

New data on mid-Cretaceous dromioid crabs (Crustacea, Decapoda, Brachyura) from northwest Germany and southwest Iran

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A single, slightly laterally compressed carapace of a dromioid crab from the middle/upper Albian part of the Kazhdumi Formation in the Hamiran area (Hormozgan Province, southwest Iran) is described as a new species, which is tentatively assigned to the brachyuran genus *Distefania* Checchia-Rispoli, 1917, *D. (?) tangishirazensis*. This constitutes the first record of the genus from the Middle East. In addition, from the long-defunct Rauhen quarry at Kassenberg, near Mülheim-Broich (northwest Germany), a carapace of *D. incerta* and a rather battered cheliped of the 'form genus' *Roemerus* Bishop, 1983 are recorded from the upper Cenomanian portion of that section, thus adding to previous records of these taxa from Germany.

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Introduction

To date, only a handful of decapod crustacean taxa of Cretaceous age have been recorded from the Islamic Republic of Iran. These comprise an Early Cretaceous (Barremian-Aptian) achelate lobster (Feldmann *et al.*, 2007) from the southwest of the country; ?astacideans (?*Hoploparia*), callianassoids and raninids from the Albian of southeast Isfahan (central Iran; Yazdi *et al.*, 2009); a mecochirid, *Huhatanka iranica*, with associated callianassoids, from the upper Albian of central Iran (Yazdi *et al.*, 2010) and a Late Cretaceous astacidean, *Paraclytia valashtensis*, from the central Alborz Ridge in the north

of the country (McCobb & Hairapetian, 2009). Here we add a new dromioid species, *Distefania(?) tangishirazensis*, from the upper Kazhdumi Formation in the Tang-i-Shiraz section (Hormozgan Province, southwest Iran), of middle/late Albian age.

In addition, we record a single carapace of *Distefania incerta* (Bell, 1863) and an isolated, rather battered cheliped here assigned to the 'form genus' *Roemerus* Bishop, 1983, from the upper Cenomanian portion (*Metoicoceras geslinianum* Zone) of the section once exposed at the classic Kassenberg locality near Mülheim-Broich (western Germany). Slightly younger representatives of these taxa have been recorded from the uppermost Cenomanian (*Praeactinocamax plenus* Zone) of Dresden-Plauen (eastern Germany), as *Cyphonotus incertus* Bell 1862 [sic] and *Necrocarcinus woodwardi* Bell 1862 [sic] by Gründel (1974).

Institutional abbreviations – MB.A, Museum für Naturkunde, Berlin (collections of fossil Arthropods), Germany; OUM, Oxford University Museum of Natural History, Oxford, England.

Geographical and stratigraphical setting

The label with the holotype of *Distefania(?) tangishirazensis* n. sp. (OUM KY.115) reads, 'Codiopsis Marl Group, Albian-Cenomanian boundary, Cretaceous; about 172 feet above base of section at Tang-i-Shirazeh [sic], north-west of Hamiran, Fars-Luristan Coast, Iran, presented by P.E. Kent, 8-11 January 1951 (P.E. Kent no. 4666)'. A comparison with the log that was presented by Kennedy *et al.* (2009, fig. 2), based on unpublished field notes by P.E. Kent, shows lot no. 4666 to have come from 'buff rubbly soft limestone with greenish marl partings', some 52 metres above the base of the section measured at Tang-i-Shiraz. Dr Luc G. Bulot (pers. comm., March 2013) has informed us that the Kazhdumi Formation exposed at the Tang-i-Shiraz section is late early to early late Albian in age, with the crab here described of middle/late Albian age (compare Soleimani, 2009; Rab-bani & Bagheri Tirtashi, 2010; Van Buchem *et al.*, 2010; Vincent *et al.*, 2010).

MB.A 1918a, b and MB.A 1919 were collected from the classic Kassenberg locality near Mülheim-Broich in northwest Germany, widely known for its highly diverse and exceptionally well-preserved macrofaunas (e.g., corals, cephalopods, brachiopods, gastropods and echinoderm; see e.g., Scheer & Stottrop, 1995; Kaplan *et al.*, 1998; Kiel & Bandel, 2004), from a so-called 'Klippen facies' (i.e., rocky shore facies) of early to late Cenomanian age. Both specimens were contained in the private collection of Dr Volker Ebbighausen, which has recently been purchased by the Museum für Naturkunde (Berlin). Kaplan *et al.* (1998, p. 31, fig. 20) noted that the section once exposed at the classic Rauen quarry at Kassenberg ranged from the lower lower Cenomanian (lower *Mantelliceras mantelli* Zone [*Neostlingoceras carcitanense* Subzone] to the *Mantelliceras dixoni* Zone, in so-called 'Rotkalk-Fazies', and into the upper Cenomanian, *Metoicoceras geslinianum* Zone, in greyish green, partially glauconitic marly chalks. The latter is the level that produced MB.A 1918a, b and MB.A 1919. The section is capped by clayey marlstones of early Turonian age, with phosphorite concretions at the base, and upper Turonian glauconitic marl-sandstones with basal hardground and remanié phosphorite concretions.

Systematic palaeontology

Section Podotremata Guinot, 1977

Subsection Dynomeniformia Guinot, Tavares & Castro, 2013

Superfamily Dromioidea De Haan, 1833

Genus *Distefania* Checchia-Rispoli, 1917(?)

(= *Cyphonotus* Bell, 1863, *non* Fischer von Waldheim, 1823)

Type species – *Distefania himeraensis* Checchia-Rispoli, 1917, by original designation.

Included species – See Table 1.

Diagnosis – Front broadly triangular, anterior end straight, steeply downturned; orbits shallow or moderately deep, forwardly directed; fronto-orbital width about 55 % to 65% maximum carapace width; cervical groove deep; well-defined mesogastric region; markedly spined anterolateral margins, with spines sometimes quadrate in shape; carapace ovate, widest at about 60% distance posteriorly; arcuate swellings lateral to cardiac region; posterolateral margin rimmed; postcervical groove and usually weaker branchial groove present (modified from Feldmann *et al.*, 2013, p. 16).

Table 1. Species of *Distefania* Checchia-Rispoli, 1917, arranged according to stratigraphic age (data from Schweitzer & Feldmann, 2010; Klompaker *et al.*, 2012; Feldmann *et al.*, 2013; Jagt *et al.*, 2014). Note that *D. sicula* Checchia-Rispoli, 1917 is a synonym of *D. himeraensis*, while *D. centrosa* Van Straelen, 1940 (northern Spain; Albian) has been synonymised with *D. incerta* (see Klompaker *et al.*, 2012). Whether or not *Stephanometopon granulatum* Bosquet, 1854, from the upper Maastrichtian of the southeast Netherlands and northeast Belgium (see Jagt *et al.*, 2014), should be assigned to *Distefania* cannot be decided at this moment, nor can the status of the genus *Stephanometopon* be determined beyond doubt. Note that two species, *D. (?) tangishirazensis* and *D. (?) vanrijsselti* are referred to the genus with a query, at least for the time being.

Species of <i>Distefania</i>	Geographic and stratigraphic provenance
<i>calva</i> Schweitzer & Feldmann, 2010	Austria; Tithonian
<i>dacia</i> Schweitzer & Feldmann, 2010	Romania; Tithonian
<i>oxythyreiformis</i> (Gemmellaro, 1869)	Sicily (Italy), Austria, Czech Republic; Tithonian
<i>autissiodorensis</i> (Van Straelen, 1936)	France; Hauterivian
<i>renevieri</i> (de Tribolet, 1876)	Switzerland; Barremian-Aptian
<i>sinuosulcata</i> (Wright & Collins, 1972)	south-central England; lower Albian
<i>renefraaijei</i> Klompaker <i>et al.</i> , 2012	northern Spain, south-central England; lower-upper Albian
<i>tangishirazensis</i> n. sp.	southwest Iran; middle/upper Albian
<i>transiens</i> (Wright & Collins, 1972)	southern England; upper Albian
<i>incerta</i> (Bell, 1863)	England, Spain, France, Germany, Austria; upper Albian-upper Cenomanian
<i>himeraensis</i> Checchia-Rispoli, 1917	Sicily (Italy); lower Cenomanian
<i>cryptica</i> (Jagt, Van Bakel & Fraaije, 2007)	southern Belgium; middle Cenomanian
<i>lauginigeri</i> Feldmann <i>et al.</i> , 2013	New Jersey (USA); lower/middle Campanian
<i>vanrijsselti</i> Jagt <i>et al.</i> , 2014	southeast Netherlands; upper Maastrichtian

Distefania(?) tangishirazensis n. sp.

Pl. 1, figs 1, 2.

Type – The holotype, and sole specimen known to date, is OUM KY.115 (ex P.E. Kent Collection, no. 4666), presented by P.E. Kent, 8-11 January 1951.

Diagnosis – Carapace subcircular, length/width ratio *c.* 0.86, widest near mid-length, markedly convex transversely and longitudinally. Rostrum triangular and downturned. Fronto-orbital margin *c.* 46 per cent of maximum width. Anterolateral margin with five rectangular projections, including outer orbital one. Posterolateral margin with four spines of varying size. Mesogastric region raised, with two conspicuous posterolateral swellings. Cervical groove broadly biconvex. Uro-/metagastric region of similar width and length. Cardiac region subpentagonal in outline, with six tubercles of various sizes. Faint, transversely directed branchial groove. Ornament of near-equally sized granules, more closely spaced in anterior portion; larger tubercles on epi-, proto- and mesogastric regions, as well as on meso- and metabranchial regions, the latter with two parallel, transverse rows of tubercles.

Derivation of name – Named after the type locality, Tang-i-Shiraz.

Type locality and stratigraphic level – Tang-i-Shiraz, northwest of Hamiran (Hormozgan Province, southwest Iran); Kazhdumi Formation, upper part; middle/upper Albian (Kennedy *et al.*, 2009; Van Buchem *et al.*, 2010; Vincent *et al.*, 2010).

Description – Carapace of medium size, subcircular, length/width ratio *c.* 0.86, widest near mid-length, markedly convex both transversely and longitudinally. Greatest width and length *c.* 28.9 and 25.7 mm (as preserved), respectively. Rostrum triangular and downturned, but damaged. Orbits rimmed, ovoid in frontal view, but incompletely preserved (Pl. 1, fig. 2); strong outer orbital spine (projection) rectangular, anteriorly directed; frontal margin slightly concave in dorsal view. Fronto-orbital margin *c.* 45 per cent of maximum width. Anterolateral margin, exclusive of outer orbital spine, with four projections, all triangular or rectangular and with tiny spines on top. Posterolateral margin apparently of (near-)equal length to anterolateral margin, with four spines, two larger and rectangular with one smaller in between, and a smaller one more posteriorly (Pl. 1, fig. 1). Posterior margin not preserved.

Epi- and protogastric regions not differentiated, with two and three tubercles, respectively; mesogastric region well-delineated and with two conspicuous posterolateral swellings (Pl. 1, fig. 2); hepatic region subtriangular, with a single large tubercle, delimited from protogastric region by slightly curved, anteriorly directed hepatic groove. Cervical groove broadly biconvex, reaching anterolateral margin between first and second quadrate projections (excluding outer orbital spine). Uro-/metagastric region of similar width and length, divided by faint, almost straight post-cervical groove, connected to epimeral muscle scars; one large (two fused) tubercle on posterior portion (Pl. 1, fig. 1). Cardiac region subpentagonal in outline, longer than wide, well-delineated laterally, with six tubercles of various sizes; flanked by elongate/subtriangular, well-delineated regions. Meso- and epibranchial confluent, differentiated from metabranchi-

al region by faint, transversely directed branchial groove, curving anteriorly laterally. Intestinal region not preserved.

Dorsal carapace evenly covered with near-equally sized granules, more closely spaced in anterior portion; larger tubercles on epi-, proto- and mesogastric regions, as well as on meso- and metabranchial regions, the latter with two rows of tubercles of diminishing size laterally.

Discussion – Although but a single, slightly deformed (left-hand side) carapace that lacks the fronto-orbital and posterior margins, is available to date, the combination of the following features clearly differentiate it from all congeners: the marked posterolateral swellings in the mesogastric region (also seen in *D. lauginigeri*); the poorly delimited uro-/metagastric region with a length/width (l/w) ratio of about 1; the two parallel rows of tubercles on the metabranchial region and the character of the posterolateral spines. In fact, the extended uro-/metagastric region differentiates this form from all other species currently assigned to *Distefania*. Future work may reveal that it is necessary to erect a new genus to accommodate this form. For the time being, we place it in *Distefania* with a query.

***Distefania incerta* (Bell, 1863)**

Pl. 2, figs. 1, 2.

*1863 *Cyphonotus incertus* Bell, p. 8 (*partim*), pl. 1, figs. 17, 18.

2010 *Distefania incerta* (Bell, 1863); Schweitzer & Feldmann, p. 370, fig. 3.

2012 *Distefania incerta* (Bell, 1863); Klompaker *et al.*, p. 783, figs. 1A-P, 2A, B.

Material – MB.A 1918a, b, a single carapace in internal and external mould preservation (part and counterpart, respectively), from the upper Cenomanian (*Metoicoceras geslinianum* Zone) of the former Rauen quarry at Kassenberg (Mülheim-Broich, Germany).

Description – Carapace of medium size, elliptical transversely, widest in posterior half, moderately convex transversely and longitudinally. Fronto-orbital margin, rostrum and orbits not preserved. Anterolateral margin not preserved. Posterolateral margin partially preserved, but not showing any spines. Posterior margin not preserved.

Epigastric region not preserved. Only posterior portion of mesogastric and proto-gastric regions retained; well-delineated posteriorly and laterally. Hepatic region large and subtriangular; delimited from epi-/protogastric region by anteriorly directed, slightly curved hepatic groove (Pl. 2, figs. 1, 2). Cervical groove strong, broadly biconvex, reaching anterolateral margin. Uro-/metagastric region wider than long, divided axially by anteriorly curving post-cervical groove, delimited by marked post-cervical groove posteriorly and by cervical groove anteriorly. Cardiac region incompletely preserved; well-delimited laterally and anteriorly; flanked by ovoid, well-delimited regions of similar length. Confluent epi- and mesobranchial regions poorly differentiated from metabranchial region by faint, transversely directed branchial groove. Intestinal region not preserved.

Dorsal carapace with even cover of tubercles of near-equal size; near grooves tubercles may be slightly larger (Pl. 2, figs. 1, 2).

Discussion – Despite being incompletely preserved, MB.A 1918a, b conforms in every respect to coeval (mid-Cretaceous) representatives of this species, from across Europe (southern England, France, northern Spain, Austria; Glaessner, 1933; Wright & Collins, 1972; Gründel, 1974; Wright, 1997; Klompmaker *et al.*, 2012). The present record is the second from Germany, the other one being that by Glaessner (1933, p. 584, pl. 28, fig. 8), from the Ratssteinbruch at Dresden-Plauen. The same specimen was illustrated by Gründel (1974, pl. 3, fig. 3). Of note is the fact that at both Kassenberg and Dresden-Plauen, *D. incerta* are found in a ‘Klippen facies’, i.e. a (sub-)tropical rocky shore habitat. Occurrences in England and northern France are from greensands and coarse-grained sands (Wright & Collins, 1972), while records from northern Spain (Klompmaker *et al.*, 2012) pertain to ~20-80 m deep reef carbonates rich in corals, deposited at depths of ~20-80 m. In conclusion, *D. incerta* appears to have inhabited a rather wide range of environmental settings.

‘Form genus’ *Roemerus* Bishop, 1983

Type species – *Roemerus robustus* Bishop, 1983, by original designation.

***Roemerus* sp.**
Pl. 2, figs. 3-5.

Material – MB.A 1919, a rather poorly preserved right manus, from the upper Cenomanian (*Metoicoceras geslinianum* Zone) of the former Rauen quarry at Kassenberg (Mülheim-Broich).

Description – Poorly preserved, subrectangular right manus of medium size; length and height 24 and 16 mm (as preserved), respectively; upper margin gently rounded; greatest height at mid-length; outer surface moderately convex longitudinally and transversely; broad, near-straight furrow separating carpal articulation from remainder of manus; distal margin straight; tubercles widely spaced over entire outer surface of manus, but all abraded and crater like; fixed finger not preserved; lower margin slightly convex; moveable finger not preserved. Inner surface smoother, with fewer tubercles of varying sizes, all abraded and crater like; furrow separating carpal articulation from remainder of manus more strongly curved.

Discussion – As discussed at length by Jagt *et al.* (2010), use of the ‘form genus’ *Roemerus* is to be preferred for describing major chelipeds of such genera as *Distefania*, *Trachynotocarcinus* Wright & Collins, 1972 and *Graptocarcinus* Roemer, 1887, whenever these are found in isolation and cannot be linked with associated carapace-based taxa beyond doubt (see also Kočová Veselská *et al.*, 2014). That such types of claw belong unambiguously to these carapace-based genera has recently been demonstrated on the basis of associations of carapaces and claws of *Graptocarcinus urbanaensis* Van Bakel, Guinot, Carmelo Corral & Artal, 2012 from the Santonian (Upper Cretaceous) of Álava and Navarra provinces, northern Spain.

The present record of *Roemerus* sp. from the upper Cenomanian of Kassenberg is reminiscent of the co-occurrence in the uppermost Cenomanian (*Praeactinocamax plenus* Zone) of Dresden-Plauen of a claw type referred to as *Necrocarcinus woodwardi* Bell, 1862 [sic] by Gründel (1974, p. 90, pl. 4, figs. 1, 2) and a carapace of *Distefania incerta* (see above).

Discussion

Klomp maker *et al.* (2012, p. 782) noted that species of *Distefania* occurred mainly in carbonate environments, some of which contained corals, and that these have been recorded exclusively from Europe, ranging in age from Late Jurassic to mid-Cretaceous, with an acme in the Albian-Cenomanian. Subsequently, two additional species have been recorded from the lower/middle Campanian of eastern North America (New Jersey; *D. lauginigeri* Feldmann, Schweitzer, Baltzly, Bennett, Jones, Mathias, Weaver & Yost, 2013), and from the upper Maastrichtian of the Netherlands (*D.(?) vanrijsselti* Jagt, Fraaije & Van Bakel, 2014). As far as the former is concerned, Feldmann *et al.* (2013, p. 16) noted that *D. lauginigeri* differed from congeners in having very inflated carapace regions with sparse, scattered tubercles and comparatively less well-defined carapace grooves. They they also described fragmentary chelipeds of the holotype of *D. lauginigeri* and remarked (p. 17) that these showed, ‘... strong ornamentation reminiscent of some species of *Necrocarcinus*.’ However, they did not refer to either did not use Roberts (1962, p. 183, pl. 89, fig. 2), who erected the claw-based *Prehepatus dilksi* on material from the Merchantville Formation of New Jersey (see also Feldmann *et al.*, 2013, fig. 17/3, 4), or Jagt *et al.* (2010), who discussed usage of the ‘form genus’ *Roemerus*. In fact, *P. dilksi* might well turn out to be the claw of *D. lauginigeri*, because both forms occur in the same area and at the same stratigraphic level.

The new species from the middle/upper Albian of southwest Iran described here adds to the mid-Cretaceous diversity and constitutes the first record of this brachyuran group from the Middle East. In recent years, a considerable range extension has been noted for *Distefania*.

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Plate 1

Figs. 1, 2. *Distefania(?) tangishirazensis* n. sp., OUM KY.115 (holotype), upper part of Kazhdumi Formation (middle/upper Albian); Tang-i-Shiraz, Hormozgan Province, southwest Iran, in dorsal and frontal views, respectively. Scale bar equals 10 mm.

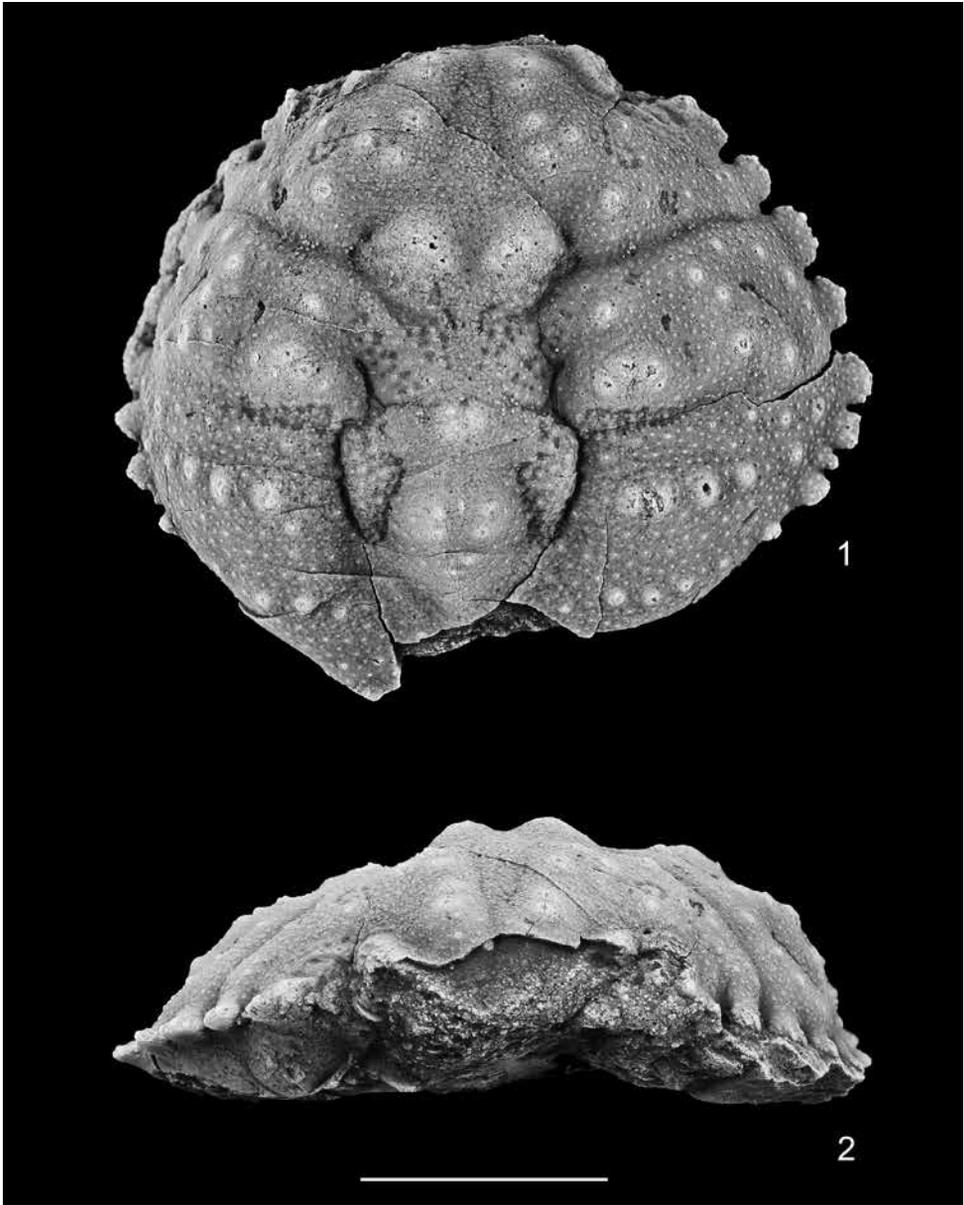


Plate 2

Both specimens are from the upper Cenomanian (*Metoicoceras geslinianum* Zone) of the former Rauhen quarry, Kassenberg (Mülheim-Broich, northwest Germany).

Figs. 1, 2. *Distefania incerta* (Bell, 1863), MB.A 1918a, b, carapace; natural internal mould and silicone rubber cast of external mould, respectively.

Figs. 3-5. *Roemerus* sp., MB.A 1919, right manus in inner, outer and upper (dorsal) views, respectively.

Scale bars equal 10 mm.

