

**Notulae malacologicae, XLVIII.  
Lauriinae (Gastropoda, Pulmonata, Orculidae/Pupillidae) from the  
Villafranchian of peninsular Italy<sup>1</sup>**

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*Prof. Tommaso Cocozza, geologist,  
1928-1989, in memoriam*

Two species belonging to the Lauriinae (Orculidae/Pupillidae), *Leiostylia* cf. *gottschicki* (Wenz, 1922) and *Lauria* cf. *cylindracea* (Da Costa, 1778), are reported for the first time from the Villafranchian of peninsular Italy. The description of the two species is followed by an analysis of the systematics, palaeontology and biogeography of the genera *Leiostylia* and *Lauria*.

Key words: Gastropoda, Pulmonata, Orculidae, Pupillidae, Lauriinae, *Lauria*, *Leiostylia*, systematics, palaeontology, biogeography, Villafranchian, Italy.

The opportunity of visiting one of the most famous palaeontological sites of central Italy, the fossil wood of Dunarobba, has enabled us to collect a rich fossil land snail fauna. After a first paper devoted to a new species of *Eostrobilops* (Manganelli et al., 1989), we now describe and discuss two species of Lauriinae (Orculidae according to Pilsbry, 1922; Schileyko, 1984; or Pupillidae according to Zilch, 1959, 1985; Schileyko, 1975; Backhuys, 1975; Damjanov & Likharev, 1975; Kerney et al., 1983; Waldén, 1983; Holyoak & Seddon, 1986; Gittenberger & Pieper, 1988; De Winter & Ripken, 1989) never before reported among the fossil fauna of peninsular Italy.

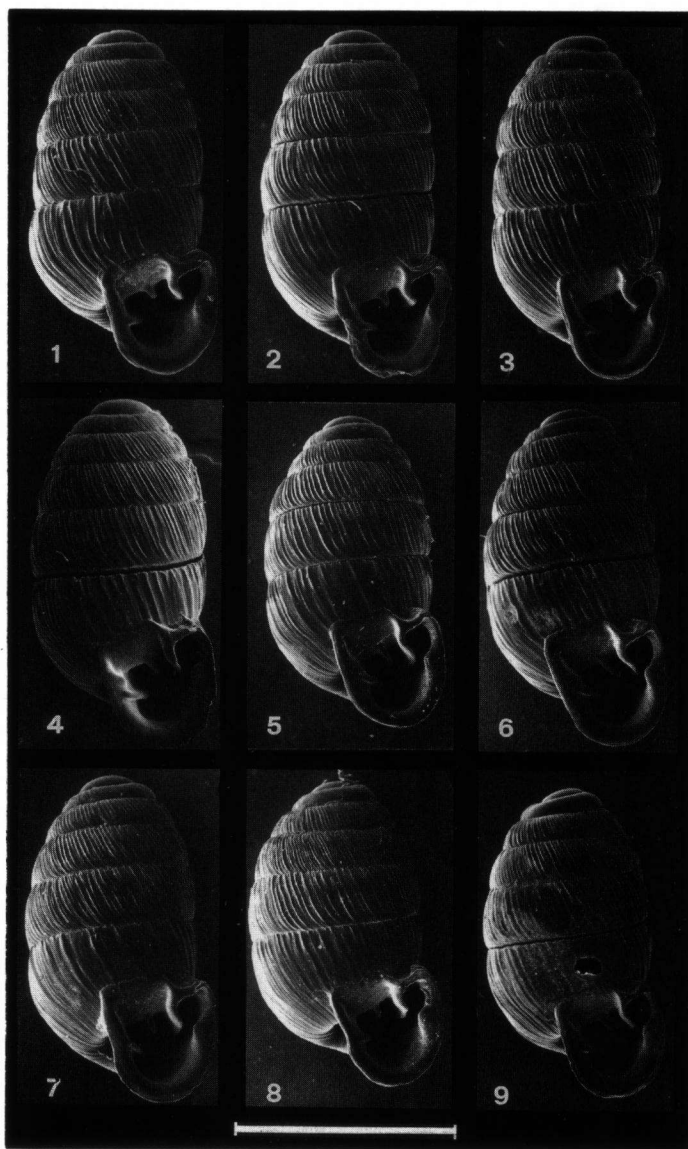
**Family Orculidae/Pupillidae  
Subfamily Lauriinae**

*Leiostylia* cf. *gottschicki* (Wenz, 1922)

*Lauria* (*Leiostylia*) *gottschicki* Wenz, 1922. — Arch. Molluskenk. 54: 107-108, text fig.

Description of the Dunarobba material (figs. 1-15, 31). — Shell (figs. 1-9) variable in shape, from cylindrical to ovoid. The spire consists of c. six moderately convex

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Figs. 1-9. Shells of *Leiostyla* cf. *gottschicki* Wenz from the Villafranchian of Dunarobba (Umbria, central Italy). Scale bar 2 mm.

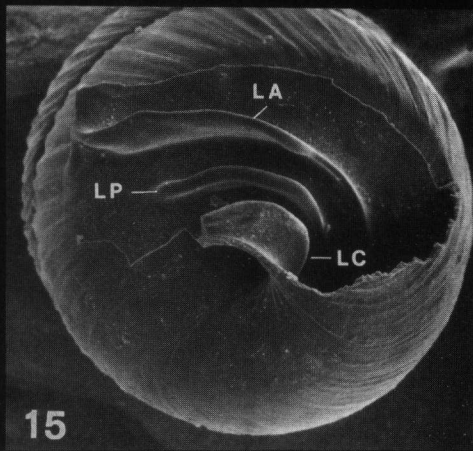
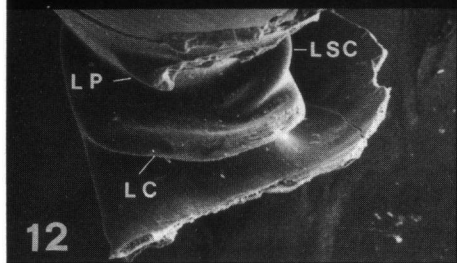
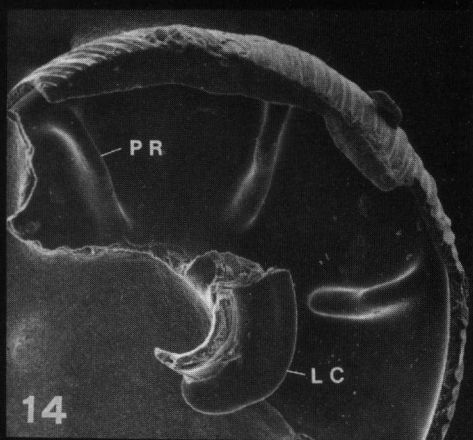
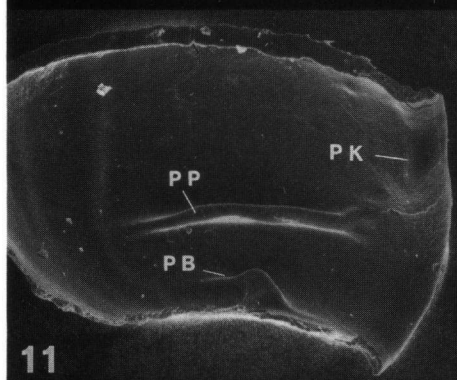
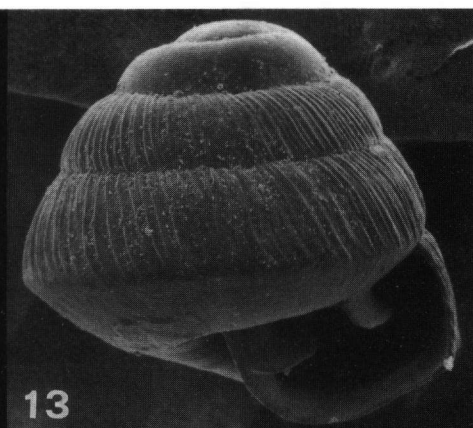
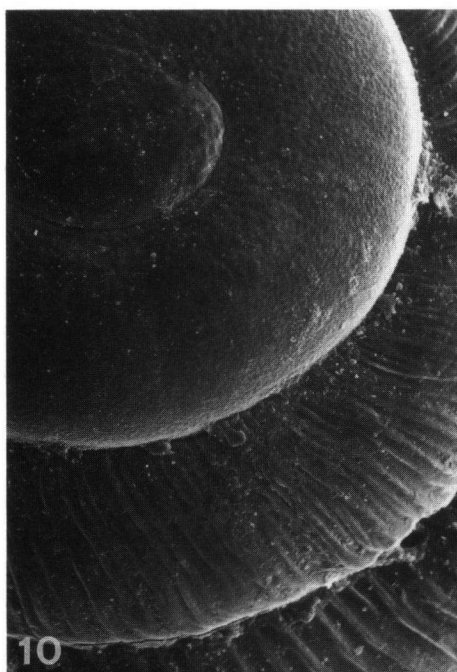
whorls. The last whorl is about half the spire length. The umbilicus is open, but very small. The aperture is large and narrowed below. The peristome is reflexed and well thickened. The parietal margin of the peristome is covered by an evident and thick parietal callus on which two parietal lamellae end. A strongly thickened and prominent callus connects the lamella angularis (LA) to the outer vertex of the peristome. The LA is higher and emerges further from the aperture than the lamella parietalis (LP); its terminal tract is sinuous. The parietal lamellae (fig. 15) originate about  $\frac{1}{2}$  whorl before the aperture and run parallel to one another over their entire length. The LA reaches the external edge of the parietal callus whereas the LP stops before that. There are two columellar lamellae on the columella (fig. 12). The lamella columellaris (LC), usually oblique or rarely horizontal, does not reach the external edge of the peristome. The lamella supracolumellaris (LSC) is difficult to see in apertural view, being very short and ending obliquely to reach the LC. Above the LC on the internal edge of the columellar peristome there is sometimes (2 specimens) a faint fold which gives rise to a small nodulus. There are two palatal plicae (fig. 11). The plica basalis (PB) is reduced, nodular or in the form of a very short lamina, and located near the columellar base; in one specimen a very small nodulus flanks the PB. The plica palatalis (PP) is centrally located in the palatum and never reaches the peristomal edge; an external furrow coincides with this plica. In one specimen there are two very small noduli above the PP. The outer margin of the peristome has a peristomal knob (PK). The PK, the LA and the interposed peristome delimit a clearly defined sinulus. Young shells have one parietal lamella, one columellar lamella and several regularly spaced transverse plicae (figs. 13-14). The surface of the protoconch is finely malleated and crossed by a few sparse spiral grooves (fig. 10). The surface of the teleoconch whorls has a strong but rather irregular ribbing, more distinct near the upper than the lower sutures.

Dimensions. Height: 2.62-3.25 mm; width: 1.43-1.56 mm.

Material examined. — Sixty whole shells and hundreds of shell fragments. Three shells are in the Nationaal Natuurhistorisch Museum (Rijksmuseum van Geologie en Mineralogie), Leiden (The Netherlands) no. RGM229-746 and in the Senckenberg-Museum, Frankfurt am Main (W. Germany), no. SMF308393. The other material is in the Giusti and Manganelli collections (University of Siena, Italy).

Collection site. — "Fossil wood of Dunarobba", in the clay encrusting the trunks. Fornace Briziarelli, Dunarobba (Avigliano Umbro, Perugia) (Sheet 130 of the geological map of Italy). Lower Villafranchian (Late Pliocene) according to Jacobacci et al., (1970), Follieri (1977), Segre (1986); Upper Villafranchian (Early Pleistocene) according to Ambrosetti et al., (1986, 1988, 1989) (for other details see Manganelli et al., 1989).

Discussion. — Comparison with shells of all the fossil species and the descriptions and drawings of living species (Pilsbry, 1922-24; Götting, 1968; Schileyko, 1975, 1984, 1987; Zilch, 1985; Holyoak & Seddon, 1986; Gittenberger & Pieper, 1988) has led to the present (preliminary) identification. Two shells of *L. gottschicki* (figs. 21, 22, 30) from the type locality (Steinheim am Albuch, W-Germany; Upper Miocene: Sarmation according to Wenz) correspond almost completely to our material, not only in shell dimensions and shape and the relief of the shell ribbing but also in number, position and strength of the apertural lamellae and plicae. To these characters a faint angularity on the surface of the last whorl immediately before the aperture, evident in most specimens and in one of the *L. gottschicki* topotypes, should possibly be added.



Due to problems related to the systematics of the species-group taxa in *Leiostyla* (see below) and the temporal hiatus between *L. gottschicki* and our material we have, nevertheless, preferred to refer the Dunarobba material to Wenz's species only by comparison. Wenz's species has been described from the Sarmatian (Upper Miocene) (Wenz, 1922, 1923; Schütt, 1967), whereas, if current dating is reliable, our material dates back to the Villafranchian.

## COMMENTS

Systematics. — The systematics of *Leiostyla* s.l. still contains many problems, some related to supraspecific and others to specific taxa. We will deal with these topics separately, beginning with the former.

Zilch (1959) subdivided *Leiostyla* Lowe, 1852 (type-species: *Pupa vincta* Lowe, 1852) into eight subgenera. *Craticula* Lowe, 1852 (type-species: *Pupa ferraria* Lowe, 1852), *Scarabella* Lowe, 1852 (type-species: *Helix cassida* Lowe, 1831), *Mastula* Lowe, 1852 (type-species: *Helix lamellosa* Lowe, 1852), and *Wollastonula* Lowe, 1852 (type-species: *Pupa gibba* Lowe, 1852) are limited to Madeira and *Azoripupa* Pilsbry, 1923 (type-species: *Pupa tessellata* Morelet, 1860) to the Azores. The other subgenera, *Euxinolauria* Lindholm, 1924 (type-species: *Pupa pulchra* Retowski, 1883) and *Caucasipupa* Pilsbry, 1926 (type-species: *Pupa caucasica* L. Pfeiffer, 1857) are limited to the Caucasus, Turkey and Crimea. Finally the nominotypical subgenus *Leiostyla* includes species of W. Europe, NW. Africa and the Macaronesian Is. (Canary Is., Azores and Madeira). Schileyko (1975, 1984, and personal communication) considers that there are anatomical differences (mainly in the organization of the epiphallic appendix) of a subgeneric level among the Caucasian species and that thus a close relationship between the Caucasian and Macaronesian group of species appears to be improbable. Consequently he regards *Euxinolauria* as a distinct genus with *E.* (s.s.), *Caucasipupa*, *Matschachelia* Schileyko, 1975 (type-species: *Euxinolauria rectidentata* Schileyko, 1975) and *Neolauria* Schileyko, 1975 (type-species: *Lauria zonifera* Pilsbry, 1934) as its subgenera. Waldén (1983: 268) regards *Craticula* as an artificial taxon and Holyoak & Seddon (1986) state that *Scarabella* cannot be distinguished from *Leiostyla* (s.s.) because a species exists that connects the two subgenera. Finally Gittenberger & Pieper (1988) describing a new species from northern Iran, give the first anatomical data on W.-European *L. anglica* (Wood, 1828), showing that no significant anatomical differences exist between this and the Casaso-Iranian species and consequently the poor foundation of the distinction into two separate genera proposed by Schileyko (1975, 1984).

The assumptions of Schileyko (1975, 1984) are not easy to accept, because a distinct geographical distribution cannot be utilized to infer systematic differentiation and

Figs. 10-15. Details of the shell of *Leiostyla* cf. *gottschicki* Wenz from the fossil Villafranchian wood of Dunarobba (Umbria, central Italy). 10: protoconch and first whorls. 11: palatum with the peristomal knob (PK), the plica palatalis (PP) and the plica basalis (PB). 12: columellar side of the parietum with the lamella columellaris (LC) and the lamella supracolumellaris (LSC). The lamella parietalis (LP) and the lamella angularis have been (partly) removed to show the columellar lamellae. 13: young shell. 14: parietum of a young shell with the lamella columellaris (LC) and the plicae radiales (PR). 15: the parietum with the lamella angularis (LA), the lamella parietalis (LP) and the lamella columellaris (LC). Fig. 10 x120, figs. 1, 12, 13, 15 x35, fig. 15 x45.

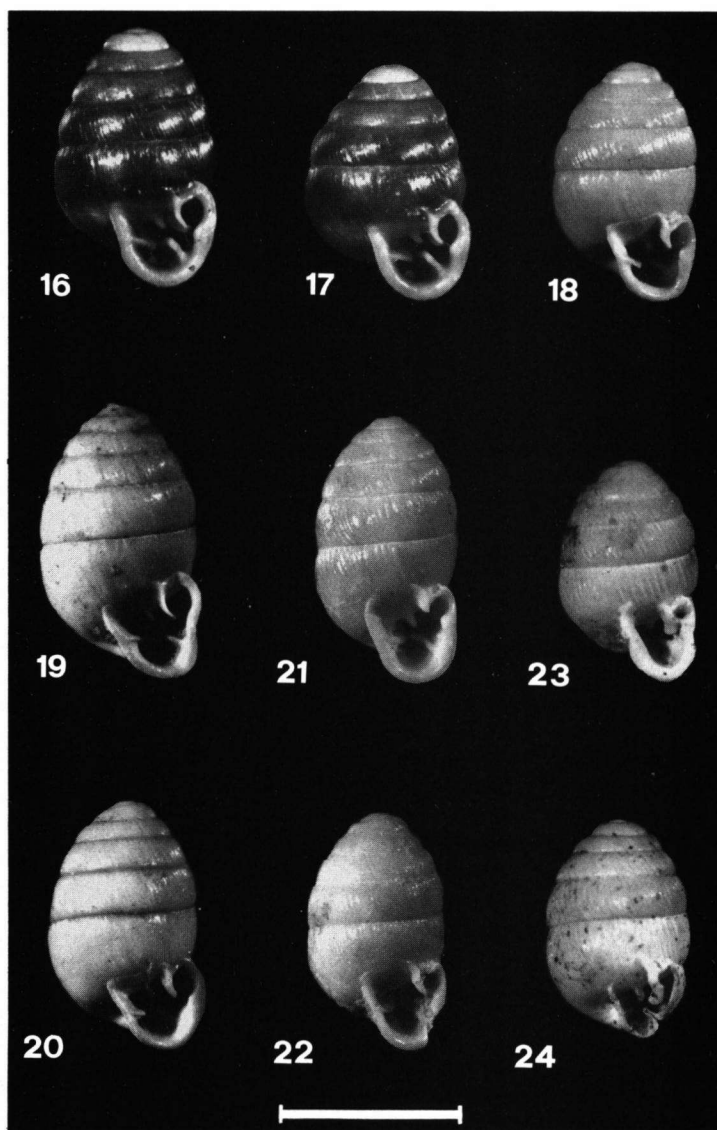
because the anatomical peculiarities utilized for distinguishing *Euxinolauria* from western *Leiostyla* appear to us of dubious significance at supraspecific rank. The genital duct scheme in apparently closely related groups is in fact strikingly constant. *Lauria* (another genus of the Lauriinae) has the same genital duct scheme (cf. Steenberg, 1925: pl. 9; Schileyko, 1984: fig. 80) as many *Euxinolauria*-species studied by Schileyko (cf. 1984: figs. 67, 69, 71, 73) and only minor differences distinguish the others. Moreover genera, usually included in other subfamilies/families, have a similar genital duct scheme: *Walklea* (Orculidae) (cf. Gittenberger, 1978: fig. 8), *Speleodentorcula* (Orculidae) (cf. Gittenberger, 1985: fig. 2), *Klemmia* (Valloniidae) (cf. Gittenberger, 1975: figs. 6-7), *Virpazaria* (Valloniidae) (cf. Gittenberger, 1975: figs. 4-5) and *Spelaeodiscus* (Valloniidae/Spelaeodiscidae) (cf. Schileyko, 1984: fig. 85).

In the face of such uncertainty we prefer to use the genus *Leiostyla* for both the eastern and western species, avoiding subgeneric divisions until more precise and complete anatomical data are available.

The systematics of the recent taxa of the species group is mainly based on shell characters. Conchological variation concerns: shell shape (from ovoid or conical to cylindrical, sometimes *Truncatellina*-like); shell ribbing; number of whorls; peristome (from simple or thickened to crenulated); shape and size of the apertural armature [two parietal lamellae: lamella angularis (LA) simple or with apical denticle or basal short twin lamella; two or three columellar lamellae: lamella supracolumellaris (LSC) visible or otherwise, parallel or oblique to lamella columellaris (LC), LC oblique or horizontal; lamella subcolumellaris (LS) absent or present; 1, 2 or no nodular or lamellar basal plicae; 1-3 palatal plicae, the lower of which is always lamellar; peristomal knob absent, nodular or plate-like]. Anatomical variation concerns the length of various tracts of the distal genitalia and shape and size of the epiphallic appendix. Comprehensive reports on recent *Leiostyla* have been published by Pilsbry (1922-1924) and more recent revisions of the Caucaso-Iranian species have been proposed by Schileyko (1974, 1984). To date there is no modern revision of the Macaronesian taxa. Many of the species that Pilsbry (1922-1924) and Waldén (1983) described and confirmed are based on a handful of specimens from one or a few localities, so it is possible that the characters used in their discrimination are only due to intra/interpopulation variation<sup>2</sup>. Despite all these problems we will discuss their morphological affinities with the *Leiostyla* of Dunarobba.

Many Recent species are reminiscent in different ways of *L. cf. gottschicki*, particularly the many forms with five folds visible from the aperture (2 parietal lamellae, 1 columellar lamella, 1 plica basalis and 1 plica palatalis). Excluding taxa with the lamella supracolumellaris visible from the aperture and parallel to the lamella columellaris, with a plate-like peristomal knob, a crenulated peristome, and the lamella angularis provided with an apical denticle or a basal twin lamella, the remaining Caucaso-Iranian species are: *L. tenuimarginata* (Pilsbry, 1922), *L. iranica* Gittenberger & Pieper, 1988, and maybe also "*Speleodentorcula*" *vitrea* Schileyko, 1987. We examined one shell of *L. tenuimarginata* (Pilsbry, 1922: 76-77, 1923, pl. 10 figs. 1-2) (SMF 52113), and found it to be very similar to the shell in fig. 2 of Pilsbry. This species, which recalls some Macaronesian species, differs from *L. gottschicki* by virtue of its more con-

<sup>2</sup> A thorough revision of the entire Macaronesian *Leiostyla* fauna is in progress by Dr. H. Waldén (Göteborg, Sweden) and Dr. B. Pokryszko (Wrocław, Poland).



Figs. 16-24. Recent and fossil *Leiostylia*-species of western Europe. 16-17: *L. anglica* (Wood) from Ballintober (Mayo, N. Ireland). 18: topotype of *Vertigo priscilla* Paladilhe (SMF 262072) from the Ruscinian of Celleneuve (France). 19: holotype of *Vertigo* (*Scarabella*) *capellinii* Sacco (BS.098.05.001) from the Villafranchian of Fossano (Piedmont, Italy). 20: holotype of *V. (S.) capellinii* var. *ligustica* Sacco (BS.098.04.003) from the Villafranchian of Tassarolo (Piedmont, Italy). 21-22: topotypes of *Lauria* (*Leiostylia*) *gottschicki* Wenz (SMF 274297) from the "Sarmatien" of Steinheim am Albuch (W. Germany) (the shell in fig. 21 has the LA broken). 23-24: topotypes of *Lauria austriaca* Wenz (NHMW 9940, 45020) from the "Pontien" of Leobersdorf (Austria). Scale bar 2 mm.

ical shape, greater number of whorls, faintly oblique aperture, absence of thickened peristome, and straight lamella angularis. The other two species, known to us only from the original description, are apparently very similar to the Dunarobba specimens. The only characters which differentiate *L. iranica* are shell shape and shell ribbing (indistinct); those which differentiate "*S.*" *vitrea* are more evident and regularly spaced ribs, more delicate parietal lamellae and apparently no plica basalis and a very short plica palatalis.

W. European *L. anglica* and NW. African *L. numidica* (Bourguignat, 1864), are also very similar. The former is known to us from direct study of N. Irish shells (figs. 16-17, 25-26), the latter from the original description (Bourguignat, 1864: 100-101, pl. 4 figs. 33-34; also reported in Pilsbry, 1922: 86-87, pl. 5 figs. 13-14) and the redescription by Gittenberger & Pieper (1988: fig. 3). *L. anglica* appears mainly differentiated from *L. gottschicki* by a different shell shape, faint shell ribbing and some dimensional characters, *L. numidica* by the absence of the plica basalis.

Among the Macaronesian *Leiostyla* we can exclude any relationship with species of the genus-group taxa such as *Craticula*, *Mastula* and *Wollastonula*. *Mastula* and *Wollastonula* have such a peculiar apertural armature that they can possibly be regarded as valid genera/subgenera. The species of *Craticula* ("group of *L. ferraria*" sensu Pilsbry, 1923) with the exception of *L. abbreviata* (Lowe, 1852), are different because of their *Truncatellina*-like shell. Excluding the taxa with LSC visible from the aperture and parallel to the LC and those with more palatal plicae, some of the remaining taxa, i.e. *L. vincta* (Lowe, 1852), *L. cassidula* (Lowe, 1852), *L. concinna* (Lowe, 1852), *L. sphinctostoma heterodon* Pilsbry, 1923, *L. abbreviata*, *L. castanea* (Shuttleworth, 1852), *L. teniata* (Shuttleworth, 1852), *L. pythiella* (Mousson, 1872), and *L. fuscidula* (Morelet, 1860), resemble the Dunarobba *Leiostyla*. Some have large dimensions, more ovoid or conical shells, less evident shell ribbing, no plica basalis, sometimes a lamella subcolumellaris, more delicate and not sinuous parietal lamellae.

Palaeontology. — Very little information is available about the fossil species. Fossil *Leiostyla* have rarely been found and always very few specimens. The present finding of plentiful and well preserved material is exceptional.

*Lauria minax* Boettger, 1889, and *Lauria minax* var. *microdoma* Boettger, 1889, from the Upper Oligocene (Chattian, according to Wenz, 1923) of Germany, are so different that it seems difficult to accept the opinion of Wenz (1923) and Zilch (1985) that they are a *Leiostyla* species. The peculiar structure of the parietal lamellae (3 lamellae, with a more developed lamella parietalis, cf. Zilch, 1985: figs. 1-2; the *Leiostyla* have two parietal lamellae of which the angularis is more developed) distinguishes this species from all the *Leiostyla*.

*Lauria gottschicki* Wenz, 1922 (figs. 21-22, 30) was described from the Upper Miocene (Sarmatian, according to Wenz, 1923) of Steinheim am Albuch (W. Germany). This species was later reported by Schütt (1967: 201, fig. 10) from the Sarmatian of Hollabrunn (N. Austria).

*Lauria austriaca* Wenz, 1919 (figs. 23-24, 32-33) from the Upper Miocene (Pontien, according to Wenz, 1923) of Austria, is only known from the original description and recent study by Lueger (1981). We traced the holotype and other topotypical material to the collection of the Naturhistorisches Museum Vienna (Austria) (NHMW 9979/1, 9940/9, 45020/1). *L. austriaca* is characterized by a small ovoid shell with distinct ribbing, well thickened peristome, markedly thickened LA inclined towards the palatum, LSC parallel to the LC, LSC and LC ending internally and not clearly visible in aper-



tural view, one PB, one long robust PP whose concavity faces the LA, a narrow groove between the LA and PP, and a very narrow sinulus. This species is very different from *L. gottschicki* and other fossil and Recent species by virtue of the position and structure of the PP (usually the PP is straight or with a concavity facing the PB).

*Vertigo priscilla* Paladilhe, 1875 (figs. 18, 27) is known from the Ruscinian (Plaisencien, according to Wenz, 1923) of Celleneuve near Montpellier (France) and has been more recently reported by Schlickum & Geissert (1980: 233, pl. 13 figs. 20-21) from the "Triptychia-Mergeln" of the Pliocene of Sessenheim (France). We studied one topotype (SMF 262062) of this species. This taxon appears based on *Leiostyla* specimens with ovoid shell, very faint shell ribbing, apertural lamellae and plicae as in *L. gottschicki*, but more delicate and with two short and closely placed basal plicae (at least in the shell studied by us; no information is available on the typical material or that studied by Schlickum & Geissert, 1980).

*Vertigo (Scarabella) capellinii* Sacco, 1885 (figs. 19, 28) and *V. (S.) capellinii* var. *ligustica* Sacco, 1887 (figs. 20, 29), from the Villafranchian (Astien, according to Wenz, 1923) of Piedmont (Italy), were considered by Wenz (1923) and Pilsbry (1926) to be a *Vertigo* (*Ptychalea*). What remains of the typical material traced to the Paleontological Museum of the University of Turin (BS.098.05.001 and BS.098.04.003), showed that they belong to *Leiostyla*. The shell shape, shell ribbing and apertural lamellae and plicae are very similar to those of *V. priscilla* but there is only one basal plica.

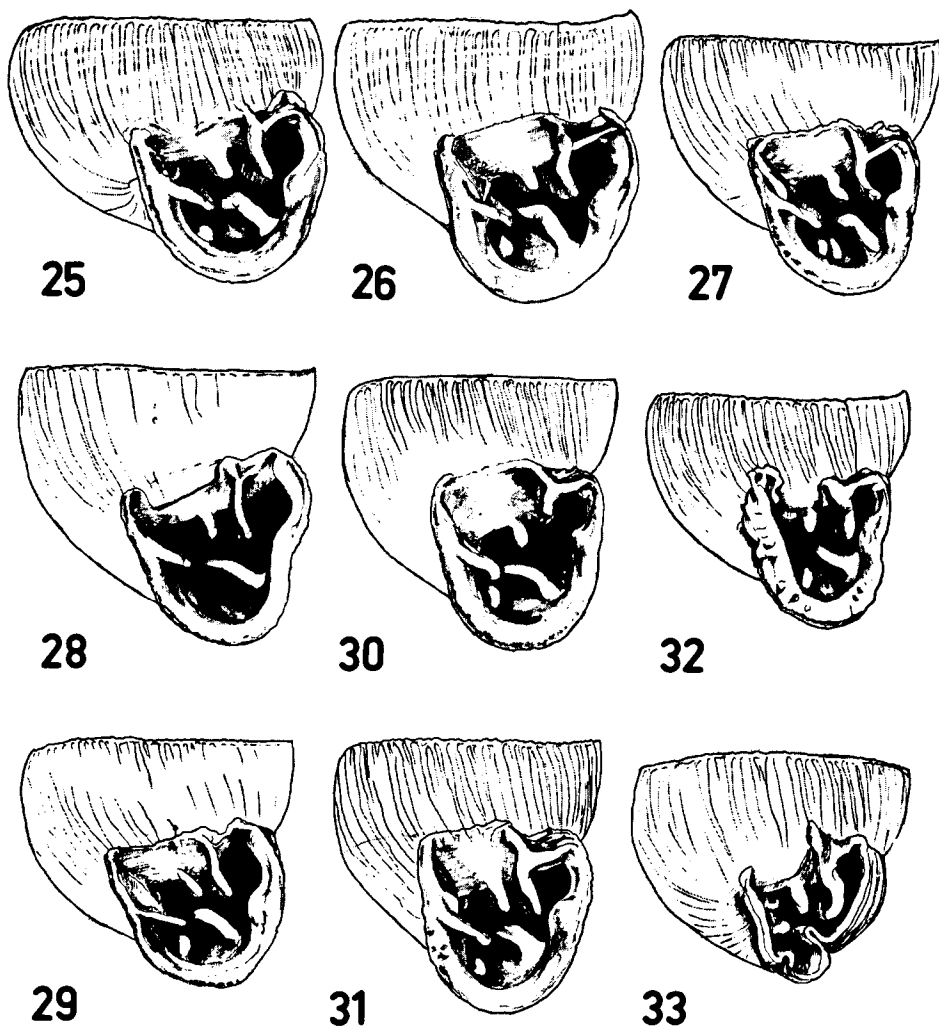
Pilsbry (1922) and Waldén (1983) regarded the species of the "*L. cheilogona* group" as primitive because they are very "close to Tertiary species of Europe, to the Recent British species, and to such Caucasian forms as *L. tenuimarginata*" (Pilsbry, 1922: 67). This is very probable, even if *L. austriaca*, one of the oldest fossil taxa known, has a very complex apertural armature different from that in the other fossil taxa.

*L. austriaca* is therefore undoubtedly distinct from *L. gottschicki*. The relationship between *L. gottschicki*, *V. priscilla*, *V. capellinii* and *V. capellinii* var. *ligustica* are more difficult to determine. The last three taxa are probably closely related and possibly conspecific. The only characters which we found to distinguish *V. priscilla* from *V. capellinii*, consists in the former having an accessory basal plica. Having studied only one shell of the Paladilhe species and three of those of Sacco it has been impossible to ascertain whether the number of plicae is stable or not. The fact that Recent *L. anglica* have one or two basal plicae (Pilsbry, 1922: 84) testifies to considerable variation and consequently the lack of diagnostic value of this character. Finally, it is possible that the three fossil taxa are closely related to *L. anglica*, because no significant differences exist between them.

A more careful study of the Recent species is necessary to promote a better understanding of the fossils.

**Biogeography.** — The discovery of a *Leiostyla* species in the Villafranchian fauna of central Italy is very interesting.

As outlined above, *Leiostyla* at present shows a disjunct distribution with two major centres of diversity (fig. 34), in the Caucasus and in the Macaronesian Is. Thirteen species live in the eastern sector, which comprises Crimea, Caucasus, N. Iran, Turkey and Cyprus (Götting, 1968; Schileyko, 1975, 1984, 1987; Zilch, 1985; Gittenberger & Pieper, 1988). In the Macaronesian Is. *Leiostyla* shows a striking radiation on Madeira, a minor radiation in the Canary Is., and an isolated, well-circumscribed group in the Azores (Waldén, 1983). Finally, only a single species occurs in a few Algerian localities: *L. numidica* (Bourguignat, 1864), and another sporadically in



Figs. 25-33. The last whorl in recent and fossil *Leiostryla*-species of western Europe. 25-26: *L. anglica* (Wood) from Ballintober (Mayo, N. Ireland). 27: topotype of *Vertigo priscilla* Paladilhe (SMF 262072) from the Ruscinian of Celleneuve (France). 28: holotype of *Vertigo (Scarabella) capellinii* Sacco (BS.098.05.001) from the Villafranchian of Fossano (Piedmont, Italy). 29: holotype of *V. (S.) capellinii* var. *ligustica* Sacco (BS.098.04.003) from the Villafranchian of Tassarolo (Piedmont, Italy). 30: topotypes of *Lauria (Leiostryla) gottschicki* Wenz (SMF 274297) from the "Sarmatien" of Steinheim am Albuch (W. Germany) (the shell has the LA broken). 31: *Leiostryla* cf. *gottschicki* from the Villafranchian of Dunarobba (Umbria, Italy); 32-33: topotypes of *Lauria austriaca* Wenz (NHMW 9940, 45020) from the "Pontien" of Leobersdorf (Austria).

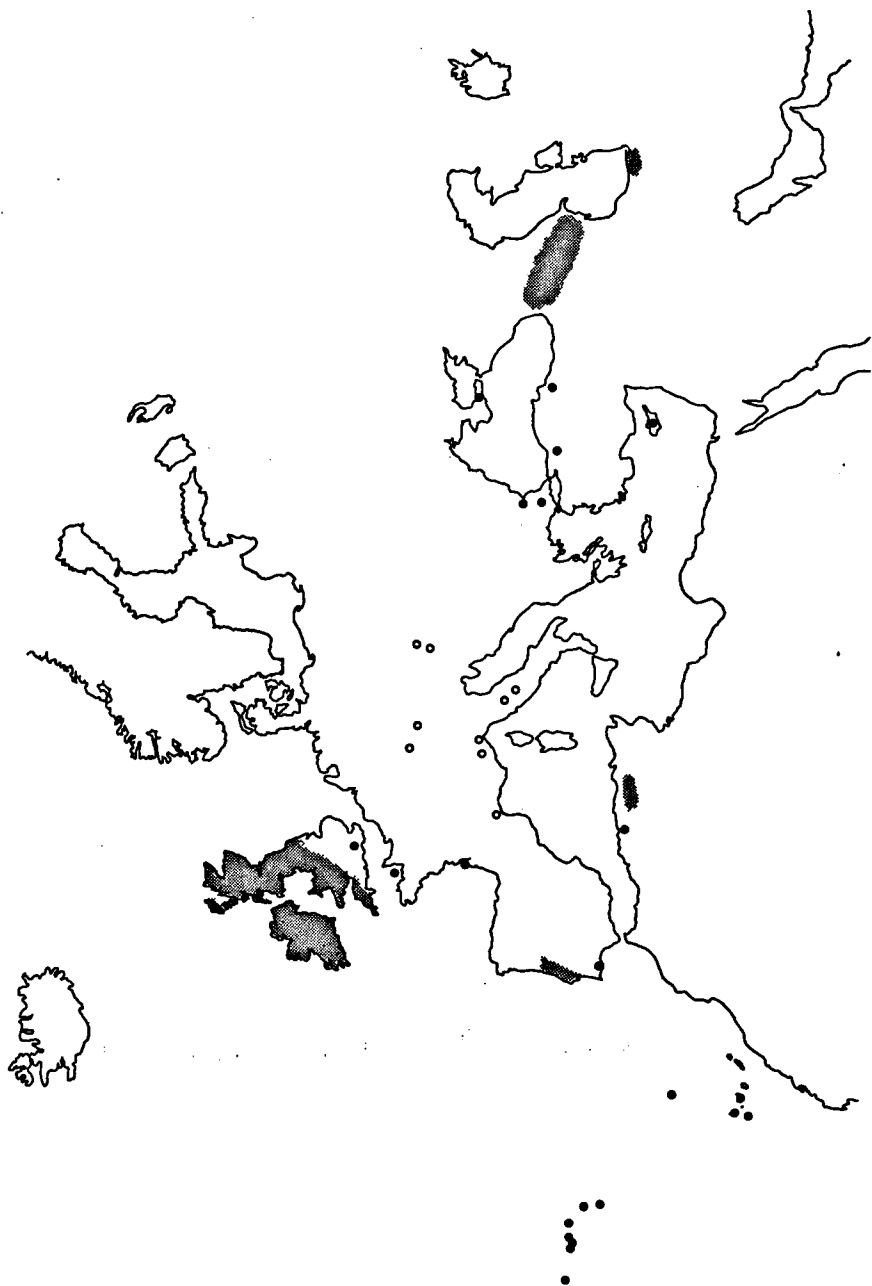


Fig. 34. Recent distribution (hatched areas and black dots) and fossil records (circles) of the genus *Leiotyla*. Recent distribution according to Pilsbry (1922-1926), Nobre (1941), Damjanov & Likharev (1975), Kerney et al., (1983), Schileyko (1984), Gittenberger & Piper (1988). Fossil records only include data back to the Early Pleistocene.

western Europe: *L. anglica* (Wood, 1828). The latter species lives in wood and marsh habitats and is common in Ireland and occurs in localized sites in mid and western Britain, the Channel Is., W. France (Ile de Ré) (Kerney & Cameron, 1979), Portugal (Nobre, 1941) and Madeira (De Winter & Ripken, 1989). It was recently reported in Bulgaria (Damjanov, 1971; Damjanov & Likharev, 1975) but Gittenberger & Pieper (1988: 69) believe that this report refers to the Turkish *L. schweigeri* Götting, 1968.

If we do not consider *Lauria minax* and *L. minax* var. *microdoma* to be *Leiostyla*, five fossil taxa of the species-group have been described, all from the Upper Miocene to Early Pleistocene of central southern Europe. No fossil record exists for the Caucasus, but some of recent Madeiran species have been found in Quaternary deposits (Pilsbry, 1922-1924).

We can thus hypothesize that *Leiostyla* originated in central Europe and subsequently dispersed to the SW.-S.-SE. Their establishment in the eastern sector may date back to the Upper Miocene when the drying-up of Paratethys (Steininger & Papp, 1979; Rögl & Steininger, 1983) may have given rise to direct land connections with Caucasia.

The origin of the Macaronesian *Leiostyla* is more difficult to interpret. Most of the Macaronesian islands, with the possible exception of the easternmost Canary Is., are oceanic archipelagos of volcanic origin (see Waldén, 1984a, for a review). Madeira began to emerge from the sea, becoming available for biotic colonization, in the Middle Tertiary, about 15 m.y. BP (Mitchell-Thomé, 1976) and the Azores date back to only a few m.y. BP. Nevertheless, many zoologists (Jeannel, 1936, 1942, 1956; Furon, 1941; Jodot, 1951; Bernardi, 1961; Colas, 1961; Mateau, 1961a, 1961b; Omodeo, 1961; Pierre, 1961; Vandel, 1961; Stock, 1988) suggest that the islands were part (or at least the bases on which volcanic material was later deposited) of a submerged continent (Atlantis) or appendages of Iberia (Madeira) or Morocco (Canary Is.). Waldén (1963, 1983, 1984a, 1984b) states that the malacofauna of Macaronesia represents a relict assemblage of Early Tertiary fauna of the western Palaearctic but believes that Madeira may have been colonized since the Middle Miocene by stepping stone dispersal from Europe, whereas the Canary Is. may have been colonized by dispersal from Europe and later also from Madeira and by land connections with NW.-Africa. Waldén also states that the younger Azores may have been colonized by dispersal from W. Europe.

Whether the Macaronesian islands are continental or oceanic in origin, it is very probable that *Leiostyla* reached Macaronesia after the Middle Tertiary. Apart from the many problems of the systematics of Macaronesian *Leiostyla*, the noticeable radiation of *Leiostyla* on Madeira is undeniable. Cook & Cameron (1989) state that this was possibly due to the fact that the islands were undersaturated with other mollusc species (for a checklist of the Madeiran land snail fauna cf. Waldén, 1983). The markedly more limited radiation of *Leiostyla* in the Azores and Canary Is. may be explained by the more recent age, more isolated position and Pleistocene cooling (Azores) or by catastrophic volcanism in the Late Tertiary (Canary Is.) (Waldén, 1984a, 1984b).

As for *L. numidica*, a species with a shell morphology very similar to *L. anglica*, its presence in Algeria (Blidah and various Kabylia localities; cf. Pilsbry, 1922: 86) is probably due to vicariance, i.e. to migration of microplates of Alpidic origin which collided and fused with NW.-Africa in the Upper Miocene (cf. Giusti & Manganelli, 1984, for a review of geological references).

Finally, it is likely that *Leiostyla* colonized Apenninic Italy as soon as it began to

emerge from the sea in the Middle Tertiary. That they are older than the fossil trunks of Dunarobba is corroborated by the finding of fragments of *Leiostylia* shells in the basal Lower Pliocene of Balze di Caspreno near Siena (Central Italy) (unpublished personal data).

It is probable that *Leiostylia* became extinct in central Europe and later in Apenninic Italy during the Pleistocene glaciations.

*L. anglica*, the only species living in western Europe and apparently related to the fossil *L. priscilla* and *L. capellinii*, may have survived the glaciations in southern sites, spreading northwards during warmer interglacial phases. *L. anglica* has been reported from the Quarternary of Great Britain by Davis & Carreck (1958) and Kerney (1959) (Hoxnian Interglacial).

*Lauria* cf. *cylindracea* (Da Costa, 1778)

*Turbo Cylindraceus* (sic!) Da Costa, 1778. British Conchology: 89, pl. 5 fig. 4 (incorrect original spelling).

Description of the Dunarobba material (figs. 37-38). — Shell cylindro-conical in shape. The spire is formed by 5½-6 convex whorls; the last whorl is c. half the spire height; umbilicus open, but very small aperture square; peristome reflexed and thickened; parietal callus thickened. Adult shells with very reduced apertural armature: there is only a short, reduced lamella columellaris and a thin lamella angularis which ends forming a tooth. The tooth is often basally expanded to reach the outer vertex of the peristome and sometimes flanked by a small twin denticle. Young shells have well developed lamella angularis and columellaris and some transverse palatal folds. Surface of the protoconch finely pitted. Surface of the teleoconch whorls with thin growth lines which are more marked near the sutures.

Dimensions. Height: 3.12-3.3 mm; width: 1.5-1.7 mm.

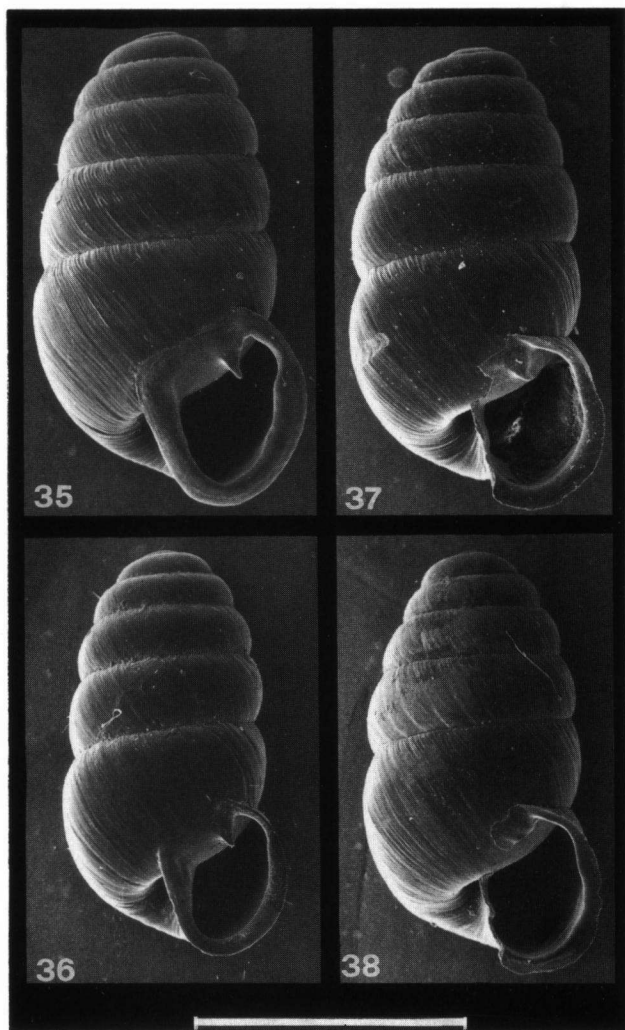
Material examined. — Two complete shells and numerous fragments (Giusti and Manganelli collections, University of Siena, Italy).

Collection site. — "Fossil wood of Dunarobba", Fornace Briziarelli, Dunarobba, (Avigliano Umbro, Perugia) (see above).

Discussion. — Shell structure is apparently extremely constant in the many *Lauria* species described in the Palaearctic and Ethiopian Regions (cf. Pilsbry, 1922). Moreover the best known European species *L. cylindracea* and *L. sempronii* (Charpentier, 1837) are hardly distinguishable. Shells presumed to be *L. cylindracea* living on non-calcareous soils or in dry habitats, frequently have smaller and thinner shells, indistinguishable from those of "typical" *L. sempronii* from alpine and high Apenninic habitats (Giusti & Castagnolo, 1983). For this reason this determination is only tentative.

## COMMENTS

All recent authors assign to *Lauria* Gray in Turton, 1840 (type species *Turbo cylindraceus* Da Costa, 1778) only species with reduced apertural armature; they assign the fully toothed forms to the distinct genus *Leiostylia* (see above). Zilch (1959: 171) writes that adult *Lauria* have one parietalis, one columellaris and one angularis lamella. Actually, the *Lauria* (s.s.) species never have any parietal lamellae! Only *Pupa fasciolata* Morelet, 1860, sometimes has a reduced lamella parietalis (cf. Backhuys, 1975: 93,



Figs. 35-38. Shells of *Lauria*. 35: *L. cylindracea* (Da Costa) from Capraia I. (Tuscan Archipelago, Italy). 36: *L. sempronii* (De Charpentier) from Bolzano (Italy). 37-38: *L. cf. cylindracea* from the Villafranchian of Dunarobba (Umbria, Central Italy). Scale bar 2 mm.

pl. 20 fig. 53). *P. fasciolata* is the type species of *Senilauria* Pilsbry, 1934 (nomen novum pro *Petrarca*, Pilsbry, 1922) regarded by Zilch (1959, 1985) and Backhuys (1975) as a subgenus of *Lauria*. Already Pilsbry (1923: 122) has underlined that *P. fasciolata* could be a "degenerated" *Leiostyla*. This opinion is probably correct and this species should thus be transferred from *Lauria* to *Leiostyla*. The question as to whether other *Lauria* species might be *Leiostyla* with a reduced apertural armature, is beyond the scope of this paper.

There exist numerous reports of fossil *Lauria*, but all of them of comparatively recent age, none being older than Upper Pliocene.

Material assigned to *L. cylindracea* has been reported from the Upper Pliocene of Norfolk (Wenz, 1923), from the Pleistocene of Algeria (Pallary, 1901), Germany, Switzerland, Belgium and England (Zilch & Jaeckel, 1962) and from the Late Quaternary of Scandinavia (Waldén, 1986). In Italy *L. cylindracea* has been reported only from the Villafranchian of Nuraghe su Casteddu (Sardinia) (Esu, 1978).

Material ascribed to *L. sempronii* is known from the Pleistocene of Germany (Zilch & Jaeckel, 1962) and from various neolithic and postglacial deposits of England (Kerney, 1957, 1983).

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