**List of taxa, geological time, and references in Zhu et al. (2022)**

*Acanthodes bronni*, Sakmarian to Asselian (BrazeauM and Valerie, 2015; Coates, 1994; Davis et al., 2012; Gross, 1935; Miles, 1973a; b; Watson, 1937)

*Aceraspis robustus*, upper Wenlock to upper Ludlow (Ritchie, 1967; Turner and Turner, 1974)

*Achoania jarvikii*, upper Lochkovian (Zhu and Yu, 2004; 2009; Zhu et al., 2001)

*Acronemus tuberculatus*, Anisian to Ladinian (Maisey, 2011)

*Akmonistion zangerli*, Serpukhovian (Coates and Sequeira, 1998; 2001; Coates et al., 1998)

*Andreolepis hedei*,Ludlow and Pridoli (Chen et al., 2016a)

*Anglaspis maccoulloughi*, Pridoli and Lochkovian (Randle and Sansom, 2016)

*Arabosteus variabilis*, Pragian to lower Emsian (Olive et al., 2011; 2014)

*Asterolepis ornate*, upper Givetian (Lukševičs, 2001; Upeniece, 2001; Vaskaninova, 2009)

*Austroptyctodus gardineri*, lower Frasnian (Long, 1997)

*Bannhuanaspis vukhuci*, upper Lochkovian to lower Pragian (Janvier et al., 1993)

*Benneviaspis holtedahli*,Lochkovian (Janvier, 1985; Ørvig, 1957)

*Boreaspis macrorhynchus*,Pragian (Janvier, 1985)

*Bothriolepis* spp., Givetian to Famennian (Long and Trinajstic, 2010)

*Brachyacanthus scutiger*, Lockhovian (Watson, 1937)

*Brindabellaspis stensioi*, lower Emsian to lower Eifelian (Young, 1980)

*Brochoadmones milesi*, Lockhovian (Hanke and Wilson, 2006)

*Buchanosteus confertituberculatus*, Emsian (Burrow and Turner, 1998; Long et al., 2014)

*Campbellodus decipiens*, lower Frasnian (Long, 1997)

*Cassidiceps vermiculatus*, Lockhovian (Gagnier and Wilson, 1996)

*Cephalaspis lyelli*, Lochkovian (Stensiö, 1932; White, 1958)

*Cheirolepis trailli*, upper Eifelian (Giles et al., 2015a; Pearson and Westoll, 1979)

*Cheirolepis canadensis*, lower Frasnian (Arratia and Cloutier, 1996; Pearson and Westoll, 1979)

*Cheiracanthus* spp.*,* Eifelian to Givetian (Burrow et al., 2020)

Chimaeroidei, Serpukhovian to present (Didier, 1995)

*Chondrenchelys problematica*, Visean (Finarelli and Coates, 2011; 2014; Moy-Thomas, 1935)

*Chuchinolepis dongmoensis*, lower Pragian (Tông-Dzuy and Janvier, 1990)

*Cladodoides wildungensis*, upper Famennian (Maisey, 2005)

*Cladoselache kepleri*, upper Famennian (Bendix-Almgreen, 1975; Maisey, 2007; Schaeffer, 1981)

*Climatius reticulatus*, Lochkovian (Miles, 1973a; Watson, 1937)

*Cobelodus aculeatus*, Sakmarian (Ivanov, 2005)

*Coccosteus cuspidatus*, Eifelian to Givetain (Miles and Westoll, 1968)

*Compagopiscis croucheri*,lower Frasnian (Gardiner and Miles, 1994)

*Cowralepis mclachlani*, upper Givetian or lower Frasnian (Ritchie, 2005)

*Culmacanthus stewarti*, Frasnian (Long, 1983)

*Damocles serratus*, Serpukhovian (Lund, 1986; Lund and Grogan, 1997)

*Dartmuthia gemmifera*, lower Ludlow (Gross, 1968; Märss et al., 2015)

*Debeerius ellefseni*, Bashkirian (Grogan and Lund, 2000)

*Diabolepis speratus*, upper Lochkovian (Chang, 1995; Chang and Yu, 1984)

*Diandongpetalichthys liaojiaoshanensis*, lower Lochkovian (Zhu, 1991)

*Dialipina salgueiroensis*,Emsian (Schultze, 1968; Schultze and Cumbaa, 2001)

*Dicksonosteus arcticus*, Lochkovian (Goujet, 1975; Goujet, 1984)

*Diplacanthus striatus*, lower Givetian (Miles, 1973a; Watson, 1937)

*Diplocercides* spp.*,* Givetian to Famennian (Forey, 1998)

*Diplodoselache woodi*, Visean (Dick, 1981)

*Dipterus* spp.*,* Eifelian to Givetian (Ahlberg and Trewin, 1995; White, 1965)

*Doliodus problematicus*, lower Emsian (Maisey et al., 2009; Miller et al., 2003)

*Dwykaselachus oosthuizeni*, Kungurian (Coates et al., 2017)

*Eastmanosteus calliaspis*, lower Frasnian (Dennis-Bryan, 1987)

*Egertonodus basanus*, Aptian (Teng et al., 2019)

*Ellopetalichthys scheii*, upper Givetian (Castiello, 2018)

*Entelognathus primordialis*, Ludfordian (Zhu et al., 2013)

*Epipetalichthys wildungensis*, upper Frasnian (Ørvig, 1957; Sallan and Coates, 2010)

*Escuminaspis laticeps*, lower Frasnian (Janvier et al., 2004)

*Eugaleaspis changi*, lower Lochkovian (Liu, 1965; Zhu and Gai, 2007)

*Eurycaraspis incilis*, Givetian (Liu, 1991)

*Eusthenopteron foordi*, lower Frasnian (Jarvik, 1980a; b)

*Euthacanthus macnicoli*, Lochkovian (Miles, 1973a; Newman et al., 2014; Watson, 1937)

*Falcatus falcatus*, Serpukhovian (Lund, 1985)

*Gavinia syntrips*, Givetian (Long, 1999)

*Gavinaspis convergens*, upper Lochkovian (Dupret et al., 2009)

*Gemuendina stuertzi*, upper Pragian to lower Emsian (Gross, 1963)

*Gladbachus adentatus*, Givetian (Coates et al., 2018)

*Gladiobranchus probaton*, Lochkovian (Hanke and Davis, 2008)

*Glyptolepis groenlandica*, upper Eifelian to lower Givetian (Ahlberg, 1989; Jarvik, 1972)

*Gogonasus andrewsae*, lower Frasnian (Holland, 2013; 2014; Long, 1985; Long et al., 1997; 2006)

*Groenlandaspis antarcticus*, Givetian (Ritchie, 1975; Young, 1989)

*Guangxipetalichthys tiaomajianensis*, lower to middle Givetian (Ji and Pan, 1997)

*Guiyu oneiros*, Ludfordian (Qiao and Zhu, 2010; Zhu et al., 2009)

*Gyracanthides* spp*.*, Famennian (Warren et al., 2000)

*Halimacanthodes ahlbergi*, lower Frasnian (Burrow et al., 2012)

*Hamiltonichthys mapesi*, Gzhelian (Maisey, 1989)

*Hanyangaspis guodingshanensis*, middle Telychian (Zhu and Gai, 2007)

*Helodus simplex*, Moscovian (Moy-Thomas, 1936)

*Hemicyclaspis murchisoni*, Ludlow (Stensiö, 1932)

*Holonema westolli*, lower Frasnian (Bechard et al., 2014)

*Homalacanthus concinnus*, lower Frasnian (Russell, 1951)

*Homalodontus aplopagus,* Lower Triassic (Mutter et al., 2007; 2008)

*Howqualepis rostridens*, Givetian (Long, 1988)

*Incisoscutum ritchiei*, lower Frasnian (Dennis and Miles, 1981; Giles et al., 2013)

*Iniopera richardsoni*, Moscovian to Kasimovian (Zangerl and Case, 1973)

*Ischnacanthus gracilis*, Lochkovian (Miles, 1973a; Watson, 1937)

*Jagorina pandora*, upper Frasnian (Stensiö, 1969; Young, 1986)

*Janusiscus schultzei*, middle Lockhovian (Giles et al., 2015c)

*Kansasiella eatoni*, upper Pennsylvanian (Poplin, 1975)

*Kathemacanthus rosulentus*, Lochkovian (Gagnier and Wilson, 1996; Hanke and Wilson, 2010)

*Kawichthys moodiei*, Gzhelian (Pradel et al., 2011)

*Kenichthys campbelli*, upper Emsian (Chang and Zhu, 1993; Zhu and Ahlberg, 2004)

*Kentuckia deani*, upper Tournaisian or lower Visean (Giles and Friedman, 2014; Rayner, 1951)

*Kimaspis tienshanica*, Lochkavian (Mark-Kurik, 1973)

*Kolymaspis sibirica,* Lochkavian (Bystrow, 1956)

*Kosoraspis peckai*, upper Lochkovian (Denison, 1978; Gross, 1959)

*Kujdanowiaspis podolica*, upper Lockhovian to lower Pragian (Dupret, 2010)

*Lawrenciella schaefferi*, upper Pennsylvanian (Hamel and Poplin, 2008)

*Ligulalepis toombsi*, Emsian (Basden and Young, 2001; Basden et al., 2000; Burrow, 1994; Schultze, 1968)

*Lophosteus superbus*, lower Ludlow (Burrow and Simpson, 1995; Pickett et al., 2000; Schultze and Märss, 2004)

*Lunaspis broili*, upper Pragian to lower Emsian (Gross, 1961)

*Macropetalichthys rapheidolabis*, Eifelian (Stensiö, 1925; 1963; 1969)

*Materpiscis attenboroughi*, lower Frasnian (Long et al., 2008; Trinajstic et al., 2012)

*Meemannia eos*, upper Lochkovian (Zhu et al., 2006; 2010)

*Mesacanthus mitchelli*, Lochkovian (Miles, 1973a; Watson, 1937)

*Microbrachius dicki*,middle Givetian (Hemmings, 1978; Long et al., 2015)

*Miguashaia bureaui*, lower Frasnian (Cloutier, 1996; Forey, 1998)

*Mimipiscis toombsi*, lower Frasnian (Gardiner, 1984; Gardiner and Bartram, 1977; Giles and Friedman, 2014)

*Minicrania lirouyii*,lower Lochkovian (Zhu and Janvier, 1996)

*Nectaspis areolate*, Emsian (Janvier, 1981)

*Moythomasia durgaringa*, lower Frasnian (Gardiner, 1984)

*Mulgaspis evansorum*, lower Eifelian (Janvier and Clément, 2005; Ritchie, 2004)

*Latviacanthus ventspilsensis*, Pragian (Schultze and Zidek, 1982)

*Lupopsyrus pygmaeus*, Lochkovian (Hanke and Davis, 2012)

*Nerepisacanthus denisoni*, upper Pridoli (Burrow and Rudkin, 2014)

*Norselaspis glacialis*, lower Pragian (Janvier, 1981)

*Notopetalichthys hillsi*, Middle Devonian (Woodward, 1941; Young, 2004)

*Obtusacanthus corroconis*, Lochkovian (Hanke and Wilson, 2004)

*Onychodus jandemarrai*, lower Frasnian (Andrews et al., 2005)

*Onychoselache traquari*, middle Visean (Coates and Gess, 2007; Dick and Maisey, 1980)

*Osorioichthys marginis*, lower Famennian (Taverne, 1997)

*Osteolepis macrolepidotus*, lower Givetian (Jarvik, 1980a; b; Thomson, 1965; Westoll, 1936)

*Ozarcus mapesae*, Serpukhovian (Pradel et al., 2014)

*Pampetalichthys longhuaensis*, lower Emsian (Zhu, 2000; Zhu and Wang, 1996)

*Parabuchanosteus murrumbidgeensis*, Pragian to Emsian (White and Toombs, 1972; Young, 1979)

*Parayunnanolepis xitunensis*,Lochkovian (Zhang et al., 2001; Zhu et al., 2012)

*Paucicanthus vanelsti*, Lochkovian (Hanke, 2002)

*Pauropetalichthys magnoculus*, Emsian (Pan et al., 2015)

*Polybranchiaspis liaojiaoshanensis*, Lochkovian (Liu, 1965; 1975)

*Procephalaspis oeselensis*, Wenlock and Ludlow (Denison, 1951)

*Psarolepis romeri*, Lockhovian (Yu, 1998; Zhu and Yu, 2004; 2009; Zhu et al., 1999)

*Parexus recurvus*, Lochkovian (Burrow et al., 2013; Miles, 1973a; Watson, 1937)

*Poracanthodes menneri*, lower Lochkovian (Valiukevicius, 1992)

*Porolepis* spp., Pragian to Emsian (Clément, 2004; Jarvik, 1972)

*Powichthys thorsteinssoni*, Lochkovian to Pragian (Jessen, 1980)

*Promesacanthus eppleri*, Lochkovian (Hanke, 2008)

*Pterichthyodes milleri*, upper Eifelian (Hemmings, 1978)

*Ptomacanthus anglicus*, Lochkovian (Brazeau, 2012; Dineley, 1999)

*Ptyctolepis brachynotus*, Pragian, (Lu et al., 2017)

*Pucapampella rodrigae*, upper Eifelian to Givetian (Maisey and Anderson, 2001)

*Qilinyu rostrata*, Ludfordian (Zhu et al., 2016)

*Qingmenodus yui*, upper Pragian (Lu and Zhu, 2010; Lu et al., 2016)

*Quasipetalichthys haikouensis*, Givetian (Liu, 1991)

*Sparalepis tingi*, Ludfordian (Choo et al., 2017)

*Radotina kosorensis*, Lochkovian (Vaškaninová and Ahlberg, 2017)

*Radotina tesselata*, Pragian (Gross, 1958; Vaškaninová and Ahlberg, 2017)

*Ramirosuarezia boliviana*, Eifelian (Pradel et al., 2009)

*Raynerius splendens*, Frasnian (Giles et al., 2015b)

*Remigolepis* spp*.*,Famennian (Andrews, 1978)

*Rhadinacanthus longispinus*, Emsian (Burrow et al., 2000)

*Rhamphodopsis threiplandi*, lower Givetian (Long, 1997; Miles, 1967)

*Romundina stellina*, Lochkovian (Dupret et al., 2014; Ørvig, 1975)

*Shearsbyaspis oepiki*, Emsian (Castiello, 2018; Young, 1985)

***Shenacanthus vermiformis***, Telychian, this paper

*Shuyu zhejiangensis*, middle to upper Telychian (Gai et al., 2011)

*Sigaspis lepidophora*, lower Pragian (Goujet, 1973)

*Sinolepis macrocephala*, Famennian (Liu and P'an, 1958; Ritchie et al., 1992)

*Sinopetalichthys kueiyangensis*, lower to middle Emsian (Zhao and Zhu, 2010)

*Squalus* spp.*,* Pliocene to present (Gans and Parsons, 1964)

*Styloichthys changae*, upper Lochkovian (Friedman, 2007; Zhu and Yu, 2002)

*Sudaspis chlupaci*, Lochkovian (Vaškaninová and Ahlberg, 2017)

*Synechodus dubrisiensis,* Upper Jurassic to Upper Cretaceous (Maisey, 1985)

*Tamiobatis vetustus*, Famennian (Schaeffer, 1981; Williams, 1998)

*Tetanopsyrus lindoei/breviacanthias*, Lochkovian (Gagnier et al., 1999; Hanke et al., 2001)

*Tlamaspis inopinatus*, Lochkovian (Vaškaninová and Ahlberg, 2017)

*Tremataspis mammillata*, Gorstian (Denison, 1947; 1951; Robertson, 1937; Robertson, 1938)

*Tribodus limae,* Albian (Lane, 2010; Lane and Maisey, 2009; 2012; Maisey and Denton, 2016)

*Triodus moorei,* Bashkirian to Changhsingian (Heidtke et al., 2004; Soler-Gijon and Hampe, 1998)

*Tristychius arcuatus*, lower Serpukhovian (Coates and Gess, 2007; Dick, 1978)

*Uraniacanthus curtus*, Lochkovian (Newman et al., 2012)

*Uranolophus wyomingensis*, Pragian (Denison, 1968)

*Vernicomacanthus waynensis*, Lochkovian (Miles, 1973a)

*Waengsjoeaspis excellens*, Lochkovian (Janvier, 1985)

*Wenshanaspis zhichangensis*, Pragian (Zhao et al., 2002)

*Widjeaspis warrooensis*, Middle Devonian (Barker and Bone, 1995; Basden, 1999)

*Wuttagoonaspis fletcheri*, Emsian to Eifelian (Ritchie, 1973)

***Xiushanosteus mirabilis****,* Telychian, this paper

*Youngolepis praecursor*, upper Lochkovian (Chang, 1982; 1991; Chang and Yu, 1981)

*Yunnanolepis* spp., Lochkovian (Zhang, 1980; Zhu, 1996)

*Zenaspis salweyi*, Lochkovian (Stensiö, 1932)

**Supplementary References**

Ahlberg, P. E., 1989. Paired fin skeletons and relationships of the fossil group Porolepiformes (Osteichthyes: Sarcopterygii). *Zool. J. Linn. Soc.* **96**: 119–166.

Ahlberg, P. E. and Trewin, N. H., 1995. The postcranial skeleton of the Middle Devonian lungfish *Dipterus valenciennesi*. *Earth Environ. Sci. Trans. R. Soc. Edinb.* **85**: 159–175.

Anderson, P. S. L., 2010. Using linkage models to explore skull kinematic diversity and functional convergence in arthrodire placoderms. *J. Morphol.* **271**: 990–1005.

Andrews, S. M., 1978. A possible occurrence of *Remigolepis* in the topmost Old Red Sandstone of Berwickshire. *Scott. J. Geol.* **14**: 311–315.

Andrews, S. M., Long, J. A., Ahlberg, P. E., Barwick, R. and Campbell, K. S. W., 2005. The structure of the sarcopterygian *Onychodus jandemarrai* n. sp. from Gogo, Western Australia: with a functional interpretation of the skeleton. *Earth Environ. Sci. Trans. R. Soc. Edinb*. **96**: 197–307.

Arratia, G. and Cloutier, R., 1996. Reassessment of the morphology of *Cheirolepis canadensis* (Actinopterygii). In: H.-P. Schultze and R. Cloutier (Editors), Devonian Fishes and Plants of Miguasha, Quebec, Canada. Verlag Dr Friedrich Pfeil, München, pp. 165–197.

Barker, C. E. and Bone, Y., 1995. The minimal response to contact metamorphism by the Devonian Buchan Caves Limestone, Buchan Rift, Victoria, Australia. *Org. Geochem.* **22**: 151–164.

Basden, A. M., 1999. Emsian (Early Devonian) microvertebrates from the Buchan and Taemas areas of southeastern Australia. *Rec. West. Aust. Mus. Suppl.* **57**: 15–21.

Basden, A. M. and Young, G. C., 2001. A primitive actinopterygian neurocranium from the Early Devonian of southeastern Australia. *J. Vertebr. Paleontol.* **21**: 754–766.

Basden, A. M., Young, G. C., Coates, M. I. and Ritchie, A., 2000. The most primitive osteichthyan braincase? *Nature* **403**: 185–188.

Bechard, I., Arsenault, F., Cloutier, R. and Kerr, J., 2014. The Devonian placoderm fish *Bothriolepis canadensis* revisited with three-dimensional digital imagery. *Palaeontol. Electron.* **17**: 1–19.

Bendix-Almgreen, S. E., 1975. The paired fins and shoulder girdle in *Cladoselache*, their morphology and phyletic significance. In: J. P. Lehman (Editor), Problèmes actuels de Paléontologie-Evolution des Vertébrés. Colloques Internationaux du Centre National de la Recherche Scientifique, Paris, pp. 111–123.

Brazeau, M. D., 2009. The braincase and jaws of a Devonian ‘acanthodian’ and modern gnathostome origins. *Nature* **457**: 305–308.

Brazeau, M. D., 2012. A revision of the anatomy of the Early Devonian jawed vertebrate *Ptomacanthus anglicus* Miles. *Palaeontology* **55**: 355–367.

Brazeau, M. D. and Valerie, D. W., 2015. The hyoid arch and braincase anatomy of *Acanthodes* support chondrichthyan affinity of 'acanthodians'. *Proc. R. Soc. B* **282**: 20152210.

Burrow, C. J., den Blaauwen, J. and Newman, M., 2020. A redescription of the three longest-known species of the acanthodian *Cheiracanthus* from the Middle Devonian of Scotland. *Palaeontol. Electron.* **23**: a15

Burrow, C. J., 1994. Form and function in scales of *Ligulalepis toombsi* Schultze, a palaeoniscoid from the Early Devonian of Australia. *Rec. West. Aust. Mus.* **27**: 175–185.

Burrow, C. J., 2011. A partial articulated acanthodian from the Silurian of New Brunswick, Canada. *Can. J. Earth Sci.* **48**: 1329–1341.

Burrow, C. J., Newman, M. J., Davidson, R. G. and Blaauwen, J. L. D., 2013. Redescription of *Parexus recurvus*, an Early Devonian acanthodian from the Midland Valley of Scotland. *Alcheringa* **37**: 393–414.

Burrow, C. J. and Rudkin, D., 2014. Oldest near-complete acanthodian: the first vertebrate from the Silurian Bertie Formation Konservat-Lagerstätte, Ontario. *PLoS One* **9**: e104171.

Burrow, C. J. and Simpson, A. J., 1995. A new ischnacanthid acanthodian from the Late Silurian (Ludlow, *ploeckensis* Zone) Jack Formation, north Queensland. *Mem. Queensl. Mus.* **38**: 383–395.

Burrow, C. J., Trinajstic, K. and Long, J. A., 2012. First acanthodian from the Upper Devonian (Frasnian) Gogo Formation, Western Australia. *Hist. Biol.* **24**: 349–357.

Burrow, C. J. and Turner, S., 1998. Devonian placoderm scales from Australia. *J. Vertebr. Paleontol.* **18**: 677–695.

Burrow, C. J., Turner, S. and Wang, S.-T., 2000. Devonian microvertebrates from Longmenshan, Sichuan, China: Taxonomic assessment. *Cour. Forsch. Inst. Senckenberg* **223**: 391–451.

Burrow, C. J. and Young, G. C., 1999. An articulated teleostome fish from the Late Silurian (Ludlow) of Victoria, Australia. *Rec. West. Aust. Mus. Suppl.* **57**: 1–14.

Bystrow, A. P., 1956. *Kolymaspis sibirica* g. n., s. n., a new representative of the Lower Devonian Agnatha. *Vestn. Leningr. Univ. Geol. Geogr.* **18**: 5–13.

Castiello, M., 2018. Neurocranial anatomy of three unusual placoderms revealed by computed tomography scanning, and their implications for early gnathostomes evolution. Ph.D. dissertation Thesis, Imperial College London. 242 pp.

Castiello, M., Jerve, A., Burton, M. G., Friedman, M. and Brazeau, M. D., 2021. Endocranial morphology of the petalichthyid placoderm *Ellopetalichthys scheii* from the Middle Devonian of Arctic Canada, with remarks on the inner ear and neck joint morphology of placoderms. *Can. J. Earth Sci.* 58: 1–12.

Chang, M.-M., 1982. The braincase of *Youngolepis*, a Lower Devonian crossopterygian from Yunnan, south-western China. Ph.D. dissertation Thesis, University of Stockholm, Department of Geology, Stockholm. 113 pp.

Chang, M.-M., 1991. Head exoskeleton and shoulder girdle of *Youngolepis*. In: M.-M. Chang, Y.-H. Liu and G.-R. Zhang (Editors), Early Vertebrates and Related Problems of Evolutionary Biology. Science Press, Beijing, pp. 355–378.

Chang, M.-M., 1995. *Diabolepis* and its bearing on the relationships between porolepiforms and dipnoans. *Bull. Mus. Natl. Hist. Nat., 4C* **17**: 235–268.

Chang, M.-M. and Yu, X.-B., 1981. A new crossopterygian, *Youngolepis praecursor*, gen. et sp. nov., from Lower Devonian of eastern Yunnan, China. *Sci. Sin.* **24**: 89–99.

Chang, M.-M. and Yu, X.-B., 1984. Structure and phylogenetic significance of *Diabolichthys speratus* gen. et sp. nov., a new dipnoan-like form from the Lower Devonian of eastern Yunnan, China. *Proc. Linn. Soc. N. S. W*. **107**: 171–184.

Chang, M.-M. and Zhu, M., 1993. A new Middle Devonian osteolepidid from Qujing, Yunnan. *Mem. Assoc. Australas. Palaeontol.* **15**: 183–198.

Chen, D.-L., Blom, H., Sanchez, S., Tafforeau, P. and Ahlberg, P. E., 2016. The stem osteichthyan Andreolepis and the origin of tooth replacement. *Nature* **539**: 237–241.

Chen, X. and Rong, J.-Y., 1996. Telychian (Llandovery) of the Yangtze region and its correlation with British Isles. Science Press, Beijing, 1–162 pp.

Chen, Z., Wang, C. and Fan, R., 2016. Restudy of the Llandovery conodont biostratigraphy in the Xiushan area, Chongqing City, China. *Can. J. Earth Sci.* **53**: 651–659.

Choo, B., Zhu, M., Qu, Q., Yu, X., Jia, L. and Zhao, W., 2017. A new osteichthyan from the late Silurian of Yunnan, China. *PLoS One* **12**: e0170929.

Clarke, J., 1901. Notes on Paleozoic Crustaceans, 2, Phyllocarida from the black shales at the base of the Salina beds in western New York. 3, Some Devonic Phyllocarida from New York. *New York State Museum. 54th Report of the Regents* **1**: 92–103.

Clement, A. M., King, B., Giles, S., Choo, B., Ahlberg, P. E., Young, G. C. and Long, J. A., 2018. Neurocranial anatomy of an enigmatic Early Devonian fish sheds light on early osteichthyan evolution. *eLife* **7:** e34349.

Clément, G., 2004. Nouvelles données anatomiques et morphologie générale des 'Porolepidae' (Dipnomorpha, Sarcopterygii). *Rev. Paléobiol.* **9**: 193–211.

Cloutier, R., 1996. The primitive actinistian *Miguashaia bureaui* Schultze (Sarcopterygii). In: H.-P. Schultze and R. Cloutier (Editors), Devonian Fishes and Plants of Miguasha, Quebec, Canada. Verlag Dr. Freidrich Pfeil,, München, pp. 227–247.

Cloutier, R. and Arratia, G., 2004. Early diversification of actinopterygians. In: G. Arratia, M. V. H. Wilson and R. Cloutier (Editors), Recent Advances in the Origin and Early Radiation of Vertebrates. Verlag Dr. Friedrich Pfeil, München, pp. 217–270.

Coates, M. I., 1994. The origin of vertebrate limbs. *Dev., Suppl.* 169–180.

Coates, M. I., Finarelli, J. A., Sansom, I. J., Andreev, P. S., Criswell, K. E., Tietjen, K., Rivers, M. L. and La Riviere, P. J., 2018. An early chondrichthyan and the evolutionary assembly of a shark body plan. *Proc. R. Soc. B* **285**: 20172418.

Coates, M. I. and Gess, R. W., 2007. A new reconstruction of *Onychoselache* Traquairi, comments on early chondrichthyan pectoral girdles and hybodontiform phylogeny. *Palaeontology* **50**: 1421–1446.

Coates, M. I., Gess, R. W., Finarelli, J. A., Criswell, K. E. and Tietjen, K., 2017. A symmoriiform chondrichthyan braincase and the origin of chimaeroid fishes. *Nature* **541**: 208–211.

Coates, M. I. and Sequeira, S. E. K., 1998. The braincase of a primitive shark. *Earth Environ. Sci. Trans. R. Soc. Edinb.* **89**: 63–85.

Coates, M. I. and Sequeira, S. E. K., 2001. A new stethacanthid chondrichthyan from the Lower Carboniferous of Bearsden, Scotland. *J. Vertebr. Paleontol.* **21**: 438–459.

Coates, M. I., Sequeira, S. E. K., Sansom, I. J. and Smith, M. M., 1998. Spines and tissues of ancient sharks. *Nature* **396**: 729–730.

Collette, J. H. and Plotnick, R. E., 2020. Redescription, paleogeography, and experimental paleoecology of the Silurian phyllocarid *Gonatocaris*. *J. Paleontol.* **94**: 906–921.

Davis, S. P., Finarelli, J. A. and Coates, M. I., 2012. *Acanthodes* and shark-like conditions in the last common ancestor of modern gnathostomes. *Nature* **486**: 247–250.

Dearden, R. P., Stockey, C. and Brazeau, M. D., 2019. The pharynx of the stem-chondrichthyan *Ptomacanthus* and the early evolution of the gnathostome gill skeleton. *Nat. Commun.***10**: 2050.

Denison, R. H., 1978. Placodermi. In: H.-P. Schultze (Editor), Handbook of Paleoichthyology, vol. 2. Gustav Fischer Verlag, Stuttgart, pp. 128.

Denison, R. H., 1947. The exoskeleton of *Tremataspis*. *Am. J. Sci.* **245**: 337–365.

Denison, R. H., 1951. Evolution and classification of the Osteostraci. *Fieldiana, Geol.* **11**: 157–196.

Denison, R. H., 1968. Early Devonian lungfishes from Wyoming, Utah, and Idaho. *Fieldiana, Geol.* **17**: 353–413.

Dennis-Bryan, K., 1987. A new species of eastmanosteid arthrodire (Pisces: Placodermi) from Gogo, Western Australia. *Zool. J. Linn. Soc.* **90**: 1–64.

Dennis, K. and Miles, R. S., 1981. A pachyosteomorph arthrodire from Gogo, Western Australia. *Zool. J. Linn. Soc.* **73**: 213–258.

Dick, J. R. F., 1978. On the Carboniferous shark *Tristychius arcuatus* Agassiz from Scotland. *Earth Environ. Sci. Trans. R. Soc. Edinb.* **70**: 63–109.

Dick, J. R. F., 1981. *Diplodoselache woodi* gen. et sp. nov., an early Carboniferous shark from the Midland Valley of Scotland. *Earth Environ. Sci. Trans. R. Soc. Edinb.* **72**: 99–113.

Dick, J. R. F. and Maisey, J.G., 1980. The Scottish Lower Carboniferous shark *Onychoselache traquairi*. *Palaeontology* **23**: 363–374.

Didier, D. A., 1995. Phylogenetic systematics of extant chimaeroid fishes (Holocephali, Chimaeroidei). *Am. Mus. Novit.* **3119**: 1–86.

Dineley, D. L., 1999. British fossil fish and amphibian sites. In: D. L. Dineley and S.J. Metcalf (Editors), Fossil Fishes of Great Britain. Joint Nature Conservation Committee, Peterborough, pp. 1–29.

Dupret, V., 2010. Revision of the genus *Kujdanowiaspis* Stensiö, 1942 (Placodermi, Arthrodira, “Actinolepida”) from the Lower Devonian of Podolia (Ukraine). *Geodiversitas* **32**: 5–63.

Dupret, V., Sanchez, S., Goujet, D., Tafforeau, P. and Ahlberg, P. E., 2014. A primitive placoderm sheds light on the origin of the jawed vertebrate face. *Nature* **507**: 500–503.

Dupret, V., Zhu, M. and Wang, J.-Q., 2009. The morphology of *Yujiangolepis liujingensis* (Placodermi, Arthrodira) from the Pragian of Guangxi (south China) and its phylogenetic significance. *Zool. J. Linn. Soc.* **157**: 70–82.

Dupret, V., Zhu, M. and Wang, J.-Q., 2017. Redescription of *Szelepis* Liu, 1981 (Placodermi, Arthrodira), from the Lower Devonian of China. *J. Vertebr. Paleontol.* **37**: e1312422.

Etheridge, R., Woodward, H. and Jones, T. R., 1887. Fourth report of the committee: consisting of Mr. R. Etheridge, Dr. H. Woodward, and Professor T. Rupert Jones (Secretary), on the Fossil Phyllopoda of the Palaeozoic Rocks. British Association. in Report of the Fifty-sixth Meeting of the British Association for the Advancement of Science; Held at Birmingham in September 1886: London, John Murray, 229–234.

Finarelli, J. A. and Coates, M. I., 2011. First tooth-set outside the jaws in a vertebrate. *Proc. R. Soc. B*. **279**: 775–779.

Finarelli, J. A. and Coates, M. I., 2014. *Chondrenchelys problematica* (Traquair, 1888) redescribed: a Lower Carboniferous, eel-like holocephalan from Scotland. *Earth Environ. Sci. Trans. R. Soc. Edinb.* **105**: 35–59.

Forey, P. L., 1998. History of the Coelacanth Fishes. Chapman&Hall, London. 419 pp.

Friedman, M., 2007. *Styloichthys* as the oldest coelacanth: implications for early osteichthyan interrelationships. *J. Syst. Palaeontol.* **5**: 289–343.

Gagnier, P. Y., Hanke, G. F. and Wilson, M. V. H., 1999. *Tetanopsyrus lindoei* gen. et sp. nov., an Early Devonian acanthodian from the Northwest Territories, Canada. *Acta Geol. Pol.* **49**: 81–96.

Gagnier, P. Y. and Wilson, M. V. H., 1996. Early Devonian acanthodians from northern Canada. *Palaeontology* **39**: 241–258.

Gai, Z.-K., Donoghue, P. C. J., Zhu, M., Janvier, P. and Stampanoni, M., 2011. Fossil jawless fish from China foreshadows early jawed vertebrate anatomy. *Nature* **476**: 324–327.

Gans, C. and Parsons, T. S., 1964. A photographic atlas of shark anatomy: the gross morphology of *Squalus acanthias*. Academic Press, New York. 106 pp.

Gardiner, B. G., 1984. The relationships of the palaeoniscid fishes, a review based on new specimens of *Mimia* and *Moythomasia* from the Upper Devonian of Western Australia. *Bull. Br. Mus. Nat. Hist. Geol. Suppl.* **37**: 173–428.

Gardiner, B. G. and Bartram, A. W. H., 1977. The homologies of ventral cranial fissures in osteichthyans. In: S. M. Andrews, R. S. Miles and A. D. Walker (Editors), Problems in Vertebrate Evolution. Academic Press, London, pp. 227–245.

Gardiner, B. G. and Miles, R. S., 1994. Eubrachythoracid arthrodires from Gogo, Western Australia. *Zool. J. Linn. Soc.* **112**: 443–477.

Ge, Z.-Z., Rong, J.-Y., Yang, X.-C., Liu, G.-W., Ni, Y.-N., Dong, D.-Y. and Wu, H.-J., 1979. Silurian in southwestern regions of China. In: Nanjing Institute of Geology and Palaeontology (Editor), Carbonatite Biostratigraphy in Southwestern Regions of China. Science Press, Beijing, pp. 155–220.

Giles, S., Coates, M. I., Garwood, R. J., Brazeau, M. D., Atwood, R., Johanson, Z., Friedman, M. and Ruta, M., 2015a. Endoskeletal structure in *Cheirolepis* (Osteichthyes, Actinopterygii), an early ray-finned fish. *Palaeontology* **58**: 849–870.

Giles, S., Darras, L., Clement, G., Blieck, A. and Friedman, M., 2015b. An exceptionally preserved Late Devonian actinopterygian provides a new model for primitive cranial anatomy in ray-finned fishes. *Proc. R Soc. B* **282**: 20151485.

Giles, S. and Friedman, M., 2014. Virtual reconstruction of endocast anatomy in early ray-finned fishes (Osteichthyes, Actinopterygii). *J. Paleontol.* **88**: 636–651.

Giles, S., Friedman, M. and Brazeau, M.D., 2015c. Osteichthyan-like cranial conditions in an Early Devonian stem gnathostome. *Nature* **520**: 82–85.

Giles, S., Rücklin, M. and Donoghue, P. C. J., 2013. Histology of “placoderm” dermal skeletons: Implications for the nature of the ancestral gnathostome. *J. Morphol.* **274**: 627–644.

Goujet, D. F., 1973. *Sigaspis*, un nouvel arthrodire du Dévonien inférieur du Spitsberg. *Palaeontogr. Abt. A* **143**: 73–88.

Goujet, D. F., 1975. *Dicksonosteus*, un nouvel arthrodire du Dévonien du Spitsberg remarques sur le squelette visceral des Dolichothoraci. In: J. P. Lehman (Editor), Problèmes actuels de Paléontologie-Evolution des Vertébrés. Colloques Internationaux du Centre National de la Recherche Scientifique, Paris, pp. 81–99.

Goujet, D. F., 1984. Les poissons placodermes du Spitsberg. Arthrodires Dolichothoraci de la Formation de Wood Bay (Dévonien inférieur), 15. Editions Centre National Recherche Scientifique, Cahiers de Paléontologie, Paris, 284 pp.

Goujet, D. F., 2001. Placoderms and basal gnathostome apomorphies. In: P. E. Ahlberg (Editor), Major Events in Early Vertebrate Evolution: Palaeontology, Phylogeny, Genetics and Development. Taylor & Francis, London, pp. 209–222.

Goujet, D. F. and Young, G. C., 2004. Placoderm anatomy and phylogeny: new insights. In: G. Arratia, M. V. H. Wilson and R. Cloutier (Editors), Recent Advances in the Origin and Early Radiation of Vertebrates. Verlag Dr. Friedrich Pfeil, München, pp. 109–126.

Grogan, E. D. and Lund, R., 2000. *Debeerius ellefseni* (fam. nov., gen. nov., spec. nov.), an autodiastylic chondrichthyan from the Mississippian bear gulch limestone of Montana (USA), the relationships of the Chondrichthyes, and comments on gnathostome evolution. *J. Morphol.* **243**: 219–245.

Gross, W., 1935. Histologische studien am Aussenskelett fossiler agnathen und fische. *Palaeontogr. Abt. A* **83**: 1–60.

Gross, W., 1958. Über die älterste Arthrodiren-Gattung. *Notizbl. hess. Landesami. Bodenforsch.* **86**: 7–30.

Gross, W., 1959. Arthrodiren aus dem Obersilur der Prager Mulde. *Palaeontogr. Abt. A* **113**: 1–35.

Gross, W., 1961. *Lunaspis broilii* und *Lunaspis heroldi* aus dem Hunsrückschiefer (Unterdevon, Rheinland). *Notizbl. hess. Landesami. Bodenforsch.* **89**: 17–43.

Gross, W., 1963. *Gemuendina stuertzi* Traquair. Neuuntersuchung. *Notizbl. hess. Landesami. Bodenforsch.* **91**: 36–73.

Gross, W., 1968. Beobachtungen mit dem Elektronenraster-Auflichtmikroskop an den Siebplatten und dem Isopedin von Dartmuthia (Osteostraci). *Palaontol. Z* **42**: 73–82.

Hamel, M.-H. and Poplin, C., 2008. The braincase anatomy of *Lawrenciella* *schaefferi*, actinopterygian from the Upper Carboniferous of Kansas (USA). *J. Vertebr. Paleontol.* **28**: 989–1006.

Hanke, G. F., 2002. *Paucicanthus vanelsti* gen. et sp. nov., an Early Devonian (Lochkovian) acanthodian that lacks paired fin-spines. *Can. J. Earth Sci.* **39**: 1071–1083.

Hanke, G. F., 2008. *Promesacanthus eppleri* n. gen., n. sp., a mesacanthid (Acanthodii, Acanthodiformes) from the Lower Devonian of northern Canada. *Geodiversitas*, **30**: 287–302.

Hanke, G. F. and Davis, S. P., 2008. Redescription of the acanthodian *Gladiobranchus probaton* Bernacsek & Dineley, 1977, and comments on diplacanthid relationships. *Geodiversitas* **30**: 303–330.

Hanke, G. F. and Davis, S. P., 2012. A re-examination of *Lupopsyrus pygmaeus* Bernacsek & Dineley, 1977 (Pisces, Acanthodii). *Geodiversitas* **34**: 469–487.

Hanke, G. F., Davis, S. P. and Wilson, M. V. H., 2001. New species of the acanthodian genus *Tetanopsyrus* from northern Canada, and comments on related taxa. *J. Vertebr. Paleontol.* **21**: 740–753.

Hanke, G. F. and Wilson, M. V. H., 2004. New teleostome fishes and acanthodian systematics. In: G. Arratia, M. V. H. Wilson and R. Cloutier (Editors), Recent Advances in the Origin and Early Radiation of Vertebrates. Verlag Dr. Friedrich Pfeil, München, pp. 189–216.

Hanke, G. F. and Wilson, M. V. H., 2006. Anatomy of the Early Devonian acanthodian *Brochoadmones milesi* based on nearly complete body fossils, with comments on the evolution and development of paired fins. *J. Vertebr. Paleontol.* **26**: 526–537.

Hanke, G. F. and Wilson, M. V. H., 2010. The putative stem-group chondrichthyans *Kathemacanthus* and *Seretolepis* from the Lower Devonian MOTH locality, Mackenzie Mountains, Canada. In: D. K. Elliott, J. G. Maisey, X.-B. Yu and D.-S. Miao (Editors), Morphology, Phylogeny and Paleobiogeography of Fossil Fishes. Verlag Dr. Friedrich Pfeil, München, pp. 159–182.

Heidtke, U. H. J., Schwind, C. and Krätschmer, K., 2004. Über die Organisation des Skelettes und die verwandschaftlichen Beziehungen der Gattung Triodus Jordan 1849 (Elasmobranchii: Xenacanthida). *Mainz. Geowiss. Mitt.* **32**: 9–54.

Hemmings, S. K., 1978. The Old Red Sandstone antiarchs of Scotland: *Pterichthyodes* and *Microbrachius*. *Palaeontogr. Soc. Monogr.* **131**: 1–64.

Hirasawa, T., Oisi, Y. and Kuratani, S., 2016. *Palaeospondylus* as a primitive hagfish. *Zool. Lett.* **2**: 20.

Holland, T., 2013. Pectoral girdle and fin anatomy of *Gogonasus andrewsae* Long, 1985: implications for tetrapodomorph limb evolution. *J. Morphol.* **274**: 147–164.

Holland, T., 2014. The endocranial anatomy of *Gogonasus andrewsae* Long, 1985 revealed through micro CT-scanning. *Earth Environ. Sci. Trans. R. Soc. Edinb.***105**: 9–34.

Hu, Y.-Z., Lu, J. and Young, G. C., 2017. New findings in a 400 million-year-old Devonian placoderm shed light on jaw structure and function in basal gnathostomes. *Sci. Rep.* **7**: 7813.

Ivanov, A., 2005. Early Permian chondrichthyans of the middle and south urals. *Rev. Bras. Paleontol.* **8**: 127–138.

Janvier, P., 1981. *Norselaspis glacialis* n.g., n.sp. et les relations phylogénétiques entre les Kiaeraspidiens (Osteostraci) du Dévonien Inférieur du Spitsberg. *Palaeovertebrata* **11**: 19–131.

Janvier, P., 1985. Les Céphalaspides du Spitsberg: anatomie, phylogénie et systématique des Ostéostracés siluro-dévoniens; revisions des Ostéostracés de la Formation de Wood Bay (Dévonien inférieur du Spitsberg). Cahiers de Paléontologie, Centre national de la Recherche scientifique, Paris, 256 pp.

Janvier, P., Arsenault, M. and Desbiens, S., 2004. Calcified cartilage in the paired fins of the osteostracan *Escuminaspis laticeps* (Traquair 1880), from the Late Devonian of Miguasha (Québec, Canada), with a consideration of the early evolution of the pectoral fin endoskeleton in vertebrates. *J. Vertebr. Paleontol.* **24**: 773–779.

Janvier, P. and Clément, G., 2005. A new groenlandaspidid arthrodire (Vertebrata: Placodermi) from the Famennian of Belgium. *Geol. Belg.* **8**: 51–67.

Janvier, P., Tông-Dzuy, T. and Ta-Hoa, P., 1993. A new Early Devonian galeaspid from Bac Thai Province, Vietnam. *Palaeontology* **36**: 297–309.

Jarvik, E., 1972. Middle and Upper Devonian Porolepiformes from East Greenland with special reference to *Glyptolepis groenlandica* n. sp. and a discussion on the structure of the head in the Porolepiformes. *Meddel. Grønland* **187**: 1–307.

Jarvik, E., 1980a. Basic Structure and Evolution of Vertebrates, Volume 1. Academic Press, London, 575 pp.

Jarvik, E., 1980b. Basic Structure and Evolution of Vertebrates, Volume 2. Academic Press, London, 337 pp.

Jessen, H. L., 1980. Lower Devonian Porolepiformes from the Canadian Arctic with special reference to *Powichthys thorsteinssoni* Jessen. *Palaeontogr. Abt.* A **167**: 180–214.

Ji, S.-A. and Pan, J., 1997. The macropetalichthyids (Placodermi) from Guangxi and Hunan, China. *Vert. PalAsiat.* **35**: 18–34.

Johanson, Z., Smith, M., Sanchez, S., Senden, T., Trinajstic, K. and Pfaff, C., 2017. Questioning hagfish affinities of the enigmatic Devonian vertebrate *Palaeospondylus*. *R. Soc. Open Sci.* **4**: 170214.

Johnson, H., Elliott, D. K. and Wittke, J. H., 2000. A new actinolepid arthrodire (Class Placodermi) from the Lower Devonian Sevy Dolomite, East-Central Nevada. *Zool. J. Linn. Soc.* **129**: 241–266.

Keating, J. N., Marquart, C. L. and Donoghue, P. C., 2015. Histology of the heterostracan dermal skeleton: insight into the origin of the vertebrate mineralised skeleton. *J. Morphol.* **276**: 657–680.

King, B., Qiao, T., Lee, M. S. Y., Zhu, M. and Long, J. A., 2017. Bayesian morphological clock methods resurrect placoderm monophyly and reveal rapid early evolution in jawed vertebrates. *Syst. Biol.* **66**: 599–516.

Lane, J. A., 2010. Morphology of the braincase in the Cretaceous hybodont shark *Tribodus* *limae* (Chondrichthyes: Elasmobranchii), based on CT scanning. *Am. Mus. Novit.* **3681**: 1–70.

Lane, J. A. and Maisey, J. G., 2009. Pectoral anatomy of *Tribodus* *limae* (Elasmobranchii: Hybodontiformes) from the Lower Cretaceous of northeastern Brazil. *J. Vertebr. Paleontol.***29**: 25–38.

Lane, J. A. and Maisey, J. G., 2012. The visceral skeleton and jaw suspension in the durophagous hybodontid shark *Tribodus limae* from the Lower Cretaceous of Brazil. *J. Paleontol.* **86**: 886–905.

Li, B., Hu, B.-W., Shi, X.-H., Li, J.-H. and Luo, Q., 2015. Study on the Silurian sedimentary system of western Hunan and the formation mode of typical foreland basin. *Earth Sci. Front.* **22**: 167–176.

Li, Q., Zhu, Y.-A., Lu, J., Chen, Y., Wang, J., Peng, L.-J., Wei, G.-B. and Zhu, M., 2021. A new Silurian fish close to the common ancestor of modern gnathostomes. *Curr. Biol.* **31**: 3613–3620.e2.

Liu, T.-S. and P'an, K., 1958. Devonian fishes from Wutung Series near Nanking, China. *Palaeontogr. Sin. C,* **141**: 1–41.

Liu, Y.-H., 1965. New Devonian agnathans of Yunnan. *Vert. PalAsiat.* **9**: 125–134.

Liu, Y.-H., 1975. Lower Devonian Agnathans of Yunnan and Sichuan. *Vert. PalAsiat.* **13**: 202–216.

Liu, Y.-H., 1991. On a new petalichthyid, *Eurycaraspis incilis* gen. et sp. nov., from the Middle Devonian of Zhanyi, Yunnan. In: M.-M. Chang, Y.-H. Liu and G.-R. Zhang (Editors), Early Vertebrates and Related Problems of Evolutionary Biology. Science Press, Beijing, pp. 139–177.

Long, J. A., 1983. A new diplacanthoid acanthodian from the Late Devonian of Victoria. *Mem. Assoc. Australas. Palaeontol.* **1**: 51–65.

Long, J. A. (1983). New bothriolepid fish from the Late Devonian of Victoria, Australia. *Palaeontology* **26**: 295–320.

Long, J. A., 1985. A new osteolepidid fish from the Upper Devonian Gogo Formation, western Australia. *Rec. West. Aust. Mus.* **12:** 361–377.

Long, J. A., 1988. New palaeoniscoid fishes from the Late Devonian and Early Carboniferous of Victoria. *Mem. Assoc. Australas. Palaeontol.* **7**: 1–64.

Long, J. A., 1997. Ptyctodontid fishes (Vertebrata, Placodermi) from the Late Devonian Gogo Formation, Western Australia, with a revision of the European genus *Ctenurella* Ørvig, 1960. *Geodiversitas* **19**: 515–555.

Long, J. A., 1999. A new genus of fossil coelacanth (Osteichthyes: Coelacanthiformes) from the Middle Devonian of southeastern Australia. *Rec. West. Aust. Mus.* Suppl. **57**: 37–53.

Long, J. A., Barwick, R. E. and Campell, K. S., 1997. Osteology and functional morphology of the osteolepiform fish *Gogonasus andrewsae* Long, 1985, from the Upper Devonian Gogo Formation, Western Australia. *Rec. West. Aust. Mus.* Suppl. **53**: 1–89.

Long, J. A., Mark-Kurik, E., Johanson, Z., Lee, M. S., Young, G. C., Zhu, M., Ahlberg, P. E., Newman, M., Jones, R., Blaauwen, J. D., Choo, B. and Trinajstic, K., 2015. Copulation in antiarch placoderms and the origin of gnathostome internal fertilization. *Nature* **517**: 196–199.

Long, J. A., Mark-Kurik, E. and Young, G. C., 2014. Taxonomic revision of buchanosteoid placoderms (Arthrodira) from the Early Devonian of south-eastern Australia and Arctic Russia. *Aust. J. Zool.* **62**: 26–43.

Long, J. A. and Trinajstic, K., 2010. The Late Devonian Gogo Formation Lägerstatte of western Australia: exceptional early vertebrate preservation and diversity. *Annu. Rev. Earth. Planet. Sci.* **38**: 255–279.

Long, J. A., Trinajstic, K., Young, G. C. and Senden, T., 2008. Live birth in the Devonian period. *Nature* **453**: 650–652.

Long, J. A., Young, G. C., Holland, T., Senden, T. J. and Fitzgerald, E. M. G., 2006. An exceptional Devonian fish from Australia sheds light on tetrapod origins. *Nature* **444**: 199–202.

Lu, J., Giles, S., Friedman, M. and Zhu, M., 2017. A new stem sarcopterygian illuminates patterns of character evolution in early bony fishes. *Nat. Commun.* **8**: 1932.

Lu, J. and Zhu, M., 2010. An onychodont fish (Osteichthyes, Sarcopterygii) from the Early Devonian of China, and the evolution of the Onychodontiformes. *Proc. R. Soc. B* **277**: 293–299.

Lu, J., Zhu, M., Ahlberg, P. E., Qiao, T., Zhu, Y.-A., Zhao, W.-J. and Jia, L.-T., 2016. A Devonian predatory fish provides insights into the early evolution of modern sarcopterygians. *Sci. Adv.* **2**: e1600154.

Lu, J., Zhu, M., Long, J. A., Zhao, W.-J., Senden, T. J., Jia, L.-T. and Qiao, T., 2012. The earliest known stem-tetrapod from the Lower Devonian of China. *Nat. Commun.***3**: 1160.

Lukševičs, E., 2001. The orbito-nasal area of *Asterolepis ornata*, a Middle Devonian placoderm fish. *J. Vertebr. Paleontol.* **21**: 687–692.

Lund, R., 1985. The morphology of *Falcatus falcatus* (St. John and Worthen), a Mississippian stethacanthid chondrichthyan from the Bear Gulch Limestone of Montana. *J. Vertebr. Paleontol.* **5**: 1–19.

Lund, R., 1986. On *Damocles serratus*, nov. gen. et sp. (Elasmobranchii: Cladodontida) from the Upper Mississippian Bear Gulch Limestone of Montana. *J. Vertebr. Paleontol.* **6**: 12–19.

Lund, R. and Grogan, E. D., 1997. Relationships of the Chimaeriformes and the basal radiation of the Chondrichthyes. *Rev. Fish Biol. Fish.* **7**: 65–123.

Maisey, J. G., 1985. Cranial morphology of the fossil elasmobranch *Synechodus dubrisiensis*. *Am. Mus. Novit.* **2804**: 1–28.

Maisey, J. G., 1989. *Hamiltonichthys mapesi*, g. & sp. nov. (Chondrichthyes; Elasmobranchii), from the Upper Pennsylvanian of Kansas. *Am. Mus. Novit.* **2931**: 1–42.

Maisey, J. G., 2001. Remarks on the inner ear of elasmobranchs and its interpretation from skeletal labyrinth morphology. *J. Morphol.* **250**: 236–264.

Maisey, J. G., 2005. Braincase of the Upper Devonian shark *Cladodoides wildungensis* (Chondrichthyes, Elasmobranchii), with observations on the braincase in early chondrichthyans. *Bull. Am. Mus. Nat.* **288**: 1–103.

Maisey, J. G., 2007. The braincase in Paleozoic symmoriiform and cladoselachian sharks. *Bull. Am. Mus. Nat.* **307**: 1–122.

Maisey, J. G., 2011. The braincase of the Middle Triassic shark *Acronemus tuberculatus* (Bassani, 1886). *Palaeontology* **54**: 417–428.

Maisey, J. G. and Anderson, M. E., 2001. A primitive chondrichthyan braincase from the Early Devonian of South Africa. *J. Vertebr. Paleontol.* **21**: 702–713.

Maisey, J. G. and Denton, J. S. S., 2016. Dermal denticle patterning in the Cretaceous hybodont shark *Tribodus limae* (Euselachii, Hybodontiformes), and its implications for the evolution of patterning in the chondrichthyan dermal skeleton. *J. Vertebr. Paleontol.* **36:**5, e1179200.

Maisey, J. G., Miller, R. and Turner, S., 2009. The braincase of the chondrichthyan *Doliodus* from the Lower Devonian Campbellton Formation of New Brunswick, Canada. *Acta Zool.* **90**: 109–122.

Mark-Kurik, E., 1973. *Kimaspis*, a new palaeacanthaspid from the Early Devonian of Central Asia. *Eesti NSV Teaduste Akadeemia Toimetised, Geoloogia* **22**: 322–330.

Märss, T., Afanassieva, O. and Blom, H., 2015. Biodiversity of the Silurian osteostracans of the East Baltic. *Earth Environ. Sci. Trans. R. Soc. Edinb.* **105**: 73–148.

Miles, R. S., 1967. Observations on the ptyctodont fish, *Rhamphodopsis* Watson. *Zool. J. Linn. Soc.* **47**: 99–120.

Miles, R. S., 1973a. Articulated acanthodian fishes from the Old Red Sandstone of England, with a review of the structure and evolution of the acanthodian shoulder-girdle. *Bull. Br. Mus. Nat. Geol.* **24**: 111–213.

Miles, R. S., 1973b. Relationships of acanthodians. In: P. H. Greenwood, R. S. Miles and C. Patterson (Editors), Interrelationships of Fishes. Academic Press, London, pp. 63–103.

Miles, R. S. and Westoll, T. S., 1968. The placoderm fish *Coccosteus cuspidatus* Miller ex Agassiz from the Middle Old Red Sandstone of Scotland. Part I. descriptive morphology. *Earth Environ. Sci. Trans. R. Soc. Edinb.* **67**: 373–476.

Miller, R. F., Cloutier, R. and Turner, S., 2003. The oldest articulated chondrichthyan from the Early Devonian period. *Nature* **425**: 501–504.

Moy-Thomas, J. A., 1935. The structure and affinities of *Chondrenchelys problematica. Proc. Zool. Soc. Lond*. **105**: 391–404.

Moy-Thomas, J. A., 1936. On the structure and affinities of the Carboniferous cochliodont *Helodus simplex*. *Geol. Mag.* **73**: 488–503.

Mutter, R. J., De Blanger, K. and Neuman, A. G., 2007. Elasmobranchs from the Lower Triassic Sulphur Mountain Formation near Wapiti Lake (BC, Canada). *Zool. J. Linn. Soc.***149**: 309–337.

Mutter, R. J., Neuman, A. G. and De Blanger, K., 2008. *Homalodontus* nom. nov., a replacement name for *Wapitiodus* Mutter, de Blanger and Neuman, 2007 (Homalodontidae nom. nov.,? Hybodontoidea), preoccupied by *Wapitiodus* Orchard, 2005. *Zool. J. Linn. Soc.***154**: 419–420.

Newman, M. J., Burrow, C. J., Den Blaauwen, J. L. and Davidson, R. G., 2014. The Early Devonian acanthodian *Euthacanthus macnicoli* Powrie, 1864 from the Midland Valley of Scotland. *Geodiversitas* **36**: 321–348.

Newman, M. J., Davidson, R. G., Blaauwen, J. L. D. and Burrow, C. J., 2012. The Early Devonian acanthodian *Uraniacanthus curtus* (Powrie, 1870) n. comb. from the Midland Valley of Scotland. *Geodiversitas* **34**: 739–759.

Olive, S., Goujet, D., Lelièvre, H. and Janjou, D., 2011. A new placoderm fish (Acanthothoraci) from the Early Devonian Jauf Formation (Saudi Arabia). *Geodiversitas* **33**: 393–409.

Olive, S., Goujet, D., Lelièvre, H. and Janvier, P., 2014. The growth of the skull roof plates in *Arabosteus variabilis* (Acanthothoraci, Placodermi) from the Early Devonian Jauf Formation (Saudi Arabia): Preliminary results. *Paleontol. J.* **48**: 992–1002.

Ørvig, T., 1957. Notes on some Paleozoic lower vertebrates from Spitsbergen and North America. *Nor. J. Geol.* **37**: 285–353.

Ørvig, T., 1975. Description, with special reference to the dermal skeleton, of a new radotinid arthrodire from the Gedinnian of Arctic Canada. In: J. P. Lehman (Editor), Problèmes actuels de Paléontologie-Evolution des Vertébrés. Colloques Internationaux du Centre National de la Recherche Scientifique, Paris, pp. 41–71.

Pan, J., 1986a. New discovery of Silurian vertebrates in China, Professional Papers Presented to Professor Yoh Sen-shing, Geol. Publ. House, pp. 67–76.

Pan, J., 1986b. Note on Silurian vertebrates of China. *Bull. Chin. Acad. Sci. Geol. Sci.* **15**: 161–190.

Pan, J. and Dineley, D. L., 1988. A review of early (Silurian and Devonian) vertebrate biogeography and biostratigraphy of China. *Proc. R Soc. B* **235**: 29–61.

Pan, Z.-H., Zhu, M., Zhu, Y.-A. and Jia, L.-T., 2015. A new petalichthyid placoderm from the Early Devonian of Yunnan, China. *C. R. Palevol.* **14**: 125–137.

Pearson, D. M. and Westoll, T. S., 1979. The Devonian actinopterygian *Cheirolepis* Agassiz. *Earth Environ. Sci. Trans. R. Soc. Edinb.* **70**: 337–399.

Pickett, J. W., Burrow, C. J., Holloway, D. J., Munson, T. J., Percival, I. G., Rickards, R. B., Sherwin, L., Simpson, A. J., Strusz, D. L., Turner, S. and Wright, A. J., 2000. Silurian palaeobiogeography of Australia. In: A. J. Wright, G. C. Young, J. A. Talent and J. R. Laurie (Editors), Palaeobiogeography of Australasian faunas and floras. Memoir 23 of the Association of Australian Palaeontologists, pp. 127–165.

Poplin, C., 1975. *Kansasiella* nomen novum remplacant *Kansasia* Poplin 1974 (Poissons: Palaeonisciformes). *Bull. Soc. Géol. Fr* **17**, 26.

Pradel, A., Maisey, J. G., Tafforeau, P. and Janvier, P., 2009. An enigmatic gnathostome vertebrate skull from the Middle Devonian of Bolivia. *Acta Zool.* **90**: 123–133.

Pradel, A., Maisey, J. G., Tafforeau, P., Mapes, R. H. and Mallatt, J., 2014. A Palaeozoic shark with osteichthyan-like branchial arches. *Nature* **509**: 608–611.

Pradel, A., Tafforeau, P., Maisey, J. G. and Janvier, P., 2011. A new Paleozoic Symmoriiformes (Chondrichthyes) from the Late Carboniferous of Kansas (USA) and cladistic analysis of early chondrichthyans. *PLoS One* **6**: e24938.

Qiao, T. and Zhu, M., 2010. Cranial morphology of the Silurian sarcopterygian *Guiyu oneiros* (Gnathostomata: Osteichthyes). *Sci. China Earth Sci* **53**: 1836–1848.

Randle, E. and Sansom, R. S., 2016. Exploring phylogenetic relationships of Pteraspidiformes heterostracans (stem-gnathostomes) using continuous and discrete characters. *J. Syst. Palaeontol.* **15**: 583–599.

Rayner, D. H., 1951. On the cranial structure of an early palaeoniscid, *Kentuckia* gen. nov. *Earth Environ. Sci. Trans. R. Soc. Edinb.* **62**: 58–83.

Ritchie, A., 1967. *Ateleaspis tessellata* Traquair, a non-cornuate cephalaspid from the Upper Silurian of Scotland. *Zool. J. Linn. Soc.* **47**: 69–81.

Ritchie, A., 1973. *Wuttagoonaspis* gen. nov., an unusual arthrodire from the Devonian of Western New South Wales, Australia. *Palaeontogr. Abt. A* **143**: 58–72.

Ritchie, A., 1975. *Groenlandaspis* in Antarctica, Australia and Europe. *Nature* **254**: 569–573.

Ritchie, A., 2004. A new genus and two new species of groenlandaspidid arthrodire (Pisces: Placodermi) from the Early-Middle Devonian Mulga Downs Group of western New South Wales, Australia *Foss. Strata.* **50**: 56–81.

Ritchie, A., 2005. *Cowralepis*, a new genus of phyllolepid fish (Pisces, Placodermi) from the Late Middle Devonian of New South Wales, Australia. *Proc. Linn. Soc. N.S.W.* **126**: 215–259.

Ritchie, A., Wang, S.-T., Young, G. C. and Zhang, G.-R., 1992. The Sinolepidae, a family of antiarchs (placoderm fishes) from the Devonian of South China and eastern Australia. *Rec. Aust. Mus.* **44**: 319–370.

Robertson, G.M., 1937. The Tremataspidae Part I. *Am. J. Sci.* **207**: 172–206.

Robertson, G.M., 1938. The Tremataspidae Part II. *Am. J. Sci.* **208**: 273–296.

Rong, J.-Y., Chen, X., Wang, C.-Y., Geng, L.-Y., Wu, H.-J., Deng, Z.-Q., Chen, T.-E. and Xu, J.-T., 1990. *Some problems on the Silurian correlation in South China*. *J. Stratigr.* **14**: 161–177.

Rong, J.-Y., Wang, Y., Zhan, R.-B., Fan, J.-X., Huang, B., Tang, P., Li, Y., Zhang, X.-L., Wu, R.-C., Wang, G.-X. and Wei, X., 2019. Silurian integrative stratigraphy and timescale of China. *Sci. China Earth Sci.* **62**: 89–111.

Rong, J.-Y., Wang, Y. and Zhang, X., 2012. Tracking shallow marine red beds through geological time as exemplified by the lower Telychian (Silurian) in the Upper Yangtze Region, South China. *Sci. China Earth Sci.* **55**: 699–713.

Russell, L. S., 1951. Acanthodians of the Upper Devonian Escuminac Formation, Maguasha, Quebec. *Ann. Mag. Nat. Hist.* **4**: 401–407.

Sallan, L. C. and Coates, M. I., 2010. End-Devonian extinction and a bottleneck in the early evolution of modern jawed vertebrates. *Proc. Natl. Acad. Sci. U.S.A.* **107**: 10131–10135.

Schaeffer, B., 1981. The xenacanth shark neurocranium, with comments on elasmobranch monophyly. *Bull. Am. Mus. Nat.* **169**: 1–66.

Schultze, H.-P., 1968. Palaeoniscoidea-schuppen aus dem Unterdevon Australiens und Kansas und aus dem Mitteldevon Spitzbergens. *Bull. Br. Mus. Nat. Hist. Geol.* **16**: 343–368.

Schultze, H.-P. and Cumbaa, S. L., 2001. *Dialipina* and the characters of basal actinopterygians. In: P. E. Ahlberg (Editor), Major Events in Early Vertebrate Evolution: Palaeontology, Phylogeny, Genetics and Development. Taylor & Francis, London, pp. 315–332.

Schultze, H.-P. and Märss, T., 2004. Revisiting *Lophosteus* Pander 1856, a primitive osteichthyan. *Acta. Univ. Latv.* **674**: 57–78.

Schultze, H.-P. and Zidek, J., 1982. Ein primitiver Acanthodier (Pisces) aus dem Unterdevon Lettlands. *Palaontol. Z* **56**: 95–105.

Soler-Gijon, R. and Hampe, O., 1998. Evidence of *Triodus* Jordan 1849 (Elasmobranchii: Xenacanthidae) in the Lower Permian of the Autun Basin (Muse, France). *Neues Jahrb. Geol. Paläontol., Monatsh.* **6**: 335–348.

Sollas, W. J. and Sollas, I. B. J., 1904. An account of the Devonian fish, *Palaeospondylus* *gunni*, Traquair. *Philos. Trans. R. Soc. B* **196**: 267–294.

Stensiö, E. A., 1969. Elasmobranchiomorphi Placodermata Arthrodires. In: J. Piveteau (Editor), Traité de Paléontologie. Masson, Paris, pp. 71–692.

Stensiö, E. A., 1925. On the head of the macropetalichthyids with certain remarks on the head of the other arthrodires. *Geol. Ser.* **4**: 87–197.

Stensiö, E. A., 1932. The Cephalaspids of Great Britain. British Museum (Natural History), London. 220 pp.

Stensiö, E. A., 1963. The brain and the cranial nerves in fossil lower craniate vertebrates. *Skr. Norske. VidenskAkad. Oslo, Mat.-Naturv. Kl.* **13**: 1–120.

Taverne, L., 1997. *Osorioichthys marginis*, "paleonisciform" from the Fammenian of Belgium, and the phylogeny of the Devonian actinopterygians (Pisces). *Bull. Inst. R. Sci. Nat. Belg.* **67**: 57–78.

Teng, Y.-H., Sone, M., Hirayama, R., Yoshida, M., Komatsu, T., Khamha, S. and Cuny, G., 2019. First Cretaceous fish fauna from Malaysia. *J. Vertebr. Paleontol.* **39**: e1573735.

Tetlie, O. E., Selden, P. A. and Ren, D., 2007. A new Silurian eurypterid (Arthropoda: Chelicerata) from China. *Palaeontology* **50**: 619–625.

Thomson, K.S., 1965. The endocranium and associated structures in the Middle Devonian rhipidistian fish *Osteolepis*. *Proc. Linn. Soc. Lond.* **176**: 181–195.

Tông-Dzuy, T. and Janvier, P., 1990. Les Vertébrés du Dévonien inférieur du Bac Bo oriental (provinces de Bac Thaï et Lang Son, Viêt Nam). *Bull. Mus. Natl. Hist. Nat., 4C* **12**: 143–223.

Trinajstic, K., Long, J. A., Johanson, Z., Young, G. C. and Senden, T., 2012. New morphological information on the ptyctodontid fishes (Placodermi, Ptyctodontida) from Western Australia. *J. Vertebr. Paleontol.* **32**: 757–780.

Turner, P. and Turner, S., 1974. Thelodonts from the Upper Silurian of Ringerike, Norway. *Nor. J. Geol.* **54**: 183–192.

Upeniece, I., 2001. The unique fossil assemblage from the Lode Quarry (Upper Devonian, Latvia). *Mitt. Mus. Natkd. Berl. Geowiss.* **4**: 101–119.

Valiukevicius, J., 1992. First articulated *Poracanthodes* from the Lower Devonian of Severnaya Zemlya. In: E. Mark-Kurik (Editor), Fossil Fishes as Living Animals. Academy of Sciences of Estonia, Tallinn, pp. 193–214.

Vaskaninova, V., 2009. *Asterolepis ornata* Eichwald, 1840 (Placodermi) ve sbirkach Ceske geologicke sluzby. *Zpravy o geologickych vyzkumech* **2008**: 131–132.

Vaškaninová, V. and Ahlberg, P.E., 2017. Unique diversity of acanthothoracid placoderms (basal jawed vertebrates) in the Early Devonian of the Prague Basin, Czech Republic: a new look at *Radotina* and *Holopetalichthys*. *PLoS One* **12**: e0174794.

Wang, C.-Y., Chen, L., Wang, Y. and Tang, P., 2010. Affirmation of *Pterospathodus eopennatus* Zone (Conodonta) and the age of the Silurian Shamao Formation in Zigui, Hubei as well as the correlation of the related strata. *Acta Palaeontol. Sin.* **49**: 10–28.

Wang, Y., Zhang, X., Xu, H., Jiang, Q. and Tang, P., 2011. Discovery of the late Silurian Xiaoxi Formation in the Xiushan Area, Chongqing City, China, and the revision of the Huixingshao Formation. *J. Stratigr.* **35**: 113–121.

Warren, A., Currie, B. P., Burrow, C. and Turner, S., 2000. A redescription and reinterpretation of *Gyracanthides murrayi* Woodward 1906 (Acanthodii, Gyracanthidae) from the Lower Carboniferous of the Mansfield Basin, Victoria, Australia. *J. Vertebr. Paleontol.* **20**: 225–242.

Watson, D. M. S., 1937. The acanthodian fishes. *Philos. Trans. R. Soc.* **228**: 49–146.

Westoll, T. S., 1936. On the structures of the dermal ethmoid shield of *Osteolepis*. *Geol. Mag.* **73**: 157–171.

White, E. I., 1958. On the original environment of the craniates. In: T.S. Westoll (Editor), Studies on Fossil Vertebrates, London, pp. 212–234.

White, E. I., 1965. The head of *Dipterus valenciennesi* Sedgwick & Murchison. *Bull. Br. Mus. Nat. Hist. Geol.* **11**: 1–45.

White, E. I. and Toombs, H. A., 1972. The buchanosteid arthrodires of Australia. *Bull. Br. Mus. Nat. Hist. Geol.* **22**: 379–419.

Williams, M. E., 1998. A new specimen of *Tamiobatis vetustus* (Chondrichthyes, Ctenacanthoidea) from the Late Devonian Cleveland Shale of Ohio. *J. Vertebr. Paleontol.* **18**: 251–260.

Woodward, A. S., 1941. IX.—The head shield of a new macropetalichthyid fish (*Notopetalichthys hillsi*, gen. et sp. nov.) from the Middle Devonian of Australia. *J. Nat. Hist. Ser. 11* **8**: 91–96.

Young, G. C., 1979. New information on the structure and relationships of *Buchanosteus* (Placodermi: Euarthrodira) from the Early Devonian of New South Wales. *Zool. J. Linn. Soc.* **66**: 309–352.

Young, G. C., 1980. A new Early Devonian placoderm from New South Wales, Australia, with a discussion of placoderm phylogeny. *Palaeontogra. Abt. A* **167**: 10–76.

Young, G. C., 1985. Further petalichthyid remains (placoderm fishes, Early Devonian) from the Taemas-Wee Jasper region, New South Wales. *BMR J. Aust. Geol. Geophys.* **9**: 121–131.

Young, G. C., 1986. The relationships of placoderm fishes. *Zool. J. Linn. Soc.* **88**: 1–57.

Young, G. C., 1989. The Aztec fish fauna (Devonian) of Southern Victoria Land: evolutionary and biogeographic significance. *Geol. Soc. Spec. Publ. Lond.* **47**: 43–62.

Young, G. C., 2004. Large brachythoracid arthrodires (Placoderm Fishes) from the Early Devonian of Wee Jasper, New South Wales, Australia, with a discussion of basal brachythoracid characters. *J. Vertebr. Paleontol.* **24**: 1–17.

Young, G. C., 2010. Placoderms (armored fish): dominant vertebrates of the Devonian period. *Annu. Rev. Earth Planet Sci*. **38**: 523–550.

Yu, X.-B., 1998. A new porolepiform-like fish, *Psarolepis romeri*, gen. et sp. nov. (Sarcopterygii, Osteichthyes) from the Lower Devonian of Yunnan, China. *J. Vertebr. Paleontol.* **18**: 261–274.

Zangerl, R. and Case, G. R., 1973. Iniopterygia, a new order of chondrichthyan fishes from the Pennsylvanian of North America. *Fieldiana Zool.* **6**: 1–67.

Zhang, G.-R., Wang, J.-Q. and Wang, N.-Z., 2001. The structure of pectoral fin and tail of Yunnanolepidoidei, with a discussion of the pectoral fin of chuchinolepids. *Vert. PalAsiat.* **39**: 1–13.

Zhang, M.-M., 1980. Preliminary note on a Lower Devonian antiarch from Yunnan, China. *Vert. PalAsiat.* **18**: 179–190.

Zhao, W.-J., Zhu, M. and Jia L.-T., 2002. New discovery of galeaspids from Early Devonian of Wenshan, southeastern Yunnan, China. *Vert. PalAsiat.* **40**: 97–113.

Zhao, W.-J. and Zhu, M., 2010. Siluro-Devonian vertebrate biostratigraphy and biogeography of China. *Palaeoworld* **19**: 4–26.

Zhu, M., 1991. New information on *Diandongpetalichthys* (Placodermi: Petalichthyida). In: M.-M. Chang, Y.-H. Liu and G.-R. Zhang (Editors), Early Vertebrates and Related Problems of Evolutionary Biology, pp. 179–194.

Zhu, M., 1996. The phylogeny of the Antiarcha (Placodermi, Pisces), with the description of Early Devonian antiarchs from Qujing, Yunnan, China. *Bull. Mus. Natl. Hist. Nat.* **18**: 233–347.

Zhu, M., 2000. Catalogue of Devonian vertebrates in China, with notes on bio-events. *Cour. Forsch. Inst. Senckenberg* **223**: 373–390.

Zhu, M. and Ahlberg, P. E., 2004. The origin of the internal nostril of tetrapods. *Nature* **432**: 94–97.

Zhu, M., Ahlberg, P. E., Pan, Z.-H., Zhu, Y.-A., Qiao, T., Zhao, W.-J., Jia, L.-T. and Lu, J., 2016. A Silurian maxillate placoderm illuminates jaw evolution. *Science* **354**: 334–336.

Zhu, M. and Gai, Z.-K., 2006. Phylogenetic relationships of galeaspids (Agnatha). *Vert. PalAsiat.* **44**: 1–27.

Zhu, M. and Gai, Z.-K., 2007. Phylogenetic relationships of galeaspids (Agnatha). *Front. Biol. China* **2**: 1–19.

Zhu, M. and Janvier, P., 1996. A small antiarch, *Minicrania lirouyii* gen. et sp. nov., from the Early Devonian of Qujing, Yunnan (China), with remarks on antiarch phylogeny. *J. Vertebr. Paleontol.***16**: 1–15.

Zhu, M. and Wang, J.-Q., 1996. A new macropetalichthyid from China, with special reference to the historical zoogeography of the Macropetalichthyidae (Placodermi). *Vert. PalAsiat.* **34**: 253–268.

Zhu, M., Wang, W. and Yu, X.-B., 2010. *Meemannia eos*, a basal sarcopterygian fish from the Lower Devonian of China –expanded description and significance. In: D.K. Elliott, J.G. Maisey, X.-B. Yu and D.-S. Miao (Editors), Morphology, Phylogeny and Paleobiogeography of Fossil Fishes. Verlag Dr. Friedrich Pfeil, München, pp. 199–214.

Zhu, M. and Yu, X.-B., 2002. A primitive fish close to the common ancestor of tetrapods and lungfish. *Nature* **418**: 767–770.

Zhu, M. and Yu, X.-B., 2004. Lower jaw character transitions among major sarcopterygian groups - a survey based on new materials from Yunnan, China. In: G. Arratia, M. V. H. Wilson and R. Cloutier (Editors), Recent Advances in the Origin and Early Radiation of Vertebrates. Verlag Dr. Friedrich Pfeil, München, pp. 271–286.

Zhu, M. and Yu, X.-B., 2009. Stem sarcopterygians have primitive polybasal fin articulation. *Biol. Lett.* **5**: 372–375.

Zhu, M., Yu, X.-B. and Ahlberg, P. E., 2001. A primitive sarcopterygian fish with an eyestalk. *Nature* **410**: 81–84.

Zhu, M., Yu, X.-B. and Janvier, P., 1999. A primitive fossil fish sheds light on the origin of bony fishes. *Nature* **397**: 607–610.

Zhu, M., Yu, X.-B., Wang, W., Zhao, W.-J. and Jia, L.-T., 2006. A primitive fish provides key characters bearing on deep osteichthyan phylogeny. *Nature* **441**: 77–80.

Zhu, M., Yu, X.-B., Ahlberg, P. E., Choo, B., Lu, J., Qiao, T., Qu, Q.-M., Zhao, W.-J., Jia, L.-T., Blom, H. and Zhu, Y.-A., 2013. A Silurian placoderm with osteichthyan-like marginal jaw bones. *Nature* **502**: 188–193.

Zhu, M., Yu, X.-B., Choo, B., Wang, J.-Q. and Jia, L.-T., 2012. An antiarch placoderm shows that pelvic girdles arose at the root of jawed vertebrates. *Biol. Lett.* **8**: 453–456.

Zhu, M., Zhao, W.-J., Jia, L.-T., Lu, J., Qiao, T. and Qu, Q.-M., 2009. The oldest articulated osteichthyan reveals mosaic gnathostome characters. *Nature* **458**: 469–474.

Zhu, Y.-A., Giles, S., Young, G. C., Hu, Y.-Z., Bazzi, M., Ahlberg, P. E., Zhu, M. and Lu, J., 2021. Endocast and bony labyrinth of a Devonian "placoderm" challenges stem gnathostome phylogeny. *Curr. Biol.* **31**: 1112–1118.e4

Zhu, Y.-A., Lu, J. and Zhu, M., 2019. Reappraisal of the Silurian placoderm *Silurolepis* and insights into the dermal neck joint evolution. *R. Soc. Open Sci.* **6**: 191181.

Zong, R.-W., Liu, Q., Wei, F. and Gong, Y.-M., 2017. Fentou Biota: a Llandovery (Silurian) shallow-water exceptionally preserved biota from Wuhan, Central China. *J. Geol.* **125**: 469–478.