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ANDRZEJ GAŹDZICKI & PAMELA REID

Upper Triassic Involutinidae (Foraminifera) of Lime Peak in Yukon, Canada

ABSTRACT: Tethyan benthic foraminifera of the family Involutinidae Bütschli have been discovered in the Upper Triassic sequence at the Lime Peak, Yukon (North Western Canada). Five species belonging to the genera *Aulotortus* Weynschenk and *Triasina* Majzon are recognized. The presence of *Triasina oberhauseri* Koehn-Zaninetti & Brönnimann in the involutinid assemblage indicates a Norian age for the investigated strata.

INTRODUCTION

The majority of involutinid foraminifera occurring in the Late Triassic of the Tethyan realm are represented by the genera: *Aulotortus* Weynschenk, *Auloconus* Piller, and *Triasina* Majzon (*see* Zaninetti 1976, Piller 1978, Gaździcki 1983). They have been used to erect local zonation (Salaj 1969, 1977; Gaździcki 1974, 1983) and they may also be of prime importance in regional biostratigraphic correlations and paleogeographic reconstructions (Brönnimann, Whittaker & Zaninetti 1975, Gaździcki & Smit 1977, Gaździcki & Gupta 1981).

This paper records the discovery of involutinids from the Late Triassic of North America. The occurrence of these involutinids, far distant from their counterparts in the Tethyan realm, casts a new light on the paleobiogeographic position of North Western America at the end of the Triassic (*see* also Gaździcki & Stanley 1983).

The investigated involutinid foraminifera are in thin sections made from Lime Peak rocks (Text-fig. 1), and are housed in the Institute of Paleobiology of the Polish Academy of Sciences, Warsaw, Poland (abbreviated as *ZPAL*).

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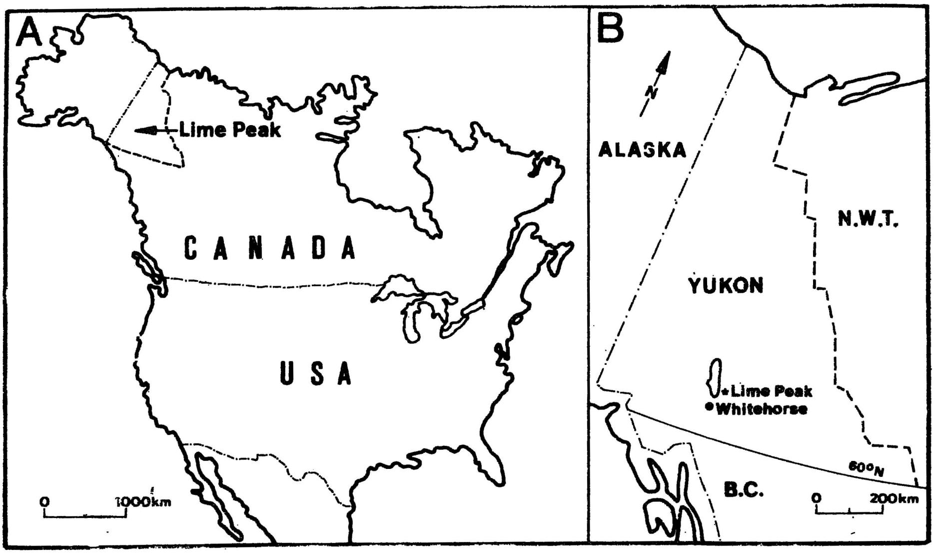


Fig. 1. Location of the study area

A — Location of the Yukon Territory and Lime Peak (*arrowed*) in the generalized map of North America; **B** — Large scale map of the Yukon Territory showing position of Lime Peak and Whitehorse

GEOLOGICAL SETTING

The Canadian Cordillera is divided into five structural and physiographic belts (Text-fig. 2). The Upper Triassic carbonate facies in which involutinid foraminifera were found, occur in the Intermontane belt of the Yukon Territory (*i.e.*, the Whitehorse Trough). The general geology of the Whitehorse Trough was described by Tempelman-Kluit (1978, 1979). It was a Mesozoic basin in which were deposited Upper Triassic and Lower Jurassic fanglomerate and flysch (derived from a volcano-plutonic arc to the southwest) intercalated with discontinuous lenticular carbonates. The prevalence of volcano-clastic sediments and the variable nature of the carbonates reflect the tectonic instability of this area (Reid & Tempelman-Kluit 1982).

The discontinuous lenticular shape of the Upper Triassic carbonates in the Whitehorse Trough has been interpreted in two ways. Tozer (1958) and Wheeler (1961) proposed that the irregularities were caused by erosional unconformities, but Tempelman-Kluit (1979) suggested that the irregular carbonates are the reefs (*see* also Reid 1981, Stanley 1982).

Lime Peak is located near the southeastern end of Lake LaBerge, approximately 40 km northeast of Whitehorse (Text-fig. 1). The mountain extends northeast-southwest along Thomas Lake about 3.5 km and north of the lake about 3 km (Text-fig. 1 and Pl. 1, Figs 1—2).

FACIES UNITS AND DISTRIBUTION OF FORAMINIFERA

The Lime Peak carbonates are well-exposed and they show multiple stages of reef growth and a complete facies zonation from massive reefal limestone to offlapping slope and basinal sediments (Pl. 1, Figs 1—2).

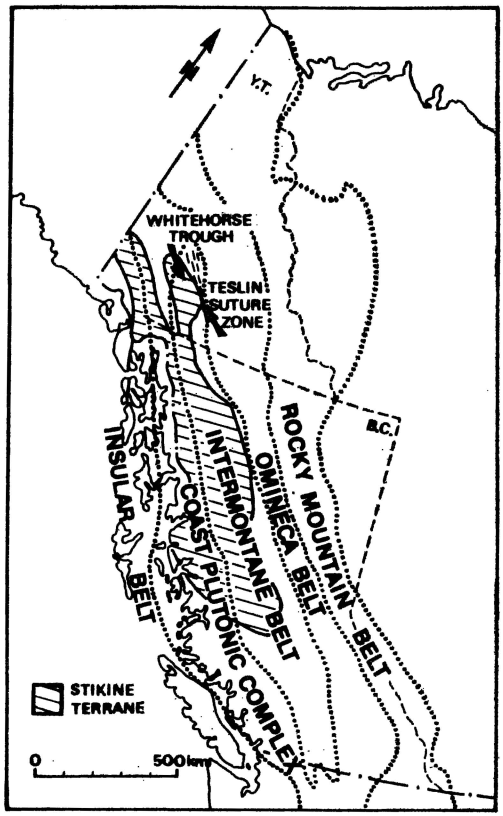


Fig. 2

Map of the Canadian Cordillera showing the five structural and physiographic belts and Stikine terrane (*after* Monger & Price, 1979)

The reefoid structure of Lime Peak is divided into a few facies units which interfinger each other (Text-fig. 3). Four main rocks types were recognized in the field: massive light grey-brown limestone, bedded limestone, dark shaley limestone, and limestone breccia (*see* Reid 1981).

The involutinid foraminifera (*see* Text-fig. 3 and Pl. 1, Figs 1—2) were found in the massive reefal limestones (sample: *LPU-1*) and bedded limestones (samples: *LPL-9* and *R-80-21-6*).

The massive limestones vary both in thickness and lithology. Thickness varies from a few meters to over 100 m; lithology ranges from peloidal mudstones to organic framestones containing spongiomorphs, tabulozoans and calcareous sponges. Contributions from corals, brachiopods, moluscs, algae, foraminifera and echinoderms to the lithology are less significant. Rare involutinid foraminifera are represented by *Triasina oberhauseri* (see Pl. 3, Figs 1—2). Other foraminiferal genera include *Ophthalmidium* and *Diplotremina*. Skeletons and bioclasts are often encrusted and bound with dark biogenic (algal?) coatings, and voids are commonly lined with radial fibrous cements and subsequently filled with sediment. The massive limestones are interpreted as reefal by Reid (1981).

The bedded limestone unit (Text-fig. 3 and Pl. 1, Figs 1—2) is an alternation of thick beds of reef-derived debris with thinner beds containing attached spongiomorphs, thick-shelled pelecypods, large gastropods and also sponge and corals which colonized the debris layers. Involutinids are represented by common *Aulotortus gaschei* (*see* Pl. 2, Figs 4—7), a few *Aulotortus tumidus* (*see* Pl. 3, Figs 5—6, 7a) and *Aulotortus sinuosus* individuals and two forms possibly referable to ?*Trocholina* (*see* Pl. 3, Fig. 7b). Other foraminifera occurring with the involutinids are: *Variostoma* sp. (common), and rare *Duotaxis* cf. *birmanica, Planiinvoluta carinata, Earlandia* sp., *Trochammina* sp., *Agathammina* sp., *Ammobaculites* sp., and nodosariids. This unit is interpreted as slope deposits by Reid (1981).

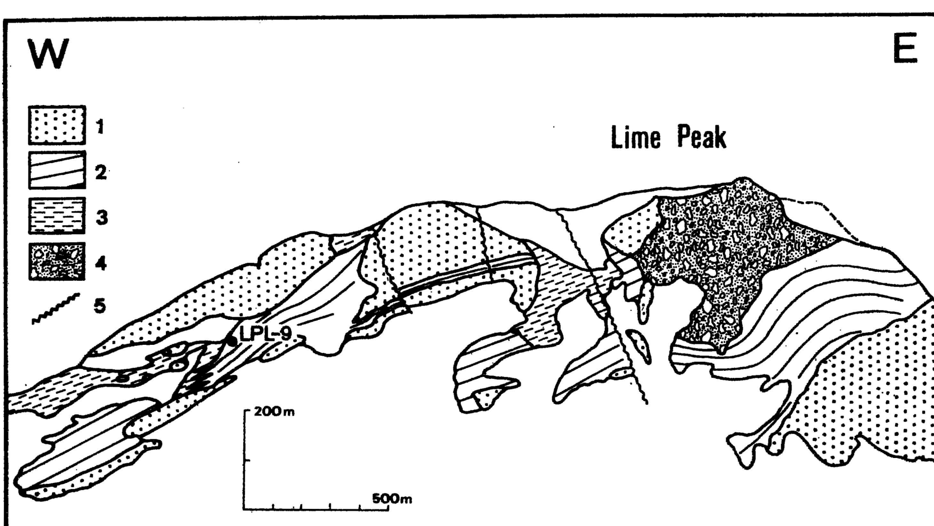
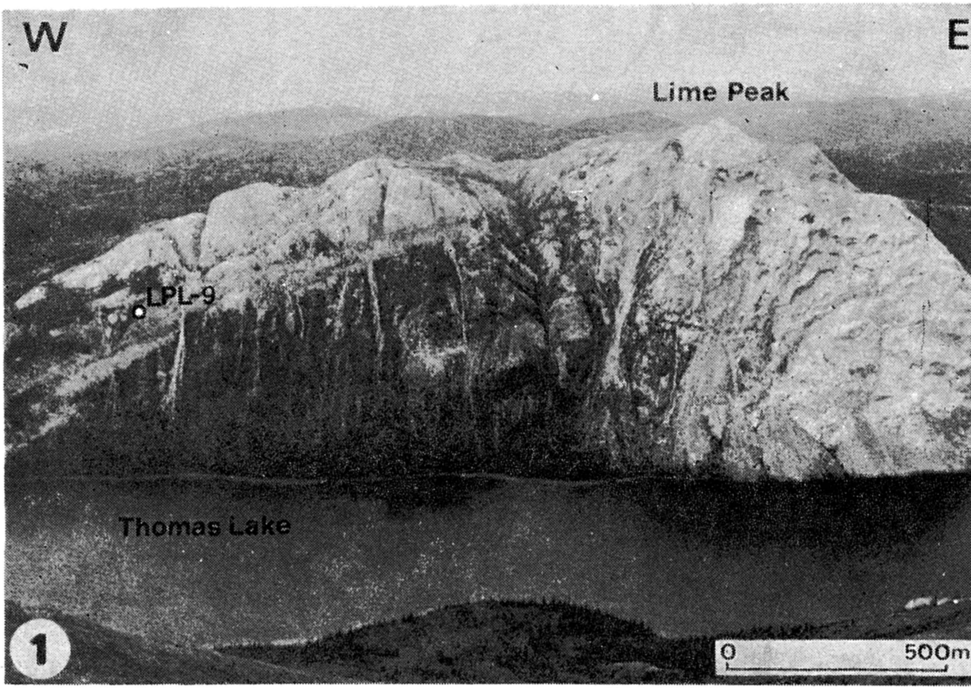
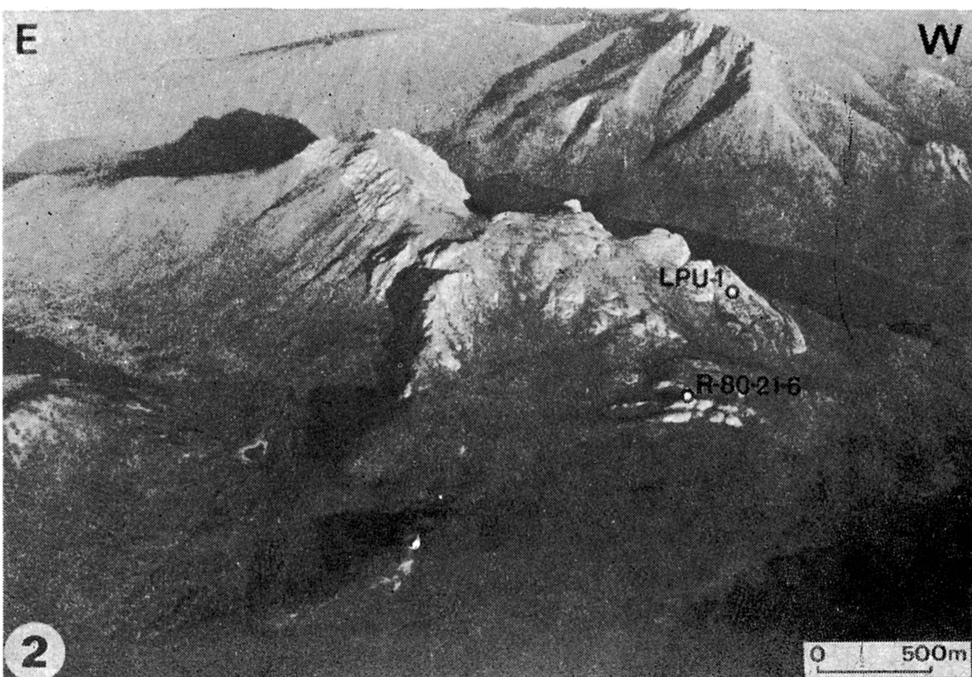


Fig. 3. Distribution of main rock types on the southern slope of Lime Peak; sampling site *LPL-9* is indicated

1 — massive reefal limestone, 2 — bedded limestone (slope deposits), 3 — shaley limestone (basinal sediments), 4 — limestone breccia, 5 — fault





1 — Southern slope of Lime Peak; 2 — Aerial view of Lime Peak from the north-west, both to show the sampling sites (*LPL-9, LPU-1* and *R-80-21-6*) with involutinid foraminifera

INVOLUTINID ASSEMBLAGE AND ITS AGE

The reefal and bedded limestones of Lime Peak are composed mainly of spongiomorphs, tabulozoans, sponges and corals. Within assemblages formed by those organisms, locally the foraminifera of the family Involutinidae Bütschli, 1880, have been also significant microfaunal component of the community.

Recognized assemblage of the involutinids from reefal limestone comprises:

Triasina oberhauseri Koehn-Zaninetti & Brönnimann, 1968 — Pl. 3, Figs 1—2
?*Triasina* sp. — Pl. 3, Figs 3—4

Involutinid assemblage from bedded limestone comprises:

Aulotortus gaschei (Koehn-Zaninetti & Brönnimann, 1968) — Pl. 2, Figs 4—7
Aulotortus sinuosus Weynschenk, 1956 — Pl. 2, Fig. 9
Aulotortus cf. *sinuosus* Weynschenk, 1956 — Pl. 2, Fig. 8
Aulotortus tumidus (Kristan-Tollmann, 1964) — Pl. 3, Figs 5—6, 7a
Aulotortus sp. — Pl. 2, Figs 1—3 and Pl. 3, Fig. 8
?*Trocholina* sp. — Pl. 3, Fig. 7b

In the above assemblages the species *Aulotortus gaschei* is dominant, whilst *A. sinuosus, A. tumidus* and *Triasina oberhauseri* are represented by a few specimens only. The bedded limestone is distinctly richer than the reefal limestone in species variety and total number of individuals.

The state of preservation of the involutinid tests is generally satisfactory although a more or less advanced sparitization makes difficult recognition of the detailed structure of some specimens (*see* Pl. 3, Figs 1—4). The method presented by Delgado (1977) proved very useful during the current study for the recognition of the internal structure of the involutinid test in thin sections. It made it possible to see underdeveloped segmentation of deuteroloculus in the strongly recrystallized *Triasina oberhauseri* specimens (Pl. 3, Figs 1—2).

The identified involutinid assemblages permit assignment of the investigated strata to the Norian. This age is particularly indicated by the presence of *Triasina oberhauseri,* an index fossil of the *oberhauseri* Partial-range-zone (Gaździcki 1983).

The studied Norian involutinid foraminifera of Lime Peak are similar to the contemporanous assemblages from the Tethyan realm (*cf.* Zaninetti 1976, Piller 1978, Gaździcki 1983) although they are impoverished in number of species as well individuals.

PALEOGEOGRAPHIC REMARKS

The Upper Triassic involutinid foraminifera are geographically extensive in their distribution. They have been recorded from shallow water carbonates of the Tethyan realm from the Rif Mts in Morroco through the Alps and Himalayas to the Calamian Islands and Papua

New Guinea (*see* Gaździcki 1983). The occurrence of Upper Triassic Involutinidae in the carbonate sequence of Lime Peak extends their known geographic range. However, it is difficult to explain their occurrence in the area located so far from the Tethyan region.

New concepts on microplates and displaced terranes in Western North America suggest that much, if not all of the Cordilleran region is allochthonous with respect to the North American craton (Irving 1979; Beck, Cox & Jones 1980; Monger & Irving 1980). It is quite probable that some of these microplates originated closer to the Tethyan region (*see also* Gaździcki & Stanley 1983). The striking similarity between the Upper Triassic carbonate facies and involutinid assemblages of Lime Peak and those of the Tethyan realm (Flügel 1981, 1982; Stanley 1982) tends to support the allochthonous concept models.

Institute of Paleobiology
of the Polish Academy of Sciences,
Al. Żwirki i Wigury 93,
02-089 Warszawa, Poland
(A. Gaździcki)

Rosenstiel School of Marine
and Atmospheric Science,
University of Miami,
Fisher Island Station,
Miami Beach, Florida 33139, U.S.A.
(P. Reid)

REFERENCES

BECK M., COX A. & JONES D. L. 1980. Mesozoic and Cenozoic microplate tectonics of western North America (Penrose Conference Report). *Geology*, **8**, 454—456. Boulder, Colorado.

DELGADO F. 1977. Primary textures in dolostones and recrystallized limestones: a technique for their microscopic study. *J. Sedim. Petrol.*, **47** (3), 1339—1341. Menasha, Wisconsin.

FLÜGEL E. 1981. Paleoecology and facies of Upper Triassic reefs in the Northern Calcareous Alps. *In*: TOOMEY D. F. (*Ed.*), European fossil reef models (*Soc. Econ. Paleont. Miner. Special Publication*, no. 30), 291—359. Tulsa, Oklahoma.
— 1982. Evolution of Triassic reefs: current concepts and problems. *Facies*, **6**, 297—327. Erlangen.

GAŹDZICKI A. 1974. Rhaetian microfacies, stratigraphy and facies development in the Tatra Mts. *Acta Geol. Polon.*, **24** (1), 17—96. Warszawa.
— 1983. Foraminifers and biostratigraphy of the Upper Triassic and Lower Jurassic of the Slovakian and Polish Carpathians. *Palaeont. Polon.*, **44**, 109—169. Warszawa—Kraków.
— & GUPTA V. J. 1981. Triassic foraminifers Involutinidae from the West Carpathians and Himalayas — its stratigraphic and palaeobiogeographic implications. *Bull. Ind. Geol. Assoc.*, **14** (2), 101—106. Chandigarh.
— & SMIT O. E. 1977. Triassic foraminifers from the Malay Peninsula. *Acta Geol. Polon.*, **27** (3), 319—332. Warszawa.
— & STANLEY G. D. Jr. 1983. First report of Involutinidae (Foraminifera) in marine Triassic rocks of North America. *N. Jb. Geol. Paläont. Mh.*, **2**, 80—90. Stuttgart.

IRVING E. 1979. Paleopoles and paleolatitudes of North America and speculations about displaced terrains. *Canad. J. Earth Sci.*, **16**, 669—694. Ottawa.

MONGER J. W. H. & IRVING E. 1980. Northward displacement of northcentral British Columbia. *Nature*, **285** (5763), 289—294. London.

— & PRICE R. A. 1979. Geodynamic evolution of Canadian Cordillera — progress and problems. *Canad. J. Earth Sci.*, **16**, 771—791. Ottawa.

PILLER W. 1978. Involutinacea (Foraminifera) der Trias und des Lias. *Beitr. Paläont. Österreich*, **5** (1), 1—164. Wien.

REID P. 1981. Lime Peak: a well-developed Upper Triassic reef complex in Northern Canada. Abstracts of papers; *International Symp. on Triassic Reefs, Erlangen*, 45—46. Erlangen.

— & TEMPELMAN-KLUIT D. 1982. An association of reefal carbonates and volcano-clastics in the Upper Triassic of the Yukon Territory, Canada. Abstracts of papers; *Eleven International Congres on Sedimentology, Hamilton, Ontario, Canada*, p. 110, Hamilton.

SALAJ J. 1969. Essai de zonations dans le Trias des Carpathes Occidentales d'après les Foraminifères. *Geol. Práce, Správy*, **48**, 123—128.. Bratislava.

— 1977. Contribution à la microbiostratigraphie du Trias des Carpathes Occidentales tchécoslovaques. *Actes du VI^e Colloque Africain de Micropaléont. — Tunis 1974, Ann. des Mines et de la Géol.*, **28**, 103—127. Tunis.

STANLEY G. D. Jr. 1982. Triassic carbonate development and reef-building in Western North America. *Geol. Rundschau*, **71** (3), 1057—1075. Stuttgart.

TEMPELMAN-KLUIT D. J. 1978. Reconnaissance geology, LaBerge map area, Yukon. Current Research, part A. *Geol. Survey of Canada, Paper* **78**-1A, 61—66. Ottawa.

— 1979. Transported cataclasite, ophiolite and granodiorite in Yukon: evidence of arc-continent collision. *Geol. Survey of Canada, Paper* **79**-14, 1—27. Ottawa.

TOZER E. T. 1958. Stratigraphy of the Lewes River Group (Triassic), central LaBerge area, Yukon Territory. *Geol. Survey of Canada, Bull.*, **43**, 1—28. Ottawa.

WHEELER J. O. 1961. Whitehorse map-area, Yukon Territory. *Geol. Survey of Canada, Memoir*, **312**, 1—156. Ottawa.

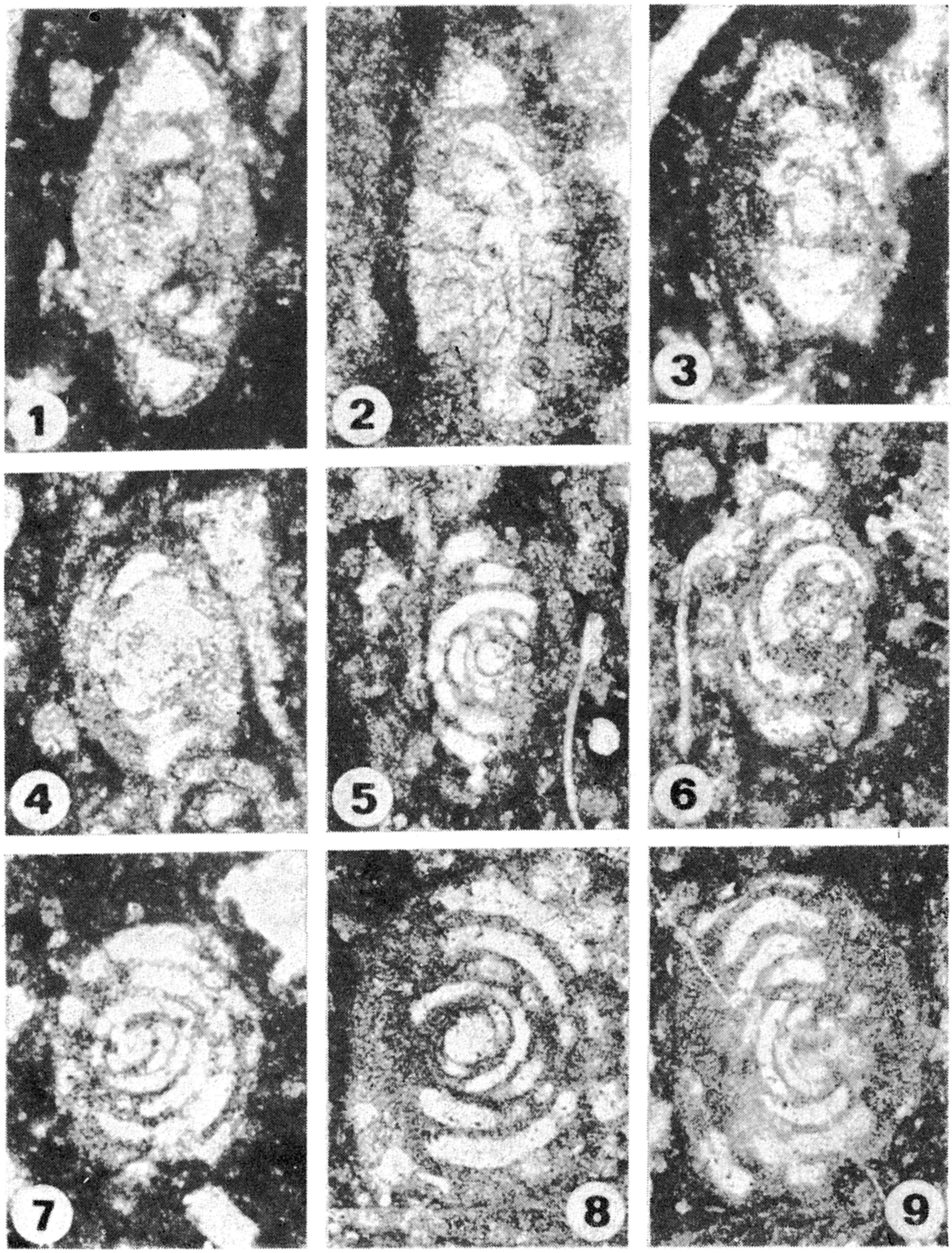
ZANINETTI L. 1976. Les Foraminifères du Trias. Essai de synthèse et corrélation entre les domaines mésogéens européen et asiatique. *Riv. Ital. Paleont.*, **82** (1), 1—257. Milano.

A. GAŹDZICKI i P. REID

OTWORNICE INVOLUTINIDAE Z GÓRNOTRIASOWEJ SEKWENCJI LIME PEAK W KANADZIE

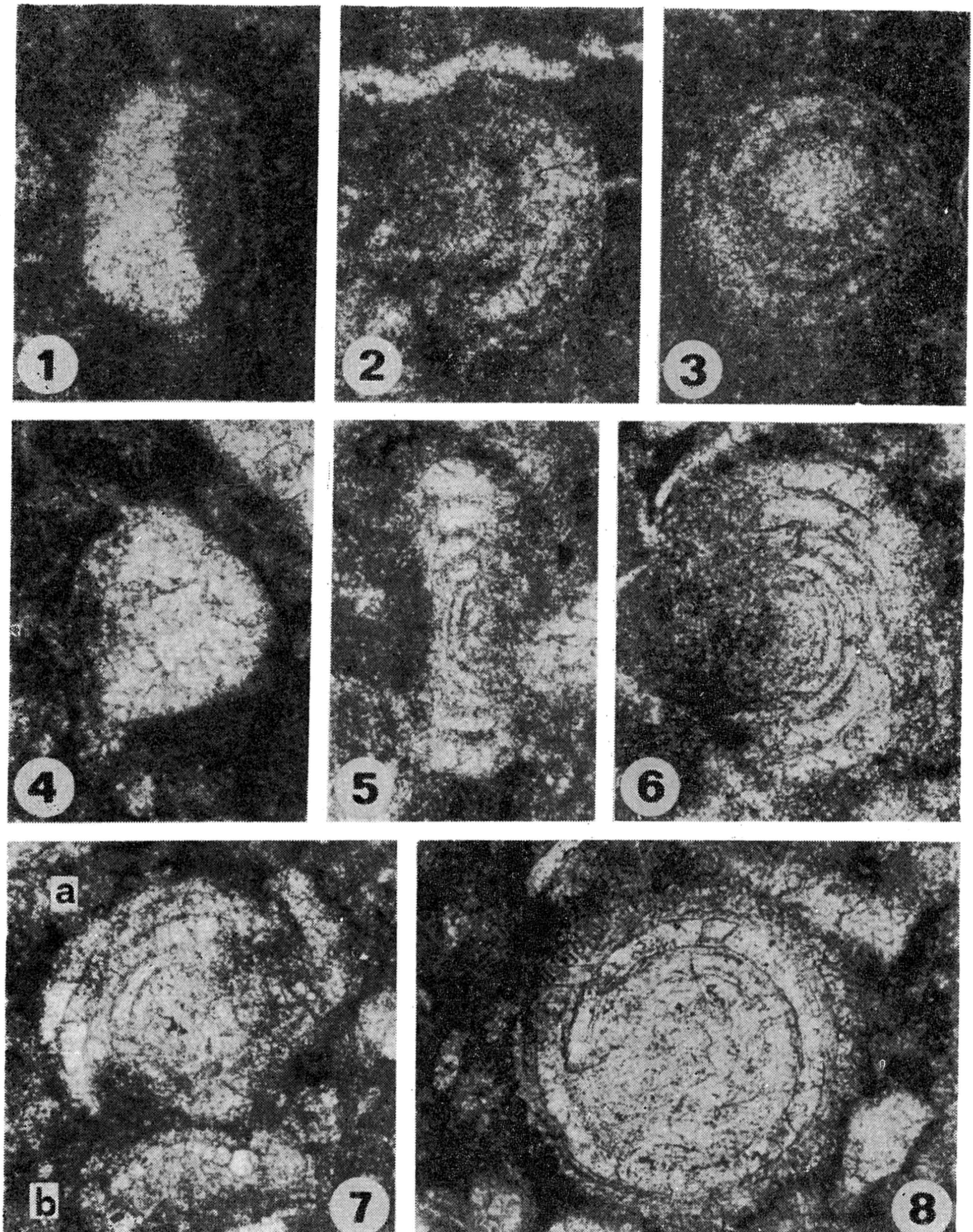
(Streszczenie)

W rafowych utworach górnego triasu Lime Peak (Terytorium Jukon) w Kanadzie znaleziono tetydzkie otwornice bentoniczne z rodziny Involutinidae Bütschli (*patrz* fig. 1—3 oraz pl. 1). Rozpoznano między innymi (*patrz* pl. 2—3): *Triasina oberhauseri* Koehn-Zaninetti & Brönnimann, *Aulotortus gaschei* (Koehn-Zaninetti & Brönnimann), *A. sinuosus* Weynschenk oraz *A. tumidus* (Kristan-Tollmann). Obecność w tym zespole gatunku *Triasina oberhauseri* — taksonu wskaźnikowego dla poziomu ścieśnionego *oberhauseri* — dokumentuje norycki wiek rozpatrywanych osadów (*por.* Gaździcki 1983). Stwierdzenie obecności triasowych inwolutin z dala od ich rodzimej, tetydzkiej prowincji rzuca z kolei nowe światło na paleogeograficzną pozycję Ameryki Północno-Zachodniej u schyłku triasu.



Norian Involutinidae of Lime Peak

1 — *Aulotortus* sp.; axial section (ZPAL F./R-80-21-6), ×150
2 — *Aulotortus* sp.; subaxial section (ZPAL F./LPL-9), ×140
3 — *Aulotortus* sp.; axial section (ZPAL F./R-80-21-6), ×150
4—7 — *Aulotortus gaschei* (Koehn-Zaninetti & Brönnimann): 4 — axial, 5—6 subaxial, 7 — subequatorial section (ZPAL F./R-80-21-6), ×140
8 — *Aulotortus* cf. *sinuosus* Weynschenk; subequatorial section (ZPAL F./R-80-21-6), ×140
9 — *Aulotortus sinuosus* Weynschenk; axial section (ZPAL F./R-80-21-6), ×130



Norian Involutinidae of Lime Peak

1—2 — *Triasina oberhauseri* Koehn-Zaninetti & Brönnimann: 1 — axial section, ×75; 2 — subaxial section, ×60 (ZPAL F./LPU-1)
3—4 — ?*Triasina* sp.; 3 — equatorial, 4 — oblique section (ZPAL F,/LPU-1), ×60
5—6 — *Aulotortus tumidus* (Kristan-Tollmann); 5 — axial, 6 — oblique section (ZPAL F./LPL-9), ×140
7a — *Aulotortus tumidus* (Kristan-Tollmann), oblique section; **7b** — ?*Trocholina* sp., axial section (ZPAL F./LPL-9), ×140
8 — *Aulotortus* sp.; equatorial section (ZPAL F./LPL-9), ×140