

Palaeocopida (Ostracoda) across the Permian–Triassic events: new data from southwestern Taurus (Turkey)

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ABSTRACT – The Palaeocopida have been considered as an entirely Palaeozoic group and their disappearance as a marker for the Palaeozoic–Mesozoic boundary. Despite this, 11 Palaeocopida species have been recorded in the Early Triassic. New data obtained in southwestern Taurus at the Permian–Triassic section of Çürük dağ, permit an assessment of this problem. This paper synthesizes the data on lowermost Triassic ostracodes and revises the youngest Palaeocopida occurrences. A new Early Triassic Palaeocopida species is described (*Reviya curukensis* n. sp.). *J. Micropalaeontol.* 23(1): 67–76, May 2004.

INTRODUCTION

For all marine biota, the end-Permian mass extinction is the most dramatic event of the Phanerozoic. At the end of the Permian, 49–57% of marine families, 83% of genera and 96% of species disappear (Sepkoski, 1992; Erwin, 1993; Jablonski, 1994; Benton, 1995; Lethiers 1998; note that the figures vary according to author).

As with other marine organisms, benthic ostracods are subject to the effects of calamitous events (among others, the great end-Permian regression followed by the quick and dysoxic Lower Triassic transgression, the modifications of climates and oceanic circulation, the salinity drop, the volcanism, linked with Pangea assemblage; synthesis in Lethiers, 1998).

The Early Triassic marine ostracods are poorly known. Some species have been mentioned, in greater or less detail, from the Early Triassic (Induan–Olenekian) of northwestern Australia (Jones, 1970), Pakistan (Sohn, 1970), the Precaspian Depression (Schneider 1948, 1960; Kukhtinov & Crasquin-Soleau, 1999), Nepal (Kozur, 1971), Kashmir (Agarwal, 1979, 1980, 1981), the Germanic Basin (Kozur, 1972), Israel (Hirsch & Gerry, 1974), South China (Wang, 1978; Wei, 1981; Hao, 1992, 1994) and Greece (Crasquin-Soleau & Baud, 1998).

The Çürük dağ section (N36°41'32"–E30°27'40") is located in western Taurus, in the Antalya Nappes (Turkey), SW of Antalya (Fig. 1) (Lys & Marcoux, 1978; Crasquin-Soleau *et al.*, 2002). The Pamucak Formation (Middle–Upper Permian) is overlain by the Kokarkuyu Formation (Lower Triassic) (Lys & Marcoux, 1978; Marcoux & Baud, 1986). In the Çürük dağ section (Fig. 1), the Pamucak Formation is a thick (400–600 m) succession of inner to outer platform facies (Capitanian to Changhsingian; dating by Foraminifera and calcareous algae; Lys & Marcoux, 1978; Marcoux & Baud, 1986). The lowest Triassic levels are rich in Induan Foraminifera (*Ammodiscus*, *Rectocornuspira*, *Cyclogira*, *Earlandia*) and rare in conodonts (*Isarcicella isarcica staeschei* (Dai & Zhang) and *Hindeodus parvus* (Kozur & Pjatakova)) (Crasquin-Soleau *et al.*, 2002). This association is an index of the second conodont Triassic biozone (Lai & Mei, 2000).

In the Upper Permian samples, the ostracod assemblage is similar to other Middle and Upper Permian assemblages observed in the Palaeo-Tethys (see, for example, Crasquin-

Soleau & Baud, 1998; Crasquin-Soleau *et al.*, 1999). It is mainly made up of Bairdiacea (*Bairdia*, *Petasobairdia*, *Acratia*, *Fabaliocypris*, *Liuzhinia*, *Macrocypris*, *Baschkirina*, *Microcheilinella*), with a minor amount of Quasillitacea (*Graphiodactyllis?*), Cavellinacea (*Sulcella*) and Cypridacea (*Basslerella*, *Arqoviella?*, *Callicythere*). The Palaeocopida are represented by genera common in the Palaeo-Tethys, such as *Hollinella*, *Knoxiella*, *Permoyoungiella* and *Sargentina*. The ostracod assemblage is characteristic of a marine platform environment, deposited under a tropical climate.

In the basal beds of the Kokarkuyu Formation (Lower Triassic), the ostracods are represented by Bairdiacea (mainly the genera *Bairdia*, *Bairdiocypris*, *Liuzhinia*), Cavellinacea (*Sulcella?*) and by Palaeocopida (Kirkbyacea, *Reviya curukensis* n. sp., and an undetermined Paraparchitacea). This assemblage, which has a lower specific and generic diversity than the assemblages observed in the Upper Permian beds, seems to indicate a shallower environment and/or with salinity variations, always under a tropical climate.

It has long been thought that the Palaeocopida (ostracods with a straight dorsal border) became extinct during the Permian and their presence was considered as an index of Palaeozoic age. However, Palaeocopida have been reported from the Early Triassic of Pakistan (Olenekian), Australia (Induan), South China (Induan and Olenekian) and Hungary (Late Early Induan) (Table 1, with references).

Ostracods of the lower part of the Kokarkuyu Formation in the Çürük dağ section are the oldest Triassic forms figured and described to date, coming from the *parvus* and *staeschei* Biozones. The Palaeocopida, Kirkbyacea, here discovered, are the youngest observed outside of South China and Pakistan. Ostracodes were mentioned in the lowermost Triassic of Dolomites (Werfen Formation, Italy) by Broglio Loriga *et al.* (1986), but they have never been studied.

Furthermore, these findings are very important in the understanding of a critical aspect of the end-Permian mass extinction – the anomalous pattern of the post-extinction recovery, which seems to be significantly delayed for most clades (Erwin, 1998; Twitchett, 1999; Rong & Shen, 2002). Even if the ostracod assemblage at the base of the Kokarkuyu Formation shows a low specific and generic diversity, it increases the

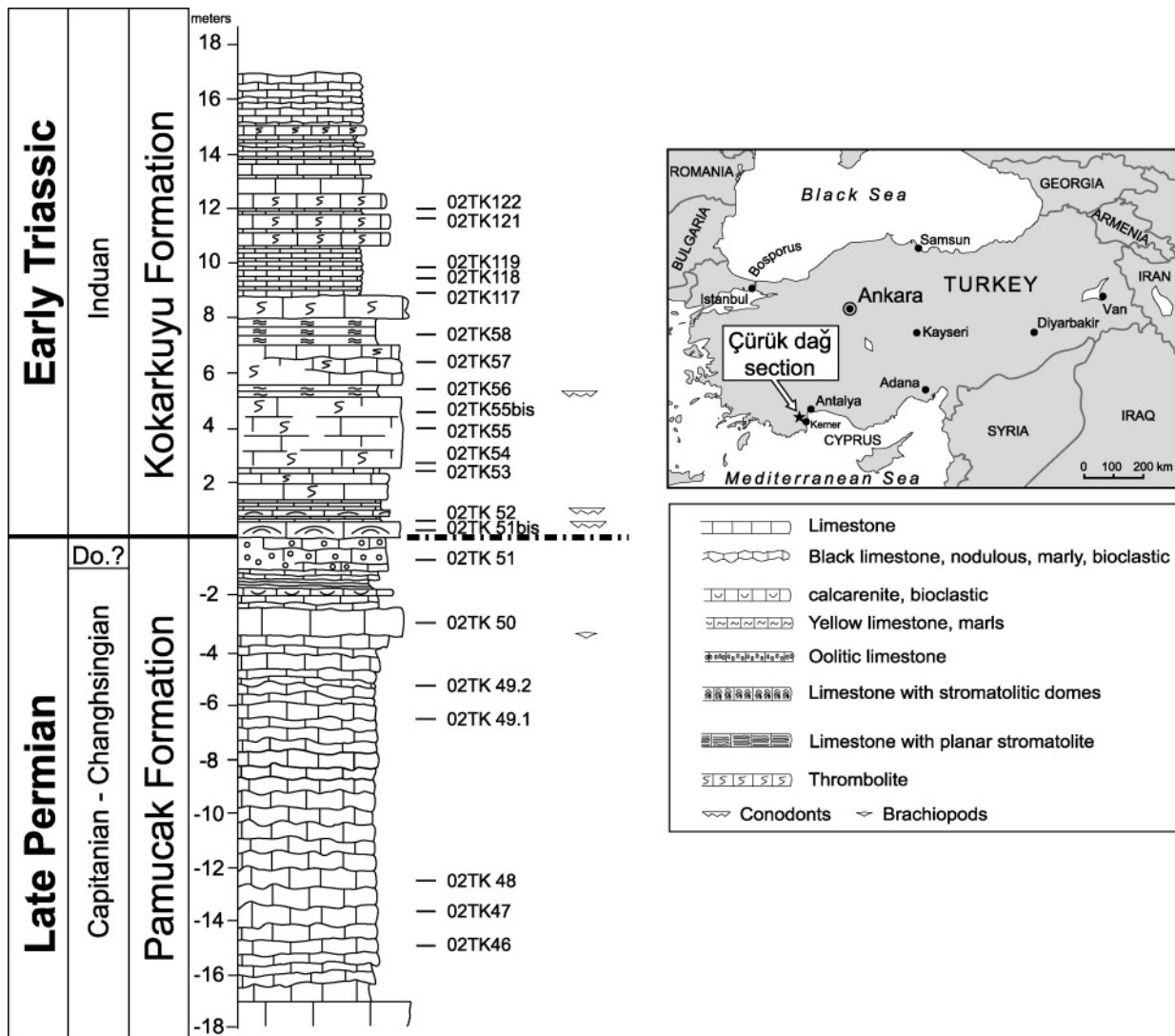


Fig. 1. Çürük dağ section, with location of ostracod-bearing samples.

number of Lower Triassic ostracods known, with the occurrence of 12 species, one of which – at least – is new. This could suggest that there are places – free from low oxygen restriction – where the recovery of benthic groups was more rapid.

PALAEOCOPIIDA ACROSS THE PERMIAN–TRIASSIC BOUNDARY

In 1961, in the ‘Treatise of Invertebrate Paleontology – Part Q: Ostracoda’ (Moore, 1961), the order Palaeocopida Henningsmoen, 1953 was reported to range from the Early Ordovician to the Middle Permian. Scott (*in* Moore, 1961) defined the Palaeocopida as follows: ‘dorsal margin long and straight; surface smooth or ornamented; lobes, sulci, ventral and adventral structures common; calcareous inner lamella absent; dimorphic or non-dimorphic; soft parts unknown’. They are marine.

In the Treatise, the stratigraphic range was questionably extended up to Recent because the superfamily Punciacea is referred, with doubt, to this order. Kozur (1993) erected a new

order, the Reticulocopida (Ordovician–Recent), bringing the Palaeozoic Kirkbyacea and Late Cretaceous–Recent Punciacea together. The problem of relationships between Kirkbyacea and Punciacea was discussed by Becker (1997 with previous references). Kozur (1998) published new Upper Triassic Punciacea genera and species which are, in his opinion, the missing link between the Punciacea and Kirkbyacea. Horne *et al.* (2002) confirmed that the Punciacea belong to the Palaeocopida with a few genera such as *Manawa* and *Promanawa*. In both cases, this is a Palaeozoic order with isolated Recent representatives, with a great gap during almost all of the Mesozoic, due to the lack of data during this time interval.

Middle and Late Permian Palaeocopida

Since 1961, numerous papers have been published with reference to Middle and Late (International scale – decision of IUGS (Beijing, 1996) and taken up by Waterhouse (1997)) Permian ostracods. Table 2 lists some of the papers where Palaeocopida were described and/or reported (not an exhaustive list).

Authors	Sohn (1970)	Jones (1970)	Zheng (1976)	Wang (1978)	Wei Ming (1981)	Kozur (1985)	Hao (1992)	Hao (1994)	Crasquin-Soleau <i>et al.</i> (2002, and this paper)
Age and location	Late Induan - Early Olenekian Salt Range (Pakistan)	Induan Perth Basin (Australia)	Early Mesozoic (SW China)	Early Induan W Guizhou and NE Yunnan (South China)	Induan - Olenekian Sichuan (South China)	Late early Induan Bükk Mts (Hungary)	Induan Guizhou (South China)	Induan Guizhou (South China)	Early Induan Çürük dağ (Turkey)
Palaeocopid species									
<i>Carinaknightina carinata</i> Sohn, 1970									
<i>C. discarinata</i> Sohn, 1970									
<i>C. neutrum</i> (Jones, 1970)		<i>Praegium neutrum</i>							
<i>C. zhenfengensis</i> Hao, 1992	= <i>C. aff carinata</i>								
<i>Hollinella tingi</i> (Patte, 1935)									
<i>Hollinella unispinata</i> Hao, 1992									
<i>Hollinella</i> sp. sensu Jones, 1970									
<i>H. cf. plana</i> Jiang, 1983 sensu Hao, 1992									
<i>H. cf. tingi</i> (Patte, 1935) sensu Hao, 1992									
<i>Langdaia suboblonga</i> Wang, 1978									
<i>Roundyella? papilliformis</i> Wang, 1978									
<i>Reviya curukensis</i> n.sp.									

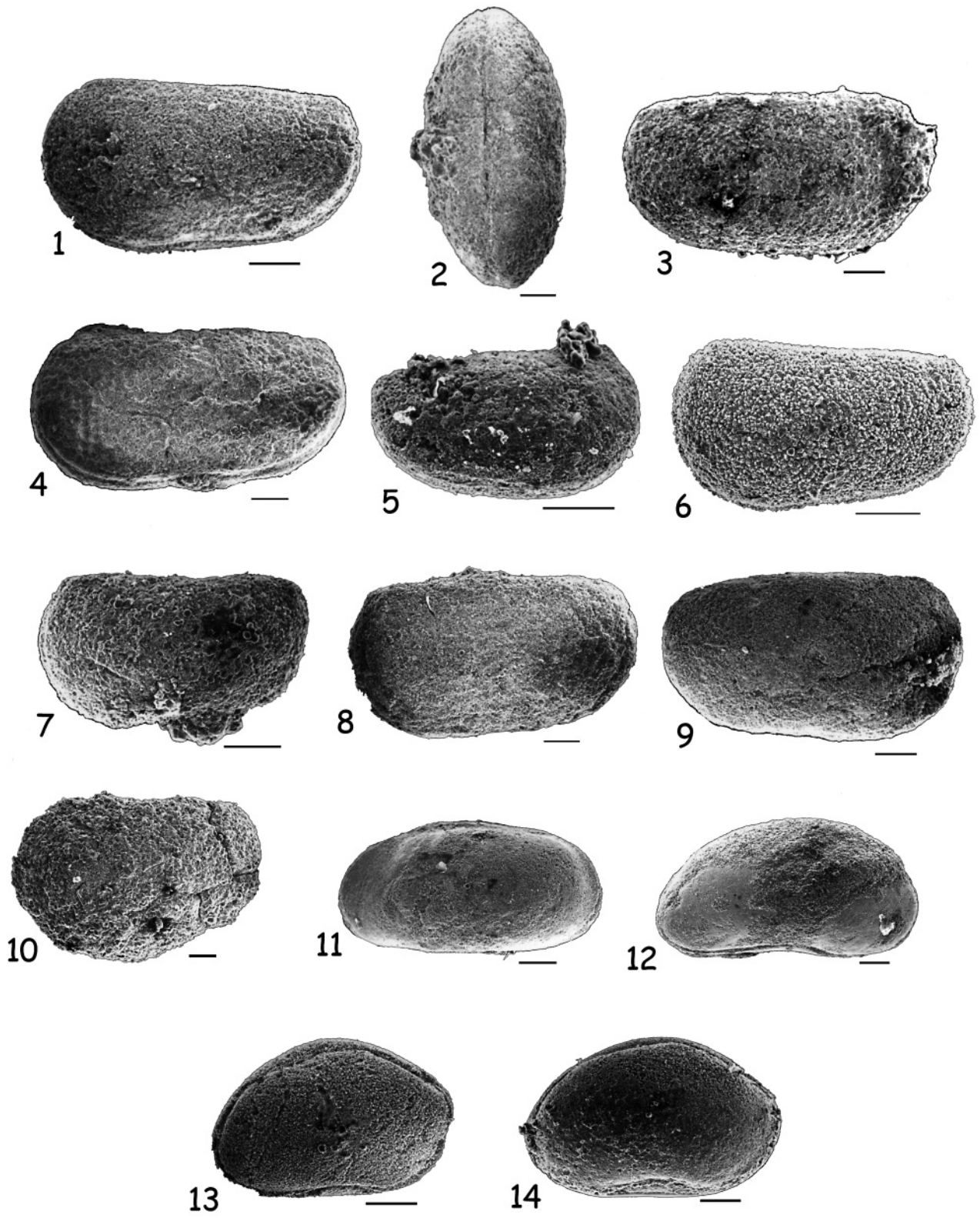
Grey boxes, papers where the species is described and/or figured and/or mentioned; crossed boxes, papers where the species is regarded as crossing the Permian–Triassic boundary.

Table 1. Early Triassic palaeocopid species in literature.

Reference	Geographical area/comment
Hamilton (1942*)	North American Platform
Schneider (1948, 1960), Kotschekova (1959*)	Russian Platform
Ishizaki (1964)	Japan
Belousova (1965)	Armenia
Krömmelbein (1958), Knüpfer (1967), Ivanov (1975), Woszczyńska (1987)	Zeichstein – Central Europe
Khivintseva (1969)	Southwestern Russian Platform
Sohn (1970)	West Pakistan
Bless & Jordan (1972)	Synthesis on Hollinellidae Family
Zalanyi (1974), Kozur (1985a, 1985b, 1991)	Bükk Mountains (Hungary)
Wang (1978)	South China (Guizhou and Yunnan)
Chen & Shi (1982)	South China (Jiangsu and Hubei)
Shi & Chen (1987)	South China (Meishan)
Gerry <i>et al.</i> (1987)	Israel
Lethiers <i>et al.</i> (1989)	Tunisia
Becker & Wang (1992)	China
Kolar-Jurkovšek & Jurkovšek (1995)	Slovenia
Olempska & Blaszyk (1996)	Spitsbergen
Gramm (1997)	Far Eastern Russia
Crasquin-Soleau & Baud (1998)	Greece
Crasquin-Soleau <i>et al.</i> (1999, 2001), Angiolini <i>et al.</i> (2003), Crasquin-Soleau (2003)	Interior Oman

*Papers published before the Treatise but not taken into account in it.

Table 2. Sources describing Palaeocopida from the Middle and Late Permian.



Early Triassic Palaeocopida

Belousova (1965) described the ostracod fauna of the Late Permian (Dzulfian=Wuchiapingian)–Early Triassic (Induan) from Dzhulfa section (Armenia). She figured 26 species, among which, 19 are new. In this paper, eight species cross the Permian–Triassic boundary. She reported two species of Palaeocopida in the Early Triassic: *Amphissites notabilis* Belousova, 1965 and *Hollinella cushmani* Kellett, 1933; this last species is a junior synonym of *Hollinella bassleri* (Kellett, 1928) (Bless & Jordan, 1972). Chao (1965) and Tozer (1967) considered this part of the section to be latest Permian.

In 1970, Sohn published the marine ostracod fauna (13 species belonging to ten genera) from the Early Triassic of the Salt and Sugar Ranges (West Pakistan). Particularly, the Palaeocopida *Carinaknightina carinata* Sohn, 1970, *Carinaknightina* aff. *carinata* Sohn, 1970, *Carinaknightina discarinata* Sohn, 1970 and Kirkbyidae gen. spp. indet. are described.

In 1970, Jones presented the Early Triassic ostracods from the Perth Basin (Western Australia). He recognized a new species, *Praegnum neutrum* Jones, 1970, which belongs to the genus *Carinaknightina* erected the same year by Sohn (1970). This species and *Hollinella* sp. are the two palaeocopids occurring in the Early Triassic of the Perth Basin.

In 1976, Zheng published a paper on Early Mesozoic ostracods from Southwestern China and recognized *Hollinella tingi* (Patte, 1935) in the Early Triassic.

Wang (1978) found two Palaeocopida in the Early Triassic of the southern border of South China: *Hollinella tingi* and a species of a new genus *Langdaia suboblonga* Wang, 1978. Wei (1981) recovered these two species from the Early Triassic of the Sichuan (South China).

Kozur (1985a) defined ostracod assemblage zones with biostratigraphic value in the Late Palaeozoic–Early Triassic of the Bükk Mountains (Hungary). According to that author, *Hollinella tingi* s.s. (this *sensu stricto* is not explained) occurs in Europe, associated with *Isarcicella isarcica* (conodont index of the second biozone of Triassic/Induan/Griesbachian) and in China in *Ophiceras*-bearing beds (Griensbachian). He considered the base of the *Hollinella tingi* assemblage zone as ‘a good marker for the Permo-Triassic boundary’. He defined the lower and the upper boundaries of the assemblage zone by the appearance and the disappearance of *Hollinella tingi* (Kozur, 1985a: 239).

In 1992, Hao presented 11 species from the Early Triassic from Guizhou (South China); he described three new species, two Palaeocopida among them: *Hollinella unispinata* Hao, 1982

and *Carinaknightina zhenfengensis* Hao, 1982 (synonym of *Carinaknightina* aff. *carinata sensu* Sohn, 1970) associated with the following Palaeocopida: *Carinaknightina carinata*, *Hollinella tingi*, *Hollinella* cf. *plana* Jiang, 1983, *Hollinella* cf. *tingi* and *Langdaia suboblonga*.

In conclusion, in the literature 11 Palaeocopida species belonging to five genera are considered to occur in the Early Triassic (Table 1).

In the Çürük dağ section, the authors have recognized two new Palaeocopida in the earliest Triassic. One species is described below (*Reviya curukensis* n. sp. Crasquin-Soleau). The other one is more problematic and the attribution should be taken with caution (*Paraparchitidae* sp. indet.) due to poor preservation of the material (Pl. 1, fig. 10).

Palaeocopida across the Permian–Triassic boundary

In the literature, three Palaeocopida species were reported to cross the Permian–Triassic boundary: *Hollinella tingi*, *Hollinella unispinata* and *Roundyella? papilliformis* Wang, 1978 (Table 3). Podocypid species – *Fabalicypis reniformis* (Chen, 1958) (Bairdiacea) and *Basslerella obessa* Kellett, 1935 (Cytheracea) – are recognized by Hao (1992, 1994) to survive to the mass extinction. These two species were not found in the Çürük dağ section and are not discussed further. On the other hand, *Bairdia subsymmetrica* (Shi, 1987), described in the Changhsingian of Meishan (South China) (Shi & Chen, 1987), is present in the earliest Triassic of the Kemer area (Pl. 1, figs 13–14), thus, crossing the Permian–Triassic boundary.

Hollinella tingi was described as *Beyrichia tingi* by Patte (1935), from the Early Permian T’ungstzu and Takuhsinch’ang Districts of South China. The preservation is poor and it was described based on external moulds on sample surfaces. According to Bless & Jordan (1972), this species is very poorly known.

In 1954, Hou recognized this species in the Upper Permian black shales of the Chihhsia Formation (Western Hupei, South China). Hou described cardinal spines, missing in the original description. This author rightly attributed the species to the genus *Hollinella*.

In 1964, Ishizaki assigned specimens discovered in the Early Pennsylvanian (Late Carboniferous) of Japan to *Hollinella tingi*. The preservation of the figured specimen (Ishizaki, 1964: pl. 1, fig. 1) is so bad that it is quite impossible to confirm the assignment.

In 1978, Wang wrote that *Hollinella tingi* occurs in the Late Changhsingian and Early Induan of Western Guizhou and

Explanation of Plate 1.

figs 1–9. *Reviya curukensis* Crasquin-Soleau n. sp. (All specimens from Kokarkuyu Formation, Induan, Early Triassic): **1**, holotype, left lateral view, collection number P6M1467, sample 02TK56; **2**, dorsal view, collection number P6M1470, sample 02TK56; **3**, paratype, right lateral view, collection number P6M1468, sample 02TK56; **4**, paratype, left lateral view, collection number P6M1469, sample 02TK57; **5**, right lateral view, collection number P6M1471, sample 02TK58; **6**, left lateral view, collection number P6M1472, sample 02TK55bis; **7**, left lateral view, collection number P6M1473, sample 02TK56; **8**, left lateral view, collection number P6M1474, sample 02TK118; **9**, right lateral view, collection number P6M1475, sample 02TK58. **fig. 10.** *Paraparchitacea* gen. and sp. indet., left lateral view, collection number P6M1476, sample 02TK118, Kokarkuyu Formation, Induan, Early Triassic. **fig. 11.** *Callicythere* sp., right lateral view, collection number P6M1477, sample 02TK47, Pamucak Formation, Capitanian–Changhsingian, Middle–Late Permian. **fig. 12.** *Liuzhinia* cf. *parva* Wei 1981, right lateral view, collection number P6M1478, sample 02TK46, Pamucak Formation, Capitanian–Changhsingian, Middle–Late Permian. **figs 13–14.** *Bairdia subsymmetrica* (Shi 1987) (specimens from Kokarkuyu Formation, Induan, Early Triassic, sample 02TK57): **13**, right lateral view, collection number P6M1479; **14**, right lateral view, collection number P6M1480. Scale bar for all figures is 100 µm. All specimens come from the Çürük dağ section, Antalya Nappes, Taurus, Turkey, N36°41’32–E30°27’40. Specimens are stored in the Pierre et Marie Curie University Collection, Paris, France.

Palaeocopida species		<i>Carinaknightina carinata</i>	<i>Carinaknightina discarinata</i>	<i>Carinaknightina neutrum</i>	<i>Carinaknightina zhenfengensis</i>	<i>Hollinella cf. plana</i> sensu Hao, 1992	<i>Hollinella tingi</i>	<i>Hollinella cf. tingi</i> sensu Hao, 1992	<i>Hollinella unispinata</i>	<i>Hollinella sp.</i> sensu Jones, 1970	<i>Langdata suboblunga</i>	<i>Roundyella? papilliformis</i>	<i>Reviya curukensis</i> n. sp.
Olenekian	Late												
	Early	☒	☒	☒	☒						☒		
Induan	Late	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	Early	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
Permian	Late						?					☒	
	Middle												
	Early						☒						
Carboniferous	Late						??						

Grey boxes, occurrence in reference list; crossed boxes, occurrence considered as valid in this paper.

Table 3. Revised distribution of Early Triassic palaeocopid species.

Northeastern Yunnan. The figured specimens (Wang, 1978: pl. 1, figs 5–7) are relatively close to Hou's specimens. However, the specimen figured (pl. 1, fig. 6) has a higher ratio height/length and a small node on L3; the specimens figured in Wang's pl. 1 (figs 5 and 7) show more arched L1 and the lobes are more rounded.

In 1981, Wei figured (pl. 1, figs 1–3) three specimens from the Induan–Olenekian of Sichuan, assigned to *Hollinella tingi*. The first two (Wei, 1981: pl. 1, figs 1 and 2) are very badly preserved and the assignment must be considered dubious. The specimen figured in Wei (1981: pl. 1, fig. 3) shows an anterior border very different (on this specimen the curvature radius is definitely shorter) than the Patte (1935) & Hou (1954) specimens.

In 1985a (pl 13, fig. 3), Kozur figured a corroded and abraded specimen from the Werfenian (Induan) of the Bükk Mountains (Hungary). It is impossible to give this specimen an assignment at the species level. Furthermore, it is not reasonable to use this species as a stratigraphic index for the Permian–Triassic boundary as suggested by that author.

In 1987, Shi & Chen figured specimens of *Hollinella tingi* from the Early and Middle Changhsingian of Meishan section. The specimen figured (pl. 16, fig. 2) is close to the type species and seems to present the cardinal spines. The three other specimens (Shi & Chen, 1987: pl. 16, figs 2–5) are very badly preserved and/or broken and could not be assigned. Shi & Chen (1987) studied all the Changhsingian and did not report the species from the upper part of the section.

Hao (1992, 1994) described specimens of *Hollinella tingi* found in the Induan of Guizhou. The specimens figured in 1992 (Hao: pl. 1, figs 5–6) do not belong to *Hollinella tingi*. The first one has a very different lateral outline (pl. 1, fig. 5) and the second one (pl. 1, fig. 6) shows strong reticulation in front of L1

and seems to have a ventral ridge. In 1994, Hao figured ostracods from the Permian–Triassic interval. *Hollinella tingi* from the Triassic (Hao, 1994: pl. 1, fig. 2) is the same picture as in the 1992 paper; the Permian specimen (pl. 1, fig. 6) is close to the type species but it shows a strong punctuation and the cardinal spines are not visible.

In conclusion, *Hollinella tingi* occurs in the Early Permian (Patte, 1935; Hou, 1954). It could occur in the Late Permian (Shi & Chen, 1987). Its presence in the Late Carboniferous is very doubtful (Ishizaki, 1964). The species is not present in the Triassic.

In 1992, Hao described *Hollinella unispinata* from the Induan of Guizhou (South China). In 1994, Hao displayed the occurrence of *Hollinella unispinata* in the Late Permian but without explanation or figures. He repeated this for *Roundyella? papilliformis* described by Wang in 1978 in the Late Permian from Western Guizhou and Northeastern Yunnan, i.e. he put an occurrence in the Early Triassic without explanation. So the range of the two species across the Permian–Triassic boundary has not yet been proven.

Worthy of note is the indisputable occurrence of the genus *Hollinella* in the Early Triassic (Jones, 1970; Wang, 1978; Wei, 1981; Kozur, 1985a; Hao, 1992, 1994).

The ostracod fauna discovered in the Çürük dağ section provides new data, with 28 species occurring in the Late Permian and 12 in the earliest Triassic (Table 4). Concerning the Palaeocopida, the occurrence of the new species *Reviya curukensis* proves the survival of this genus into the Triassic. One specimen, badly preserved, seems to belong to Paraparchitacea (Pl. 1, fig. 10), which be confirmed by further study.

Two Triassic genera, *Callicythere* (Cytheracea) and *Liuzhinia* (Bairdiacea) (Pl. 1, figs 11–12), are recognized for the first time

Permian – 28 species	Triassic – 12 species
<i>Acratia changxingensis</i> (Shi, 1987)	<i>Bairdia</i> cf. <i>piscariformis</i> Chen, 1958
<i>Acratia</i> n. sp. 1	<i>Bairdia</i> n. sp.
<i>Arqoviella?</i> n. sp.	<i>Bairdia</i> sp. <i>B</i>
<i>Bairdia</i> sp. <i>A</i>	<i>Bairdia subsymmetrica</i> (Shi, 1987)^b
<i>Baschkirina</i> n. sp.	<i>Bairdiacypris</i> n. sp. (aff. <i>ventralis</i>)
<i>Basslerella tota</i> Chen & Bao, 1986	<i>Bairdiacypris</i> sp. 2
<i>Callicythere</i> n. sp.^a	<i>Bairdiacypris</i> sp.1
<i>Cavellina</i> cf. <i>visnyoensis</i> Kozur, 1985	<i>Bairdiacypris?</i> n. sp.
<i>Fabalitypris parva</i> Wang, 1978	<i>Liuzhinian</i> . sp.
<i>Graphiadactyllis?</i> sp.	Paraparchitacea indet.^c
<i>Hollinella</i> (<i>H.</i>) <i>herrickiana</i> (Girty, 1909)	<i>Reviya curukensis</i> Crasquin-Soleau n. sp.^d
<i>Hollinella</i> (<i>H.</i>) cf. <i>martensi</i> Crasquin-Soleau, 1999	<i>Sulcella?</i> cf. <i>mesopermiana</i> Kozur, 1985
<i>Hollinella</i> (<i>H.</i>) n. sp.	
<i>Hollinella</i> sp.	
<i>Knoxella infirma</i> Shi, 1982	
<i>Liuzhinia</i> cf. <i>parva</i> Wei, 1981^a	
<i>Macrocypris</i> cf. <i>deducta</i> Zarányi, 1974	
<i>Macrocypris?</i> <i>panxianensis</i> Wang, 1978	
<i>Macrocypris?</i> sp. <i>A</i>	
<i>Microcheilinella</i> sp.	
<i>Permoyoungiella bogschi</i> Kozur, 1985	
<i>Petasobairdia</i> cf. <i>subnantongensis</i> Chen, 1982	
<i>Petasobairdia nantongensis</i> Chen, 1987	
<i>Reviya?</i> sp.	
<i>Sargentina</i> cf. <i>woutersi</i> Crasquin-Soleau, 1999	
<i>Sargentina</i> n. sp.	
<i>Sulcella sulcata</i> Coryell & Sample, 1932	
<i>Sulcella</i> cf. <i>suprapermiana</i> Kozur, 1985	

^aTriassic genera recognized for the first time in Late Palaeozoic.

^bSpecies which survive to Permo-Triassic events.

^cFirst occurrence of the superfamily in Triassic.

^dLate Palaeozoic genus recognized for the first time in Triassic.

Table 4. Ostracod species of the Çürük dağ section near the Permian–Triassic boundary.

in the Permian. One species of Bairdiacea crosses the Permian–Triassic boundary in the Çürük dağ section, namely *Bairdia subsymmetrica* (Shi, 1987) (Pl. 1, figs 13–14).

CONCLUSIONS

As yet there is no conclusive evidence to show that individual species of Palaeocopida range across the Permian–Triassic boundary, although it is known that some genera do so (e.g. *Hollinella*, *Carinoknightina* and *Reviya*). To date, 12 species of Palaeocopida are known from lowermost Triassic sediments. It is also possible that members of the Paraparchitacea may survive into the earliest Triassic but this has yet to be proven with certainty.

Three non-palaeocopid Permian species are known to occur in the Early Mesozoic – *Fabalitypris reniformis* (Chen, 1958), *Bairdia subsymmetrica* (Shi, 1987), both belonging to Bairdiacea, and *Basslerella obessa* Kellett, 1935 (Cytheracea). This study revises upwards the ostracod species extinction rate evaluated by Lethiers (1998) for the Permian–Triassic boundary, from 93% to 98%.

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APPENDIX A: TAXONOMY

Order **Palaeocopida** Henningsmoen, 1953

Suborder **Kirkbyocopina** Gründel, 1969

Superfamily **Kirkbyacea** Ulrich & Bassler, 1906

Family **Kirkbyidae** Ulrich & Bassler, 1906

Genus *Reviya* Sohn, 1961

Reviya curukensis Crasquin-Soleau n. sp.

(Pl. 1, figs 1–9)

2002 *Reviya?* sp. 1. Crasquin-Soleau *et al.*: 493, figs 4.6–4.8.

Derivation. From the type locality, Çürük dağ section.

Diagnosis. Species of *Reviya* with posterior border showing smaller curvature radius than anterior border; and reticulation free of anastomosing ridges.

Holotype. One complete carapace (Pl. 1, fig. 1), collection number P6M1467.

Paratypes. Two complete carapaces (Pl. 1, figs 3–4), collection numbers P6M1468 and P6M1469.

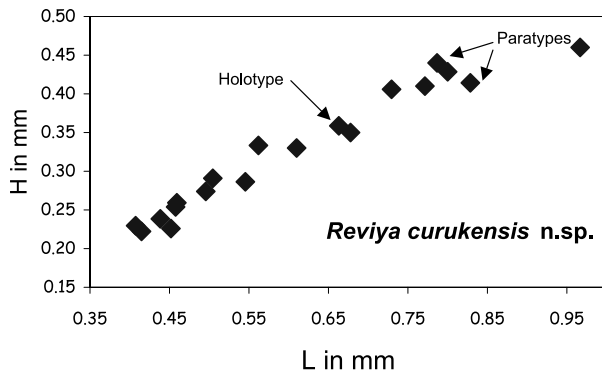


Fig. A1. Height-length diagram of *Reviya curukensis* Crasquin-Soleau n. sp.

Material. Nineteen carapaces, 15 valves and numerous fragments.

Type level. Sample 01TK56, *Hindeodus parvus*–*Isarcicella isarcica* Zone, Early Induan.

Type locality. N36°41'32"–E30°27'40", Çürük dağ section, Antalya Nappes, Taurus, Turkey.

Description. Species of *Reviya* (Kirkbyidae with straight-backed sub-elliptical tumid reticulated carapace without nodes or carinae and with elongate sub-central pit; Sohn, 1961: 141; rewritten by Becker, 1997: 161); right valve larger than left; overlapping along all free margins; anterior border regularly arched with radius of curvature larger than posterior; ventral border slightly concave in median part, stronger on left valve; carapace slightly compressed in antero-ventral part; presence of a smooth and narrow marginal ridge.

Dorsal view biconvex, right valve larger than left; slight depression at pit; maximum width near mid-length; hinge line straight; more compressed than the other species of the genus.

Surface punctuated; sub-central elongated kirkbyian pit, located at the lower third of height.

Comparisons. *Reviya curukensis* n. sp. seems to be closely comparable to *Reviya mimicus* (Geis, 1932) from the Late Mississippian of Indiana from which it differs by its smaller width and its posterior border being less high than the anterior one. It differs from the type species *Reviya obesa* (Cronis & Gale, 1932) by the absence of the reticulation formed by anastomosing ridges sub-parallel to free margins.

Dimensions. Adults: L=0.55–0.97 mm; H=0.29–0.46 mm; W=0.30–0.49 mm (see Fig. A1).

Occurrence. Induan of the Çürük dağ section, Antalya Nappes, Taurus, Turkey; Kokarkuyu Formation, Induan, Early Triassic. Marine.

Stratigraphic remarks. The genus *Reviya* Sohn, 1961 is known in the Late Mississippian (Early Carboniferous). The Early Triassic occurrence of *Reviya curukensis* n. sp. extends the stratigraphic range of the genus from the Late Mississippian up

to the Early Triassic. Another *Reviya* species is present in the Late Permian of the Çürük dağ section (Crasquin-Soleau *et al.*, in press).

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