

process was advanced to the point that it had become detached. In the photographs (Fig. 1a of ref. 2), neither wing membrane clearly indicates where it was attached to the leg, although illustrations^{1,2} of the right wing show an imprint identical in shape and position to that of the left wing. This observation may be suspect because, as reconstructed here, the left wing may have originally attached near the knee.

I can accept that a membrane may have spanned from the lateral digits to either side of the tail (it would not impede terrestrial locomotion), but I question how a membrane spanning the legs and attached medially can also be attached to the lateral digits. The image of pterosaurs with broad bat-like wing membranes is traditional, but at least two Solnhofen specimens^{3,4,7} were preserved with very narrow wings stretched only between the elbow and wing finger. Thus, either *Sordes* is different from these specimens, or previous interpretations^{1,2} are in error.

David Peters

12812 Wood Valley Court, St Louis, Missouri 63131-2051, USA

UNWIN AND BAKHURINA REPLY — Reconstructions of the Upper Jurassic pterosaur *Sordes pilosus* with broad wings attaching to the hindlimbs and a medial membrane, the uropatagium, between the legs^{1,2}, have been challenged by Peters, and others⁴, on the grounds that preservation of the remains is too poor to permit such inferences. However, comparison of *Sordes* with other exceptionally preserved pterosaurs shows that the holotype is one of the best-preserved individuals in existence^{2,8}. As originally interred, the skeleton was complete and fully articulated, with the neck flexed backward as in some Solnhofen pterosaurs³. Each forelimb is partially folded and, although parts of the left forelimb were lost during collection, it is evident that, like the hindlimbs, they are almost perfectly symmetrical with respect to each other, contradicting claims⁴ of post-mortem disturbance.

Interestingly, the position of the skele-

ton corresponds almost exactly to that exhibited by complete, undisturbed examples of *Rhamphorhynchus*, from the Upper Jurassic Solnhofen limestone¹⁰. However, the evidence for soft tissues, especially the extent and structure of the wing membranes, is much clearer in *Sordes*. The wing membranes of Solnhofen pterosaurs are preserved as impressions^{3,4,9,10}, but even the best examples can be interpreted in a variety of ways^{3,4,11}. The decomposition of *Sordes* was halted at an earlier stage than in Solnhofen pterosaurs: extensive tracts of black, mineralized soft tissues⁸ pick out impressions left by the wing membranes. Outlines of the wings can be traced with ease and show, quite unambiguously, the existence of a uropatagium and attachment of the cheiropatagium to the leg as far as the ankle^{1,2,8}.

Peters' narrow-winged reconstruction of *Sordes* is based on a highly unreliable technique, interpretation of photographs, and unfounded suppositions of post-mortem disturbance. Central to his argument is the claim that the uropatagium is part of the right cheiropatagium which, somehow, drifted into a symmetrical position between the hindlimbs, the internal fibres fortuitously lining up parallel to the lower leg. However, Peters' interpretation (his figure b) omits parts of the central region of the right cheiropatagium, preserved lateral to the right knee and clearly visible together with the uropatagium in

Sharov's¹ plate 4. Impressions of the flight membrane, the posterior boundary of which is evident in Sharov's¹ plate 5, Fig. 1a, show that the right cheiropatagium remained intact and did not undergo any post-mortem transport. The wings occupy almost identical positions, as Sharov correctly showed¹, but the outline of the right cheiropatagium is more difficult to trace in photographs because of the patchy preservation of the black, mineralized tissues in this area.

Peters' reconstruction also fails to explain the unusual morphology and position of the fifth toe^{2,8,12} and is contradicted by details of the internal composition of the membranes. The uropatagium, preserved in three other individuals as well as the holotype, contains relatively short, sinuous, loosely packed fibres, clearly distinguishing it from the middle and outer parts of the cheiropatagium, which is characterized by much longer, straighter, closely packed fibres².

David M. Unwin

Department of Geology, University of Bristol, Bristol BS8 1RJ, UK

Natasha N. Bakhurina*

Palaeontological Institute, Russian Academy of Sciences, Moscow 117647, Russia

*Present address: Department of Geology, University of Bristol.

Early AGEing and Alzheimer's

SIR — Mattson *et al.* suggest¹ that in Alzheimer's disease "glycation is a late event" and that it "results from free radical generation". Despite their citation of some of our papers to support their view²⁻⁴, their opinion is directly contrary to the findings that the protein PHF- τ /A β 68, regarded as the precursor to neurofibrillary tangles⁵, is modified by advanced glycation end products (AGE)^{2,6}.

We have also demonstrated that AGE epitopes localize to diffuse amyloid- β senile plaques³ (lesions that represent one of the earliest pathological changes in Alzheimer's disease⁷), as well as neurofibrillary tangles and neuritic senile plaques. Moreover, the proteins found in these lesions are continuously exposed to glucose *in vivo* and therefore constantly subject to Schiff base formation followed by Amadori rearrangements and AGE modification. Of relevance is that intracellular AGE modification, contrary to popular dogma, often occurs very rapidly⁸.

Rather than representing a tombstone or late event, the process resulting in glycation-related modification appears to represent a very early event that promotes the formation of free radicals⁹ and

enhances the aggregation of τ or amyloid- β ⁹ into neurofibrillary tangles and senile plaques. Therefore, a contribution of glycoxidation modifications early, as well as later, in the pathogenesis of Alzheimer's disease should be seriously considered.

Mark A. Smith*

Lawrence M. Sayre*

Michael P. Vitek†

Vincent M. Monnier*

George Perry*

*Institute of Pathology, Case Western Reserve University, Cleveland, Ohio 44106, USA

†The Picower Institute, Manhasset, New York 11030, USA

1. Mattson, M. P., Carney, J. W. & Butterfield, D. A. *Nature* **373**, 481 (1995).
2. Yan, S. D. *et al. Proc. natn. Acad. Sci. U.S.A.* **91**, 7787-7791 (1994).
3. Smith, M. A. *et al. Proc. natn. Acad. Sci. U.S.A.* **91**, 5710-5714 (1994).
4. Vitek, M. P. *et al. Proc. natn. Acad. Sci. U.S.A.* **91**, 4766-4770 (1994).
5. Trojanowski, J. Q. & Lee, V. M. *Am. J. Path.* **144**, 449-453 (1994).
6. Ledesma, M. D. *et al. J. Biol. Chem.* **269**, 21614-21619 (1994).
7. Giaccone, G. *et al. Neurosci. Lett.* **97**, 232-238 (1989).
8. Giardino, I., Edelstein, D. & Brownlee, M. *J. clin. Invest.* **94**, 110-117 (1994).
9. Hunt, J. V. & Wolff, S. P. *Free Radic. Res. Commun.* **12-13**, 115-123 (1991).

1. Sharov, A.G. *Akad. nauk SSSR paleont. Inst. Tr.* **130**, 104-113 (1971).
2. Unwin, D. M. & Bakhurina, N. N. *Nature* **371**, 62-64 (1994).
3. Wellnhofer, P. *Ann. Naturhist. Mus. Wien* **88A**, 149-162 (1987).
4. Padian, K. & Rayner, J. M. V. *Am. J. Sci.* **293A**, 91-166 (1993).
5. Gekker, R. F. *Trudy paleont. Inst.* **15**, 7-85 (1948) (in Russian).
6. Doludenko, M. P., Sakulina, G.V. & Ponomarenko, A.G. *The Geology and Late Jurassic Fauna and Flora of a Unique Locality, Aulie (Karatau Range, Southern Kazakhstan)* (Inst. Geol., Russian Acad. Sci., Moscow, 1990) (in Russian).
7. Wellnhofer, P. *The Illustrated Encyclopedia of Pterosaurs 1-192* (Salamander, London, 1991).
8. Bakhurina, N. N. & Unwin, D. M. *Hist. Biol.* (in the press).
9. Wellnhofer, P. *Abh. Bayer. Akad. Wiss. (N.F.)* **141**, 1-133 (1970).
10. Wellnhofer, P. *Palaeontographica* **149**, 1-30 (1975).
11. Pennycook, C. *J. Biol. Rev.* **63**, 209-231 (1988).
12. Bakhurina, N. N. & Unwin, D. M. *J. vert. Paleont.* **12** (Suppl.), 18A (1992).