NEW EARLY MESOZOIC BRACHIOPODS FROM SOUTHERN TURKEY

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ABSTRACT. — New Late Triassic and Early Jurassic brachiopod faunas are described from the Taurus Mountains in Southern Turkey. They include the distinctive Norian rhynchonellid *Halorella amphitoma* (not previously recorded from Turkey), the aberrant Upper Norian rhynchonellid Carapezzia (only previously recorded from Austria and Sicily) and Sinemurian or Pliensbachian faunas. The significance of these typically North European faunas in a Tethyan realm is discussed.

I. INTRODUCTION

The brachiopods described in this paper were found in the course of field mapping in the Taurus chain of southern Turkey (Brunn & al., 1971) and were discussed with and identified by one of us (D.V.A.). They are worthy of special consideration, firstly because of the evidence of age they provide to several formations in an area of structural complexity, and secondly because of their ecological and biogeographical interest.

II. STRATIGRAPHY

The Western Taurides lie along the Mediterranean coasts of southern Turkey in direct prolongation of the Hellenides, between the Agean sea and the meridian of Cyprus. Stratigraphic and tectonic studies in part of this chain (Brunn & al., 1971) have disclosed several large nappes overlying relatively autochthonous carbonate series which appear in a lower position: these series constitute the Bey Dağları massif west of Antalya, and the Pisidian autochthonous carbonate series which appear in a lower position east and north of Isparta. The stratigraphy of these very thick series (up to 3000 m) composed mainly of shallow-water carbonates or siliceous detritic formations, ranges from Cambrian to Eocene. The attribution, of Triassic and Liassic ages to some important formations of the relatively autochthonous series in the Western Taurides was based upon several faunas, including several Brachiopod assemblages.

Up to now, no Mesozoic Brachiopods have-been described from the Taurus chain, and these assemblages clearly exhibit unexpected affinities with European types. Prior to their paleontological description, a short stratigraphical introduction will summarize their geological setting.

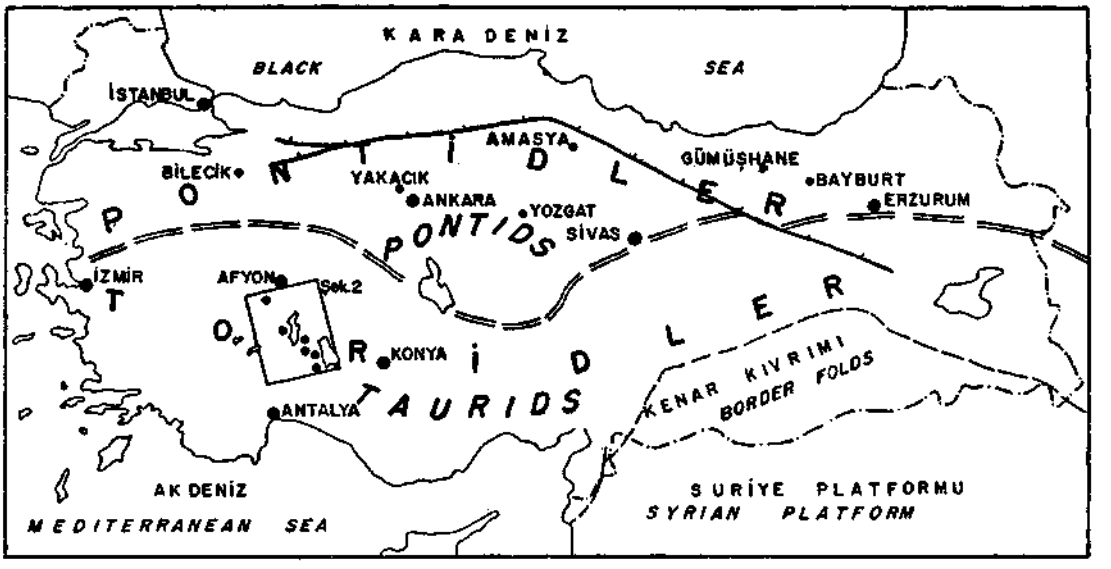

Fig. 1 - Sketch map of Turkey showing the emplacement of the different faunas discussed in the text. The double interrupted line shows the approximate position of the main ophiolitic «scar» separating the Pontids from the Taurids.

Several stratigraphical type-series have been defined in the autochthonous Pisidian Taurus (Brunn *et al.,* 1971) among which the Anamas Dağ series, the Barla Dağ series and the Sandıklı series (Gutnic, 1977) contain occasional Brachiopod faunas in various Triasico-Liasic formations.

A. The Anamas Dağ series (Brunn & al., 1971; Dumont, 1976; Gutnic, 1977)

Largely represented east of the lake of Eğridir, the Anamas Dağ series comprises a thick succession of Upper Triassic shales and sandstones at the base (Kasımlar shales), followed by shallow water carbonates (Menteşe Dolomite, Leylek Limestone) of Upper Norian (Rhaetian)age, often overlain by coarse detritals (Çayır Fm.) and succeeded by algal limestones (Yassıviran lst)of Liassic age.

The Kasımlar shales consist of alternating argilaceous black shales and predominantly fine-grained sandstones containing numerous patch-reefs and biostromal limestone beds which protrude conspicuously from the shales. These limestone lenses are highly fossiliferous, with a great variety of organisms including Corals, Bryozoa, calcareous sponges and algae, Crinoids, Lamellibranchs, while in the black shales, different faunas include *Halobia* sp., *Daonella* sp., Ammonites *(Arcestes* sp., *Pinacoceras* sp.,? *Juvavites sp.)* along with *Aulacoceras timorensis* Warriner and *Heterastridium congkbatum* Reuss which indicate Upper Carnian to Upper Norian ages for this formation, according to places. In spite of its great thickness (1000 m ?) the Kasımlar shales appear as a shallow water deposit upon a subsiding carbonate platform.

Fossiliferous localities 1 and 2 belong to the Kasımlar shales:

Locality N° 1 (İslibucak) is a loose limestone block found in the Kasımlar shales about 1 km west of the locality İslibucak on the track climbing to the high pass of İncebel, south of the Dipoyraz Dağ. In this block, many Lamellibranchs *(Paleonucula* sp.), a few Ammonites of Upper Norian type, and Rhynchonellids are in a surprisingly close association. The Brachiopods include only one species *Halorella amphitoma,* determined by H. Termier (pers. comm. to O.M.), and considered as dwarf forms by D.V.A.

Locality N° 2 (Terziler) is situated along the road from the village of Anamas to Yaka, at the cross-road leading to the village of Terziler, north of the road, near a small fountain. Several large blocks of dark limestones are conspicuously protruding from the black Kasımlar shales, and are unusually fossiliferous (Collignon & al., 1970): Pelecypods *(Pleuromya* sp., *Mytilus* sp. *Modiola* sp., gastropods *Murchisonia* sp.) cephalopods of Upper Triassic age are closely associated with numerous Rhynchonellids (Halorella).

Localities n° 3 & 4 (Banos) are situated about 4 km east of the village of Gökçehüyük (new name for Banos) and include two fossiliferous outcrops: one is situated precisely in the pass between the valley of Banos to Bacik, and the long depressed area of Sorkun Yayla, at the foot of high Anamas Dag. There, in a faulted position between Triassic shales (with numerous Heterastridium) and the overlying Menteşe Dolomite, is found a large limestone block containing numerous Terebratulidlooking Brachiopods (Carapezzia). A few hundred meters northwards, along the path leading towards the Anamas Dag, about ten meters of tectonised limestones have also yielded some Lamellibranchs, Gastropods and Brachiopods *(Fissirhynchia fissicostata, Austrorhynchia* sp.).

Above the Kasımlar shales, the *Menteşe Dolomite* consists of white, massive, fine-grained dolomite with frequent supra-tidal textures (bird eyes, laminar vugs) about 150 m thick. At its top, the *Leylek limestone* shows well stratified beds with alternating stromatolites and Megalodonts (cf. Lofer cyclothems) with abundant microfauna (Involutinidae, Triasina) of Upper Norian age (Vegh-Neubrandt *et al,* 1976).

The Menteşe and Leylek shallow-water carbonates are overlain by an irregular deposit of sandstones and conglomerates (Çayır formation, 0 to 200 m) which, in turn, are succeeded by thick black limestones, the *Yassıviran Limestones,* of Liassic age.

B. The Bark Dag series (Gutnic, 1968, 1977; Brunn & al., 1971)

The Barla Dağ massif (2800 m) is situated on the W side of the Eğridir Lake, and its stratigraphical series closely ressembles that of the Anamas Dag series. The Upper Triassic dolomites, or Barla Dag Dolomite, is extremely thick (over 700 m) and is directly overlain by the Yassıviran limestones (300 m), which have yielded a small Brachiopod fauna on the eastern flank of the Barla Dag (Gutnic, 1977).

The fossiliferous locality (N° 5) lies about 2 km east of the Karabeygir Tepe, at an altitude of 1650 m on the path between the villages of Barla and Garipköy. The Yassiviran limestones consist of well bedded black micrites and packstones with abundant oncoides, shell fragments, benthonic Foraminifera and Dasycladaceae. The most significant fossils include two well known Tethian genera: *Paleodasycladus mediterraneus* Pia and *Orbitopsella praecursor* which are reliable markers for Lower-Middle Lias throughout the Mediterranean area.

In contrast with the high energy environment of the scattered reefs in the Kasımlar shales, the Yassıviran limestones exhibit moderate to low energy levels, although of relatively shallow-water origin.

C. The Sandıklı series (Brunn & *al,* 1971; Gutnic, 1977)

About 70 km north of Isparta, in the region of Sandıklı, the relatively autochtonous series of the Pisidian Taurus includes Mesozoic formations transgressive upon an epimetamorphic basement. Coarse conglomerates and red sandstones (Verrucano facies) of possible Upper Trias to Lower Liassic age are followed by a thick terrigenous formation, the Derealam shales (Gutnic, *in* Brunn &

al., 1971). This formation consists mainly of silty shales and sandstones with extremely abundant benthonic faunas (Pelecypods, Gastropods, Corals and Brachiopods) in its lower half. Above, the facies grade into finer shales and limestone beds with Ammonites, among which *Polyplectus discoides* indicates an Upper Lias age. The series ends with thick Jurassic and Cretaceous neritic limestones. The Brachiopod fauna described here (N° 6) belong to the lower part of the Derealanı shales which are well exposed near the main road from Afyon to Isparta, on a small hill (Karatepe) 7 km south of Sandıklı. There, the Derealam shales contain massive accumulations of Lamellibranchs (Limidae Astartidae), Corals (Stylophyllidae), and Brachiopods.

In spite of the proximity of the Sandıklı series and Barla Dağ series, no correlations are possible, due to major lithological differences.

D. The Antalya Nappes (Eğridir region)

About 20 km E-SE from Eğridir, the long depressed area of Sorkun Yayla exhibits large outcrops of alternating sandstones and marls, radiolarites and pillow-lavas which belong to the Lower Antalya units in this area (equivalent to the Alakır Çay unit in Antalya region). The fossiliferous locality N° 7 is situated about half way on the western flank of Sorkun Yayla, 4 km North of the village of Bucak. Several inliers in the Antalya units show repeated exposures of sandstones, sandy limestones and shales containing very large blocks of dark limestones (more than 10 cubic meters) with poorly preserved Ammonites, Gastropods and Brachiopods. Due to the tectonic position of the sandstones containing the fossiliferous blocks, their precise stratigraphical setting in the Antalya nappes is still uncertain.

III. SYSTEMATIC PALEONTOLOGY

Genus : Halorella BITTNER, 1884

1884 — *Halorella* Bittner, p. 107.

1890 — *Halorella* Bittner, p. 172.

1960 — *Halorella* Bittner, Ager, p. 158.

1963 — *Halorella* Bittner, Dagis, p. 53.

1968 — *Halorella* Bittner, Ager, p. 54.

Type species: *Terebratula amphitoma* BRONN, 1832

After the detailed description given of this genus by Bittner in his classic work on the Alpine Triassic brachiopods, practically nothing was done until the last decade. Ager (1960) then split the genus into Halorella s.s. and a new genus Halorelloidea. This division was accepted by Dagis (1963) who published the first details of the internal structures. The type species. *H. amphitoma,* is widely distributed around the world (Ager, 1968) and the material from southern Turkey certainly belongs to that species.

Halorella amphitoma (BRONN)

1832 — *Terebratula amphitoma* Bronn.

1890 — *Halorella amphitoma* (Bronn), Bittner, p. 183.

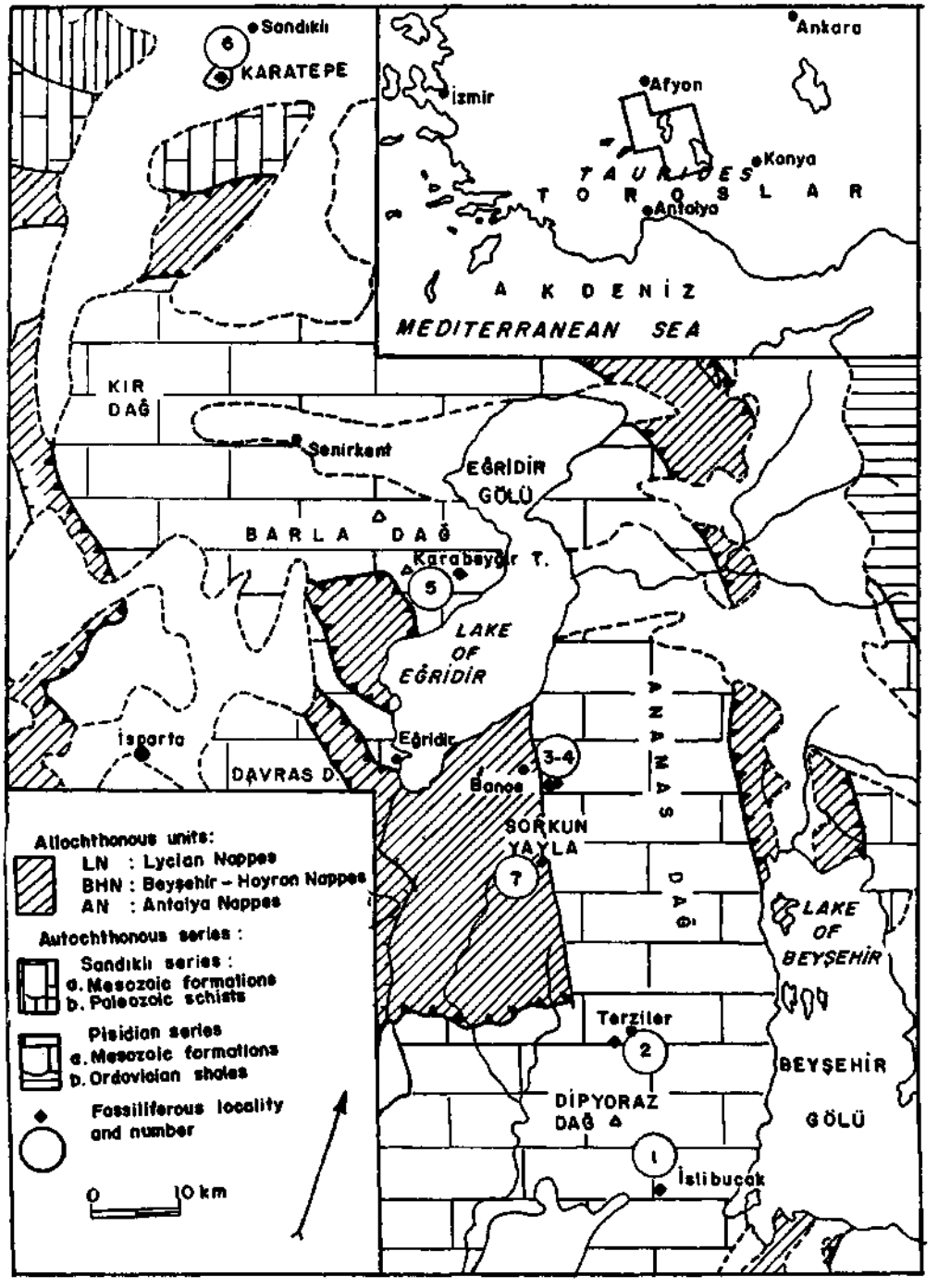

Fig. 2 - Geological sketch map of the Isparta region (W Taurus) and the various localities cited in the text.

1963 — *Halorella amphitoma* (Bronn), Dagis, p. 54.

1968 — *Halorella amphitoma* (Bronn), Ager, p.54.

About 20 specimens of this species were found in a limestone block within the flysch near Terziler (Fig. 2). This is undoubtedly the form whose external characters were well described by Bittner (1890) and has been recorded in many places outside the type area of the Austrian Alps (Ager, 1968).

Externally the Turkish specimens show the same range of variation as that described by Bittner (1890), with the characteristic opposed sulci and sharp costae ranging from 10 to 14 on each valve. The variants with fewer costae would fall within Bittner's variety *rarecostata.*

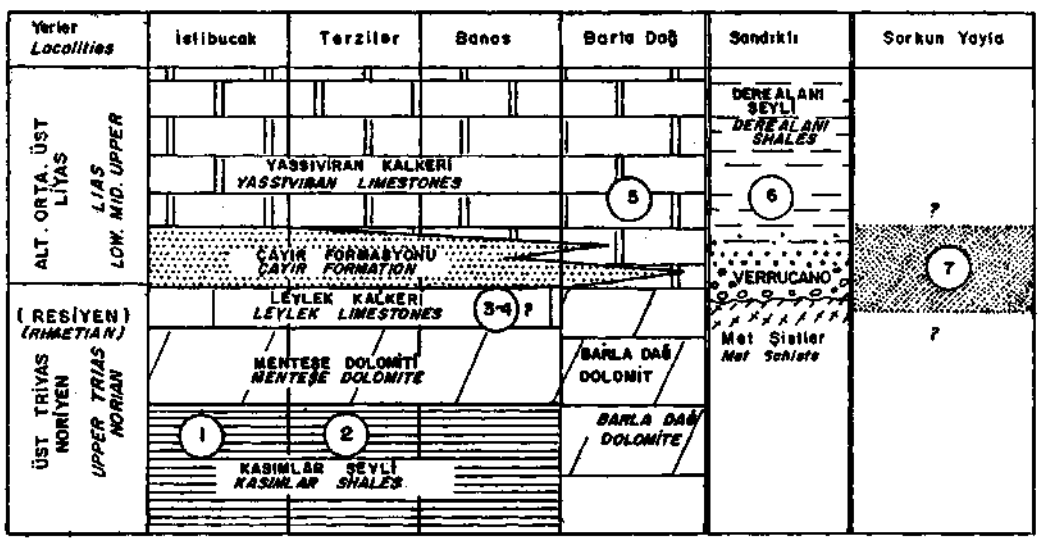

Fig. 3 - Schematic stratigraphical series in the Western Taurides and relative emplacement of the Brachiopod faunas.

No. 1 : *Halorella amphitoma* Bronn
No. 2 : *Halorella amphitoma* Bronn
No. *3-4:Carapezzia globosa* (Carapezza & Schopen)
Carapezzia geyeri Bittner
Fissi rhynchia fissicostata Suess
Austrirhynchia cornigera (Schafhaütl)
Rhaetina sp.

Note: Emplacement of samples 3 & 4 is doubtful.

No. 5 : *Cuneirhynchia oxynoti* (Quenstedt)
Piarorhynchia sp. ?
Tetrarhynchia sp. ?
Lobothyris sp. ?
No. 6 : *Calcirhynchia calcaria* Buckman
No. 7 : *Aulacothyris* cf. *A. resupinata* (Sowerby)
Cincta numismalis (Lamarck)
Lobothyris sp.
Spiriferina sp.

Internal characters, unfortunately, were not so well preserved as the external and though a number of specimens were serially sectioned, none produced a perfect set of sections but fig. 4 shows the best set available. These are sufficient to confirm the identification and show a strong resemblance to the sections published by Dagis (1963) of specimens from the Pamirs, in the southern U.S.S.R. and by Ager (1968) of specimens from the type area in Austria and from Oregon. It may be significant that no dorsal median septum was observed in the Turkish specimens. This matches the situation in the Soviet forms and differs from that in the topotypes and in the American forms.

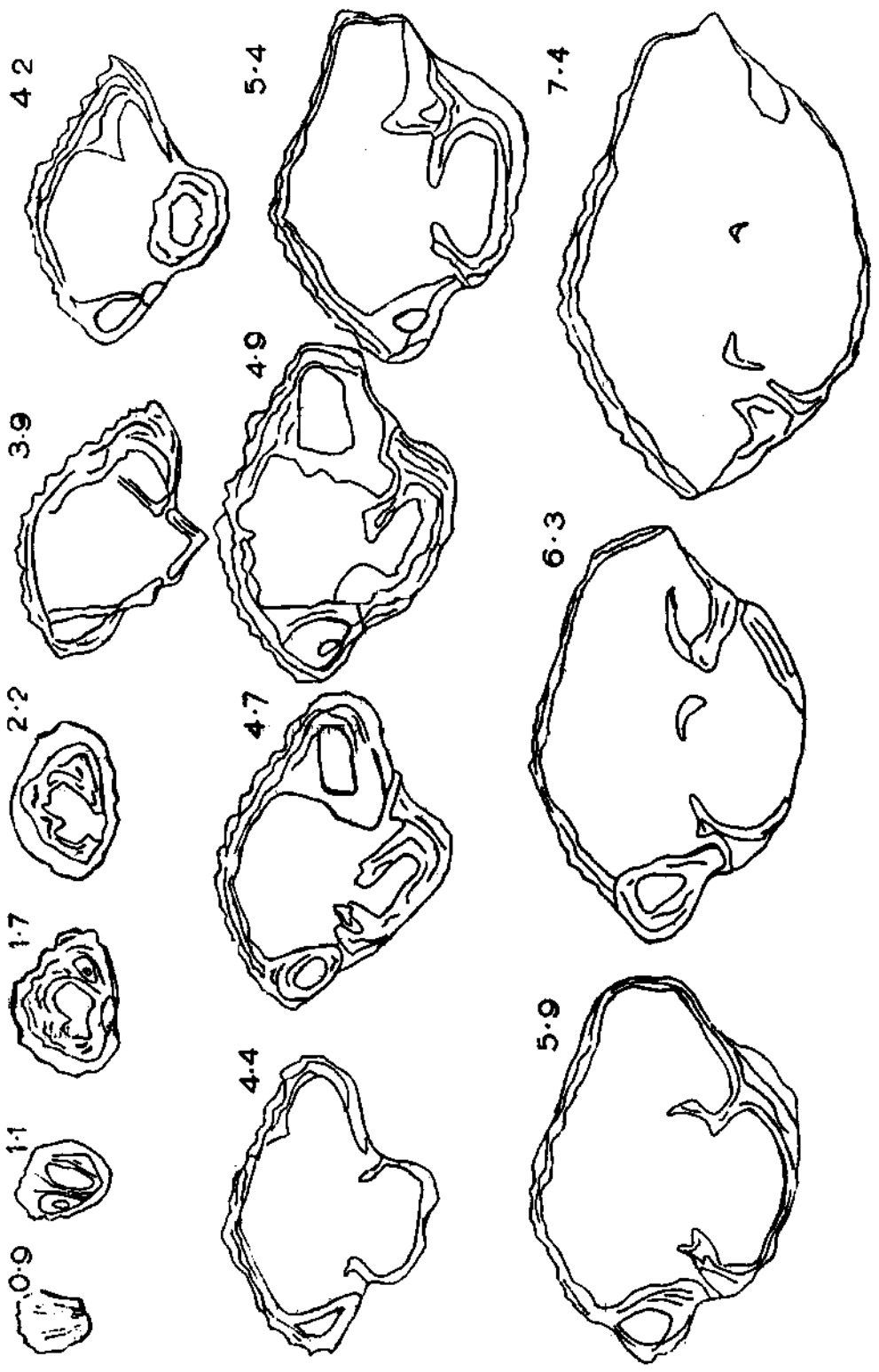

Fig. 4 - Serial transverse sections of *Halorella amphitoma* (Bronn) from the shales near Terziher. The small figures indicate the distance (in millimetres) from the posterior end. The pedicle value in each case is uppermost.

Genus : Carapezzia TOMLIN, 1930

1899 — *Rhynchonellina (Geyeria)* Carapezza & Schopen, p. 248.

1930 — *Carapezzia* Tomlin, p. 24.

1965 — *Carapezzia* Tomlin; Ager, p. 603.

Type species: *Rhynchonellina (Geyeria) ghbosa* CARAPEZZA & SCHOPEN, 1899

This genus was first proposed by Carapezza and Schopen on the basis of material from the Rhaetian of the Gailtaler Alps in Southern Austria, and the Lower Jurassic of Sicily. The name Geyeria was an invalid junior homonym and the name Carapezzia was substituted by Tomlin. It is a very unusual rhynchonellid with internal characters reminiscent of Peregrinella from the Lower Cretaceous and Eoperegrinella from the Upper Devonian (Ager 1968, p. 69). It differs from both these forms, however, in its completely smooth shell . It probably has affinities with Rhynchonellina, with which it was originally grouped. Again the internal structures were not very well preserved in the Turkish specimens, but were sufficiently clear to show the characteristic form of the crura arising directly from the median septum.

Carapezzia globosa (CARAPEZZA & SCHOPEN)

1899 — *Rhynchonellina (Geyeria) globosa* Carapezza & Schopen, p. 248.

1965 — *Carapezzia globosa* (Carapezza & Schopen), Ager, p. 603.

This species was first described by Carapezza and Schopen from the supposed Lower Jurassic of Sicily, though the original authors emphasised its close resemblance to the Rhaetian species *geyeri* (in fact they chose their subgeneric name with this in mind). The distinguishing features of this species, that is its extremely globose form and massive, strongly incurved beak are only seen in one or two large specimens up to more than 40 mm long. These come from a single mass of dark shelly limestone lower down in the Col de Banos. They are accompanied by smaller specimens with upright beaks and unconcealed delthyria which may confidently be placed in C. *geyeri*. It is therefore not thought that there is any clear dividing line between this and the next species, as was apparent from the original figures of Bittner (1898) and Carapezza and Schopen (1899). In fact Bittner's first figures *ofgeyeri* (which were accompanied by what were probably the first set of serial sections ever published) are in many ways intermediate between the typical *globosa* and the typical *geyeri* as now understood. It seems probable that *globosa* merely represents *geyeri* reaching its maximum growth form under optimum conditions. It is doubtful if the differences are stratigraphically significant and there is no reason to believe that all these forms do not indicate a Rhaetian age.

Carapezzia geyeri (BITTNER)

1898 — *Rhynchonellina geyeri* Bittner; p. 387, Pl. 11, fig. 1-9; Pl. 12, fig. 1-7.

1899 — *Rhynchonellina (Geyeria) geyeri* Bittner; Carapezza & Schopen, p. 249.

1963 — *Rhynchonellina geyeri* (Bittner), Schlager, p. 69.

This species was described from a Rhaetian limestone above Oberpirkach, near Drautal, in the Gailtaler Alps of Southern Austria. Schlager (1963) suggested a Lower Jurassic age for one of the two known localities, but Pearson (personal communication, 1970) thinks that this is very unlikely on lithological grounds.

As already indicated, it is by no means certain that the separation of this form from the one just described is fully justified. The latter is merely a larger form with a greater incurvature of the beak. It may be significant, however, that the two species occur most abundantly at two different localities in Turkey.

The Turkish specimens of C. *geyeri* come from lumachelles in bedded argillaceous limestone on the Col de Banos on the west side of Anamas Dağ, South of Lake Eğridir. They are up to 26 mm long, equally biconvex, rectimarginate and smooth apart from the characteristic fine radial striae seen in the better preserved specimens. The beak is prominent, upright to slightly incurved, with a clearly displayed delthyrium and a large hypothyrid pedicle opening.

This is by far the most abundant brachiopod at this locality, though most specimens are poorly preserved. They are too numerous in the lumachelles to be counted individually.

Fissirhynchia fissicostata (SUESS)

1854 — *Rhynchonella fissicostata* Suess, p. 30.

1890 -- *Rhynchonella fissicostata* Suess, Bittner, p. 280.

1963 — *Septaliphoria fissicostata* (Suess), Dagis, p. 50.

1977 — *Fissirhynchia Fissicostata* (Suess), Pearson, p. 48.

A few fragmentary ribbed rhynchonellids which occur in the same lumachelles as C. *geyeri* may well belong to this well - known species. The species has been revised by Pearson and he placed it in his new genus Fissirhynchia. Dagis's reference of the species to the late Jurassic genus Septaliphoria is not acceptable. The species was first described from the Kossener Schichten in Austria and is one of the commonest forms in the European Rhaetian.

Rhaetina sp.

A few obscure terebratulids in the saine beds as the two previous species may belong to this genus, which is based on the well-known Rhaetian species *«Terebratula» gregaria* Suess (1854).

Austrirhynchia cornigera (SCHAFHAUTL)

1851 — Terebratula cornigera Schafhautl, p. 408.

1854 - *Rhynekonella cornigera* (Schafhautl), Suess, p. 31.

1959 — *Austrirhynchia cornigera* (Schafhautl), Ager, p. 325.

A single specimen from the same beds, somewhat expanded anteriorly andwith lateral branching costae, may belong to this highly distinctive rhynchonellid, which is entirely restricted to the Rhaetian rocks.

Aulacothyris cf. *A. resupinata* (J. SOWERBY)

1816 — *Terebratula, resupinata* J. Sowerby, p. 116.

1852 — *Terebratula resupinata* J. Sowerby, Davidson, p. 31.

1878 — *Waldheima resupinata* (J. Sowerby), Davidson, p. 177.

1879 — *Aulacothyris resupinata* (J. Sowerby), Douville, p. 277.

About 6 specimens of this form were found in boulders, within a flyscfrlike series at Sorkun Yaylası. They were accompanied by some poorly preserved gastropods and ammonites, and the other brachiopods mentioned below. The Aulacpthyrid is exactly like those described and figured by one of us (Ager, 1959) from the Lias of Yakacık, about 16 km north-northwest of Ankara. This similarity relates not only to their shape, but also to their small size and mode of preservation in a fine-grained ferruginous limestone.

There seems little doubt that this fauna is of the same age as that of Yakacık, i.e. Sinemumn or possibly Pliensbachian. This form differs from the Late Pliensbachian *A. resupinata* s.s. (the type species of the genus) in being narrower with a more rounded sulcus. It somewhat approaches *A. fusiformis* Rollier, of the same age, but is most probably an undescribed species coming from the previous stage.

Lobothyris sp.

Several specimens at Sorkun Yaylası seem to belong to this rather featureless Liassic terebratulid. Lobothyris is not, however, very helpful stratigraphically as it ranges all through the Lower Jurassic and up into the Bajocian without any significant variation. The form found in Turkey could well be *L. punctata* (J. Sowerby) of the Sineinurian and Pliensbachian, but it is not possible to be dogmatic about this and later forms are very similar.

*Cincta numismalis (*LAMARCK)

1819 — *Terebratula numismalis* Lamarck, p. 334.

1852 — *Terebratula numismalis* Lamarck, Davidson, p. 36.

1907 —*Cincta numimalis* (Lamarck), Buckman, p. 40.

Three or four specimens from Sorkun Yaylası appear to belong to this very variable species. Buckman (1907) erected no less than 19 species for specimens from a single quarry and there is no doubt that these would fall within the same sort of range of variation. Many species attributed to the closely related genus Zeilleria are also very close, for example *Z. subdigona* (Oppel). The whole complex is characteristic of the Sinemurian and Lower Pliensbachian. In the strictest sense, the name *Cincta numismalis* is usually associated with extremely compressed forms from the Lower Pliensbachian, but this form is not close enough to that to justify being pinned down so accurately.

Spiriferina sp.

The collection from Sorkun Yaylası includes one small dorsal valve of a Spiriferina. It is distinctive in having about 11 sharp costae, several of which bifurcate anteriorly. The specimen is too incomplete, however, to attribute it with confidence to any named species.

IV. STRATIGRAPHICAL PALEONTOLOGY AND PALEOECOLOGY

Seven faunas need to be considered.

1. The fauna from Terziler consisting solely of *H. amphitoma*. This species is confined to the Norian wherever it occurs and there is no reason to suppose it is any different in Turkey. The occurrence of the specimens in what seems to be an exotic block in a deep-water facies is in line with the hypothesis of the present author (Ager, 1965a) that this genus was probably adapted to life on a shallow, rocky sea-floor, where sediments did not normally accumulate. Brachiopods of this

type are only normally preserved under special circumstances, e.g. immediately below a transgressive sequence, in clastic dykes and in exotic blocks that have fallen into a deeper, accumulatory facies, such as the Kasımlar shales here.

2. The faunas from Banos Anamas and the Col de Banos. These are typified by the two species of Carapezzia, *Rhynchonella fissicostata, Austrirhynchia cornigera* and *Rhaetina* sp. These species are all highly typical of the Rhaetian stage. The most interesting by far is the aberrant rhynchonellid genus Carapezzia, which is only known at two other localities in the world. Like Halorella it is characteristically only preserved under special circumstances and was probably similarly adapted for life on a shallow, rocky sea floor.

It is interesting that Carapezzia occurs at the Col de Banos in a tectonized succession immediately adjacent to a flyschlike succession. In the Banos Anamas section, the Rhaetian fauna occurs in great abundance (albeit poorly preserved) in a well-bedded lumachelle type succession, which is practically all shelly material.

3. The fauna from Sorkun Yaylası bears a striking resemblance to the Brachiopod fauna previously described by the present author (Ager, 1959) from another Turkish locality—Yakacık near Ankara—although the fossiliferous limestone blocks in the shales differ completely from the red *«ammonitico rosso»* marls at Yakacık. The specimens of Aulacothyris and Cincta are almost identical in preservation as well as in morphology. The ammonite evidence at Yakacık suggested a slightly earlier age than was suggested by the brachiopods (i.e. early to late Sinemurian rather than Late Sinemurian to Late Pliensbachian). It is noteworthy that certain highly distinctive Late Pliensbachian forms, such as Prionorhynchia and *Zeilleria quadrifida* (Lamarck), are absent both at Yakacık and at Sorkun Yaylası. The balance of evidence therefore suggests a Sinemurian or early Pliensbachian age for this fauna.

It is interesting, however, that though the fauna, as normally developped, is one that is characteristic of shallow shelf environments, it occurs at Sorkun Yaylası in a flysch-like series adjacent to pillow-lavas.

4.The fauna from Barla Dağ collected by Gutnic was difficult to determine because of the preservation. They were, however, provisionally identified as follows:

Cuneirhynchia oxynoti (Quenstedt)
Piarorhynchia sp.
Tetrarhynchia ? sp.
Lobothyris ? sp.

These seem to indicate a Sinemurian or (at latest) an Early Pliensbachian age. They are comparable to the other Liassic faunas described here in.

5. The fauna from Menteşe, near Sandıklı collected by Gutnic is clearly older than the other Liassic faunas recorded here. The specimens all seemed to belong to the well-known species *Cakirhynchia calcaria* S.S. Buckman, which characterizes the Hettangian and lowermost Sinemurian. This is a rather «generalized», «ordinary-looking» rhynchonellid in external view, so too much dependence should not be placed on the identification, though serial sections appear to show the highly distinctive internal characters of the genus.

Two further faunas are not directly relevant to this paper, but are of interest:

6. A further brachiopod fauna was collected recently by Miss Füsun Alkaya in the Upper Sinemurian to Lower Pliensbachian of the Bilecik-Amasya district of Northern Turkey and was identified (by D.V.A.) as follows:

Cirpa kiragliae Ager (including variety *globosa)*
Cuneirhynchia, dalmasi (Dumortier)
Tetrarhynchia sp.
Lobothyris punctaia (J. Sowerby)
Auldcothyris anatolica (Vadasz)-
A. cf. *resupinata* (J. Sowerby)
Zeilleria perforata (Piette)
Spiriferina alpina (Oppel)
S. cf. *tumida* (von Buch)

This fits in perfectly with the age suggested by Miss Alkaya, but what was particularly remarkable was that the preservation and generally stunted appearance of the specimens is exactly like that of the Liassic fauna described earlier form Yakacık (Ager, 1959) and that described here from Sorkun Yaylası. In other words the Liassic brachiopod faunas are closely alike whether they be from northern, central or Southern Turkey and all seem to be living in a somewhat unfavourable environment. Alkaya refers to her fauna as occurring in an *ammonitico rosso* facies (appropriately since her name means red rock in Turkish!). From the containing lithologies generally it could well be that the brachiopods were living in deeper water than their normal optimum environment and could have been concentrated into their remarkable abundance by episodes of very slow deposition.

7. The final brachiopod fauna to be mentioned is one collected by Cazibe Sayar from Yozgat, east of Ankara in central Turkey. Differences exist about the true age of this fauna but jn the view of the writer, shared by Howard Brunton of the British Museum (Natural History) and by Christopher Walley of Swansea who first examined the collection is of late Triassic age. It is hoped that this fauna will be described at a later date but it seems to be remarkably similar to Norian and «Norian / Rhaetian» faunas described from the southern part of the Soviet Union, by Dagis (1963).

In this connection, Miguel Mancenido drew the writer's attention to a fauna described from the Crimea by Moiseev (1934, pl. figs. 1-32) and said to be mid-Jurassic in age. The forms were attributed to the genus Rhynchonellopsis and were certainly rhynchonellinids, which made a mid Jurassic age unlikely. In fact to the writer they are remarkably like the form described here as Carapezzia. In reply to an enquiry, Dagis kindly informed the writer that, though he did not think they were Carapezzia, Victor Kamyshan had collected more material at the same locality. He now attributed the brachiopods to Rhynchonellina and the containing rock to the early Jurassic. Whatever the precise determination, forms belonging to the Rhynchonellina complex are characteristic of the latest Triassic and earliest Jurassic of southernmost Europe (just extending into Africa with other Euorpean forms in the Rif mountains at the westernmost end of the Mediterranean).

V. CONCLUSIONS

In the view of the present writer (D.V.A.) the Late Triassic and Early Jurassic braehiopod faunas so far described and seem from Turkey are wholly European in character. What is more, there is no record in Turkey of any of the highly distinctive Jurassic brachiopod faunas of the Middle East and East Africa. Most of these are admittedly later in age, so a direct comparison is not

possible, though there is a little evidence of roughly contemporary faunas (e.g. that described by Hudson & Jeffries, 1961 from the Oman Peninsula).

So far as the exact age of the Late Triassic brachiopods is concerned, Dagis in his detailed work on Soviet faunas commonly lumped the Norian and Rhaetian together. Pearson (1977, p. 11) in his study of the Rhaetian brachiopods of Central Europe thought that most of Dagis's material was Norian in age. At the same time he claimed a quite distinctive assemblage of Rhaetian age including forms such as Carapezzia described her. He was, in fact, doubtful if any of Dagis's faunas was truly Rhaetian. The matter remains to be settled. However, the association of *Carapezzia gejeri, Austrirhynchia corrigera* and *Fissirhynchia fissicostata* is so characteristically Rhaetian in Europe that it is difficult to accept an early age.

VI. DISCUSSION

According to the present-day kownledge of the geology of Turkey, the northern mountain range, or Pontids, exhibits many stratigraphical and tectonic characteristics which differ markedly from the southern range, or Taurids, at least since the beginning of Mesozoic times. Although a precise limit cannot be accurately drawn between the two chains, its amplacement seems to coincide roughly with several major ophiolitic bodies in central Anatolia, which provide a convenient separation between the two chains.

To the north, the Pontids have suffered from the Hercynien orogeny, as shown by the thick cover of red sandstones and conglomerates which lies on the coal basin of Bartın (Westphalian) and the clear disconformity of Lower Triassic formations east of Istanbul (Tokay, 1952; Haas, 1968; Kaya, 1973; Assereto, 1972). The Mesozoic series above shows repeated tectonic phases between Lias and Late Cretaceous and Eocene time (Fourquin, 1975) which may be related to various erogenic crises already known in the Alps or the Carpathian mountains.

Distinctive facies have been recorded from the Pontids which may be related to remarkably similar ones in the Mesozoic formations either in Southern Europe or Northern Iran (Elbourz). A good example is given by the thick volcano-detritic formation containing several coal seams of Liassic age, which appears almost unchanged from Gresten in Austria to Gümüşhane in Eastern Turkey, and to Semsak in Iran (Brunn, 1960; Bergougnan, 1975; Stöcklin, 1968: Stampfli, 1978). It is not surprising, therefore, that identical brachiopods faunas, all of European type, have been extracted all along the trend of this formation (Ager, 1970), including near-by localities such as Yozgat, Yakacık & Bilecik (Fig. 1). Faunal similarities also apply to the Ammonites of Late Jurassic age, which clearly indicate their European origins (Enay, 1972).

Qn the other hand, the Taurids do not contain evidences of the Hercynian orogeny and its subsequent phases which characterise the European border of the Alps. The Taurids are related westwards to the peri-Adriatic chains of Greece and Yugoslavia (Hellenids and Dinarids) whilst to the east, the Taurids pass into the Zagros Mountains around the Arabian peninsula. The thick deyelopmejit of undisturbed Mesozoic carbonates in the relatively autochthonous external zones of the Taurids may thus be correlated to many similar series in Western Greece and Yugoslavia, in Southern Italy, in Iran, Lebanon and Syria (Brunn, 1956, 1957; Aubouin, 1960, 1973, 1976) which in turn may be regarded as the northern extension of the Arabo-African continental platform (cf. Ricou & al., 1976).

What is more, in the Taurids, numerous allochthonous units, including gigantic ophiolitic nappes have come from the North and now lie upon the more external carbonate platforms of Mesozoic

to Tertiary age. Careful geological investigations carried out in the sedimentary allochtonous units have repeatedly shown that the purely pelagic series and basic effusive volcanics (pillow-lavas) never appeared before Mid to Late Triassic times (Brunn & al., 1971) suggesting that a major facies differentiation from the formely neritic formations took place at this period, and may be considered as opening of a break which ultimately led to the Mosozoic Tetliys (Argyriadis 1975).

The distribution of the ophiolitic massifs and their closely related pelagic series of Triassic or younger age in Anatolia strongly support the separation of the Taurids from the Pontids as early as Middle Trias. In that way, the Pontids would belong to the European rim of the Eurasian platform from which no major tectonic accident can separate them, whereas the Taurids clearly are independent from the Eurasian platform, although their link to the northern part of the African platform is not fully demonstrated.

Faunal evidence partly supports this image, with presence of various genera in the Taurids which are well known from the Mesogean basin but not from the European platform (Hirsch, 1976; Enay, 1976).

In constrat with this view, the Brachiopods studied here have strong European affinities, which are most surprising in the Taurids.

It is difficult to be dogmatic about this because one just does not know, for example, what an «African» Late Triassic brachiopod fauna would look like, since none has been described. However, one can be dogmatic in saying that not one distinctively «African» Mesozoic brachiopod has been found so far in Turkey. The Triassic forms are all close to those known from «Tethyan» parts of Southern Europe, but the Jurassic faunas are close to those of extra-alpine Europe.

This may be explained by various hypotheses:

The most obvious one concerns the actual place of the limit between Taurids and Pontids, which still is conjectural in most of the Turkish territory, except near Erzincan ((Bergougnan, 1977), so that large fragments of the Pontids might have been thrust onto the Taurids (and inversely) without having been already properly identified (Bailey & McCallien, 1953). Localities 3 & 6 might indeed belong to distinct tectonic units of more northern origin (Gutnic, 1977). However, all the other localities undoubtedly belong to the Taurus chain, and contain typical Tethyan faunas at various levels (from Triassic to Eocene) (Brunn & al., 1971).

An alternative hypotheses to explain the distribution of European brachiopods in the Taurids as well as in the Pontids might be related to their fixed mode of life: having evolved from a common Palaezoic stock which appears to be evenly distributed in the Pontids and in the Taurids (Kırağlı-Ünsalaner, 1941; Blumenthal, 1963; Haas, 1968; Dil, 1975), the Triassic faunas were still probably uniformly scattered in Turkey, when the break of the new-forming Tethys began to separate northern from Southern Turkey, and progressively grew wider between the (future) Pontids and Taurids. Not until the gap had become large enough, would be fixed faunas have evolved differently on both margins of the Tethys. This type of «explanation» applies well to the Gibraltar strait where the gap between Europe and Africa never seems to have been large, and where accordingly the faunas are closely comparable in Mesozoic times from Southern Spain to the Rif and Atlas mountains; it is proposed here that a similar pattern occurred between Pontids and Taurids during Triassic and Liassic periods. Later on, the gap having sufficiently increased, the two populations independently evolved on the two sides of the Tethys.

Manuscript received December 21, 1978

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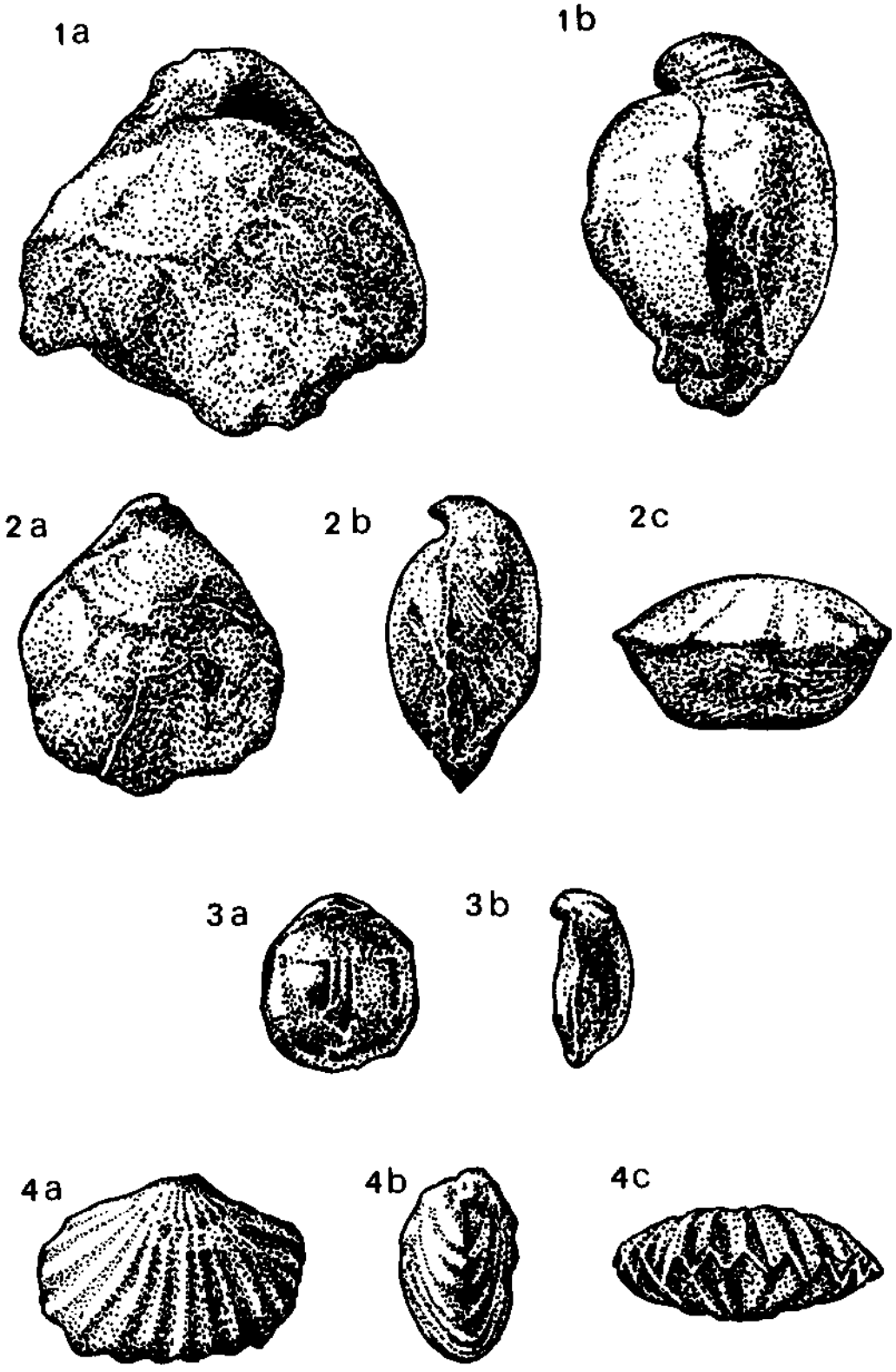
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Fig. 1 a-b - *Carapezzia globosa* (Carapezza and Schopen).

Dorsal and lateral views; Rhaetian, Col de Banos. XI.

Fig. 2 a-c - *Carapezzia geyeri* (Bittner).

Dorsal, lateral and anterior views; Rhaetian, west side of Anamas Dağ, south of Lake Eğr

Fig. 3 a-b - *Carapezzia* sp.

Juvenile showing muscle scars; dorsal and lateral views; Rhaetian, same locality. XI.

Fig. 4 a-c - *Halurella amphituma* (Bronn).

Dorsal lateral and anterior views; Norian, near Terziler. XI.

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