bristles that arise along the mantle margin of each valve. Their ultrastructure is identical to the chaetae of annelid polychaetes[3], animals which at first glance look very different with their metameric segmentation and chaetae arising in bundles from the parapodia. Zoologists adhering to the deuterostome camp are content to accept the shared ultrastructure as yet another example of convergence. If, however, brachiopods and related lophophorates are indeed protostomes, then this similarity may become much more significant. Nevertheless, with only crown groups available, the argument of whether setae and chaetae are convergent or share a common descent is difficult to resolve.

The fossil record, however, suggests a possible way forwards. What appear to be equivalents to polychaete chaetae occur as the sclerites of the Burgess Shale animal *Wiwaxia*[4], although overall this Cambrian worm differs in several important respects from polychaetes. Significant similarities in sclerite arrangement exist, however, between wiwaxiids and a slightly older group, known as the halkieriids. This latter group, however, has the peculiarity of possessing a prominent shell at either end of its slug-like body[5]. These shells have what may be more than a passing similarity to the valves of brachiopods. Imagine a juvenile halkieriid, that, rather than having its shells back to back early in its development, swung one valve beneath the other. This is not implausible given that a similar rotation of the shell rudiments as occurs in the embryology of the living brachiopod *Crania*[6]. If we accept that the sclerites of halkieriids and wiwaxiids are equivalent[5], but the latter have the ultrastructure of chaetae[4], then a subsequent transformation of the sclerites that surround each shell to the setae of brachiopods becomes an intriguing hypothesis.

Suppose further evidence, including molecular data (Bernard Cohen, personal communication), places the lophophorates firmly in the protostomes. It certainly now seems to be very difficult to homologize the lophophores of the lophophorates and deuterostome pterobranchs. Their similarity now becomes convergent. Should we accept the recent proposal[2] that the tentacular lophophore was a primitive protostome feature and was lost in the annelids and molluscs? This hypothesis may be difficult to reconcile with the widely accepted derivation of molluscs from a turbellarian ancestor, especially if the halkieriids represent an intermediate condition[5]. In this alternative scheme, the lophophore is a relatively late acquisition first appearing in the brachiopods, which themselves may derive from either a halkieriid worm or near relative.

Simon Conway Morris
Department of Earth Sciences,
University of Cambridge,
Cambridge CB2 3EQ, UK

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Crust formation in the Lewisian

SIR — Burton *et al.*[1] have presented U–Pb and Sm–Nd mineral regression ages on rocks from the Lewisian complex at Gruinard Bay, which apparently require that "the history of crustal development in the Lewisian complex will have to be radically rethought"[2]. They[1] consider that their data provide information about "... how the earliest continental crust may have formed", despite being 600 Myr younger than the earliest substantial continental crust[3]. Furthermore, previous geochronology on mafic–ultramafic complexes (~ 2,900 Myr, $\varepsilon_{Nd}t = +2$), which could also be a potential source[4], has been ignored.

A Pb–Pb age for the northern-region granodiorites[5], considered to be spurious[6], has been used (Fig. 2*b* of ref. 1), despite the observation that this suite does not fit the Nd evolution model (Fig. 2*a* of ref. 1). The latter point is explained partly on the basis of "... unusually low ..."[1] $f_{Sm/Nd}$ values, but these are indistinguishable from the Scourie gneisses (−0.507 versus −0.486; ref. 5). Trondhjemite mineral regression data[1] are also assumed to be magmatic protolith ages because they fall on the Pb and Nd isotope evolution trends for the proposed tonalite, trondhjemite and granodiorite (TTG) precursor, whereas previously published whole-rock ages of 2,800 to 3,000 Myr (Sm–Nd[4,7] and Pb–Pb[6]) are "... considered simply to reflect the age of the mantle source"[1]. How can the trondhjemite whole-rock age reflect the age of a source through two magmatic events (derivation of TTG precursor followed by trondhjemite production)? If the whole-rock ages reflect only the age of the TTG precursor, why are these not 3,310 Myr?

M. B. Fowler, C. R. L. Friend
Geology and Cartography Division,
Oxford Brookes University,
Headington, Oxford OX3 0BP, UK
M. J. Whitehouse
Department of Earth Sciences,
Parks Road, Oxford OX1 3PR, UK

BURTON *ET AL.* REPLY — The comments of Fowler *et al.* give us no cause to change our views, for the reasons outlined in our original manuscript[1].

Fowler *et al.* suggest that mafic–ultramafic complexes in the high-grade part of this terrain, to which they assign an age of ~2,900 Myr, may also be a potential source of the tonalite, trondhjemite and granodiorite rock types. In fact, five mafic–ultramafic complexes have been dated, and these give $^{147}Sm–^{144}Nd$ ages ranging from 2,600 to 2,900 Myr and $\varepsilon_{Nd}t$ values around +2 (refs 4, 8). Clearly, those that give ages around 2,600 to 2,700 Myr cannot have been a source for the Scourian tonalites ($\varepsilon_{Nd}t = -2$), as they are contemporaneous, and yet show a significant difference in ε_{Nd} at the time of regional metamorphism recorded by the tonalites. It might be claimed that the oldest of these bodies could be a potential source, but the implied evolution from mafic–ultramafics at 2,900 Myr to regional metamorphism at 2,600 Myr requires a $^{147}Sm/^{144}Nd$ ratio of 0.0834, unreasonably low for the average continental crust. Although a few (4 of 17) of the Scourie tonalites do indeed possess such low $^{147}Sm/^{144}Nd$ ratios, these result from the fractionation of Sm/Nd during regional granulite metamorphism[7], which occurred after their formation. Moreover, as noted previously[8], the data suggest that the older ages of around 2,900 Myr result from contamination and mixing with the pre-existing tonalites, in which case any isotopic correlation will have no time significance.

With regard to the northern-region granodiorite data, neither the Pb–Pb nor the Sm/Nd ages were used to construct the best-fit lines shown, but were included as they are discussed in the text. We are sorry that this was not made clear in our paper. The Pb–Pb age for these rocks proposed by Whitehouse[5] was later considered to be spurious on the grounds that some of these samples had experienced extreme uranium depletion[6]. The same samples have very low Sm/Nd ratios, which suggests that they may also have undergone Sm/Nd fractionation similar to that experienced by the Scourian tonalites. The fact that these samples show similar Sm/Nd ratios to those that have experienced granulite metamorphism clearly illustrates this point. If the authors wish to place some significance on the derived age estimate (note that the data do not define an isochron; MSWD = 8.3), then they are guilty of exactly what they have criticized others for[7,9] — that is,

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