

A C T A Z O O L O G I C A
C R A C O V I E N S I A

Tom IV

Kraków, 31 III 1959

Nr 1

Jan STACH

Fauna Apterygota Polskiego Narodowego Parku Tatrzańskiego

Фауна Apterygota Польского Национального Парка в Татрах

The Apterygotan Fauna of the Polish Tatra National Park

[With 5 plates and 2 maps in text]

INTRODUCTION

The present paper contains the results of my studies on the fauna of the *Apterygota* of the Polish part of Tatra Mountains. I have begun these studies already in 1909, and continued these during 1918—1924 and further 1931—1937 years. I have gathered abundant materials of these insects and many observations on their life and occurrence in these mountains. Some of these observations and data concerning the species I have already published in various papers (1925a, 1925b, 1955a, 1955b) and in the monograph of „The Apterygotan Fauna of Poland“, which of work seven volumes have been published 1947—1957 up to day.

The present paper on the fauna of the *Apterygota* of the Tatra Mts is published bearing on the collective studies and publications made by some zoologists of the Kraków Branch of the Institute of Zoology of the Polish Academy of Sciences in the years 1953—1956 on the fauna of some groups of animals living in these mountains. My paper is attempted to

draw an image of the Apterygotan fauna of the Polish part of Tatra Mts, in which a detailed list of species, data concerning the appearance of them in some biotopes and altitudes, zoogeographical composition of this fauna and its characteristics should be given.

A SHORT OUTLINE OF THE PHYSIOGRAPHY OF THE TATRA MTS.

For the better orientation in the area, from which the fauna of the *Apterygota* is described I give here a short outline of the physiography of the Tatra, especially of the Polish part of these mountains. It is restricted to the information on some, most important details only, as the Tatra Mts and the natural conditions of this range of mountains were already many a time described in detail in various publications.

Tatra are a part of the long chain of Carpathian mountains running in the length of about 1300 km in form of a bow bend northwards. The Carpathians are on their whole length richly and variably divided orogeographically and geologically, and their eastern parts differ considerable from the central and western ones. The Tatra are the highest western range of Carpathians, and are divided into: Western-, High- and Bielskie-Tatra. The whole length of the main of the Tatra Mts, which is strongly and variably curved, is 82 km, of which 42 km fall on the Western Tatra and 24 km on the High Tatra.

Geologically the Tatra Mts are divided into two areas, the southern area composed of the crystalline rocks and the northern one of the sedimental deposits, mainly the lime-stones and dolomites.

The branches running away from the main ridge of mountains close many valleys lying in course of the meridians. To the long valleys of the northern region of the Polish Tatra Mts belong: Chochółowska, Kościeliska, Mała Łąka, Strążyska, Bystrego, Sucha Woda, and others. Each of the long valleys, and in the High Tatra even many shorter ones, show well preserved traces of the activity of the Pleistocene glaciers in the form of the moraines or the kars; each of these valleys has a proper stream. The abundance of water in the Tatra

Mts is increased by many lakes formed by the check of the course of the streams by the moraines (eg. Morskie Oko, Czarny Staw near Mount Kościelec and others) or lying in the postglacial kettles (eg. Czarny Staw lying over Morskie Oko). The greatest lake is Wielki Staw in the valley Pięć Stawów Polskich (= Five Polish Lakes). In general the lakes lie above the limit of the forests in region of *Pinus mughus* SCOP.

The proper range of the Polish Tatra Mts is separated from the close, parallelly to Polish Tatra Mts northwards lying Gubałówka (1123 m alt.), Palenica (1193 m) and other hills by the dale of Zakopane and by in this dale flowing stream Cicha Woda further Dunajec Biały. This dale rises in environs of the way in Kościeliska-valley up to 950 m altitude and falls towards the Zakopane-town to 850 m, and further still more gradually with the course of Biały Dunajec-river.

At the right side of this dale there begin to ascend the gradually higher elevations, called „regle“, and over them protrude many summits of the high mountains.

This right side of the Zakopane-dale represents also the northern boundary of the Polish National Park of Tatra Mts, which comprises the whole terrain of the Polish Tatra (area of a 174 km). The western boundary of this Park runs along the western border of the Chochołowska-valley, the eastern one along the valley of Białka and Rybi Potok, and the southern one runs along the high summits from Jarząbcezy, Kamienista, Tomanowa, Czerwone Wierchy, Kasprowy, Świnica, Liptowskie Mury, Mieguszwieckie, Cubryna up to Rysy, also along the frontier between the Polish and Czechoslovakian Republic, and unites immediately with the considerably spacious Slovakian National Park of the Tatra Mts.

The division of the Polish Tatra-Mts into regions of their altitudes is based on the vegetation characteristic for some altitudes.

At the immediate base of the Polish Tatra-Mts lies in the Zakopane- dale a submontan area of the about 700—900 m alt. inhabited by the local population, and covered by the arable fields, many meadows with exuberant vegetation, and sparse mixed forests, mainly with spruce-trees.

The first altitudes of the mountains, so called „low regle“,

are covered with natural, here and there still dense forests composed of fir- and beech-trees with very abundant addition of the spruce. There is a lack here of the dense shrubs, but sparse ones appear beyond the forests or on their borders. Instead there appear here some fields with the mosses growing dense on the moist ground, banks of the springs and streams. The region of the „low regel“ extends from about 900—1250 m altitude.

The higher region, called „high regel“, is characterized by the uniform spruce forests and reaches up to about 1550 m alt. This altitude represented the upper limit of the forests in the Polish Tatra Mts and belongs to the most important line separating distinctly the regions of vegetation. This upper limit of the forests falls a little in the valleys. Here and there the compact forests disjoin, split in the groups of the trees and the separate specimens of the spruces invade in to higher lying region of brushwoods composed of the *Pinus mughus* SCOP.

The region of the dense brushwoods of the *Pinus mughus* SCOP. reaches up to about 1800 m alt. In the fields grown with *Pinus mughus* SCOP. appear also sparsely separate specimens of the sorb-tree (*Sorbus aucuparia* v. *glabrata* WIMM. & GR.), the alder *Alnus viridis* (CHAIN) LAM. & DC. is, however, absent in the Tatra Mts.

Over the region of the *Pinus mughus* SCOP. extends the region of the alpine meadows with the extensive fields with the more or less densely growing various grasses. This region reaches up to about 2150—2200 m alt.

The highest region in the High Tatra, restricted to the crystalline rocks is the subnival region, called the region of „turnie“. It extends from 2300 m altitude up to the summits of the mountains. In this region appear only sparse cluster of grasses, low growing plants and richly the mosses and lichens covering here and there the large stones and walls of the rocks.

THE LIST OF *APTERYGOTA* OF THE POLISH TATRA
NATIONAL PARK

The list of the Apterygotan species given here by me is based on the ground of materials collected by me on the terrain of the Polish part of Tatra Mountains. This part creates to-day the Polish Tatra National Park. During many years of my studies of the Apterygotan fauna of the Tatra Mts I have gathered the materials of this group of insects also from many places* of the other parts of the Tatra Mts, belonging to the Slovakia, some species from there I have received also from my colleague Prof. W. Roszkowski. As, however, the detailed studies on the fauna of the *Apterygota* are made by me mainly in the area of the Polish part of the Tatra Mts, so I enumerate here only the species caught in this region. But I mention in the general part of this paper some species from the Slovakian part of the Tatra Mts. They were found only in the western and eastern part of Tatra Mts in which there exist rather different climatic conditions as in the northern and middle parts of these mountains. The number of such species not observed up to day in the Polish part of the Tatra Mts is, however, very small.

Ordo: Collembola1. — *Tetrodontophora bielensis* (WAGA)

Submontane: Zakopane, Krzeptówki.

Montane: Cyrhla, Kopieniec, Boczań, valleys: Strążyska, Kościeliska, Mała Łąka, Suchy Złebek, Chochołowska, Gąsienicowa Hala; on the borders of lakes: Zielony, Dwoisty, Czarny near Kościelec, and on other places in many specimens.

A common species occurring in dead leaves and needle-litter, under mouldy timber, stones, loose bark of tree-stumps, in moist moss and on mushrooms. The greatest number of spe-

* The materials of the *Apterygota* were collected from about 750 localities during my studies in the Tatra. Not all of these localities are, however, enumerated here, especially in case of the more common species.

cimens is found in the „Regle“ between 900—1300 m alt., * but sometimes this species rises also higher in mountains and in High Tatra it was found also in the region of *Pinus mughus* SCOP. under stones in 1700 m alt. — In the Slovakian part (valley Zlomiska in 1700 m alt. in valley Spiskie-lakes in 2050 m alt.). *Tetrodontophora* can be considered as a proper element of the fauna of the chain of the Carpathian-mountains. It is not known from the mountains of Germany. Along the Carpathians it advanced in the Sudetes and, eastwards up to the Transylvanian Alps. It is not known from the mountains of Bulgaria, Crimea and Caucasus, also from the Central Alps, but is noted from Carinthia and Velebit.

2. — *Onychiurus affinis* (ÅGREN)

Submontane: Zakopane, Krzeptówki, Jaszczurówka.

Montane: Cyrhla, valley Mała Łąka, Skoruśniak (1240 m), Czarny Staw near Kościelec (1620 m), Kasprowy (1989 m), Hala Gąsienicowa (1650 m).

It occurs generally under loose bark of various trees and in mouldy timber as well in the neighbourhood of human settlements as in forests in lowland and in mountains. Over the upper limit of *Pinus mughus* SCOP. — region it lives in moss and lichens.

Distributed widely in Europe (East Carpathians, the Alps, Caucasus).

3. — *Onychiurus sibiricus* (TULLBERG)

Submontane: Chłabówki, Krzeptówki.

Montane: valleys Strażyska, Kościeliska, Chochołowska, Suchy Złebek, Mała Łąka; Sarnia Skalka (1318 m) Skoruśniak (1240 m), Świnica-peak (2306 m); cave Dziura).

A rather common species occurring mostly under loose bark and in mouldy timber of tree-stumps, but also under

* The altitudes of localities given here are in dependence on the ones in which the specimens were caught and not on the highest altitudes of the valleys or summits.

stones, leaf-litter and in humus-soil in forests, in moss in greater altitude in mountains, sometimes also in caves.

Distributed widely in Europe, generally in mountains, but also in lowland from Lapmark up to Crimea. Known also from Siberia, Novaja Semlja and East Greenland.

4. — *Onychiurus armatus* (TULLB.) s. STACH.

Submontane: Zakopane, Krzeptówki, Chłabówki.

Montane: valleys Kościeliska, Chochołowska, Strążyska, Mała Łąka, Suchy Złebek, Białego, Kalatówki; Toporowa Cyrhla, Sarnia Skalka (1375 m), Łysanki (1454 m), Skoruśniak (1240 m), Giewont (1800 m), Hala Pyszna (about 1400 m), Hala Gąsienicowa (about 1600 m), Liliowe (1720 m), Czuba Kasprowa (1913 m), Kopa Magóra (1704 m), Kościelec (2159 m), Zawrat (2158 m), Świnica (2306 m), Hruby Mięguszowiecki (2437 m), valley „Za Mnichem“ (2060 m).

Under stones and loose bark of trees, in dead beech-leaves and needle-litter, in moss and other biotops, in many specimens.

4a. — *Onychiurus armatus* var. *multituberculatus* STACH

Montane: Cave in valley Kalatówki (1220 m), cave Magóra (1460 m).

A modified form of the *Onych. armatus* (TULLB.), different in the number and shape of vesicles in postantennal organ, which always exceed the number 40 and reach up to 64, and are narrow; the body length 3,5—4 mm. Known also from cave Klutert in Westphalia.

5. — *Onychiurus granulosus* STACH

Submontane: Chłabówki.

Montane: Skoruśniak (1350 m), Kościeliska-vall. (1308 m), Pyszna (1650 m), Kopa Magóra (1650 m), cave „Za Smrekiem“ (1236 m).

Occurs under loose bark of trees, in dead leaves and needle-litter, in mouldy timber and others, as well in lowland, as in mountains, also in caves.

Known from East Carpathians, Bakony Mts, Rila and Lulin Mts in Bulgaria, Styrian Alps.

6. — *Onychiurus denisi* STACH

Montane: Mała Łąka-vall. (1100 m), cave Dziura (1010 m).

A rare species in the Tatra Mts, common in the Sudetes, abundant in cave Domaszków in Silesia.

7. — *Onychiurus fimetarius* (auct.) STACH

Submontane: Krzeptówki.

Montane: Caves: Zimna (1125 m), Za Smrekiem (1236 m), Lodowa w Ciemniaku (1715 m), Dziura Wyżnia (1030 m), Magóra (1460 m).

8. — *Stenaphorura quadrispina* BÖRNER

Submontane: Chłabówki.

Montane: Cyrhla (1003 m), Mała Łąka (1100 m), Skupniowy Upłaz (1377 m).

Occurs concealed under large stones lying on moist ground, also in humus-soil.

Distributed widely over Europe from Finland up to southern countries, Spain, Italy. Known from East Carpathians, Witoša in Bulgaria, Styrian Alps.

9. — *Mesaphorura krausbaueri* BÖRNER

Submontane: Chłabówki.

Montane: Cyrhla (1010 m), Kościeliska (1120 m), Suchy Złebek (1000 m), Mała Łąka (1173 m), Sarnia Skalka (1380 m), Dwoisty-lake (1656 m).

Kondratowa (1360 m) in a sample of frozen soil, 12 II 1939. 1 sp., and in a sample of frozen soil under a high layer of snow in Mała Łąka, 20 III 1942 .. 6 young sp.

Generally a common species in lowland, in the Tatra Mts occurs under stones, loose bark of trees, in humus-soil and needle-litter in smaller number of specimens.

Distributed widely over all Europe, mentioned from Greenland, North America, South Africa and New Zealand. Known from East Carpathians, and the Alps.

10. — *Metaphorura bipartita* (HANDSCHIN)

Montane: Chochołowska-valley, under stones .. 3 sp. Occurs mostly under large stones.

Distributed widely over Europe

11. — *Morulina verrucosa* (BÖRNER)

Montane: Strążyska-valley, ab. 900—1025 m, in moist dead beech-leaves .. 5 sp.;

Mała Łąka-valley, ab. 950 m, in moos and mouldy timber .. 2 sp.;

Kościeliska-valley, over Pyszna alpine meadow, (ab. 1600 m) in the region of *Pinus mughus* SCOP., in needle-litter .. 1 sp.;

Osobita (ab. 1300 m) .. 7 sp.

Occurs under stones, moist dead leaves, needle-litter, moss, mouldy timber, loose bark of stumps.

Morulina verrucosa (BÖRN.) seems to be a Carpathian element, a relict, somewhat modified, from the glacial period. Its relatives occur circumpolarly in High Nord.

12. — *Neanura muscorum* (TEMPLETON)

Submontane: Zakopane, Krzeptówki, Chłabówki, Jaszczurówka.

Montane: Cyrhla (1012 m), Mała Łąka (1120 m), Strążyska (1040 m),

Kościeliska (1100 m), Suchy Złebek (1000 m), valley „Do Białego“ (1020 m), Kobylarz (1430 m), Pyszna-pass (1700 m), on moraine of Czarny-lake near Kościelec (1620 m).

A common species occurring mostly under loose bark of trees, in mouldering timber, also in moss and needle-litter, appears in Tatra Mts mostly in forest-region, rarely and in few specimens it is found in the region of *Pinus mughus* SCOP.

Distributed very widely in Holoartctic.

13. — *Neanura parva* (STACH)

Montane: Skoruśniak (1360 m) under loose bark of a spruce (2);

Pyszna (1550 m) in needle-litter and moss (4);

Gąsienicowa alpine-meadow, close Sobkowy-lake (1628 m)

in the region of dense *Pinus mughus* SCOP. from the soil covered by grass and moss (1);
Czarny-lake near Kościelec (1650 m) on the moraine under loose bark of an old *Pinus mughus* (24).

Appears in Poland mostly in mountains; found also in North-East Alps.

14. — *Neanura tetrophthalma tatricola* STACH

Montane: Mała Łąka (1070 m) in mouldy timber of an old spruce-stump (2); Kościeliska, Kopki (1180 m), under loose bark of a spruce-stump (2);
Gąsienicowa, near Sobkowy-lake (1590 m) in humus-soil covered with grass and moss (1).

This variety differs in some details from the principal form found in Hungaria (at Balaton-lake). It represents probably an endemic form in the Tatra Mts.

15. — *Thaumanura carolii* (STACH)

Submontane: Chłabówki, Krzeptówki.

Montane: Cyrhla (1003 m), Nosal (1208 m), Suchy Zlebek (960 m) Strążyska-vall. (1050—1460 m), Kościeliska-vall. (1107 m). Boczań (1290 m), Przysłop Miętusi (1360 m).

Generally lives in mountains, but not above the limit of the forest-region, and in the foreland of mountains. Occurs under loose bark of spruces, mouldy timber, needle-litter, moss and stones in forests.

Distributed in the Carpathians, Rila, North-East Alps, Velebit, here and there in regions neighbouring these mountains. Also in Romania and Serbia.

16. — *Lathriopyga conjuncta* (STACH)

Submontane: Chłabówki.

Montane: Cyrhla (1010 m), Strążyska-vall. (1150 m), Kościeliska (1200 m), Mała Łąka-vall. (1020 m), Hala Gąsienicowa (1650 m) and others, mostly in region of the forests, between 900—1500 m alt., rarely in region of *Pinus mughus* SCOP. in moss, beech-leaves, needle-litter, mouldering timber, under loose bark of trees and under stones, in many specimens.

It seems to be generally a mountainous element of the fauna; it appears, however, also in lowland in nearness of the mountains, but rarely.

Distributed in the Carpathians, eastern part of the Alps, Bulgarian mountains (Rila, Witoša), Slovakia and Hungary, Yugoslavian Julish Alps (Vaganski Vrh).

17. — *Lathriopyga phlegraea* (CAROLI) s. STACH (an *stachi* GISIN, 1952)

Submontane: Chłabówki.

Montane: Strażyska-vall. (1050 m), Suchy Zlebek-vall. (950 m), Boczań (1180 m).

I have remarked in my paper (1919 m) that the Polish specimens of this species differ a little from those described by CAROLI (1912) from Italy as they have the lateral tubercles of the abd. V not so strongly elongated backwards and the tubercles of the abd. VI lie not so close together as in Italian specimens. GISIN (1952) has considered on the ground of these differences and some others the Polish specimens as a separate species and called it *Lathriopyga stachi* GIS. I have not an occasion to examine the Caroli's type of *Lathriopyga phlegraea*, and are not wholly convinced that the Polish specimens should be considered as a separate species.

Among the specimens of the principal form there appear f. *plena* STACH in the Tatra and other localities.

This species occurs above all in mouldereing timber and under loose bark of old tree-stumps, but also in needle-litter, dead-leaves, moss, under stones as well in the mountains as in low-land.

It is widely distributed over central and southern Europe.

18. — *Pseudachorutella asigillata* (BÖRNER)

Montane: Cyrhla (1003 m) under loose bark of a spruce-stump, 28 spec.

Occurs under loose bark of trees and in needle-litter in the forests.

Distributed widely over Europe from Norway, Sweden

and Finland up the Yugoslavia and Italy. Noted from the Carpathians and Alps.

19. — *Pseudachorutes corticicolus* (SCHÄFFER)

Montane: Strażyska-vall. (950 m), 15. IV in frozen needle-litter; Boczań (1300 m) under loose bark of a spruce-stump, (15 sp.);

Gąsienicowa (1600 m) and on Czarny-lake near Kościelec under loose bark of an old *Pinus mughus* SCOP.

A species considered generally as a typical representative of insects living under loose bark of various trees. In Poland I have found it only in the mountains, in the Tatra in the region of *Pinus mughus* SCOP., in winter time also in lower altitude in frozen needle-litter.

Distributed widely over Europe, from Scandinavia up to the Alps.

20. — *Pseudachorutes subcrassus* TULLBERG

Montane: Skoruśniak (1240 m) in needle-litter;

Strażyska-vall. (1047 m), in moist dead beech-leaves (6 sp.).

At the foot of Beskid (1750 m) in needle-litter (1).

Occurs mostly in moist dead-leaves and needle-litter of the forests, often in mouldy timber of old tree-stumps.

Distributed from Scandinavia over Europe up to Spain. Known from the Carpathians and Alps.

21. — *Pseudachorutes dubius* KRAUSBAUER

Montane: Strażyska-vall. (1000 m), under moist beech-leaves (4);

Kościeliska-vall., Pyszna-alpine meadow (1400 m), in needle-litter and moss in region of *Pinus mughus* SCOP.

Lives usually in dead leaves and needle-litter of the forests as well in lowland as in mountains, also in moss growing on the ground in forests, more rarely under moist loose bark of tree-stumps or in mouldy timber. In the Tatra and Carpathians it does not occur over the region of *Pinus mughus* SCOP. In material from the woods of Crimea-mountains I have found it in samples of soil taken in 700—1100 m alt., and in material from Caucasus in 1700—1800 m alt.

Distributed widely over Europe from Scandinavia up to Italy and Caucasus.

22. — *Anurida hexophthalmica* STACH

Submontane: Chłabówki, under mouldy trunk of a spruce (5);

Krzęptówki, under loose bark of a spruce-stump (6);

Montane: Suchy Złebek-vall. (1000 m), under a mouldy timber piece lying on the ground in the forest (1);

Strążyska vall. (1020 m), under loose bark of a mouldy spruce-stump (1);

Łysanki (1430 m), in rock-crevices (1);

Skoruśniak (1240 m), in needle litter (1);

Kobylarz (1430 m), in the region of *Pinus mughus* SCOP. in a sample of the soil covered by short moss (1);

Czarny-lake near Kościelec, on the moraine (1620 m) under the loose bark of a *Pinus mughus* SCOP. (2).

GISIN (1957) considered that *Anurida hexophthalmica* STACH is a synonym of *Micranurida sexpunctata* HANDSCHIN 1924, but does not mention if he has examined exactly the mouth parts of the *Micranurida sexpunctata* HANDSCH. HANDSCHIN referred this species to the genus *Micranurida* BÖRN. on the ground of its needle-like head of maxilla. *Anurida hexophthalmica* STACH has, however, the head of maxilla composed of abundantly serrated ungulum and two lateral lamellae, one of the characteristics of the genus *Anurida* LA-BOULB.

Lives under loose bark of old trees, in mouldering timber, needle-litter and moss generally in mountains.

Occurs in the chain of the Carpathians (Tatra, Beskid, Czar-nohora).

23. — *Anurida pseudogranaria* STACH

Submontane: Krzęptówki, under flowerpots in a house (16).

Caught by me in Poland in free nature only once in mouldering timber near a house; besides only under flower-pots. I have found this species also in material from the Westphalian and Francovian caves. Specimens very similar to this species noted FRANZ (1954) from the North-East Alps.

24. — *Micranurida pygmaea* BÖRNER

Montane: Gąsienicowa-alpine meadow (1540 m), under loose bark of a mouldering spruce-trunk lying on the ground (3);
Czarny-lake near Kościelec (1620 m), on the moraine under loose bark of an old mouldering branch of *Pinus mughus* Scop. (17).

Lives under loose bark of mouldering tree-trunks, in needle litter, moss and vegetable-soil.

Distributed widely from Scandinavia and some arctic islands up to the Alps. In Poland in the Carpathians (Tatra, Beskid), the adjoining low-land, and in one cave.

25. — *Micranurida hasai* KSENEMAN

Submontane: Krzeptówki, on the border of a spruceforest, under loose bark of an old, mouldering spruce-stump (1).

Occurs in needle-litter of the forests and under loose bark of trees in the mountains only.

Known from Iceland, northern Canada, Greenland, also from the Carpathians (Tatra, Czarnohora) and the Alps.

26. — *Micranurida anophthalmica* STACH

Montane: Mała Łąka-vall. (1050 m) in mouldy timber of an old spruce-stump (3);
Suchy Zlebek vall. (950 m), in a sample of soil covered by grass and short moss on the border of the forest (1);
Kościeliska-vall. (1020 m), under damp loose bark of a spruce-stump (3);
Skoruśniak (1240 m), under damp bark of an old mouldering spruce lying on the ground in the forest (4);
Gąsienicowa-alpine meadow (1580 m), in mouldering, moist timber of one spruce lying on the ground (2).

Lives under loose bark and in timber of the trees, also in humus-soil of the woods.

Known at present from the Carpathians (Tatra, Czarnohora); perhaps it is an endemic for these mountains.

27. — *Friesea octooculata* STACH

Montane: Skoruśniak (1240 m) in needle-litter of the forest (1);

Kalatowa-vall. (1100 m), from a sample of strongly frozen needle-litter (1);

Gąsienicowa alpine meadow (1600 m), in needle-litter (1).

Till now known only from Tatra Mts; perhaps an endemic species for these mountains.

28. — *Friesea albida* STACH

Montane: Gąsienicowa alpine meadow, on the shore of Dwoisty-lake (1656 m) in dense *Pinus mughus*-wood from about 1 dm³ large quantity of material of needle-litter, covering with short moss a granite-block, 615 specimens of 16 species of *Collembola*, among which 41 specimens of *Friesea albida* STACH; Kasprowe Uhrocie (1750 m) in needle litter (2).

Seems to be a species of high mountains, which lives there under loose bark of trees, in needle-litter of woods, plant-detritus, moss and in the soil.

Known at present from high chains of the Carpathians (Tatra, Czarnohora) and high Alps.

29. — *Friesea claviseta* AXELSON

Submontane: Chłabówki, in mouldering timber on the border of a spruce forest (1).

Occurs under loose bark of various trees in needle-litter, moss and under stones.

Registered almost from all Europe; mentioned also from Canada and the U. S. America. In Poland more common in low-land.

30. — *Friesea mirabilis* (TULLBERG)

Submontane: Krzeptówki, under the loose bark of a mouldering spruce-stump (38), and under flower-pots in a house (5) and (3) of ab. *alba*; Chłabówki, in damp needle-litter of a spruce-forest.

Montane: Strążyska- and Kościeliska-valleys (ab. 1000 m) in grass and dead beech-leaves; Skoruśniak (1240 m), Sarnia Skalka (1380 m), Kobylarz (1431 m), Gąsienicowa (1600 m), Kasprowy (1950 m) in the soil; Kasprowa Czuba (1900 m) in moss and lichens; Kalatowa (1200 m) on the border of a spruce-forest, in a sample of strongly frozen needle-litter.

Lives in various localities in pretty different conditions, under flower-pots in dwellings, frequently in free nature also far away from human settlements as e. g. high in the mountains. Lives in dead leaves and needle-litter, in lichens and moss, even in damp *Sphagnum*, under stones, and loose bark of mouldering tree-stumps.

In the Tatra Mts advanced up to summits of the high mountains.

Widely distributed over the whole Europe from high North (Lapland) down to southern countries.

31. — *Brachystomella parvula* (SCHÄFFER)

Submontane: Chłabówki, on moist meadow (3).

I have found this species only at the foot of the Tatra Mts, and not in a greater altitude in these mountains. Also in lowland of Poland this species is rare. In some other countries belongs it to common species.

Lives mostly concealed in damp soil of moist terrains, as on the banks of water reservoirs or in damp moss. It seems to be a cosmopolitan species, as it is registered from many countries of Europe, also from Palestine, South Africa, New Zealand, U. S. America, Costa Rica and Australia.

32. — *Xenyllodes armatus* AXELSON

Submontane: Krzeptówki, under loose bark of an old spruce-stump (1);

Montane: Gąsienicowa alpine meadow, near the shore of Dwoisty-lake (1656 m) in dense *Pinus mughus* SCOP.-wood from the needle-litter and moss covering a large granite-block (11); On the foot of Uhrocie Kasprowe from moss and needle-litter (1).

A species occurring mostly on moist terrains; in the Tatra Mts it lives in the forests and *Pinus mughus* SCOP.-region in needle-litter, moss, humus-soil and under loose bark of old tree-stumps.

Distributed widely in Europe, but in the North in lowland and in Central Europe generally in mountains (Tatra,

Alps, Jura, French Alps). Seems to belong to the group of boreo-alpine species.

33. — *Hypogastrura socialis* (UZEL)

Montane: Koziniec (1000 m) in great quantities on the snow (4. VII);

On the foot of Regle (900 m) in great number on the snow (18. III);

Pyszna (1500 m) in region of *Pinus mughus* Scop. in needle-litter (10. VIII .. 1 sp.).

Lives probably in the moss and lichens; it passes the winter as adult individuals, multiplies in spring, and during the summer lives concealed as young individuals. Appears during the winter-time usually on snow, often in incredibly vast numbers, therefore it is considered as a true winter-species. Occurs usually in mountains or their foreland, but is not an exclusive species of the mountains, and in winter-time appears also in low-land, usually in forests or in their neighbourhood.

Widely distributed over Europe from Scandinavia down to Italy, noted from Canada and U. S. America.

34. — *Hypogastrura assimilis* (KRAUSBAUER)

Submontane: Chłabówki, near a house under a plank lying on the ground (1).

A species occurring generally in neighbourhood of human settlements.

Distributed probably widely over Europe.

35. — *Hypogastrura brevipodialis* (STACH)

Montane: Magóra (1460 m) in short moss growing on large rock-blocks near the entrance to the cave (194).

Known at present only from the Tatra Mts; perhaps an endemic species for these mountains.

36. — *Hypogastrura crassaegranulata* (STACH)

Montane: Kościeliska-valley, at the entrance to the Groby-cave (1230 m), in a sample of vegetable-soil, covered by needle-litter (1);

Świnica-peak, (2306 m) in short dense moss growing in the crack of granite-blocks (5).

It is probably a typical element of the fauna of high mountains. Since it is not known from the Arctic territories, cannot be considered as a relict from a glacial period in the mountains.

Caught in free nature till now only in Tatra Mts, in Caucasus (Domagor, 3600 m) and North-East Alps, besides in the caves of Slovakia (Dobšina) and Bavaria.

37. — *Hypogastrura tatrica* (STACH)

Montane: Valley „Za Mnichem“, near the summit of „Mnich II“, at about 2050 m alt., on the border of a snow-field under stones in great numbers (14. VII).

Till now known from one place only in the Tatra. Probably a nivicole animal occurring only at great altitudes in high mountains, and perhaps an endemic species for the Tatra Mts.

38. — *Hypogastrura monticola* STACH

Montane: On the southern slope of Zawrat-summit (2100 m), in very great numbers on the snow (V);
On the foot of Giewont-summit (1400 m) in moss in immediate nearness of a large snow-field (13 VII).

Found only in greater altitudes in the Tatra Mts on the snow only or in immediate nearness of the snow-fields.

Known also from the Alps (Graubündener, Tauern), where it is caught at 2050—2500 m alt. near the snow-fields.

39. — *Hypogastrura aequipilosa* (STACH)

Montane: Nosal (1206 m) under loose bark of a spruce-trunk (4).

Lives in mountainous forests under loose bark of various needle-trees, in litter and moss.

Occurs in the Carpathians (Tatra, Beskides, Czarnohora), also found by me in material from Spitsbergen.

Perhaps a boreo-alpine element of the fauna.

40. — *Hypogastrura purpurescens* (LUBBOCK)

Submontane: Chłabówki, under a mouldering plank lying on the ground near a house (4).

Lives almost exclusively only in the vicinity of human settlements, usually on the moist vegetable soil, under mouldy timber-pieces, in cellars on plant-detritus, under flower-pots in dwellings, sometimes in a great numbers of specimens. Very often occurs also in various caves, but only as a troglophile animal; unknown from caves in the Tatra Mts.

Distributed very widely over Europe, registered also from Greenland, North and South Africa, Australia and New Zealand. Perhaps a cosmopolitan species.

41. — *Ceratophysella armata* (NICOLET)

Submontane: Zakopane, Kasprusie, Krzeptówki, Chłabówki; Jaszczurówka.

Montane: Cyrhla (1000 m), Kopieniec (1170 m), Mała Łąka (1160 m), Kościeliska (1180 m), Strażyska (1050 m), Sarnia Skałka (1380 m), Kozia Przełęcz (2200 m), and other places from 800—2200 m alt.

Lives in very various life conditions. It occurs in vicinity of human settlements in humus-soil, under stones and mouldering timber-pieces, very often also under flower-pots in houses. In the woods it lives in needle-litter and dead leaves, in moss, under loose bark of various trees and others. On moors it occurs in *Sphagnum* and in mountains often in the immediate neighbourhood of snow-fields. In great number of individuals it appears most frequently on mushrooms.

It hibernates as adult individuals, and sometimes appears in the winter on snow in great quantity of specimens, but it does not belong to the group of proper snow species.

Distributed widely over the continents, probably a cosmopolitan species. Noted from High North (Siberia, Arctic Ural, Lapland, Spitsbergen, Iceland, Greenland).

42. — *Ceratophysella luteospina* (STACH)

Submontane: Chłabówki, under damp loose bark of a spruce (40);

Jaszczurówka, in moss in a forest (10).

Montane: Cyrhla (1000 m) on mushrooms and moss (51);

Kościeliska-vall. (1180 m), Kopki, on mushrooms (2000 sp.).

Occurs commonly and in a great number of specimens on the mushrooms in the forests, but also in moss, needle-litter, under stones and wood-fragments in the forests. Known at present from Poland, generally the mountains, Carpathians (Beskides, Tatra), Pieniny, also from North-East Alps. It is, however, distributed also in other European countries.

43. — *Ceratophysella granulata* STACH

Montane: Strażyska-valley (970 m) under stones (9);

Kościeliska-valley, Kopki (1190 m) from moss growing on a spruce-stump in the forest (2); in a sample of humus-soil (1); in anterior part of a cave (1100 m), on the border of Smreczyński-lake (1226 m) in the *Sphagnum* saturated with water (1);

Pyszna (1600 m) in the region of *Pinus mughus* SCOP. in needle-litter (9);

Cave Dziura (1010 m) from mouldering beech-leaves (4); Kopa Magóra, at the entrance into cave (1460 m) from cushions of dense short moss growing on large rock-blocks (5); Czarny-lake near Kościelec (1620 m) from short moss and needle-litter (1); under loose bark of *Pinus mughus* SCOP., growing on moraine (1650 m);

Świnica-peak (2306 m) from dense short moss growing between the rocks (4); on northern slope of Świnica (2200 m) from lichens (1).

Occurs in very various biotopes, but mostly in the mountains in moss growing on the tree-stumps and rocks, needle-litter, under loose bark of trees, under stones, on mushrooms in the forests and in region of *Pinus mughus* SCOP.; also in caves as a troglophile animal.

Described from the Carpathians (Tatra, Czarnohora), Pieniny, Slovakia, Yugoslavia (cave Canzian), France (Arles) and eastern Low Alps, but probably distributed also in other localities in Europe.

44. — *Schoettella ununguiculata* TULLBERG.

Montane: Cyrhla (1000 m), in moss and needle-litter in the forest (44), on a mushroom (103), under a large stone on a meadow (1), under an old spruce-stump (91), and on *Vaccinium* and grass in the forest (11);

Mała Łąka vall. (1050 m) on the border of a forest under loose bark of a spruce-trunk (67), on mushrooms (78);

Strążyska-vall. (1010 m) from a sample of strongly frozen litter of a spruce, covered by high layer of snow (16. III. .. 2 sp. and 10 young);

Kalatówki, (1200 m), on the border of a spruce-forest from a sample of strongly frozen litter (15. IV. .. 206 specimens);

Hala Gąsienicowa (1600 m) in needle litter (2).

Occurs mostly in the forests under loose bark of mouldering tree-stumps, in moss, on mushrooms, mouldering cones, and under stones. Sometimes appears in great number of individuals, especially on mushrooms. In mountains it does not ascend to great altitude.

Widely distributed over all Europe, mentioned from Canada, and U. S. America.

45. — *Xenylla schillei* BÖRNER

Montane: On the shore of Morskie Oko-lake (1406 m) from a damp moss (1).

Lives in forests in moss, needle-litter, mostly in very damp localities.

Generally distributed in mountains, Tatra, Beskides, East Carpathians, Pyrenees and Alps.

46. — *Xenylla maritima* TULLBERG

Gąsienicowa alpine meadow (1600 m) in region of dense *Pinus mughus*-wood, from a branch of the *Pinus* (10).

Lives in various biotopes, under loose bark of trees in needle- and leaf-woods, in moss and lichens growing on trees, in dead leaves and needle-litter, under mouldering timber-pieces, in bird-nests, on sea- and lake-shores under plant-detritus, and stones. Sometimes appears in great number of individuals.

Distributed over all Europe, registered from Palestine, North- and South Africa, Australia and U. S. America. Probably a cosmopolitan species.

47. — *Willemia anophthalma* BÖRNER

Montane: Skoruśniak (1240 m) under loose bark of an old spruce lying on the ground in forest Kobylarz. (1431 m), in dense

Pinus mughus-wood in needle-litter (2); and in a sample of soil covered by short moss (1);

Gąsienicowa alpine meadow (1610 m), under loose bark of a mouldering spruce-trunk lying on the ground;

On the way between Kasprowy and Gąsienicowa Czuba (1900 m), in dense moss and lichens (2).

Lives usually in single specimen under loose bark of mouldering trees, also in needle-litter and moss in low-land and mountains.

Mentioned from many localities in Europe, but it was probably not correctly identified in all cases. Occurs in the Carpathians (Tatra, Beskides, Czarnohora) and in the Alps.

48. — *Willemia inermis* (BÖRNER)

(= *Willemia aspinata* STACH)

Montane: Cyrhla (1003 m) under a large stone (1);

Kościeliska-vall., Kopki (1180 m), in needle-litter (1);

Skoruśniak (1240 m) in needle-litter (5);

Kalatowa (1200 m), on the border of the forest in a sample of strongly frozen needle-litter (15 IV .. 1 sp.);

Kobylarz (1430 m), from a sample of soil covered by short moss (1).

Lives under loose bark of old tree-stumps, in needle-litter, in moss and under stones.

Known from mountains, the Tatra, Czarnohora, Alps and lowland of Poland, Germany and Finland.

49. — *Tetracanthella brevifurca* STACH

Montane: Gąsienicowa alpine meadow (1610 m) in moss.

Occurs only in higher altitude as a mountainous species. At present known only from the Tatra Mts and Sudetes. In the Tatra it is a rare animal, more abundant in the Sudetes; from the East Carpathians and Alps it is till now not noted.

50. — *Tetracanthella wahlgreni* AXELON

Submontane: Krzeptówki.

Montane: Cyrhla (1000 m), Strażyska (1020 m), Kościeliska (1100 m), Kobylarz (1430 m), Giewont (1500 m), Hala Gą-

sienicowa (1550 m), on the borders of lakes: Dwoisty (1656 m), Zadni (1700 m), Czarny Staw (1620 m), Morskie Oko (1406 m), Kozia-pass, (2200 m), Pyszna (1700 m), Zawrat (2150 m), Kasprowy (1980 m), Świnica (2306 m), and others.

Tetrac. wahlgreni AXELS. lives under loose bark of old spruce-stumps in the forests and in the region of *Pinus mughus* SCOP., but mostly in moss; in higher altitudes and summits of the mountains the tufts of short, dense moss and lichens are the only places in which the species finds its nourishment and a shelter, especially in winter. In such moss-tufts it is restricted to a small space, lives therefore in very condensed groups and appears sometimes in great number of specimens.

Tetrac. wahlgreni AXELS. may be considered on the territory of Poland as a species restricted in its distribution to the mountains, and specially to high mountains.

It could be considered as a boreo-alpine animal. In the high North it is widely circumpolar in distribution, known so far from North Finland, Lapland, Sweden, Norway, North England, Scotland, Ireland, Faroes, Bearislands, Spitsbergen, East-and West Greenland and North Canada. In countries lying more to the south it is found only in the mountains, namely in the Sudetes, West-Beskides and in the Tatra. In Czarnohora I have not found it and in the Alps it is replaced by another species *Tetracanthella afurcata* HANDSCH., living also in high altitudes up to 2500 m.

51. — *Tetracanthella carpatica* STACH

Montane: Near the path from Karb to Pośrednia-summit, about 1900 m alt. in the cushion of dense short moss growing a large rock-block (2);

On the base of the Giewont-summit (1500 m), in the short moss growing on the rocks in the immediate nearness of a large snow-spot (8).

Seems to be an inhabitant of moss similarly to other species of this genus. It occurs probably only on the higher places as an alpine or subalpine animal.

At present found only in the Carpathians, namely in the Tatra and in Transsilvanian Alps (Retyezat).

52. — *Uzelia setifera* ABSOLON

Submontane: Chłabówki (950 m), under loose bark of a spruce-trunk (2).

Lives in moss and lichens and under loose bark of trees. Probably an element of the mountains-fauna, common in the Sudetes, but also pretty widely distributed in Europe.

53. — *Anurophorus laricis* NICOLET

Montane: Cyrhla, under loose bark of a spruce-stump (11);
 Strażyska-vall. (1000 m), from a sample of solid frozen soil covered with high bed of snow near a spruce (20 III ... 6 sp.);
 Kościeliska-vall. (1080 m), under a stone (1);
 Pyszna (1400 m), under loose bark of a spruce lying on the ground (1).

Occurs in general under loose bark of various trees, and is considered as a true corticolle species, but it lives also in the moss.

In the Tatra Mts and Czarnohora it appears only in the lower altitudes and the region of *Pinus mughus* SCOP.; in the Swiss Alps up to 2000 m alt. and in Caucasus it is found in moss at the 3200—3600 m alt.

Known nearly from the whole of Europe, also from Siberia and U. S. America.

54. — *Pseudanurophorus binoculatus* KSENNEMAN

Montane: Biały-vall. (1000 m), at the border of the spruce-forest in a sample of a strongly frozen soil covered with snow (20 III .. 2 sp.);
 Strażyska-vall. (1050 m) in the forest, in a sample of almost totally frozen soil covered with snow (15 IV .. 2 sp.);
 Gąsienicowa alpine meadow (1680 m), Uhrocie, in needle litter and moss (6); at the base of Beskid-summit (1700 m) in needle-litter (2);
 Kopa Magóry (1600 m) in a sample of soil (1);
 Czuba Goryczkowa (1900 m) from moss and lichens (1).

Lives in moss, lichens and humus-soil. Belongs probably to the group of boreo-alpine animals, as it is found till now in Central Europe in mountains only, namely in High- and Low Tatra, Czarnohora-chain, Sudetes, Swiss and Styrian-Alps

and in nothern part of Europe in Swedish-Lapland, in moss and humus-soil.

55. — *Folsomia inoculata* STACH

Submontane: Jaszczurówka, under loose-bark of a spruce-stump;
also in Chłabówki, under the bark and in mouldering wood;

Montane: Cýrhla, under stones (5);

Kopieniec (1170 m), in mouldering wood (2);

Mała Łąka-vall. (1000 m), in mouldering spruce-stump (3);

Przyślup Miętusi (1300 m), in humus-soil of a meadow (3);

Kasprowe Uhrocie (1680 m) in humus-soil (2).

Occurs under loose bark of trees, in moss and humus-soil. Till now known only from mountains (Tatra, Czarnohora) North-East Alps and Caucasus. Seems to be a mountainous species.

56. — *Folsomia montigena* STACH

Montane: Skoruśniak (1240 m), in a sample of the soil covered with spruce-needles in the forest (36);

Lives in litter of various woods, in European mountains also in humus-soil.

Seems to be an element of the fauna of mountains. Known at present from Tatra Mts, North-East Alps and Crimean-mountains.

57. — *Folsomia fimetaria* (LINNÉ)

Submontane: Chłabówki, under wood near a house (101).

Montane: Strażyska-vall. (1020 m), under large parts of wood (3);

Between Kasprowy-and Goryczkowa-summits (1960 m), in moss and lichens (2);

Lives in the vegetable soil near human settlements, but also far from them under large stones and timber, in moss and litter in the forests, and high in mountains in moss and lichens.

Probably widely distributed over Europe.

58. — *Folsomia quadrioculata* (TULLBERG)

On numerous places from the foot of mountains up to 2300 m alt.

(valleys: Strażyska, Suchy Zlebek, Mały Zlebek, Mała Łąka,

Kościeliska; Cyrhla, Łysanki, Sarnia Skalka, Kopki, Kobylarz, Skoruśniak, Nosał, Kopieniec, Pyszna, Giewont, Gąsienicowa, Kopa Magóra, Kasprowy, Goryczkowa, Pośrednia Turnia, Zawrat, Świnica and others).

A common eurytope species, occurring under stones, timber pieces, in mouldering tree-stumps and other materials near the human settlements, also far from them in the forests, on the moors in *Sphagnum*, and on the summits of the mountains in moss, lichens, soil and in rock-clefts.

The geographical distribution of the species is very extensive. It occurs in arctic islands of Europe and Asia (Spitsbergen, Bear-islands, King Carls-land, Whiteisland, Novaja Semlja and oth.), also in Greenland. Southwards it is distributed down to southern Italy.

59. — *Folsomia multiseta* STACH

Montane: Mała Łąka vall. (1000 m) under a mouldering spruce-trunk lying on the ground near a forest (3);
Kościeliska-vall., Kopki (1180 m) in needle litter (2); and Żary (1600 m) in moss and needle-litter (56);
Gąsienicowa alpine meadow (1580 m) in dense *Pinus mughus* — wood (5);
Uhrocie Kasprowe (1800 m) near the summit from a sample of soil covered by needle litter and moss (5);
Świnica-peak (2306 m) in short moss growing in crevices of the rocks (2).

Seems to be a mountainous animal living, however, also in the nearnes of the mountains. In the forests it occurs in dead leaves and needle-litter, moss, humus-soil, under moist loose bark of tree-stumps, and others.

In the mountains it goes up the great altitudes; in Caucasus it was found at 2500 m alt. Probably that species is widely distributed in Europe, known from the Carpathians (Tatra, Beskides, Czarnohora), also from the Alps, where it appears as the subspecies *Folsomia multiseta dives* STACH.

60. — *Folsomia candida* WILLEM

Submontane: Krzeptówki, in a house under flower-pots (7).
It is a troglophile animal occurring in many European caves (Poland, Germany, Hungary, Yugoslavia, Italy, Spain and

oth.). Out of the caves it lives mostly under flower-pots in the houses and in vicinity of human settlements.

Probably widely distributed in Europe.

61. — *Subisotoma variabilis* GISIN

Montane: Pyszna (1550 m) reserve forest, in a sample of soil (2).

Probably a mountainous species, known at present only from the Tatra and Swiss Alps, where it is found in many specimens on alpine pasture meadows at 2200—2500 m alt.

62. — *Proisotoma minima* (ABSOLON)

Submontane: Krzeptówki, under loose bark of a mouldering spruce-stump on the border of the forest (5);

Montane: Łysa Polana (1119 m) under the bark of a spruce-stump (1);

Pyszna (1500 m) in a piece of mouldering timber (3).

Occurs mostly under the bark of mouldering stumps of various trees as well in the nearness of human settlements as also far away from them in mountains. Known from North- and Central Europe, noted also from the U. S. America.

63. — *Proisotoma recta* STACH

Submontane: Krzeptówki, from the mould accumulated under the bark of an old spruce-stump on the border of a forest (1);

Montane: Suchy Złebek (950 m) from water-full *Sphagnum* growing on the slopes of a ravine (22); and from a place covered with *Sphagnum* (187);

Łysanki (1446 m) near summit in a sample of the humus-soil (1);

Pyszna (1600 m) from moss growing in a small water-reel (2); Gąsienicowa alpine meadow, near Sobkowy-lake (1618 m), from moss covering the stones protruding from the water (6); at the base of Kasprowy (1800 m) in a sample of moist humus-soil (3); near the Beskid-summit (1900 m) from a sample of soil (1);

Świnica-summit (2306 m) from dense short moss growing on granit-rocks (30).

It seems to be an element of the moss-fauna and occurs in the short dense moss in greater altitudes, as well as in the

water-full *Sphagnum*, rarely in humus-soil of mountainous forests.

Till now known from the Tatra Mts and only from one locality in the Central Alps.

64. — *Hydroisotoma schäfferi* (KRAUSBAUER)

Submontane: Kuźnice (900 m), in winter (21 III .. 2);

Montane: In winter, valleys: Za Bramką, Olczyską, Kościeliska Biała Woda, Rybi Potok; Gąsienicowa alpine meadow on the brook (1600 m);

In summer: Mała Łąka-vall. (1100 m) on slopes of the vall. in water full moss (4);

Kościeliska-vall., Pisana (1080 m) from moss growing on stones protruding over the water in the stream (17);

Goryczkowa-meadow (1250 m), very frequent in water dripping moss in the stream (23).

It is a cold-loving animal which in the mountains occurs in winter-time often in the immediate nearness of brooks not wholly covered with ice in company with the other winter-species, and in the summer lives in the waterfull moss, covering the stones in beds of mountainous brooks. This species may be included in the group of animals, which are adapted to the life on the water-surface of the mountainous small brooks as a superficial-aquatic rheobiont animal.

From Poland known only from the Tatra Mts. It occurs, however, also in the Carpathians (Czarnohora), Alps and Caucasus, and in some countries of Central-and South Europe. Noted also from the U. S. America.

65. — *Agrenia bidenticulata* (TULLBERG)

Montane: In winter: On the way „Pod Reglami“ (950 m) on snow (18 III);

Biała Woda-vall. (1120 m), (III—IV);

Gąsienicowa alpine meadow (1600 m), on the bank of a brook (10 III);

In summer: Goryczkowa (1900 m), on a spring, in numerous spec.;

Pyszna (1650 m); in moss growing on the ground of a small spring, very abundant;

Gąsienicowa alpine meadow, Sobkowy-lake (1618 m), from water-full moss-cushions immediately near the water;

Zielony-lake (1672 m) in moss growing on stones lying in the water of the lake;

Czarny-lake near Kościelec (1620 m) in the moss at the shore of the lake;

Zmarzły-lake near Zawrat (2150 m) in moss.

During the summer *Agrenia bidenticulata* (TULLB.) lives only in immediate nearness of cold waters in water-full moss-cushions; in the winter-time it appears in the Tatra Mts often in great quantities of individuals in lower altitude than in summer.

A typical arctic animal, widely distributed circumpolarly.

In Poland *Agrenia bidenticulata* (TULLB.) is restricted only to the Tatra Mts. In East Carpathians it is not found. The wide and almost continuous distribution of this species in the Holarctic, towards South restricted only to high mountains, permits to conclude, that it is a typically boreo-alpine animal, and historically a relict-form from the older cold period, probably the glacial phase of the Pleistocene.

66. — *Isotomiella minor* (SCHÄFFER)

Submontane: Krzeptówki, Chłabówki.

Montane: Cyrhla (1000 m), Kopieniec (1170 m), Nosal (1206 m), Lysanki (1447 m), Sarnia Skałka (1380 m), Skoruśniak (1240 m), Kopki (1180 m), Kobylarz (1431 m), Giewont (1700 m), valleys: Suchy Złebek (1000 m), Strążyska (1050 m), Mała Łąka (1100 m), Kościeliska (1150 m), Pięć Stawów. Gąsienicowa (1600 m); on the shores of the lakes: Sobkowy (1618 m), Dwoisty (1656 m), Zielony (1672 m), Zadni (1860 m), Czarny near Kościelec (1620 m); Morskie Oko (1406 m), Smreczyński (1226 m); on the peaks of Kasprowy (1988 m), Goryczkowa Czuba (1918 m), and others.

Occurs in dead leaves and in needle-litter, under the bark of mouldering tree-stumps, in moss and lichens, in humus-soil, under stones, from the basis of the mountains up to the summits.

Widely distributed over all Europe, registered from the U. S. America, Hawaii, Japan, New Zealand; probably a cosmopolitan species.

67. — *Pseudisotoma sensibilis* (TULLBERG)

Montane: Cyrhla (1000 m), Kopieniec (1170 m), Mała Łąka-vall. (950 m), Suchy Zlebek-vall. (1000 m), Łysanki (1440 m), Sarnia Skalka (1380 m), Bacug (1500 m), Kościeliska-vall. (1250 m), Kopki (1200 m) and oth.

Occurs usually in moss, but also under loose bark of various trees, especially in low-lands; in the mountains it seeks shelter also in grass-tufts and under stones. It is widely distributed in Europe also in North America in low-land as well as in mountains. It advances widely towards the North, is known from arctic islands and frequent in West-and East-Greenland. Ascends also high in the mountains and was collected by HANDSCHIN (1924) in the Swiss Alps at the alt. 2000—3100 m, in moss and under stones as a common species. I have found it among materials from the High Tauern (2500 m), the Caucasus (2500 m), and East Carpathians.

68. — *Pseudisotoma monochaeta* (KOS)

Montane: Mała Łąka (1050 m), in water-full *Sphagnum* on the slope of Hruby (4);

Kościeliska-vall., near cave „Groby“, from grass-tufts (1) and from lichens at the entrance to the cave Mylna (1150 m); Magóra, in short moss growing on rock-blocks near the cave (1460 m);

At the foot of Pyszna-pass (1650 m), between dense *Pinus mughus*-wood, from moss, lichens and needle-litter (21);

Krzyżne-pass (2186 m) from moss and lichens (2);

Valley of Five Polish Lakes, Pusta (1700 m), in moss (1); Czarny Staw near Kościelec (1620 m), on the moraine, in moss, lichens and needle litter (11);

Łysanki-summit (1447 m), in clefts of the dolomite-rocks on the south slope (5);

Gięwont-summit, on the northern slope (1510 m) from moss growing next to a snow-field (4);

Gąsienicowa alpine meadow, on the shore of Zielony-lake (1672 m) and Dwoisty-lake (1656 m), from water-full moss covering the stones protruding over the water-surface (8);

Kasprowy-summit (1988 m) from a sample of soil covered with short grass (3);

Between Kasprowa-czuba and Goryczkowa (1900 m) from moss and lichens (1);

Świnica-summit (2301 m), on northern slope, from lichens (1).

A typical inhabitant of the moss. It lives principally in dense cushions of short moss covering rock-blocks and rock-walls, but also in water-full *Sphagnum* on the border of mountain-brooks and lakes. In the *Pinus mughus*-region it occurs in moss and needle-litter.

A mountainous species known at present from the Tatra and Czarnohora, also from Bulgarian mountains, East Julic Alps and Pyrenees.

69. — *Vertagopus westerlundi* (REUTER)

Montane: Roztoka-valley (1100 m) in winter (2 II .. 2 sp.); Rybi-Potok-valley, near the road to Morskie Oko-lake, also in winter (1 III .. 3).

Lives in the mountains in moss, lichens, needle-litter and under loose bark of trees.

In the Tatra Mts it appears in winter-time in company of other winter-*Collembola* on the snow in forests; it can be found, however, also in summer, but only in higher altitudes. In low-land it appears only during the winter-time in Scandinavia.

It must be considered as belonging to the group of boreo-alpine animals.

Till now it is known also from the Sudetes, East Carpathians and Alps.

70. — *Vertagopus cinerea* (NICOLET)

Submontane: Krzeptówki, Chłabówki, Kuźnice.

Montane: Cyrhla (1000 m), Kopieniec (1170 m), Boczań (1200 m), Nosal (1206 m), valleys: Suchy Zlebek (950 m), Strążyska (1200 m), Mały Zlebek (980 m), Mała Łąka (1180 m), Kościeliska (1300 m), Gąsienicowa (1650 m) and oth.

Is a typical corticicole animal which lives frequently under the loose bark of various species of trees, as well in forests as close to human habitations.

In higher mountains it occurs usually only to the upper limit of *Pinus mughus* region. I did not find it in the Tatra Mts or in East Carpathians beyond this limit. Distributed widely in Holartetic, but restricted probably only to the forest-region.

71. — *Vertagopus arborea* (LINNÉ)

Submontane: Krzeptówki, near a peasant-house, from a cleft in the bark of a pear-tree (1).

Montane: Strażyska-valley (1210 m), in mouldering timber covered by soil (3).

Belongs to the group of corticicole animals, but sometimes it can be found also under pieces of timber lying on the ground.

Known from some European countries, the Tatra and Alps.

72. — *Spinisotoma pectinata* STACH

Submontane: Chłabówki, under a mould board near a stable (2).

Montane: Mała Łaka (1150 m), on the slopes of the mountains, from water-full moss-cushions (3);

Gąsienicowa alpine meadow, Sobkowy-lake (1618 m), from a large bed of a water-full moss covering the stones lying in the water (19).

A cold-loving animal living on very damp places, occurring usually and in numerous specimens in water-full moss growing on stones lying in the water of small mountainous brooks and lakes.

Known till now from some countries of Europe, and from mountains Tatra, Beskides, East Carpatians, Hungarian mountains and Alps.

73. — *Isotoma bipuctata* AXELSON

Submontane: Krzeptówki, under the flower-pots in a house (12).

Occurs in more numerous individuals usually under flower-pots in houses, or in the vicinity of human settlements under stones, pieces of timber and in humus-soil. It lives also far from human settlements in soil, forest-litter and mouldering tree-stumps.

Known from some countries of Europe. I have found it also in materials from environs of Admont, Styria, and HANDSCHIN noted it from high Swiss Alps (2000 m alt.).

74. — *Isotoma notabilis* SCHÄFFER

Submontane: Zakopane, Krzeptówki, Chłabówki.

Montane: Cyrhla (1003 m), Nosal (1206 m), Łysanki (1447 m), Sarnia Skalka (1380 m), Kopieniec (1170 m), Kopki (1180 m), valleys: Mała Łąka (1110 m), Suchy Złebek (1000 m), Strążyska (1200 m), Kościeliska (1110 m); Pyszna (1600 m), Kobylarz (1430 m), Skoruśniak (1240 m), Hala Gąsienicowa (1650 m), on the borders of Smreczyński-lake (1226 m), Czarny Staw (1620 m), Dwoisty-lake (1656 m), on the Kasprowy-summit (1988 m), in the cave Dziura (1010 m) and others.

A typical inhabitant of moss and forest-litter, which lives in a greatest number of specimens in low-land. Near human habitations it occurs mostly under pieces of timber lying on the humus-soil and under loose bark of various tree-stumps; appears also under flower-pots in houses. It lives just as well in damp *Sphagnum*, in forests under loose bark of various species of trees, on mushrooms and in the soil. It was found also in caves as a troglaxene animal. In higher altitudes of mountains it becomes gradually rarer and occurs less numerously.

A common species distributed widely over all Europe from Scandinavia down to Spain, Italy and Caucasus, noted also from other continents.

75. — *Isotoma hiemalis* SCHÖTT

Submontane: Kuźnice (20 III), on the way „Pod regłami“ on snow (18. III and 21 IV).

Montan: In winter: Chochołowska-vall., on snow (10 IV);

Kościeliska-vall. (950—1250 m), in many places, on snow (I—III) and under stones (12 IV);

Strążyska-vall. (1050 m), on the border of a brook (2 I), and under pieces of timber (15 IV);

Kalatowa (1200 m), on snow (4 I) and under stones near a snow-field (4 III);

Toporowy-lake (1125 m) on snow (22 IV);

Kopieniec (1171 m), in forest (15 III);

Gąsienicowa (1610 m) in a brook (10 III);

Biała Woda-vall. (1120 m) on snow (20 III);

Valley of Rybi Potok (1360 m), in many places on snow (I—III);

Boczań (1200 m) on snow (30 III);

Pyszna (1450 m) on snow (30 III);

In summer: Zawrat-summit (2159 m), in moss and under stones in immediate nearness of a snow-field (20 VII).

A true winter-animal, which appears in North-and Central Europe in the winter-time often in greater number of specimens. It occurs during winter on snow in lower altitudes of the Tatra Mts and in summer in higher altitudes under stones in immediate nearness of the snow-fields.

76. — *Isotoma fennica* (REUTER)

Montane: Mała Łąka-vall. (1100 m) in water-full moss (1 VIII .. 1);
 Dziura-cave (1010 m), in mouldering beech leaves (15 VI .. in numerous specimens);
 Pyszna (1600 m), in water-full moss covering the bottom of a shallow small spring, together with numerous sp. of *Agrenia bidenticulata* (TULLB.);
 Zadni-lake in Gąsienicowa alpine meadow (1860 m), in water-full moss growing on the stones lying in the lake;
 Pośrednia Turnia-peak (2050 m), in water-full moss partly covered by snow (7 VIII);
 Roztoka-valley (1250 m) in winter-time on snow (I—III);
 Kalatowa (1200 m), from a sample of strongly frozen needle-litter and moss on the border of the forest (15 IV .. 16).

During the winter it appears in the Tatra Mts in company with the other winter-species near the brooks not wholly covered by ice. In summer it lives in the water-full moss usually in the immediate nearness of cold water, mostly together with its winter-companions.

It is a boreo-alpine animal, which in higher North occurs in the mountains and in the winter also in low-land, yet in Central Europe in mountains only (Tatra, Czarnohora, Alps).

77. — *Isotoma olivacea* TULLBERG

Submontane: Krzeptówki, under flower-pots in a house;
 Chłabówki, under pieces of timber lying on moist meadow near a house;
 Montane: Valleys „Ku Dziurze“, (980 m), Mała Łąka (1150 m), Kościeliska (1200 m); Magóra (1560 m), Hala Gąsienicowa (1600 m) and many other places of the altitude 1000—1650 m.

Lives in dead leaves and needle-litter in the forests, in damp *Sphagnum*, cushions of dense moss growing on the rocks, under pieces of timber lying on the ground.

var. *neglecta* (SCHÄFFER).

Chłabówki, on the surface of a small spring;

Sobkowy-lake in Gąsienicowa alpine meadow (1618 m) from dense cushions of water dripping *Sphagnum* on the shore of the lake.

Probably a holarctic species occurring in high North (Spitsbergen, Jan Mayen, Greenland, northern Canada) as in all Europe, mentioned also from the U. S. America and South Australia.

78. — *Isotoma albella* PACKARD

Submontane: Krzeptówki, Zakopane;

Montane: Cyrhla (1000 m), Kopieniec (1170 m), Boczań (1200 m).

Nosal (1206 m), valleys: Mały Złebek (980 m), Mała Łąka (1100 m), Kościeliska (1200 m) and other places, from the foot of the mountains up to the upper forest-line, always only under loose bark of needle-trees, mostly spruce, often in numerous specimens.

It is probably widely distributed in the whole Holarctic.

79. — *Isotoma violacea* TULLBERG

Submontane: Chłabówki, under pieces of timber and in needle-litter in a spruce-forest.

Montane: Cyrhla (1000 m) under loose bark of a spruce-stump in forest (2);

Strążyska-vall. (950—1300 m), in damp dead beech leaves and needle-litter (33);

Kościeliska-vall. (1050 m) under a piece of timber (2);

Kopki (1180 m), in short moss growing on a mouldering spruce-stump (1);

Chocholowska-vall. (1200 m), in needle-litter (2);

Mała Łąka (1170 m), on dry spruce-branch lying on the ground (10), and in very damp moss (1);

Dziura-cave (1010 m) in the layer of dead leaves (14);

Kopieniec (1171 m), under pieces of timber (1);

Pyszna (1550 m), in needle-litter at the upper forest-line (33);

Czarny-lake near Kościelec (1620 m) on moraine in *Pinus mughus*-wood, from moss (1);

Valley of Five Polish Lakes (1700 m), in needle-litter in *Pinus mughus*-region (2);

Zawrat-summit (2150 m), in short moss growing in rock-clefts (3);

Goryczkowa-summit (1913 m), from moss and lichens (79);

Świnica-summit (2306 m), in dense short moss growing in granite-clefts (2), and on northern slope from moss and lichens (38).

Occurs mostly far away from human habitations. Lives in various biotopes in Central Europe, mostly in mountains, generally in moss and lichens, and in the forests in needle litter. In lowland it is rarer, and occurs also in forests, or in the nearness of water-reservoirs. Distributed widely in Holarctic from arctic islands (Spitsbergen, Novaja Semlja) to the Alps, Ukraine and Roumania.

80. — *Isotoma viridis* BOURLET

Submontane: Zakopane, Chłabówki, Kuźnice.

Montane: Cyrhla (1000 m), Kopieniec (1170 m), Skupniów Uplaz (1370 m), valleys: Mała Łąka, Kościeliska, Chochołowska, Roztoka; Gąsienicowa alpine meadow, and many other places, but generally in lower altitudes.

It is a very common species, which lives in great number of individuals in various biotopes usually in immediate nearness of human settlements. Much rarer it appears in mountains, occurring mostly in lower altitudes and not ascending to the region of *Pinus mughus* SCOP. Also in the other mountains it seems to live in lower altitudes in Caucasus (1330 m), in the Alps up to 1700 m.

Very widely distributed in Holarctic, from northern islands and land territories (Spitsbergen, Novaja Semlja, Jan Mayen, Siberia, Taimyr, West- and East Greenland, Alaska, Ellesmere-Land and oth.) down to Yugoslavia and Italy, but towards the South it becomes gradually rarer being an animal, which needs to live colder and water full territories.

81. — *Isotoma pseudomaritima* STACH

Montane: Cyrhla (1000 m), under loose bark of an old spruce-stump in a forest (11);

Mała Łąka vall. (1030 m), in water-dripping moss growing on the slopes of the rocks (1);

Kościeliska-vall. (1230 m) from short moss and needle-litter at the entrance to the „Groby“-cave (1);

Kopki (1180 m), in moss growing on a mouldering spruce-stump (8);

Pyszna (1560 m), in the region of dense *Pinus mughus*-wood,

from short moss and needle-litter (27); and (1620 m) from dense water-dripping moss growing in a small spring (1); Magóra (1460 m) at the entrance to cave, from moss covering the rock-blocks (1);

Zadni-lake in Gąsienica alpine meadow (1860 m), in water dripping moss growing on the rock-blocks lying in the water (25);

The lakes in Gąsienicowa alpine meadow:

Sobkowy (1618 m) and Zielony (1672 m), in water-dripping moss growing on the blocks lying in the water (23);

Dwoisty-lake (1656 m), from short moss growing on a granite-block in the region of dense *Pinus mughus*-wood (8);

Zmarzły-lake (1785 m), in very damp moss immediately to a snow-field (1);

At the foot of the Giewont-summit (1530 m), from short water-dripping moss growing on the rock-walls immediately to a snow-field (3);

On the path from Karb-pass to Pośrednia Turnia (1900 m), in water-dripping moss, partly covered by snow (6);

Pośrednia Turnia-summit, in water-dripping moss immediately to a snow-field (9);

Świnica-summit (2306 m), in short moss growing in rock-clefts (8);

Krzyżne-pass (2186 m), in water-dripping moss growing on the rock-walls (2);

Kalatova (1200 m), under a stone immediately to a snow-field (30 III .. 3 sp.), and on the border of the forest from strongly frozen needle-litter (14 IV .. 23 sp.);

A cold-loving animal occurring only in mountains. In the Tatra Mts it occurs from the foot of mountains up to highest summits.

Known only from the Carpathians (Tatra, Baskides, Czarnohora) and Alps.

82. — *Isotomurus palustris* (MÜLLER)

Montane: Magóra, at the entrance to the cave (1460 m), in moss and under stones (3);

Zawrat-pass (2150 m) under stones and in moss near a snow-field (5);

Niebieska Turnia (1800 m), in water dripping moss on the mouth of the Zadni-lake (1860 m);

Kozia-pass (2200 m), on very-damp walls of the rocks (8);

Niżnie Rysy (2430 m), under stones (2);

Krzyżne-pass (2186 m), in short very damp moss covering the rock-walls (3).

Lives usually on moist ground near human settlements, but also far from them in *Sphagnum* on the moors and on the banks of water-reservoirs. In the Tatra Mts I have found it only in higher altitudes, but also on very moist places in the moss.

Distributed very widely over all Europe.

83. — *Isotomurus palliceps* (UZEL)

Montane: Mała Łąka (1020 m), under a piece of a mouldering timber lying on a very damp ground (1);

Kobylarz-pass (1430 m), under stones (3);

Gąsienicowa alpine meadow, near Dwoisty-lake (1656 m), in short moss growing on a granite block in dense *Pinus mughus*-wood (15);

Gąsienicowa, on the shore of the Sobkowy-lake (1618 m), in water-dripping moss growing on stones lying in water (3);

Valley of Five Polish Lakes (1750 m), in moss and under stones (14);

Magóra, at the entrance to the cave (1460 m), in moss and under stones (5);

At the foot of Niebieska Turnia (1700 m), in waterdripping moss growing on stones lying in water (15);

Świnica-summit (2306 m), in dense short moss growing in rock-clefts (1);

Zawrat-pass (2150 m), in short dense moss (3);

Kozi-summit (2291 m), in damp moss covering the rock-wall.

Lives in higher mountains of Central Europe, generally only above forest-line, going as high as the summits of the mountains. It occurs in moss, usually very damp, or covering the stones lying in alpine streams, also on damp rock-walls, and under stones.

A mountainous animal known till now from the Carpathians (Tatra, Czarnohora), Sudetes and the Alps.

84. — *Oncopodura crassicornis* SHOEBOOTHAM

Montane: Strażyska-vall. (1400 m), under loose bark of a spruce-stump (1).

Lives in forests under loose bark of trees, in needle-litter, dead leaves, also under stones.

Noted from some countries of Europe, seems to belong to the elements of fauna of the more south-lying areas simi-

larly as other species of this genus. In Poland it is known from the Tatra, Beskides and Pieniny-mountains.

85. — *Tomocerus minor* (LUBBOCK)

Submontane: Kasprusie, Chłabówki, Zakopane, Krzeptówki.

Montane: Cyrhla (1000 m), Kopieniec (1170 m), Boczań (1224 m), Skupniowy Upłaz, Kondratowa (1220 m), Kalatowa (1200 m), Łysanki (1440 m), Sarnia Skałka (1380 m), Skoruśniak (1240 m), Kobylarz (1430 m); valleys: Strążyska, Do Białego, Ku Dziurze (1000 m), Mały Złebek (980 m), Suchy Złebek (1000 m), Kościeliska (950—1200 m), Chochołowska (930—1300 m), Jarząbca (1350 m), Roztoki (1150 m); alpine meadows: Pyszna (1300 m), Gąsienicowa (1500—1700 m), Pięć Stawów Polskich (1780 m); on the lake-shores: Długi, Kustkowiec (1687 m), Zielony (1672 m), Morskie Oko (1406 m), Czarny Staw nad Morskim Okiem (1582 m), Smreczyński (1236 m), on the summits of Zawrat (2150 m), Krzyżne (2186 m), Kasprowy (1988 m), Świnica (2306 m), Magóra (1700 m), Miedziane (2234 m) and others.

A very common species on the whole terrain of the Tatra Mts., living in various conditions, mostly in moss often very moist, on the lake-shores, also under pieces of wood lying on the ground, stones, in needle-litter and dead leaves, under loose bark of trees, in the neighbourhood of human settlements as well as far from them in forests and mountains up to the highest summits. — Distributed very widely over all Europe, registered also from other continents (Asia, North America, Australia, New Zealand), probably a cosmopolite.

86. — *Tomocerus minutus* (TULLBERG)

Montane: Cyrhla (1000 m), under a stone in a moist forest (12).

Mała Łąka-vall. (1050 m), in moss, also very moist, growing on the slopes of valley, and under stones (100);

Suchy Złebek-vall. (980 m), in water full moss (27), and under loose bark of a spruce stump (3);

Kościeliska-vall. (1200 m), under a piece of wood lying on the ground (3);

At the foot of Giewont-peak (1500 m), in moss near a snow-field (3).

Lives generally on moist localities in moss, mostly water full, also under stones and wood lying on the ground, rarely under loose bark of trees.

Known from arctic and subarctic Europe, also from Siberia; noted from the Sudetes and Carpathians. Probably a boreo-alpine animal.

87. — *Tomocerus vulgaris* (TULLBERG)

Submontane: Kasprusie, under a stone near a house (1);
Chłabówki, under a piece of wood lying on the moist ground near a house (48).

Occurs generally in neighbourhood of human settlements under stones and pieces of wood lying on the humus-soil, more rarely in the forests of lowland and in lower altitudes of mountains.

Registered from many countries of Europe and North America, also from Himalaya, but not rightly determined in all cases.

88. — *Pogonognathellus flavescens* (TULLBERG)

Submontane: Zakopane, Chłabówki.

Montane: Cyrhla (1000 m), Nosal (1200 m), Boczań (1180 m), Sarnia Skalka (1380 m), Kobylarz (1860 m); valleys: Strążyńska (1400 m), Suchy Złebek (1000 m), Chochotowska (1250—1480 m), Jarząbcza (1380 m), Mała Łąka (1200 m), Kościeliska (1000—1300 m), Roztoka (1120 m); alpine meadows: Kalatowa (1200 m), Pyszna (1400 m), Hala Gąsienicowa (1500—1700 m); on the lake-shores: Czarny Staw near Kościeliec (1620 m), Zielony (1672 m), Długi (1640 m), Morskie Oko (1406 m); summits of Liliowe (1952 m), Beskid (1980 m), Kasprowy (1988 m), Mnich (2068 m), Czubryna and others.

A very common species occurring in various biotopes, in vicinity of human settlements under pieces of wood, stones, mouldering timber, dead leaves and others, as well as high in mountains in needle-litter, moss and stones.

Distributed widely over Europe, noted from North America.

89. — *Heteromurus nitidus* (TEMPLETON)

Submontane: Chłabówki, under a plank of timber lying on the ground near a house (8);

Kasprusie, under a piece of wood near a house (1);

Krzepiówki, in mould gathered under loose bark of an old spruce-stump (2);

Montane: Mały Złebek (1000 m), under loose bark of a spruce-stump (1).

Occurs generally in vicinity of human settlements under stones and pieces of wood lying on the humus-soil, also under loose bark of trees.

It is widely distributed in Europe, known from many caves as a troglophile animal. In mountains it appears rarely and only in lower altitudes.

90. — *Orchesella bifasciata* NICOLET

Submontane: Chłabówki, under mouldering wood (22);

Montane: Cyrhla (1000 m), in moss (1) and under a stone (1);
Strażyska-vall. (1050 m), under stones, in needle-litter, and in dead leaves (15);

Valley „Do Białego“ (1000 m), under stones and loose bark of trees (3);

Chochółowska-vall. (1340 m), in needle-litter (4);

Mała Łąka-vall. (1170 m) in very moist moss growing on the slopes of valley (1);

Suchy Złebek-vall. (1050 m), in short moss growing on the rocks (8) and under stones (5);

Lysanki (1440 m), in the crevices of the rocks (14);

Skoruśniak (1350 m), in needle-litter of the forest (11);

Kalatowa alpine meadow (1130 m), under stones near a snow-field (30 III .. 12).

Lives generally in forests in needle-litter, dead leaves and in moss growing on the ground and the rocks. Occurs usually only on dry places.

Distributed widely in Europe. Known from mountains: Beskides, Tatra, Czarnohora, Harz, Alps, Crimea, Caucasus.

91. — *Orchesella alticola* UZEL

Montane: Suchy Złebek-vall. (1200 m), under stones on the rocks;

Sarnia Skalka (1380 m), under stones at the summit (36);

Lysanki (1440 m), in the rock-crevices (11);

Stoly (1429 m), in Kościeliska-vall., under stones (8);

Zawrat (2150 m), in short moss growing on the rocks (22), and under a stone (1);

Kozi Wierch (2290 m), in dry lichens (2);

Swinica (2301 m), from moss and lichens (46);

Hrubby Mieguszowicki (2437 m), under a stone (1);
 Niżnie Rysy (2438 m), near to summit (23), and under stones
 at the peak (20);
 Valley „Za Mnichem“ (2000 m), under large stones (3), and
 at the foot of Czubryna (2000 m) under a stone (1).

A proper element of the fauna of high mountains, living
 in clusters of moss and lichens, also under stones, usually
 on dry places at higher altitude.

Known at present from the Tatra, western part of Sudetes,
 high Alps and Caucasus; noted also from Roumania and
 England.

92. — *Orchesella flavescens* BOURLET

Submontane: Krzeptówki, Chłabówki.

Montane: Cyrhla (1000 m), Boczań (1820 m), Olczyńska (1090 m);
 valleys: Dziura (1080 m), Mała Łąka (1100 m), Suchy Złebek
 (1000 m), Strążyska (980—1100 m), Kościeliska (1000—1400),
 Chochołowska (950—1350 m), Roztoka (1160 m); Czarny
 Staw near Kościelec (1620 m) and others; Kalatowa (1130 m)
 on snow (30 III.. 1), and Toporowy Staw (1200 m), on
 snow (22 IV.. 4).

A common species living in various biotopes, generally
 in the forests of lowland in moss, needle-litter and dead leaves,
 on pieces of wood, also on various plants near to banks of
 forests and on meadows, under loose bark of trees, and others.
 It appears in many colour-varieties. In mountains it is rarer,
 restricted in its life mostly to the forests and lower altitudes.
 Here it appears sometimes also in winter time on snow, but
 never in great number of specimens.

Distributed very widely over Europe, known from Siberia
 and North America.

93. — *Orchesella luteoviridis* STACH

Montane: Mała Łąka (1100 m), in water full moss growing on
 the slopes of the valley (5);
 Suchy Złebek (1200 m), in very moist moss on the slopes
 of the valley (2);
 Kobylarz (1430 m), under stones (3);
 Jarząbca-vall. (1275 m), under loose bark of a spruce-stump;
 Pyszna (1400 m), on the mouldering wood (2);
 Opalony (1680 m) under stones (2);
 Rakoń (1700 m), under stones (3);

Valley „Pięć Stawów Polskich“ (1700—2000 m) on plants (31) and on the shore of Zielony-lake (12);

Hala Gasienicowa, in moss on the shore Sobkowy-lake (1630 m), Kustkowiec (1690 m), and Długi (1780 m. 16 sp.; Kopa Magóra (1670—1704 m), under stones (9);

Kasprowy (1988 m), under a piece of wood lying on a grassy place (2);

Czuba Goryczkowa (1920—1989 m), under stones (6);

Hrudy Mieguszowiecki (2437 m), under stones (4);

Niżnie Rysy (2430 m), under large blocks (12).

A species living in mountains generally at high altitudes under stones and in moist moss growing on the lake-shores. — Known at present from the Tatra, Czarnohora and Alps.

94. — *Entomobrya nivalis* (LINNÉ)

Submontane: Zakopane, Chłabówki, Krzeptówki, Antalówka;

Montane: Cyrhla (1000 m), Kopieniec (1170 m), Nosal (1206 m),

Boczań (1200 m), valleys: Olczyska (1090 m), Dziura (1050 m),

Kościeliska (980—1200 m), Strążyska (1100 m), Chocho-

łowska (1200 m), Mała Łąka (1180 m), Suchy Zlebek (1100 m),

Biała Woda (1200 m); Kondratowa (1220 m), and others;

Toporowy Staw (1125 m), on snow (22 IV .. 5), valley Biała

Woda (1180—1280 m), on snow (III—IV).

A common species occurring on grassy places, various plants and shrubs, in moss and mouldering cones, under stones and loose bark of trees, also others. In mountains it lives in lower altitudes generally in the region of the forests and *Pinus mughus* SCOP. — woods.

Distributed widely over Europe, registered also from North America, Australia and New Zealand.

95. — *Entomobrya multifasciata* TULLBERG

Submontane: Chłabówki, under a plank lying near a house (48).

Montane: Sarnia Skalka (1380 m), under a stone near *Pinus mughus* (1);

Lysanki (1447 m), under stones lying on the grassy ground (3);

Occurs usually on the sunny grassy places, seeking shelter under stones. In the Tatra found in lower altitudes only.

Registered from Europe, North America, Australia and New Zealand, but not so common as the preceding species and in Tatra Mts rare.

96. — *Entomobrya lanuginosa* (NICOLET)

Submontane: Kasprusie, Krzeptówki, near a house in the bark-crevices of a pear-tree (7);

Montane: Mała Łąka-vall. (1100 m), on the plants (2), and on mushrooms (4);

Chochołowska-vall. (1400 m), under a stone in forest (1);

Valley Pięć Stawów Polskich (1700 m), under a stone (1);

Pyszna (1550 m), on a *Pinus mughus*-tree (3);

On the shore of Zielony-lake (1672 m), and Długi-lake (1720 m) .. 3;

Liliowe (1980 m), under a stone (2).

Lives usually on grassy places and meadows, also on branches of shrubs and on the bark of trees.

Distributed widely over Europe, noted also from North America.

97. — *Entomobrya corticalis* (NICOLET)

Submontane: Krzeptówki, near a house, in bark-crevices of a pear-tree (1).

A corticicole species living mostly near human settlements under loose bark of trees, also in moss and under stones in the forests of the lowland.

Known from some countries of Europe, noted also from the North America.

98. — *Entomobrya marginata* TULLBERG

Submontane: Chłabówki, in moss growing on an old spruce-stump (3);

Montane: Mała Łąka (1100 m), in moss and under stones (14);

Łysanki (1440 m), in moss growing in block-crevices (3);

Kopa Królowa (1704 m), in lichens (1).

Lives generally in forests under loose bark of trees, also in moss and under stones.

Distributed widely over Europe, registered also from North America and Australia.

99. — *Entomobrya arborea* TULLBERG

Submontane: Kasprusie, on a piece of paper lying near a house (1);

Chłabówki, under dry loose bark of the fence-pales near the house (27);

Krzęptówki, on the veranda of the house (1), and in bark-crevices of a pear-tree near a house (1);

Lives generally in lowland near human settlements, and in forests on the branches, loose bark of various trees, also lichens growing on the trees.

Noted from some countries of Europe.

100. — *Sira bushii* LUBBOCK

Submontane: Kasprusie, in a house (1);

Chłabówki, under a piece of wood lying near the house (1), and on mouldering timber (1);

Krzęptówki, under flower-pots in a house (66);

Montane: Dziura-vall. (1010 m), on plants (5), and on dead leaves in the cave (3);

Kościeliska-vall. (1000 m), under stones (3);

Skoruśniak (1240 m), in needle-litter of the forest (6), and in a sample of the soil (1);

Kobylarz (1680 m), in needle litter in region of *Pinus mughus*-wood (1);

Mała Łąka (1200 m), in a sample of strongly frozen soil at the border of a forest (20 III .. 1).

A corticicole animal living on and under loose bark of various trees near the human settlements, and in the forests of low-land and mountains.

Distributed widely over Europe, registered also from North America.

101. — *Sira nigromaculata* LUBBOCK

Submontane: Chłabówki, Zakopane, Krzęptówki, in wooden-houses on various objects and under flower-pots.

Montane: Ornak (1200 m), in shelter-house on the plank (1).

In the Tatra Mts I found this species only in the human houses, never out the houses. In the Alps it occurs also in free nature.

Noted from some European countries registered also from North America and Australia.

102. — *Lepidocyrtus rivularis* BOURLET

Submontane: Zakopane, Chłabówki, Jaszczurówka.

Montane: Cyrhla (1000 m), Kopieniec (1170 m), Sarnia Skalka

(1380 m), Łysanki (1447 m), Kobylarz (1600 m), valleys: Suchy Złebek (1000 m), Kościeliska (980—1300 m), Strążyska (1000—1200 m), Chochołowska (1140 m), Jarząbca (1275—1425 m), Sucha (1820 m), Pięć Stawów Polskich (1700—1790 m); Kalatowa (1200 m), Pyszna (1600 m), Magóra (1650 m), Kasprowy (1988 m), Krzyżne (2186 m), Zawrat (2150 m), Świnica (2301 m), Miedziane (2234 m), Czubryna (1918 m), on the lake-shores: Smreczyński (1226 m), Czarny Staw near Kościelec (1620 m), Zielony (1672 m), Sobkowy (1618 m), Morskie Oko (1406 m) and others.

A very common species occurring on various plants, in moss often very moist, in needle-litter and dead leaves, under stones, loose bark of trees, as well in lowland in vicinity of human settlements on meadows and arable fields, as also in forests and in mountains up to highest altitudes.

103. — *Lepidocyrtus violaceus* (GEOFFROY) LUBBOCK

Submontane: Kasprusie, Chłabówki;

Montane: Łysanki (1447 m), valleys: Suchy Złebek (1010 m), Strążyska (1100 m), Kościeliska (1000—1350 m); on the shore of Sobkowy-lake (1618 m) and Długi-lake; Zawrat (2150 m), Świnica (2306 m), Karb (1852 m), Hruby Mięgoszowski (2172 m), Czubryna (2000 m), Niżnie Rysy (2430 m).

Lives generally on various plants, also in moss and lichens, under stones, loose bark of trees, in needle litter and dead leaves, in lowland as well as in mountains. — Noted from many countries of Central Europe and from North America.

104. — *Lepidocyrtus cyaneus* TULLBERG

Submontane: Kasprusie, under a stone (5);

Montane: vall. Strążyska (950—1200 m), in needle-litter and dead beech-leaves (10);

Kościeliska-vall. (1100 m), under a stone (1);

Mała Łąka-vall. (950—1200 m), under stones on moist place (6).

A common species especially in vicinity of human settlements, occurring under stones lying on vegetable-soil, also in plant-detritus, dead leaves and others. In the Tatra Mts rare.

It seems to be a cosmopolitan species, noted from Europe, Asia, North America and Africa.

105. — *Lepidocyrtus curvicollis* BOURLET

Submontane: Chłabówki, under a plank lying on moist meadow near a house;

Montane: Dziura-cave (1010 m), in dead beech leaves (1);

Strążyska vall. (1200 m), under a mouldering beam (1).

Lives in moist plant-detritus, and under pieces of wood lying on moist places. In Tatra Mts in lower altitudes only. Fragmently it occurs also in caves as a troglophile animal.

Distributed widely in Europe, especially in central part.

106. — *Pseudosinella immaculata* (LIE PETTERSEN)

Montane: Cyrhla (1000 m), under a stone deepened in the ground of the pasture (1);

Cave Dziura (1010 m), in dead beech leaves (1).

A troglophile animal living concealed in the caves or under large stones deepened with their bases in the humus-soil.

Known from some European countries.

107. — *Pseudosinella wahlgreni* (BÖRNER)

Submontane: Chłabówki, Zakopane;

Montane: Cyrhla (1000 m), Kopieniec (1170 m), Boczań (1200 m), Sarnia Skalka (1380 m), Kobylarz (1430 m), valleys: Strążyska (900—1200 m), Dziura (1100 m), Kościeliska (980—1350 m), Białego (1200 m), Jarzabcza (1350—1625 m), Mały Złebek (1100 m), Mała Łąka (1170 m), Suchy Złebek (1050 m); Hala Gąsienicowa (1551—1670 m), on the shore of Sobkowylake (1618 m), Kopa Magóra (1704—1900 m), Beskid (2010 m)

A species fairly common in all Poland, occurring in lowland as well as in mountains. It lives mostly under stones, in needle-litter, moist moss, and under loose bark of trees.

Noted from some countries of Central- and Southern Europe.

108. — *Megalothorax minimus* WILLEM

Submontane: Krzeptówki, under loose bark of an old spruce-stump (2);

Montane: Cyrhla (1000 m), under loose bark of a spruce-stump (4);

Suchy Zlebek (1100 m), on the summit of a small rock, under a stone (1), and in a sample of grass-grown soil taken near the border of the forest (166);

Nosal, at the summit (1206 m) in *Polytrichum*-moss (1);

Skoruśniak (1240 m) in needle-litter (3);

Kobylarz (1430 m) in needle-litter of *Pinus mughus* (39);

Dwoisty-lake (1656 m), in the needle-litter of *Pinus mughus*, on the bank of the lake (1);

Czarny-lake near Kościelec (1620 m), under loose bark of a *Pinus mughus* Scop., growing on the moraine (2).

A common species occurring mostly on arable fields, in the Tatra Mts in various biotopes, as in needle-litter and dead leaves in forests, in moss, under loose bark of old tree-stumps, mouldering wood, from the foot of mountains up to highest summits.

Widely distributed over Europe, known also from North America.

109. — *Megalothorax aquaticus* STACH

Montane: Suchy Zlebek-vall. (1050 m), in very moist moss growing on the slopes of the valley (41);

Mała Łąka (1100 m), from very moist moss growing on the slope of the valley in a place where water flow down (118);

Sobkowy-lake (1618 m), in very moist *Sphagnum*-moss growing on the bank of the lake (1).

Occurs only in very moist, water-dripping moss.

Known at present from Tatra Mts only; perhaps an endemit form for these mountains.

110. — *Sminthurides aquaticus* (BOURLET)

Montane: Toporowy-lake (1125 m), on the surface of the water (2);

Kościeliska-vall. (1100 m) in moss growing on a stone in the stream (3);

Smreczyński-lake, on the surface of the water (15) and on water-plants (9);

Kondratowa (1220 m) on a puddle (9);

A common species well adapted to living on the surface of the water and on various aquatic plants.

Widely distributed over all Europe known also from other continents.

111. — *Sminthurides malmgreni* (TULLBERG)

Montane: Cyrhla (1000 m), on the surface of a small spring (3);
Mała Łąka-vall. (1100 m), on the plants growing on the
bank of a stream (2), and in very moist moss (1);
Gąsienicowa alpine meadow, Sobkowy-lake (1618 m), in
very moist moss growing on stones protruding over the sur-
face of the water in the stream (4).

Occurs commonly on the surface of small water reservoirs,
near the banks of lakes and small streams on various aquatic
plants, on moors in moist *Sphagnum*, also in moss growing
on stones protruding from the water.

A species very widely distributed over all Europe, known
also from other continents. It advanced far northward, is
registered from arctic islands (Spitsbergen, Bear-Isl., Novaja
Semlja). Occurs in the Carpathians (Tatra, Beskides, Czarno-
hora) and in Alps.

112. — *Sminthurides schoetti* (AXELSON)

Montane: Suchy Złebek-vall (1000 m), in very moist *Sphagnum*-
moss, growing on the slopes of valley (12).

Lives before all in very moist *Sphagnum*-moss, also on the
surface of small pools on peat-moors.

Known from some countries of North-and Central-Europe.

113. — *Sphaeridia pumilis* (KRAUSBAUER)

Montane: Strażyska-vall., (1000 m), in a sample of frozen soil
(IV .. 12);

Kościeliska-vall., Tomanowa (1200 m) in needle litter (1),
and Kominy Tylkowe (1400), under a piece of wood (1);

Kasprowa-czuba (1913 m), in moss (9).

In lowland it occurs near human settlements, in gardens,
on grassy places, under pieces of timber lying on the ground,
in soil of various arable-fields, also under flower-pots in dwel-
lings. In mountains it lives in moss also in higher altitudes.

A cosmopolite species distributed widely not only in Europe,
but also noted from America, Africa and Australia.

114. — *Arrhopalites caecus* (TULLBERG)

Submontane: Krzeptówki, under flower-pots in a peasant-house
(22);

Montane: Kościeliska-vall. (1180 m). Kopki, under mouldering wood (1).

In the human dwellings one of very common species. In the open relatively rare, occurring, however, sometimes also far from the human settlements in mountains under stones and in mouldering wood in forests.

Known from some European countries, also from some mountains (Tatra, Czarnohora).

115. — *Arrhopalites principalis* STACH

Montane: Suchy Zlebek-vall. (1000 m), in moss full of water (5);
 Strążyska-vall. (1120 m), in very damp beech-leaves (1);
 Skoruśniak (1240 m), from a sample of soil near a *Pinus mughus* SCOP. (1);
 Czarny-lake near Kościelec (1620 m), in moss (1);
 Świnica-summit (2306 m), in short moss growing in rock-clefts (2).

In Poland I have found it only in mountains ascending up to highest summits, where it lives in damp moss also in humus-soil.

The species is probably widely distributed in Europe, as in Northern as in Central territories of this continent, also known from Greenland. It lives in mountains (Tatra, Czarnohora, Alps) and in low-land.

116. — *Arrhopalites pygmaeus* (WANKEL) S. STACH

Montane: Valley Kościeliska, cave Zimna (1125 m), and cave Groby (1230 m);
 Valley „Ku Dziurze“, cave Dziura (1010 m), and cave Dziura Wyżnia (1030 m).

A species known from many caves in Europe (Poland, Hungary, Austria, Germany), as a generally troglophile animal. It appears, however, sometimes also out of the caves in Switzerland and France.

117. — *Sminthurinus niger* (LUBBOCK)

Montane: Mały Kopieniec (1170 m), under loose bark of a spruce (3);
 Boczań (1180 m), under loose bark of a spruce (9);

Strążyska-vall. (1200 m), in a piece of mouldering timber lying on the ground (2);

Pyszna (1400 m), under loose bark of an old mouldering stump (6).

Occurs under loose bark of various trees, in mouldering timber, in moss, dead leaves and needle-litter, also under stones. Lives in proximity of human settlements and appears sometimes also under flower-pots in houses; but it occurs also far from human settlements in forests and mountains.

Mentioned from many European countries and also all other continents.

118. — *Smithurinus aureus* (LUBBOCK)

Submontane: Krzeptówki, under flower-pots in a house (103); Chłabówki, in moss growing on old spruce-stump; under mouldering timber; in moss growing on a moist meadow near a house;

Montane: Mały Kopieniec (1170 m), under loose bark of a spruce-stump (3);

Dziura-vall. (1000 m), from grass and low plants (1);

Kościeliska-vall. (1100 m) from grass and low plants (5);

Mała Łąka-vall. (1050 m), from grass and low plants (1);

Suchy Złebek-vall. (1080 m), in moss growing on the rocks (1), and in a sample of soil (1);

Near Dwoisty-lake in Gąsienicowa alpine meadow (1650 m) in dense *Pinus mughus*-wood, in moss and needle-litter (2);

Niżnie Rysy (2430 m), under a large stone (1);

Strążyska-vall. (1000 m), in a sample of frozen soil (15 IV .. 4).

A common species which occurs in moss growing on the ground, old tree-stumps and rocks, also under loose bark of trees. Lives also on low plants in meadows and gardens, and appears often under flower-pots in human dwellings. In high mountains it occurs rarely, but in Tatra Mts it was caught under a stone on 2430 m alt.

Widely distributed over Europe and mentioned from almost all other continents.

119. — *Sminthurinus elegans* (FITCH)

Montane: Strążyska-vall. (1050 m), in a sample of frozen soil (15 IV .. 2 sp.);

Occurs on grass and low plants of moist meadows, on mouldering timber and in moss.

Known from many European countries and registered from North America.

120. — *Sminthurinus bimaculatus* (AXELSON)

Montane: Kopki (1180 m) in Kościeliska-vall., on sunny clearing with abundant vegetation (1);

Kościeliska-vall. (1200 m), from needle litter (1).

Occurs on low plants, lichens, in needle-litter, under stones and mouldering timber.

At present certainly noted from Finland, Poland, Ukraina and Hungary. In the Carpathians collected by me in Tatra and Czarnohora.

121. — *Bourletiella arvalis* (FITCH)

Submontane: Kasprusie, on moist meadow near a peasant-house (20);

Montane: Cyrhla (1000 m), on dry pasture ground (14).

A species occurring mainly in low-land on meadows and arable fields, sometimes appearing in a very great number of specimens especially in the cultures of various plants.

Widely distributed in Europe, mentioned from North America, Australia, New Zealand, also from Kashmir.

122. — *Bourletiella hortensis* (FITCH)

Submontane: Kasprusie, on grass near a peasant-house (23).

Montane: Dziura-vall., on low vegetation (1);

Boczań, (1180 m), on the border of a forest (2);

Cyrhla (1000 m), on a dry pasture-ground (14);

Zielony Staw Gąsienicowy (1672 m), near the shore of the lake.

A common species in low-land living on the grass and other plants on dry and on moist meadows, appearing often on arable fields with various plants. In mountains it occurs rarely.

Probably a cosmopolitan species, a little varying in some localities.

123. — *Deuterosminthurus repandus* (ÅGREN)

Submontane: Kasprusie, Krzeptówki, Chłabówki, on moist meadows;

Montane: Strażyska-vall. (1100 m), on low vegetation;

Kościeliska-vall. (1150 m) on plants near to a stream;

Kopki (1180 m), on sunny clearing with abundant vegetation;

Mała Łąka-vall. (1000 m), on sunny clearing;

Suchy Złebek-vall. (980 m) on grassy places.

Occurs on various plants on the dry, sunny meadows, but also on moist ones; appears sometimes in great number of specimens on arable fields with various plants. It lives mostly in low-land, appears also in mountains, but generally only in lower altitudes up 1500 m. — Distributed over whole Europe, known also from other continents. Noted from the mountains: Tatra, Beskides, Czarnohora, Ural, Caucasus, Alps.

124. — *Deuterosminthurus bicinctus* (KOCH)

Montane: Mała Łąka (1200 m), in a sunny clearing with exuberant vegetation (6);

Strażyska-vall. (1100 m), on the low plants (12);

Suchy Złebek-vall. (1000 m), on the sunny places (5);

Kościeliska-vall. (1300 m), on the terrain grown with brushwoods (9);

Kopki (1180 m), on sunny clearing grown with various plants (8);

Oleczyska (1090 m), on sunny grassy meadow (10).

Lives generally on the exuberant vegetation of sunny, dry localities or on terrains grown with brushwoods. In Poland occurs mostly in low-land, and in mountains only in lower altitudes (Tatra, Beskides, Pieniny, Czarnohora).

Distributed probably over the whole Europe, known from Siberia and Caucasus.

125. — *Heterosminthurus linnaniemii* (STACH)

Submontane: Kasprusie, on moist peaty meadow (29);

Montane: Cyrhla (1000 m), on moist meadow near a house (39);

Kopieniec (1170 m), on the grass and low plants (18);

Valleys: Dziura (1000 m), Strażyska (1100 m), Suchy Złebek (1000 m), Mała Łąka (1100 m), Kościeliska (1000—1300 m), on low plants (many spec.);

Pyszna-peak (1789 m), on grassy sunny places (16);
Valley Pięć Stawów Polskich (Five Polish Lakes) (1700 m)
on an alpine meadow (3).

Occurs on grassy places, meadows, arable fields, in proximity of human settlements, but also far away from the settlements in forests on low plants, on peat-moors and in mountains, in the Tatra up to 1800 m alt.

Known at present only from Poland and neighbouring part of Ukraina and Belo-Russia, occurs in the Carpathians (Tatra, Beskides, Gorce, Czarnohora).

126. — *Heterosminthurus insignis* (REUTER)

Submontane: Kasprusie, on moist meadow near a house (1);
Chłabówki, near a house on moist peat meadow (4);

Montane: Strążyska-vall. (1100 m), on a moist meadow (21).

Species adapted to living on the water surface of small water reservoirs, occurs generally in moist localities, such as peaty meadows, on low vegetation of the lake-shores and in *Sphagnum* of the moors.

Known from many European countries, mostly from the northern and central part of this continent, probably also from the U. S. America. Noted from all Scandinavia and from High Tauern at 2500 m alt. (FRANZ).

127. — *Sphyrotheca lubbocki* (TULLBERG)

Submontane: Krzeptówki, under loose bark of an old spruce-stump (20);

Montane: Cyrhla (1000 m), in moss growing on an mouldy old spruce-stump and on stones (3); under loose bark of a spruce (2);

Kościeliska-vall. (1100 m), in mouldering timber (2);

Dziura-vall. (1050 m), under a stone (1).

Occurs mostly under stones, loose bark of old tree-stumps, in moss growing on the ground and on the rocks, in mouldering timber and in the needle-litter in the forests.

Distributed widely over Europe, also known from Algeria and from the mountains Tatra, Beskides, Gorce, Czarnohora and Alps.

128. — *Allacma fusca* (LINNÉ)

Submontane: Chłabówki, on mouldering timber;

Montane: Cyrhla (1000 m), Jaszczurówka (900 m), valleys: Strążyska (1100 m), Ku Dziurze (1000 m), Kościeliska (1000—1350 m), Chochołowska (1200 m), Roztoka (1250 m), Hala Gąsienicowa, and many other places, under stones, loose bark of trees, pieces of timber lying on the ground, on mushrooms and low plants, in many specimens.

A common species living mostly in forests on trunks of various trees, also under bark of tree-stumps. In proximity of human settlements it is rarer. It occurs in lowland as well as in mountains, but only up to the upper limit of forests.

Widely distributed over the whole Europe, noted from U. S. America and North Africa.

129. — *Sminthurus viridis* (LINNÉ)

Submontane: Zakopane, Kasprucie, Krzeptówki; Jaszczurówka;

Montane: Cyrhla (1000 m), Kopieniec (1170 m), valleys: Strążyska (1100 m), Dziura (1000 m), Kościeliska (1200 m), Chochołowska (1100 m), Mała Łąka (1050 m), Białej Wody (1160 m), and others; Boczań (1200 m), Kopa Magóra (1600 m), Kopa Królowa (1650 m), Hala Gąsienicowa (1600 m), Zielony Staw (1672 m), Pięć Stawów Polskich (1700—1790 m), Morskie Oko (1406 m), Kasprowa Czuba (1913 m), Gładka Przełęcz (1994 m), Pyszna (1770 m), and others.. in many specimens.

A common species living in the proximity of human settlements as well as also far from them on various plants. In the Tatra Mts and in Czarnohora I have caught it up to 2000 m alt., also in the Alps it ascends to that altitude. — Distributed over all Europe. It is registered also from America, Australia, New Zealand, where it is probably imported with some plants.

130. — *Dicyrtomina minuta* (O. FABRICIUS)

Submontane: Chłabówki, near a house on a moist meadow (7).

Montane: Cyrhla, under a stone (1).

v. *flavosignata* (TULLBERG)

Montane: Jaszczurówka (950 m) on plants (1);

Roztoka-vall. (1100 m), on *Petasites* (1);

Kościeliska-vall. (1100 m), on plants (3); under pieces of wood lying on the ground (5).

Lives mostly on grass and other plants on meadows and in gardens, but also under pieces of wood lying on the ground and under stones, generally in low-land and near human settlements. In mountains it appears more rarely and at not too high altitudes.

A common species widely distributed over Europe, noted also from northern Africa.

131. — *Dicyrtomina ornata* (NICOLET)

(= *Dicyrtomina minuta* v. *couloni* LINNANIEMI, 1912)

Submontane: Zakopane, under a piece of bark lying on the ground near a forest (1);

Montane: Dziura-vall. (1000 m) on plants (1) + *signata* (2);

Kościeliska vall. (1100 m), under pieces of bark lying on the ground (1) + *signata* (1);

Strażyska-vall. (1000 m), on *Petasites*, near a stream (1) + *signata* (1);

Chochołowska-vall. (1340 m), under a piece of wood (1);

Mała Łąka-vall. (1200 m), under moist wood lying on moss full of water (2) + *signata* (1).

Occurs in Poland mostly in lowland on various plants under pieces of wood lying on the ground and stones; it appears, however, also in mountains, but mostly in single specimens or in small numbers and only in lower altitudes.

Known from some European countries.

v. *signata* Stach

(= *Dicyrtomina minuta* v. *signata* STACH, 1919).

Submontane: Zakopane, under pieces of wood lying on the ground (4);

Montane: Strażyska-vall. (1100 m), on various plants (35); on very moist dead leaves (6); on *Petasites* (1);

Dziura-vall. (1000 m), on plants (2);

Kościeliska-vall. (1200 m), under pieces of bark lying on the ground (3);

Mała Łąka-vall. (1050 m), on a mushroom (1); under a piece of wood lying on very moist moss (1);

Suchy Złebek-vall. (1000 m), under a branch lying on the ground (18);

Roztoka-vall. (1200 m), on moss (1);

Czarny Staw near Kościelec (1620 m), on moraine in needle-litter of *Pinus mughus* SCOP. (1);

Pięć Stawów Polskich (1700 m), in moss (1).

Occurs mostly in moist localities on plants, under pieces of wood and bark lying on the ground, also in dead leaves and moss, more frequently in mountains than in lowland. In mountains it reaches to higher altitude than the principal form; in Tatra Mts it appears higher than the upper limit of the forest, up to 2000 m alt.

Known from Poland, also from the southern slopes of the Tatra Mts and East Carpathians.

132. — *Dicyrtoma fusca* (LUCAS)

Montane: Cyrhla (1000 m), under mouldering wood lying on the ground (3);

Dziura-vall. (1000 m), under stones (3);

v. *medialis* STACH, 1930

Kościeliska-vall. (1200 m), under pieces of moist wood lying on the ground (1).

Lives in moist localities under stones and pieces of mouldering timber mostly in forests of mountains and in lowland.

Distributed over all Europe, noted also from Siberia and Japan.

133. — *Ptenothrix atra* (LINNÉ)

Montane: Mała Łąka-vall. (1100 m), on mushrooms (5); under stones (3);

Mały Zlebek-vall. (1000 m), on a mushroom in forest (1).

Occurs mostly in various forests on mushrooms, in dead leaves and under stones and pieces of wood lying on moist ground.

Distributed widely over the whole Europe.

134. — *Ptenothrix leucostrigata* STACH

Montane: Mała Łąka-vall. (1180 m), under pieces of timber lying on very moist moss (2).

Occurs under stones, pieces of timber, dead leaves and plant-detritus in moist localities.

Known at present only from Poland and Polesie (Belorussia).

Ordo Protura

135. — *Eosentomon transitorium* BERLESE

(= *Eosentomon armatum* STACH)

Montane: Cyrhla (1000 m), under loose bark of an old spruce-stump (1);

Suchy Zlebek (1050 m), in a sample of soil covered with grass (13); and under stones (2);

Kobylarz (1450), in needle litter in region of *Pinus mughus* SCOP. (2);

Skoruśniak (1250 m), in needle-litter in the forest (13);

Mała Łąka (1150 m), in a sample of strongly frozen soil (3 III .. 21);

Kościeliska vall. (1250 m) in needle-litter and soil (20);

Hala Gąsienicowa (1560—1700 m), in samples of soil (6).

Lives in moist vegetable soil, in needle-litter, under stones, rarely under loose bark of tree-stumps.

A common species very widely distributed in Europe.

136. — *Acerentomon dispar* STACH

Montane: Cyrhla (1000 m), under loose bark of an old spruce stump near the ground (2);

Kościeliska vall. (1200 m), Kopki, in needle-litter (5), and in moss (1);

Suchy Zlebek (1050 m), in a sample of soil (3);

Kobylarz (1450 m), in moss in region of *Pinus mughus* (2);

Skoruśniak (1250 m), in needle-litter in the forest (3);

Near Sobkowy-lake (1618 m), from a sample of moist soil in dense *Pinus mughus*-wood (39);

Pięć Stawów Polskich-vall. (1700 m), in needle-litter in region of *Pinus mughus* SCOP. (1);

Mała Łąka-vall. (1180 m), in a sample of strongly frozen soil (3 III .. 2).

Lives in moist vegetable soil, also in needle litter.

At present known from Poland only, generally from mountainous land and mountains.

Ordo Diplura

137. — *Campodea (Campodea) plusiochaeta* SILVESTRI

Montane: Cyrhla (1000 m), under loose dry bark of a spruce stump (2);

Suchy Zlebek (1050 m), in mould under the loose bark of

an old spruce-stump (1);
Kopieniec (1170 m), under a stone (1).

Occurs under stones, vegetable soil, and under loose bark of trees.

Registered from some European countries.

138. — *Campodea (Campodea) silvestrii* BAGNALL

Montane: Cyrhla (1000 m), under loose bark of trees (4), from moss growing on the bark of an old spruce-stump (3), in moist forest under stones (7);
Kopieniec (1170 m), under stones (3);
Sarnia Skalka (1380 m), under stones (8);
Kościeliska vall., Kopki (1190 m), under a stone (1).

Lives under stones on moist vegetable soil, also under loose bark of trees.

Noted from many European countries.

THE CHARACTER OF THE APTERYGOTAN FAUNA OF THE
POLISH TATRA NATIONAL PARK

The preceding list of *Apterygota* found in the Polish Tatra National Park permits to define more strictly the character of the fauna of this group of insects inhabiting that terrain.

This fauna ought be considered as a relatively rich since it comprises 134 species of *Collembola*, then somewhat more than the half of the number of species of this group known at present from all Poland, a country well investigated in reference to this group of insects.

The Apterygotan fauna of the Polish Tatra National Park approaches with the number of species that of the „Parc national suisse“ in Engadin. HANDSCHIN, in 1924, has found in this park 95 species of the *Collembola* only, but after the following studies of GISIN the number of species known from that terrain is increased up to 120—130, so it is almost equal to that from the Tatra. The identity of the species occurring on both these terrains is, however, not concordant.

FRANZ, in 1954, enumerated from the North-East Alps 236 species of *Collembola*. But that part of the Alps is approximately one third of the whole chain of those mountains,

and comprises area of about three hundred square-kilometer, while the Polish Tatra National Park area is 172 km² only, and while the High Tatra occupy 50 km², in Switzerland there are 29.000 of high mountains.

The climatic life-conditions in the wide and long range of the Alps are and were for animals different than those in the small Tatra Mts and the influence of the neighbouring south Mediterranean and the eastern xerothermic fauna considerable greater.

The comparison of the Apterygotan fauna of the Tatra Mts with that of the Alps may not be till now exactly accomplished. I mention, however, on many places of this paper some remarks concerning the resemblances and differences between the Apterygotan fauna of the Tatra and that of the Alps.

The examined Apterygotan fauna of the Tatra Park consists in most part of species distributed widely in lowland of all Europe, especially in Poland and the countries neighbouring to it.

There exist, however, some of such widely distributed species, occurring also in the Alps, which in Tatra Mts are wanting. To such belong for instance the supraquatic forms: *Ballistura crassicauda* (TULLB.) and *Podura aquatica* L.

Ballistura crassicauda (TULLB.) noted from Scandinavia, Shetland, England, Scotland, Germany (Westfalen), Poland, Hungary, Belo-Russia, environs of Moscow, Ural, north-western Siberia (Obj-territories), was collected by CARL (1901) in Alps in numerous specimens on the shore of Geneva-lake and on the glacier Piz Muttar at 3100 m alt., and by HANDSCHIN (1924) at 2650—3000 m alt. HANDSCHIN (1924) regards it as a boreo-alpine animal, but the northern limit of its distribution in Finland lies below 65° N. lat. and it lives within a wide area in Europe in lowland.

Podura aquatica L., a common species and very widely distributed over all Europe, North America (U. S. America, Canada, Alaska) and North Africa (Algeria, Morocco), registered also from Siberia and low-land of Poland, occurs in the Alps mostly in lower altitudes, but — according to HANDSCHIN — is noticed also at 2500 m alt. (Faller-Alps).

Also some of the terricole species occurring commonly in the low-land of Poland, even in the territory of Podhale closely adjacent to Tatra, known from the other ranges of Carpathians and mountains of Europe are not found till now in Tatra Park. For example:

Ceratophysella bengtssoni (ÅGR.) widely distributed especially in the northern- and central Europe, noted from Podhale (Czarny Dunajec), in the Alps ascending up to 2500 m alt.

Hypogastrura manubrialis (TULLB.), a cosmopolite, living in Podhale and on Czarnohora, known from Caucasus (1800 m alt.) and in Alps ascending up to 3400 m alt.

Hypogastrura vernalis (CARL) occurring almost in all Europe from Sweden down to the southern countries (Spain, Albania), known from Podhale and from the Alps at 2500—3100 m alt.

Odontella lamellifera (AXELS.), a corticicole species known from some countries of northern Europe, also Podhale, the East Carpathians (Czarnohora) and Swiss Alps;

Onychiurus tuberculatus (MON.), a troglophile animal (caves in Westfalia, Franconia and oth.), out the caves found in Podhale, Gorce — and Pieniny-mountains, in the Alps occurring up to 3000 m alt.;

Onychiurus serratotuberculatus STACH, occurring mostly under stones in Podhale, East Carpathians (Czarnohora) and Alps (1800 m alt.);

Metaphorura affinis (BÖRN.), distributed widely over Europe, known from Podhale, Styrian Alps and Bulgarian mountains;

Xenylla brevicauda TULLB., living generally in moss and needle-litter in northern Europe (Sweden, Finland), as well as in Podhale and the Alps;

Xenylla planipila STACH, known from some European countries, occurring also in Podhale and the Alps;

Proisotoma minuta (TULLB.), a cosmopolite, living sometimes even in human dwellings under flower-pots, occurring also in Podhale and the Alps (1700 m alt.).

Also some other species of *Collembola*.

But the most astonishing and interesting is the fact of the lack in the Tatra National Park of the species of the family *Machilidae*. Of this group of *Apterygota* occur in Poland some species, namely besides the halophil *Petrobius brevistilis*

(CARP.), also *Ditta hybernica* (CARP.), *Trigoniophthalmus alternatus* (SILV.), *Lepismachilis feminata* STACH, *Lepismachilis notata* STACH and *Machilis hessei* STACH.

The fundamental part of the Collembolan fauna of the Tatra Polish National Park is constituted of 94 species living also in lowland of Poland and many localities of Europe. It is 70,15% of the whole fauna of this group of insects known till now from the territory of the Park.

Save:

Onychiurus denisi STACH, .
Anurida pseudogranaria STACH,
Entomobrya arborea TULLB.,
Arrhopalites caecus (TULLB.),
Sminthurinus bimaculatus (AXELS.),
Heterosminthurus linnaniemii STACH,
Dicyrtoma ornata (NIC.),
Ptenothrix leucostrigata STACH,

the same group of *Collembola* occur also in the Alps, especially in North-East Alps—after the list given by FRANZ (1954). Some of the wanting species as *Entomobrya arborea* TULLB. *Arrhopalites caecus* (TULLB.) and *Dicyrtomina ornata* (NIC.) should be probably still found in the Alps.

The remaining part of Collembolan fauna of the Tatra Park I divide into four groups:

1. The species occurring chiefly in the mountains, thus also in the Park, but here and there appearing also in hilly land of Poland and other territories;
2. The true mountainous species living in the mountains of Central Europe;
3. The boreo-montane species;
4. The endemite species of the Tatra.

In the first group I include:

Tetrodontophora bielanecksis (WAGA), occurring chiefly in mountains (Sudetes, Tatra, Gorce, Pieniny, Beskides, Gorgany, East Carpathians, Cracovian Jurassig, Świętokrzyskie-mountains, environs of Vienna, North-East Alps and Velebit), but brought down by the water in lowland, living also in highland of Poland.

Anurida hexophthalmica STACH, more abundant in the

mountains (Tatra, Beskides, Czarnohora), but known also from lowland (Myszków, distr. Zawiercie).

Neanura parva STACH, living in Tatra, Cracovian Jurassig, North-East Alps, also in lowland of Poland (Czarny Dunajec, Kochanów near Kraków, Orłowiny ad Łagów) and Hungary.

Thaumanura carolii (STACH), occurring generally in mountains, but only in median altitudes of the Carpathians (Tatry, Gorce, Beskides, Pieniny, Czarnohora) also Rila, Borsöny Mts, Velebit, North-East Alps and hilly-land of southern Poland, Slovakia, Hungary.

Lathriopyga conjuncta STACH, living in the mountains mostly in median altitudes (the Carpathians, Alps, Velebit, Rila), but also widely distributed in low-land of Europe.

Xenylla schillei BÖRN., known from mountains (Tatra, Beskides, East Carpathians, North-East Alps) also from lowland of Slovakia.

Pseudachorutes corticicolus (SCHÄFF.), known from the Carpathians (Tatra, Beskides, Czarnohora) and the Alps, but also from lowland of Poland, Germany, France, Great Britain, Scandinavia.

Folsomia multiseta STACH, a mountainous species going up to the highest altitudes in mountains (the Carpathians, Caucasus), but appearing sometimes in lowland in nearness of mountains. In North-East Alps as form *Folsomia multiseta dives* STACH.

Hydroisotoma schäfferi (KRAUSB.), a cold-loving animal, known from the Tatra, Czarnohora, Alps, Caucasus, also in low-land of Europe and North America.

Isotoma hiemalis SCHÖTT, a true winter animal, ascending in summer high in mountains (Tatra, Gorce, Alps) appearing in lowland of North- and Central Europe in winter time on the snow.

Orchesella bifasciata NIC., known generally from mountains Europe (the Carpathians, Harz, Alps, Crimea, Caucasus), but also not rare in hilly-land of Central Europe.

These 11 species make 8,21% of the whole fauna of the *Colembola* of the Park. Only one of them viz. *Anurida hexophthalmica* STACH is till now not known from the Alps.

In the second group of the mountainous *Collembola* of the Tatra Park I include such species which in Poland and in other countries occur in mountains only. Some of these species are known till now only from two neighbouring chains of mountains, from the Sudetes and Tatra, or the Tatra and East Carpathians (Czarnohora), or also Tatra and the Alps.

Micranurida hasai KSEN., a species living in the mediocre altitudes of the mountains (Tatra, East Carpathians, Alps).

Micranurida anophthalma STACH, known till now from the Carpathians only (Tatra, Czarnohora), perhaps an endemite species of the Carpathian-chain of mountains.

Friesea albida STACH, a typical mountainous species occurring in higher altitudes of Tatra (1650 m), Czarnohora 1350—1700 m) and Alps (1900—2600 m).

Hypogastrura crassaegranulata (STACH), an element of the fauna of high mountains (Tatra 1200—2306 m, Slovakian mountains, Caucasus 3600 m), living in a little modified forms in a cave in Slovakia and in one in Bavaria.

Hypogastrura monticola STACH, a winter animal living only in mountains (Tatra 1400—2100 m, Alps).

Folsomia inoculata STACH, living generally in the forests of the mountains (Tatra, Czarnohora, Caucasus).

Folsomia montigena STACH, known at present only from Tatra, North-East Alps and mountains of Crimea (Alushta).

Tetracanthella brevifurca STACH, till now known from Tatra (1500—1700 m), more abundantly appearing in the Sudetes (1250—1425 m).

Tetracanthella carpatica STACH, a species found at present in the long Carpathian-chain of mountains, in their higher ridges, namely in the Tatra and far away from these on the opposite end in the Transsilvanian Alps (Retyezat mountains); perhaps an endemite species of the Carpathians.

Subisotoma variabilis GIS., a species known at present from the Tatra and Swiss Alps only.

Proisotoma recta STACH, living in the Tatra in 900—2306 m altitudes, in the Central Alps found in one locality.

Pseudisotoma monochaeta (KOS), a species occurring in higher altitudes of the mountains of Central and Southern Europe, noted from Tatra (1100—2200 m), Czarnohora (1450—

1800 m), Bulgarian mountains and East Julic Alps (2350—2580 m).

Isotoma pseudomaritima STACH, an animal living only in the mountains generally in the moss, in Tatra from the foot of these mountains up to the highest summits, further in Beskides, Czarnohora and Alps.

Isotomurus palliceps (UZEL), occurs only in higher mountains of Central Europe, above forest-line going as high as the summits of the mountains. It is registered from the Sudetes, Carpathians (Tatra, Czarnohora), the Swiss and North-East Alps, perhaps also from the East Julic Alps.

Orchesella alticola UZEL, a species living in higher chains of mountains in Europe (Sudetes, Tatra, Alps, East Carpathians).

Orchesella luteoviridis STACH, occurring generally in mountains at higher altitudes (Tatry, Czarnohora, Alps).

This group of species makes 11,94% of the whole fauna of the *Collembola* known from the Tatra Park. Of these 16 species, considered as true inhabitants of the mountains, 4, namely *Micranurida anophthalma* STACH, *Tetracanthella brevifurca* STACH, *Tetracanthella carpatica* STACH and *Pseudisotoma monochaeta* (KOS) are not found at present in the Alps.

As boreo-montane species are considered:

Morulina verrucosa (BÖRN.), a species inhabiting the long Carpathian-range of mountains from Roumania up to the eastern Sudetes and, here and there, in some neighbouring parts of hilly-land. Indeed it does not occur in northern and other European countries, is, however, very related to *Morulina gigantea* (TULLB.) widely distributed in the area from arctic Ural over Siberia up to Alaska.

Xenyllodes armatus AXELS., occurring in the Sudetes, Tatra, Austrian- and Swiss-Alps, Finistère (France) and the Scandinavia and Ireland.

Hypogastrura aequepilosa STACH, living generally in mountainous forests (Beskides, Tatra, Czarnohora, Cracovian Jurassic, vicinity of Świętokrzyskie-mountains in Poland and the Alps), known also from Spitsbergen.

Tetracanthella wahlgreni AXELS., widely distributed circum-polarly (Scandinavia, Spitsbergen, Bear-island, East-and West

Greenland, North Canada) also in mountains of Europe (Sudetes, Tatra, Beskides, Pyrenees), but wanting in the Alps.

Pseudanurophorus binoculatus KSEN., found till now in Central Europe only in mountains (Sudetes, Tatra, Czarnohora, Pop Ivan, Swiss and North-East Alps) and northern part of Europe in Swedish Lapland.

Agrenia bidenticulata (TULLB.), very widely distributed circumpolarly (Lapland, Kanin, Spitsbergen, Bear-isl., King Carl's-isl., Franz Josef's-isl., White-isl., Ob-river, Talmyr, Tscheljusckin, Hopen-isl., West Greenland) and in northern countries of Europe. As inhabitant of mountains it is registered from Harz, Vogeses, Sudetes, Tatra, Alps, Julic Alps, Sierra Morena in Spain, also from Rocky Mts in North America and mountains of Japan.

Vertagopus westerlundi (REUT.), living in Scandinavia and in Central Europe only in some high mountains as Alps, Eastern Sudetes and higher chains of Carpathians (Tatra, Gorce, Czarnohora).

Isotoma fennica (REUT.) known from all countries of Scandinavia and the mountains of Central Europe (Tatra, Cracovian Jurassic, Czarnohora, and Alps).

Tomocerus minutus (TULLB.), occurring in northern countries (Scandinavia, Kanin, Novaja Semlja, Siberia), and in some mountains of Central Europe (Sudetes, Tatra, Pieniny and Swiss Alps).

These nine species found in the fauna of the Tatra, and barring *Morulina verrucosa* BÖRN. and *Tetracanthella wahlgreni* AXELS. known also from the Alps make 6,72% of the whole fauna of the *Collembola* of the Park.

The smallest is the number of the *Collembola* which in the Tatra represent the endemite species. They are:

Friesea octooculata STACH,

Hypogastrura tatraica (STACH),

Hypogastrura brevipodialis (STACH),

Megalothorax aquaticus STACH,

what makes only 2,98% of the Collembolan fauna of the Tatra Polish National Park.

Summing up, the fauna of the *Collembola* of the Polish Tatra National Park with its 134 species it must be defined

as composed in its greater part (70%) of the species occurring also in the lowland of Poland, but differing from that by the presence, in 30%, of species characteristic for the mountains of Europe.

THE ZOOGEOGRAPHICAL ANALYSIS OF THE APTERYGOTAN FAUNA OF THE POLISH TATRA NATIONAL PARK

The very insufficient knowledge of the Apterygotan fauna of some countries of Europe, especially of the eastern ones, and almost total ignorance of this fauna from the very extensive area of the Central Asiatic continent do not permit to achieve the more exact zoogeographical analysis of the fauna of this group of insects in the Polish Tatra National Park.

At most the Apterygotan fauna of the Park may be compared with that northwards from the Tatra lying territory of Scandinavia, in which this fauna can be considered as relatively well examined.

From the *Collembola*, a better known group of *Apterygota*, are registered till now in Poland 232 species, without counting the varieties of these species. The Collembolan fauna of Finland is composed of about 170 species, that of the Sweden approximately of the same number, that of Norway of about 120, and of the Lapland about of 80.

On account of species represented in the fauna of these Scandinavian countries this fauna does not differ very much from that of the lowland of Central Europe and Poland, it seems to become only gradually poorer with the advance to the North.

For the nearer comparison of the Collembolan fauna of the Polish Tatra National Park with that of the Scandinavia I have chosen the fauna known from the mountains lying in the Swedish Lapland northwards from polar-circle. This fauna was studied by SCHÖTT (1893), ÅGREN (1904), and WAHLGREN which in 1919 has given the list of 65 species of *Collembola* known at this time from Sarek Mts and some other Laplandian mountains (Lycksele, Lule, Torne).

The further studies over the *Collembolan* fauna of the

territory of Swedish Lapland has undertaken AGRELL, and the results of his exact studies he has published in 1941. The terrain of these studies was chiefly the Abisko National Park, partly also the Sarek National Park and the chain of Kebnekaise mountains.

As we are interested principally with the knowledge of the Apterygotan fauna of the mountains, we compare here the better known fauna of the mountains of Sarek- and Abisko National Parks with that of the Polish Tatra National Park.

The Sarek Mts occupy the area of about 2000 km² and are abundant in glaciers (about 100) and some summits reaching up to 2000 m altitude. The Sarek Park lies at 67° 10' northern latitude. The upper limit of the forest in the mountains of the Park runs about at 800 m alt.

Abisko lies higher northwards on the southern shore of Torneträsk-lake (68° 21'), surrounded from South, East and West by the mountains of 1100—1804 m alt. Between the summits Karsonjuonje (1182 m) and Kierona (ab. 1700 m) lies a valley with a small lake Abiskojaure which, with a part of the mount Njulja (1199 m) and Tsasinnjaskatjakko (1804 m), compose the proper Abisko National Park. The upper limit of the forest lies here at 600 m altitude.

The Collembolan fauna of the Sarek- and Abisko Parks, registered at present, contains 73 species of which 55 are common for both these parks; 3 are known from the Sarek Park only and 15 from the Abisko.

By comparison of this fauna with that of the Polish Tatra National Park we find that 50 species are common in these three groups of mountains; 9 other species are wanting in the Tatra Park, but not in the lowland of Poland; 14 species, however, are unknown from Poland and Tatra.

The are:

Hypogastrura sahlbergi (REUT.),

Hypogastrura lapponica (AXELS.),

Hypogastrura longispina (TULLB.),

Xenylla mucronata AXELS.,

Anurida granaria (NIC.),

Anurida alpina AGRELL,

Folsomia brevicauda AGRELL,

Folsomia fimetaroides (AXELS.),
Folsomia microchaeta AGRELL,
Proisotoma borealis AXELS.,
Proisotoma abiskoensis AGRELL,
Isotoma propinqua AXELS.,
Pseudosinella octopunctata (BÖRN.),
Sminthurides signatus (KRAUSB.).

To the species enumerated in this list should be remarked:

Some of these species such as *Hypogastrura lapponica* (AXELS.), *Anurida alpina* AGRELL, *Folsomia brevicauda* AGRELL, *Folsomia microchaeta* AGRELL, *Proisotoma abiskoensis* AGRELL and *Proisotoma borealis* (AXELS.), known till now almost from the Lapland only, seem to be endemite forms of the high North.

A part of the species belongs, judging from the data of their distribution, to the cosmopolites or more probably are incorrectly determined in some cases. So:

Ceratophysella longispina (TULLB.), described by Tullberg (1876) from Novaja Semlja and mentioned afterwards from many arctic localities (Spitsbergen, Franz Josef-land, Scandinavia, Kanin, Siberia, Iceland, East Greenland) is noted also from England, Ireland, France, Swiss Alps, South Africa, North America, Argentine, New Zealand and the Antarctic.

Xenylla mucronata AXELS. described from Finland, is afterwards noted from the Russian SSR (Moscow) NE-Alps, Costa Rica, Australia.

Pseudosinella octopunctata (BÖRN.) is noted from Finland, Norway, Germany, Slovakia, Hungary, Switzerland, France, Albania, Italy, Libia and Costa Rica.

Anurida granaria (NIC.) mentioned from Scandinavia, Spitsbergen, Franz Josef-land, Jan Mayen-isl., Siberia, Greenland, but also from Belgium, France, Tyrol, Switzerland, Slovakia, Spain.

Not entirely certain are the determinations of:

Isotoma propinqua AXELS. which is noted from Scandinavia and Spain;

Sminthurides signatus (KRAUSB.) registered from Finland, Germany and the U. S. America.

Two latter species *Hypogastrura sahlbergi* (REUT.) and

Folsomia fimetarioides (AXELS.) belong — if correctly identified — to the group of boreo-alpine animals, perhaps in the true sense of this term, as both these species are noted from the high North and the Alps, but not from the Tatra Mts.

Hypogastrura sahlbergi (REUT.), living mostly in very moist moss is noted from Lapland, Finland, Reval, Germany (Wetzlar) and in the Swiss Alps ascending up to 2650—3298 m altitude (HANDSCHIN).

Folsomia fimetarioides (AXELS.) was found in Finland, Reval and in Switzerland (Lausanne).

Still greater number of the *Collembola* living in the Polish Tatra National Park are wanting in the fauna of the mountains of Sarek- and Abisko-Park. Of this number 48 live in the Poland also in lowland, following 11 (enumerated on the p. 63) occur mostly in the Tatra, but also here and there in lowland, further 16 (p. 64) are the proper species of the mountains, 5 forms from the group considered here as boreo-montane element and 4 endemites of the Tatra.

Summing up:

Species common for the Tatra and mountains of Sarek- Abisko Park are	50
Species living in the Tatra, but wanting in mountains of Sarek-Abisko Park are.	84
	<hr/> 134

Of the 84 species wanting in these Laplandian mountains are:

endemite forms	4
boreo-alpine forms	5
montane forms	16
chiefly montane forms	11
chiefly lowlands forms	48
	<hr/> 84

In per cent the Polish Tatra National Park has with the mountains of Sarek-Abisko Park 37,36% of the common species of *Collembola*, and 62,64% such forms which are wanting in these Laplandian Mts.

The Collembolan fauna of the Laplandian mountains is then in comparison with that of the Tatra distinctly poor.

If we reach by the examination of the northern fauna of *Collembola* still further northwards to the territory of the Spitsbergen-islands — the fauna of which is relatively sufficiently known — we find among 29 species noted from these islands 20 which occur in Poland (16 occurring in the Tatra), and 27 in the fauna of Scandinavia, then only 2 species *Onychiurus arcticus* (TULLB.) and *Hypogastrura tullbergi* (SCHÄFF.) are up till to-day not remarked from Scandinavia.

The number of the species of *Collembola* which inhabit the high North of Europe and do not live in Poland is then relatively small, restricted about to 25 species.

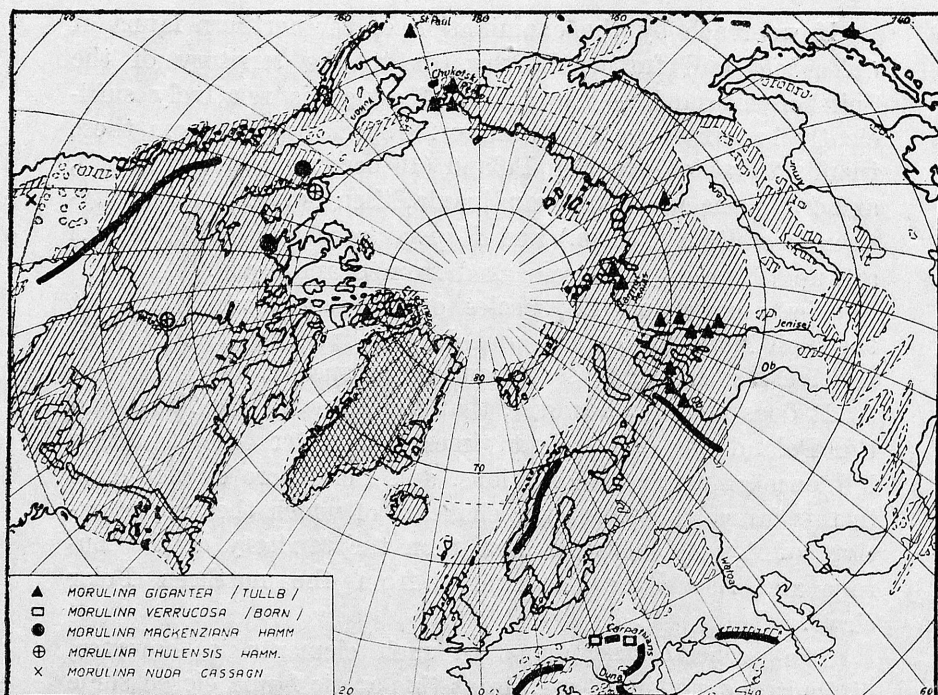
It does not say, however, that the fauna of the Tatra and the Poland was in ancient times not under the faunistic influence of northern conditions, and that there do not exist in this fauna at present the elements of which the proper native country is the arctic area, then the territory of the Europe and Asia lying northwards from the northern Polar circle.

The accurate assignment of such elements is, however, difficult and not in all certain as this arctic fauna closed some a little different types, namely the circumpolar, boreal and boreo-montane ones. We have, however, up to-day still very insufficient knowledge of the Apterygotan fauna of the arctic Asia and America. E. g. from the whole northern Siberia are known at present only about 45 species of *Apterygota*.

The difficulty in the assigning of the proper elements of arctic fauna lies also in the fact, that some of the species very widely distributed to-day in the Holarctic belong to the group of the cosmopolitans which might be introduced by the man just now in the high North which in reality is not their native country.

Also some of the proper holarctic *Apterygota* transported in other localities appear after longer time and over the influence of various life-conditions some changes in their primary characteristics, and in that case to resolve a doubt, whether such a little morphologically modified forms are only the geographical varieties or still various good species. It depends upon the subjective consideration of the examiner.

The more certain primary arctic elements in the Aptery-



Distribution of species of the genus *Morulina* (BÖRNER).

gotan fauna of the Tatra may be sought only among the species of the boreo-montane group.

To such very interesting species belongs before all *Morulina verrucosa* BÖRN., a species which live only in the whole chain of the Carpathian mountains. Of the genus *Morulina* BÖRN. was known up to not long ago only one another species *Morulina gigantea* (TULLB.). This species inhabits a very wide area from the arctic Ural over the northern territories of Ob-Yenisey-Lena-rivers up to the seashore of Alaska (St. Paul-isl., Bering-sea). In the last time H. HAMMER (1953) has found in environs of Mackenzie-delta and some other localities of northern Canada two further species, *Morulina mackenziana* HAMM. and *Morulina thulensis* HAMM., and CASSAGNAU (1955) has described from Oregon *Morulina nuda* CASSAGN. The species of the genus *Morulina* BÖRN. are then inhabitants of the very wide circumpolar area. This wide arctic inhabitation-area of the genus *Morulina* BÖRN. is interrupted only

in the area of the whole northern Europe and arctic islands up to Greenland inclusively. Instead, along the Carpathian chain of mountains from Roumania up to the Sudetes, extends a territory inhabited by *Morulina verrucosa* (BÖRN.).

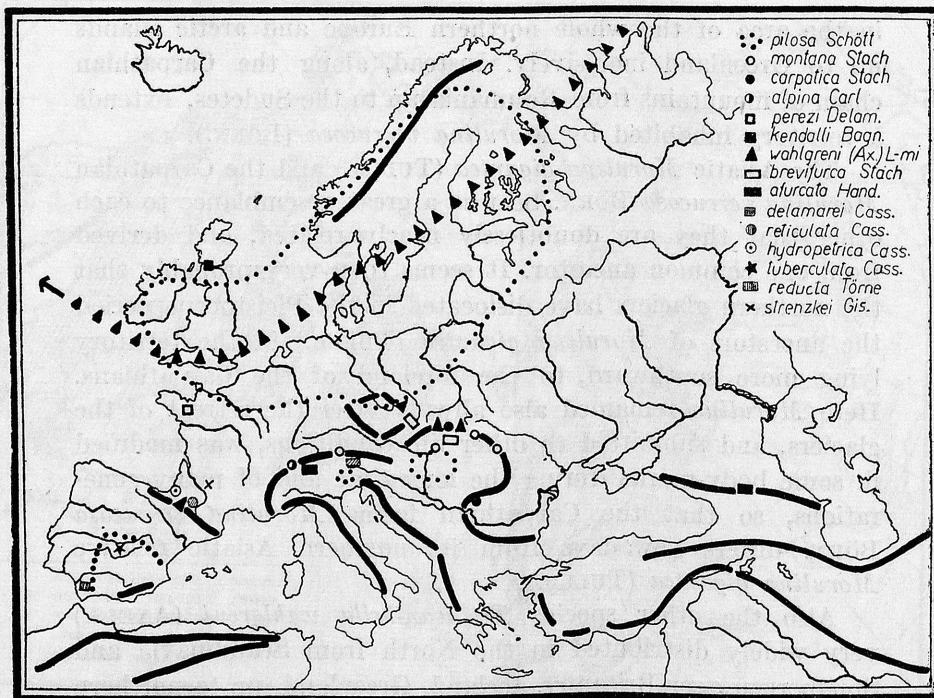
The Asiatic *Morulina gigantea* (TULLB.) and the Carpathian *Morulina verrucosa* BÖRN. bear so a great resemblance to each other that they are doubtlessly nearly related, and derived from one common ancestor. It seems then very probably that the northern glaciers have dislocated in the Pleistocene period the ancestors of *Morulina gigantea* (TULLB.) in the territory lying more southward, to the foreland of the Carpathians. Here *Morulina* remained also already after the retreat of the glaciers, and submitted to other life conditions, was modified in some body-marks during the long time and of many generations, so that the Carpathian forms *Morulina verrucosa* BÖRN. differs nowadays from its northern Asiatic relative *Morulina gigantea* (TULLB.).

Also the other species *Tetracanthella wahlgreni* (AXELS.) very widely distributed in the North from Scandinavia and Spitsbergen over Brittany, Iceland, Greenland, up to northern Canada appears in central Europe restricted in its distribution to the mountains, Sudetes, West Beskid and the Tatra. It had also not advanced more southward, and is not found in the Alps. It must be considered in the Tatra similarly as *Morulina verrucosa* BÖRN., as an element of the arctic fauna and a relic from the glacial phase of the Pleistocene.

Not known from the Alps is also *Tomocerus minutus* TULL. a circumpolarly widely distributed species, remarked from Scandinavia, Kanin, arctic Ural, Novaja Semlja, Siberia, northern Canada, and in European mountains occurring in the Sudetes, Tatra, Pieniny, Czarnohora and noted from Mount Morvan, France.

There are much more species belonging very probably to the primary arctic fauna which have invaded more widely in to southern regions of Europe and were not restricted to the Tatra Mts only. Such are for example:

Agrenia bidenticulata (TULLB.) widely distributed circumpolarly (Lapland, Kanin, Spitsbergen, Bear-isl., King Carl's-land, Franz Josef's-land, White Island, Ob-river, Talmyr,



Distribution of the species of the genus *Tetracanthella* SCHÖTT.

Tcheljuschkin, Hopen-isl., and West Greenland). Southward from the polar-circle the territories of its inhabitation reach indeed widely South in western and central Europe, down to Spain and Yugoslavia, but these habitat-territories are still strongly interrupted and restricted only to the mountains, mostly only to high mountains, namely these of Scandinavia, Britanny, Harz, Vogeses, Sudetes, Tatra, Alps, Julie Alps and Sierra Morena in Spain. In North America its distribution is still more restricted, namely only to the Rocky Mts and running along this high range of mountains from British Columbia southwards to the Wyoming and Colorado. From the eastern part of the Asia is noted *Agrenia bidenticulata* (TULL.B.) from Japan (Japanese North-Alps).

To the primary arctic fauna belong probably also some species which invade not as widely to the North as the preceding ones or are till now still not found in all arctic localities. For example:

Hypogastrura aequipilosa STACH, caught in Spitsbergen, and in mountains of Central Europe widely distributed (Tatra, Beskides, Cracovian Jurassic, Świętokrzyskie-mountains, Czarnohora, Styrian Alps).

Micranurida hasai KSEN. noted from Iceland, northern Canada, Greenland, from the Tatra, Alps, East Carpathians.

Isotoma fennica (REUT.) occurring in Scandinavia and in Central Europe in mountains only (Tatra, Czarnohora, Cracovian Jurassic, NE-Alps).

Vertagopus westerlundii (REUT.) living in Scandinavia and in Central Europe only in some high mountains (Tatra, Gorce, Sudetes, Czarnohora, Alps).

Xenyllodes armatus AXELS. remarked from Spitsbergen, Finland, Iceland, northern Canada, Alaska, occurs in Central Europe in mountains (Sudetes, Tatra, Austrian-and Swiss-Alps, Lidnice CSR, Finistère, France).

A species which was perhaps primarily a montane animal of Central Europe and just later, probably in Pleistocene time had gone to the North is *Pseudanurophorus binoculatus* KSEN., known from Central Europe only from mountains, namely the Swiss-and Styrian Alps, also from Sudetes, Tatra, East Carpathians and in North from the mountains of Swedish Lapland and Iceland. While the specimens of *Pseudanurophorus quadrioculatus* TÖRNE (1955) from Tyrol have still 2 eyes on each side of the head, the *Pseudanurophorus binoculatus* KSEN. from the Tatra has one only eye on each side of the head, the Laplandian *Pseudanurophorus binoculatus* var. *lapponicus* AGRELL has the body-pigment in the eyes only, and the specimens of *Pseudanurophorus binoculatus* var. *inoculatus* BÖDV. (1957) from Iceland are totally devoid of the pigment and blind. It seems to be an interesting case of the gradually disappearance of the pigment and the eyes in a species.

It is unquestionable that some elements of the Mediterranean fauna have entered into primary fauna of the Alps and remained there up till to-day in their former or more or less greatly modified forms. Some of these elements have also doubtlessly advanced still more northwards as well into the territories of lowland as of the mountains. Over the Moravian hill-land and the Hungarian and Slovakian mountains they

have come also to the Tatra. It is, however, very difficult to show at present which of them should be considered as belonging to the elements of the primary southern fauna.

To such primary alpine Submediterranean forms belong perhaps in the Tatra Park species known at present only from the Alps and Tatra, e. g. *Hypogastrura monticola* STACH, *Friesea albida* STACH, *Subisotoma variabilis* GISIN and others.

Uncertain and at any rate very weak is the influence of the Pontian fauna on the Apterygotan fauna of the Polish Tatra National Park. The elements of the Pontian fauna especially of the Ponto-alpine type occur in Central and East Europe principally in lowland on xerothermic terrains with the steppe-flora, but also in mountains.

I refer to this type of elements in Apterygotan fauna of the Tatra Park such species which are known at present also from the East Carpathian mountains. Some of these species occur also in the North-East Alps, in which mountains the fauna was subjected to greater influence of the xerophilous fauna from the neighbouring Hungary.

So of the 23 species known at present only from the Czarnohora-ridge of the East Carpathians 7 species may be enumerated which belong probably to the elements of the Ponto-alpine type and live also in the Tatra and Alps.

Onychiurus granulatus STACH, occurring also in Hungarian Mts (Bakony) and Bulgarian Mts,

Thaumanura carolii (STACH), living also in mountains of Roumania, Bulgaria, Serbia and Julic Alps,

Lathriopyga conjuncta (STACH), known from mountains of Slovakia, Hungary, Bulgaria, Julic Alps,

Folsomia inoculata STACH, occurring also in Caucasus,

Folsomia multiseta STACH, noted from Caucasus,

Xenylla schillei BÖRN. known also from Beskides.

Common to fauna of Czarnohora and Alps, but not occurring in the Tatra are 5 following Pontian elements:

Onychiurus bureschi HANDSCH., known also from the Bulgarian Mts,

Bilobella aurantiaca (CAR.), living also in Italy,

Friesea denisi KSEN.,

Folsomia sensibilis KSEN.,

Isotomurus alticolus (CARL).

Only one species *Pseudisotoma monochatea* (KOS) of the probably Pontian fauna living in Czarnohora Mts is known also in the Polish Tatra National Park.

SOME REMARKS ON THE HISTORY OF THE APTERYGOTAN FAUNA OF THE POLISH TATRA NATIONAL PARK

The fauna of the *Apterygota* has occupied doubtlessly very early the Tatra and its character during the Middle and Upper Pliocene period was in its composition of species perhaps somewhat similar to the type of the fauna inhabiting the terrains of the present south-eastern Asia. The woods of the similar type have covered then the slopes of the Tatra. But also at that time besides the fauna characteristic for the woods and that associated by the necessities of their life with the wet and fertile humus-soil, has existed certainly a group of other species living at the greater altitudes of the Tatra, the forms of the montane type.

If of this ancient fauna of *Apterygota* are remained up till to-day the generations of some species we do have no proof. It may at most suppose that one or the other of the representatives of this ancient fauna of the Tatra lives to-day in these mountains. Such a species is perhaps *Tetrodontophora bielanensis* (WAGA). It is a monotypical species of the genus *Tetrodontophora* REUT., having only a single relative in *Homaloproctus sauteri* BÖRN., also a monotypical species of its genus. By its in Europe strongly restricted small habitation-area, namely to the mountains of Eastern Europe (Sudetes, Carpathians, Velebit), and also by some relatively primitive body features *Tetrodontophora bielanensis* (WAGA) seems to belong to the elements of the old fauna. To such species may be referred perhaps also *Thaumanura carolii* (STACH), a monotypical species of the genus *Thaumanura* BÖRN., living in the mountains of Eastern Europe.

To the elements of the ancient fauna of the Tatra belong perhaps also the species which live at present also in the high mountains of the southern Asia far from the human settle-

ments as e. g. *Sminthurides aquaticus* (BOURL.), noted by DENIS (1936) from Kashmir (Kyam, 4763 m alt.).

A great devastation in this primary fauna of the warm Pliocene climate and many changes in its composition was done doubtlessly by the Pleistocene glaciations.

At that time various were the causes of the change of this fauna in the Tatra. The principal one was the descend of the woods from the slopes of the Tatra which in glacial phases were covered by high layers of the snow, and also the driving out of the woods by the glaciers from the valleys and rock-kettles of these mountains. The species of *Apterygota* depended by the manner of their life on the trees, before all the corticicole species living under the loose bark of various old mouldering tree-trunks were forced to follow the trees also in the lowland.

Many of other differently feeding species had not to go very far from the foot of the Tatra as we take into consideration that many species of the *Apterygota*, especially belonging to the moss-fauna live also to-day not much distant from the glaciers, e. g. in Laplandian mountains, Greenland or Spitsbergen, and appear there even in a great abundance of the specimens.

Another cause of the change of the old fauna of the Tatra, namely of its primary composition, was the invasion of the northern glaciers, which in some phases of the glaciation have reached widely in the territory of Poland, coming near almost at the foot of the Beskides and the Tatra Mts. Between these northern glaciers and those going out from the valleys of the Tatra remained relatively very small and narrow ice-free area, on which must have lived the fauna driven away from the Tatra, together with that of the arctic and northern type retreating before the northern glaciers pushing forwards. It has given the ground for the mixing and exchange of some elements of both these faunae. On the place of some southern forms, which have not lived through the cold times unadvantageous for their life, have entered the fauna of Tatra some new species preferring the cold climate of the North.

Not without significance for the composition of the *Aptery-*

gotan fauna of the Tatra were also the wide overflows of the terrain at the foot of the mountains as well during the glaciations as well as also after the melting of the glaciers. The extensive peaty swamps which have remained during long time after the retreat of the overflows were an obstacle for some species in their succeeding return in the Tatra.

There were 3—4 periods of the glaciation in the Tatra according to the opinion of the glaciologists, separated one from another by the interglacial phases persisting many thousand years each.

At the end of each glaciation the ice-free area lying between the retreating northern ice-masses and the melting glaciers of the Tatra began gradually to increase. This small area neighbouring the glaciers was at first grown only with the arctic or subarctic vegetation and inhabited by the fauna of such a climate. But this territory free from ice became more or more wide, the climate warmer, and on the place of the primary vegetation and fauna characteristic for the tundra began to return the forests and the exuberant vegetation, and together with them also the survived elements of the fauna of warmer climate. Under the influence of the oncoming higher temperature and aridity, many elements of the northern fauna have perished, and only such animals and their following generations were survived, which have returned to the high North, to their primary and proper territories of habitation, and also those which have found shelter in the higher altitudes of the Tatra. This way had arise in the fauna of the Tatra a group of boreo-montane species which elements live at present in these mountains and in lowland of the North.

It is not known, however, which elements of the Pliocene fauna of the *Apterygota* have survived the glaciation and which returned to the Tatra. We may only suppose with great probability that the number of these elements was already smaller than that before the glaciation.

We have also no knowledge if during the following interglaciations have returned to the Tatra constantly the same elements of the fauna which have inhabited these mountains during the first interglacial time. Also if the boreo-montane

group of *Apterygota* were introduced into Tatra during the first interglacial or during one of the following ones and in which number of species.

Many details referring to the history of the Apterygotan fauna of the Tatra will remain never cleared up. We may at most try to explain only some details of this history.

The lack in the present fauna of the *Apterygota* of the Polish Tatra National Park of any species of the *Machilidae* and *Lepismatidae* is striking.

In the Eocene amber are preserved many species of the *Machilidae*. The remains of the representatives of these *Apterygota* from the following geological periods are wanting. At present to the family *Machilidae* belong many species which are widely distributed over all continents. Many of them live also in Europe, especially in Mediterranean faunistic area, many, however, also in the Alps, reaching up to the highest summits of the mountains. In the Polish Tatra they are entirely wanting although in the neighbouring mountains Gorce and Pieniny there occurs the species *Lepismachilis notata* STACH, common also on the terrain not very distant (about 17 km) from the foot of the Tatra.

Also some species of *Collembola* which live in their near vicinity and occur in the Alps and other mountains of the Poland and Europe are not found in the Tatra Park either. Such are for example the species of the genus *Odontella* SCHÄFF., *Choreutinula* PACLT, *Subisotoma* STACH, *Ballistura* BÖRN., *Podura* L., *Cyphoderus* NIC., *Sinella* BROOK, *Stenacidia* BÖRN.

It is very probable that these elements of *Apterygota*, many of which are characteristic for the fauna of the mountains were driven away from the Tatra by the last glaciation of these mountains, and are at present on the way to return to them.

Various must have been and are at present the causes of that late return of some elements of the Apterygotan fauna of the Tatra to their proper territory of inhabitation.

Of the more important ones was probably the lack in the neighbourhood of the Tatra, especially near to Polish Tatra National Park, of any reservation in which the fauna driven away by the glaciers from these mountains could have survived the disadvantageous glaciation-times.

The devastation of the fauna was probably greater in the Tatra than that in the Alps, if we take into consideration that the Tatra Mts are in comparison with the Alps a very small territory, and their fauna might be more easily devastated than in the extensive Alps, in which also during the glaciations were the nunataces on which many elements of the fauna might survive, and immediately the Alps have also exist for them advantageous reservances.

The last northern ice-masses were more distant from the Alps than from the Tatra, and their influence on the life-conditions of the fauna of the Tatra was still worse than on the fauna of the Alps, by which reason some of the boreo-montane *Collembola* did not reach up to Alps (e. g. *Tetracanthella wahlgreni* AXELS., *Morulina verrucosa* BÖRN.), the climate was in the Tatra not so warm as in the Alps, and the terrain at the foot of the Tatra during long time more strongly irrigated.

This irrigation at the foot of the Tatra is still at present too moist to make it passable for some species.

The new-comers in the Polish Tatra National Park are the species living chiefly in the human dwellings under the flower-pots, as *Anurida pseudogranaria* STACH, *Folsomia candida* WILL., *Isotoma bipunctata* AXELS. They were introduced by the man immediately up to the foot of the Tatra, but are only a small part of the group of such species occurring in the human dwellings, and no one of these species is passed from the human dwellings into the free nature of the Tatra.

To sum up, the Apterygotan fauna of the Polish Tatra National Park should be considered as one still at present not wholly returned after the last glaciation.

THE CAVE APTERYGOTAN FAUNA OF THE POLISH TATRA NATIONAL PARK

Some data to the knowledge of the character of Apterygotan fauna of the Tatra may be obtained by the study of the cave fauna of these mountains.

There is a great number of the caves in the Tatra, espe-

cially on the northern side of them. They are collected chiefly in environment of the Kościeliska and Chochołowska-valley, but they occur also in some other valleys of the Polish Tatra National Park as in Kondratowa, Goryczkowa, Kasprowa, Jaworzynka. The entrances into these caves lie mostly at the altitudes of 1050—1250 m above sea level, thus not higher than the level of the valleys. There are, however, in the Tatra Park some more higher lying caves as e. g. Kasprowa (about 1400 m) or Magóra (1460 m). A greater part of these caves has the form of galleries of various length, 100—1000 m.

In materials of the fauna collected in the caves of the Polish Tatra National Park are found 16 species and 2 varieties of *Collembola*, and none from the other groups of *Apterygota*. They are:

- Ceratophysella armata* (NIC.),
- Ceratophysella granulata* STACH,
- Tetrodontophora bielensis* (WAGA),
- Onychiurus sibiricus* (TULLB.),
- Onychiurus armatus* (TULLB.) s. STACH,
- Onychiurus armatus* var. *multituberculatus* STACH,
- Onychiurus granulatus* STACH,
- Onychiurus denisi* STACH,
- Onychiurus fimetarius* (auct.) s. STACH,
- Folsomia quadrioculata* (TULLB.),
- Isotoma notabilis* SCHÄFF.,
- Isotoma hiemalis* SCHÖTT,
- Isotoma fennica* (REUT.),
- Isotoma olivacea* TULLB.,
- Isotoma olivacea* var. *neglecta* (SCHÄFF.),
- Isotoma violacea* TULLB.,
- Pogonognathellus flavescens* (TULLB.),
- Arrhopalites pygmaeus* (WANKEL) s. STACH.

Save *Arrhopalites pygmaeus* (WANK.) all species here listed belong to the group of the animals which live generally out of caves, in plant-detritus, wood-litter and moss as well in the Tatra and other mountains as in lowland. They are introduced into caves of the Tatra very probably by the water from the surface, as *Isotoma hiemalis* SCHÖTT, *Isotoma violacea* TULLB., *Isotoma fennica* (REUT.), or seeking shelter in them. Almost

all occur in the caves of the Tatra Park as the troglaxene or troglophile temporary inhabitants.

Two only of the enumerated species are more interesting, *Arrhopalites pygmaeus* (WANK.) and *Onychiurus armatus* var. *multituberculatus* STACH.

Arrhopalites BÖRN. is a cosmopolitan genus, distributed in various species widely over all continents. Of the four species of this genus living in Poland, three are known also from the Tatra Park, namely *Arrhopalites pygmaeus* (WANK.) occurring in Poland only in the caves, *Arrhopalites caecus* (TULLB.) frequent in human dwellings under flower-pots, but appearing also in caves and sometimes even in free nature, and *Arrhopalites principalis* STACH living only in free nature as well in high North as in mountains of Europe.

The first of these three species *Arrhopalites pygmaeus* (WANK.) lives in Poland and some other countries of Europe only in the caves, in Switzerland and France appears, however, also out of the caves in free nature. It may be considered indeed in the fauna of Poland as a troglobionte animal, but because of its living in some other localities also in free nature it must be referred into the group of the troglophile animals.

Since the greatest part of the species of the genus *Arrhopalites* BÖRN. live in the caves only as true troglobionte animals, and show the marks of the good adaptation to such form of life, this genus must be considered with very probability as belonging to the elements of the Tertiary fauna.

Is this supposition right then the species *Arrhopalites pygmaeus* (WANK.) should be considered in the Tatra as an element of the ancient fauna which in the caves of these mountains has survived all the glacial phases. But as the specimens caught in the Tatra do not differ in any detail of their body from those occurring in the other caves on Poland and Europe, it is more probable that they have invaded into caves of the Tatra lately and were in these caves still not subjected to the further specific modifications.

The other form, *Onychiurus armatus* var. *multituberculatus* STACH, collected in the Kalacka- and Magóra-cave represent, the only one troglobionte form in the caves of Tatra Polish

National Park. The principal form of this species very common in lowland as well as in mountains of whole Europe lives generally free in nature in very different biotopes. It is, however, very often met also in various caves as a troglone animal. The variety „*multituberculatus* “ differs from the principal form by its greater length and unusual number of vesicles in postantennal organ. These differences are distinct, but not to such a grade that the specimens from the Kalacka — and Magóra-cave should be defined as belonging to a separate, good species.

The cause of the almost total want of the true troglone in the caves of the Polish Tatra National Park may be interpreted either by the supposition that the present caves of these mountains, at least those lying at not high altitudes, are young, perhaps formed during the last glacial period, or that the fauna inhabiting formerly these caves was completely destroyed by the water filling the caves during the last glaciation. In the one or other case the present fauna of the caves of Tatra Park must be considered as new, and the time too short for the arising in this cave-inhabitants of the specific modifications.

In the caves of the Alps there live many true troglone forms as well of the ordo *Collembola*, e. g. *Pseudosinella* SCHÄFF. and other genera, as of the ordo *Diplura*, e. g. *Plusiocampa* SILV.

THE APTERYGOTAN FAUNA OF THE POLISH TATRA NATIONAL PARK IN RELATION TO ITS ARRANGEMENT IN VARIOUS ALTITUDES OF THE MOUNTAINS

The fauna of the *Apterygota*, especially of the group of *Collembola* is more closely connected with the vegetation than the other insects. They indeed feed only a little on higher plants, but profit very much from living on the lower vegetation composed of algae, moss, lichens and mushrooms and also on the terrains covered with the forests, in which the very great crowd of many species of this group seek the food in the plant-detritus accumulated on the ground and in the layers of the vegetable soil. Many other species live in moul-

dering wood and seek the shelter under the loose bark of the old trunks of various trees.

As the life of the *Apterygota* is so manifoldly and strictly bound with the plants it is most rightly to compare the problem of their arrangement at various altitudes in the mountains with the regions of the vegetation distinguished in the Polish Tatra National Park.

It is accepted to divide the vegetation in the Tatra into following regions characteristic by the composition of the plants. They are the region at the foot of the mountains (700—900 m alt.), the first region of the mountains, the „low regle“ (900—1250 m alt.), the higher elevations „high regle“ (1250—1550 m alt.), that of dense brushwoods (1550—1800 m alt.), the region of Alpine plants and meadows (1800—2200 m alt.), and the subnival region, (the „turnie“), extending up to summits of the mountains, in the Polish Tatra National Park to the highest mount Rysy (2499 m alt.).

The whole fauna of the *Collembola* in the Polish Tatra National Park known at present in the number of 134 species may be divided into two groups, the fundamental part of 119 species occurring already at the foot of the mountains and decreasing further more and more in the number as the ascending to the higher altitudes, and the another part, considerably smaller of 15 species in number, which are found in higher regions only.

Of this fundamental part only 19 species do not enter into low region of the „regle“. They are before all these living in the human dwellings, as e. g. *Anurida pseudogranaria* STACH, *Folsomia candida* WILL., or occurring in the vicinity of human settlements, as e. g. *Uzelia setifera* ABS., *Tomocerus vulgaris* TULLB., or living chiefly on the bark of branches of the fruit-trees, as e. g. *Entomobrya corticalis* (NIC.), *Entomobrya arborea* TULLB. and others.

Of the remaining 100 species invading into first elevations of the Tatra 25, i. e. 36,97%, do not pass the upper limit of the region of the „low regle“ (1250 m alt.), and in the region of the „high regle“ are missing further 15 species in number, so that of the primary whole of the fauna remains only the half, 60 species, i. e. 50,42%.

In the region of the shrub-woods of *Pinus mughus* SCOP. the fauna decreased of further 26 species (28,57%), and the upper limit of this region overstep only 34 species of the primary fauna.

In the Alpine region the fauna is still further deminuted of the 18 species in number, of the primary fundamental fauna are remain there only 16 species, that is 13,44% of the whole.

The difference in the composition of the Collembolan fauna between this of the „low regle“ and that of the „high regle“ is relatively insignificant as the terrain of these regions covered for the most part with monotonous spruce-forests supplied many elements of this fauna with almost identical life-conditions.

Also by the transgression of the theoretical upper limit of the forests (1550 m alt.), accepted for the vegetation, do not appear still more distinct differences in the composition of the Collembolan fauna of the Polish Tatra National Park. More important decrease of these components come to light just at the 1650 m altitude, so on the terrain on which the shrub-woods of *Pinus mughus* SCOP. become not too dense, but interrupted here and there by the stretches grown by the grasses and low vegetation, on which many species of *Collembola* proper for the woods, do not find advantageous conditions for their life. Also the species living mostly on the mouldering wood disappear, as for example *Morulina verrucosa* BÖRN., *Neanura muscorum* (TEMPL.) and *N. parva* (STACH), *Lathriopyga conjuncta* (STACH), which do not transgress the upper limit of the region of *Pinus mughus* SCOP., also the forms occuring under loose bark of the trees and many living in needle-litter.

The rest of the species, 16 in number, which are remaining from the primary fauna of the *Collembola* occurring at the foot of the Tatra, and the 7 ones, which are increased from the higher regions, then 23 species in all, consist of various faunistic elements. They are the species distributed widely over Europe:

Onychiurus sibiricus (TULLB.),

Onychiurus armatus (TULLB.),

Ceratophysella armata (NIC.),

Ceratophysella luteospina (STACH),
Ceratophysella granulata STACH,
Folsomia quadrioculata (TULLB.),
Isotoma violacea TULLB.,
Isotoma pseudomaritima STACH,
Isotomurus palustris (MÜLLER),
Isotomurus palliceps (UZEL),
Tomocerus minor (LUBB.),
Lepidocyrtus violaceus (GEOFF.) LUB.,
Arrhopalites principalis STACH,
Sminthurinus aureus (LUBB.).

The group of montane species:

Hypogastrura crassaegranulata (STACH),
Hypogastrura montana STACH,
Proisotoma recta STACH,
Folsomia multiseta STACH,
Tetracanthella carpatica STACH,
Orchesella alticola UZEL.

The boreo-montane species:

Tetracanthella wahlgreni AXELS.

The endemite form:

Hypogastrura tatrica (STACH).

Only a little different proportion in relation of the arrangement of the *Collembola* at various altitudes in the Alps has given HANDSCHIN (1924) for the fauna of Swiss National Park in Engadin. Of this fauna composed of 115 number of species 52 species overstep the low limit of the Alpine region, of which only 36 come from the foot of the mountains up to their summits.

THE SUPERAQUATIC FAUNA OF COLLEMBOLA IN THE POLISH TATRA NATIONAL PARK

A more interesting group of the *Collembola* of the Polish Tatra National Park represent the species living in immediate nearness of various water-reservoirs. Some of these species as *Sminthurides aquaticus* (BOURL.), *Sminthurides malmgreni*

(TULLB.), *Megalothorax aquaticus* STACH, *Hydroisotoma schäfferi* (KRAUSB.) are very well adapted by the specific modifications of some parts of their body to the life on various aquatic plants and to free moving on the surface of the water, other belong to the forms preferring the terrains with the considerable abundance of water, as *Agrenia bidenticulata* (TULLB.), *Proisotoma recta* STACH, *Spinisotoma pectinata* STACH, and still other species living in very various biotopes as some of the genus *Isotoma* BOURL., *Lepidocyrtus* BOURL. and *Tomocerus* NIC. are often, but inconstantly, companions of the preceding supraquatic *Collembola*.

The species adapted to the living on the surface of the water are naturally the true elements of the fauna connected with the biotopes rich in the water. But not all above mentioned species appear in the same composition in this biotope in all localities of the Tatra Park, at it is dependent as well on type of the water-reservoir as also on its situation and the altitude.

So, e. g. on Smreczyński-lake (1226 m alt.) surrounded by the dense spruce-wood, and covered on the borders with wide and thick layers of the water-full *Sphagnum* I have found of the supraquatic species only *Sminthurides aquaticus* (BOURL.) and *Agrenia bidenticulata* (TULLB.), which replaced in the Tatra Park *Podura aquatica* L. frequent in lowland.

Still another supraquatic species appear in the small and shallow inundated terrains at the banks of the streams, e. g. in Kościeliska-valley, where the larger stones protruding from the ground of the stream over the surface of the water and covered with the moss are constantly sprinkled with the water. Here *Hydroisotoma schäfferi* (KRAUSB.) a rheobiont species accompanies *Sminthurides aquaticus* (BOURL.).

In higher altitudes, e. g. on Hala Gąsienicowa (1600—1750 m alt.) an alpine meadow, in dense cushions of very moist *Sphagnum* growing on the shores of the lakes in immediate nearness of the water, and in water-dripping moss covering the large stones protruding over the surface of the water in rapid current streams lives *Sminthurides malmgreni* (TULLB.) which replaced here *Sminthurides aquaticus* (BOURL.), and together with it abundantly *Agrenia bidenticulata* (TULLB.),

both forms of the high North. Beside them occur here also the group of the montane aquatic *Collembola*, *Hydroisotoma schäfferi* (KRAUSB.), *Proisotoma recta* STACH, *Spinisotoma pectinata* STACH, *Isotoma pseudomaritima* STACH, *Isotomurus palliceps* (UZEL), *Pseudisotoma monochaeta* (KOS) and *Isotoma fennica* (REUT.).

Also the water flowing from the very moist moss covering on several spaces the slopes of ravines and valleys and also the rock-walls of the mountains brings down many specimens of the *Collembola*. They assemble together on the surface of the water filling full the small hollows of the ground. In small altitudes appears here very abundantly the small *Megalothorax aquaticus* STACH, and some in moist moss living, but not aquatic forms, especially the species of the genus *Tomocerus* NIC. and *Lepidocyrtus* BOURL.

High in mountains in the water flowing down from the short moss covering the rock-walls occur only *Agrenia bidenticulata* (TULLB.) and from the other montane species species *Isotomurus palliceps* (UZEL) and *Isotomurus palustris* (MÜLL.).

This fauna gathering together in the immediate nearness of the water-reservoirs is very similar to that living also in the other high mountains as e. g. in the range Czarnohora in East Carpathians or in the Alps. But the *Agrenia bidenticulata* (TULLB.), *Hydroisotoma schäfferi* (KRAUSB.) and *Sminthurides* BÖRN., accompany in both these mountains *Isotomurus alticolus* (CARL), which does not live in the Tatra. *Megalothorax aquaticus* STACH, an endemic species of the Tatra, is wanting in other mountains.

With the beginning of the winter-time, when the Tatra are covered with high layers of the snow, the lakes with ice, and the small streams are frozen over, the greater part of the superaquatic fauna of the *Collembola* dies or seeks the shelter in the moss. Some representatives of this fauna remain, however, living also during this disadvantageous period, especially the cold-loving species *Agrenia bidenticulata* (TULLB.), *Hydroisotoma schäfferi* (KRAUSB.) and *Isotoma fennica* (REUT.). These species assemble at that time in lower altitudes (1000—1300 m) of the Tatra Park upon the streams not quite covered with ice or on small morass-places which never are frozen, and

appear almost constantly in company with a true winter animal *Isotoma hiemalis* SCHÖTT, besides often also with *Hypogastrura socialis* (UZEL), *Vertagopus cinerea* (NIC.), *Vertagopus westerlundii* (REUT.). More rarely appear in this company *Isotoma viridis* BOURL. or *Entomobrya nivalis* L.

Not in company with the other species, but also not mixed together appear high in mountains the true montane winter-species *Hypogastrura monticola* STACH and *Hypogastrura tatrica* (STACH). They gather densely together on the snow in winter-time, or in spring on snow-fields on small spaces in great quantities of individuals.

REFERENCES

- AGRELL, I. 1941. Zur Ökologie der Collembolen. Untersuchungen im Schwedischen Lappland. — Opuscula Entom., Supplem. III, Lund, 1—236.
- ÅGREN, H. 1904. Lappländische Collembola. — Ark. Zool. 2: 1—30.
- BÖDVARSSON, H. 1957. Apterygota. — The Zoology of Iceland, Copenhagen a. Reykjavik, 3: 1—86.
- CARL, J. 1901. Zweiter Beitrag zur Kenntnis der Collembolafauna der Schweiz. — Revue Suisse de Zool., Genève, 9: 243—278.
- CAROLI, E. 1912. Contribuzioni alla conoscenza dei Collemboli italiani. I. La tribù degli Achorutini CB. (1906). — Arch. zool. ital., 6: 349—374.
- CASSAGNAU, P. 1955. Sur un essai de classification des Neanuridae holarctiques et sur quelques espèces de ce groupe. — Revue française d'entomologie, 22: 134—163.
- DENIS, J. R. 1936. Report of Collembola. — Mem. Connecticut Acad. Sci., 10, Art. XV: 261—282.
- FRANZ, H. 1954. Die Nordost-Alpen im Spiegel ihrer Landtierwelt. Innsbruck, 1: 1—664.
- GISIN, H. 1947. Sur les insectes Aptérygotes du Parc National Suisse. Espèces et groupements euédaphiques. — Aarau, 2: 77—91.
- GISIN, H. 1952. Notes sur les Collemboles, avec démembrement des Onychiurus armatus, ambulans et fimetarius auctorum. — Mitteil. Schweiz. Entom. Gesellsch., Lausanne, 25: 1—22.
- GISIN, H. 1957. Sur la faune européenne des Collemboles I. — Revue suisse de Zoologie, Genève, 64: 475—496.
- HANDSCHIN, E. 1924. Die Collembolenfauna des Schweizerischen Nationalparks. — Denkschr. d. Schweiz. Naturf. Gesellsch., Zürich, 60: 89—174.
- HAMNER, M. 1953. Investigations on the microfauna of Northern Canada, Part II *Collembola*. — Acta Arctica, Kobenhavn, Fasc. VI: 1—108.

- SCHÄFFER, C. 1900. Die arktischen und subarktischen Collembola. — Fauna arctica, 1: 237—258.
- SCHÖTT, H. 1894. Zur Systematik und Verbreitung paläarktischer Collembola. — Svensk. Vet.-Akad. Handl., 25: 1—100.
- STACH, J. 1925 a. Über die in Polen vorkommenden Felsenspringer (*Machilidae*) und über die Bedeutung dieser Insekten zur Beurteilung einiger zoogeographischen Probleme. — Bull. Acad. Pol. Scien., Cl. d. Sc. math.-nat., Ser. B., Cracoviae, 633—650.
- STACH, J. 1925 b. Polskie przerzutki (*Machilidae*, ordo *Thysanura*), ich rozszedlenie i znaczenie dla pewnych zagadnień zoogeograficznych. — Spraw. Kom. Fizjogr. P. Akad. Um., Kraków, 60: 143—159.
- STACH, J. 1947—1957. Apterygotan Fauna of Poland, in Relation to the World-Fauna of this group of Insects: I. Isotomidae, II. Onychiuridae, III. Anuridae and Brachystomellidae, IV. Bilobidae, V. Onychiuridae, VI. Sminthuridae, VII. Neelidae and Dicyrtomidae. — Pol. Acad. Sc., Kraków, pp. 1637, pl. 170.
- STACH, J. 1955 a. Klucze do oznaczania owadów Polski. Część II. Skoczogonki-*Collembola*. Warszawa, pp. 3—215.
- STACH, J. 1955 b. Klucze do oznaczania owadów Polski. Część III—V, Pierwogonki-*Protura*, Widlogonki-*Diplura*, Szczeciogonki-*Thysanura*. Warszawa, pp. 3—63.
- TÖRNE, E. von. 1955. Neue Collembola aus Österreich. I. Material. — Rev. suisse Zool., 62, 151—162.
- TULLBERG, T. 1876. Collembola borealia. — Nordiska Collembola. — K. Vet.-Akad. Förhandl., Stockholm, 33: 23—42.
- WAHLGREN, E. 1919. Über die alpine and subalpine Collembolenfauna Schwedens. — Naturwissensch. Untersuch. d. Sarekgebirges in Schwedisch-Lappland, 4, Zoologie, Stockholm, pp. 743—762.

STRESZCZENIE

Po krótkim zarysie obszaru Polskiego Narodowego Parku Tatrzańskiego i jego fizjografii autor zestawia całość fauny owadów bezskrzydłych (*Apterygota*) poznanej dotychczas z terenu Parku w liczbie 134 gatunków z rzędu skoczogonków (*Collembola*), 2 gat. z rzędu pierwogonków (*Protura*) i 2 gat. z rzędu widlogonków (*Diplura*). Przy każdym z gatunków wymienione są dane dotyczące miejsc złowienia, występowania oraz geograficznego rozszedlenia.

Autor omawia następnie charakter fauny bezskrzydłych Parku Tatrzańskiego na tle fauny tych owadów w całej Polsce oraz porównuje z występującą w Szwajcarskim Parku Narodowym w Engadinie. Fauna Parku Tatrzańskiego obejmuje nieco więcej

niż połowę gatunków wykazanych dotychczas z całego obszaru Polski i jest nieco większa niż fauna Parku w Engadinie.

Z rzędu *Collembola* Parku Tatrzańskiego 70% gatunków znanych jest również z niżu Polski. Pozostałe 40 gatunków (30%) rozdziela autor na cztery grupy:

1. Gatunki żyjące głównie w górach Europy, ale tu i ówdzie także w Polsce, spotykane czasem na terenach o charakterze podgórskim. Do tej grupy zalicza autor 11 gat., co stanowi 8,21% całej fauny *Collembola* Parku Tatrzańskiego;

2. Gatunki, które tak w Polsce, jak i w innych krajach Europy ograniczone są w swym występowaniu tylko do gór. Grupa ta złożona z 16 gat. tworzy 11,94% całości fauny Parku; cztery z tych gatunków nie są znane dotychczas z obszaru Alp;

3. Gatunki boreo-górskie w liczbie 9, tj. 6,72% fauny Parku;

4. Endemity tatrzańskie 4, tj. 2,98%.

Brak w Tatrach kilkunastu gatunków występujących na niżu Polski nawet w niewielkiej odległości od Tatr, na Podhalu. Wśród nich jest parę pospolitych, nawet kosmopolitycznych, docierających w Alpach do znacznej wysokości. Zaskakującym jest brak w Tatrach jakiegokolwiek gatunku z rodziny *Marchilidae*, reprezentowanej w Alpach przez sporą liczbę gatunków.

W części poświęconej zoogeograficznej analizie fauny Parku Tatrzańskiego autor porównuje faunę bezskrzydłych krajów Skandynawii, przede wszystkim gór w Parkach Narodowych Sarek i Abisko, położonych na północ od koła podbiegunowego w szwedzkiej części Laponii, z fauną Parku Tatrzańskiego.

Fauna skoczogonków tych Parków składa się z 73 gatunków, z których 50 występuje również w Tatrach, 9 brak w Parku Tatrzańskim, żyją jednak na niżu Polski, a z pozostałych 14 gat. część należy do endemitów wysokiej północy, a część została może mylnie oznaczona. Brak natomiast w górach Laponii 84 gatunków skoczogonków żyjących w Tatrach tj. 62,64% fauny Parku Tatrzańskiego.

Pomimo stosunkowo dużej dzisiaj różnicy pomiędzy fauną obszarów północnych a Tatrami fauna ta wywarła pewien

wpływ na skład obecny *Collembola* Parku Tatrzańskiego. Dowodem tego jest występowanie w Tatrach gatunków boreo-górskich. Do więcej interesujących należy *Morulina verrucosa* BÖRN., znana z Tatr i innych pasm łuku Karpackiego. Pokrewny jej gatunek *Morulina gigantea* (TULLB.) żyje rozsiedlona na bardzo rozległym obszarze palearktyki począwszy od północnego Uralu przez arktyczne obszary Azji do brzegów Alaski. W arktycznej części Ameryki żyją trzy inne pokrewne gatunki *Morulina* BÖRN. Jedynie północ Europy stanowi przerwę w tym dookoła biegunowym rozsiedleniu *Morulina* BÖRN. Zdaje się nie podlegać żadnej wątpliwości, że pewne populacje *Morulina* BÖRN. dotarły do Tatr z właściwych temu rodzajowi arktycznych siedzib w czasie, gdy w okresach zlodowacenia fauna północy zbliżyła się znacznie do łuku Karpackiego. Następne generacje pierwotnej formy *Morulina* BÖRN. uległy z czasem w Tatrach pewnym zmianom, dając początek gatunkowi *Morulina verrucosa* BÖRN., różniącemu się od swych pokrewnych w arktyce.

Właściwym gatunkiem fauny arktycznej jest także *Tetracanthella wahlgreni* (AXELS.), rozprzestrzeniona szeroko w holarctyce, która ku południowi dosięga linii Karpat, nie przekraczając jej jednak.

Natomiast niektóre inne gatunki holoarktyczne północne np. *Agrenia bidenticulata* (TULLB.) sięgają swym rozsiedleniem dalej ku południowi i występują w Alpach, a *Agrenia* nawet dotarła do gór Hiszpanii i Jugosławii.

Trudniej doszukać się w faunie bezskrzydłych Tatr śladów wpływu fauny alpejskiej, jakkolwiek w faunie *Collembola* jest parę gatunków w występowaniu swym ograniczonych tylko do Tatr i Alp. Niepewne jest też oddziaływanie na faunę *Collembola* Tatr fauny pontyjskiej, które zaznacza się nieco wyraźniej na faunie bliżej wschodowi położonych Karpat Wschodnich, a także wschodniej części Alp; żyje w tych górach parę wspólnych gatunków skoczogonek, w Tatrach nie występujących.

Dla skreślenia historii dzisiejszej fauny bezskrzydłych Parku Tatrzańskiego bardzo mało pozostało pewnych danych. Bogata zapewne była ta fauna w trzeciorzędzie, kiedy Tatry pokrywała bujna roślinność i lasy, charakterem swym zbliża-

jące się do lasów dzisiejszych południowo-wschodniej Azji. W obecnej faunie bezskrzydłych Tatr brak śladów zachowania się składników tej trzeciorzędowej fauny. Można by conajwyżej przypuszczać, że relikdami tej fauny w Tatrach są gatunki, które pewnymi szczegółami budowy ciała, zarazem ograniczonym arealem występowania oraz brakiem form blisko spokrewnionych zdają się wskazywać na odległe czasy swego powstania. Takim starodawnym składnikiem fauny tatrzańskiej mogłaby być *Tetrodontophora bielanensis* (WAGA), jedyny przedstawiciel rodzaju *Tetrodontophora* REUT., lub *Thaumanura carolii* (STACH), albo też żyjący wysoko w górach południowej Azji (4763 m n. p. m.) *Sminthurides aquaticus* (BOURL.).

Zlodowacenia plejstocenyjskie zaznaczyły się niewątpliwie w wysokiej mierze niszcząco na tej faunie ciepłego klimatu. Wyginęły wtenczas bez śladu lub ustąpiły z Tatr liczne składniki fauny pierwotnej. Takimi były zapewne liczne w eocenie *Machilidae* i *Lepismatide* oraz gatunki żyjące obecnie na południu i w Alpach, dla których ostojami w okresie zlodowaceń były liczne, w sąsiedztwie Alp wolne od lodów tereny. Natomiast z pierwotnej fauny Tatr mogły się zachować co najwyżej formy żyjące w chłodniejszych, wyższych wzniesieniach lub na zimniejszych wilgotnych terenach, które wyparte z gór przez śniegi i lodowce mogły zatrzymać się w niewielkiej od Tatr odległości w wilgotnej tundrze mchów i porostów, tak jak i dzisiaj krzewi się życie wielu gatunków niemal bezpośrednio przed czołem lodowców północnych.

Zmiany w pierwotnej faunie bezskrzydłych Tatr powstały w plejstocenie nie tylko w wyniku wyginiecia lub ustąpienia pewnych jej składników. W okresach zlodowaceń fauna Tatr wypierana ku podnóżu gór spotykała się z fauną ustępującą pod naporem lądolodu północnego, i przebywała zamknięta na stosunkowo niewielkiej przestrzeni niżu wolnego od lodu. W nagromadzonej tu faunie następowała wymiana pewnych składników, w miejsce wyginionych wkraczały nowe. Powstawały też nowe formy zmodyfikowane pod wpływem odmiennych warunków życiowych, grupy gatunków wytrzymałych na zimno, innych dostosowanych do życia nawet na śniegach i lodowcach, albo na powierzchni zimnych zbiorników wody.

Z nastawianiem okresów międzylodowcowych obszary wspólnego bytowania fauny miejscowej z północną zwiększały się zwolna w miarę zaniku lodowców, osuszały i pokrywały coraz bujniejszą roślinnością. Wysoka temperatura i wysychanie terenu uwolnionego z lodu powodowały rozluźnianie się tej mieszaniny form niżej z fauną północy. Gatunki przystosowane do zimnego klimatu i roślinności właściwej temu klimatowi cofały się częściowo w chłodniejsze obszary gór, w znaczniejszej zaś ilości wracały do swych pierwotnych północnych siedzib. Powstawały dla niektórych gatunków znacznie od siebie oddalone disjunkcje.

Zlodowacenia powtarzały się w Tatrach 3—4-krotnie. Tylokrotnie też następowało współzycie form z gór spędzonych z niżowymi i przybyłymi z północy, tylokrotnie też w okresach międzylodowcowych następował powrót fauny bezskrzydłych Tatr do ich górskiej siedziby. Brak jednak jakichkolwiek danych, które gatunki pierwotnej cieplej fauny ubywały z niej z czasem, które nowe przybywały z niżej i z północy, i z których interglacjałów datują się te nabytki.

Istnieją jednak pewne dane, wskazujące, że powrót fauny bezskrzydłych do Tatr odbywał się powoli, gdyż i dzisiaj jeszcze po dawnym minięciu ostatniego zlodowacenia brak w Tatrach pewnej liczby gatunków właściwych górcom, jak *Machilidae* i sporej liczby rodzajów z rzędu *Collembola*, których gatunki żyją w bliskim sąsiedztwie Tatr, w Gorcach i Pieninach, a także w Alpach.

Świadectwem znacznego zniszczenia pierwotnej fauny bezskrzydłych Tatr jest dzisiejszy stan tej fauny w jaskiniach Polskiego Narodowego Parku Tatrzańskiego. W składzie jej brak jakiegokolwiek gatunku, który mógłby być zaliczony do grupy troglobiontów, tj. form żyjących tylko w jaskiniach. Pewne zmiany charakterystyczne dla form przebywających stale w jaskiniach uwidoczniają się tylko na populacjach pospolitego w Europie gatunku *Onychiurus armatus* (TULLB.), które w jaskini Kalackiej i Magóry odróżniają się pewnymi cechami budowy ciała od formy głównej, tworząc odmianę var. *multituberculatus* STACH.

Brak troglobiontów w jaskiniach Tatr Polskich, jakkolwiek istnieją one w jaskiniach na niżej Polski, a także w wielu gó-

rach Europy może być brany za dowód, że pierwotna fauna bezskrzydłych uległa w Tatrach znacznemu zniszczeniu, zarazem także, że zasiedlenie jaskiś tatrzańskich przez bezskrzydłe datuje się z niedawnego stosunkowo czasu.

Przy rozpatrywaniu ugrupowania fauny bezskrzydłych w Parku Tatrzańskim pod względem wysokości autor dzieli faunę *Collembola* na dwie grupy, grupę główną, złożoną z 119 gatunków, która wchodzi w góry od ich stóp i grupę obejmującą 15 gat. przybywających do grupy głównej dopiero w znacznie wyższych wysokościach. Z grupy głównej 19 gat. nie wchodzi już do regła dolnego. W reglu dolnym ubywa z tej grupy 25 gat. tj. 36,97%, a w reglu górnym dalszych 15 gat., tak, że z pierwotnej liczby gatunków pozostaje tylko połowa, 60 gatunków tj. 50,42%, która wkracza do regionu kosówki i traci tu dalsze 25 gat. (28,57%). Z pozostałych 34 gat. przekraczających górną granicę kosówki tylko 16, tj. 13,44% głównej grupy fauny *Collembola*, dociera do najwyższych szczytów gór Polskiego Narodowego Parku Tatrzańskiego.

Granice występowania *Collembola* w pewnych regionach nie są ostre dla większości gatunków. Ponieważ *Collembola* żyją głównie w glebie humusowej, w ściółce leśnej, butwiejącym drewnie, pod luźną korą starych pniaków drzewnych, przeto pomiędzy obszarem pokrytym lasami a kosówką nie występują w składzie fauny *Collembola* znaczniejsze różnice. Najważniejsza granica przebiega mniej więcej w wysokości 1650 m, to jest zaczynających się ubytków w zwartych łąkach kosówki.

Skład 16 gat. grupy głównej *Collembola* powiększonej o 7 gat. przyłączających się do niej w wyższych regionach i docierającej do szczytów Tatr, to jest łącznie 23 gat. jest niejednorodny. Z liczby tej 14 gat. należy do form szeroko rozprzestrzenionych w Europie, 6 jest górskich, 1 gat. boreo-górski i jeden endemit tatrzański.

Autor omawia następnie skład fauny *Collembola* skupiającej się przy różnego typu zbiornikach wodnych w Parku Tatrzańskim i w różnych wysokościach położenia tych zbiorników. Skład tej fauny, w którą wchodzi kilka gatunków przystosowanych budową ciała do swobodnego poruszania się do powierzchni wody, jest nieco inny w Tatrach niż w Alpach.

i paśmie Czarnohory w Karpatach Wschodnich; brak w nim pospolitego nadwodnego gatunku w Alpach i na Czarnohorze *Isotomurus alpinus* (CARL), natomiast w tych górach nie żyje interesujący tarzański nawodny endemit *Megalothorax aquaticus* STACH.

Interesującym jest skład tej fauny nadwodnej w okresie zimowym w Parku, kiedy większość zbiorników wodnych zamarza w większych wysokościach gór. Część fauny nadwodnej zamiera wtenczas w górach, mniejsza skupia się w niższych położeniach Parku na brzegach niezamarniętych całkowicie potoków, małych oparzeliskach i wokół wytrysków ciepłej wody, i towarzyszy faunie zimowej skoczogonek Tatr.

Nigdy w towarzystwie innych gatunków nie pojawiają się typowe wysokogórskie gatunki zimowe Tatr, *Hypogastrura monticola* STACH i endemit tatrzański *Hypogastrura tatrica* (STACH).

РЕЗЮМЕ

После короткого описания территории физиографии Польского Национального Парка в Татрах, автор дает обзор фауны бескрылых насекомых (*Apterygota*), найденных до настоящего времени на территории Парка и приводит 134 вида из ряда *Collembola*, 2 вида из ряда *Diplura*. У каждого вида обозначены: его местонахождение, данные о его появлении в натуральной среде и географическое распространение.

Далее автор оговаривает характер фауны бескрылых насекомых Парка в Татрах, основываясь на фауне этих насекомых на территории всей Польши и на фауне Швейцарского Национального Парка в Энгадине. Фауна Парка в Татрах содержит немного более половины видов, найденных до настоящего времени на территории всей Польши. Она богаче фауны Парка Энгадине. Из числа видов ряда *Collembola*, найденных в Парке в Татрах, 70% встречается также и в низменной Польше. Остальные 40% (30%) автор разделяет на четыре группы:

1) виды, живущие преимущественно в горах Европы, но иногда, в том числе и в Польше, встречаются в местностях, имеющих характер предгорий. К этой группе автор причисляет 11 видов, что составляет 8,21% всей фауны *Collembola* Парка в Татрах;

2) виды, которые равно как в Польше, так и в других странах Европы встречаются исключительно в горах. Группу эту составляют 16 видов, что равняется 11,94% всей фауны Парка. Из этого числа четыре вида до настоящего времени не были найдены в Альпах.

3) виды, бореоальпийские, в числе 9, то есть 6,72% фауны Парка;

4) эндемины из Татр — четыре вида, что составляет 2,98%.

В Татрах не найдено несколько видов, встречающихся в низменностях Польши, даже в близком от них соседстве — в Подгале. Среди них есть несколько обыкновенных видов, даже космополитических, доходящих в Альпах до значительной высоты. Замечательно, что в Татрах не встречается ни один вид из семейства *Machilidae*, имеющее в Альпах значительное количество представителей.

В той части работы, которая посвящена зоогеографическому анализу фауны Парка в Татрах, автор сравнивает эту фауну с фауной бескрылых насекомых скандинавских стран, главным образом с фауной Национального Парка в Сарек и Абиско расположенных в шведской части Лапландии, к северу от полярного круга.

Фауну *Collembola* этих Парков составляют 73 вида, из которых 50 встречается также и в Польше. Виды эти живут однако только в низменностях Польши. Среди остальных 14 видов, часть принадлежит к числу эндемиков далекого севера, остальные были вероятно неправильно определены. 84 вида, из числа живущих в Татрах, не были найдены в горах Лапландии. Число этих видов составляет 62,64% фауны Парка в Татрах.

Помимо сравнительно большой разницы между фауной северных территорий и фауной Татр, фауна эта имела известное влияние на теперешний состав фауны *Collembola* Парка в Татрах. Доказательством этого является нахождение в Татрах борео-горных видов. Более интересными являются *Morulina verrucosa* BÖRN. Найденная в Татрах и других горных цепях Карпат. Другой родственный вид — *Morulina gigantea* (TULLB.), широко распространен в палеарктической области и встречается начиная с северного Урала, через арктические области Азии до берегов Аляски. В арктической части Америки живут три вида, родственные *Morulina* BÖRN. Одна только северная Европа составляет перерыв в этом кругу расселения рода *Morulina* BÖRN. вокруг полюса. Нет ка-

жется сомнения в том, что известные популяции *Morulina* BÖRN. дошли до Татр из свойственных этому роду арктических жилищ, в то время, когда в период обледенения, северная фауна сильно приблизилась к Карпатской горной цепи. Следующие поколения первичной формы *Morulina* BÖRN. со временем изменились и дали начало виду *Morulina verrucosa* BÖRN., который отличается от своих родственников в арктике.

Свойственным для арктической фауны видов является также *Tetracanthella wahlgreni* (AXELSS.) широко распространенный в холарктике, доходящий к югу до линии Карпат. Однако вид этот за линию Карпат не переходит.

Некоторые другие северные, холарктические виды доходят в своем распространении до далее на юге лежащих областей и встречаются в Альпах, а род *Agrenia* достиг даже гор Испании и Югославии.

Труднее найти в фауне бескрылых насекомых Татр следы влияния альпийской фауны, хотя в фауне *Collembola* есть несколько видов, встречающихся только в Татрах и Альпах. Сомнительным также кажется влияние на фауну *Collembola* Татр фауны понтийской. Влияние это обозначается немного отчетливее в фауне восточных Татр, находящихся далее к востоку, а также в восточной части Альп. В этих горах живет несколько общих видов, не встречающихся в Татрах.

Для описания истории теперешней фауны бескрылых насекомых Парка в Татрах, имеется очень мало верных данных. В третичном периоде фауна эта было вероятно очень богата. Тогда Татры покрыты были богатой растительностью и лесами, близкими по характеру теперешним лесам юговосточной Азии. В теперешней фауне бескрылых насекомых Татр нет следов сохранения составных частей этой третичной фауны. Можно было-бы только предполагать, что реликтами этой фауны являются виды, которые известны деталями строения своего тела и ограниченным ареалом распространения, а также отсутствием родственных форм, могли-бы указывать на свое древнее происхождение. Таким древним составным элементом фауны Татр можно считать *Tetrodontophora bielaniensis* (WAGA), являющимся единственным представителем рода *Tetrodontophora* REUT. или *Thaumanura carolii* (STACH) или же, живущим также высоко в горах южной Азии (4763 м над уровнем моря), *Sminthurides aquaticus* (BOUD.).

Плейстоценское обледенение обозначилось несомненно в высо-

кой степени деструктивно в отношении к фауне теплого климата. В это время совершенно исчезли или отошли из Татр многие элементы первичной фауны. К ним принадлежали вероятно многочисленные в эоцене *Machilidae* и *Lepismatidae*, а также виды, живущие в настоящее время на юге и в Альпах, которым удалось избежать гибели во время обледенения на многочисленных, расположенных в соседстве Альп, свободных от льда местностях. Из первичной фауны Татр могли в лучшем случае сохраниться формы, живущие в более холодных, высоких возвышенностях или на более холодных, сырых местах и которые вследствие этого, будучи вытесненными снегом и ледниками из Татр, могли задержаться в небольшом расстоянии от Татр, в сырой тундре мхов и лишайников. И в настоящее время многие виды живут в непосредственной близости фронта северных ледников.

Изменения в первичной фауне бескрылых насекомых Татр возникли в плейстоцене не только под влиянием исчезновения или вытеснения некоторых элементов этой фауны. В периоды обледенения, фауна Татр, вытесняемая к подножию гор, встречалась с фауной, уступающей под напором северных ледников, и пребывала изолированная на сравнительно маленькой территории низменности, свободной от льда. В сплоченной в этих местах фауне происходил обмен некоторых элементов. На место исчезнувших видов вступали новые. Появились также и новые формы, модифицированные под влиянием изменившихся условий жизни, формы, приспособленные к жизни в холоде и даже на снегу и ледниках, или же на поверхности холодных водоемов. Во время наступления междуледниковых периодов, площади, занятые местной и северной фауной, постепенно увеличивались и, по мере исчезновения ледников, подсыхали и покрывались более обильной растительностью. Высокая температура и высыхание территории, освобожденных от льда влияли на раз'единение смеси фаун низменной и северной. Виды, приспособленные к пребыванию в холодном климате и среди растительности, свойственной этому климату, возвращались постепенно в более холодные местности в горах или в большинстве случаев возвращались в свои первичные северные жилища. Для некоторых, сильно между собою разнящихся видов, возникли дисъюнкции.

Обледенения повторялись в Татрах 3—4 раза. Столькоже раз повторялась совместная жизнь горных форм с низменными, при-

пешными с севера формами. Столькоже раз в периодах междуледниковых повторялось возвращение фауны бескрылых насекомых Татр в ее горные жилища. Однако нет никаких данных относительно убытка видов первичной теплой фауны и относительно прибыли новых видов, пришедших с низменностей и с севера. Нет также никаких данных относительно интерглацталов, во время которых происходила эта прибыль.

Однако имеются некоторые данные о возвращении фауны бескрылых насекомых в Татры. Возвращение это происходило медленно, так как и сегодня еще, под влиянием последнего периода обледенения, отсутствует в Татрах известное число видов, свойственных гористым местностям, так например: *Machilidae* и значительное число родов из ряда *Collembola*. Виоы этих родов живут в ближайшем соседстве с Татрами — в Горцах и Пенинах, а также в Альпах.

Подтверждением гипотезы относительно сильной редукции первичной фауны бескрылых насекомых Татр, является теперешний состав пещерной фауны Польского Национального Парка в Татрах. В составе этой фауны отсутствуют все виды, могущие быть причисленными к группе троглобионтов, то есть группе видов, жизнь которых протекает исключительно в пещерах. Известные изменения, характерные для форм пребывающих в пещерах, заметны лишь у популяций обыкновенного в Европе вида *Onychiurus armatus* (TULV.), которые в пещерах Калядской и Магуры отличаются строением тела от главной формы (*var. multituberculatus* STACH).

Отсутствие троглобионтов в пещерах Польских Татр, хотя они существуют в пещерах польской низменности и в многих горах Европы, может служить, доказательством, что первичная фауна бескрылых насекомых Татр сильно обнищала и что заселение пещер в Татрах бескрылыми насекомыми произошло не очень давно.

При анализе группировки фауны бескрылых насекомых в Парке в Татрах с точки зрения высоты местонахождений над уровнем моря, автор делит фауну *Collembola* на две группы: главную группу, заключающую 119 видов и входящую в горы с подножия, и группу, заключающую 15 видов. Эти последние прибывают к главной группе только на значительной высоте. 19 видов главной группы не доходит до нижней границы лесов. На нижней границе лесов убывает из этой группы 25 видов, то есть 36,97%, а у верхней границы — дальнейших 15 видов, так что из первоначального

числа видов остается только половина — 60 видов, то есть 50,42%, которые вступают в район карликовой сосны. Тут убывают дальнейшие 25 видов (28,57%). Из оставшихся 34 видов, переступающих верхнюю границу карликовой сосны, только 16, то есть 13,44% видов главной группы фауны *Collembola*, доходит до высочайших вершин гор Польского Национального Парка в Татрах.

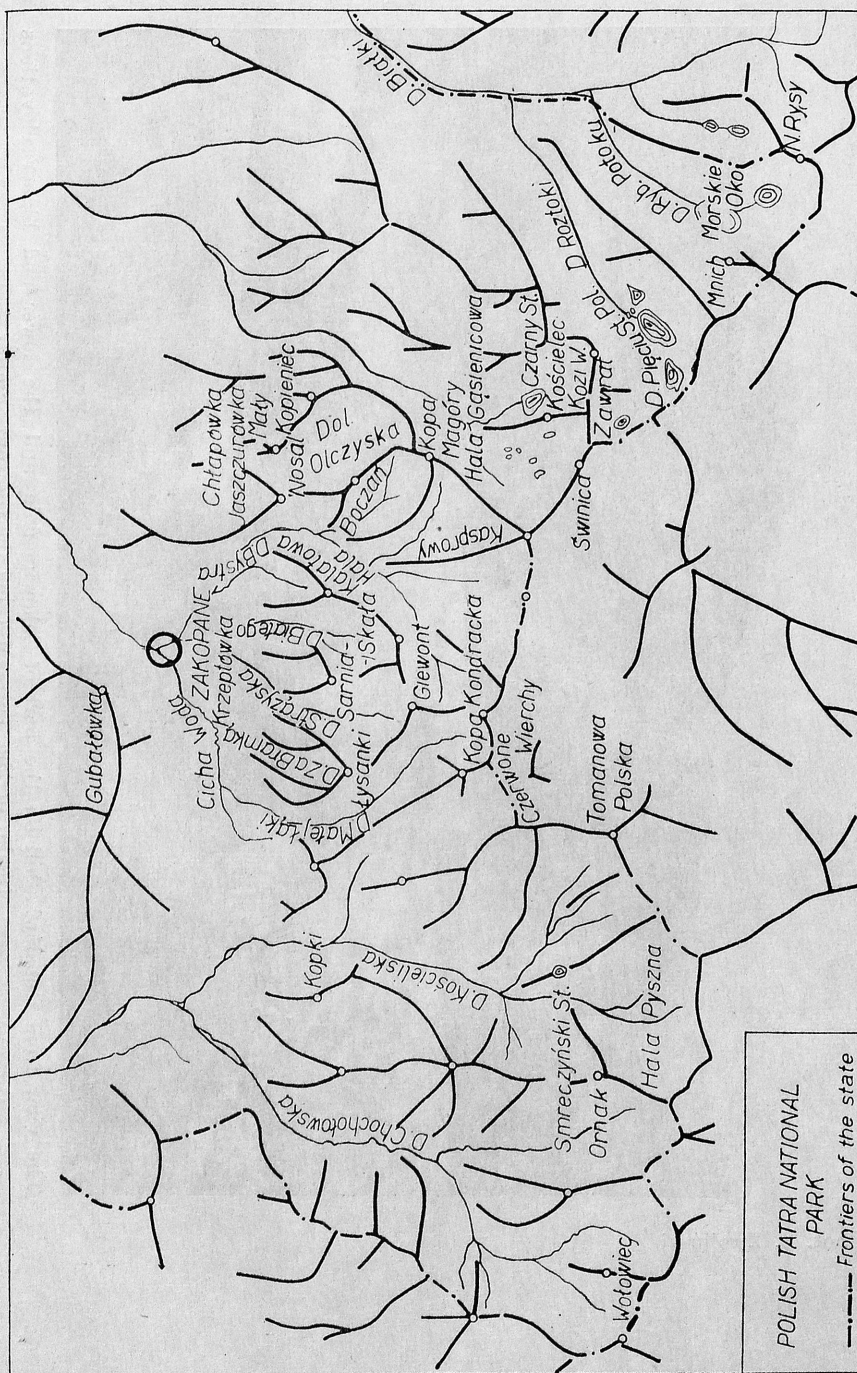
Границы появления *Collembola* в известных районах для большинства видов не выступают резко. Как известно *Collembola* живут преимущественно в гумусной почве, среди опавших листьев и игл, в гниющей древесине, под отстающей корой старых древесных пней. Вследствие этого, в составе фауны *Collembola* территорий, покрытых лесом и территорий, покрытых карликовой сосной, особенных разниц не замечается. Самая важная граница проходит на высоте 1650 м, где начинается убыток в сплоченных пространствах карликовой сосны.

Состав из 16 видов главной группы *Collembola* увеличивается через присоединение 7 видов в более высоких районах до 23 видов. Состав этот неоднобразен. Тут находятся 15 видов широко распространенных в Европе, 6 видов горных, 1 вид борео-горный и один эндемит из Татр.

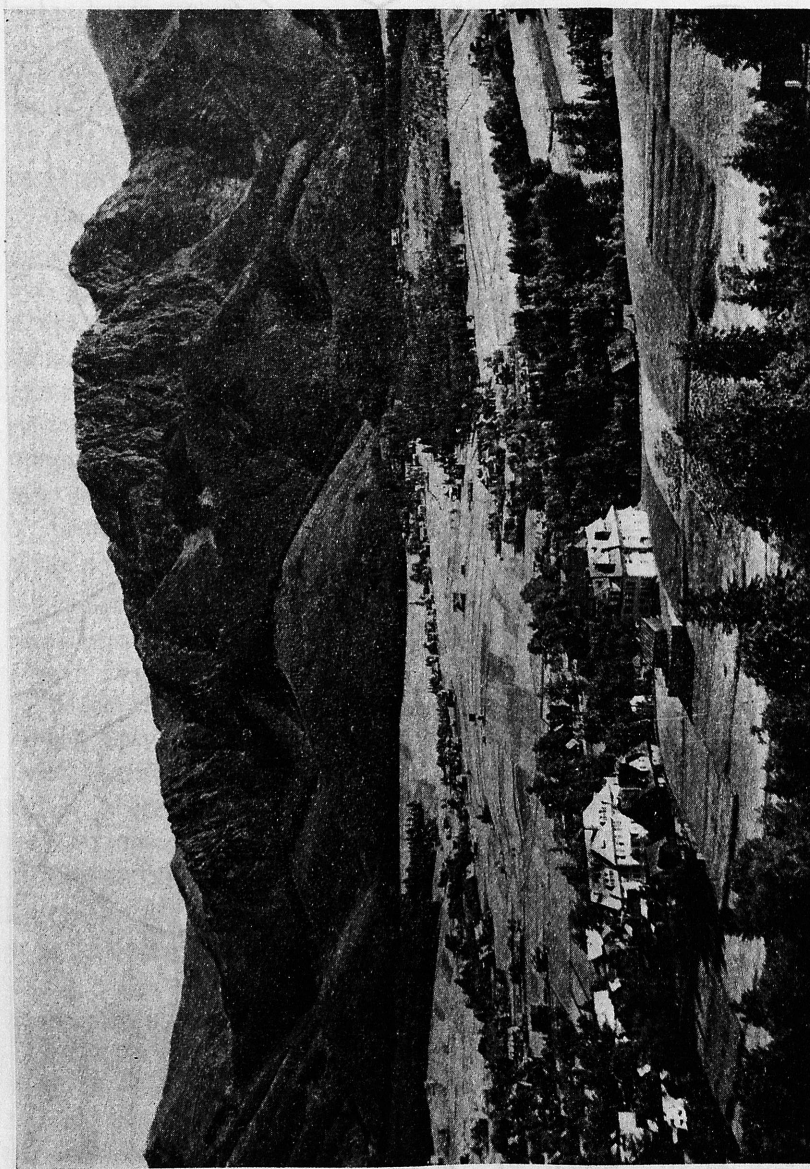
Далее автор оговаривает состав фауны *Collembola*, сосредоточенной около различного типа водоемов Парка в Татрах и на различных высотах положения этих водоемов. В состав этой фауны входит несколько видов, приспособленных строением тела к свободным движениям на поверхности воды. Состав этот немногим отличается от такого в Альпах и в цепи Черногоры в высоких Карпатах. Тут отсутствует обыкновенный вид, живущий вблизи воды в Альпах в Черногоре — *Isotomurus alpinus* (CARL.). Зато в этих горах отсутствует интересный Эндемит из Татр — *Megalothorax aquaticus* STACH.

Интересен состав приводной фауны Парка во время зимы, когда большинство расположенных высоко водоемов замерзает. В горах большая часть этой фауны замирает в это время, меньшая часть сосредоточивается в ниже расположенных местах Парка, вдоль несомненно замерзших речек, маленьких болот и вблизи ключей с теплой водой и сопутствует зимней фауне *Collembola* Татр.

Типичные вершинные зимние виды Татр, как *Hypogastrura monticola* STACH и эндемит из Татр *Hypogastrura tatrica* STACH никогда не появляются совместно с другими видами.

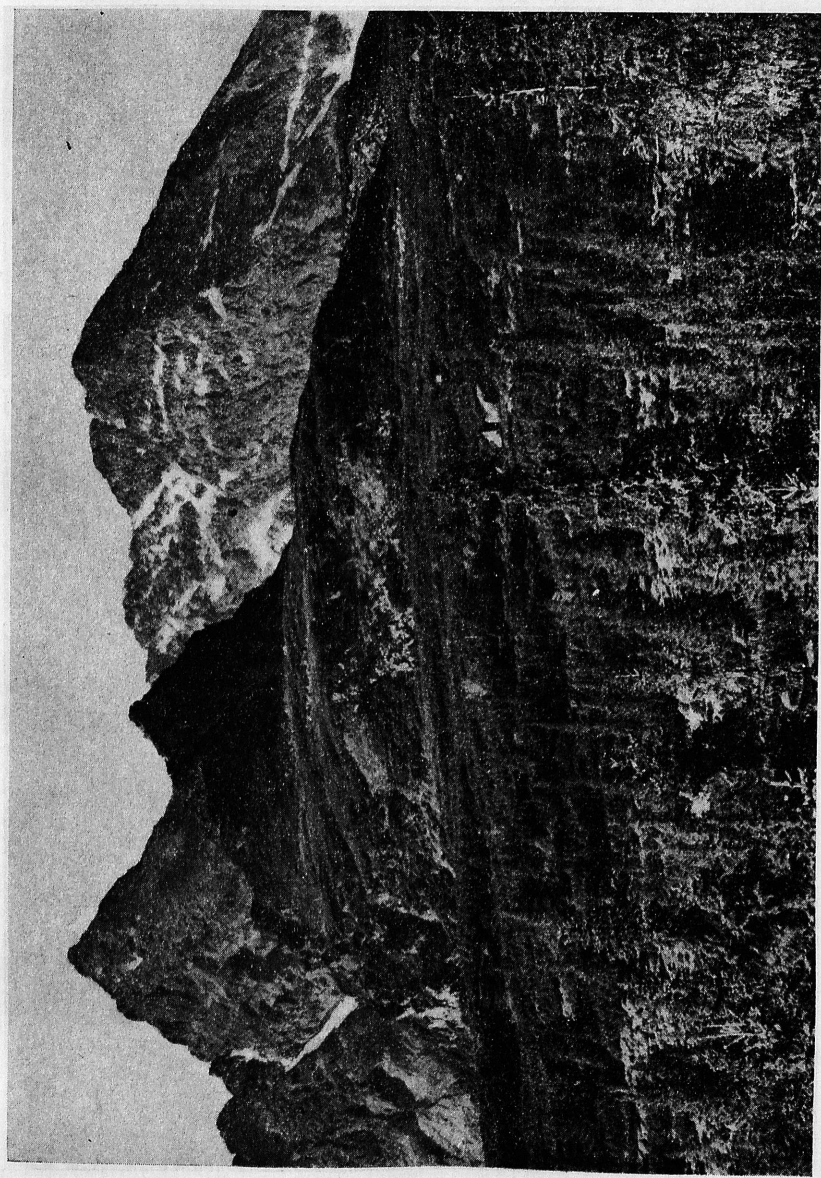


The frontiers of the Polish Tatra National Park.



The view from Gubałówka-hill on the part of Zakopane-dale and the lower and higher elevations (regle) of the Tatra Mts and the Giewont-summit.

Phot. S. Zwoliński



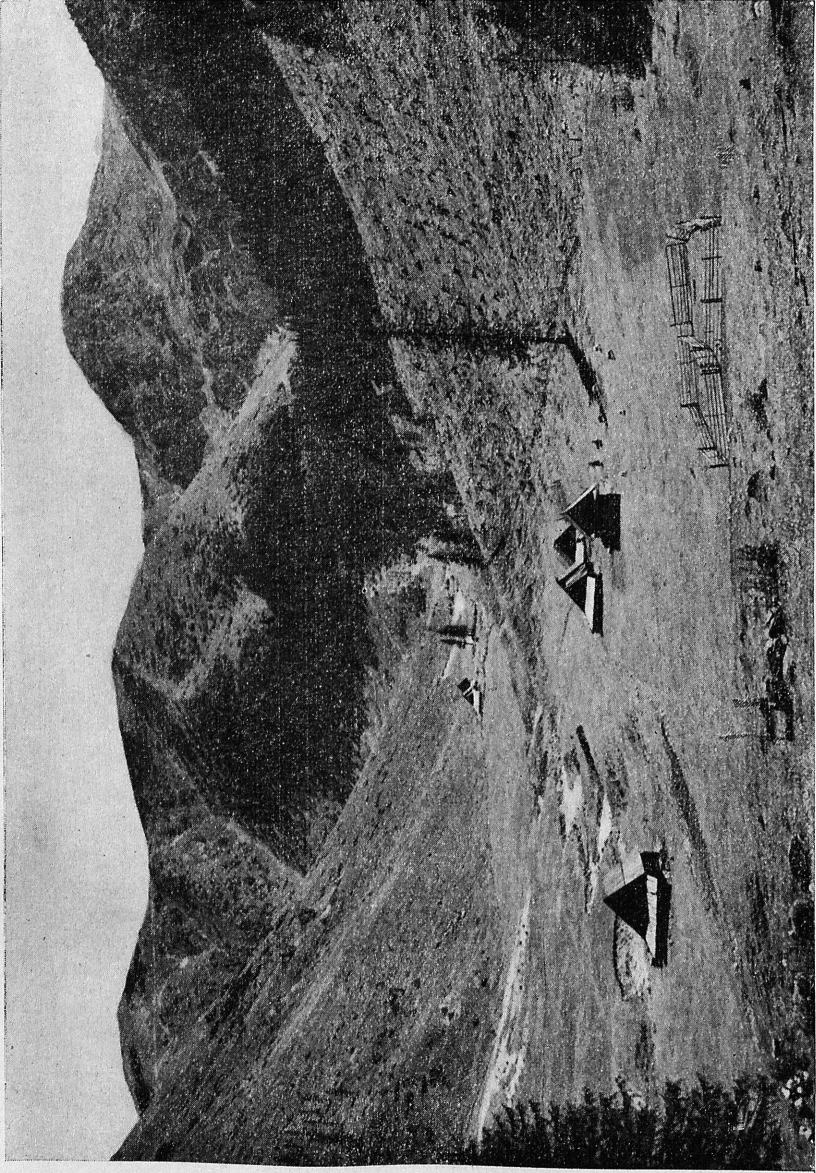
A part of Gasienicowa Hala and the mountains Kościelec and Świnica.

Phot. S. Zwoliński



Enviorns of Morskie Oko-lake and higher lying Czarny Staw-lake.

Phot. S. Zwoliński



The valley Jaworzynka.

Phot. S. Zwoliński

Redaktor zeszytu: Doc. dr K. Kowalski

Państwowe Wydawnictwo Naukowe — Oddział w Krakowie 1959

Nakład 800+100 egz. — Ark. wyd. 6,25. — Ark. druk. $6\frac{3}{4}$ — Papier ilustr. kl. III 80 g 70×100
Zam. 564/58 Cena zł 20,—

Drukarnia Uniwersytetu Jagiellońskiego w Krakowie