

A Legacy in Fossils: a Tribute to Stan Wood – Preface

Nicholas C. Fraser¹, Timothy R. Smithson² and Jennifer A. Clack²

¹ Department of Natural Sciences, National Museums Scotland, Chambers Street, Edinburgh EH1 1JF, UK.

² University Museum of Zoology, Downing Street, Cambridge CB2 3EJ, UK.

ABSTRACT: Stan Wood had a gift for finding exceptional Early Carboniferous fossils. Among them are 32 type specimens. His discoveries significantly changed our understanding of the history of life on Earth. Many of the fossils he collected are on display in museums across the UK and the localities he discovered continue to yield important new material. Here we briefly review some of Stan Wood's key achievements and describe the legacy he left.



KEY WORDS: arthropods, Early Carboniferous, fishes, localities, tetrapods, type specimens.

When Stan Wood first began looking for fossils in 1969, Carboniferous vertebrate palaeontology in the UK was based almost entirely on the re-study of fossils collected from the spoil heaps of 19th-century coal, ironstone and oil shale workings. In a career lasting more than 40 years, Stan demonstrated time and again that fossils were not restricted to those deposits of economic importance, but could be found wherever there was a Carboniferous outcrop. He collected from the banks and beds of rivers and streams, from quarries and open cast coal mines, and from the cliffs and tidal reaches of the coast. He discovered many new localities across the Midland Valley and in the Scottish Borders (**Smithson & Rolfe this volume**) and revealed the new potential of old and often neglected localities. The significance of these discoveries is perhaps most readily appreciated by the number of letters to *Nature* that were based on them (seven). Almost without knowing it, Stan established Scotland as the centre of Early Carboniferous palaeobiology.

Stan registered nearly 4700 vertebrate specimens in his collection catalogue, together with 833 invertebrates and 69 plants. Many of them were new taxa. He collected everything he found, but had a particular interest in sharks, actinopterygians and tetrapods. His shark specimens included rare whole-body fossils from the early Viséan, the late Viséan and the Serpukhovian that are now providing evidence of the origins of the modern chondrichthyan fauna. He collected actinopterygians throughout the Early Carboniferous, from the restricted faunas of the Tournaisian to the rich diversity of the Viséan and Serpukhovian. His tetrapod finds attracted the greatest public attention and revealed, for the first time, an unexpected diversity of terrestrial vertebrate communities in the Early Carboniferous. His discoveries at East Kirkton Quarry extended the known range of crown group tetrapods, by more than 15 my, into the Early Carboniferous.

The fossils Stan Wood collected are on display in museums across the UK. So far, his discoveries have provided research opportunities for three generations of palaeontologists, prompting new insights into the morphology, phylogeny and evolution of vertebrates. Many new taxa have been named in his honour and a new fund to promote field work, The Stanley Wood

Award, has recently been established by The Palaeontology Association.

Here, by way of an introduction to this collection of papers in his honour, we briefly set out some of Stan's key achievements and describe the legacy he has left, linking each paper in the volume to the various stages in Stan's life and career.

1. Results

1.1. The localities

Stan began his collecting career searching for fossil fish in the oil shales around Edinburgh, first along the southern shore of the Firth of Forth (Wood 1975) and then at inland sites in West Lothian. Although the sites were well known and had yielded a rich variety of taxa in the past, Stan discovered many new specimens of known as well as new taxa. Among them was an important collection of Early Carboniferous sharks. This formed the basis of John Dick's PhD research with Alec Panchen at the University of Newcastle upon Tyne, and it is a collection that is still yielding important insights into the morphology and relationships of chondrichthyans (**Coates & Tietjen this volume**).

But Stan made his name as a fossil collector by discovering and excavating new sites. The first of these was the Dora Opencast Site, near Cowdenbeath, in Fife (Andrews *et al.* 1977). Here, Stan discovered his first Carboniferous tetrapods. The anthracosaurs formed the basis of Tim Smithson's PhD research with Alec Panchen, but the most spectacular find was an articulated and near complete specimen of the aberrant early tetrapod *Crassigyrinus scoticus*, which was studied by Alec himself (Panchen 1985). This specimen continues to be a source of new information (**Clack *et al.* this volume**) but, despite being one of the best known Early Carboniferous tetrapods, the relationships of *Crassigyrinus* remain uncertain (**Clack *et al.* this volume**). A novel demonstration of the significance of Stan's discoveries at Dora is the diorama of the site used as the cover illustration of Bob Carroll's most recent book *The Rise of Amphibians* (Carroll 2009), with Mike Coates' life restoration of *Crassigyrinus* a central figure.

Following an excavation at Foulden (Wood & Rolfe 1985), Stan made a spectacular discovery in the banks of the Manse Burn at Bearsden, near Glasgow (Wood 1982). Here, he found an extraordinarily rich fauna of beautifully preserved fishes and crustaceans. The actinopterygians formed the basis of Mike Coates' PhD research with Alec Panchen, and the crustaceans were studied by Neil Clark for a PhD with Ian Rolfe and Christopher Burton at the University of Glasgow. But the site is best known for its fossil sharks, including the most famous *Akmonistion zangerli* (Coates & Sequiera 2001), with its remarkable 'shaving brush' dorsal fin spine. Its discovery was the subject of two poems by the Scottish poet Edwin Morgan – *Carboniferous* (Morgan 1984) and *The Bearsden Shark* (Morgan 2010) – and a restoration by Mike Coates was used by Stan as part of the logo for his business, Mr Wood's Fossils.

Stan followed up his discoveries at Bearsden with unexpected finds in the East Kirkton Limestone. This is a well-known deposit which had yielded important eurypterid fossils in the past (Hibbert 1836), but fossil vertebrates had never been found. What Stan unearthed was the earliest record of an upland fauna. It included tetrapods, arachnids and myriapods in a unique environmental setting (Wood *et al.* 1985). Most of the fossils he found were new taxa (see Table 1). Amongst them are the earliest known members of many major tetrapod groups, including, anthracosaurs, microsaur and temnospondyls. He also discovered *Westlothiana lizziae*, initially thought to be the earliest known reptile (Smithson 1989), but which in most phylogenetic analyses is now placed on the amniote stem (Clack 2012). Stan's discoveries at East Kirkton revealed, for the first time, tetrapod diversity away from the coal swamps. Here, amongst the vegetated uplands of equatorial Scotland were some of the earliest-known members of the groups from which the modern tetrapod fauna evolved.

Stan's discoveries at Dora, Bearsden and East Kirkton were celebrated in a very popular travelling exhibition, designed and curated by the Hunterian Museum, Glasgow, entitled *Mr Wood's Fossils* (Sandy 1987; Morgan 2015). It was opened in 1986 by Sir David Attenborough and was hosted by a number of museums across the UK in the following three years. The exhibition brought Stan's achievements to the attention of a much wider audience and with it, invitations to speak to local geological clubs and societies across the country.

East Kirkton kept Stan busy for many years. It was a hard act to follow, but in the mid-1990s he finally realised a long-held ambition to collect in the Glencartholm fishbeds (Smithson & Rolfe *this volume*; Wood *this volume*). He excavated a new site, Mumbie Quarry, a few hundred metres from the original outcrop. In a section 18 metres thick, he identified three distinct fish beds and discovered further fossiliferous horizons throughout the sequence (Wood *this volume*). One horizon at the top of the section contained horseshoe crabs. These have not previously been reported from Glencartholm. Little of this important collection has yet been studied, but what has been published (Coates & Gess 2007; Finarelli & Coates 2012, 2014) suggests that the new material will provide important new information on the morphology and relationships of Early Carboniferous fishes and arthropods.

In the last ten years of his collecting career, Stan opened up sites which continue to be explored by others. The first of these was Tantallon, on the East Lothian coast near North Berwick. Material had been collected from the area in the 1970s, including a partial tetrapod jaw (Chen *et al.* *this volume*), but the precise location of the fossil beds had not been recorded. The site was rediscovered by Stan in 1999 (Smithson & Rolfe *this volume*) and new material has been collected from it recently as

part of the Tetrapod World: early evolution and diversification (TW:eed) Project.

The second was Whitrope Burn, near Hawick in the Scottish Borders (Richards *et al.* *this volume*). Vertebrate fossils had not been found in this area previously and its potential is only now beginning to be realised.

The third site is Willie's Hole on Whiteadder Water, near Chirnside in Berwickshire (Smithson *et al.* 2012). Stan discovered three distinct fossiliferous horizons at this site, each with a different fauna. The material was found in the bed of the river and Stan collected as much as he could between 2008 and 2009, before the dip of the beds and the depth of water defeated him. His collection includes numerous new tetrapods (Clack *et al.* 2016; Smithson & Clack *this volume*), a new lungfish (Smithson *et al.* 2016), and five different millipedes (Ross *et al.* *this volume*), together with exquisitely preserved actinopterygians, disarticulated rhizodonts, and crustaceans and scorpions.

A large-scale excavation was undertaken in 2015 as part of the TW:eed Project, which involved damming part of the river and carefully removing more than 2500 kg of rock. Preliminary analysis has already identified many new vertebrate specimens, including tetrapods, together with numerous crustaceans and a large scorpion with at least one intact pedipalp.

Stan's endeavours at Willie's Hole were included in another travelling exhibition, this time designed and curated by National Museums Scotland, entitled *Fossil Hunters: Unearthing the Mystery of Life on Land*. It opened at the National Museum of Scotland in 2016 and showcased the results of the TW:eed Project. It was one of the most popular temporary exhibitions at the Museum and once again revealed the extraordinary power that Stan's discoveries have to fire people's interest and wonder in the world of fossils.

1.2. The collection

Stan registered more than 5500 specimens in his collection catalogue. Amongst them are 32 type specimens. Eight have been named in his honour (Table 1). We anticipate that new names will be added to this list as specimens he collected from Mumbie Quarry and Willie's Hole are described.

Many of Stan's specimens are on display in museums across the UK, notably the National Museum of Scotland, Edinburgh, the Hunterian Museum, Glasgow and the University Museum of Zoology, Cambridge. Many others continue to be studied in the UK, Europe and North America.

The specimens Stan collected have added greatly to our understanding of the morphology, relationships and evolution of life during the Carboniferous. His collecting encompassed the entire Early Carboniferous from the Tournaisian to the Serpukovian, and from marine to terrestrial environments. It has provided sustained evidence of how the vertebrate fauna recovered after the end-Devonian extinction and how the surviving taxa diversified to fill the gaps in ecospace created by this extinction (Clack *et al.* 2016). The importance of this period in Earth's history is only now becoming clear (e.g., Sallan 2014) and future work based on the material Stan collected is expected to add greatly to our understanding of the foundations of the modern vertebrate fauna.

1.3. The people

Stan took a great pleasure in seeing people working on the specimens he had collected. He was particularly keen to help young researchers at the start of their careers and was very proud of the copies of the PhD theses he received in thanks from Neil Clark, Mike Coates, John Dick and Tim Smithson. Since these early PhD studies, Stan's discoveries have been

Table 1 A list of new taxa based on type specimens collected by Stan Wood. New taxonomic names shown in bold type.

Name	Locality	Museum	Reference
Vertebrata			
Actinopterygii			
<i>Mesopoma carricki</i>	Bearsden	Hunterian Museum Glasgow	Coates 1993
<i>Mesopoma smithsoni</i>	Bearsden	National Museums Scotland	Coates 1993
<i>Mesopoma pancheni</i>	Bearsden	National Museums Scotland	Coates 1993
<i>Frederichthys musadentatus</i>	Bearsden	Hunterian Museum Glasgow	Coates 1993
<i>Melanecta aneae</i>	Bearsden	Hunterian Museum Glasgow	Coates 1998
<i>Woodichthys bearsdeni</i>	Bearsden	National Museums Scotland	Coates 1998
Chondrichthyes			
<i>Onychoselache traquairi</i>	Glencartholm	National Museums Scotland	Dick 1978
<i>Diplodolaelachi woodi</i>	Wardie	National Museums Scotland	Dick 1981
<i>Akmonistion zangerli</i>	Bearsden	Hunterian Museum Glasgow	Coates & Sequeira 2001
<i>Whitropus longicalcus</i>	Whitrope Burn	National Museums Scotland	Richards <i>et al.</i> this volume
<i>Deltodus tubineus</i>	Whitrope Burn	National Museums Scotland	Richards <i>et al.</i> this volume
Dipnoi			
<i>Ctenodus whitropei</i>	Whitrope Burn	National Museums Scotland	Smithson <i>et al.</i> 2016
<i>Ctenodus williei</i>	Willie's Hole	University Museum of Zoology	Smithson <i>et al.</i> 2016
<i>Xylognathus macrustenus</i>	Burnmouth	University Museum of Zoology	Smithson <i>et al.</i> 2016
Tetrapoda			
<i>Doragnathus woodi</i>	Dora	National Museums Scotland	Smithson 1980
<i>Proterogyrinus pancheni</i>	Dora	National Museums Scotland	Smithson 1986
<i>Westlothiana lizziae</i>	East Kirkton	National Museums Scotland	Smithson & Rolfe 1990
<i>Balanerpeton woodi</i>	East Kirkton	National Museums Scotland	Milner & Sequeira 1994
<i>Ophiderpeton kirktonense</i>	East Kirkton	National Museums Scotland	Milner 1994
<i>Sivanerpeton miripedes</i>	East Kirkton	National Museums Scotland	Clack 1994
<i>Eldeceon rolfei</i>	East Kirkton	National Museums Scotland	Smithson 1994
<i>Eucritta melanolimnetes</i>	East Kirkton	University Museum of Zoology	Clack 1998
<i>Kirktonecta milnerae</i>	East Kirkton	University Museum of Zoology	Clack 2011
<i>Diploradus austiumensis</i>	Burnmouth	University Museum of Zoology	Clack <i>et al.</i> 2016
<i>Perittodus apscoditus</i>	Willie's Hole	University Museum of Zoology	Clack <i>et al.</i> 2016
<i>Koilops herma</i>	Willie's Hole	National Museums Scotland	Clack <i>et al.</i> 2016
<i>Mesanerpeton woodi</i>	Willie's Hole	National Museums Scotland	Smithson & Clack this volume
Arthropoda			
Arachnida			
<i>Pulmonoscorpium kirktonensis</i>	East Kirkton	National Museums Scotland	Jeram 1994
<i>Brigantibunum listoni</i>	East Kirkton	Hunterian Museum Glasgow	Dunlop & Anderson 2005
Xiphosura			
<i>Rolfeia fouldenensis</i>	Foulden	National Museums Scotland	Waterston 1985
<i>Incertae sedis</i>			
<i>Polyurida aenigmatica</i>	Foulden	National Museums Scotland	Almond 1985
Plantae			
Gymnospermae			
<i>Stanwoodia kirktonensis</i>	East Kirkton	Hunterian Museum Glasgow	Galtier & Scott 1991

incorporated into a number of post-graduate research projects, including those by Ian Goodacre with Nigel Trewin at Aberdeen; Elisabeth Pringle, Esther Sharp and Ben Otoo with Jenny Clack at Cambridge; Lauren Sallan with Mike Coates at Chicago; Janet Sherwin with Sarah Davies at Leicester; and Eva Herbst with John Hutchinson at the Royal Veterinary College.

Stan's excavations at Foulden, Bearsden and East Kirkton brought him into contact with the wider international palaeontology community and he helped many track down old Scottish localities and find new material (Smithson & Rolfe **this volume**). Stan's discoveries also provided a stimulus to established and new research groups to undertake macro-evolutionary analyses, particularly on the interrelationships of early tetrapods (e.g., Panchen & Smithson 1988; Ruta *et al.* 2003, 2006; Coates *et al.* 2008).

Although Stan's field exploits were focused entirely in the UK, they had ramifications on an international scale. Admirers of his work include John Long, who has published widely on the famed Gogo fishes from the Devonian of Western Australia (Long & Trinajstić **this volume**); and John is just one of many palaeontologists around the world who have drawn inspiration from Stan and his discoveries.

2. Conclusions

During a career that spanned more than 40 years, Stan Wood had a profound impact on British palaeontology. His discoveries invigorated research on Early Carboniferous vertebrates and significantly changed our understanding of the morphology, relationships and evolution of chondrichthyans, bony fishes and

tetrapods. His collaboration with researchers in museums and universities was the catalyst for a number of multidisciplinary projects. The excavations at Foulden and East Kirkton resulted in two special volumes published by the Royal Society of Edinburgh in 1985 (*TRSE:ES* volume 76.1: 'The Dinantian of Foulden') and 1994 (*TRSE:ES* volume 84.2/3: 'Volcanism and Early Terrestrial Biotas'). This current volume, more than 30 years after the first, confirms both the scale of Stan's achievements and the enduring impact his collecting has had on British palaeontology. Perhaps Sir David Attenborough puts Stan's work into true perspective. When commenting on his feats at the 'Willie's Hole' locality near Chirnside, Sir David said:

"Stan Wood's discoveries at Willie's Hole are indeed remarkable and of great importance. One is accustomed these days to hear of sensational new fossil finds being made in parts of the world – China, Mongolia, Siberia, Morocco, Brazil – where few palaeontologists have worked before. But to learn of a site in this country, where after all the basics of geological science were first established nearly two hundred years ago and which must surely be counted among the most extensively explored, in geological terms, of any part of the world, is wonderful and exciting. The fact that they shed light on a part of geological history that hitherto has been almost blank makes Stan Wood's discoveries of world-wide importance"

3. Acknowledgements

We thank Mike Coates for reading and commenting on an early version of the manuscript, Maggie Wood for information on Stan's collection and Ian Rolfe for introducing us to the poems of Edwin Morgan.

4. References

- Almond, J. E. 1985. A vermiform problematicum from the Dinantian of Foulden, Berwickshire, Scotland. *Transactions of the Royal Society of Edinburgh: Earth Sciences* **76**, 41–48.
- Andrews, S. M., Browne, M. A. E., Panchen, A. L. & Wood, S. P. 1977. Discovery of amphibians in the Namurian (Upper Carboniferous) of Fife. *Nature* **265**, 529–32.
- Carroll, R. L. 2009. *The Rise of Amphibians: 365 Million Years of Evolution*. Baltimore: The Johns Hopkins University Press. 392 pp.
- Clack, J. A. 1994. *Silvanerpeton miripedes*, a new anthracosauroid from the Viséan of East Kirkton, West Lothian, Scotland. *Transactions of the Royal Society of Edinburgh: Earth Sciences* **84**, 369–76.
- Clack, J. A. 1998. A new Lower Carboniferous tetrapod with a mélange of crown group characters. *Nature* **394**, 66–69.
- Clack, J. A. 2011. A new microsauroid from the Early Carboniferous (Viséan) of East Kirkton, Scotland, showing soft tissue evidence. *Special Papers in Palaeontology* **86**, 45–56.
- Clack, J. A. 2012. *Gaining Ground: The origin and evolution of tetrapods*. Second Edition. Indiana: Indiana University Press. 544 pp.
- Clack, J. A., Bennett, C. E., Carpenter, D. K., Davies, S. J., Fraser, N. C., Kearsley, T. I., Marshall, J. E. A., Millward, D., Otoo, B. K. A., Reeves, E. J., Ross, A. J., Ruta, M., Smithson, K. Z., Smithson, T. R. & Walsh, S. A. 2016. Phylogenetic and environmental context of a Tournaisian tetrapod fauna. *Nature Ecology and Evolution* **1** DOI: 10.1038/s41559-016-0002.
- Coates, M. I. 1993. New actinopterygian fish from the Namurian Manse Burn Formation of Bearsden, Scotland. *Palaeontology* **36**, 123–46.
- Coates, M. I. 1998. Actinopterygians from the Namurian of Bearsden, Scotland, with comments on early actinopterygian neurocrania. *Zoological Journal of the Linnean Society* **122**, 27–59.
- Coates, M. I., Ruta, M. & Friedman, M. 2008. Ever since Owen: changing perspectives on the early evolution of tetrapods. *Annual Review of Ecology, Evolution and Systematics* **39**, 571–92.
- Coates, M. I. & Gess, R. W. 2007. A new reconstruction of *Onychoselache traquairi*, comments on early chondrichthyan pectoral girdles and hybodont phylogeny. *Palaeontology* **50**, 1421–46.
- Coates, M. I. & Sequeira, S. E. K. 2001. A new stethacanthid chondrichthyan from the Lower Carboniferous of Bearsden, Scotland. *Journal of Vertebrate Paleontology* **21**, 438–59.
- Dick, J. R. F. 1978. On the Carboniferous shark *Tristychius arcuatus* Agassiz from Scotland. *Transactions of the Royal Society of Edinburgh* **70**, 63–109.
- Dick, J. R. F. 1981. *Diplodoselache woodi* gen. et sp. nov., an Early Carboniferous shark from the Midland Valley of Scotland. *Transactions of the Royal Society of Edinburgh: Earth Sciences* **72**, 99–114.
- Dunlop, J. A. & Anderson, L. I. 2005. A fossil harvestman (Arachnida, Opiliones) from the Mississippian of East Kirkton, Scotland. *Journal of Arachnology* **33**, 482–89.
- Finarelli, J. A. & Coates, M. I. 2012. First tooth-set outside the jaws in a vertebrate. *Proceedings of the Royal Society, London, Series B: Biological Sciences* **279**, 775–79.
- Finarelli, J. A. & Coates, M. I. 2014. *Chondrenchelys problematica* (Traquair, 1888) redescribed: a Lower Carboniferous, eel-like holocephalan from Scotland. *Earth and Environmental Science Transactions of the Royal Society of Edinburgh* **105**, 35–59.
- Galtier, J. & Scott, A. C. 1991. *Stanwoodia*, a new genus of probable early gymnosperms from the Dinantian of East Kirkton, Scotland. *Transactions of the Royal Society of Edinburgh: Earth Sciences* **82**, 113–23.
- Hibbert, S. 1836. On the freshwater limestone of Burdiehouse in the neighbourhood of Edinburgh, belonging to the Carboniferous group of rocks. With supplementary notes on other freshwater limestones. *Transactions of the Royal Society of Edinburgh* **13**, 169–282.
- Jeram, A. J. 1994. Scorpions from the Viséan of East Kirkton, West Lothian, Scotland, with a revision of the infraorder Mesoscorpionina. *Transactions of the Royal Society of Edinburgh: Earth Sciences* **84**, 283–99.
- Milner, A. C. 1994. The aistopods from the Viséan of East Kirkton, West Lothian, Scotland. *Transactions of the Royal Society of Edinburgh: Earth Sciences* **84**, 363–68.
- Milner, A. R. & Sequeira, S. E. K. 1994. The temnospondyl amphibians from the Viséan of East Kirkton, West Lothian, Scotland. *Transactions of the Royal Society of Edinburgh: Earth Sciences* **84**, 331–62.
- Morgan, E. 1984. *Sonnets from Scotland*. Glasgow: Mariscat Press.
- Morgan, E. 2010. *Dreams and Other Nightmares: New and Uncollected Poems 1954–2009*. Glasgow: Mariscat Press.
- Morgan, E. 2015. *The Midnight Letterbox: Selected Correspondence, 1950–2010*. McGonigal, J. & Coyle, C. (eds.) Manchester: Carcanet Press.
- Panchen, A. L. 1985. On the amphibian *Crassigyrinus scoticus* Watson from the Carboniferous of Scotland. *Philosophical Transactions of the Royal Society, London, Series B* **309**, 461–568.
- Panchen, A. L. & Smithson, T. R. 1988. The relationships of the earliest tetrapods. In Benton, M. J. (ed.) *The Phylogeny and Classification of the Tetrapods 1 Amphibians, reptiles, Birds*, 1–32. Oxford: Clarendon Press. 392 pp.
- Ruta, M., Coates, M. I. & Quicke, D. L. J. 2003. Early tetrapod relationships revisited. *Biological Reviews* **78**, 251–345.
- Ruta, M., Wagner, P. J. & Coates, M. I. 2006. Evolutionary patterns in early tetrapods. 1. Rapid initial diversification followed by decrease in rates of character change. *Proceedings of the Royal Society, London, Series B: Biological Sciences* **273**, 2107–11.
- Sallan, L. C. 2014. Major issues in the origins of ray-finned fish (Actinopterygii) biodiversity. *Biological Reviews* **89**, 950–71.
- Sandy, M. R. 1987. Exhibition Review: Mr Wood's Fossils – A Travelling Exhibition. *The Geological Curator* **4**, 502.
- Smithson, T. R. 1980. A new labyrinthodont amphibian from the Carboniferous of Scotland. *Palaeontology* **23**, 915–23.
- Smithson, T. R. 1986. A new anthracosauroid from the Carboniferous of Scotland. *Palaeontology* **29**, 603–28.
- Smithson, T. R. 1989. The earliest known reptile. *Nature* **314**, 676–78.
- Smithson, T. R. 1994. *Eldeceeon rolfei*, a new reptiliomorph from the Viséan of East Kirkton, West Lothian, Scotland. *Transactions of the Royal Society of Edinburgh: Earth Sciences* **84**, 377–82.
- Smithson, T. R., Wood, S. P., Marshall, J. E. A. & Clack, J. A. 2012. Earliest Carboniferous tetrapod and arthropod faunas from Scotland populate Romer's Gap. *Proceedings of the US National Academy of Sciences* **109**, 4532–37.
- Smithson, T. R., Richards, K. R. & Clack, J. A. 2016. Lungfish diversity in Romer's Gap: reaction to the end-Devonian extinction. *Palaeontology* **59**, 29–44.
- Smithson, T. R. & Rolfe, W. D. I. 1990. *Westlothiana* gen. nov.: naming the earliest known reptile. *Scottish Journal of Geology* **26**, 137–38.

- Waterston, C. D. 1985. Chelicerata from the Dinantian of Foulden, Berwickshire, Scotland. *Transactions of the Royal Society of Edinburgh: Earth Sciences* **76**, 25–34.
- Wood, S. P. 1975. Recent discoveries of Carboniferous fishes in Edinburgh. *Scottish Journal of Geology* **11**, 251–58.
- Wood, S. P. 1982. New basal Namurian (Upper Carboniferous) fishes and crustaceans found near Glasgow. *Nature* **297**, 574–77.
- Wood, S. P., Panchen, A. L. & Smithson, T. R. 1985. A terrestrial fauna from the Scottish Lower Carboniferous. *Nature* **314**, 355–56.
- Wood, S. P. & Rolfe, W. D. I. 1985. Introduction to the palaeontology of the Dinantian of Foulden, Berwickshire, Scotland. *Transactions of the Royal Society of Edinburgh: Earth Sciences* **76**, 1–6.
-