TETRAPOD REMAINS FROM THE LADINIAN (MIDDLE TRIASSIC) SCELTRICH BEDS OF MONTE SAN GIORGIO UNESCO SITE

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Abstract. The Sceltrich beds at the base of the upper Meride Limestone (Ladinian) above the Cassina beds, yielded a rich and diversified fish fauna comprising several specimens of the predatory fish *Saurichthys* and sarcopterygians. Reptile findings instead are scarce and limited to few disarticulated teeth and bones, however, their description can give an, albeit limited, insight about the reptile fauna of the Sceltrich beds which was never documented before, testifying the presence of large to mid-sized eusauropterygians and of the terrestrial tanystropheid *Macrocnemus*. The results indicate that the composition of the tetrapod fauna of the Sceltrich beds is similar to that of the upper levels of the Cassina beds. The taphonomic conditions that led to preservation as isolated remains could be due to a combination of different factors most probably involving a disarticulation and loss of elements during a floating phase. However it cannot be excluded that at least in some cases a residence phase of the carcass occurred for enough time to allow decomposition of soft parts, leading to disarticulation and removal of isolated elements by currents.

INTRODUCTION AND GEOLOGICAL SETTING

The aim of the present study is to describe and propose a taxonomic assignment for the isolated tetrapod remains collected from the Sceltrich beds (Stockar 2012; Stockar et al. 2013) belonging to the upper Meride Limestone (Ladinian, Middle Triassic), of the Monte San Giorgio area (Swiss/Northern Italy), in order to acquire some data about the diversity of the tetrapod fauna and its taphono-mic history as well as make a comparison with the tetrapod fauna from the underlying Cassina beds also belonging to the Meride Limestone.

The Middle Triassic carbonate succession of Monte San Giorgio (Switzerland-Italy; Figs. 1, 2), belonging to the western part of the Southern Alps, has been inscribed in the UNESCO World Heritage List (WHL) because of its unique paleontological value. It is, in particular, world-famous for the exceptionally well-preserved fossil fishes and marine reptiles (e.g. Rieber 1973a; Kuhn-Schnyder 1974; Bürgin et al. 1989; Etter 2002; Rieppel 2019).
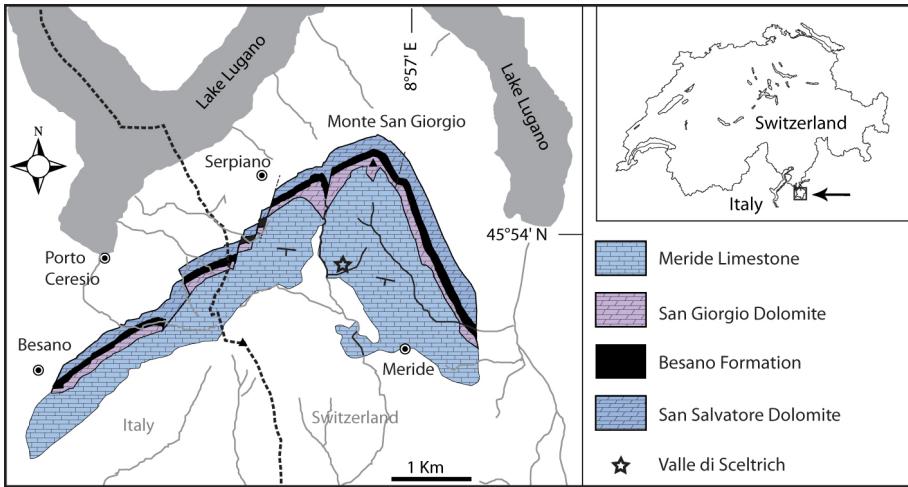
In Middle Triassic times, the South-Alpine domain was situated at a northern intertropical latitude of about 15-18° (Muttoni et al. 2004) and was strongly influenced by monsoonal circulation (Preto et al. 2010). This passive continental margin open to the western Neo-Tethys was progressively submerged by a long-term transgression from the east. The marginal location of the Monte San Giorgio Basin resulted in a peculiar sedimentary succession and in temporarily dysoxic to anoxic bottom water conditions (e.g. Bernasconi 1994; Röhl et al. 2001; Etter 2002; Stockar 2010; Stockar et al. 2013; Klug et al. 2024). The stratigraphic succession begins with an erosional unconformity at the top of a Lower Permian volcanic basement, overlain by Lower Triassic transitional clastic deposits (Servino, Induan - Olenekian; Frauenfelder 1916; Sciunnach et al. 2015). The overlying Middle Triassic succession (Fig. 2) starts with fluvio-deltaic sediments (Bellano Formation, Illyrian; Sommaruga et al. 1997). The following upper Anisian sediments indicate the progressive transgression of a shallow epicontinental sea and the related expansion of carbonate platforms (San Salvatore Dolomite; Zorn 1971) north of an emerged land area, which is nowadays covered by the Po Plain (Brusca et al. 1981). During the latest Anisian and the Ladinian, although shallow-water sedimentation continued in the north, an intraplatform basin opened in the area of the Monte San Giorgio, which led to the deposition of the Besano Formation, the San Giorgio Dolomite, and the Meride Limestone (Rieber 1973a; Bernasconi 1994; Furrer 1995; Röhl et al. 2001). The Besano Formation ("Grenzbitumenzone"; Frauenfelder 1916) directly overlies the Lower Salvatore Dolomite and is composed of a 16 m thick alternation of black shale and laminated dolostone (see Klug et al. 2024). Its uppermost part includes the Anisian/Ladinian boundary (Brack & Rieber 1993; Brack et al. 2005). Most of the spectacular vertebrate fossils together with important index invertebrate fossils come from this formation (e.g. Rieber 1973a,b; Kuhn-Schnyder 1974; Bürgin et al. 1989, Etter 2002; Rieppel 2019). The Besano Formation grades upwards into the San Giorgio Dolomite and the Meride Limestone, together constituting a 614 m-thick sequence in total (Stockar et al. 2012). The lower Meride Limestone consists of well-bedded micritic limestone, laminated limestone and volcaniclastic layers. Three fossiliferous intervals, informally known as "Cava inferiore beds", "Cava superiore beds" and "Cassina beds", mainly consist of finely laminated limestone and yielded different vertebrate fossil assemblages (e.g. Peyer 1931; Sander 1989; Furrer 1995; Stockar 2010; Stockar & Renesto 2011). The top of the lower Meride Limestone is defined by a discontinuous dolostone horizon ("Dolomitband"; Frauenfelder 1916) resulting from late diagenetic dolomitization cutting across the stratification of the Meride Limestone (Stockar 2012; Stockar et al. 2013). The overlying upper Meride Limestone is a sequence of alternating well-bedded micritic limestone and marlstone. The uppermost part comprises the 120 m thick "Kalkschieferzone" (Senn 1924), made up of thinly-bedded, mostly laminated, limestone and marlstone with rich and diverse faunas of fishes, crustaceans and insects (e.g. Wirz 1945; Furrer 1995; Krzeminski & Lombardo 2001; Bechly & Stockar 2011; Lombardo et al. 2012; Montagna et
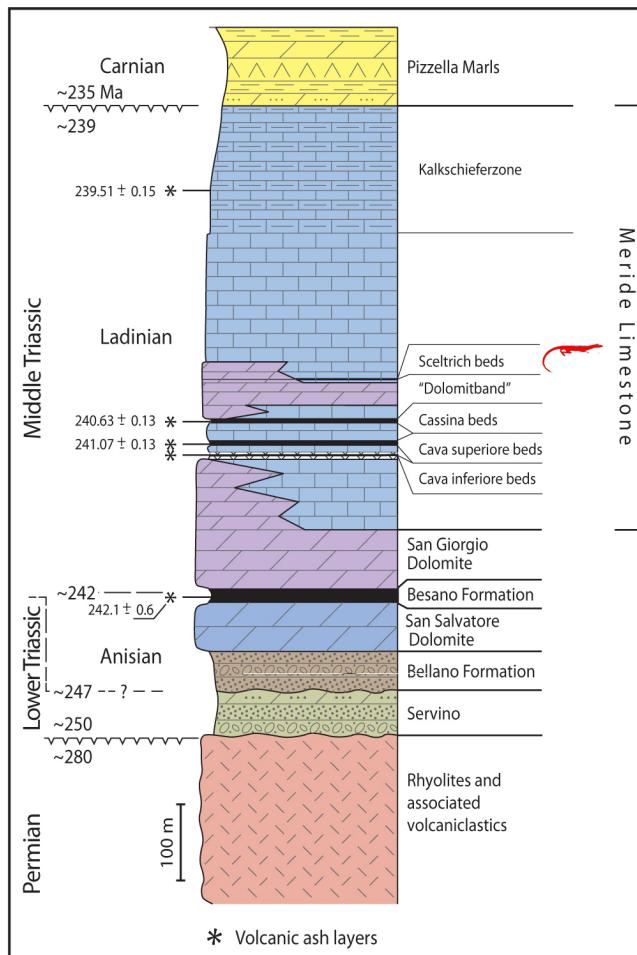
Fig. 2 - Stratigraphic column of the Monte San Giorgio area, reptile shape indicates the level that yielded the tetrapod remains.

al. 2018, 2024). Finally, the following Carnian regressive phase resulted in the formation of sabkha-type depositional environments and in the related sedimentation of evaporites (Pizzella Marl, Furrer 1995).

The fossiliferous interval yielding the specimens described herein belongs to the lowermost part of the upper Meride Limestone and was informally introduced as "Sceltrich beds" in Stockar (2012) and Stockar et al. (2013). Its age is assigned to the transition interval between the Gredleri and Archelaus Ammonoid Zones (*sensu* Brack & Rieber 1993) of the Ladinian Stage (Stockar et al. 2012). The site is located on the northern bank of a small creek (Valle di Sceltrich; Swiss National Coordinates: 716'910/84'370; WGS8 coordinates 8.4503/45.90084; Fig. 1), northwest of the village of Meride. The fossiliferous interval consists of a 30 cm thick sequence of prevailing organic-rich

laminated limestone (up to 3.1 % TOC) intercalated between thick-bedded marly limestone. In the Valle di Sceltrich area, this fossiliferous horizon lies around 2.5 m above the "Dolomitband". At places, the laminated limestone shows storm-generated concentrations of platform-derived skeletal grains and thin-shelled bivalve pavements (Stockar 2012; Stockar et al. 2013). Benthic microbial activity accounts for the microfabrics observed in the laminated limestone, including clotted-peloidal micrite and amorphous organic matter showing EPS (extracellular polymeric substance) -like structures as well as for the geochemical signature being characterized by high hydrogen indices and prevailing Type-II (Type I) kerogen (Stockar et al. 2013). Preservation of such a labile lipoid-rich organic material requires anoxic/lower dysoxic bottom-water conditions (Stockar et al. 2013 and references therein). Lower dysoxic conditions were accompanied by episodic seafloor colonization by thin-shelled opportunistic posidonioid bivalves (Stockar 2012; Stockar et al. 2013). On the other hand, both lower dysoxic and anoxic bottom-water conditions ruled out macrobenthos, including scavengers, and resulted in complete oxygen depletion within the sediment. Coupled with widespread oxygen depletion excluding benthic scavenger organisms, rapid coating of skeletons by benthic bacterial mats ('microbial shroud' effect; Gall 2001) played the key role in protecting the carcasses from decay and in holding skeletal elements together (see also Furrer 1995, 1999; Stockar 2010), thus accounting for the microfabrics observed in the laminated limestone and for the exquisite preservation of the vertebrate fossils (Stockar et al. 2013).

So far, the excavation carried out in the Sceltrich beds yielded a rich vertebrate fossil fauna consisting mainly of articulated fish specimens (López-Arbarello et al. 2016, 2019; Renesto & Stockar 2018; Renesto et al. 2021). Invertebrate fossils mainly consist of bivalves, gastropods (Pieroni & Stockar 2020), crustaceans (Stockar & Garassino 2013; Pasini et al. 2022), one insect (Montagna et al. 2024) and terrestrial plant remains. Tetrapods are represented only by rare isolated bones and teeth which however are of interest, because they give an insight, about the diversity of the reptile fauna in the Sceltrich beds, revealing the presence of both marine and terrestrial taxa.
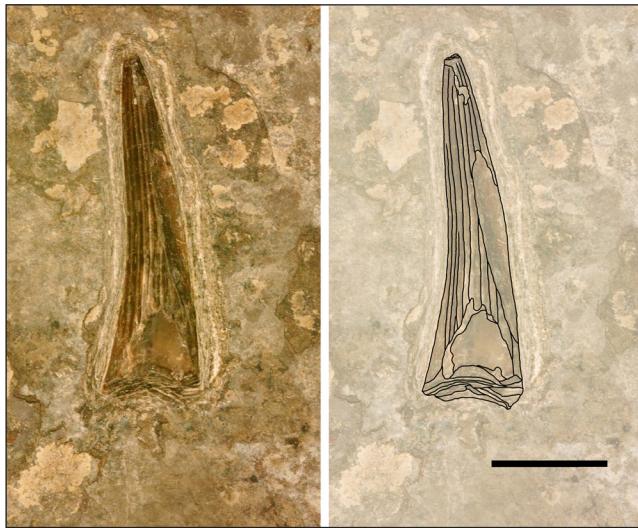
Fig. 3 - Specimen MCSN 8709 (A) and sketch (B) superimposed on a faded copy of the same photo. Scale bar equals 10 mm.

Material and Methods

Examined specimens: MCSN 8708 tooth, MCSN 8709 tooth, MCSN 8710 tooth, MCSN 8711 tooth, MCSN 8712 rib fragment, MCSN 8707 isolated femur, complete and well preserved apart for flattening and crushing by compression.

All specimens were mechanically prepared with vibrotools and sharp steel needles under a stereomicroscope. Photos were taken using a SIGMA Sd Quattro H camera with a SIGMA 105 mm f2.8 Macro OS lens. Institutional abbreviations: MCSN – Museo cantonale di storia naturale in Lugano; PIMUZ - Paläontologisches Institut und Museum, Universität Zürich

Systematic Palaeontology

Sauropterygia Owen, 1860
Eosauropterygia Rieppel, 1994
Nothosauroidea Young, 1965

Assigned specimens MCSN 8709 (Fig. 3) MCSN 8710 (Fig. 4) .

Description. Specimen MCSN 8709 (Fig. 3) consists of the middle and upper portion of a conical elongated tooth crown, only the base of the crown is missing. The preserved portion of the tooth is 29.5 mm high and 5.2 mm wide at its base, with a sub-circular cross section, carinae are absent. The crown is gently recurved but not uniformly, the curvature is more pronounced in the mid and basal portion of the preserved part of the crown. The curvature suggests that the tooth may have been procumbent and that very prob-

ably is an anterior (mesial) tooth, either from the dentary or from the premaxilla. The apex is broken with an irregular surface. In addition, the enamel layer is abraded the middle portion of the crown (Fig. 3). Accurate investigation under microscope shows that the pattern of abrasion is most probably due to friction possibly against another tooth rather than splintering by other causes. Where preserved, the tooth surface shows the presence of apicobasal ridges, regularly spaced, with a density of three ridges per mm both close to the base and at mid-height.

Remarks. Among the reptile fauna from Monte San Giorgio, conical teeth with ridges or striae are present in three groups, ichthyosaurs, nothosauroid eosauropterygians and the tanystropheid *Tanystropheus*. Apicobasal ridges are known to be present in some ichthyosaurian taxa, however the tooth crown of ichthyosaurs does not show a similar curvature of the apicobasal axis. Moreover, albeit not decisive, it has also to be considered that in the Monte San Giorgio area the stratigraphic distribution of ichthyosaurs is restricted only to the Besano Formation (Grenzbitumenzone). No ichthyosaur has ever been found in the Meride Limestone, despite to the relative abundance of remains of other marine reptiles comprising eosauropterygian pachypleurosauroids and nothosauroids (Peyer 1931; Sander 1989; Tintori & Renesto 1990; Rieppel 1998; Hänni 2004; Renesto et al. 2004; Stockar & Renesto 2011) along with marine and terrestrial tanystropheids (Peyer 1937; Wild 1980). It seems thus reasonable to assume that specimen MCSN 8709 does not belong to an ichthyosaur.

Tanystropheus is mostly known from the Besano Formation (Grenzbitumenzone), with a large species *T. hydroides* Spiekman, Neenan, Fraser, Rieppel, Nosotti, Scheyer, 2020, which could have reached five meters in length, and a smaller one *T. longobardicus* Bassani, 1886, up to one meter in length (Spiekman et al. 2020). However, a small, incomplete *Tanystropheus* specimen (PIMUZ T 3901, Wild 1980) was collected from the Cassina beds (it was assigned to *T. meridensis* Wild, 1980, but recently considered a junior synonym of *T. longobardicus* (Nosotti 2007; Spiekman et al. 2019) and a further *T. longobardicus* specimen of small size (MCSN 4451) was described from the slightly older Cava inferiore beds (Renesto 2005). These findings suggest that the presence of *Tanystropheus* in the Sceltrich beds is feasible.
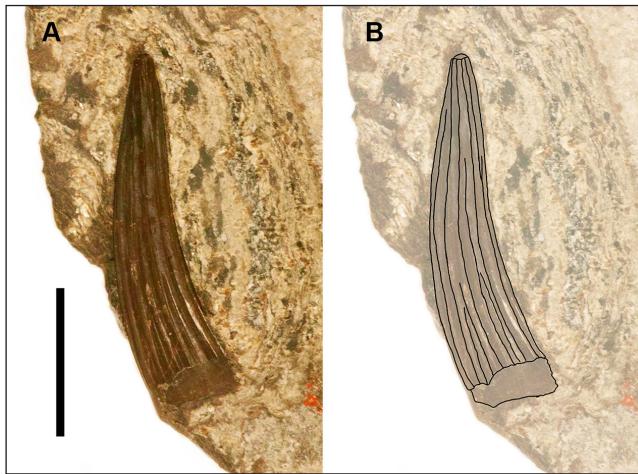
Fig. 4 - Specimen MCSN 8710 (A) and sketch (B) superimposed on a faded copy of the same photo. Scale bar equals 5 mm.

The teeth of *Tanystropheus* (Peyer 1931; Wild 1973, 1980; Dalla Vecchia 2006) show two morphoypes, premaxillary and anterior dentary teeth in both species are fang-like elongated conical with sharp apexes, and lack carinae, being very similar to the teeth of nothosaurs (while in *T. longobardicus* the lateral teeth are tricuspid). According to Dalla Vecchia (2006, p. 37) and Dalla Vecchia & Avanzini (2002), *Tanystropheus* conical teeth may be distinguished from those of nothosaurs by the presence of much thinner secondary ridges on the main ridges and in the grooves between the ridges, that are irregularly spaced, characters that are absent in the examined specimen. Thus, it seems more reasonable to consider the specimen MCSN 8709 as belonging to an eusauropterygian rather than to *Tanystropheus*.

Specimen MCSN 8709 (Fig. 3) could be identified as an anterior (mesial) tooth of a large-sized (hypothetically about the size of *Ceresiosaurus calcagnii*) eosauropterygian. The ridges are similar to those of *Nothosaurus* teeth but the tooth shape is more slender (see Peyer 1939; Rieppel & Wild 1996; Shang 2007) being reminiscent of the teeth of *Ceresiosaurus* (Peyer 1931; Rieppel 1998; Hanni 2004), however, on the basis of isolated and incomplete elements we consider not advisable any assignment of a single tooth at genus level.

Sauropterygia Owen, 1860
Eosauropterygia Rieppel, 1994
Nothosauroidea Young, 1965

Specimen MCSN 8710 (Fig. 4).

Description. It consists of an almost complete crown (probably only part of the crown base is missing) of a sharp and elongated conical tooth, the morphology of which is nearly identical to that of MCSN 8709, and only the size is slightly smaller. The preserved portion of the tooth is 11.5 mm high and 3.1 mm in cross section at its base. Again, distinct longitudinal ridges are present, their density being three ridges per mm.

Remarks. Given the nearly identical structure and shape with respect to the previously described specimen, it is also considered an anterior (mesial) tooth of a large or mid-sized eosauropterygian.

Sauropterygia Owen, 1860
Eosauropterygia Rieppel, 1994
Eosauropterygia indet.

Specimen MCSN 8708 (Fig. 5).

Description. It is a conical tooth 10.8 mm high and with a maximum width of 3.1 mm, with a slight curvature. The apex is broken while a portion of the root is preserved. The crown is slightly curved. The crown surface bears many long, spaced longitudinal ridges, less prominent that those of the previously described specimens and thinner secondary ridges are present especially close to the crown base often merging or extending only to the mid-crown, starting either from the base or from the apex of the crown, resembling elongate wrinkles. The preserved portion of the root has a smooth surface.
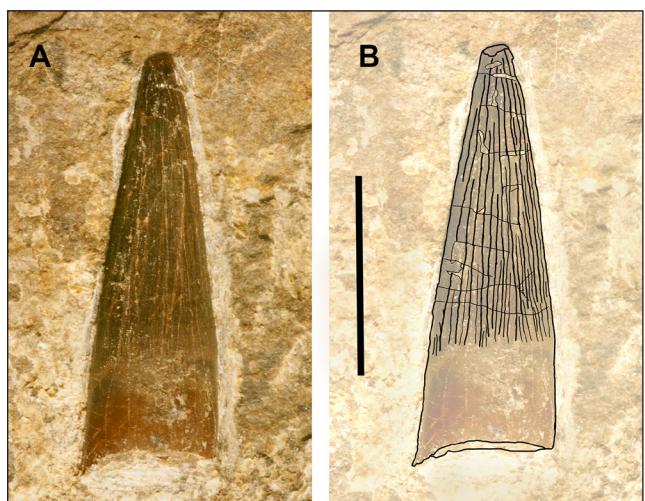

Fig. 5 - Specimen MCSN 8708 (A) and sketch (B) superimposed on a faded copy of the same photo. Scale bar equals 5 mm.
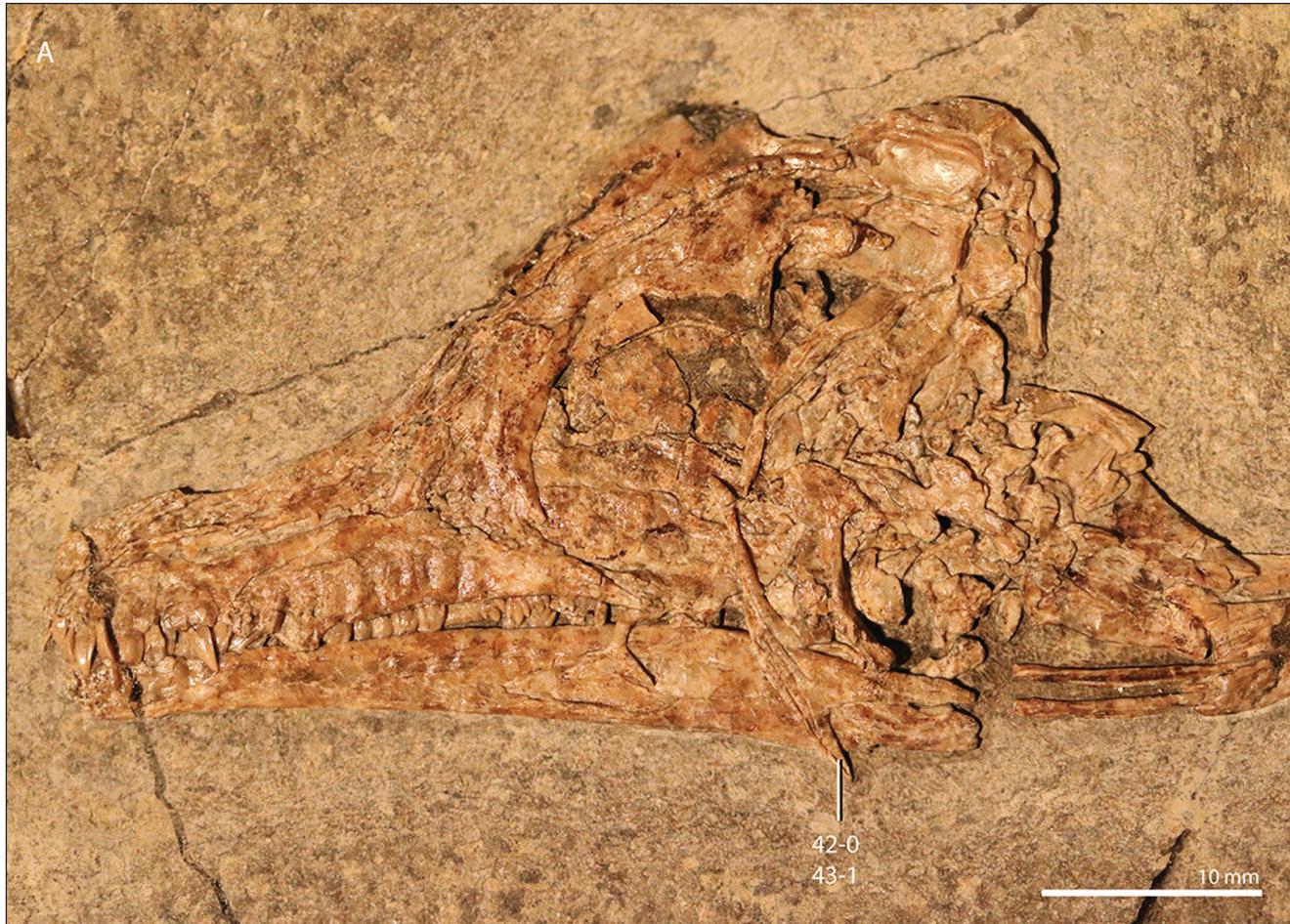
Fig. 6 - Skull of *Tanystropheus longobardicus*, specimen PIMUZ T3901, formerly known as *T. meridensis* (Wild, 1980) showing front teeth. Scale bar equals 10 mm. Modified from Spiekman et al. (2021) and reproduced under Creative Commons Attribution n. 4 https://creativecommons.org/licenses/by/4.0/deed.en source commons wikimedia.org, (image uploaded by Neil Pezzoni).

Remarks. While it is possible to consider MCSN 8709 and 8710 as eosauropterygian teeth with confidence, a taxonomic assignment of MCSN 8708 is more difficult. The sharp edged conical shape is shared both by sauropterygians and *Tanystropheus*, however, aside the older stratigraphical age, the teeth of *T. hydroides* are more robust and bear more prominent ridges while the anterior teeth of the specimen *T. longobardicus* (formerly *T. meridensis* Wild, 1980, Fig. 6) from Meride Limestone are more flattened labiolingually and wider at their base, as shown by specimen PIMUZ 3901 (Wild 1980; Spiekman et al. 2021, Fig. 6). For these reasons it is preferred to ascribe also specimen MCSN 8708 only to the Eosauropterygia.

Sauropterygia Owen, 1860
Eosauropterygia Rieppel, 1994
Eosauropterygia indet.

Assigned specimens: MCSN 8711 (Fig. 7), Specimen MCSN 8712 (Fig. 8).

Specimen MCSN 8711
Description. (Fig. 7) consists of an almost complete but poorly preserved tooth crown, broken at its base (possibly the crown base is missing). The preserved portion of the tooth is 11.5 mm high and its maximum width is 3.1 mm. The tooth is conical, with a sharp apex and a more convex anterior margin and a slightly concave posterior margin, no serrations are present. Where the outer surface of the tooth is preserved it is possible to ascertain that it is mostly smooth and lacks ridges or striae.

Remarks. The poor preservation renders difficult to ascribe the tooth to any taxon with confidence, because apicobasal ridges and striae seem nearly absent in the preserved portions of the enamel, but they may represent a taphonomic artifact, since few ridges can be detected on a portion of the enamel close to the apex of the tooth. The size of the specimen may instead exclude it belonged to a pachypleurosaur. The narrower outline is different

Fig. 7 - Specimen MCSN 8711 (A) and sketch (B) superimposed on a faded copy of the same photo. Scale bar equals 5 mm.
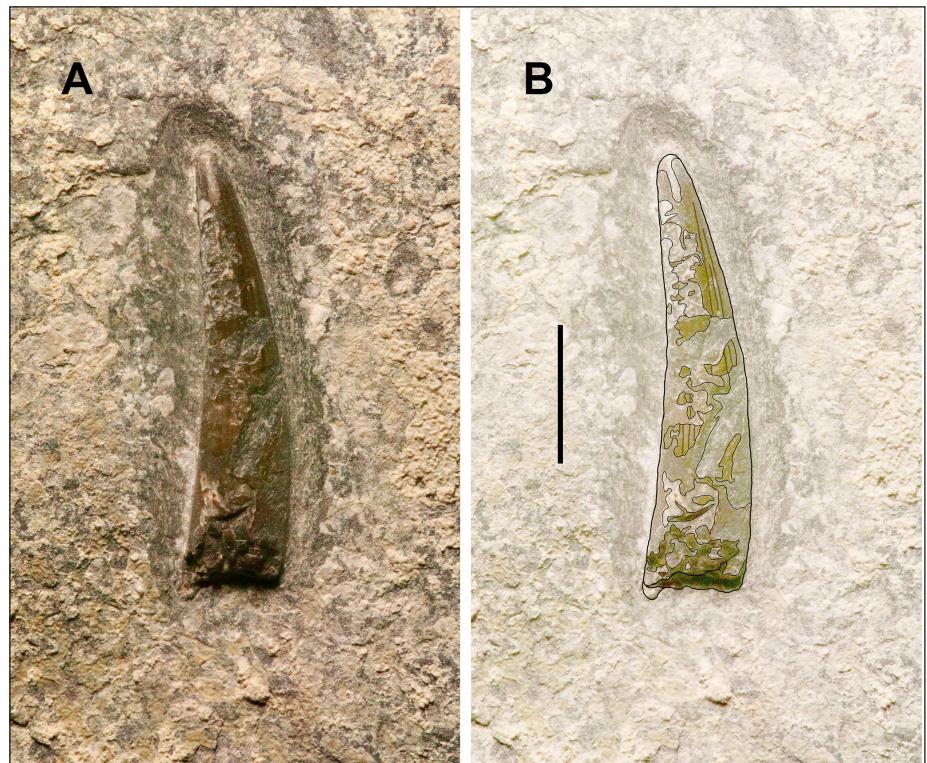
from that of the anterior teeth of *T. longobardicus*. The teeth of *Macrocnemus* indeed show a smooth surface, but are more recurved with a distinctly concave distal margin (see Jaquier et al. 2017) which is absent in MCSN 8711. For these reasons the specimen is tentatively assigned to an indetermined eusauropterygian.

Specimen MCSN 8712 (Fig. 8)

Description. It is an incomplete bone with a maximum height of 1.8 mm and a length of 9 mm. Portions of the bone are missing at both ends, their shape being partially reproduced by impressions in the matrix. The preserved portion has a concave-convex profile, it is rather thick at one extremity while gradually tapering at the other one.

Remarks. The shape of specimen MCSN 8712 matches that of the proximal portion of a small pachyostotic sauropterygian dorsal rib. As already reported above, specimen of *Neusticosaurus edwardsii* (Carroll & Gaskill 1985; Sander 1989 and references therein), *N. peyeri*, (Stockar & Renesto 2011) and of "*Ceresiosaurus lanzii*" (Hanni 2024) are known from the slightly older Cassina beds and may be present also in the Sceltrich beds. The small size of MCSN 8712 may support its assignment to *Neusticosaurus*, however, the thickness and the curvature of the preserved portion of the rib shaft is more
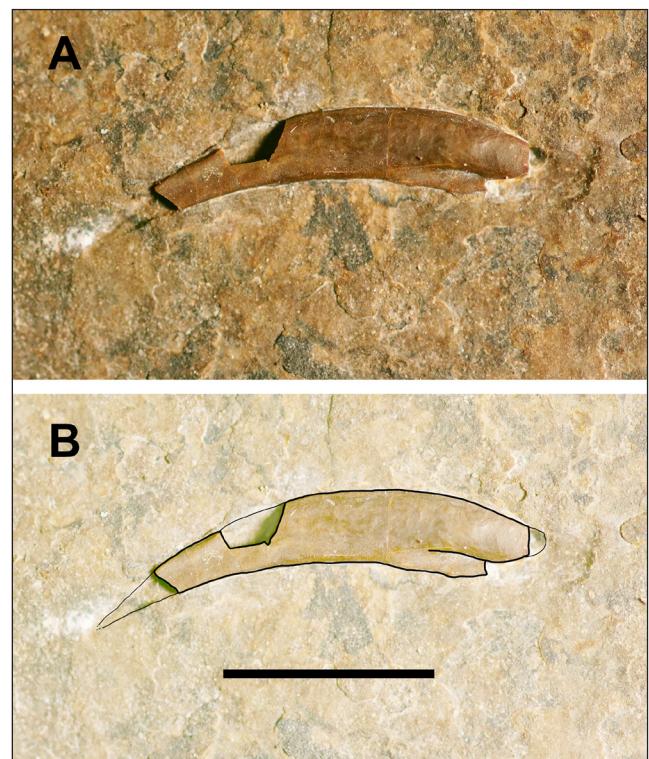

Fig. 8 - Specimen MCSN 8712 (A) and sketch (B) superimposed on a faded copy of the same photo. Scale bar equals 5 mm.

similar to that of the anteriormost dorsal ribs of small nothosaurid-like juvenile specimens of *Lariosaurus* cf. *L. valceresii* (Renesto 1993) or *Lariosaurus* sp. (Rieppel 1998, formerly *Lariosaurus lavizzarii*

Kuhn-Schnyder 1987). While *Lariosaurus* is known from younger levels, it is possible that juvenile specimens of *Ceresiosaurus lanzii* may have had the same rib structure. However lacking solid evidences, it is not possible to ascribe MCSN 8712 to any group with confidence but only point out the similarity with an anteriormost dorsal ribs of a small eosauropterygian.

Protorosauria Huxley, 1871
Tanystropheidae Gervais, 1859
Macrocnemus Nopcsa, 1931
Macrocnemus cf. *M. bassanii*

Assigned specimen: MCSN 8707 (Fig. 9).

Description. MCSN 8707 is an elongate limb bone, identifiable as a femur with a nearly straight shaft; a larger proximal extremity that lies in line with the shaft, and the narrower distal head that forms two distinct convex articular surface, and is somewhat deflected ventrally so that the outline of the bone is slightly sigmoidal. The two articular surfaces extend also ventrally indicating the possibility of flexion of the foreleg. The proximodistal length is 68 mm, the proximal head is 13.5 mm wide, while the distal one is narrower (10 mm wide), the mid shaft width is 7.5 mm.

The pattern of crushing and flatting of the shaft indicates that the bone was hollow. The proximal head lies in the long axis of the bone, the shaft is straight while the distal articular head is slightly deflected ventrally, giving a fain sigmoid curve to the bone. The articular surfaces for the tibia and fibula are at the same level and cove the entire distal head of the bone extending also on the ventral surface.

Remarks. The above described morphology and the size of the bone matches perfectly that of the femur of the tanystropheid genus *Macrocnemus* Nopcsa, 1931(Peyer 1931; Rieppel 1989 and first hand observation by SR and FM of several *Macrocnemus* specimens) which also has hollow limb bones, and it is different from the femora of known triassic sauropterygians (see Rieppel 2000), of *Tanystropheus longobardicus* (Wild 1973; Nosotti 2007 and direct observation by SR and FM). Thalattosaurs (Müller 2005; Rieppel 1987) and the archosaur *Ticinosuchus* (Krebs, 1965) are not present in the Meride Limestone, while they are represented in the older
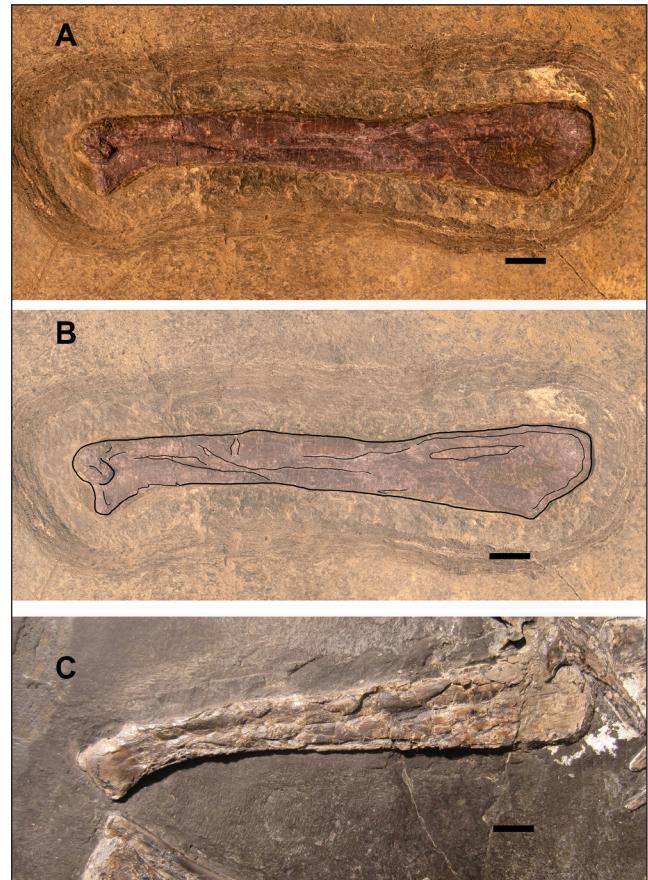

Fig. 9 - *Macrocnemus* cf *M. bassanii*. Specimen MCSN 8707 (A), (B) sketch superimposed on a faded copy of the same photo, (C) femur of *Macrocnemus bassanii*, specimen T3455 (photo by Franco Saller). Scale bar equals 5 mm.

Besano Formation, however their limb bones differ significantly from those of *Macronemus* which is known by specimens from Cassina beds as well as from some levels of the Grenzbitumenzone (Peyer 1937; Kuhn-Schnyder 1962; Fraser & Furrer 2013, Rieppel 1989; Renesto & Avanzini 2002; Jaquier et al. 2017; Miedema et al. 2020). The proximodistal length of specimen MCSN 8707 is nearly the same of specimen PIMUZ T4355 from the Besano Formation (Fig. 9 C) stored at Paläontologische Institut und Museum der Universtität Zürich. Thus, all available evidences support the identification of specimen MCSN 8707 as a left femur of *Macrocnemus*. At least two species of *Macrocnemus* are present in the Monte San Giorgio localities: *M. bassanii* Nopsca, 1931 from the Besano Formation and Meride Limestone and *M.* aff *M. fuyuanensis* (Jaquier et al. 2017) from the Besano Formation. The stratigraphic provenance may suggest that the specimen belongs to *M. bassanii*, however, taking into account that the main differences between the two species

concern the shape of the pectoral girdle and limb proportions, while the shape of the femur is substantially indistinguishable, it is preferred here to consider MCSN 8707 as *Macrocnemus* cf. *M. bassanii.*

DISCUSSION

The presence of very few and fragmentary reptile remains in the Sceltrich beds excavated so far, is not related with environmental conditions at the bottom of the basin, as testified by the findings of several excellently preserved fish specimens from the same layers. Bottom waters were anoxic and/or lower dysoxic (Stockar 2010; Stockar et al. 2013) thus precluding the activity of benthic necrophagous organisms, as the low dissolved oxygen levels in the overlying water column excluded higher macrobenthos, including scavengers. This means that benthic organisms could not have caused the disarticulation of these carcasses.

According to Stockar (2010) and Stockar et al. (2013), the lithofacies of the Sceltrich beds suggest that reptile remains were deposited in levels characterized by an undulating laminar fabric, likely resulting from microbial activity. Light laminae, formed by the trapping and binding of platform-derived sediment by extracellular polymeric substances (EPS), alternate with dark laminae composed of organic, micrite-rich material. The latter may indicate periods of low detrital carbonate input, suggesting minimal burial (Stockar 2010; Stockar et al. 2013) that could be related to a prolonged residence phase and increased possibility of disarticulation of the remains. Concentrations of flattened carbonate nodules (Stockar 2010) of bioclastic material, primarily platform-derived taxa, are interpreted as storm-generated accumulations resulting from episodic storm wave activity (Stockar 2010; Stockar et al. 2013). These structures may coincide with periods of increased storm activity that also stirred the basin bottom, potentially shifting the basin's oxygenation from anoxic to lower dysoxic conditions, accompanied by episodic colonization by thin-shelled opportunistic posidonioid bivalves (Stockar 2010; Stockar et al. 2013).

The primary cause of disarticulation for these reptiles is difficult to establish; likely a combination of different factors: death in warm surface waters, where the carcasses floated due to the development of putrefactive gases. While floating, surface currents transported the carcasses while decomposing, thus allowing disarticulation and loss of bones and teeth, which could also be due to scavenging of the floating carcass, so that some may have settled to the bottom of the basin due to decomposition, predation, or episodic storm events; in certain cases, as with terrestrial reptiles, disarticulation could have occurred during prolonged transport from land to the sea.

In contrast, the fish fauna is often perfectly preserved and articulated, and this may be again due to a combination of factors either related to different morphologies and buoyancy, or possibily rapid sinking of the corpses to the bottom in deep waters that decreases the chances of disarticulation (Anderson et al. 2013) and or a brief duration of the residence phase (Beardmore 2012; Beardmore & Furrer 2015).

CONCLUSIONS

The number of collected specimens is too low to be considered as an adequate sampling of the reptile diversity present in the Sceltrich beds, nevertheless it is significant, since available data allow comparisons with the reptile fauna of other levels of the upper Meride Limestone. In particular, the reptile fauna from the Sceltrich beds was similar to that of underlying Cassina beds, with prevalence of mid-sized and small eosauropterygians (possibly *Ceresiosaurus* and *Neusticosaurus*) and the presence of rare taynstropheids. Of relevant interest is the finding of the femur of *Macrocnemus*, a terrestrial reptile, incidentally the best preserved reptile bone collected from the Sceltrich beds. The scarcity of reptile findings in the Sceltrich beds mirrors what occurs in the upper part of the Cassina beds. In fact, Cassina beds are renowned for yielding excellently preserved specimens belonging to a diversified reptile fauna, which comprises the pachypleurosauroids *Neusticosaurus edwardsii* and *N. peyeri* (Carroll & Gaskill 1985; Sander 1989), the nothosaurid *Ceresiosaurus lanzi* (Rieppel 1998, 2007; Hanni 2004), the tanystropheids *Macrocnemus bassanii* (Peyer, 1937) and *Tanystropheus longobardicus* (a very incomplete specimen consisting only of the head and part of the neck originally described as *T. meridensis* by Wild, 1980, then synonymized with

T. longobardicus by Nosotti 2007 and Spiekman et al. 2020). However, findings of most of the articulated specimens (mainly eosauropterygians) are restricted to the lower beds while reptile remains are rare and mostly fragmentary in the upper part of the Cassina beds where only few isolated teeth of eusauropterygians, probably *Ceresiosaurus,* have been collected, along with only one articulated specimen of a small pachypleurosaurid belonging to the genus *Neusticosaurus.* The *Tanystropheus* specimen has instead been found in the middle part of Cassina beds, while the provenance of the "Cassina specimen" of *Macrocnemus* (PIMUZ T4822) is uncertain (Peyer 1937).

It can be thus hypothesized that the depositional environment of the Sceltrich beds was similar to that of the upper levels of the Cassina beds, both being less favourable to preservation of tetrapods with respect to the lower levels of Cassina beds.

Stockar et al. (2013) suggested a regression with sea depth decreasing gradually from Cava inferiore and Sceltrich beds, where there are evidences of tempestites. This implies that Sceltrich levels and the upper levels of Cassina were deposited more and more closer to emerged land than the lower levels of Cassina and those of Cava inferiore beds.

It cannot be excluded however that, despite the sedimentation regime, an extension of the excavations could allow to find levels yielding better preserved and more complete reptile specimens.

Data Availability Statement

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