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Notes on fish, reptilian, and several fragmentary mammalian dental fossils from the Pondaung Formation

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Abstract

We provide photos of fish and reptile fossils and several fragmentary mammalian dento-gnathic fossils from the Eocene Pondaung Formation of Myanmar with description of primate-like dento-gnathic fossils. The figured fossils consist of four specimens of fishes, 11 specimens of reptiles (two vertebral specimens of snake-like reptile, six lower jaws of agamid lizard, three jaws of indeterminate lizard, and two teeth of crocodile), and 42 specimens of mammals (24 fragmentary fossils, 12 fossils of the MGW specimens, three unreported primate-like fossils, and three previously reported primate fossils). Although these figured specimens are fragmentary, they add new evidence on the Pondaung vertebrate fauna, contributing to the understanding of the fauna.

Introduction

The Eocene Pondaung Formation of Myanmar yields many vertebrate fossils including fishes, reptiles, mammals, and a bird (e.g., Pondaung Fossil Expedition Team, 1997; Stidham *et al.*, 2005; Tsubamoto *et al.*, 2006). Although the mammalian and turtle faunas of the Pondaung Formation are relatively well-known (Hutchison *et al.*, 2004; Tsubamoto *et al.*, 2005), other vertebrates are still poorly studied.

Here, we provide photos of fish and reptilian (snake-like, lizard, and crocodile) fossils from the Pondaung Formation to introduce the poorly-known fish and reptile fauna of the formation. Although fish and reptile fossils are relatively abundantly collected in the field, but the studies of these fossils have been still poor (Hutchison and Holroyd, 1996; Pondaung Fossil Expedition Team, 1997; Hutchison *et al.*, 2004; Head *et al.*, 2005). These fossils figured here provide new information on the fish and reptilian fauna of the formation.

Also, we provide (1) several photos of fragmentary but informative dento-gnathic fossils of mammals, (2) the MGW (Department of Geology, Magway University, Magway, Magway Division, Myanmar) Pondaung specimens, and (3) a description of dento-gnathic fossils of primate-like mammals from the Pondaung Formation. Although the mammalian dento-

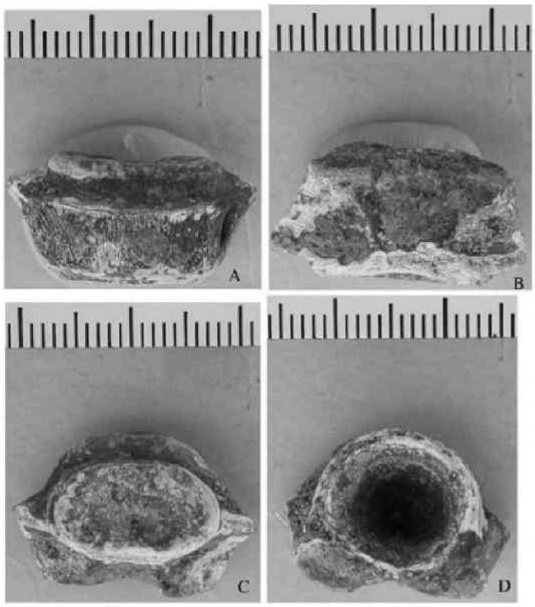

Figure 1. A fish vertebral fossil, NMMP-KU 1353. **A,** ?ventral view. **B,** ?dorsal view. **C,** ?anterior view. **D,** ?posterior view. One division of scale equals 1 mm.

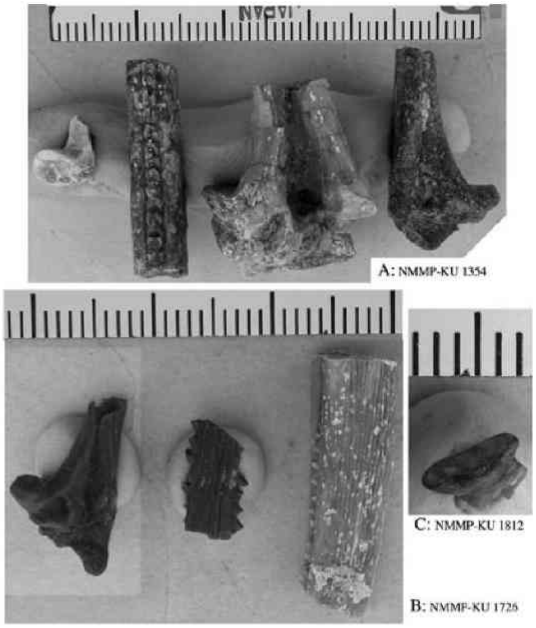

Figure 2. Fragmentary fish fossils. **A,** NMMP-KU 1354, siluriform fish fossils. **B,** NMMP-KU 1726, siluriform fish fossils. **C,** NMMP-KU 1812, a pharyngeal tooth of cypriniform fish. One division of scale equals 1 mm.

gnathic fossils figured here are fragmentally, they have not been figured yet, so that these fossils bear useful information. The MGW Pondaung specimens are figured here because these specimens are difficult to access for foreign researchers. The primate-like specimens are described here because the Pondaung primates are attracting the attention of many researchers in terms of the anthropoid (= "higher primate") origins debate (e.g., Takai *et al.*, 2000; Ciochon and Gunnell, 2002; Marivaux *et al.*, 2003; Jaeger *et al.*, 2004; Kay *et al.*, 2004) and because the present fossils may contribute the debate.

The detailed data of the specimen lists, localities, abbreviations, and geological information are provided in Tsubamoto *et al.* (2006).

Fish fossils

(Figures 1, 2)

NMMP-KU 1353 (Figure 1) is a vertebra of an indeterminate fish. NMMP-KU 1354 and 1726 (Figure 2A, B) are fragmentary bones of siluriform fish. NMMP-KU 1812 (Figure 2C) is a pharyngeal tooth of cypriniform fish.

Reptile fossils

(Figures 3-12)

Snake-like vertebral fossils (small type) (Figures 3A, 4)

At the PGN1 locality (the type locality of *Pondaungia cotteri*), many vertebral fossils

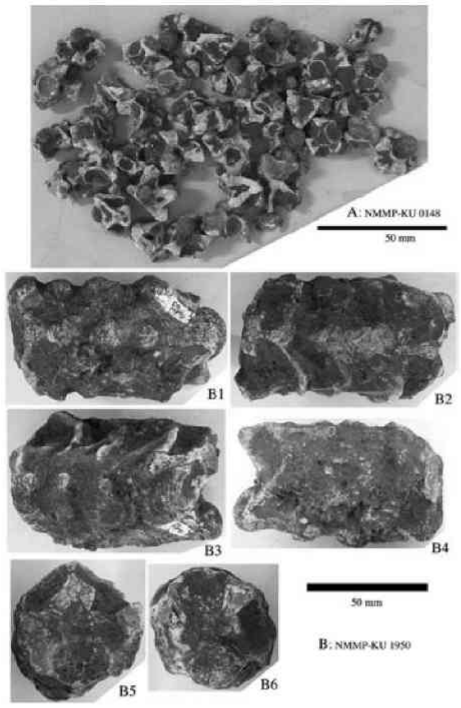

Figure 3. Snake-like vertebral fossils. **A,** the small type of a snake-like vertebral fossil, NMMP-KU 0148. **B,** the large type of a snake-like vertebral fossil, NMMP-KU 1950, four connected vertebrae: **B1,** ventral view; **B2,** dorsal view; **B3,** left lateral view; **B4,** right lateral view; **B5,** anterior view; **B6,** posterior view.

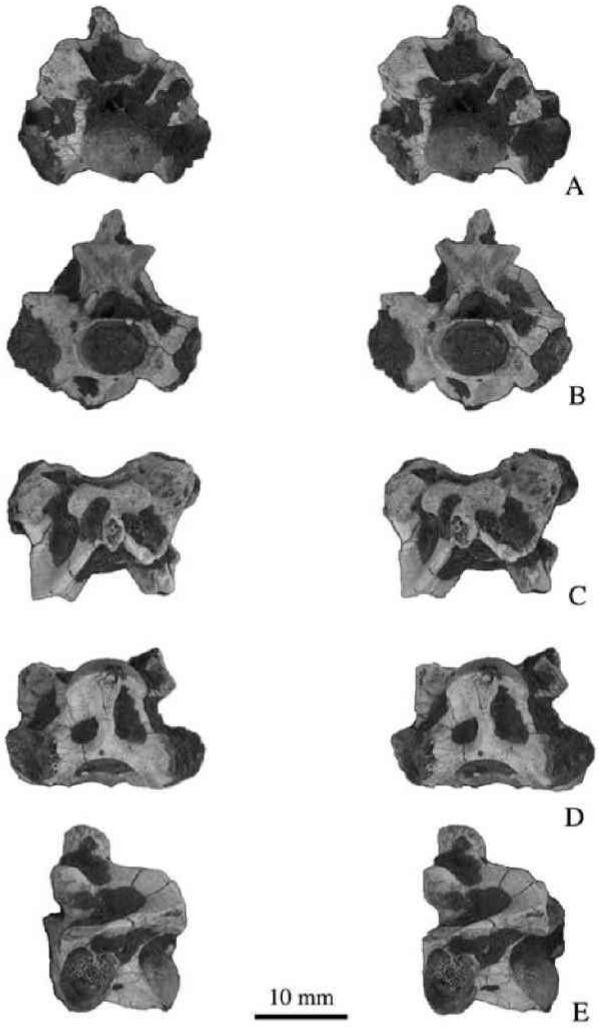

Figure 4. Stereo views of a vertebra from NMMP-KU 0148, the small type of a snake-like vertebral fossil. **A,** posterior view. **B,** anterior view. **C,** dorsal view. **D,** ventral view. **E,** left lateral view.

gnathic fossils figured here are fragmentally, they have not been figured yet, so that these fossils bear useful information. The MGW Pondaung specimens are figured here because these specimens are difficult to access for foreign researchers. The primate-like specimens are described here because the Pondaung primates are attracting the attention of many researchers in terms of the anthropoid (= "higher primate") origins debate (e.g., Takai *et al.*, 2000; Ciochon and Gunnell, 2002; Marivaux *et al.*, 2003; Jaeger *et al.*, 2004; Kay *et al.*, 2004) and because the present fossils may contribute the debate.

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Fish fossils

(Figures 1, 2)

NMMP-KU 1353 (Figure 1) is a vertebra of an indeterminate fish. NMMP-KU 1354 and

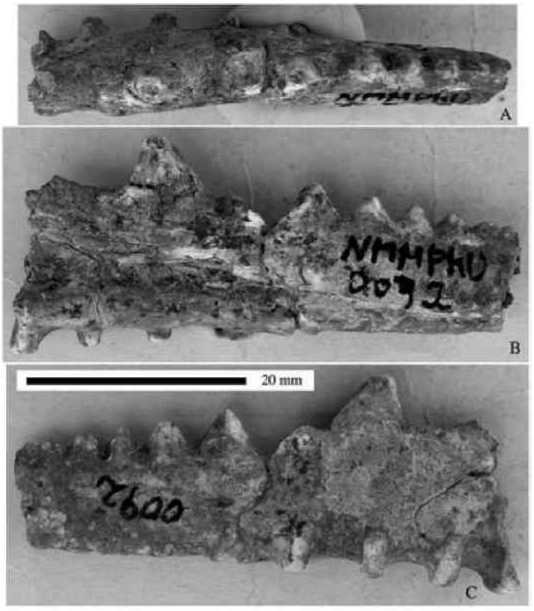

Figure 5. A lower jaw of agamid lizard, NMMP-KU 0092. **A,** dorsal (occlusal) view. **B,** lingual (inner lateral) view. **C,** buccal (outer lateral) view.

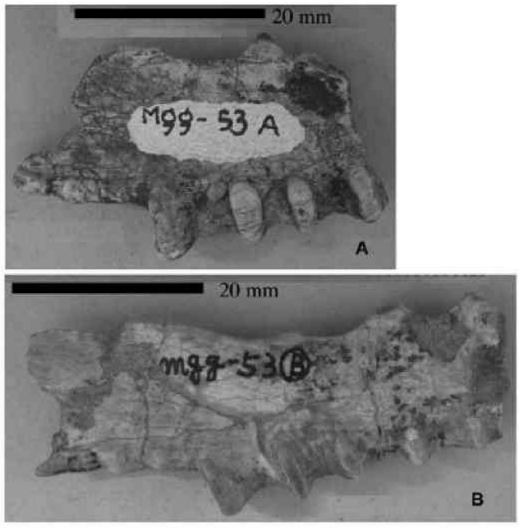

Figure 6. Lower jaws of agamid lizard. **A,** NMMP-KU 1924, buccal (outer lateral) view. **B,** NMMP-KU 1926, buccal (outer lateral) view.

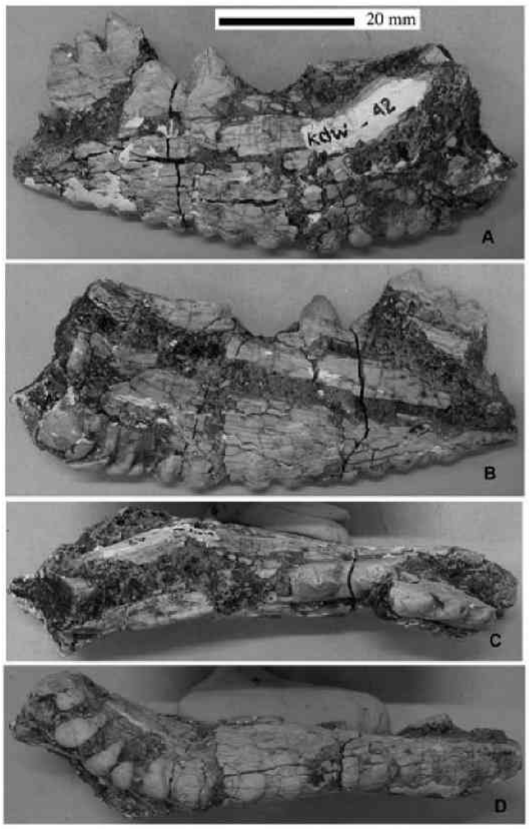

Figure 7. A lower jaw of agamid lizard, NMMP-KU 1923. **A,** buccal (outer lateral) view. **B,** lingual (inner lateral) view. **C,** dorsal (occlusal) view. **D,** ventral view.

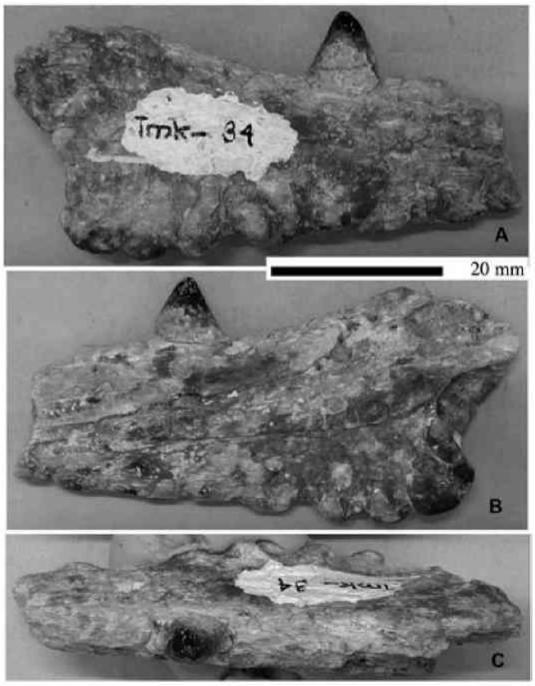

Figure 8. A lower jaw of agamid lizard, NMMP-KU 1925. **A,** buccal (outer lateral) view. **B,** lingual (inner lateral) view. **C,** dorsal (occlusal) view.

Figure 9. A lower jaw of agamid lizard, NMMP-KU 0648. **A,** dorsal (occlusal) view. **B,** buccal (outer lateral) view. **C,** lingual (inner lateral) view.

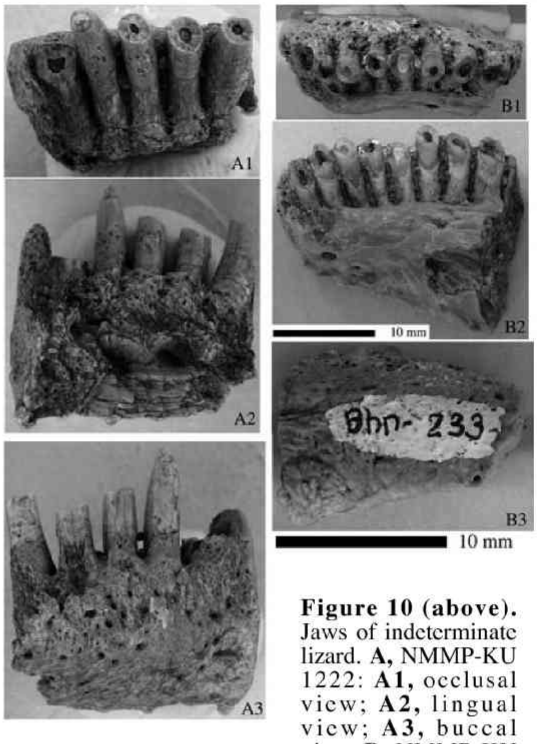

Figure 10 (above). Jaws of indeterminate lizard. **A,** NMMP-KU 1222: **A1,** occlusal view; **A2,** lingual view; **A3,** buccal view. **B,** NMMP-KU 1961: **B1,** occlusal view; **B2,** lingual view; **B3,** buccal view.

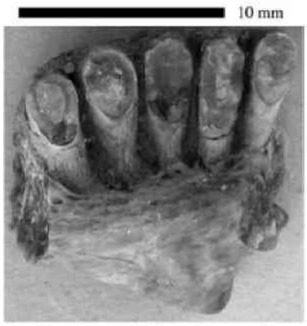

Figure 11 (left). Occlusal view of a jaw of indeterminate lizard, NMMP-KU 1953.

1726 (Figure 2A, B) are fragmentary bones of siluriform fish. NMMP-KU 1812 (Figure 2C) is a pharyngeal tooth of cypriniform fish.

Reptile fossils

(Figures 3-12)

Snake-like vertebral fossils (small type) (Figures 3A, 4)

At the PGN1 locality (the type locality of *Pondaungia cotteri*), many vertebral fossils of a snake-like squamatan reptile (NMMP-KU 0148) were found in 1998 (Figures 3A, 4). NMMP-KU 0148 consists of many vertebrae and small bone fragments, which probably belong to a single individual. These vertebral fossils differ from UCMP 147114, a vertebra of a colubroid snake from the Pondaung Formation (Head *et al.*, 2005), in being much larger and in having morphologically laterally wider and dorsoventrally shorter zygapophyseal facets. They also differ from UCMP 147018, a vertebra of palaeophiid snake from the Pondaung Formation (Head *et al.*, 2005), in having morphologically laterally much wider and dorsoventrally much shorter zygapophyseal facets.

Snake-like vertebral fossils (large type) (Figure 3B)

NMMP-KU 1950 (Figure 3B) consists of four connected cervical vertebrae of snake-

Figure 12 (left top). Crocodile teeth. **A,** lateral view of a normal tooth of crocodile, NMMP-KU 1352. **B,** lateral view of a ziphodont tooth of crocodile (No specimen number). One division of scale equals 1 mm.

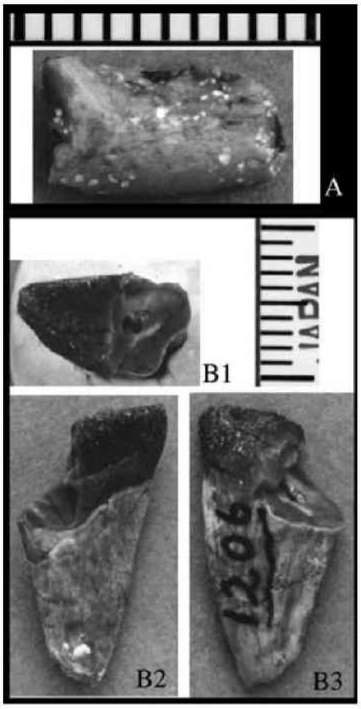

Figure 13 (left bottom). A small mammal. **A,** NMMP-KU 0721, a mandible of a very small mammal, buccal view. **B,** NMMP-KU 1206, a ?incisor: **B1,** occlusal view; **B2,** ?buccal view; **B3,** ?lingual view. One division of scale equals 1 mm.

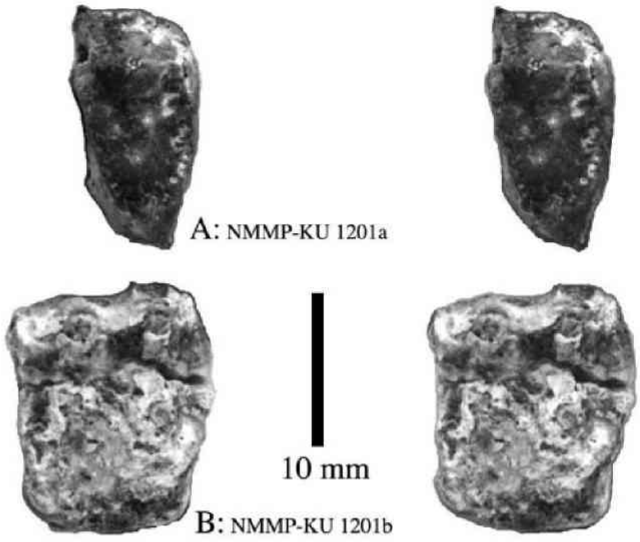

Figure 14 (right). A bunodont artiodactyl-like mammal. **A,** NMMP-KU 1201a, a fragment of an upper molar, stereo pair of occlusal view. **B,** NMMP-KU 1201b, an upper molar, stereo pair of occlusal view.

like reptile. It is much larger than NMMP-KU 0148.

Agamid lizard fossils (Figures 5-9)

The Pondaung Formation yields agamid (Squamata; Iguania) lower jaw fossils (Figures 5-9). There are at least two morphotypes based on the ventral projections at the posterior part of the lower jaw: one (NMMP-KU 0092, 1924, 1926; Figures 5, 6) has sharper and antero-posteriorly thinner ventral projections, and the other (NMMP-KU 1923, 1925; Figure 7, 8) has more rounded and antero-posteriorly thicker projections.

Indeterminate lizard fossils (Figures 10, 11)

NMMP-KU 1222, 1961, and 1953 (Figures 10, 11) are jaws of indeterminate lizards. They are distinguished from the agamid lower jaw from the Pondaung Formation (Figures 5-9) particularly in the morphology of the base of the teeth.

Figure 15. *Anthracotherium*. **A,** NMMP-KU 0440, ?canine: **A1,** ?buccal view; **A2,** ?lingual view. **B,** NMMP-KU 0441, canine: **B1,** lingual view; **B2,** buccal view. **C,** NMMP-KU 0445, ?canine: **C1,** ?lingual view; **C2,** ?buccal view. **D,** NMMP-KU 0442, canine: **D1,** lingual view; **D2,** buccal view. **E,** NMMP-KU 0443, ?canine/first premolar: **E1,** buccal view; **E2,** lingual view. **F,** NMMP-KU 0381, first premolar: **F1,** lingual view; **F2,** buccal view. **G,** NMMP-KU 0444, incisor: **G1,** lingual view; **G2,** buccal view. One division of scale equals 1 mm.

Figure 16. Brontotheriidae. **A,** NMMP-KU 0370, a right I^3: **A1,** buccal view; **A2,** lingual view; **A3,** mesio-lingual view. **B,** NMMP-KU 0344, canine, lateral view. One division of scale equals 1 mm.

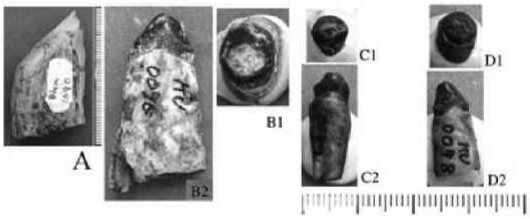

Figure 17. Amynodontiidae. **A,** *Paramynodon*, NMMP-KU 0362, canine, in lateral view. **B-D,** amynodontid incisors. **B,** NMMP-KU 0096: **B1,** occlusal view; **B2,** lateral view. **C,** NMMP-KU 0097: **C1,** occlusal view; **C2,** lateral view. **D,** NMMP-KU 0098: **D1,** occlusal view; **D2,** lateral view. One division of each scale equals 1 mm (left scale corresponds to **A**; right scale corresponds to **B-D**).

Crocodile tooth fossils (Figure 12)

The Pondaung Formation yields many crocodile teeth fossils. There are at least two types of crocodile teeth in the formation, normal and ziphodont teeth (Figure 12; Li, 1991).

Mammalian dento-gnathic fossils

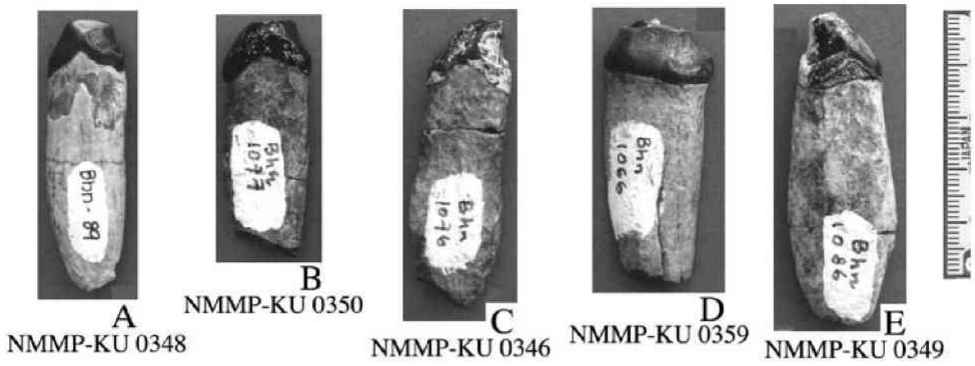

Figure 18. Amynodontid incisors in lateral views. **A,** NMMP-KU 0348. **B,** NMMP-KU 0350. **C,** NMMP-KU 0346. **D,** NMMP-KU 0359. **E,** NMMP-KU 0349. One division of scale equals 1 mm.

(Figures 13-20)

Fragmentary mammalian dento-gnathic fossils (Figures 13-20)

NMMP-KU 0721 (Figure 13A) is a fragmentary mandible of a very small mammal. NMMP-KU 1206 (Figure 13B) is a broken incisor-like tooth. NMMP-KU 1201a and 1201b (Figure 14) are upper molars of a bunodont artiodactyl-like mammal. Anthracotheriid canines, first premolars, and an incisor are shown in Figure 15. Brontotheriid incisor and canine are shown in Figure 16. Amynodontid incisors and a canine are shown in Figures 17 and 18.

The MGW Pondaung specimens (Figures 19, 20)

Figures 19 and 20 lists the photos of the MGW Pondaung specimens. The MGW Pondaung specimens now consist of 13 specimens (MGW 0022-0034) (Tsubamoto *et al.*, 2006, table 4). All the MGW Pondaung specimens, except for MGW 0032 (= very fragmentary material), are figured here.

Description of primate-like fossils

(Figure 21A, C, D)

Large amphipithecid-like fossil (Figure 21A)

NMMP-KU 0004 (Figure 21A) is an isolated left upper canine of primate-like mammal, which was collected at the point about 10 m distant from the point that the upper dentition of *Pondaungia* (NMMP-KU 0003) was found (PGN2 locality; Takai *et al.*, 2000; Shigehara *et al.*, 2002). Its crown is fully preserved and is almost unworn. It is rather straight than curved, suggesting that it is an upper canine. It is slightly oval in cross section. The ratio of mesiodistal length (5.9 mm) to buccolingual width (5.6 mm) is 1.05. The root is broken. A well-delineated but low lingual cingulum surrounds the cervical part of the crown, although its mesiobuccal part is very weak. A ridge on the lingual surface leads from the apex of the crown to the base of the lingual cingulum, delimiting shallow mesial and distal foveae.

NMMP-KU 0004 can be referable to *Amphipithecus mogaungenesis* or *Pondaungia cotteri*. Compared to the Pondaung primates, this upper canine specimen (NMMP-KU 0004)

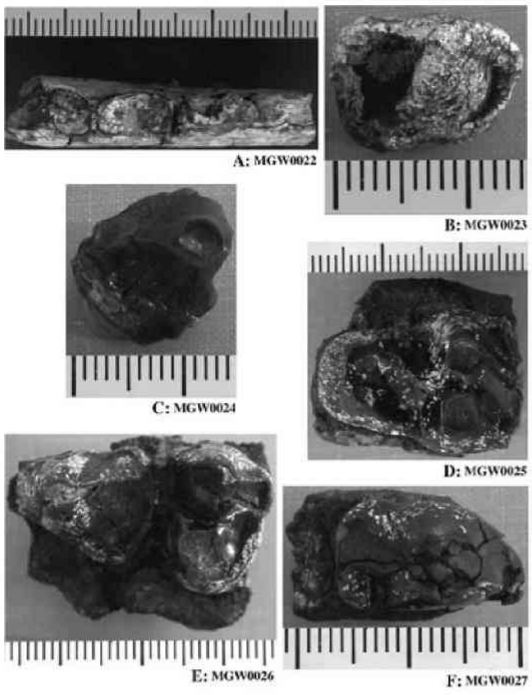

Figure 19. MGW specimens in occlusal views. **A,** MGW 0022, a left mandibular fragment with fragments of P_4 and M_1 of an indeterminate proviverrine hyaenodontid creodont (Egi *et al.*, 2005). **B,** MGW 0023, left P_4 of an amynodontid. **C,** MGW 0024, an upper molar fragment of *Anthracotherium*. **D,** MGW 0025, a left mandibular fragment with M_3 talonid of *Anthracotherium*. **E,** MGW 0026, a left maxillary fragment with P^{3-4} of *Anthracotherium*. **F,** MGW 0027, a left mandibular fragment with P_4 of *Anthracotherium*. One division of each scale equals 1 mm.

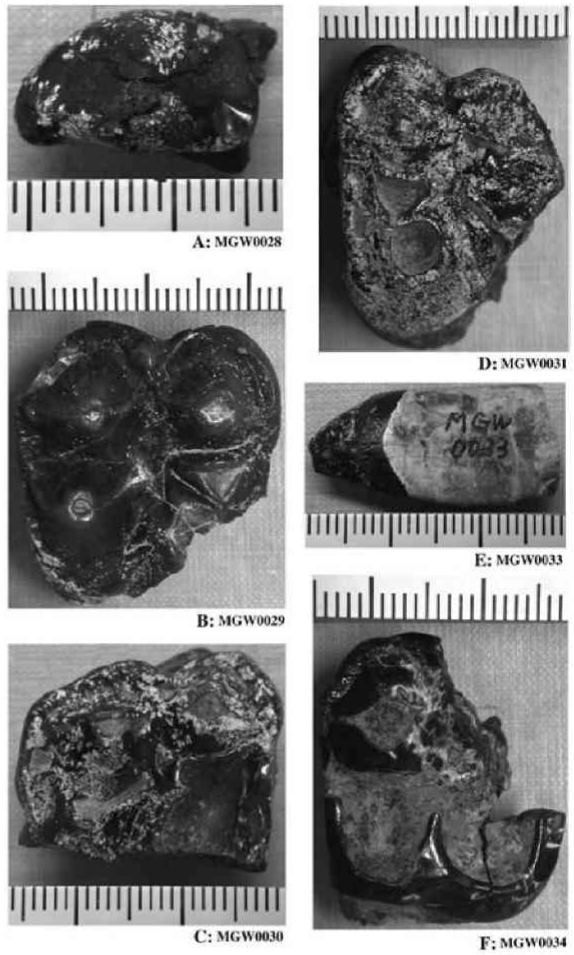

Figure 20. MGW specimens (cont'd.). **A,** MGW 0028, right P_4 of *Anthracotherium*, in occlusal view. **B,** MGW 0029, right M^3 fragment of *Anthracotherium*, in occlusal view. **C,** MGW 0030, a right upper molar of *Anthracotherium*, in occlusal view. **D,** MGW 0031, a left upper molar of *Anthracotherium*, in occlusal view. **E,** MGW 0033, an upper incisor of an amynodontid, in lateral view. **F,** MGW 0034, right $M^{1 \text{or } 2}$ of *Anthracotherium*, in occlusal view. One division of each scale equals 1 mm.

is referable in size to that expected for *Amphipithecus mogaungenesis* or *Pondaungia cotteri* and is much larger than that of *Myanmarpithecus* and eosimiids. Although NMMP-KU 0004 is smaller than the upper canine of *Pondaungia savagei* (NMMP-KU 0003; Shigehara *et al.*, 2002; Gunnell *et al.*, 2002), the crown morphology of NMMP-KU 0004 is roughly similar to each other in having cingulum that surrounds the cervical part of the crown and in having a ridge at the lingual surface (Figure 21A, B; Shigehara *et al.*, 2002). The mesiodistal to buccolingual dimension ratio of NMMP-KU 0004 (1.05) is smaller than that of NMMP-KU 0003 (1.21; Shigehara *et al.*, 2002).

***Myanmarpithecus*-like fossils** (Figure 21C, D)

There are the two edentulous primate-like mandibles, NMMP-KU 0592 (Figure 21C)

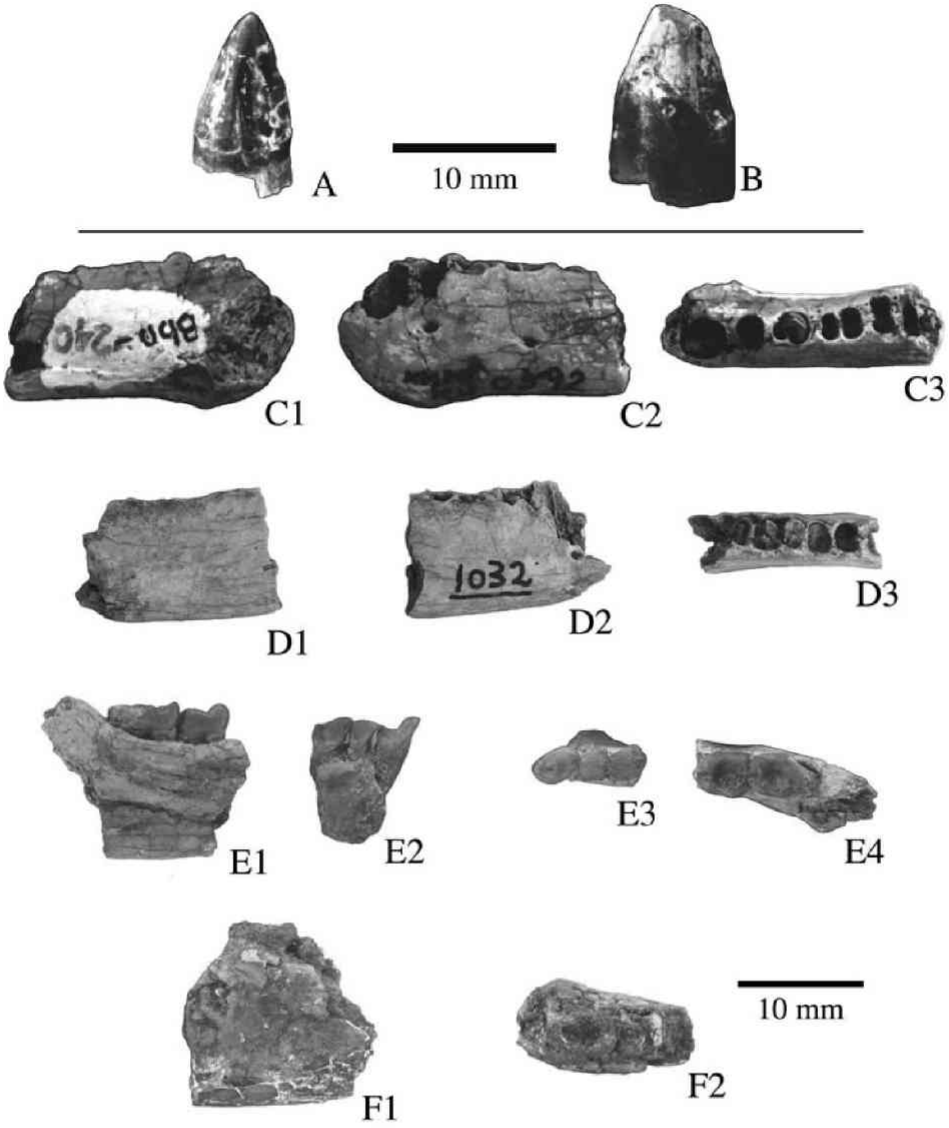

Figure 21. Primate and primate-like fossils. **A,** NMMP-KU 0004, an left upper canine, lingual view. **B,** Left upper canine of one of the larger specimens of *Pondaungia* (NMMP-KU 0003), lingual view. **C,** NMMP-KU 0592, a fragment of a left edentulous mandibular corpus: **C1,** lingual view; **C2,** buccal view, **C3,** occlusal view. **D,** NMMP-KU 1032, a fragment of a right edentulous mandibular corpus: **D1,** lingual view; **D2,** buccal view; **D3,** occlusal view. **E,** Left mandible of the type of *Myanmarpithecus yarshensis* (NMMP-KU 0001): **E1,** lingual view of the posterior part (preserving M_{2-3}); **E2,** lingual view of the anterior part (preserving C_1, P_{1-2}); **E3,** occlusal view of the anterior part; **E4,** occlusal view of the posterior part. **F,** Referred material of *Myanmarpithecus yarshensis* (NMMP-KU 0002, a left mandibular fragment preserving M_3): **F1,** lingual view; **F2,** occlusal view. Scale bars = 10 mm (upper scale corresponds to **A-B**, lower scale corresponds to **C-F**).

and 1032 (Figure 21D). NMMP-KU 0592 is from Bahin area and NMMP-KU 1032 is from Bh1 (Yarshe Kyitchaung) locality (Tsubamoto *et al.*, 2000, 2006).

NMMP-KU 0592 (Figure 21C) is a left edentulous mandibular fragment. The corpus is rather deep and thick. The most anterior preserved alveolus is very large and is rounded in occlusal view, suggesting that it is for a canine. Posterior to the C_1 alveolus is the smaller rounded alveolus, suggesting single-rooted premolar that we will assume P_2 here for the purpose of description. Posterior to the P_2 alveolus is the single-rooted P_3 alveolus. The P_3

alveolus has a slight interradicular septa in its deep part, suggesting that the ventral part of the P_2 root is slightly biradiculated. Posterior to the P_3 alveolus, there are two mesiodistally compressed alveoli that are separated by incomplete interradicular septa with each other. The tooth for these alveoli seems to be not M_1 but somewhat molariform P_4 because the interradicular septa is incomplete. Posterior to the P_4 alveoli, there are two more two mesiodistally-compressed alveoli that are separated by complete interradicular septa with each other, suggesting that they are double rooted M_1 alveoli. The posterior half of the posterior M_1 alveolus is broken. The mandibular symphysis is short and erect, extending to the level of the septa between C_1 and P_2. There are two mental foramina: the anterior one is below the P_2 alveolus, and the posterior one is below the P_4 interradicular septa. A broken root of incisor can be observed just anterior to the C_1 alveolus. The mesiodistal space between the C_1 alveolus and symphysis region is very short, implying that this mammal may have only one or at most two incisors.

NMMP-KU 1032 (Figure 21D) is a right edentulous mandibular fragment. It is slightly smaller than NMMP-KU 0592, but its corpus is also relatively deep and thick. It preserves six mesiodistally compressed alveoli of about equal size. The anterior half of the most anterior alveolus and the posterior half of the most posterior alveolus are broken. At the broken anterior edge, the posterior margin of the mandibular symphysis can be observed, indicating that the preserved part is relatively anterior part of the mandibular corpus. Two mandibular foramina are observed on the anterior part the preserved mandible: the anterior one is much larger than the posterior one.

Although the present mandibular specimens (Figure 21C, D) do not preserve teeth, they can be referable to mandibular corpora of *Myanmarpithecus*-sized primates. They are similar in size to *Myanmarpithecus* (Figure 21E, F), are much larger than eosimiids, and are much smaller than *Amphipithecus* and *Pondaungia* (Egi *et al.*, 2004). They have relatively deep and thick mandibular corpus, a short and erect mandibular symphysis, and mesiodistally crowded and compressed premolar alveoli. At least, NMMP-KU 0592 has elect and anteroposteriorly short mandibular symphysis, also implying that it is referable to primates. On the other hand, the expected canine and $P_{1\text{-}2}$ of NMMP-KU 0592 (Figure 21C) is proportionally larger and its corpus is thicker than those of the type specimen of *Myanmarpithecus* (NMMP-KU 0001) (Figure 21E). However, the corpus of NMMP-KU 0592 (Figure 21C) is as robust and thick as that of NMMP-KU 0002, a referred specimen of *Myanmarpithecus* (Figure 21F; Takai *et al.*, 2001), implying that NMMP-KU 0592 may be a corpus of *Myanmarpithecus*. The differences of the mandibular robustness and size and of the canine proportion between the type specimen of *Myanmarpithecus* and NMMP-KU 0592 can be referred to the sexual dimorphism or specific separation. On the other hand, the alveolar morphologies at the level just behind the posterior margin of mandibular symphysis of NMMP-KU 1032 (Figure 21D) shows mesiodistally more compressed than those of NMMP-KU 0592 (Figure 21C) and the type specimen of *Myanmarpithecus* (Figure 21E), implying NMMP-KU 1032 may not be

assigned to *Myanmarpithecus*.

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References

Ciochon, R.L. and Gunnell, G.F. (2002b) Eocene primates from Myanmar: historical perspectives on the origin of Anthropoidea. *Evolutionary Anthropology* 11:156-168.

Egi, N. Holroyd, P.A., Tsubamoto, T., Aung Naing Soe, Takai, M., and Ciochon, R.L. (2005) Proviverrine hyaenodontids (Creodonta: Mammalia) from the Eocene of Myanmar and a phylogenetic analysis of the proviverrines from the Para-Tethys area. *Journal of Systematic Palaeontology* 3:337-358.

Egi, N., Takai, M., Shigehara, N., and Tsubamoto, T. (2004) Body mass estimates for Eocene eosimiid and amphipithecid primates using prosimians and anthropoid scaling models. *International Journal Primatology* 25:211-236.

Gunnell, G.F., Ciochon, R.L., Gingerich, P.D., and Holroyd, P.A. (2002) New assessment of *Pondaungia* and *Amphipithecus* (Primates) from the late middle Eocene of Myanmar, with a comment on 'Amphipithecidae.' *Contributions from the Museum of Paleontology, The University of Michigan* 30:337-372.

Head, J.J., Holroyd, P.A., Hutchison, J.H., and Ciochon, R.L. (2005) First report of snakes (Serpentes) from the late middle Eocene Pondaung Formation, Myanmar. *Journal Vertebrate Paleontology* 25:246-250.

Hutchison, J.H. and Holroyd, P.A. (1996) Preliminary report on the lower vertebrate fauna of the late middle Eocene Pondaung Sandstones. *Journal Vertebrate Paleontology* 16:43A.

Hutchison, J.H., Holroyd, P.A., and Ciochon, R.L. (2004) A preliminary report on Southeast Asia's oldest Cenozoic turtle fauna from the late middle Eocene Pondaung Formation, Myanmar. *Asiatic Herpetological Research* 10:38-52.

Jaeger, J.-J., Chaimanee, Y., Tafforeau, P., Ducrocq, S., Aung Naing Soe, Marivaux, L., Sudre, J., Soe Thura Tun, Wanna Htoon, and Marandat, B. (2004) Systematics and Paleobiology of the anthropoid primate *Pondaungia* from the late Middle Eocene of Myanmar. *Comptes Rendus Palevol* 3:243-255.

Kay, R.F., Williams, B.A., Ross, C.F., Takai, M., and Shigehara, N. (2004) Anthropoid origins: a phylogenetic analysis. p.91-135. In "*Anthropoid origins: new visions.*" Ross, C. and Kay, R.F. (eds.) Kluwer Academic/Plenum Press: New York.

Li, J. (1991) Fossil reptiles from Hetaoyuan Formation, Xichuan, Henan. *Vertebrata PalAsiatica* 29:190-203.

Marivaux, L., Chaimanee, Y., Ducrocq, S., Marandat, B., Sudre, J., Aung Naing Soe, Soe Thura Tun, Wanna Htoon, and Jaeger, J.-J. (2003) The anthropoid status of a primate from the late middle Eocene Pondaung Formation (Central Myanmar): tarsal evidence. *Proceedings of the National Academy of Sciences of the United States of America* 100:13173-13178.

Pondaung Fossil Expedition Team (1997) *Report on work achieved by the Pondaung Fossil Expedition Team.* Office of Strategic Studies, Ministry of Defence: Yangon. [in Burmese, partly in English.]

Shigehara, N., Takai, M., Kay, R. F., Aye Ko Aung, Aung Naing Soe, Soe Thura Tun, Tsubamoto, T., and Tin Thein (2002) The upper dentition and face of *Pondaungia cotteri* from central Myanmar. *Journal of Human Evolution* 43:143-166.

Stidham, T.A., Holroyd, P.A., Gunnell, G.F., Ciochon, R.L., Tsubamoto, T., Egi, N., and Takai, M. (2005) An *ibis*-like bird (Aves: cf. Threskiornithidae) from the late middle Eocene of Myanmar. *Contributions from the Museum of Paleontology, The University of Michigan* 31:179-184.

Takai, M., Shigehara, N., Aye Ko Aung, Soe Thura Tun, Aung Naing Soe, Tsubamoto, T., and Tin Thein (2001) A new anthropoid from the latest middle Eocene of Pondaung, central Myanmar. *Journal of Human Evolution* 40:393-409.

Takai, M., Shigehara, N., Tsubamoto, T., Egi, N., Aye Ko Aung, Tin Thein, Aung Naing Soe, and Soe Thura Tun (2000) The latest middle Eocene Primate fauna in the Pondaung area, Central Myanmar. *Asian Paleoprimatology* 1:7-28.

Tsubamoto, T., Egi, N., Takai, M., Chit Sein, and Maung Maung (2005) Middle Eocene ungulate mammals from Myanmar: a review with description of new specimens. *Acta Palaeontologica Polonica* 50:117-138.

Tsubamoto, T., Egi, N., Takai, M., Shigehara, N., Aye Ko Aung, Tin Thein, Aung Naing Soe, and Soe Thura Tun (2000) A preliminary report on the Eocene mammals of the Pondaung fauna, Myanmar. *Asian Paleoprimatology* 1:29-101.

Tsubamoto, T., Egi, N., Takai, M., Shigehara, N., Suzuki, H., Nishimura, T., Ugai, H., Maung-Maung, Chit-Sein, Soe-Thura-Tun, Aung-Naing-Soe, Aye-Ko-Aung, Tin-Thein, Thaung-Htike, and Zin-Maung-Maung-Thein (2006) A summary of the Pondaung fossil expeditions. *Asian Paleoprimatology* 4:1-66.