

Groundwater Inhabitants in Poland

by

Andrzej W. SKALSKI*

This paper gives a review of the present knowledge of the ground (underground) water fauna of Poland. This fauna inhabits different biotopes of the aqueous media which constitute a broad aquatic environment of the subterranean life zone. The organisms associated with both subterranean (endogenous) waters and interstitial medium are discussed here. The subterranean waters are understood in a broad sense as those infiltrating or accumulated in large chambers or channels and small spaces in rock beds mainly limestones. They form mostly large aquifers associated with various geological levels at varying depths from the surface. In the interstitial medium different biotopes have been distinguished, but only phreatic and parafluvial nappes are discussed by Vandel (1965) as true underground habitat. Because the surface sandy interstitial layer in many respects occupies an intermediate place between subterranean and epigeous environments, it has also been included in this paper.

In Poland the best known are those subterranean aquifers which are accessible for collection and study via entrances of caves, artificial galleries, wells, springs and seeps. Some hypogeous forms, in particularly gammarids belonging to the genus *Niphargus*, were found in mountain lakes and streams. The cave waters received special attention and were intensively investigated by many speleologists and biologists (Skalska & Skalski, 1969). Larger water reservoirs are found only in some caves of the Tatra Mts. and the Sudeten Mts. By now about 1000 caves are known in Poland, with 20% of them located in the Tatra Mts. and 4% in the Sudeten Mts. On the other hand, biological data from underground waters of non-cavernous areas are fragmentary or virtually non-existent (most of Middle and North Poland).

Those subterranean waters for which biological data exist are very unequally

* Muzeum w Częstochowie 42-200 Częstochowa, Ratusz, Poland

distributed in Poland. The most intensive investigations took place only in mountain and submountain regions of the country; the Tatra Mts. (Wrześniowski, 1888, 1890; Kowalski, 1955; Chodorowska & Chodorowski, 1958, 1963; Doroszewski, 1960, 1963; Fischer, 1963; Prószyńska, 1963; Skalski, 1967; Gadzińska, 1974), the Beskid Mts. (Kowalski, 1954) and the Sudeten Mts. (Arndt, 1921, 1923; Pateff, 1926; Moszyński, 1936; Pax, 1936; Pax & Maschke, 1935; Stammer, 1936a, 1936b). Wrześniowski (1888, 1890) was the first in Poland to find in wells of Zakopane, obligate underground-dwelling organisms. The fauna of wells was also examined in Kraków and Lwów (Jaworowski, 1893a, 1893b 1895), in Krosno on the Oder (Haeckel, 1908), in Kazimierz Dolny on the Vistula (Skalski in litt.) and recently in some places in the Carpathians by Dr. T. Sywula (Biesiadka, 1975). Most of these researches are concentrated upon faunistical and systematical problems. Among all the animals occurring in subterranean waters of Poland only the Gammaridae were intensively studied and are better known taxonomically (Wrześniowski, 1888, 1890; Jaworowski, 1893b, 1895; Grochowski, 1904; Schellenberg, 1933, 1935, 1937; Micherdziński, 1856; Skalski, 1970, 1972, in litt.; Karaman, 1974). Also Ostracoda (Sywula, 1974a, 1974b) and Hydracarina (Biesiadka, 1975) of that are studied in modern aspect.

Interstitial waters are an environment rarely studied in Poland. Only some groups associated with them have been examined; Turbellaria (Gieysztor, 1938) of the sandy beaches of the Wigry lake, and Rotatoria (Wiszniewski, 1934a, 1934b, 1935, 1936a, 1936b, 1937, 1954) of sandy beaches of some lakes and rivers in Middle and North Poland, Gastrotricha (Roszczak, 1939) and Rhizopoda of the sandy beaches along the border of the Baltic sea (Golemansky, 1970, 1973, 1974a), Hydracarina of the parafluvial nappes of some Carpathian rivers (Biesiadka, 1972, 1974, 1975) and Ostracoda of that of the Raba river (Sywula, 1974a).

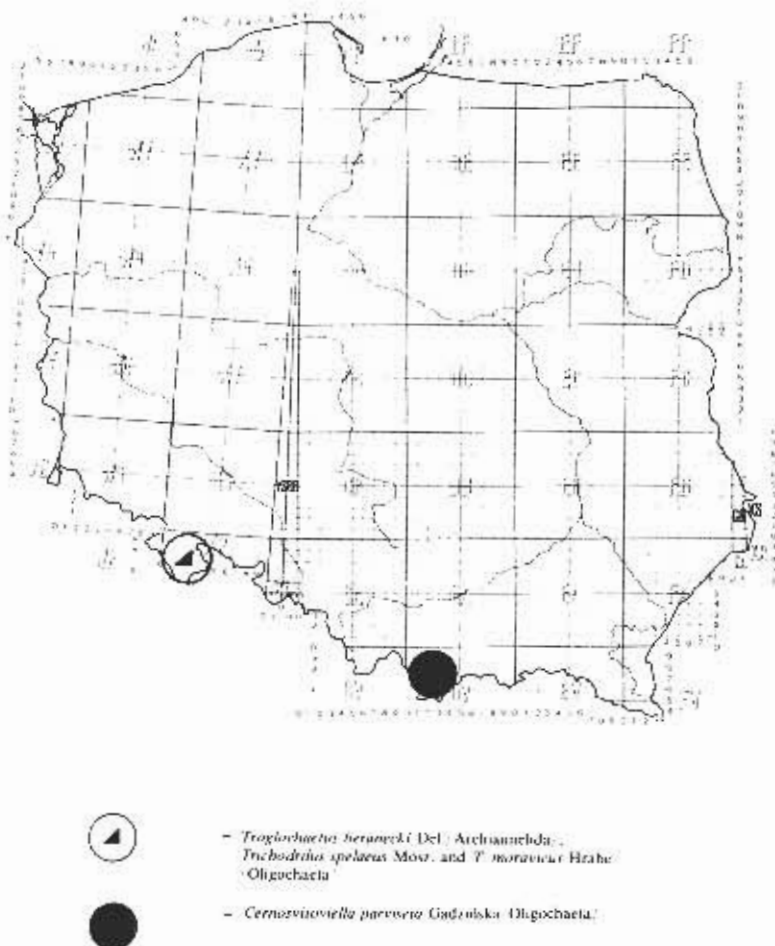
The ecology and biology of the fauna of subterranean and interstitial waters have been practically limited to the cave waters particularly of the Tatra Mts. (Chodorowski, 1959; Chodorowska & Chodorowski, 1960).

As a result of these researches about 200 species of invertebrates have been recorded in all types of underground waters in Poland. The majority of these have entered into this environment quite accidentally from the surface. Limitations upon space make it impossible to list here all those species recorded in the underground waters of Poland. Only true underground forms, stygobionts or trogllobionts according to biospeleological terminology, and phreatobionts are listed below. Psammobionts have been listed separately. The species in italics have been described from territory of Poland; those marked with an asterisk are known from Poland to this moment.

STYGOBIONTS AND PHREATOBIONTS

Archiannelida

Troglochaetus beranecki Delachaux — found in the Jaskinia w Rogózce cave and the Radochowska cave* in the Sudeten Mts. (Maschke, 1936; Stammer, 1936b).

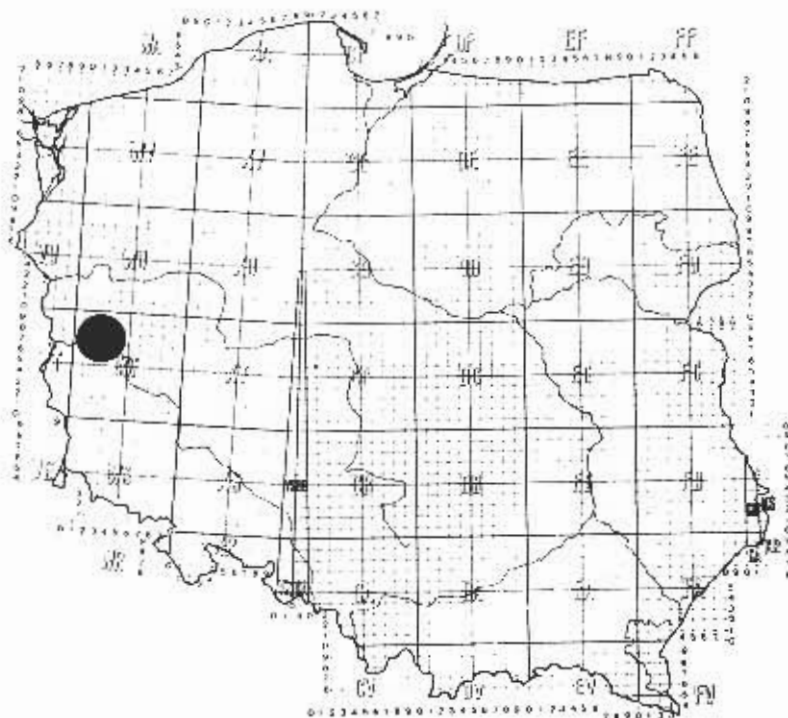


1. Distribution of Archiannelida and Oligochaeta. Distribution of some stygobionts based on the U.T.M. grid accepted by the European Invertebrate Survey.

* Names of caves after Kowalski (1951-1954).

Oligochaeta

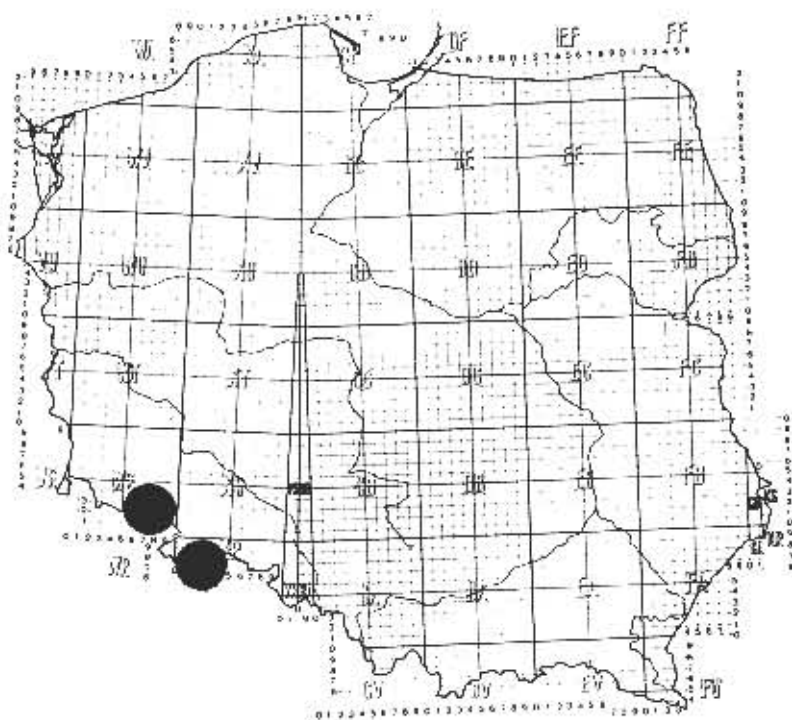
**Cernosvitoviella parviseta* Gadzińska — known from the Zimna cave in the Tatra Mts.; **Trichodrilus spelaeus* Moszyński — known from subterranean waters of Klecienko in the Sudeten Mts.; *T. moravicus* Hrabe — in subterranean waters of Śnieżnik Kłodzki in the Sudeten Mts. (Moszyńska, 1962).



2. Distribution of *Balcanohydracarus corsicus* E. Angelier (Hydracarina) a species known from interstitial waters of Corsica found in underground waters of all continental Europe by Dr. T. Sywula (Biesiadka, 1975).

Hydracarina

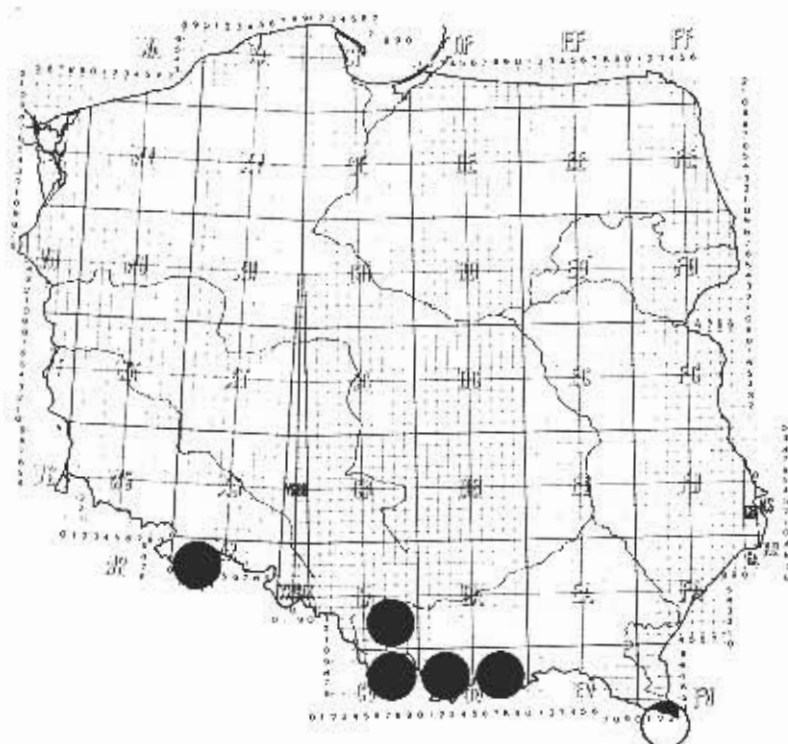
**Spherchon carpathicus* Biesiadka, **Spherchonopsis phreaticus* Biesiadka, *Kawamuracarus chappuisi* Motas and Tanasachi, *Atractides latipalpis* (Motas and Tanasachi), *A. pilosus* Schwoerbel, *A. primitivus* (Walter), **A. gorcensis* Biesiadka, **A. barbarae* Biesiadka, *Azugofeltia mira* Motas and Tanasachi, *Lethaxona cavifrons* Szalay, *Erebaxonopsis brevipes* Motas and Tanasachi, **Axonopsis cogitatus* Biesiadka, **A. monstrabilis* Biesiadka, *Frontipodopsis reticulatifrons* Szalay, ? *Aturus pauciporus* Walter, **A. pulchellus* Biesiadka, *Kongsbergia alata* Szalay, *K. dentata* Walter, *Stygomomonnia latipes* Szalay, *Neocarus hibernicus* Halbert, *Hungarohydracarus subterraneus* Szalay, *Balcanohydracarus corsicus* E. Angelier, *Lobohalacarus weberi quadriporus* (Walter) — found in wells and interstitial waters of parafluvial nappes in South Poland, mainly surround some Carpathian streams and rivers. In underground waters of Poland 40 species of Hydracarina have been recorded (Biesiadka, 1975).



3. Distribution of *Niphargellus arndti* Schell. (Amphipoda).

Ostracoda

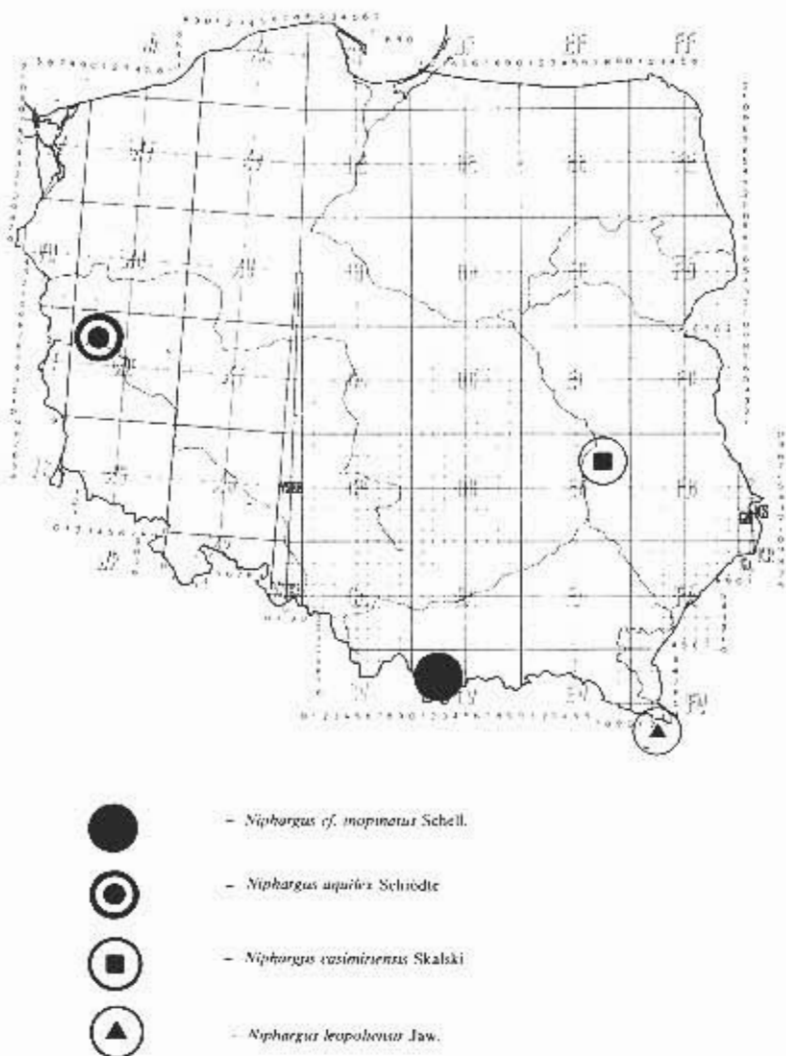
Candona wegelini Petkovski — found in interstitial waters of parafluvial nappes of the Raba river (Sywula, 1974a), *Cypridopsis subterranea* Wolf — found in the environs of Klodzko and the Gorce Mts. (Sywula, 1974b).



4. Distribution of *Niphargus tatrensis* Wrzešn. (Amphipoda).

Copepoda

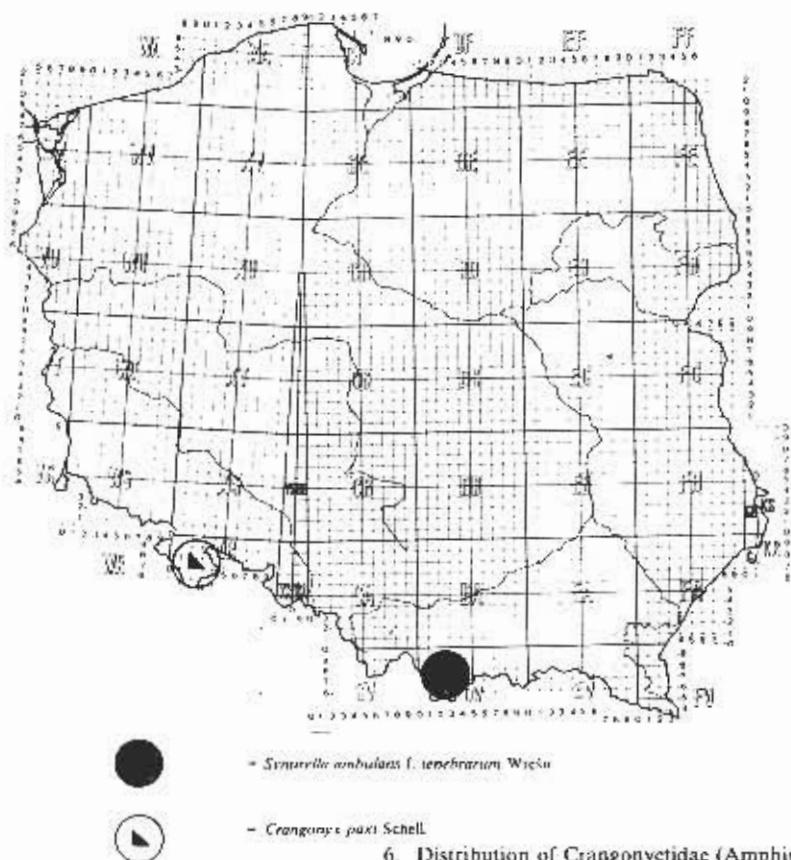
Acanthocyclops longoides var. *clandestinus* (Kiefer) — found in the Zimna cave in the Tatra Mts. (Prószyńska, 1963), **Nitocrella hibernica* var. *hyalina* (Jakubisiak) — described from water pipings of Poznań (Jakubisiak, 1929).



5. Distribution of some *Niphargus* species (Amphipoda).

Amphipoda

Synurella ambulans form tenebrarum Wrześniowski — known from specimens collected by Prof. A. Wrześniowski in two wells at Zakopane, reported also from caves in Czechoslovakia (Hrabe, 1954); **Crangonyx paxi* Schellenberg — known from specimens collected by Prof. F. Pax in an artificial gallery in the Śnieżnik Kłodzki region in the Sudeten Mts. (Schellenberg, 1935), its systematic position is unclear; *Niphargellus arndti* Schellenberg — distributed in the Sudeten Mts., caves and springs; ? *Niphargus aquilex* Schiödte — recorded from a well in Krosno on the Oder (Haeckel, 1908); *N. cf. inopinatus* Schellenberg — Prof. F. Pax collected two specimens in a spring in Jaszczurówka near Zakopane, these specimens differ by some characters from the type form; *N. leopoliensis* Jaworowski — common in seeps in the Bieszczady Mts.; *N. tatrensis* Wrześniowski — wide distributed and common in the Carpathians and the Sudeten Mts., caves, springs, seeps, lakes and streams; **N. casimiriensis* Skalski — common in wells of Kazimierz Dolny on the Vistula.



6. Distribution of Crangonyetidae (Amphipoda).

PSAMMOBIONTS

Rhizopoda

Pseudocorythion acutum (Wailes) Valkanov, *Psammonobiotus communis* Golemansky, *P. linearis* Golemansky, *P. balticus* Golemansky, *Corythionella minima* Golemansky, *C. acola* Golemansky, *Cyphoderia littoralis* Golemansky, *Micropsammella retorta* Golemansky, *Micramphora pontica* Valkanov, *Centropxyiella arenaria* Valkanov, *Cryptodiffugia lanceolata* Golemansky, *Diffugiella psammophila* Golemansky, *Microchlamys patella* Clap. and Lachmann, *Amphorellopsis elegans* Golemansky, *Hyalosphaenia cuneata* Stein., *Euglypha rotunda* Wailes, *Lagenidiopsis valkanovi* Golemansky — found in interstitial waters of the sandy beaches of the Baltic sea. Some genera belong to the lately erected family *Psammonobiotidae* (Golemansky, 1974b) which grouped forms typical for the biocenosis of interstitial ground waters of sea littoral (Golemansky, 1969).

Turbellaria

**Gieystoria wiszniewskii* (Gieysztor) — Interstitial waters of the sandy beaches of the Wigry lake (Gieysztor, 1938).

Rotatoria

Aspelta egregia Myers, *Cephalodella compacta* Wiszniewski, *C. megalotrocha* Wiszniewski, *Dicranophorus hercules* Wiszniewski, *D. leptodon* Wiszniewski, *Elosa spinifera* Wiszniewski, *Encentrum diglandula* (Zawadowsky), *E. sutor* Wiszniewski, ? *E. wiszniewskii* Wulfert, *Erignatha sagittoides* Wiszniewski, *Lecane psammophila* (Wiszniewski), *Lindia janickii* Wiszniewski, *Myersinella tetraglena* (Wiszniewski), *Notommata diasema* Myers, *Trichocerca intermedia arenosa* Wiszniewski, *T. pygocera* Wiszniewski, *T. taurocephala* Hauer, *Wierzejskiella elongata* (Glascott), *W. sabulosa* (Wiszniewski), *W. velox* (Wiszniewski), *Wigrella depressa* Wiszniewski — found in interstitial waters of the sandy beaches of some reservoirs in North-Eastern Poland. In psammon Wiszniewski (1954) found 113 species of Rotatoria, among these he recognized the above mentioned as true psammobionts.

Gastrotricha

Xenotrichula bispina Roszczak, *Chaetonotus balticus* (Roszczak), *Lepidodasys platyurus* Remane — sandy beaches of the Baltic sea.

REMARKS

The fauna of the subterranean aquatic environment in Poland is very poor. This phenomenon has generally been attributed to past glacial conditions which destroyed forms that inhabited circumboreal regions during the Tertiary. Certain ancient forms, e.g. *Troglochaetus* or *Niphargus*, persisted in refuges particularly in the Carpathians and Sudeten Mts. Other colonized subterranean environment during the post glacial period. Because the studies on the interstitial medium have recently been initiated in Poland this list will be completed in near future. Also, the systematic status of some forms must be revised.

ACKNOWLEDGMENTS

I wish to acknowledge the Deutschen Forschungsgemeinschaft for supporting my participation in 3rd International Colloquium on Gammarus and Niphargus, and 1st International Symposium on Groundwater Ecology. I am indebted to Dr. S. Husmann and Dr. M. P. D. Meijering, Limnologische Flussstation des Max-Planck-Instituts für Limnologie in Schlitz, for their various help. I am also deeply indebted to Dr. T. Gledhill, Freshwater Biological Association, Dorset, for critical review of the paper.

SUMMARY

This paper states the present progress achieved in research regarding the ground-water fauna of Poland.

RÉSUMÉ

Cet article présente l'état actuel des recherches sur la faune des eaux souterraines de la Pologne.

ZUSAMMENFASSUNG

In der vorliegenden Arbeit wird ein Abriss zum Erforschungsstand der Grundwasserfauna in Polen gegeben.

REFERENCES

- Arndt, W. (1921) — Beitrag zur Kenntnis der Höhlenfauna. Ergebnis einer faunistischen Untersuchung der Höhlen Schlesiens. — Zool. Anz. 52, 12/13: 310-315.
- Arndt, W. (1923) — Speläobiologische Untersuchungen in Schlesien. — Speläologisches Jahrbuch 4: 95-114.
- Biesiadka, E. (1972) — Sur quelques Hydracariens nouveaux recueillis en Pologne. — Bull. Acad. pol. Sci. ser. biol. 20: 249-256.
- Biesiadka, E. (1974) — Hydracarina of the River Raha and some of its tributaries. — Acta hydrobiol. 16, 1: 31-50.
- Biesiadka, E. (1975) — Materiały do znajomości wodopójek (Hydracarina) wód podziemnych Polski, z opisem czterech nowych gatunków (Contribution à la connaissance des Hydracariens des eaux souterraines de Pologne, avec la description de quatre espèces nouvelles). — Fragm. faun. 20, 7: 77-113.
- Chodorowska, W. & Chodorowski, A. (1958) — Badania fauny wodnej jaskiń tatrzańskich (investigations of water fauna in caves of the Tatra Mts.). — Materiały IV Zjazdu Hydrobiologów Polskich w Krakowie.
- Chodorowska, W. & Chodorowski, A. (1960) — Ugrupowania fauny wodnej w jaskiniach tatrzańskich (Groupements de la faune aquatique dans les cavernes des montagnes des Tatras). — Speleologia 2, 1: 57-62.
- Chodorowska, W. & Chodorowski, A. (1963) — Recherches sur la biologie aquatique des grottes des montagnes Tatras. — Actes IIe CIS 2: 94-97.
- Chodorowski, A. (1959) — Kilka danych o warunkach środowiskowych zbiorników wodnych w jaskiniach tatrzańskich (Quelques données sur les études du milieu de petits réservoirs d'eau dans les grottes des montagnes Tatras). — Speleologia 1, 1/2: 39-85.
- Doroszewski, M. (1960) — Pare uwag o występowaniu wymoczków w jaskiniach (Quelques remarques sur l'apparition des Infusoires dans les cavernes). — Speleologia 2, 1: 41-49.
- Doroszewski, M. (1963) — L'apparition des Infusoires dans les cavernes des montagnes des Tatras et leur rôle écologique. — Actes IIe CIS 2: 74-77.
- Fischer, E. (1963) — L'eau des réservoirs des grottes des montagnes Tatras au point de vue micro-biologique. — Actes IIe CIS 2: 78.

- Gadzińska, E. (1974) — *Cernovitoviella parviseta* sp. n. — a new species of Enchytraeidae (Oligochaeta) from the Polish Tatra Mountains. — *Bull. Acad. pol. Sci. ser. biol.* 22, 6: 403-404.
- Gieysztor, M. (1938) — Über eine Turbellarie aus dem Süßwasserpsammon. — *Arch. Hydrobiol. Ryb.* 11: 364-382.
- Golemansky, V. (1969) — Sur une biocénose thécamoébienne peu connue des eaux souterraines littorales des mers. — *Abstr. 3rd Int. Congr. Protozool.* 194.
- Golemansky, V. (1970) — Contribution à la connaissance des Thécamoébiens (Rhizopoda, Testacea) des eaux souterraines littorales du golf du Gdafiak (Pologne). — *Bull. Inst. Zool. Mus. Sofia* 32: 77-87.
- Golemansky, V. (1973) — Deuxième contribution à la connaissance des Thécamoébiens (Rhizopoda, Testacea) du psammon littoral de la Mer Baltique. — *Bull. Inst. Zool. Mus. Sofia* 38: 49-60.
- Golemansky, V. (1974a) — *Lagenidiopsis valkanovi* gen. n., sp. n. — un nouveau Thécamoébien (Rhizopoda: Testacea) du psammon supralittoral des mers. — *Acta protozool.* 13, 1: 1-4.
- Golemansky, V. (1974b) — *Psammonobiotidae* fam. nov. — une nouvelle famille de Thécamoébiens (Rhizopoda, Testacea) du psammon supralittoral des mers. — *Acta protozool.* 13, 11: 137-141.
- Grochowski, M. (1904) — O rodzaju studniczka (*Niphargus*) (On the genus *Niphargus*). — *Kosmos* 29: 31-50, 81-100, 266-301.
- Haeckel, K. (1908) — *Niphargus aquilex* im Odergebiet. — *Zool. Anz.* 32: 430-431.
- Hrabe, S. (1954) — Různonožci — Amphipoda (in:) *Klíč zvěřiny CSR*, 1, Praha.
- Jakubisiak, S. (1929) — Sur les Harpacticidae observés en Pologne. — *Bull. Soc. Zool. France* 54, 3: 191-193.
- Jaworowski, A. (1893a) — Fauna studzienna miast Krakowa i Lwowa (Well fauna of Kraków and Lwów). — *Sprawozd. Kom. Fizjogr. PAU* 28: 29-48.
- Jaworowski, A. (1893b) — Nowe gatunki fauny studziennej miast Krakowa i Lwowa (New species of well fauna of Kraków and Lwów). — *Sprawozd. Dyrektora C. K. IV Gimnazjum we Lwowie*: 3-44.
- Jaworowski, A. (1895) — Neue Arten der Brunnenfauna von Krakau und Lemberg. — *Archiv für Naturgeschichte* 1, 1: 319-345.
- Karaman, G. S. (1974) — 58. Contribution to the knowledge of the Amphipoda. Genus *Synurella* Wrzes. in Yugoslavia with remarks on its all World known species, their synonymy, bibliography, and distribution (fam. Gammaridae). — *Poljoprivreda i sumarstvo* 20, 2/3: 83-133.
- Kowalski, K. (1951-1954) — *Jaskinie Polski* (Caves of Poland), I-III, Warszawa.
- Kowalski, K. (1955) — Fauna jaskiń Tatr Polskich (Cave fauna of the Polish Tatra Mts.). — *Ochr. Przyr.* 23: 283-333.
- Maschke, K. (1936) — Die Metazoenfauna der Bergwerke bei Mährisch-Altschloß. — *Beitr. zur Biol. des Glatzer Schneeberges* 2: 175-191.
- Micherdziński, W. (1956) — Taksonomia i ekologia *Niphargus tatrensis* Wrześniowski 1888 (Amphipoda) (Taxonomy and ecology of *Niphargus tatrensis*). — *Ann. zool.* 16, 9: 81-134.
- Muszyńska, M. (1962) — Skąposzczety Oligochaeta (in:) *Katalog fauny Polski*, XI, 2, Warszawa.
- Muszyński, A. (1936) — Ein neuer Vertreter der Gattung *Trichodrilus* Clap. (*Trichodrilus speleus* nov. spec.) aus dem Stollen in Neu-Klessengrund. — *Beitr. zur Biol. des Glatzer Schneeberges* 2: 214-216.
- Pateff, P. (1926) — Süßwasser-Rhizopoden aus der Höhle Salzlöcher (Schlesien). — *Mitt. über Höhlen und Karstforschung* 2: 46-49.
- Pax, F. (1936) — Die Reysdorf-Tropfsteinhöhle und ihre Tierbevölkerung. — *Ibidem* 3: 97-122.
- Pax, F. & Maschke, K. (1935) — Die Höhlenfauna des Glatzer Schneeberges. 1. Die rezente Metazoenfauna. — *Beitr. zur Biol. des Glatzer Schneeberges* 1: 4-72.
- Prószyńska, M. (1963) — Les Copepoda Cyclopoida des grottes des montagnes Tatras. — *Actes IIe CIS* 2: 73.
- Roszczak, R. (1939) — Die Psammitgastrotricha des polnischen Ostseestrandes. — *Zool. Pol.* 4: 1-23.
- Schellenberg, A. (1933) — Weitere deutsche und ausländische *Niphargiden*. — *Zool. Anz.* 102, 1/2: 22-33.

- Schellenberg, A. (1935) — Höhlenamphipoden des Glatzer Schneeberges. — Beitr. zur Biol. des Glatzer Schneeberges 1: 72-75.
- Schellenberg, A. (1937) — Bemerkungen zu meinem Niphargus-Schlüssel und zur Verbreitung und Variabilität der Arten, nebst Beschreibungen neuer Niphargus-Formen. — Mitt. Zool. Mus. Berlin 22: 1-30.
- Skalska, B. & Skalski, A. W. (1969) — The recent fauna of the Polish caves. — Actes IVe CIS 4/5: 213-223.
- Skalski, A. W. (1967) — Charakterystyka współczesnej fauny Szczeliny Chocholowskiej w Tatrach (Characteristics of the recent fauna from the Szczelina Chocholowska cave in the Tatra Mts.). — Prace Muzeum Ziemi 11: 281-290.
- Skalski, A. W. (1970) — The hypogean gammarids in Poland. — Acta hydrobiol. 12, 4: 431-437.
- Skalski, A. W. (1972) — Distribution des Amphipodes souterrains en Pologne, avec notes sur la variabilité du *Niphargus tatrensis* Wrześniowski. — Actes I. Coll. Int. Niphargus, Mem. Mus. Civ. St. Nat. Verona 5: 47-53.
- Skalski, A. W. (in litt.) — *Niphargus casimiriensis* sp. n. — a new species of hypogean gammarid from Poland (Amphipoda, Gammaridae). — Ann. zool.
- Stammer, H. J. (1936a) — Die Wasserfauna der Schneeberghöhlen. — Beitr. zur Biol. des Glatzer Schneeberges 2: 199-214.
- Stammer, H. J. (1936b) — Die aquatile Fauna der Reyersdorfer Höhle. — Mitt. über Höhlen und Karstforschung 3: 125-129.
- Sywula, T. (1974a) — The ostracods (Ostracoda) of the River Raha and of certain aquatic environments connected with it. — Acta hydrobiol. 16, 3/4: 255-271.
- Sywula, T. (1974b) — Małżorzeczki Ostracoda (in:) Fauna słodkowodna Polski 24, Warszawa — Poznań.
- Wisniewski, J. (1934a) — Les mâles des Rotifères psammiques. — Mém. Acad. pol. Sci. math. nat., 6: 143-165.
- Wisniewski, J. (1934b) — Les Rotifères psammiques. — Ann. Mus. Zool. Pol. 10, 19: 339-399.
- Wisniewski, J. (1935) — Notes sur le psammon II. Rivière Czarna aux environs de Varsovie. — Arch. Hydrobiol. Ryb. 9, 3/4: 221-238.
- Wisniewski, J. (1936a) — Notes sur le psammon III. Deux tourbières aux environs de Varsovie. — Ibidem 10, 3: 173-187.
- Wisniewski, J. (1936b) — Notes sur le psammon IV-V. — Ibidem 10, 1-3.
- Wisniewski, J. (1937) — Différenciation écologique des Rotifères dans le psammon d'eaux douces. — Ann. Musei Zool. Pol. 12, 1: 1-13.
- Wisniewski, J. (1954) — Fauna wrótków Polski i rejonów przyległych (Rotifera of Poland and adjacent regions). — Pol. Arch. Hydrobiol. 1: 317-490.
- Wrześniowski, A. (1888) — O trzech kielzach podziemnych. — Pam. Fizjogr. 8: 1-110.
- Wrześniowski, A. (1890) — Über drei unterirdische Gammariden. — Zeit. Wiss. Zool. 50: 600-724.
- Vandel, A. (1965) — Biospeleology. The biology of cavernicolous animals, Pergamon Press.