite imperfectly investigated. Under all circumstances the remains belong to a species not living in the Fennoscandia of to-day. Pl. 1, fig. 2.

14. *Pterostichus (Argutor) diligens* STURM. Härnön, 1 prothorax differing from recent specimens through the peculiar, presumably postmortal punctuation only. Långsele, 1 prothorax and 2 left elytra; these fragments also show slight traces of the same punctuation.

Other fossil finds. Skåne, late glacial and (?) preglacial (Kolbe 1932). Denmark, postglacial (Henriksen 1933, p. 138). Finland, postglacial (Poppius 1911). Iceland, interglacial (Thorkelsson 1935, p. 5). Ireland, undetermined age (Bell 1922, p. 51). Bavaria, glacial (Flach 1884, p. 6).

Distribution. Eurasiatic. Generally distributed and common throughout Europe except in the southernmost parts. In Fennoscandia all over the countries. Map: Lindroth 1945.

Ecology. A quite ubiquitous hygrophilous species. In the *regio betulina* local but extending in isolated places also into the lower parts of the *regio alpina*; also found on the tundra.

15. *Agonum (Europhilus) fuliginosum* PANZ. Långsele, two right elytra.

Other fossil finds. Denmark, late glacial and postglacial (Henriksen 1933, p. 133). Finland, postglacial, determination uncertain (Poppius 1911).

Distribution. Eurasiatic. In the whole of Europe except the southern parts. In Fennoscandia all over the countries. Map: Lindroth 1945.

Ecology. A hygrophilous species nearly as ubiquitous as *Pterostichus diligens* with which it often lives in company. Not regularly in the *regio betulina*, in the lower *regio alpina* one Fennoscandian find only. There is, however, a record from the Siberian tundra.

16. *Agonum (Europhilus) consimile* GYLL. Långsele, 1 left elytron which is so well preserved that it can with certainty be distinguished from *A. Munsteri* HELLÉN through the characteristic profile arch and the distinct metallic lustre. Two other damaged elytra probably belong to the same species.

Distribution. Eurasiatic. In Europe hitherto known from Fennoscandia only, where it is apparently continuously distributed from the Kola peninsula to the S-Norwegian fjelds. Map: Lindroth 1945.

Ecology. A hygrophilous species confined to fens with mosses (not Sphagnum) and Carices. The maximum lies in the *regio betulina*, but it extends regularly into the lower *regio alpina*. In the conifer belt it is only met with if fjelds exist in the immediate vicinity.

Fam. Dytiscidae.

17. *Hydroporus* (?) *acutangulus* THOMS. (det. Per Brinck). Långsele, one complete but slightly deformed right elytron. The determination is not quite certain.

Distribution. Eurasiatic. A northern species wanting in Central Europe extending to the south into central S Norway, Hälsingland and S Finland. The record from Stockholm (Catalogus 1939) is uncertain.

Ecology. In small bodies of standing water, especially among mosses. Regularly in the *regio betulina*, in Norway extending to the lower *regio alpina*, also found on the tundras of the peninsulas of Kola and Kanin.

18. *Agabus guttatus* PAYK. Långsele, a complete left elytron.

Distribution. Eurasiatic. Almost the whole of Europe. In Fennoscandia throughout the countries.

Ecology. Characteristic for small running streams and for springs with cold water. Generally extending into the *regio alpina*, in Swedish Lapland to at least 1000 metres.

19. *Agabus Solieri* AUBÉ. Pilgrimstad, fragments of all parts in quite amazing quantities in nearly every sample, also \pm fragmentary oedeagi the most complete of which shows the dorsal furrow ending versus the apex asymmetrically to the right, as figured by Guignot (1931—33, p. 556).

Other fossil finds. Iceland, interglacial (Thorkelsson 1935, p. 6).

Distribution. If *A. Solieri* is regarded as constantly different from *A. bipustulatus* L. (vide Guignot l. c.; Holdhaus & Lindroth 1939, p. 126) it is a clearly borealpine species occurring in the north of Europe (incl. the British Isles), southward to Dalarna and the southern Norwegian fjelds, and furthermore in the Central European Alps.

Ecology. In clear, cold water, often in lakes and ponds without any vegetation. In the regio alpina it extends to the superior belt, in the higher parts of the regio coniferina local and rare.

20. *Colymbetes dolabratus* PAYK. Pilgrimstad, central part of thorax and abdomen and elytral fragments of the same specimen still lying together in the clay sample.

Other fossil finds. Denmark, Sjælland, late glacial (Henriksen 1933, p. 156). Finland, Karelian Isthmus, late glacial (Poppius 1911). Galicia, glacial (Lomnicki 1894).

Distribution. Circumpolar. In Europe an exclusively northern form, only in Scandinavia (and in Iceland) extending south of the Arctic circle to Dalarna and the S Norwegian fjelds; one old isolated, perhaps accidental, find in Västergötland.

Ecology. In shallow, also quite small bodies of water with \pm rich vegetation of Carices, sometimes with Sphagnum. In Fennoscandia it is a true inhabitant of the regio betulina and the lower parts of the regio alpina, where in Swedish Lapland it extends to at least 1000 metres. In Siberia, N America and Greenland also in the northernmost parts.

Fam. Gyrinidae.

21. *Gyrinus opacus* C. R. SAHLB. (*sculpturatus*, Mjöberg 1905; 1916, p. 9; »*Gyrinus sp.*» 1916, p. 9). Härnön, fragments of 3 elytra, well characterized by the reticulated microsculpture presumed by Mjöberg to be essential to his new species, but in fact the best criterion for *opacus*. Though long described, this species was generally confused with other species, however, at the time of Mjöberg's first publication. — It is somewhat doubtful whether any of the fragments mentioned represents the type specimen, for none is labelled as »*sculpturatus*». If this, notwithstanding, be the case, only the anterior third of the elytron in question is left, but this fits in rather well with Mjöberg's picture (1905).

Other fossil finds. Among the numerous subfossils of »*marinus*» published by Henriksen (1933, p. 160—161) at least those from late glacial beds (Skåne and Sjælland) will certainly prove to be *opacus*. Also the remaining finds from Finland and Central Europe mentioned by him need a revision.

Distribution. Probably circumpolar. In Europe boreo-british, in Fennoscandia southward to Östergötland and Southern Norway.

Ecology. In various bodies of standing water, also in slowly running rivers. Mainly in the *regio coniferina* and *betulina* but extending in the fjelds of Swedish Lapland to at least 1000 metres.

Fam. *Hydrophilidae*.

22. *Coelostoma orbiculare* FBR. Bollnäs, an almost complete right elytron.

Other fossil finds. Very numerous finds in Skåne and Denmark, chiefly postglacial, but one, from N Jutland, determined as interglacial (Henriksen 1933, p. 167—168). Finland, several postglacial finds (Poppius 1911). Also in England and France, whereas the glacial find from Bavaria is uncertain (Henriksen l. c.; cfr. p. 270).

Distribution. Eurasiatic. Widely distributed in Europe, also in the southernmost parts. In Fennoscandia a southern species, not passing the Arctic circle and wanting in the fjelds.

Ecology. In all sorts of standing water rich in vegetation, also in quite small ponds.

23. *Hydrobius arcticus* KUW. Långsele, 1 large and 1 small fragment of the shoulder region of elytra, apparently not belonging to the same specimen. Pl. 2, fig. a.

Distribution. With certainty known only from Fennoscandia but possibly overlooked farther east. It is pronouncedly a northern species not found south of the Arctic circle (fig. 6).

Ecology. In small, often periodically exsiccating bodies of standing water rich in vegetation. Almost all the finds known were made in the *regio betulina* and in the uppermost part of the conifer belt. The only records from the *regio alpina* are the original find by J. Sahlberg in Norway at Junkersdal and a specimen found on the surface of a glacier at Kebnekaise in Swedish Lapland (Bergwall) and surely accidental.

Fam. *Liodidae*.

24. *Agathidium* (?) *arcticum* THOMS. Långsele, a complete right elytron, differing from *nigrinum* STURM by the small size and also, as it seems to me, by the less obtuse shoulder angle.

Distribution. Eurasiatic. In Europe boreoalpine, on one hand in the highest mountains of Central Europe and in Scotland, on the other in N Russia and in Fennoscandia, where it extends southward to S Norway, Närke and SW Finland.

Ecology. In mosses and among leaves, also under loose bark of trees and in fungi. In the conifer belt as well as in the *regio betulina*, locally in the lowest parts of the *regio alpina*.

Fam. *Staphylinidae*.

25. *Arpedium brunnescens* J. SAHLB. (*Gyllenhali* ZETT. nec C. R. SAHLB.). («*Boreaphilus?* *Eudectes?* sp.», Mjöberg 1916, p. 10, Taf. II, fig. 11). Härnön, 1 right elytron.

Distribution. Eurasiatic, possibly circumpolar. In Europe exclusively in the North, extending in Fennoscandia to central S Norway, Värmland and Tavastland.

Ecology. Under moss, leaves and detritus in damp places by rivers, in meadows etc. It appears abundantly only in the fjelds, where in Swedish Lapland it ascends to at least 1000 metres. Locally in the conifer belt.

26. *Acidota crenata* FBR. («*Genus?* *species?*», Mjöberg 1916, p. 11, Taf. II, fig. 8). Härnön, 3 nearly complete elytra.

Other fossil finds. Denmark, Jutland, interglacial (Henriksen 1933, p. 163). Also recorded from interglacial beds in N America (l. c.).

Distribution. Circumpolar. Generally distributed in Europe except the southern peninsulas. In Fennoscandia all over the countries.

Ecology. Under moss and leaves in rather damp places, also taken in birch sap. The species is seldom met with under «natural conditions» but more often when swarming, sometimes in great numbers, and it can then be found in snowfields at the highest mountain tops. It is doubtful whether it may be regarded as a true inhabitant of the Scandinavian *regio alpina*, but in the Kola Peninsula and in Siberia it was found on the tundra.

27. *Tachinus (Drymoporus) elongatus* GYLL. («*Genus?* *species?*» [«Omalide»], Mjöberg 1916, p. 11, Taf. II, fig. 12). Härnön, 1 complete right elytron.

Distribution. Circumpolar. Almost the whole of Europe except in the southernmost parts, preferably in the mountains. In Fennoscandia generally distributed, but more common in the North.

Ecology. This species agrees very well with *Acidota crenata*, living normally under leaves and other vegetable refuse (though also in drier places) but more often caught when swarming, also in snow fields in very high altitudes (Swedish Lapland up to 1800 metres). Under «natural conditions» it is, however, found at least up to 1150 metres. Also on the tundra of the Kola Peninsula.

Fam. *Byrrhidae*.

28. *Simplocaria metallica* STURM. Härnön, 1 nearly complete right elytron. Långsele, 1 nearly complete prothorax, 6 ± complete elytra (an incomplete head probably also belongs here). Pilgrimstad, 1 complete but highly deformed left elytron (this is the single fragment with preserved metallic lustre). Bollnäs, 1 complete left elytron. Pl. 2, fig. b, c.

Owing to the difficulty of distinguishing between the closely related *Simplocaria* species I have made careful comparisons with recent material also of the following ones: *arctica* POPP., *basalis* J. SAHLB., *elongata* J. SAHLB., *frigida* KROG., *obscuripes* POPP., *Palméni* POPP. and *semistriata* FBR. Confusions as

to the structure of elytra, are only possible with *arctica* and *elongata* but the former shows the striae more irregular towards the apex, the latter is too large and elongated. Most, but not all of the subfossils (especially those from Långsele) have stronger striae and interstitial puncture than the recent *metallica*. As they do not otherwise disagree I am inclined to interpret the phenomenon as due to postmortal changes. — I take the opportunity to state that, though it was given with some hesitation, the record of *S. arctica* POPP. from Sweden (Abisko; BRUNDIN 1934, p. 363; Catalogus 1939) must be incorrect. The single specimen (Swed. State Mus.) undoubtedly belongs to *metallica*.

Other fossil finds. Finland, Karelian Isthmus, late glacial (Poppius 1911, p. 44). Saxony, Deuben, glacial, very numerous fragments (Nathorst 1894, p. 539).

Distribution. A boreoalpine species outside Europe with certainty known from Greenland only. In C Europe confined to higher mountain districts. In Fennoscandia partly in the fjelds (bicentric), partly isolated in S Finland (fig. 2). Maps: Holdhaus & Lindroth 1939, p. 263, Taf. XIII; Lindroth 1939, p. 252).

Ecology. On open, sandy, not too dry ground with coarse and short vegetation especially mosses on which it feeds. Often in the vicinity of rivulets. In S Finland in the *regio coniferina*, otherwise only in fjeld districts in the *regio betulina* and the lower *regio alpina*.

29. *Cytilus sericeus* FORST. Långsele, 1 right elytron.

Other fossil finds. Denmark, late glacial and postglacial (Henriksen 1933, p. 174). Bavaria, glacial (Flach 1884).

Distribution. Circumpolar. Throughout Europe and in the whole of Fennoscandia.

Ecology. In open, not too dry places rich in mosses on which it feeds. In fjeld districts the species is rare (it is for instance absent in the northern part of the Kola Peninsula) but it ascends regularly into the *regio betulina*. Its appearance in the *regio alpina*, however, has not yet been stated.

Fam. Scarabaeidae.

30. *Aegialia sabuleti* PANZ. Långsele, 1 right elytron. Pl. 2, fig. d.

Distribution. Not known outside Europe, its presence in Siberia being dubious. Almost boreomontan, rare in Central Europe. Generally distributed in Fennoscandia but rare and local in the southern parts of Sweden.

Ecology. This species is not found in dung but lives under stones and detritus on sandy or finely gravelled banks of standing and running water; in the high North also on the sea-shore. It ascends exceptionally into the lowest parts of the *regio alpina*.

Fam. Curculionidae.

31. *Deporaus betulae* L. Härnön, 1 left elytron.

Distribution. Eurasiatic. Almost the whole of Europe. In Fennoscandia all over the countries except on the northernmost peninsulas.

Ecology. It is a well-known insect feeding on birch (not *Betula nana*) and sometimes noxious, more seldom on *Alnus*. It also lives regularly in the *regio betulina*.

32. *Apion amethystinum* MILL. Pilgrimstad, 1 complete right elytron. It agrees in all details with specimens from Abisko (Swed. Lapland) and thus surely belongs to the sbsp. *Brundini* WAGN. (Notulae Ent. 22. Helsingfors 1943, p. 160). — It would be worth while to make a new inspection of the »*Apion? marchicum*» from late glacial beds in Skåne (Henriksen 1933, pp. 109, 203).

Distribution. Eurasiatic. In Europe boreomontan, in the mountain districts of the central parts and, quite isolated, in the extreme north of Fennoscandia (sbsp. *Brundini* WAGN.; fig. 7).

Ecology. The species feeds on Papilionaceae plants, in N Europe apparently on *Astragalus alpinus*; in C Europe observed on *Trifolium pratense*. Sbsp. *Brundini* is a true fjeld form found as far as I know, only in the *regio betulina* and *regio alpina* where in Swedish Lapland it ascends to 900 metres.

33. *Otiorrhynchus arcticus* O. FABR. Bollnäs, a nearly complete head (without eyes). Pl. 2, fig. e.

Other fossil finds. Denmark, Sjælland, »preglacial» (Henriksen 1933, p. 195). Poland, Pilzno, glacial (Makólski & Smreczynski, C. R. Acad. Pol. Sci. & Lettr. 6. Crakow 1936). It furthermore seems doubtful whether the extinct *O. blanduloides* (Lomnicki 1894, p. 85) from glacial beds in Galicia is really specifically distinct from *arcticus*.

Distribution. Strictly European but extending to Greenland, eastward only to the Kanin Peninsula. Boreoalpine, on one hand along the western coast south to Ireland, on the other in many Central European Alps (fig. 8). Maps: Sainte-Claire Deville 1930, p. 113; Holdhaus & Lindroth 1939, p. 253, Taf. XVII; Lindroth 1939, p. 254).

Ecology. A slow, flightless ground-beetle living on open, rather dry, sandy or gravelly grassland with short and coarse vegetation. Wood-land is strictly avoided. It feeds on all sorts of phanerogams. Partly in the epilitoral belt along the coasts, partly in the *regio alpina* of the fjelds where in N Sweden it ascends to 800 metres; in Iceland also high-alpine. The larva on plant roots.

34. *Otiorrhynchus dubius* STRØM. Långsele, 3 small fragments (1 of prothorax, 2 of elytra).

Other fossil finds. Jämtland, late postglacial (Sandegren 1924). Skåne and Denmark, numerous finds from pre-, inter- and late glacial beds (Kolbe 1932; Henriksen 1933, p. 196). Finland, postglacial (Poppius 1911). England, interglacial, also from postglacial moor-log on the Dogger Bank (Bell 1922).

Distribution. Strictly European but extending to Greenland, eastward to the Petschora. Boreo-alpine but with a rather narrow »Auslöschungs-

zone» in northern C Europe. In Fennoscandia generally distributed except in S Sweden from where only 2 localities are known; formerly in N Jutland. Maps: Henriksen 1933, p. 294; Holdhaus & Lindroth 1939, Taf. XVII).

Ecology. Like *O. arcticus* a polyphagous ground-beetle but considerably more eurytopic, occurring also in wood- and fen-lands, but preferring moraine ground. In the fjelds it is especially frequent and ascends to the *regio alpina superior* (in Swed. Lapland to at least 1225 metres).

35. *Polydrosus undatus* FBR. (det. Harald Lindberg). Långsele, a somewhat deformed left elytron making a strange impression because of the almost total absence of scales.

Distribution. Eurasiatic. Almost the whole of Europe except the southern peninsulas. In Fennoscandia widely distributed except in the extreme North (wanting for instance on the Kola Peninsula) as well as in true fjeld districts.

Ecology. Almost monophagous on trees and bushes of *Betula* (not *B. nana*). It has not been found, however, in the *regio betulina* of the Fennoscandian fjelds, but is widely distributed in the conifer belt.

36. *Eremotes ater* L. (det. T. Nyholm). Bollnäs, apical part of left elytron.

Distribution. Eurasiatic. The whole of Europe except the southernmost parts. In Fennoscandia it is absent from the northernmost peninsulas only.

Ecology. In dead or half-dead stems or in trunks, normally of *Pinus* more seldom of *Betula*. In the fjelds it ascends into the *regio betulina*.

37. *Notaris aethiops* FBR. Långsele, 1 head and \pm complete fragments of 3 left elytra. Pl. 2, fig. g, h.

Other fossil finds. Skåne, late glacial (Kolbe 1932; Henriksen 1933, p. 201). ? England, glacial, determined with hesitation (Blair 1924).

Distribution. Almost circumpolar. In Europe mainly a northern species occurring moreover in the mountainous districts of Central Europe. In Fennoscandia nearly all over the countries and extending to the farthest North.

Ecology. On moist ground with \pm thin vegetation, on shores and in fens. It has been found feeding on *Sparganium* but surely lives on other hydrophilous plants also. In Fennoscandia it reaches the lowest *regio alpina* occasionally only, but lives on the tundras of the peninsulas of Kola and Kanin.

38. *Lepyrus arcticus* PAYK. («*Eryx* sp.»), MJÖBERG 1916, p. 11). Härnön, a quite small fragment from near the apex of right elytron. The sculpture is very characteristic and the identification as *Prionychus* (*Eryx*) made by Mjöberg (and J. Sahlberg), maybe after some hesitation, is not easy to understand. Pl. 2, fig. f.

Distribution. Eurasiatic. In Europe an exclusively northern species,

only in Fennoscandia south of the Arctic circle; isolated in central S Norway (fig. 3).

E c o l o g y. Feeds exclusively on *Salix*, but on all sorts, from *caprea* to the small *herbacea-polaris*. Rare in the higher parts of the conifer belt, more abundant in the *regio betulina* and *alpina* where it ascends to very high altitudes (1300 metres in N Sweden). Also on the Eurosiberian tundra northward to Taimyr.

39. *Ceuthorrhynchus quadridens* PANZ. Långsele, 1 left elytron. Pl. 2, fig. 1.

D i s t r i b u t i o n. Probably not outside Europe (and N Africa) where it occurs over all southern and central parts. In Fennoscandia exclusively southern, in Sweden to Värmland and Uppland, in Norway and Finland in the extreme South only.

E c o l o g y. It feeds on different wild Cruciferae, e. g. *Alliaria*, *Lepidium* and *Nasturtium*, but has also become a heavy pest on cultivated forms of *Brassica*, *Raphanus* and *Sinapis* (Ent. Blätter 6. Berlin 1910, p. 263; 17. 1921, p. 119).

40. *Phytobius velaris* GYLL. (*Phytobius* sp., Mjöberg 1916, p. 12, Taf. II, fig. 13). Härnön, 1 right elytron. Långsele, 1 right elytron. Pl. 2, fig. k.

D i s t r i b u t i o n. Eurasiatic. In Central Europe south to N Italy and Roumania. The Fennoscandian area of the species seems isolated as it is lacking in Denmark and in Sweden south of Värmland-Dalarna. In Finland partly in the South, partly in Lapland and Österbotten. It is not known from European Russia (incl. E Carelia and the Kola Peninsula).

E c o l o g y. As food-plant in Germany *Polygonum amphibium* was stated. It must be assumed that the species in the North lives also on other *Polygonum* species. Constantly at the margin of water, in Fennoscandia especially on the banks of larger rivers, on clay-mixed sand with thin and short vegetation. It ascends into the *regio betulina* but has hitherto not been found in the alpine region.

41. *Orobites cyaneus* L. Långsele, 1 right elytron. Pl. 2, fig. i.

D i s t r i b u t i o n. Strictly European. South to the Mediterranean region. In Fennoscandia a clearly southern species, in Norway and Finland with a northern limit about the Arctic circle, whereas in Sweden the northernmost locality is Jämtland, Ragunda (Frisendahl, 3 spec. coll. Växtskyddsanstalten, Stockholm).

E c o l o g y. Feeds on different species of *Viola* (excl. *biflora*, *tricolor*, *arvensis*; Ent. Blätter 21. Berlin 1925, p. 139). In open, rather dry places. Not found in field districts.

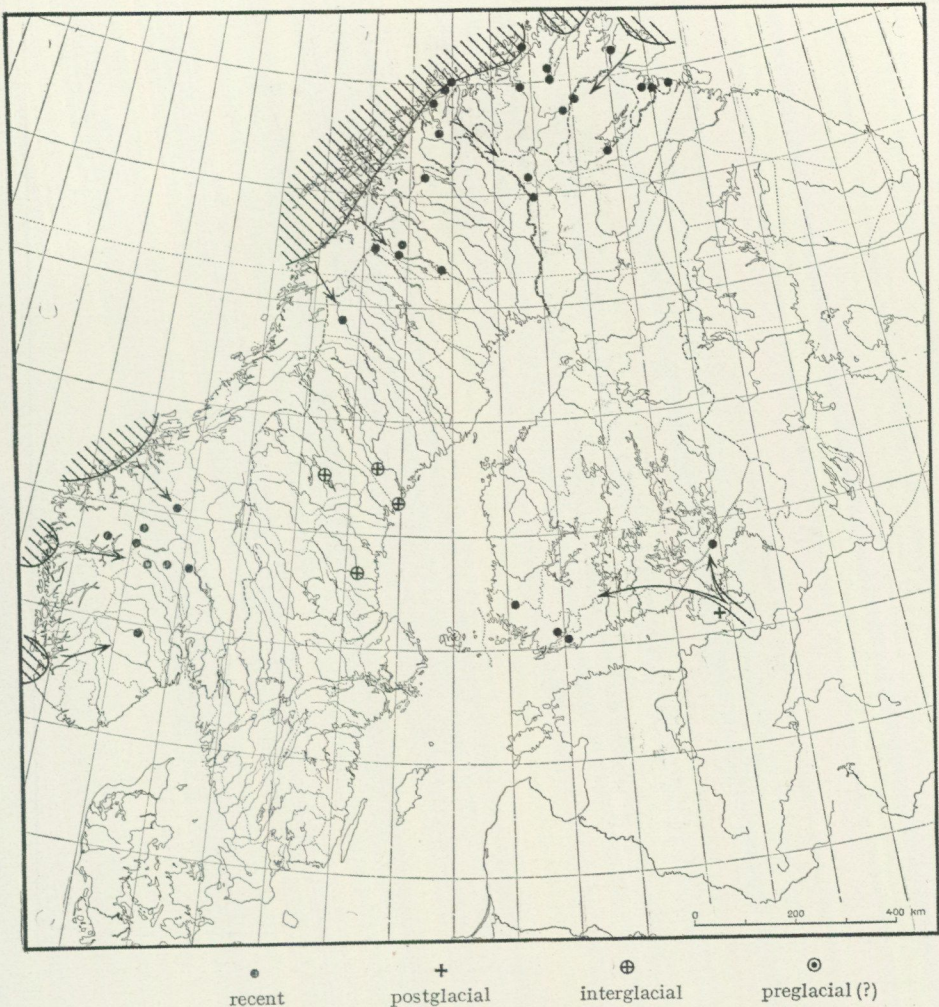


Fig. 2. *Simplicaria metallica* STURM. The proposed Würm-refuges on the Norwegian coast (acc. to NORDHAGEN 1933, 1935) are striated. The arrows indicate the hypothetical migration routes in postglacial times.

General Remarks.

Even apart from the geological evidences, a zoogeographical study of the four samples here treated demonstrates that their fauna can hardly be of a postglacial age.

An illustrative example is *Simplicaria metallica* (fig. 2), at the present time a very rare insect. In the period when the investigated layers were formed, it must have been a common species in these parts of Sweden, for it is the single beetle represented in all four samples. But it is totally lacking in the



Fig. 3. *Lepyrus arcticus* PAYK.

rich late- and postglacial material from Skåne and Denmark described by Henriksen (1933). It therefore seems highly improbable that its earlier occurrence in the area represented by our subfossil finds should be the result of a southern postglacial immigration. From an easterly direction the possibilities were even less, as the map of the present distribution shows that the species is absent east of Finland, and furthermore that the postglacial stem, separated from the north-Fennoscandian one by a wide gap and documented also by a late-glacial subfossil find on the Karelian Isthmus, reached southernmost Finland only.

The present clearly bicentric distribution of *Simplocaria metallica* in Scandinavia would likewise be quite impossible to understand if we assume that our subfossils were postglacial. Their position just at the latitude of the »gap» gives rise to the question: Why could the species, if commonly distributed in lower Norrland during early postglacial time, not reach the fjelds of Jämt-

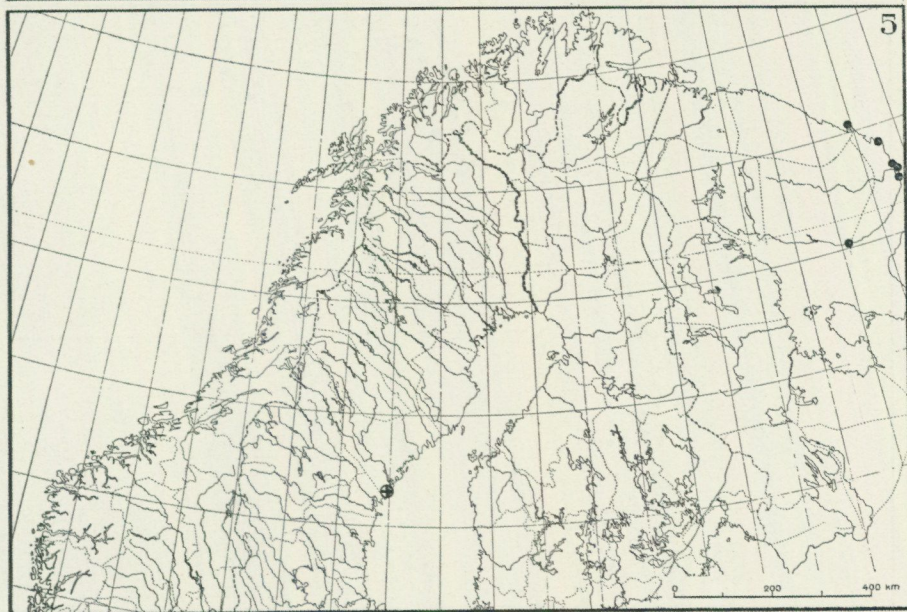
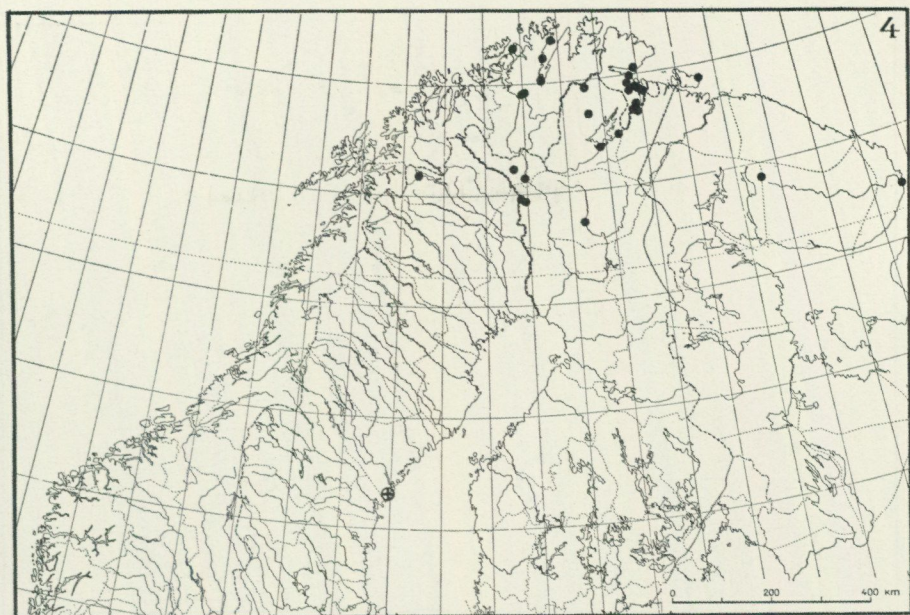


Fig. 4. *Diachila arctica* GYLL. — Fig. 5. *Diachila polita* FALD.

land, Härjedalen and Dalarna and fill out the gap? The answer is clear: The bicentric type was formed by the last glaciation (Würm) due to the «hibernation» possibilities within two separated main-areas on the Norwegian coast. A wide distribution of *Simplocaria metallica* in Scandinavia, as indicated by our subfossils, could have existed only before that period.

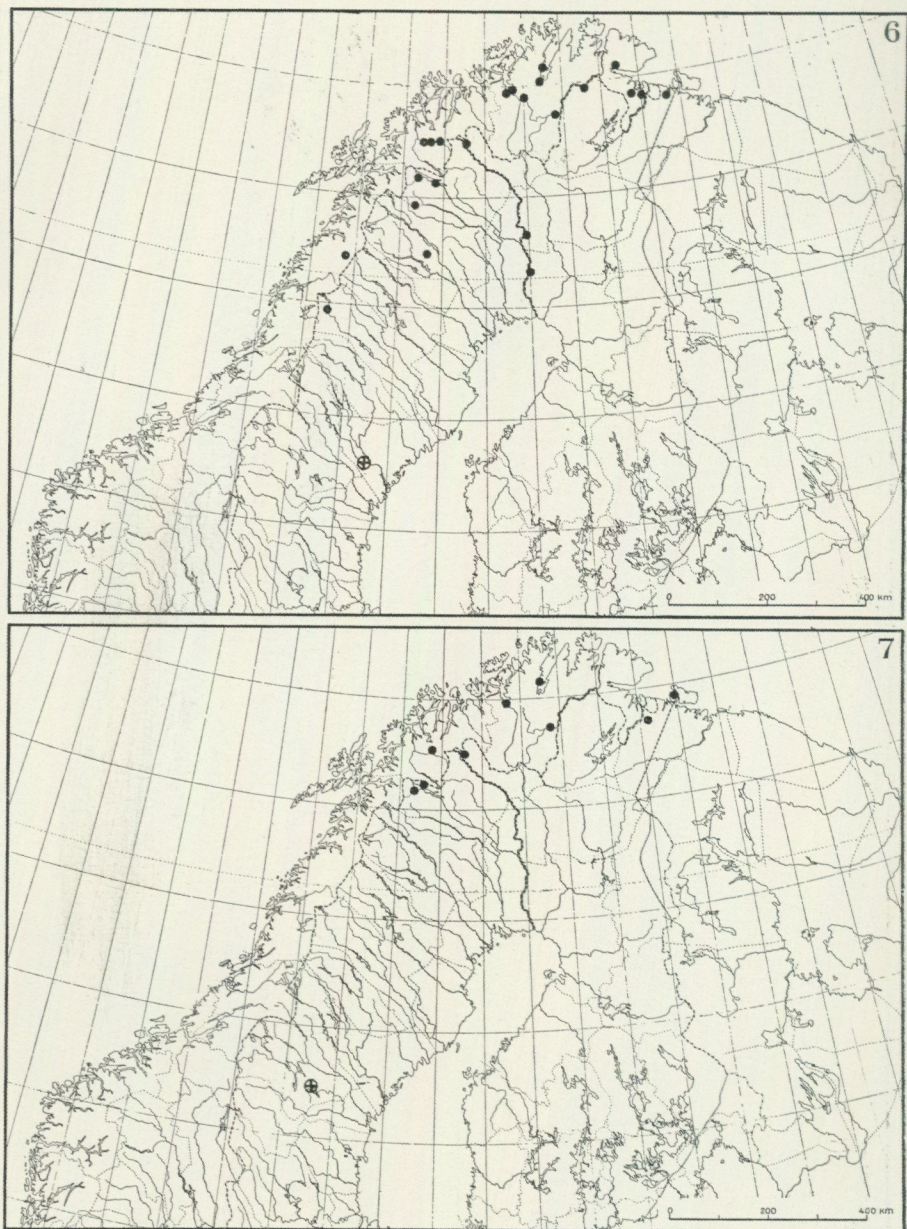


Fig. 6. *Hydrobius arcticus* Kuw. — Fig. 7. *Apion amethystinum* MILL.

A similar argumentation could be used about two other, likewise bicentric species: *Lepyryrus arcticus* (fig. 3), represented in the Härnö material, and *Elaphyrus lapponicus*, from Långsele.

Other alpine or subalpine species are »northern unicentric», *Diachila arctica* (fig. 4), *Hydrobius arcticus* (fig. 6) and *Apion amethystinum* (fig. 7), occurring

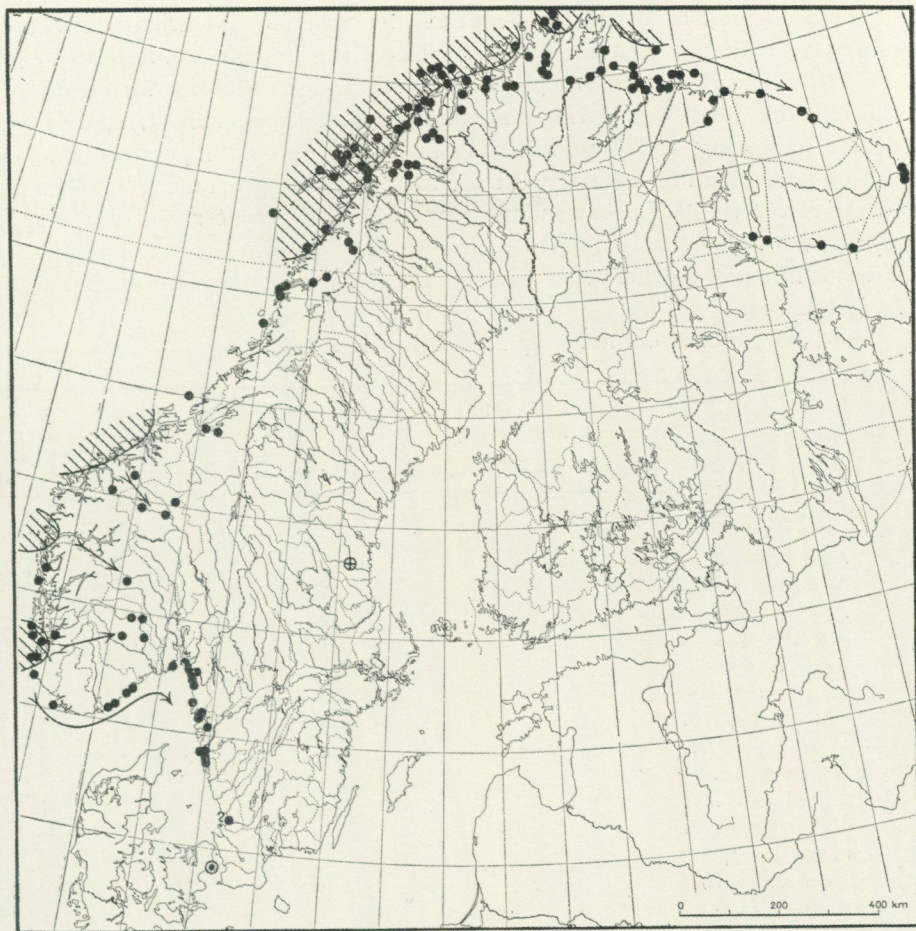


Fig. 8. *Otiorrhynchus arcticus* O. FABR. Vide explication on fig. 2.

in the material from Härnön, Långsele and Pilgrimstad respectively. Only the area of *Diachila* possesses at the present time a connection with Siberia and may be (though, of course, does not have to be) a postglacial immigrant from this direction. Under all circumstances none of these three species ought to have been wanting in the Central- and South-Scandinavian fjelds at the present day if they had really lived in early postglacial time in the places where the subfossil remains were detected.

A still more foreign impression, as members of a postglacial Scandinavian fauna, is made by *Diachila polita* (fig. 4), *Pterostichus vermiculosus* and *Cryobius sp.*, all present in the Härnön fauna.

It is also worth pointing out that *Otiorrhynchus arcticus* (fig. 8) from its present distribution must have entered the Scandinavian fjelds from the west but not from the east, which makes the interpretation of the Bollnäs deposits as postglacial practically impossible.

	Regio alpina (without trees)			Regio betulina (with birches)	Regio co- niferina (also with conifers)	Regio quercina (also with oak etc.)	Regio fagina (also with beech etc.)
	superior	media	inferior				
Pilgrimstad.							
(-) <i>Agabus Solieri</i> ...	+	+	+	+	+		
- <i>Amara alpina</i> ...	+	+	+	+	(+)		
- <i>Apion amethysti-</i> <i>num</i>		+	+	+			
- <i>Bembidion Hasti.</i> <i>B. prasi-</i> <i>num</i>		+	+	+	(+)		
(-) <i>Colymbetes dola-</i> <i>bratus</i>	+	+	+	+	(+)		
<i>Nebria Gyllenhali</i>	(+)	+	+	+	+	+	
<i>Notiophilus aqua-</i> <i>ticus</i>	+	+	+	+	+	+	+
(-) <i>Simplocaria me-</i> <i>tallica</i>		+	+	+	+		
Amount 9	5=56 %	8=89 %	9=100 %	9=100 %	8=89 %	2=22 %	1=11 %
Härnön.							
<i>Acidota crenata</i> ..	(+)	(+)	+	+	+	+	+
- <i>Amara alpina</i> ...	+	+	+	+	(+)		
(-) <i>Arpedium brun-</i> <i>nescens</i>	+	+	+	+	+		
<i>Deporaus betulae</i>				+	+	+	+
- <i>Diachila arctica</i> ..			+	+	+		
- <i>D. polita</i> ...		+	+	+	+		
<i>Gyrinus opacus</i> ..	(+)	+	+	+	+	+	
- <i>Lepyrus arcticus</i> ..	+	+	+	+	+		
<i>Notiophilus aqua-</i> <i>ticus</i>	+	+	+	+	+	+	+
<i>Phytobius velaris</i>			?	+	+	+	+
<i>Pterostichus dili-</i> <i>gens</i>			+	+	+	+	+
- <i>P. vermiculosus</i>	+	+	+				
(-) <i>Simplocaria me-</i> <i>tallica</i>		+	+	+	+		
<i>Tachinus elonga-</i> <i>tus</i>	(+)	+	+	+	+	+	(+)
Amount 14 ¹	8=57 %	10=71 %	12=86 %	13=93 %	12=86 %	7=50 %	6=43 %
Bollnäs.							
<i>Coelostoma orbi-</i> <i>culare</i>					+	+	+
<i>Eremotes ater</i> ...				+	+	+	+
<i>Otiorrhynchus</i> <i>arcticus</i>	+	+	+	+	(+)	(+)	
(-) <i>Simplocaria me-</i> <i>tallica</i>		+	+	+	+		
Amount 4	1=25 %	2=50 %	2=50 %	3=75 %	4=100 %	3=75 %	2=50 %

¹ In addition the *Cryobius sp.*, which is without doubt a pronounced «minus-species».

The most striking feature seen in these tables is the heterogenous composition of the Långsele fauna. There can be no doubt that it represents the deposits of more than one climatic period. Unfortunately the position of the strata where the insect remains were found could not be stated. It is therefore doubtful whether the »colder» fauna belongs to the initial or the final phase of the interglacial period in question. The plant remains and the geological stratification, which will be described in greater detail by Sandegren, seem to indicate the firstnamed alternative.

The greatest interest, indeed, is connected with the two species of the Långsele fauna indicating a climate warmer than the present one, i. e. *Ceuthorrhynchus quadridens* and *Orobites cyaneus*. Their presence here definitely cannot be due to postmortal transport because such a movement can hardly be thought to have taken place other than by running water from higher situated regions.

The Pilgrimstad fauna indicates throughout a colder time than at present and has been of a low-arctic or subarctic character. Nothing prevents, from a zoogeographical point of view, its being contemporary with the colder facies of the Långsele fauna. They have, it is true, only 2 species (*Amara alpina*, *Simplocaria metallica*) in common, but, estimating the arctic-subarctic coleopterous fauna of that time (in accordance with the number of species in similar Fennoscandian areas at the present day) at at least 300 species, we must admit that the discovery of identical forms in such small sample as those from Långsele and Pilgrimstad is merely due to chance.

The stratification at Pilgrimstad indicates (Kulling 1945, p. 41) a warmer period following the deposition of the fossiliferous arctic layers and before the last glaciation. It thus seems probable that the Pilgrimstad insect fauna lived during the first part of the last interglacial period.

The Härnö fauna in some respects (e. g. the percentage of species living in the *regio alpina superior*) has the most pronounced arctic character and thus shows the greatest differences from the present conditions. In fact it is (with the exception of *Deporaus betulae* and perhaps *Phytobius velaris*) a true tundra fauna, above all indicated by 3 species not now occurring in Scandinavia (*Diachila polita*, *Pterostichus vermiculosus*, *Cryobius* sp.).

It seems absolutely out of the question that the Härnö fauna should be of a postglacial age. The 3 mentioned species, being quite bound to the ground due to rudimentary wings,¹ can hardly have followed the retreating ice margin through the whole southern half of Sweden, for it is generally doubted by biogeographers that a true arctic biota could have immigrated to the northern parts of Scandinavia in that way. If that be the case, it can hardly be understood why the three species in question (and others) should not have walked also the remaining comparatively short distance to the Scandinavian fjelds and become members of their present fauna. It is more likely that the Härnö fauna represents the final phase

¹ No macropterous *Cryobius* seems to be known (Poppius 1906, p. 9).

of an interglacial period, when the deterioration of the climate caused an invasion by the Eurosiberian tundra fauna into Scandinavia from the northeast. It must be assumed that, according to isostatic movements, the land-connection between Scandinavia and Russia was broader than at present (and, especially, than at the initial phase of an interglacial period) providing a relatively comfortable immigration way for the tundra fauna.

Also the presence of 5 brachypterous (besides the 3 Carabids mentioned also *Arpedium brunnescens* and *Lepyrus arcticus*) and 2 dimorphic species (*Notiophilus aquaticus*, *Pterostichus diligens*, both usually brachypterous) in the Härnö material indicates a more »ripe» fauna than that of Pilgrimstad where only *Apion amethystinum* is incapable of flight.

The depth-figures given by Munthe for nearly each separate insect remain, point in the same direction (though it cannot be proved that the layers are undisturbed). From the greatest depths, 6—6.8 metres there originate the following species (»minus-species» indicated as in the table above):

<i>Acidota crenata</i>	<i>Gyrinus opacus</i>
(—) <i>Arpedium brunnescens</i>	<i>Notiophilus aquaticus</i>
<i>Deporaus betulae</i>	(—) <i>Simplocaria metallica</i>
— <i>Diachila polita</i>	
	At 5—5.9 metres:
— <i>Amara alpina</i>	— <i>Pterostichus (Cryobius) sp.</i>
<i>Pterostichus diligens</i>	
	At 4—4.9 metres:
— <i>Diachila polita</i>	— <i>Pterostichus (Cryobius) sp.</i>
<i>Notiophilus aquaticus</i>	— <i>P. vermiculosus</i>
<i>Phytobius velaris</i>	
	At 3.8—3.9 metres:
— <i>Diachila arctica</i>	— <i>Lepyrus arcticus</i>
— <i>D. polita</i>	

The fauna thus seems to have changed gradually towards a »colder» type.

Owing to its more foreign character, perhaps also to the bad condition and therefore higher age (?) of the insect remains, it will not be surprising if geologists in the future eventually show that the Härnö-gyttja was formed during an earlier interglacial period.

Conclusions.

1. Part of the last interglacial period also in Fennoscandia had a climate at least as warm as the present one.
2. The biogeographical consequences of the last glaciation (Würm) upon the Fennoscandian biota seem to have been overestimated. This conclusion quite agrees with results obtained merely from the study of the recent distribution

of Coleoptera within this area (Lindroth 1939): »Unter allen Umständen kann der Einfluss der letzten Vereisung auf die skandinavische Flora und Fauna am besten so ausgedrückt werden, dass diese Periode für die Kleinverbreitung der Arten einen massgeblichen Einfluss ausgeübt hat. Aber der skandinavische Artenbestand wurde wenig verändert.»

The only acceptable explanation of this striking stability of the fauna seems to be, that a considerable part of it survived the Last Glaciation within the limits of Fennoscandia.

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Explanation of plates.

Plate 1.

- a *Diachila arctica* GYLL. Härnön.
- b » *polita* FALD. Härnön.
- c *Elaphrus lapponicus* GYLL. Långsele.
- d *Patrobus assimilis* CHAUD. Långsele.
- e » *septentrionis* DEJ. Långsele.
- f *Amara alpina* FBR. Långsele.
- g *Pterostichus vermiculosus* MÉN. Härnön.
- h *Harpalus nigritarsis* C. R. SAHLB. Långsele.
- i *Pterostichus (Cryobius) sp.* Härnön.

Plate 2.

- a *Hydrobius arcticus* KUW. Långsele.
 - b *Simplocaria metallica* STURM. Långsele.
 - c » » » »
 - d *Aegialia sabuleti* PANZ. Långsele.
 - e *Otiorrhynchus arcticus* O. FABR. Bollnäs.
 - f *Lepyryus arcticus* PAYK. Härnön.
 - g *Notaris aethiops* FBR. Långsele.
 - h » » » »
 - i *Orobites cyaneus* L. Långsele.
 - k *Phytobius velaris* GYLL. Långsele.
 - l *Ceuthorrhynchus quadridens* PANZ. Långsele.
-



a



b



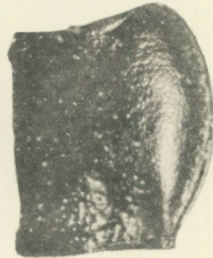
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g



h



i



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