

## A REVISION OF *LANGOBARDISAURUS ROSSII* BIZZARINI AND MUSCIO, 1995 FROM THE LATE TRIASSIC OF FRIULI (ITALY)\*

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**Abstract.** A nearly complete but poorly preserved amniote from the Middle-Upper Norian of Friuli (NE Italy), previously attributed to a new species of the protorosaur genus *Langobardisaurus* (*L. rossii* Bizzarini & Muscio, 1995), is re-described. Study reveals that the specimen does not exhibit any protorosaurian characters, instead all available evidence supports its attribution to the Lepidosauromorpha. Some skull characters might support sphenodontian affinities, but preservation is too poor to allow a firm assignment to this group.

**Riassunto.** Nel presente lavoro viene ridescritto uno scheletro quasi completo ma molto mal conservato di un tetrapode del Norico Medio/Superiore del Friuli, attribuito da Bizzarini & Muscio (1995) ad una nuova specie del Protorosauro *Langobardisaurus* (*L. rossii*). La revisione dimostra che l'esemplare non possiede alcun carattere in comune con i Protorosauria, mentre tutti gli elementi scheletrici conservati a sufficienza indicano la sua appartenenza ai Lepidosauromorpha; alcune caratteristiche del cranio suggerirebbero inoltre affinità con gli Sphenodontia, ma la conservazione troppo frammentaria non consente un'attribuzione sicura.

### Introduction and geological setting

The specimen, labelled as MFSN 19235 of the Museo Friulano di Storia Naturale di Udine (Friuli, Northern Italy), was collected from an outcrop of the upper part of the lower member of the Dolomia di Forni (Forni Dolostone) Formation (sensu Dalla Vecchia 1991) at the confluence of the Secco Creek with the Seazza Creek (Fig. 1), close to the village of Preone (Udine province, Friuli Venezia Giulia Region, north-

eastern Italy). The age of the unit is Middle-Upper Norian (Alaunian-Sevatian, Dalla Vecchia 2006). The Dolomia di Forni was deposited in a marine anoxic basin and it is well known for its relatively diverse fossil assemblage. Findings comprise plant remains (Dalla Vecchia 1991), decapod (Garassino et al. 1996) and thylacocephalan crustaceans, and several vertebrates, primarily fishes (Dalla Vecchia et al. 1991). Reptiles were also present and well represented by the drepanosaurid *Megalancosaurus* (Calzavara, Muscio & Wild 1980; Renesto 1994a, 2000; Renesto & Dalla Vecchia 2000), the protorosaur *Langobardisaurus* (Muscio 1997; Renesto & Dalla Vecchia 2000; Renesto et al. 2002), and the basal pterosaurs *Preondactylus* and *Eudimorphodon* (Wild 1984; Dalla Vecchia 1995, 1998, 2003, 2004).

Specimen MFSN 19235 was found in 1991 and preliminarily described by Bizzarini & Muscio (1995) who made it the holotype of a new species of the protorosaur genus *Langobardisaurus* (*L. rossii*), that at that time was known only from a species collected in the Norian of Lombardy (*L. pandolfii* Renesto, 1994b). Later, an unquestionable *Langobardisaurus* specimen was also found in the Dolomia di Forni, along the Rio Seazza valley, and became the holotype of *Langobardisaurus tonelloi* Muscio, 1997. Bizzarini & Muscio (1995, p. 75) however, considered the attribution of MFSN 19235 to the genus *Langobardisaurus* as tentative, for which reason they put a question mark in the original denomination (*Langobardisaurus? rossii*). The referral of MFSN 19235 to the genus *Langobardisaurus* and, more

\* The present paper is dedicated to the late Antonio Isidoro Rossi, for his valuable contribution to the field research in paleontology of the Friuli area.

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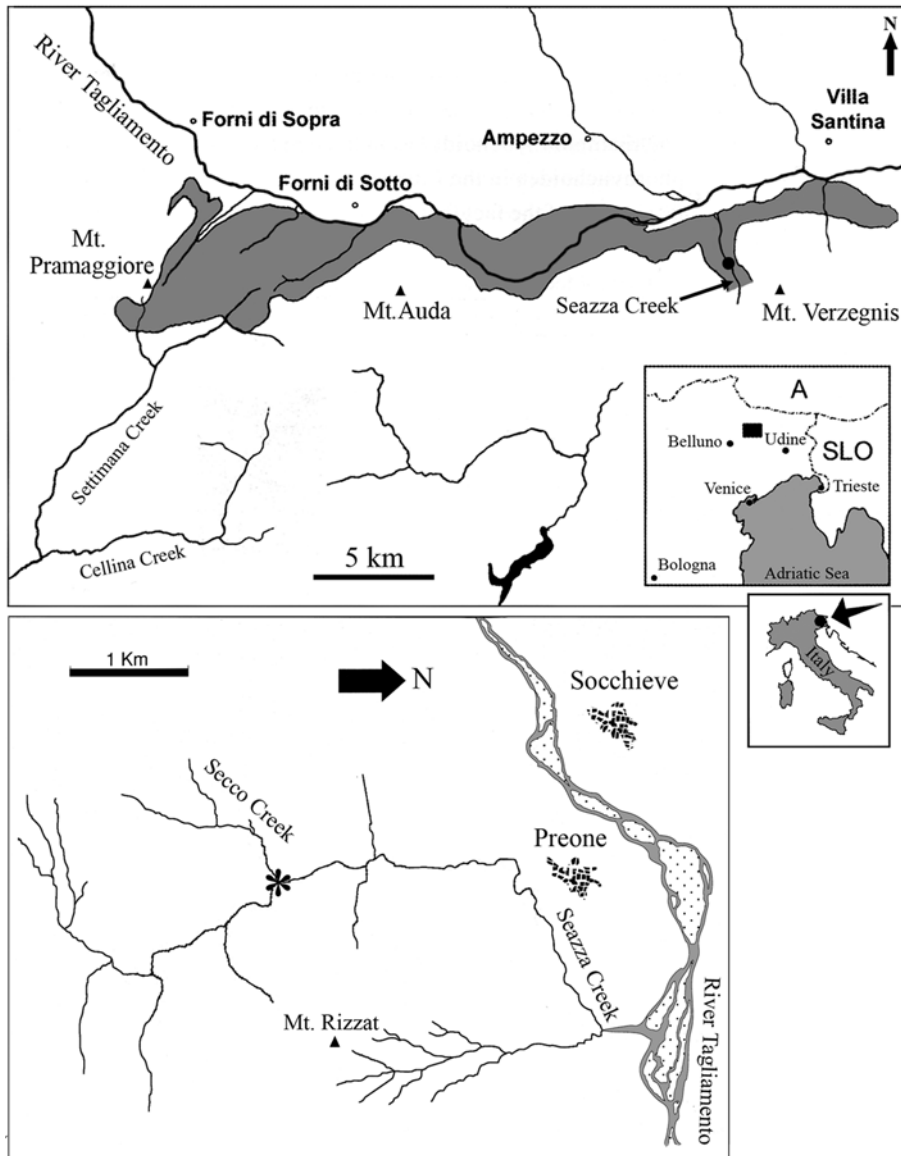


Fig. 1 - Map of the Rio Seazza valley. The asterisk indicates the locality in which the specimen was found.

broadly, to the Protorosauria as a whole were later questioned by Renesto & Dalla Vecchia (2000) because the specimen exhibits no protorosaurian character. Here, the osteology of MFSN 19235 is described in as much detail as possible and a more viable taxonomic assignment is proposed.

**Systematic Palaeontology**

Reptilia

Diapsida Osborn, 1903

Lepidosauromorpha Benton, 1983

Lepidosauromorpha indet.

1995 *Langobardisaurus? rossii* Bizzarini & Muscio pp. 67-76, figs. 1-2.

1995 *Langobardisaurus? rossii* pp. 7-23, figs. 4,6-18 in Bizzarini, Muscio & Rossi.

1995 *Langobardisaurus? rossii* pp. 24-35, figs. 19-29 in Bizzarini, Muscio & Rossi.

**Material.** Specimen MFSN 19235 of the Museo Friulano di Storia Naturale, Udine, Friuli Venezia Giulia, Italy, consisting of an incomplete yet articulated skeleton exposed in right lateral view (Pl. 1).

The specimen was originally preserved as a slab and counterslab (Fig. 2), both broken in several fragments that were subsequently glued together (see Bizzarini et al. 1995), but some fragments were also lost. In the original description, Bizzarini & Muscio (1995) figured only the most complete of the two slabs, where the postcranial bones are heavily damaged by weathering and the central part of the skull is not preserved. Later (in 1999) part of the counterslab was glued to the main slab and the specimen was prepared from above at the Staatliches Museum für Naturkunde, Stuttgart as reported in the files of the catalogue of the Museo Friulano di Storia Naturale. As a consequence, the specimen is no longer visible in the original unprepared view, as described by Bizzarini & Muscio (1995).

PLATE 1

Specimen MFSN 19235, as actually preserved. Scale bar equals 4 cm.



Yet, if part of the counterslab had been glued to the main slab as described above, then the subsequent preparation should have exposed, at least in some places, the well preserved bone surface that was originally hidden in the matrix. On the contrary, most of the now-exposed skeleton displays heavily fragmented and poorly preserved bones and traces of post exposure weathering are still present on the vertebral column and rib cage. Furthermore the skull portions look as if they were glued in place, but were collected as scattered fragments.

**Horizon.** Upper part of the Lower Member of the Dolomia di Forni (Forni Dolostone) Formation (sensu Dalla Vecchia 1991), Middle-Upper Norian (Alaunian-Sevastian) age (Dalla Vecchia 2006).

**Locality.** Confluence of the Secco Creek with the Seazza Creek, close to the village of Preone (Udine province, Friuli Venezia Giulia Region, Northeastern Italy).

**General remarks.** The specimen (Pl. 1) is exposed in lateral (right) view; as stated above, the fully articulated skeleton is nearly complete, apart from the skull and the pelvic girdle (the latter almost completely missing due to erosion), but it is heavily weathered and most bones are poorly preserved. As a consequence it is difficult to observe any detail of the bones.

When the specimen was found, both slabs were broken into small fragments and there was a hole in the main slab in the skull region (Fig. 2B). The counterslab lacked the cervical region, fore limb, and ventral portion of the trunk. A slab with a large part of the skull was

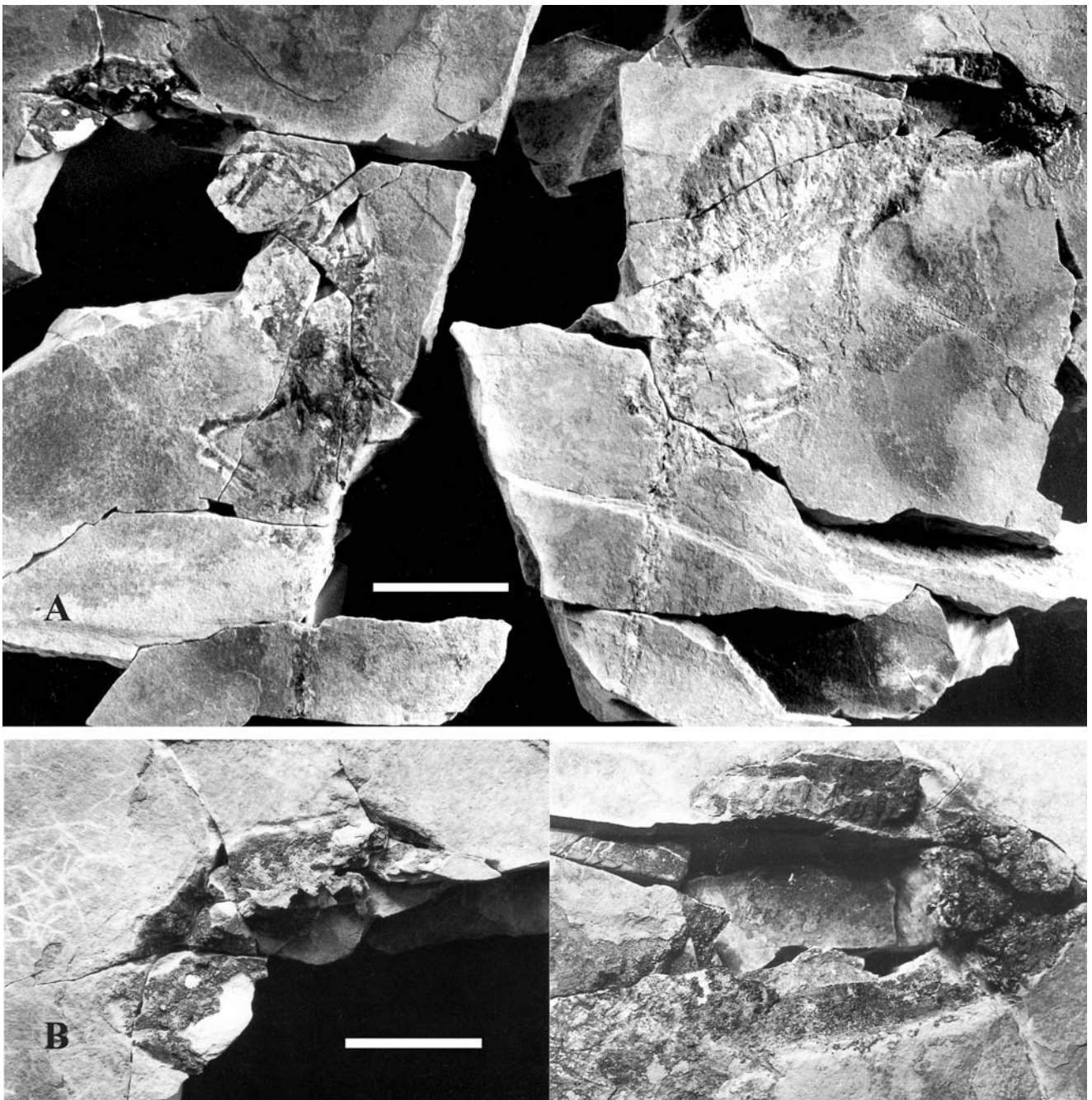


Fig. 2 - Specimen MFSN 19235; A) as originally preserved and figured in Bizzarini et al. (1995, p.10, fig. 4); B) a close up of the skull area.

recovered, but it did not match the hole in the main slab, and was not glued until the specimen was in Udine (see fig. 20 in Bizzarini et al. 1995). Despite careful searching in the debris around which the specimen was situated, the missing pieces could not be located. During the final preparation of the specimen, the skull and lower jaw fragments were detached from their slab and re-positioned and adhered with some glue, while the hole corresponding to still missing parts was filled by a sort of cement.

This reconstruction, however, does not appear to have been very accurate, and creates problems for the identification of bones, especially concerning the elements of the lower jaw.

#### Measurements (in mm).

Specimen MFSN 19235: The length of the radius is in parentheses because the bone is broken in two pieces and the measurement may be somewhat inaccurate.

Humerus max length	Ulna max length	Radius max length	Mc III. max length	Femur max length	Tibia max length	Fibula max length
33	26	(22)	7	40	27	23

#### Description.

*Skull.* The only reliable thing that can be said about the skull (Fig. 3) is that it was large and bulky. This was not realized by Bizzarini & Muscio (1995) who considered this part of the skeleton as comprising a much narrower, backward pointing skull surrounded anteriorly and ventrally by a long neck that formed a sort of loop (see Bizzarini et al. 1995, fig. 19A, here reproduced as Fig. 4).

Only a few fragments of the skull are preserved in the postorbital and cheek regions and due to poor preservation the identification of skull bones is made mostly on topological basis. In addition, having been repositioned and glued together, the following attempted description and interpretation (Fig. 3) is reliable only if the re-positioning of the fragments was correct. A wide, trapezoidal piece of bone could be interpreted as part of the maxilla, though no teeth are visible. If correctly identified, it is conceivable that they were completely worn out and replaced by secondary bone growth forming a sharp cutting edge as in sphenodontian rhynchocephalians. Posterior to the ?maxilla fragment are pieces of a stout and deep bone, here considered a ?jugal. At the top of the skull two elongated splints of bone may represent remains of paired frontals. More posteriorly, fragments of an elongate, narrow bone are visible, forming the dorsal border of a narrow upper temporal fenestra, indicative of a diapsid condition. A stout and deep lateral projection of a bone, perhaps the ?squamosal, forms most of the posterior and ventral margin of the same fenestra. No other skull bone is presently exposed or sufficiently preserved that permits adequate description and even the above description must be considered as tentative.

*Lower jaw.* The lower jaw (Fig. 3) was interpreted by Bizzarini & Muscio (1995) as a row of cervical vertebrae. Actually, the “row” appeared, and still appears, as a large unsegmented bone, possibly the dentary alone.

Regardless of its exact identity, the jaw appears to be stout and ventrally deep. Its anterior tip is badly damaged and only splints of bone can be seen that have been amalgamated with some sort of resin. In its middle

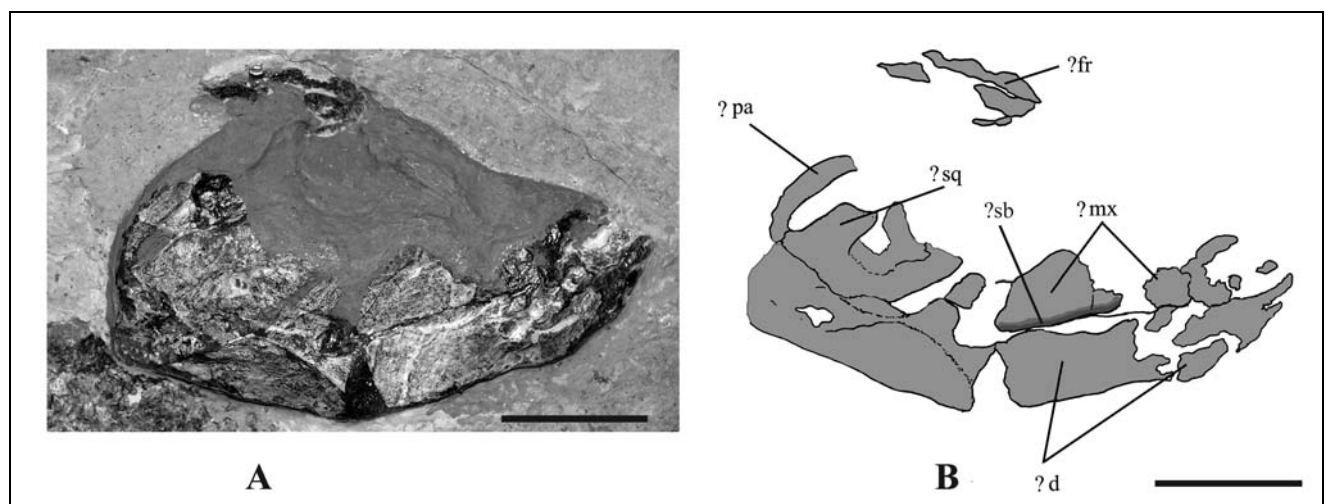


Fig. 3 - Specimen MFSN 19235; A) the skull after preparation. B) Tentative identification of preserved bones of the skull and lower jaw of specimen MFSN 19235. Abbreviations are: d=dentary, fr=frontal, mx=maxilla, pa=parietal, ?sb=secondary bone growth at the edge of the maxilla, ?sq=squamosal. Scale bar equals 1 cm.

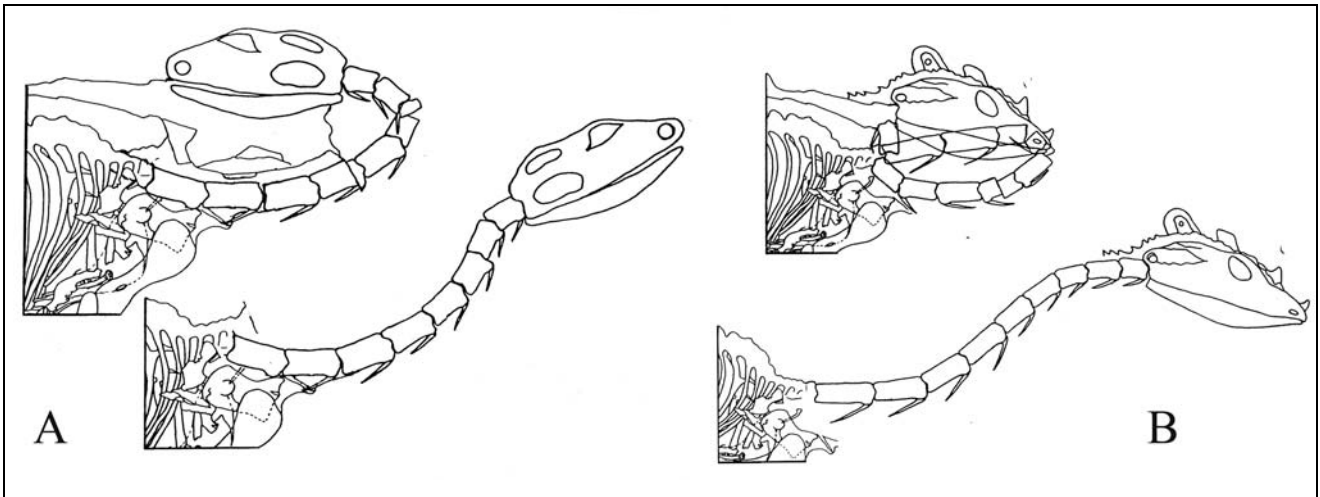


Fig. 4 - Two interpretative drawings of the skull and neck of specimen MFSN 19235 published in Bizzarini et al. (1995), p. 25 fig. 19 (A) and p. 26 fig. 21 (B). In A the skull is oriented to the opposite direction with respect to what represented in B and also the reconstruction of the neck is different.

section, the deep piece of bone bears an elongate shearing edge dorsally, that might be interpreted as worn out posteriormost acrodont dentition. Posterior to this shearing edge, the bone is broken and a triangular gap is filled by a resin again. The gap is followed posteriorly by another large fragment of bone that shows both a deep embayment and a thin, elongate process that projects dorsolaterally. The posterior margin of this process ends close to the squamosal and the quadrate region (not preserved), but no traces of either an articular area or a retroarticular processes are present. If this is the correct analysis of bone, then no reliable interpretation can be given of the whole structure. It is possible, however, that the fragment was incorrectly placed and somewhat rotated with respect to its original position; in this case the bone fragment may represent an element bounding a well developed adductor fossa.

**Vertebral column.** Although individual vertebrae are difficult to discern, it is evident (Pl. 1) that the neck is short (contra Bizzarini & Muscio 1995) and consists of only a few, short cervical vertebrae. Nothing can be said about their morphologies.

The dorsal region (Pl. 2A, C) consists of at least 15-16 vertebrae. In the mid region of the trunk the outlines of some individual elements are preserved; their centra are square in lateral view, and their neural arches low with low, trapezoidal neural spines. Praezygapophyses are blunt and slightly forward projecting; the morphologies of the postzygapophyses cannot be described.

The sacral region seems to consist of two sacral vertebrae bearing stout sacral ribs.

The caudal segment of the vertebral column is poorly preserved permitting no detailed description. It can only be stated that the tail was fairly long and the

caudal vertebrae in the mid section bear low, squared neural spines. Unfortunately it is impossible to ascertain the presence of fracture planes for caudal autotomy, if they were present at all.

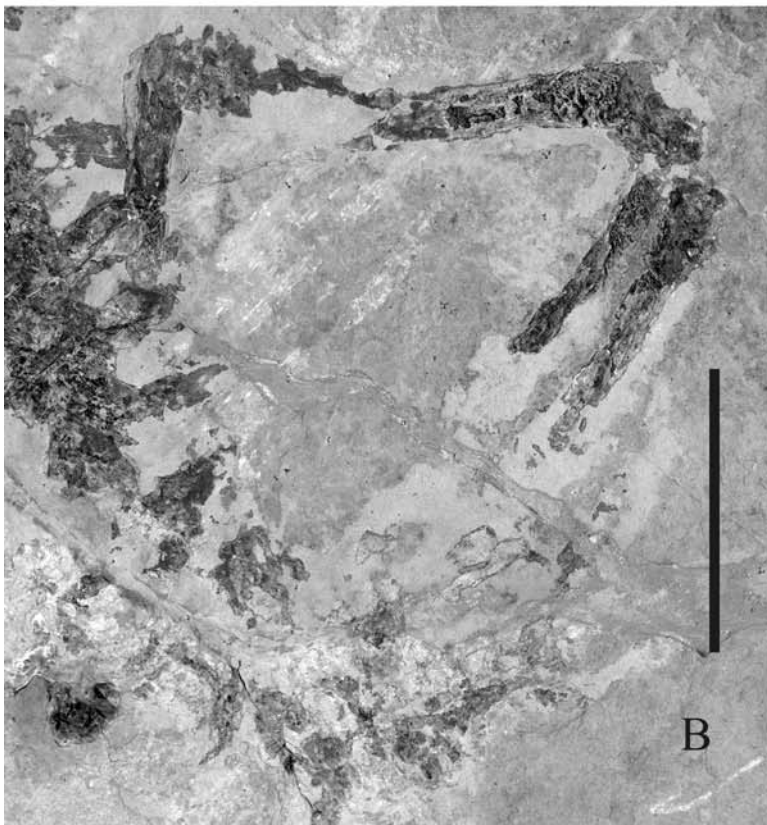
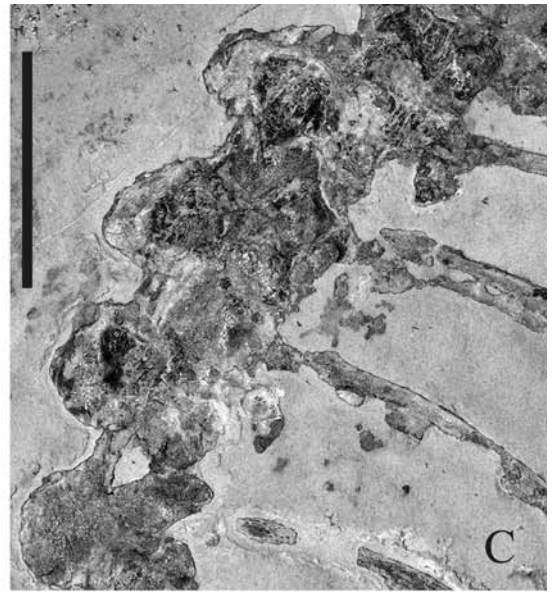
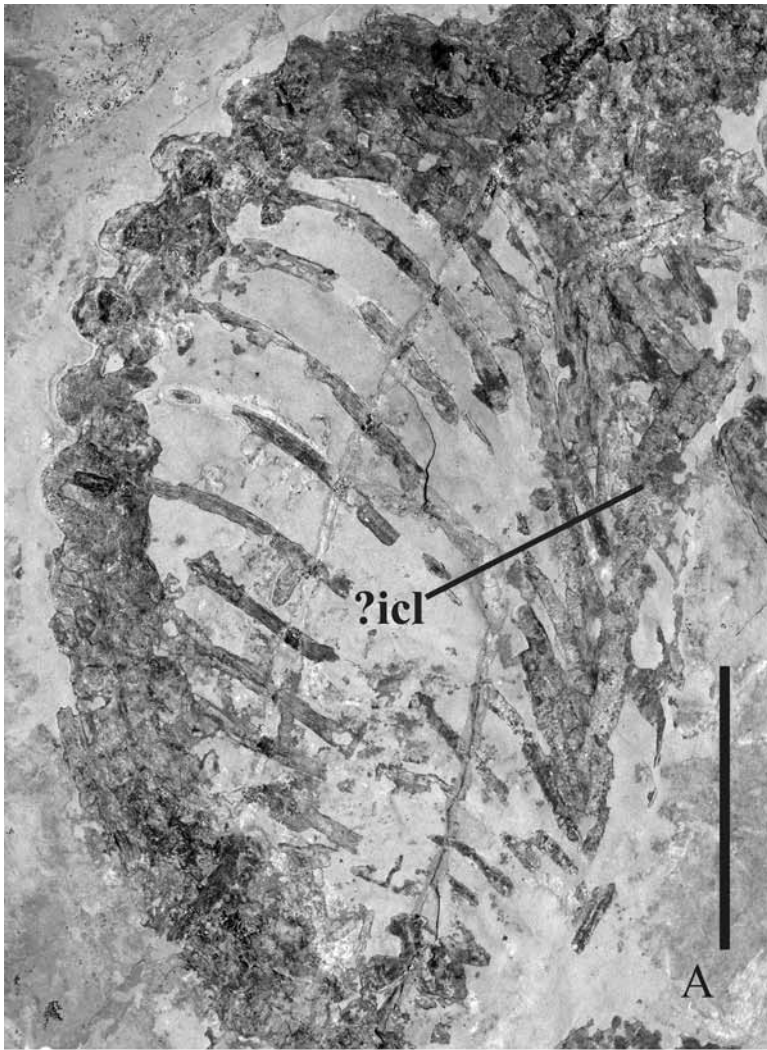
**Ribs.** At least 11 dorsal ribs can be observed (Pl. 2A), along with the aforementioned sacral ribs are preserved. The dorsal ribs are holocephalous, and their shafts quite long and thin suggesting that the trunk was rather bulky and deep. The ribs are curved proximally, but distally become nearly straight and ventrally directed. The short, stout sacral ribs are distally expanded; the first pair is somewhat bent posteriorly, while the second points slightly forward. Caudal ribs are wide and robust proximally, but, their size gradually decreases posteriorly.

**Gastralia.** A few thin splints of bone lie ventral to the posterior portion of the ribcage and may represent fragments of gastralia.

**Pectoral girdle.** A tall and ventrally wide bony structure partially crossing the cervical elements very probably represents the right scapulocoracoid (Fig. 5A). The anterior margin of the scapular blade shows a distinct embayment. Ventrally a long, narrow bony rod is present (Pl. 2A), that could be the elongate posterior stem of an interclavicle, missing its wider anterior portion. Some other fragments very probably represent

#### PLATE 2

Specimen MFSN 19235. A) dorsal region: icl) ?interclavicle, B) right posterior limb, C) anterior dorsal vertebrae, D) right anterior limb. Scale bars equal 2 cm (A, B, D) and 0,5 cm (C).



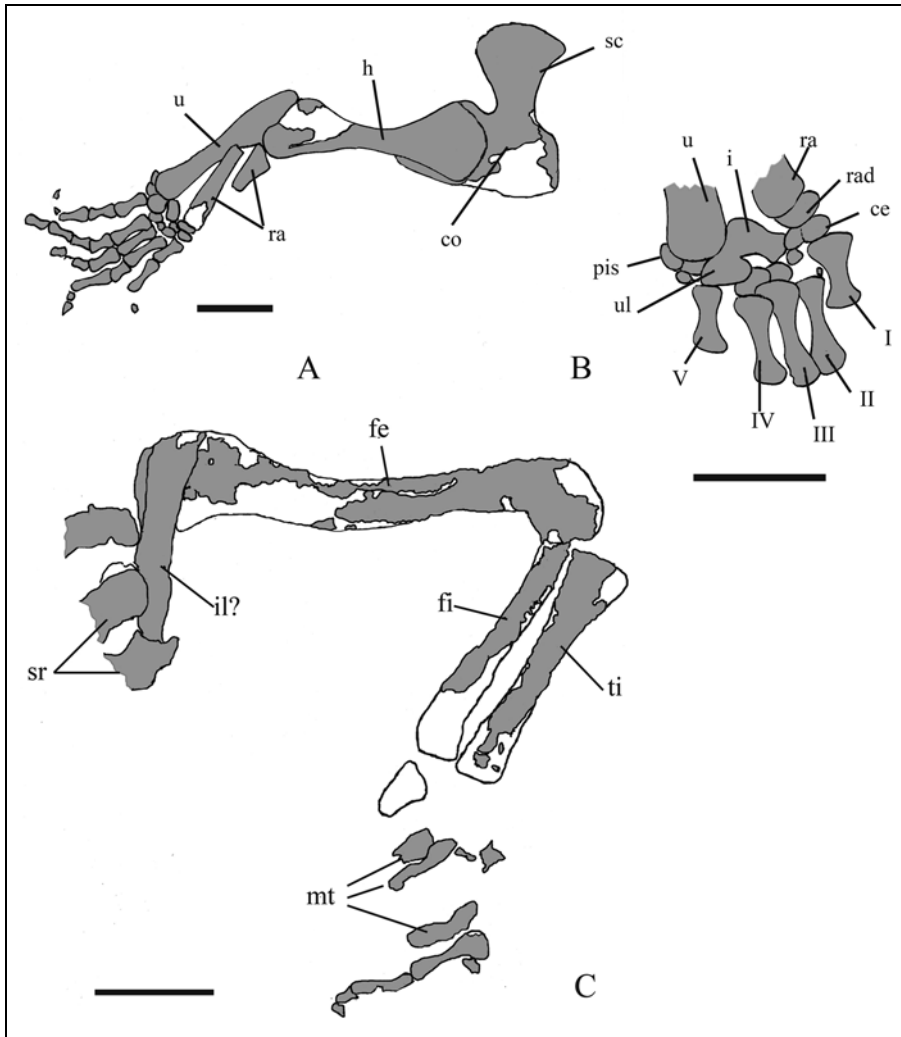


Fig. 5 - Specimen MFSN 19235. A) pectoral girdle and right forelimb, shaded areas are the actually preserved ones; B) carpus; C) pelvic girdle and right hindlimb. Abbreviations are: ce=centrale, co=coracoid, fe=femur, fi=fibula, h=humerus, i=intermedium, il?=iliac blade?, mt=metatarsals, pis=pisiform, ra=radius, rad=radiale, sc=scapula, sr=sacral ribs, ti=tibia, ul=ulnare, I-V=metacarpals. Scale bars equal 1 cm.

remains of the other bones of the pectoral girdle, but they cannot be identified with any certainty.

*Fore limbs.* Only the right fore limb is visible (Fig. 5A-B, Pl. 2D). The stout humerus has expanded and flattened proximal and distal heads. The humeral shaft is constricted in the middle. The ulna is long but similarly stout, with a straight shaft. It is more expanded in its proximal half, and a well developed olecranon is present; its distal head is slightly expanded with a gently convex outline where it meets the carpal bones. The radius is a straight, featureless bone that is fractured midway along its shaft, its distal half is preserved in anatomical articulation with the carpus and is slightly superimposed on the ulna, while the proximal half is still articulated with the humerus. Interestingly, the right radius is the only broken bone in an otherwise articulated and fairly intact (excluding weathering) limb, thus it is feasible that the radius had been already broken and the two halves of the shaft displaced when the carcass reached the bottom of the depositional basin. Perhaps the radius may have been fractured in the

living animal (perhaps contributing to its death) or during the transport of the carcass.

The carpus (Fig. 5B) is somewhat better preserved than the rest of the skeleton, but many elements are still difficult to interpret. A wide subrectangular radiale contacts distally a large medial centrale; smaller rounded elements distal to the carpus may be the lateral centrale and the first distal carpal. Medial to the radiale an oblique subrectangular element is probably the intermedium. This latter bone contacts the ulna proximally and a large bone fragment laterally that may be part of the ulnare; its exact borders cannot be determined and it appears to be overlapped by the fourth distal carpal. A suboval pisiform is present on the lateral edge of the distal head of the ulna. The distal carpals are rounded elements, of which the fourth seems to be the largest, but it is barely distinguishable from the ulnare. The metacarpals are rather stout hourglass shaped bones, the third of which is the longest. The phalanges exhibit a concave proximal head and a convex, rounded distal heads except for the unguals which are small and subtriangular in shape. Only the first and second digit



preserve all phalanges making it is impossible to give the exact phalangeal formula of the manus; preserved elements allow the following count: 2 3 3+ 4+ 2+. If, as seems reasonable, only the unguals are missing in the last three digits, the phalangeal formula could have been 2 3 4 5 3 as in most amniotes.

*Pelvic girdle and hind limbs.* An anteroposteriorly elongate and poorly preserved element (Fig. 5C, Pl. 2B) displays a lateral concavity that houses the proximal head of the right femur, while medially it articulates with the sacral ribs; and is therefore interpreted here as part of the ilium, most likely part of the blade and the acetabular area. Further remains of the pelvic girdle may have been present in the counterslab (Bizzarini et al. 1995, fig. 4), but are now missing. The femur is elongate and sigmoidal in shape, with expanded and gently convex proximal and distal heads. Only the proximal halves of the tibia and fibula are preserved; both are a straight shaft. The tibia widens near its proximal head, reaching about twice the dimension of mid shaft. No tarsal elements are recognizable, though a few unremarkable metatarsal fragments can be discerned, along with a series of phalanges, possibly belonging to the second or third pedal digit, their morphology being similar to that of the manual phalanges.

## Discussion

Poor preservation hinders any detailed analysis, and most of the potentially diagnostic characters are far from being unambiguous. However, some skeletal correlates allow us to attempt a taxonomic assessment of MFSN 19235. The large skull, short neck, bulky trunk, and morphology of all elements of both the anterior and posterior limbs are completely different from those of known protorosaurs and from *Langobardisaurus* in particular. As a consequence, *Langobardisaurus* ? *rossii* cannot pertain to *Langobardisaurus*. *L.*

*rossii* must be considered as *nomen dubium*, since it cannot be defined in its basic characters.

The postcranial skeleton of MFSN 19235 exhibits a generalized amniote pattern that only permits exclusion of a synapsid assignment on the basis of the pattern of the carpus and manus – all Triassic synapsids for which this region is known already possess either the basal mammalian phalangeal formula 2 3 3 3 3 or at least a marked reduction of the size of middle phalanges in digits 3-5 (Carroll 1988). The architecture of the preserved portion of the temporal region (if correctly interpreted), the pattern of the carpus and manus, and the sigmoidal femur are diapsid features. It thus seems reasonable to nest MFSN 19235 within the Diapsida (*sensu* Benton 1985; Carroll 1988). The pattern of the carpus, with an ossified pisiform, suggests inclusion within the Lepidosauromorpha (Carroll 1988; Evans 1988). The possible presence of a shearing blade replacing lateral teeth both on the maxilla and dentary, is a character typical of sphenodontian rhynchocephalians (Fraser 1982, 1986, 1988; Fraser & Walkden 1984; Fraser & Benton 1989). Sphenodontians were both diverse and geographically widespread during the Early Mesozoic, having been found in England (Evans 1980; Fraser 1982, 1986; Whiteside 1986), North America (Olsen 1980; Murry 1987), southern Africa (Gow & Raath 1977), China (Young 1982; Wu 1994; Jones 2006) and Italy (Renesto 1995, a juvenile specimen attributed to the genus *Diphydontosaurus*). However, even if no other character observed in MFSN 19235 argues against its placement within Sphenodontia, the identification of the maxilla and dentary are too tentative to support the attribution of MFSN 19235 to that group with confidence, so we prefer here to consider it only as Lepidosauromorpha indet.

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