Sahelanthropus tchadensis: the facts

Sir,—In a recent article in this journal,1 Beauvilain and Le Guellec suggest that our initial description of *Sahelanthropus tchadensis* was flawed by the inaccurate identification and association of specimens. Their claims are without foundation. Beauvilain and Le Guellec1 offered supplementary information on the hypodigm and geological context of the oldest known hominin, *Sahelanthropus tchadensis*, discovered at TM266, in the Djurab Erg, northern Chad, by the MPFT in 1994. They claimed in our view represent any ‘reactivated ancient faulting’ as they allege (p. 142). These geomorphological features do not suffer from such a weathering by sand-blasting. During its exposure, it lost most of its front teeth. As reported in Beauvilain and Le Guellec, the broken right canine belonging to this skull was found separately. There is no doubt that this canine belonged to this cranium, because, as correctly noted by Beauvilain and Le Guellec (p. 143): ‘The tooth consisted of two fragments which fitted perfectly onto the right canine root’. However, they erroneously reported it as a ‘hemimandible’ canine whereas in fact it is the distal half of the canine. This canine was published in its natural position on the cranium.2

A parallel case occurred for the mandible in question. The right third molar had been displaced from the tooth row by erosion and transported by wind to where it was recovered, some metres away from the mandible with the remaining teeth. After recovery, we established that it belonged to the mandible itself, and that it was a right M3, of the ‘hemimandible’ TM266-02-154-1. Beauvilain and Le Guellec now assert that this tooth has been attributed to and mounted on the incorrect side. This moderately worn tooth bears substantial occlusal anatomy which unambiguously identifies it as a third molar. The identification of the side was based on two decisive independent criteria, one set physical and the other set biological. First, there is an unambiguous match between the lower surface of the tooth and its roots, which remained in the mandible. There is no doubt about the identity of this jaw (Figs 1D, E). This is further confirmed by the matching interproximal facet preserved on the mesial surface of the tooth in question and the second molar retained by the mandible. Second, the anatomy of the third molar allows unambiguous sizing. As in all hominoid teeth, the buccal cusps are the more worn, with a larger, most heavily worn cusp (the protoconid), marked here by heaviest occlusion and placed mesiobuccally (Fig. 1D, E). The occlusal rims of the lingual cusps stand out slightly but distinctly, from less wear due to well-known masticatory mechanisms common to modern humans, fossil hominids, and fossil modern apes.

Conclusion

The logistical contributions of Beauvilain to the fieldwork in Chad are gratefully acknowledged, but the claims and assertions by him and Le Guellec have no bearing on either the interpretation of the geology of TM266 or of the associations, taxonomy, or phylogeny of *Sahelanthropus tchadensis*.

**Fossil specimens reported in references 2 and 3 were derived from this local section as published therein. There is no doubt about their provenance.**

**Inventory issues**

The MPFT practices of inventorying and publishing fossils does not differ from those normally practised in palaeontology. All collected specimens, including hominids, are registered under an inventory number comprising the name of the site, the year, a specimen number, and, in the case of several pieces of the same individual, a part number (e.g. the cranium nicknamed ‘Toumai’ was numbered TM266-01-060-1). This attribution of an inventory number occurs at different stages when processing the discoveries: 1) for most of them, directly in the field after a precise identification; 2) in the laboratory (at N’djaména or Poitiers) for all the specimens recovered after sieving, or after cleaning for some specimens completely embedded in matrix. Beauvilain, a geographer in charge of MPFT logistics, was unfamiliar with this process and the way in which specimens were assembled into the published hypodigm of *S. tchadensis*.2

The first paper describing the new taxon *S. tchadensis* included only the specimens which were definitely identified as hominid by their anatomical characters. These specimens belong to several individuals, as we reported in Nature:2 the holotype cranium is one of these specimens. Beauvilain and Le Guellec wondered why a very worn incisor (TM266-01-460) and a damaged partial mandibular symphysis (TM266-02-203) were not included in the paratype series. They were not included because their exact affinities are yet to be fully developed and determined. Further studies of more fragmentary remains have identified additional individuals, and the MNI count will expand as both excavations and preparation work continue.

**Issues of restoration and interpretation**

In the Djurab desert, the discovery of fossils is facilitated by an intense erosion of the sediments in which they are embedded through the action of the sand blown by winds across the sedimentary units. When the fossils are unearthed, the sand is eroded, the same aeolian erosion also affects them. The damage mostly consists of polishing, cracking, breaking, dispersion of the different parts, and, finally, total destruction of the specimens if they are not collected immediately after their first exposure. For example, the cranium TM266-01-060-1 of *Sahelanthropus tchadensis* was partially unearthed when found and had

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Fig. 1. Right hemi-mandible TM266-02-154-1 of \textit{Sahelanthropus tchadensis}. A, B, and C: CT scans (courtesy: University Museum, University of Tokyo) at the level of the M$_3$. The mandibular corpus and the retained roots of the M$_3$ are in light red. The crown of the third lower molar found separately and claimed to be a left one is in blue. A precise matching between the M$_3$ crown and the corresponding roots in the hemi-mandible can be observed. The interstitial space between the M$_3$ and its roots corresponds to thickness of the glue used to affix the tooth to its roots. A, Sagittal sections with mesial side at right – from right to left, CT scans are respectively shot at 3.33 mm, 4.41 mm, 7.83 mm, and 8.70 mm from the buccal edge of the tooth; B, Transversal sections with lingual side at right – from right to left, CT scans are respectively shot at 2.67 mm, 3.89 mm, 4.11 mm, and 9.36 mm from the mesial edge of the tooth; C, Sections parallel to the occlusal surface, at the cervical level and below, with mesial side at top – from right to left, CT scans are respectively shot at 6.93 mm, 7.14 mm, 7.44 mm, and 7.80 mm from the occlusal edge of the tooth. Mesially, the mesio-buccal and mesio-lingual roots remaining in the corpus (see on the side at top – from right to left, CT scans are respectively shot at 6.93 mm, 7.14 mm, 7.44 mm, and 7.80 mm from the mesial edge of the tooth; D, Occlusal view of the complete specimen with its M$_3$; E, Occlusal view of the M$_3$; F, Occlusal view of the M$_3$ roots; G, Disto-lingual view of the join (white arrow) between the M$_3$ and its distal root. All scale bars are 0.5 mm.

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**Correspondence**

E-mail: michel.brunet@univ-poitiers.fr

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**Michel Brunet**$^{1}$$^{,2}$ and **M.P. E.**

$^{1}$Jean-Renaud Boisserie$^{1}$, Djimdoumaibaye Ahounta$^{1}$, Cécile Blonde$^{4}$, Louis de Bonis$^{5}$, Yves Coppens$^{1,5}$, Christiane Deny$^{1}$, Philippe Duringer$^{1}$, Éva Eisenmann$^{1}$, Pierre Fronty$^{1}$, Denis Geraads$^{2}$, Gondélibé Fanoné$^{1}$, Franck Guy$^{2}$, Thomas Lehmann$^{2}$, Fabrice Lihoreau$^{2}$, Andossa Likius$^{4}$, Antoine Louchart$^{5}$, Hassane Taisso Mackaye$^{4}$, Olga Otero$^{4}$, Pablo Pelaz Camponames$^{1}$, David Pilbeam$^{2}$, Marcia Ponce De Leon$^{5}$, Jean-Claude Rage$^{5}$, Mathieu Schuster$^{1}$, Pascal Tassy$^{2}$, Xavier Valentin$^{1}$, Patrick Vignaud$^{1}$, Laurent Vinot$^{1}$ and Christoph Zollikof$^{5}$.

**CNRS UMR 6046**, Université de Poitiers, 46 Avenue du Rector Pineau, 86022 Poitiers Cedex, France; $^{2}$Laboratory for Human Evolutionary Studies, University of California, 300 Valley Life Sciences Building, CA 94720, U.S.A.; $^{3}$Centre National d’Appui la Recherche, BP 1228, N'Djaména, Chad; $^{4}$Collège de France, place Marcellin
Figs 1–3. Photographs of specimens attributed to *Sahelanthropus tchadensis* (taken of the cranium at 08.00 on 19 July 2001): 1, the M⁳ in the cranium; 2, oblique lingual view of the roots of the M³ in the mandible (note in particular the relatively planar fracture surface of the distal root, which curves distally and buccally at a constant level (black arrow), and compare it with the antero-posteriorly curved surface marked by an arrow in the image provided by Brunet et al.); 3, root of the right C³ in the cranium of Toumai. (Scale bars: 10 mm.)
necessary to recognize the detailed work which allowed the fitting of the M₃ crown so precisely onto the roots of the hemimandible. The hard sandy matrix which covered the base of the isolated molar when it was found first had to be removed and then the space now occupied by glue had to be prepared millimetre by millimetre. A similar operation was required for the parts of the root in the mandible, which were similarly covered in matrix (Fig. 2). In general, a section immediately beneath the cervix of left and right mandibular molars reveals radicular surfaces that may be superposed to within about one millimetre. So, it is not surprising in this particular case that a left tooth seemed to correspond to the roots in a right mandible.

The right upper canine of Toumai

We apologize for the possibility that our text regarding Toumai’s right C₁ could be misinterpreted, the canine root being in situ in the skull as shown in Fig. 3. In contrast we could only write that the canine crown found in November 2001 fits onto the root, we being in the Djourab, and the skull at the University of Poitiers.

Curatorial issues

Writing catalogue numbers on fossil specimens is a daily activity in the field. At such an important site as TM 266, all the fossils were collected. That is why, from July to December 2001, 52 postcranial bones, whose zoological group could not be determined in the field, were catalogued, in the expectation that some of them might belong to *Sahelanthropus*. Among these fragments, 36 are long bones (tibia, femur, humerus and ulna) including intact specimens and broken diaphyses. Considering the excellent preservation of the Toumai cranium, a careful examination of these bones should yield interesting information, as we consider it likely that the collection of postcranial elements collected there may well contain some specimens that belong to *Sahelanthropus*.

**Alain Beaulieu**

Université de Paris X Nanterre, 200 avenue de la République, 92000 Nanterre Cedex, France.

**Yves Le Guelc**

Rue du Manoir, 76190 Yvetot, France.


**Philip D. Gingerich**

Department of Anthropology and Paleoanthropology, University of Poitiers in December 2001, a single fossil had been added to the field catalogue. It consists of specimen TM 266-01-447 (a right M₃ according to Brunet et al.), whereas the catalogue entry states that it is ‘Classification – primate; Description – fragments morceaux racines M₁/ M₃; Dépôt – Poitiers (reliquat tami)’. These specimens were returned to the CNAR, N’Djaména, on 30 January 2002.

**Correspondence**