Permian and Triassic Red Beds and the Penarth Group of Great Britain

M. J. Benton

Department of Earth Sciences, University of Bristol, Bristol, UK

E. Cook

Department of Earth Sciences, University of Bristol, Bristol, UK

and

P. Turner

School of Earth Sciences The University of Birmingham Birmingham, UK

GCR Editor: G. Warrington



References

In this reference list the arrangement is alphabetical by author surname for works by sole authors and dual authors. Where there are references that include the first-named author with others, the sole-author works are listed chronologically first, followed by the dual author references (alphabetically) followed by the references with three or more authors listed *chronologically*. Chronological order is used within each group of identical authors.

- Ager, D.V. and Smith, W.E. (1965) The coast of South Devon and Dorset between Branscombe and Burton Bradstock. *Geologists' Association Guide*, 23, 21 pp.
- Akhurst, M.C., Chadwick, R.A., Holliday, D.W., McCormac, M., McMillan, A.A., Millward, D. and Young, B. (1997) Geology of the west Cumbria district. *Memoir of the British Geological Survey*, Sheets 28, 37, and 47 (England and Wales), British Geological Survey, Nottingham, 138 pp.
- Alberti, F. von (1834) Beitrag zu einer Monographie des Bunten Sandsteins, Muschelkalks und Keupers, und die Verbindung dieser Gebilde zu einer Formation. Cotta, Stuttgart and Tübingen, 366 pp.
- Alkattan, M.M. (1976) The Geochemistry of Lower Keuper Marl at Lavernock Point, Glamorgan, South Wales. Unpublished MSc thesis, University of Wales.
- Anderson, J.G.C. (1960) Geology around the university towns: the Cardiff District. *Geologists' Association Guide*, 16, 12 pp.
- Anderson, T.B., Parnell, J. and Ruffell, A.H. (1995) Influence of basement on the geometry of Permo-Triassic basins in the northwest British Isles. In *Permian and Triassic Rifting in Northwest Europe* (ed.S.A.R. Boldy),

Geological Society of London Special Publication No. 91, 103–22.

- Anderton, R., Bridges, P.H., Leeder, M.R. and Sellwood, B.W. (1979) A Dynamic Stratigraphy of the British Isles, Allen and Unwin, London, 301 pp.
- Andrews, I.J., Long, D., Richards, P.C., Thompson, A.R., Brown, S., Chester, J.A. and McCormac, M. (1990) The Geology of the Moray Firth. United Kingdom Offshore Regional Reports, HMSO for British Geological Survey, London, 96 pp.
- Antia, D.J. and Sykes, J.H. (1979) The surface textures of quartz grains from a Rhaetian bone-bed, Blue Anchor Bay, Somerset. *Mercian Geologist*, 7, 205–10.
- Arkell, W.J. (1933) The Jurassic System in Great Britain, Clarendon Press, Oxford, 681 pp.
- Arthurton, R.S. (1971) The Permian evaporites of the Langwathby Borehole, Cumberland. *Report of the Institute of Geological Sciences*, No. 71/17.
- Arthurton, R.S. (1980) Rhythmic sedimentary sequences in the Triassic Keuper Marl (Mercia Mudstone Group) of Cheshire, northwest England. *Geological Journal*, 15, 43–58.
- Arthurton, R.S. and Hemingway, J.E. (1972) The St. Bees evaporites – a carbonate-evaporite

formation of Upper Permian age in west Cumberland, England. *Proceedings of the Yorkshire Geological Society*, **38**, 43–8.

- Arthurton, R.S. and Wadge, A.J. (1981) Geology of the country around Penrith. *Memoir of the Geological Survey of Great Britain*, Sheet 24 (England and Wales), HMSO, London, 178 pp.
- Arthurton, R.S., Burgess, I.C. and Holliday, D.W. (1978) Permian and Triassic. In *The Geology* of the Lake District (ed.F. Moseley), Yorkshire Geological Society Occasional Publication, 3, 189–206.
- Astin, T.R. and MacDonald, D.I.M. (1983) Syndepositional faulting and valley-fill breccias in the Permo-Triassic of Arran. *Scottish Journal of Geology*, **19**, 47–58.
- Aveline, WT. (1861) The geology of the country around Nottingham. *Memoir of the Geological Survey of Great Britain*, Quartersheet 71NE (England and Wales), HMSO, London, 21 pp.
- Aveline, W.T. (1880) The geology of the country around Nottingham, 2nd edn. *Memoir of the Geological Survey of Great Britain*, Quartersheet 71NE (England and Wales), HMSO, London, 51 pp.
- Bailey, E.B. and Anderson, E.M. (1925) The geology of Staffa, Iona, and Western Mull. *Memoir of the Geological Survey of Scotland*, Sheet 43 (Scotland), HMSO, Edinburgh, 107 pp.
- Balchin, D.A. and Ridd, M.F. (1970) Correlation of the younger Triassic rocks across eastern England. *Quarterly Journal of the Geological Society of London*, **126**, 91–101.
- Ball, H.W. (1980) Spirorbis from the Triassic Bromsgrove Sandstone Formation (Sherwood Sandstone Group) of Bromsgrove, Worcestershire. Proceedings of the Geologists' Association, 91, 149-54.
- Barclay, WJ., Ambrose, K., Chadwick, R.A. and Pharaoh, T.C. (1997) Geology of the country around Worcester. *Memoir of the British Geological Survey*, Sheet 199 (England and Wales), The Stationery Office, London, 156 pp.
- Barnes, R.P., Ambrose, K., Holliday, D.W. and Jones, N.S. (1994) Lithostratigraphical subdivision of the Triassic Sherwood Sandstone Group in west Cumbria. *Proceedings of the Yorkshire Geological Society*, **50**, 51–60.
- Beasley, H.C. (1902) The fauna indicated in the Lower Keuper Sandstone of the neighbourhood of Liverpool. *Transactions of the*

Liverpool Biological Society, 16, 3-26.

- Becker, L., Poreda, R.J., Hunt, A.G., Bunch, T.E. and Rampino M. (2001) Impact event at the Permian–Triassic boundary: Evidence from extraterrestrial noble gases in fullerenes. *Science*, **291**, 1530–3.
- Bell, B.R. and Harris, J.W. (1986) An Excursion Guide to the Geology of the Isle of Skye, Geological Society of Glasgow, Glasgow, 317 pp.
- Bell, J., Holden, J., Pettigrew, T.H. and Sedman,
 K.W. (1979) The Marl Slate and basal Permian
 breccia at Middridge, Co. Durham.
 Proceedings of the Yorkshire Geological
 Society, 42, 439-60.
- Benton, M.J. (1983) The Triassic reptile Hyperodapedon from Elgin: functional morphology and relationships. Philosophical Transactions of the Royal Society of London, Series B, 302, 605-720.
- Benton, M.J. (1990) The species of *Rbynchosaurus*, a rhynchosaur (Reptilia, Diapsida) from the Middle Triassic of England. *Philosophical Transactions of the Royal Society of London, Series B*, **328**, 213-306.
- Benton, M.J. (1994) Late Triassic terrestrial vertebrate extinctions: stratigraphic aspects and the record of the Germanic Basin. *Paleontologia Lombarda*, Nuova Serie, 2, 19–38.
- Benton, M.J. (1999) Scleromochlus and the origin of dinosaurs and pterosaurs.
 Philosophical Transactions of the Royal Society, Series B, 354, 1-25.
- Benton, M.J. and Gower, D.J. (1997) Richard Owen's giant Triassic frogs: archosaurs from the Middle Triassic of England. *Journal of Vertebrate Paleontology*, **17**, 74–88.
- Benton, M.J. and Spencer, P.S. (1995) Fossil Reptiles of Great Britain, Geological Conservation Review Series No. 5, Chapman and Hall, London, 345 pp.
- Benton, M.J. and Walker, A.D. (1985) Palaeoecology, taphonomy and dating of Permo-Triassic reptiles from Elgin, north-east Scotland. *Palaeontology*, **29**, 207–34.
- Benton, M.J., Warrington, G., Newell, A.J. and Spencer, P.S. (1994) A review of the British Mid Triassic tetrapod faunas. In *In the Shadow of the Dinosaurs, Early Mesozoic Tetrapods* (eds N.C. Fraser and H.-D. Sues), Cambridge University Press, New York, pp. 131-60.

- Benton, M.J., Juul, L., Storrs, G.W. and Galton, P.M. (2000) Anatomy and systematics of the prosauropod dinosaur *Thecodontosaurus antiquus* from the Upper Triassic of southwest England. *Journal of Vertebrate Paleontology*, 20, 77–108.
- Benton, M.J., Cook, E., Shreve, D., Currant, A. and Hooker, J. (in press) *Fossil Mammals and Birds of Great Britain*, Geological Conservation Review Series, Joint Nature Conservation Committee, Peterborough.
- Berridge, N.G. and Ivimey-Cook, H.C. (1967) The geology of a Geological Survey borehole at Lossiemouth, Morayshire. *Bulletin of the Geological Survey of Great Britain*, 27, 155–69.
- Binney, E.W. (1855) On the Permian beds of the north-west of England. *Memoir and Proceedings of the Manchester Literary and Philosophical Society, Series 2*, **12**, 369–96.
- Binney, E.W. (1857) Additional observations on the Permian beds of the north-west of England. *Memoir and Proceedings of the Manchester Literary and Philosophical Society, Series 2*, 14, 101-20.
- Blackith, R.E. (1956) The Haffield Breccias. Scientific Journal of the Royal College of Sciences, 26, 77–85.
- Blair, T.C. and McPherson, J.G. (1994) Alluvial fans and their natural distinction from rivers based on morphology, hydraulic processes, sedimentary processes and facies assemblages. *Journal of Sedimentary Research*, 64, 450–89.
- Blodgett, R.H. and Stanley, K.O. (1980)
 Stratification, bedforms and discharge relationships of the Platte braided river system, Nebraska. *Journal of Sedimentary Petrology*, 50, 139–48.
- Bluck, B.J. (1965) The sedimentary history of some Triassic conglomerates in the Vale of Glamorgan, South Wales. *Sedimentology*, 4, 225–45.
- Boomer, I.D., Duffin, C.J. and Swift, A. (1999)
 Arthropods 1: crustaceans. In Fossils of the Rhaetian Penarth Group (eds A. Swift and D.M. Martill), The Palaeontological Association, London, pp. 129–48.
- Bott, M.H.P. (1974) The geological interpretation of a gravity survey of the English Lake District and the Vale of Eden. *Journal of the Geological Society*, *London*, **130**, 309–31.
- Bott, M.H.P. (1978) Deep structure. In *The Geology of the Lake District* (ed.F. Moseley),

Yorksbire Geological Society, Occasional Publication, 3, 25–40.

- Boyd Dawkins, W. (1864a) On the Rhaetic Beds and White Lias of western and central Somerset; and on the discovery of a new fossil mammal in the Grey Marlstones beneath the Bone Bed. *Quarterly Journal of the Geological Society of London*, 20, 396–412.
- Boyd Dawkins, W. (1864b) Outline of the Rhaetic Formation in West and Central Somerset. *Geological Magazine*, *Decade 1*, **1**, 257–60.
- Bradshaw, R. and Hamilton, D. (1967) Conjugate gypsum veins at Blue Anchor Point, Somerset. *Proceedings of the Bristol Naturalists' Society*, **31**, 305–9.
- Brickenden, L.B. (1852) Notice of the discovery of reptilian foot-tracks and remains in the Old Red or Devonian strata of Moray. *Quarterly Journal of the Geological Society* of London, **8**, 97–100.
- Briden, J.C. and Daniels, B.A. (1999) Palaeomagnetic correlation of the Upper Triassic of Somerset, England, with continental Europe and eastern North America. Journal of the Geological Society, London, 156, 317–26.
- Bridge, D. McC., Carney, J.N., Lawley, R.S. and Rushton, A.W.A. (1998) Geology of the country around Coventry and Nuneaton. *Memoir* of the Geological Survey of Great Britain, Sheet 169 (England and Wales), The Stationery Office, London, 185 pp.
- Bristow, C.R. and Scrivener, R.C. (1984) The stratigraphy and structure of the Lower New Red Sandstone of the Exeter district. *Proceedings of the Ussher Society*, 6, 68–74.
- Bristow, W.H. (1867) On the Lower Lias or Lias-Conglomerate of a part of Glamorganshire. Quarterly Journal of the Geological Society of London, 23, 199–207.
- Brodie, P.B. (1845) A History of the Fossil Insects in the Secondary Rocks of England, John van Voorst, London, 130 pp.
- Brodie, P.B. (1856) On the Upper Keuper Sandstone (included in the New Red Marl) of Warwickshire. Quarterly Journal of the Geological Society of London, 12, 374-6.
- Brodie, P.B. (1858) Contributions to the geology of Gloucestershire. *The Geologist*, **1**, 41–8; 81–8; 227–33; 289–91; 369–77.
- Brodie, P.B. (1886) On the discovery of fossil fish in the New Red Sandstone (Upper Keuper) in Warwickshire. *Geological Magazine*, *Decade* 3, 3, 507–8.

- Brodie, P.B. (1887) Notes on the Upper Keuper Section at Shrewley where the fish were found, and on the Trias generally in Warwickshire. Quarterly Journal of the Geological Society of London, 43, 540-2.
- Brodie, P.B. (1893) On some additional remains of cestraciont and other fishes in the Green Gritty Marls, immediately overlying the Red Marls of the Upper Keuper in Warwickshire. *Quarterly Journal of the Geological Society* of London, 49, 171-4.
- Brodie, P.B. (1894) On the discovery of molluscs in the Upper Keuper at Shrewley in Warwickshire. Quarterly Journal of the Geological Society of London, 50, 170.
- Brookfield, M.E. (1977) The origin of bounding surfaces in ancient aeolian sandstones. *Sedimentology*, 24, 303–32.
- Brookfield, M.E. (1978) Revision of the stratigraphy of Permian and supposed Permian rocks of southern Scotland. *Geologische Rundschau*, 67, 110–43.
- Brookfield, M.E. (1979) Anatomy of a Lower Permian aeolian sandstone complex, southern Scotland. Scottish Journal of Geology, 15, 81–96.
- Brookfield, M.E. (1980) Permian intermontane basin sedimentation in southern Scotland. Sedimentary Geology, 27, 167–94.
- Brookfield, M.E. (1981) Field guide to the Permian rocks of the Thornhill and Moffat Basins. *Transactions of the Dumfries and Galloway Natural History and Antiquarian Society*, **56**, 1–9.
- Brookfield, M.E. (1984) Eolian sands. In *Facies Models*, 2nd edn (ed.R.F. Walker), Geoscience Canada Reprint Series No. 1, pp. 91–103.
- Brookfield, M.E. (2000) Temporary desert lake deposits, Lower Permian (Rotliegendes) Southern Scotland, U.K. In *Lake Basins Through Space and Time* (eds E.H. Gierlowski-Kordesch and K.R. Kelts) AAPG Studies in Geology No. 46, The American Assoation of Petroleum Geologsts, Tulsa, pp 67–74.
- Bruck, P.M., Dedman, R.E. and Wilson, C.L. (1967) The New Red Sandstone of Raasay and Scalpay, Inner Hebrides. *Scottish Journal* of Geology, **3**, 168–80.
- Buckland, W. (1829) On the discovery of coprolites, or fossil faeces, in the Lias at Lyme Regis, and in other formations. *Transactions* of the Geological Society of London, Series 2,

1, 223-36.

- Buckland, W. (1844) President's address, 1839. Proceedings of the Ashmolean Society, 16, 5-7.
- Buckland, W. and Conybeare, W.D. (1824) Observations on the south-western coal district of England. *Transactions of the Geological Society of London, Series 2*, 1, 210–316.
- Burckhardt, R. (1900) On Hyperodapedon gordoni. Geological Magazine, Decade 4, 7, 486–92, 529–35.
- Burgess, I.C. (1965) The Permo-Triassic rocks around Kirkby Stephen, Westmoreland. Proceedings of the Yorkshire Geological Society, 35, 91-101.
- Burgess, I.C. and Holliday, D.W. (1974) The Permo-Triassic rocks of the Hilton Borehole, Westmorland. Bulletin of the Geological Survey of Great Britain, 46, 167–82.
- Burgess, I.C. and Holliday, D.W. (1979) Geology of the country around Brough-under-Stainmore. *Memoir of the British Geological Survey*, Sheets 25, 30, and 31 (England and Wales), HMSO, London, 131 pp.
- Burgess, I.C. and Wadge, A.J. (1974) *The Geology* of the Cross Fell Area, Institue of Geological Sciences, HMSO, London, 92 pp.
- Burley, S.D. (1984) Patterns of diagenesis in the Sherwood Sandstone Group (Triassic), United Kingdom. *Clay Minerals*, 19, 403–40.
- Cameron, T.D.J. (1993) Triassic, Permian and pre-Permian of the central and northern North Sea. In *Litbostratigraphic* Nomenclature of the UK North Sea, Volume 4 (eds R.W. O'B. Knox and W.G. Cordey), British Geological Survey for the United Kingdom Offshore Operators Association, Keyworth, 163 pp.
- Cameron, T.D.J., Crosby, A., Balson, P.S., Jeffrey, D.H., Lott, G.K., Bulat, J. and Harrison, D.J. (1992) The Geology of the Southern North Sea, United Kingdom Offshore Regional Reports No. 7, HMSO for British Geological Survey, London, 152 pp.
- Cameron Smith, A. (1925) The Locharbriggs Sandstone. Transactions of the Dumfries and Galloway Natural History and Antiquarian Society, 12, 231–6.
- Campbell Smith, W. (1963) Description of the igneous rocks represented among pebbles from the Bunter Pebble Beds of the Midlands of England. Bulletin of the British Museum (Natural History, Mineralogy Series, 2, 1–17.

- Carter, H.J. (1888) On some remains in the Triassic strata of the south coast of Devonshire between Budleigh Salterton and Sidmouth. Quarterly Journal of the Geological Society of London, 44, 318–19.
- Carus-Wilson, C. (1913) Cupriferous sandstones at Exmouth. *Nature*, **91**, 530.
- Cave, R. (1977) Geology of the Malmesbury district. Memoir of the Geological Survey of Great Britain, Sheet 251 (England and Wales), HMSO, London, 343 pp.
- Chadwick, R.A. (1986) Extension tectonics in the Wessex Basin, southern England. *Journal of the Geological Society, London*, 143, 465–88.
- Chadwick, R.A. and Evans, D.J. (1995) The timing and direction of Permo-Triassic extension in southern Britain. In *Permian and Triassic Rifting in Northwest Europe* (ed.S.A.R. Boldy), *Geological Society of London Special Publication No.* 91, 161–92.
- Chaloner, W.G. and Clarke, R.F.A. (1961) A new British Permian spore. *Palaeontology*, 4, 648–52.
- Charsley, T.J. (1989) Geology of the Nottingham (South) district, 1:10,000 sheet SK53NE. British Geological Survey, Onshore Geology Series, Technical Report, WA/89/4.
- Charsley, T.J., Rathbone, P.A. and Lowe, D.J. (1990) Nottingham: a geological background for planning and development. British Geological Survey, Onshore Geology Series, Technical Report, WA/90/1.
- Clark, N.D.L. (1999) The Elgin marvel. Open University Geological Society Journal, 20, 16-19.
- Clarke, R.F.A. (1965a) Keuper miospores from Worcestershire, England. *Palaeontology*, **8**, 294–321.
- Clarke, R.F.A. (1965b) British Permian saccate and monosulcate miospores. *Palaeontology*, **8**, 322–54.
- Clemens, W.A., Lillegraven, J.A., Lindsay, E.H. and Simpson, G.G. (1979) Where, when and what – a survey of known Mesozoic mammal distribution. In *Mesozoic Mammals* (eds J.A. Lillegraven, Z. Kielan-Jaworowska and W.A. Clemens), University of California Press, Berkeley, pp. 7–58.
- Clemmensen, L.B. (1987) Complex star dunes and associated aeolian bedforms, Hopeman Sandstone (Permo-Triassic), Moray Firth Basin, Scotland. In *Desert Sediments: Ancient* and Modern (eds L. Frostick and I. Reid), Geological Society of London Special

Publication No. 35, 213-31.

- Clemmensen, L.B. (1989) Preservation of interdraa and plinth deposits by the lateral migration of large linear draas (Lower Permian Yellow Sands, northeast England).
 Sedimentary Geology, 65, 139–51.
- Clemmensen, L.B. and Abrahamsen, K. (1983) Aeolian stratification and facies association in desert sediments, Arran basin (Permian), Scotland. *Sedimentology*, **30**, 311–39.
- Clemmensen, L.B. and Hegner, J. (1991) Eolian sequence and erg dynamics, the Permian Corrie Sandstone, Scotland. *Journal of Sedimentary Petrology*, **61**, 768–74.
- Clemmensen, L.B., Øxnevad, I.E.I. and de Boer, P.L. (1994) Climatic controls on ancient desert sedimentation: some late Palaeozoic and Mesozoic examples from NW Europe and the Western Interior of the USA. Special Publications of the International Association of Sedimentologists, 19, 439–57.
- Cocks, L.R.M. (1989) Lower and Upper Devonian brachiopods from the Budleigh Salterton Pebble Bed, Devon. Bulletin of the British Museum (Natural History), Geology Series, 45, 21–37.
- Cocks, L.R.M. (1993) Triassic pebbles, derived fossils and the Ordovician to Devonian palaeogeography of Europe. *Journal of the Geological Society, London*, **150**, 219–26.
- Colter, V.S. and Barr, K.W. (1975) Recent developments in the geology of the Irish Sea and Cheshire Basins. In *Petroleum and the Continental Shelf of North West Europe* (ed. A.W. Woodland), Applied Science Publishers, London, pp. 61–75.
- Colter, V.S. and Ebbern, J. (1978) The petrography and reservoir properties of some Triassic sandstones of the northern Irish Sea Basin. Journal of the Geological Society, London, 135, 57-62.
- Conybeare, W. D and Phillips, J. (1822) Outlines of the Geology of England and Wales, William Phillips, London, 470 pp.
- Cope, J.C.W. (1971) Mesozoic rocks of the southern part of the Vale of Glamorgan. In *Geological Excursions in South Wales and the Forest of Dean* (eds D.A. Bassett and M.G. Bassett), Geologists' Association South Wales Group, Cardiff, pp. 114–24.
- Cope, J.C.W., Getty, T.A., Howarth, M.K., Morton, N. and Torrens, H.S. (1980) A Correlation of the Jurassic Rocks in the British Isles. Part One: Introduction and Lower Jurassic.

Geological Society of London, Special Report, 14, 73 pp.

- Cowan, G. (1993) Identification and significance of aeolian deposits within the dominantly fluvial Sherwood Sandstone Group of the East Irish Sea Basin UK. In *Characterization of Fluvial and Aeolian Reservoirs* (eds C.P. North and D.J. Prosser), *Geological Society of London Special Publication No.* 73, pp. 231–45.
- Coward, M.P. (1995) Structural and tectonic setting of the Permo-Triassic basins of northwest Europe. In Permian and Triassic Rifting in Northwest Europe (ed S.A.R. Boldy), Geological Society of London Special Publication No. 91, pp. 8–39.
- Coysh, A.W. (1927) The petrology of the Avonian rocks at Sodbury, Gloucestershire. *Geological Magazine*, 64, 167.
- Craig, G.Y. (1965) Permian and Triassic. In *The Geology of Scotland* (ed.G.Y. Craig), Oliver and Boyd, Edinburgh and London, pp. 385–400.
- Cuny, G. and Benton, M.J. (1999) Early radiation of the neoselachian sharks in western Europe. *Geobios*, **32**, 193–204.
- Curtis, M.T. (1982) Playa cycles in the Mercia Mudstone (Keuper Marl) of Aust Cliff, Avon. Proceedings of the Bristol Naturalists' Society, 42, 13-22.
- Dakyns, J.R., Tiddeman, R.H. and Goodchild, J.G. (1897) The geology of the country between Appleby, Ullswater, and Haweswater. *Memoir of the Geological Survey of Great Britain*, Sheet 30, (England and Wales), HMSO, London, 110 pp.
- Dalglish, J. and Forster, G.B. (1864) On the Magnesian Limestone of Durham. Transactions of the Northern England Institution of Mining Engineers, 13, 205–13.
- Davies, J. (1961) Two derived fossils from the Bunter Pebble Beds of Hilbre Island, Cheshire. *Liverpool and Manchester Geological Journal*, 2, 626.
- De la Beche, H. (1846) On the formation of the rocks of South Wales and south-western England. *Memoir of the Geological Survey of Great Britain*, 1, HMSO, London, 1–261.
- Dineley, D.L. and Metcalfe, S.J. (1999) Fossil Fishes of Great Britain. Geological Conservation Review Series No. 16, Joint Nature Conservation Committee, Peterborough, 675 pp.

Donovan, D.T. (1955) Mesozoic. In Bristol and

its Adjoining Counties (eds C.M. MacInnes and W.F. Whittard), British Association for the Advancement of Science, Bristol, pp. 23–8.

- Donovan, D.T. and Kellaway, G.A. (1984) Geology of the Bristol District: the Lower Jurassic Rocks. *Memoir of the British Geological Survey*, HMSO, London, 69 pp.
- Duff, K.L., McKirdy, A.P. and Harley, M.J. (1985) New Sites for Old. A Students' Guide to the Geology of the east Mendips, Nature Conservancy Council, Peterborough, 189 pp.
- Duff, P. (1842) Sketch of the Geology of Moray, Forsyth and Young, Elgin, 72 pp.
- Duffin, C.J. (1978) The Bath geological collections. f. The importance of certain vertebrate fossils collected by Charles Moore: an attempt at scientific perspective. *Geological Curators Group Newsletter*, 2, 59–67.
- Duffin, C.J. (1982) Teeth of a new selachian from the Upper Triassic of England. Neues Jabrbuch für Geologie und Paläontologie, Monatsbefte, **1982**, 157–66.
- Dunham, K.C. (1932) Quartz dolerite pebbles (Whin Sill type) in the Upper Brockram. *Geological Magazine*, 69, 425–9.
- Durrance, E.M. and Laming, D.J.C. (1982) *The Geology of Devon*, University of Exeter, Exeter, 345 pp.
- Earp, J.R. and Taylor, B.J. (1986) Geology of the country around Chester and Winsford. *Memoir of the British Geological Survey*, Sheet 109 (England and Wales), HMSO, London, 119 pp.
- Eastwood, T. (1953) Northern England, 3rd edn, British Regional Geology Series, No. 7, HMSO for Geological Survey and Museum, London, 72 pp.
- Eastwood, T., Whitehead, T.H. and Robertson, T. (1925) The geology of the country around Birmingham. *Memoir of the Geological Survey of Great Britain*, Sheet 168, (England and Wales), HMSO, London, 152 pp.
- Eastwood, T., Dixon, E.E.L., Hollingworth, S.E. and Smith, B. (1931) The geology of the Whitehaven and Workington district. *Memoir* of the Geological Survey of Great Britain, Sheet 28, (England and Wales), HMSO, London, 304 pp.
- Eccles, J. (1870–1871) On some sections of Permian strata near Kirkby Stephen. *Transactions of the Manchester Geological* Society, 21, 30–7.
- Edmonds, E.A. and Williams, B.J. (1985)

Geology of the country around Taunton and the Quantock Hills. *Memoir of the British Geological Survey*, Sheet 295 (England and Wales), HMSO, London, 92 pp.

- Edmonds, E.A., McKeown, M.C. and Williams, M. (1975) South-West England, 4th edn, British Regional Geology Series, No. 17, HMSO for Institute of Geological Sciences, London, 138 pp.
- Edwards, H.E., Becker, A.D. and Howell, J.A. (1993) Compartmentalization of an aeolian sandstone by structural heterogeneities: Permo-Triassic Hopeman Sandstone, Moray Firth, Scotland. In *Characterization of Fluvial and Aeolian Reservoirs* (eds C.P. North and D.J. Prosser), *Geological Society of London Special Publication No.* 73, pp. 339-65.
- Edwards, R.A. (1999) The Minehead district a concise account of the geology. *Memoir of the British Geological Survey*, Sheet 278 and part of Sheet 294 (England and Wales), The Stationery Office for the British Geological Survey, London, 128 pp.
- Edwards, R.A. and Scrivener, R.C. (1999) Geology of the country around Exeter. *Memoir of the British Geological Survey*, Sheet 325 (England and Wales), The Stationery Office for the British Geological Survey, London, 184 pp.
- Edwards, R.A., Warrington, G., Scrivener, R.C., Jones, N.S., Haslam, H.W. and Ault, L. (1997) The Exeter Group, south Devon, England: a contribution to the early post-Variscan stratigraphy of northwest Europe. *Geological Magazine*, 134, 177–97.
- Elliott, R.E. (1961) The stratigraphy of the Keuper series in southern Nottinghamshire. Proceedings of the Yorkshire Geological Society, 33, 197-234.
- Ellis, N.V., Bowen, D.Q., Campbell, S. et al., (1996) An Introduction to the Geological Conservation Review, Geological Conservation Review Series No.1, Joint Nature Conservation Committee, Peterborough, 131 pp.
- Erwin, D.H. (1993) *The Great Paleozoic Crisis: Life and Death in the Permian*, Columbia University Press, New York, 327 pp.
- Etheridge, R. (1865) On the Rhaetic or Avicula contorta beds at Garden Cliff, Westburyupon-Severn, Gloucestershire. Proceedings of the Cotteswold Naturalists' Field Club, 3, 218–34.

- Etheridge, R. (1867a) Physical structure of north Devon and the palaeontological value of the Devonian fossils. *Quarterly Journal of the Geological Society of London*, 23, 251–2.
- Etheridge, R. (1867b) Physical structure of west Somerset and north Devon and the palaeontological value of the Devonian fossils. *Quarterly Journal of the Geological Society* of London, 23, 568–98.
- Etheridge, R. (1870) On the geological position and geographical distribution of the Reptilian or Dolomitic Conglomerate of the Bristol area. *Quarterly Journal of the Geological Society of London*, 26, 174–92.
- Etheridge, R. (1872) On the physical structure and organic remains of the Penarth (Rhaetic) beds at Penarth and Lavernock, also with descriptions of the Westbury-on-Severn section. *Transactions of the Cardiff Naturalists' Society*, **3**, 39–64.
- Evans, D.J., Rees, J.G. and Holloway, S. (1993) The Permian to Jurassic stratigraphy and structural evolution of the central Cheshire Basin. *Journal of the Geological Society*, *London*, **150**, 857–70.
- Farris, M.A., Oates, M.J. and Torrens, H.S. (1999) New evidence on the origin and Jurassic age of palaeokarst and limestone breccias, Loch Slapin, Isle of Skye. *Scottish Journal of Geology*, 35, 25–9.
- Fisher, M.J. (1972) The Triassic palynofloral succession in England. *Geoscience and Man*, 4, 101–9.
- Fleet, W.F. (1927) The heavy minerals of Keele, Enville, "Permian", and Lower Triassic rocks of the Midlands, and the correlation of these strata. *Proceedings of the Geologists' Association*, **38**, 1–48.
- Forster, S.C. and Warrington, G. (1985) Geochronology of the Carboniferous, Permian and Triassic. In *The Chronology of the Geological Record* (ed.N.J. Snelling), *Memoir of the Geological Society*, 10, 99–113, Blackwell Scientific Publications, Oxford.
- Francis, E.H. (1959) The Rhaetic of the Bridgend district. *Proceedings of the Geologists' Association*, **70**, 158–70.
- Fraser, N.C. (1994) Assemblages of small tetrapods from the British Late Triassic fissure deposits. In *In the Shadow of the Dinosaurs, Early Mesozoic Tetrapods* (eds N.C. Fraser and H.-D. Sues), Cambridge University Press, New York, pp. 214–26.

- Fraser, N.C. and Benton, M.J. (1989) The Triassic reptiles *Bracbyrbinodon* and *Polysphenodon* and the relationships of the sphenodontids. *Zoological Journal of the Linnean Society*, 96, 413–45.
- Frederiksen, K.S., Clemmensen, L.B. and Lawaetz, H.S. (1998) Sequential architecture and cyclicity in Permian desert deposits, Brodick Beds, Arran, Scotland. *Journal of the Geological Society, London*, **155**, 677–83.
- Frostick, L.E., Reid, I., Jarvis, J. and Eardley, H. (1988) Triassic sediments of the Inner Moray Firth, Scotland: early rift deposits. *Journal of the Geological Society*, *London*, 145, 235–48.
- Gardiner, P.R. R.R. and Visscher, H. (1971) Permian-Triassic transition at Kingscourt, Ireland. *Nature Physical Science*, 229, 209-10.
- Garrett, P.A., Hardie, W.G., Lawson, J.D. and Shotton, F.W. (1958) Geology of the area around Birmingham. *Geologists' Association Guide*, 1, 22 pp.
- Geiger, M.E. and Hopping, C.A. (1968) Triassic stratigraphy of the southern North Sea Basin.
 Philosophical Transactions of the Royal Society of London, Series B, 254, 1–36.
- George, G.T. and Berry, J.K. (1993) A new lithostratigraphy and depositional model for the Upper Rotliegend of the UK sector of the southern North Sea. In *Characterization of Fluvial and Aeolian Reservoirs* (eds C.P. North and D.J. Prosser), *Geological Society of London Special Publication No.* 73, pp. 291–319.
- George, T.N., Harland, W.B., Ager, D.V., Ball, H.W., Blow, W.H., Casey, R. et al. (1969) Recommendations on stratigraphical usage. Proceedings of the Geological Society of London, 1638, 75–87.
- Gibson, W. (1905) The Geology of the North Staffordshire Coalfields. *Memoir of the Geological Survey*, Sheets 110, 123 and 124, (England and Wales), HMSO, London, 525 pp.
- Gillen, C. (1987) Huntly, Elgin and Lossiemouth. In *Excursion Guide to the Geology of the Aberdeen Area* (eds N.H. Trewin, B.C. Kneller and C. Gillen), Scottish Academic Press, Edinburgh, pp. 149–160.
- Glennie, K.W. (1970) Desert Sedimentary Environments. Developments in Sedimentology, 14, Elsevier, Amsterdam, 222 pp.
- Glennie, K.W. (1972) Permian Rotliegendes of northwest Europe interpreted in light of

modern desert sedimentation studies. Bulletin of the American Association of Petroleum Geologists, 56, 1046–71.

- Glennie, K.W. and Buller, A.T. (1983) The Permian Weissliegend of NW Europe. The partial deformation of aeolian dune sands caused by the Zechstein transgression. *Sedimentary Geology*, **35**, 43–81.
- Glover, B.W. and Powell, J.H. (1996) Interaction of climate and tectonics upon alluvial architecture: Late Carboniferous-Early Permian sequences at the southern margin of the Pennine Basin, UK. *Palaeogeography*, *Palaeoclimatology*, *Palaeoecology*, **121**, 13–34.
- Goodchild, J.G. (1881) The Penrith Sandstone. Transactions of the Cumberland and Westmoreland Association, 9, 31.
- Goodchild, J.G. (1893) Observations on the New Red Series of Cumberland and Westmoreland with especial reference to classification. *Transactions of the Cumberland Association*, 17, 1–24.
- Goudie, A.S. (1973) Duricrusts in Tropical and Sub-tropical Landscapes, Clarendon Press, Oxford, 174 pp.
- Green, G.W. (1992) Bristol and Gloucester Region, 3rd edn. British Regional Geology Series, No.16, HMSO for British Geological Survey, London, 188 pp.
- Green, G.W. and Welch, F.B.A. (1965) The geology of the country around Wells and Cheddar. *Memoir of the Geological Survey of Great Britain*, Sheet 280 (England and Wales), HMSO, London, 225 pp.
- Greenwood, H.W. (1916) The origin of the British Trias – a re-statement of the problem in the light of recent research. *Proceedings of the Liverpool Geological Society*, **12**, 209–35.
- Gregory, J.W. (1915) The Permian and Triassic rocks of Arran. *Transactions of the Geological Society of Glasgow*, **15**, 174–87.
- Groom, T.T. (1902) The sequence of the Cambrian and associated beds of the Malvern Hills. Quarterly Journal of the Geological Society of London, 58, 89–135.
- Hains, B.A. and Horton, A. (1969) Central England. 3rd edn. British Regional Geology Series, No. 10, HMSO for the Institute of Geological Sciences, London, 142 pp.
- Hallam, A. (1960) The White Lias of the Devon coast. Proceedings of the Geologists' Association, 71, 47-60.
- Hallam, A. (1981) A revised sea-level curve for

the early Jurassic. Journal of the Geological Society, London, 138, 735-43.

- Hallam, A. (1990) Correlation of the Triassic-Jurassic boundary in England and Austria. Journal of the Geological Society, London, 147, 421–4.
- Hallam, A. (1994) Strontium isotope profiles of Triassic–Jurassic boundary sections in England and Austria. Geology, 22, 1079–82.
- Hallam, A. and Wignall, P.B. (1997) Mass Extinctions and their Aftermath, Oxford University Press, Oxford, 320 pp.
- Hamblin, R.J.O., Crosby, A., Balson, P.S., Jones, S.M., Chadwick, R.A., Penn, I.E. and Arthur, M.J. (1992) *The Geology of the English Channel*. United Kingdom Offshore Regional Reports No.10, HMSO for the British Geological Survey, London, 106 pp.
- Hamilton, D. (1961) Algal growth in the Rhaetic Cotham Marble of Southern England. *Palaeontology*, 4, 324–33.
- Hamilton, D. (1977) Aust Cliff. In *Geological Excursions in the Bristol District* (ed.R.J.G. Savage), University of Bristol, Bristol, pp. 110–18.
- Hamilton, D. and Whittaker, A. (1977) Coastal exposures near Blue Anchor, Watchet and St. Audrie's Bay, north Somerset. In *Geological Excursions in the Bristol District* (ed.R.J.G. Savage), University of Bristol, Bristol, pp. 101–9.
- Hardie, W.G., Bennison, G.M., Garrett, P.A., Lawson, J.D. and Shotton, F.W. (1971) *The Area around Birmingham*, The Geologists' Association, Colchester, 27 pp.
- Harkness, R. (1850) On the New Red Sandstone of the southern portion of the Vale of the Nith. Quarterly Journal of the Geological Society of London, 6, 389–99.
- Harkness, R. (1862) On the sandstones and their associated deposits in the Vale of Eden, the Cumberland Plain and the south-east of Dumfriesshire. *Quarterly Journal of the Geological Society of London*, **18**, 205–18.
- Harkness, R. (1864) On the reptiliferous rocks and the footprint-bearing strata of the northeast of Scotland. *Quarterly Journal of the Geological Society of London*, 20, 429–43.
- Harland, W.B. and Hacker, J.F. (1966) Fossil lightning strikes 250 million years ago. *Report of the British Association for the Advancement of Science*, **22**, 663–71.
- Harland, W.B., Cox, A.V., Llewellyn, P.G., Pickton, C.A.G., Smith, A.G. and Walters, R. (1982) A

Geologic Time Scale, Cambridge University Press, Cambridge, 131 pp.

- Harland, W.B., Armstrong, R.I., Cox, A.V., Craig, L.E., Smith, A.G. and Smith, D.G. (1990) A Geologic Time Scale 1989, Cambridge University Press, Cambridge, 263 pp.
- Harris, T.M. (1938) *The British Rhaetic Flora*, British Museum (Natural History), London, 84 pp.
- Harrison, R.K. (1975) Concretionary concentrations of the rarer elements in Permo-Triassic red beds of South-West England. Bulletin of the Geological Survey of Great Britain, 52, 1–26.
- Henson, M.R. (1970) The Triassic rocks of south Devon. *Proceedings of the Ussher Society*, 2, 172–7.
- Henson, M.R. (1972) The form of the Permo-Triassic Basin in south-east Devon. Proceedings of the Ussher Society, 3, 447-57.
- Henson, M.R. (1973) Clay minerals from the lower New Red Sandstone of South Devon. *Proceedings of the Geologists' Association*, 84, 429–45.
- Hesselbo, S.P. and Jenkyns, H.C. (1995) A comparison of the Hettangian to Bajocian successions of Dorset and Yorkshire. In *Field Geology of the British Jurassic* (ed.P.D. Taylor), Geological Society, London, pp. 105-50.
- Hickling, G. (1909) British Permian footprints. Memoir and Proceedings of the Manchester Literary and Philosophical Society, 53 (22), 1–31.
- Hodge, M.B. (1932) The Permian Yellow Sands of North East England. Proceedings of the University of Durham Philosophical Society, 8, 410-58.
- Hodges, P. (1994) The base of the Jurassic System: new data on the first appearance of *Psiloceras planorbis* in southwest Britain. *Geological Magazine*, 131, 841–4.
- Holliday, D.W. (1993) Geophysical log signatures in the Eden Shales (Permo-Triassic) of Cumbria and their regional significance. Proceedings of the Yorkshire Geological Society, 49, 345-54.
- Hollingworth, S.E. (1942) The correlation of gypsum-anhydrite deposits and the associated strata in the north of England. *Proceedings of the Geologists' Association*, 53, 141-51.
- Holloway, S. (1985a) Permian. In Atlas of Onshore Sedimentary Basins in England

and Wales: Post-Carboniferous Tectonics and Stratigraphy (ed.A. Whittaker), Blackie, London, pp. 26–30.

- Holloway, S. (1985b) Triassic: Sherwood Sandstone Group (excluding the Kinnerton Sandstone Formation and the Lenton Sandstone Formation). In Atlas of Onsbore Sedimentary Basins in England and Wales: Post-Carboniferous Tectonics and Stratigraphy (ed.A. Whittaker), Blackie, London, pp. 31-3.
- Holloway, S. (1985c) Triassic: Mercia Mudstone and Penarth Groups. In Atlas of Onsbore Sedimentary Basins in England and Wales: Post-Carboniferous Tectonics and Stratigraphy (ed.A. Whittaker), Blackie, London, pp. 34-6.
- Holloway, S., Milodowski, A.E., Strong, G.E. and Warrington, G. (1989) The Sherwood Sandstone Group (Triassic) of the Wessex Basin, southern England. *Proceedings of the Geologists' Association*, 100, 383–94.
- Hopkins, C. (1999) New finds in the Hopeman Sandstone. Open University Geological Society Journal, 20, 20–5.
- Horne, J. and Gregory, J.W. (1916) The Annan Red Sandstone Series of Dumfriesshire. *Transactions of the Geological Society of Glasgow*, 15, 374–86.
- House, M.R. (1989) Geology of the Dorset coast. Geologists' Association Guide, 22, 164 pp.
- Howard, F.T. (1894) Plesiosaurus from Ostrea Beds of Lower Penarth. Transactions of the Cardiff Naturalists' Society, 25, 44.
- Howell, H.H. (1859) The Geology of the Warwickshire Coal-field and the Permian Rocks and Trias of the Surrounding District. *Memoir of the Geological Survey*, (England and Wales), HMSO, London, 57 pp.
- Hudson, J.D. (1983) Mesozoic sedimentation and sedimentary rocks in the Inner Hebrides. Proceedings of the Royal Society of Edinburgh, Series B, 83, 47–63.
- Hull, E. (1860) On the new subdivisions of the Triassic rocks of the central countries. *Transactions of the Manchester Geological and Mining Society*, **2**, 22–34.
- Hull, E. (1869) The Triassic and Permian Rocks of the Midland Counties of England. *Memoirs of the Geological Survey*, England and Wales, HMSO, London, 127 pp.
- Hull, E. (1892) A comparison of the Red Rocks of the South Devon coast with those of the Midland and Western counties. *Quarterly*

Journal of the Geological Society of London, **48**, 60–7.

- Hunter, R.E. (1977) Basic types of stratification in small eolian dunes. *Sedimentology*, 24, 361–87.
- Hutchinson, P.O. (1906) Geological section of the cliffs to the west and east of Sidmouth, Devon. Report of the British Association for the Advancement of Science, 1905, 168–70.
- Huxley, T.H. (1859a) Postscript [to Murchison (1859)]. Quarterly Journal of the Geological Society of London, 15, 435-6.
- Huxley, T.H. (1859b) On the Stagonolepis robertsoni; and on the recently discovered footmarks in the sandstones of Cummingstone. Quarterly Journal of the Geological Society of London, 15, 440-60.
- Huxley, T.H. (1869) On Hyperodapedon. Quarterly Journal of the Geological Society of London, 25, 138–52.
- Huxley, T.H. (1877) The crocodilian remains found in the Elgin Sandstones, with remarks on the Ichnites of Cummingstone. *Memoir of the Geological Survey of the United Kingdom, Monograph* No. 3, 1–52.
- Ireland, R.J., Pollard, J.E., Steel, R.J. and Thompson, D.B. (1978) Intertidal sediments and trace fossils from the Waterstones (Scythian-Anisian?) at Daresbury, Cheshire. *Proceedings of the Yorksbire Geological* Society, 41, 399-436.
- Irving, A. (1874) On the geology of the Nottingham district. *Geological Magazine*, *Decade 2*, **1**, 314–9.
- Irving, A. (1888) The red-rock series of the Devon coast-section. Quarterly Journal of the Geological Society of London, 44, 149-63.
- Irving, A. (1892) Supplementary note to the paper on the 'Red rocks of the Devon coastsection'. *Quarterly Journal of the Geological Society of London*, **48**, 68–80.
- Irving, A. (1893) The base of the Keuper formation in Devon. Quarterly Journal of the Geological Society of London, 49, 79–83.
- Ivimey-Cook, H.C. (1974) The Permian and Triassic deposits of Wales. In *The Upper Palaeozoic and Post-Palaeozoic Rocks of Wales* (ed.T.R. Owen), University of Wales Press, Cardiff, pp. 295–321.
- Ivimey-Cook, H.C., Warrington, G., Worley, N.E., Holloway, S. and Young, B. (1995) Rocks of Late Triassic and Early Jurassic age in the Carlisle Basin, Cumbria (north-west

England). Proceedings of the Yorksbire Geological Society, 50, (4), 305–16.

- Jackson, D.I. and Johnson, H. (1996) Lithostratigraphic Nomenclature of the Triassic, Permian and Carboniferous of the UK Offshore East Irish Sea Basin, British Geological Survey for the United Kingdom Offshore Operators Association, Keyworth, 161 pp.
- Jackson, D.I. and Mulholland, P. (1993) Tectonic and stratigraphic aspects of the East Irish Sea Basin and adjacent areas: contrasts in their post-Carboniferous structural. In *Petroleum Geology of Northwest Europe, Proceedings of the Fourth Conference* (ed.J.R. Parker), Geological Society, London, pp. 791–808.
- Jackson, D.I., Mulholland, P., Jones, S.M. and Warrington, G. (1987) The geological framework of the East Irish Sea Basin. In *Petroleum Geology of North West Europe* (eds J. Brookes and K.W. Glennie), Graham and Trotman, London, pp. 191–203.
- Jackson, D.I., Jackson, A.A., Evans, D., Wingfield, R.T.R., Barnes, R.P. and Arthur, M.J. (1995) *The Geology of the Irish Sea*. United Kingdom Offshore Regional Reports, No. 6, HMSO for the British Geological Survey, London, 123 pp.
- Jackson, D.I., Johnson, H. and Smith, N.J.P. (1997) Stratigraphical relationships and a revised lithostratigraphical nomenclature for the Carboniferous, Permian and Triassic rocks of the offshore East Irish Sea Basin. In Petroleum Geology of the Irish Sea and Adjacent Areas (eds N.S. Meadows, S.P. Trueblood, M. Hardman and G. Cowan), Geological Society of London Special Publication No. 124, pp. 11–32.
- Jeans, C.V. (1978) The origin of the Triassic clay assemblages of Europe with special reference to the Keuper Marl and Rhaetic of parts of England. *Philosophical Transactions of the Royal Society of London, Series B*, **289**, 549–639.
- Jin Yugan, Wardlaw, B.R., Glenister, B.F. and Kotlyar, G.V. (1997) Permian chronostratigraphic subdivisions. *Episodes*, **20**, 10–15.
- Johnson, H., Warrington, G. and Stoker, S.J. (1994) 6. Permian and Triassic of the Southern North Sea. In *Lithostratigraphic Nomenclature of the UK North Sea* (eds R.W. O'B. Knox and W.G. Cordey), British Geological Survey for the United Kingdom Offshore Operators Association, Keyworth,

141 pp.

- Jones, N.S. and Ambrose, K. (1994) Triassic sandy braidplain and aeolian sedimentation in the Sherwood Sandstone Group of the Sellafield area, west Cumbria. *Proceedings of the Yorksbire Geological Society*, **50**, 61–76.
- Jones, T.R. (1863) A monograph on the fossil Estheriae. Monograph of the Palaeontographical Society, 14 (62), 1-134.
- Judd, J.W. (1873) The Secondary rocks of Scotland. First Paper. Quarterly Journal of the Geological Society of London, 29, 97-195.
- Judd, J.W. (1878) The Secondary rocks of Scotland. Third paper. The strata of the Western Coast and Islands. Quarterly Journal of the Geological Society of London, 34, 660–743.
- Judd, J.W. (1886) On the relation of the reptiliferous sandstone of Elgin to the Upper Old Red Sandstone. *Proceedings of the Royal Society, London, Series B*, 39, 394–404.
- Judd, J.W. (1893) On composite dykes in Arran. Quarterly Journal of the Geological Society of London, 49, 536-64.
- Jukes-Brown, A.J. (1892) The Building of the British Isles, Geo. Bell and Sons, London, 465 pp.
- Jukes-Brown, A.J. (1902) On a deep boring at Lyme Regis. Quarterly Journal of the Geological Society of London, 58, 279–89.
- Karpeta, W.P. (1990) The morphology of Permian palaeodunes – a reinterpretation of the Bridgnorth Sandstone around Bridgnorth, England, in the light of modern dune studies. Sedimentary Geology, 69, 59–75.
- Kellaway, G.A. and Welch, F.B.A. (1993) Geology of the Bristol District. *Memoir of the British Geological Survey*, (England and Wales), HMSO for the British Geological Survey, London, 199 pp.
- Kendall, P.F. (1902) On the brockrams of the Vale of Eden and the evidence they afford of an inter-Permian movement of the Pennine faults. *Geological Magazine*, **39**, 510–13.
- Kent, P.E. (1967) Outline geology of the Southern North Sea Basin. Proceedings of the Yorksbire Geological Society, 36, 1–22.
- Kent, P.E. (1970) Problems of the Rhaetic in the East Midlands. *Mercian Geologist*, 3, 361-72.
- Kent, P.E. (1975) Review of North Sea Basin development. Journal of the Geological Society, London, 131, 435-68.
- King, M.J. and Thompson, D.B. (2000a) Triassic

vertebrate footprints from the Sherwood Sandstone Group, Hilbre, Wirral, northwest England. *Proceedings of the Geologists' Association*, **111**, 111–32.

- King, M.J. and Thompson, D.B. (2000b) A history of the vertebrate footprint discoveries on Hilbre, Wirral, Merseyside, England 1990–1994. North West Geologist, 10, 10–38.
- King, W.W. (1893) Clent Hill Breccias. Midland Naturalist, 16.
- Klein, G. de V. (1962) Sedimentary structures in the Keuper Marl (Upper Triassic). Geological Magazine, 99, 137–44.
- Kocurek, G. (1988) First-order and super bounding surfaces in eolian surfaces – bounding surfaces revisited. *Sedimentary Geology*, 56, 193–206.
- Laming, D.J.C. (1965) Age of the New Red Sandstone in south Devonshire. *Nature*, 207, 624–5.
- Laming, D.J.C. (1966) Imbrication, palaeocurrents and other sedimentary features in the Lower New Red Sandstone, Devonshire, England. *Journal of Sedimentary Petrology*, 36, 940–59.
- Laming, D.J.C. (1968) New Red Sandstone stratigraphy in Devon and West Somerset. Proceedings of the Ussber Society, 2, 23–5.
- Laming, D.J.C. (1969) A guide to the New Red Sandstone of Tor Bay, Petitor and Shaldon. *Transactions of the Devonshire Association*, 101, 207–18.
- Laming, D.J.C. (1982) The New Red Sandstone. In *The Geology of Devon* (eds E.M. Durrance and D.J.C. Laming), University of Exeter, Exeter, pp. 148–78.
- Lamplugh, G.W., Gibson, W., Sherlock, R.L. and Wright, W.B. (1908) The geology of the country between Newark and Nottingham. *Memoir of the Geological Survey of Great Britain*, Sheet 126, (England and Wales), HMSO, London, 126 pp.
- Lang, W.D. (1924) The Blue Lias of the Devon and Dorset Coasts. *Proceedings of the Geologists' Association*, 35, 169–85.
- Lapworth, C. (1898) Sketch of the geology of the Birmingham district. *Proceedings of the Geologists' Association*, **15**, 313–416.
- Large, N.F. (1966) The significance of Spartina townsendii at Aust Cliff. Proceedings of the Cotteswold Naturalists' Field Club, 35, 55-8.
- Lebour, H.H. (1902) The Marl Slate and Yellow Sands of Northumberland and Durham. *Transactions of the Institute of Mining*

Engineers, 24, 370-91.

- Lee, G.W. (1920) The Mesozoic rocks of Applecross, Raasay, and north-east Skye. *Memoir of the Geological Survey of Great Britain*, Sheet 81 (Scotland), HMSO, Edinburgh, 93 pp.
- Lee, G.W. and Bailey, E.B. (1925) The pre-Tertiary geology of Mull, Loch Aline, and Oban. *Memoir of the Geological Survey of Great Britain*, Sheet 44 (Scotland), HMSO, Edinburgh, 140 pp.
- Lee, G.W. and Pringle, J. (1932) A synopsis of the Mesozoic rocks of Scotland. Transactions of the Geological Society of Glasgow, 19, 158–224.
- Leonard, A.J., Moore, A.C. and Selwood, E.B. (1982) Ventifacts from a deflation surface marking the top of the Budleigh Salterton Pebble Beds. *Proceedings of the Ussher Society*, 5, 333-9.
- Leslie, A.B., Tucker, M.E. and Spiro, B. (1992) A sedimentological and stable isotopic study of travertines and associated sediments within the Upper Triassic lacustrine limestones, South Wales, UK. *Sedimentology*, **39**, 613–29.
- Leslie, A.B., Spiro, B. and Tucker, M.E. (1993) Geochemical and mineralogical variations in the upper Mercia Mudstone Group (Late Triassic), southwest Britain: correlation of outcrop sequences with borehole geophysical logs. *Journal of the Geological Society*, *London*, **150**, 67–75.
- Lobley, J.L. (1875) Excursion to the Cheltenham district. *Proceedings of the Geologists'* Association, 4, 167–74.
- Lockley, M.G., King, M., Howe, S. and Sharpe, T. (1996) Dinosaur tracks and other archosaur footprints from the Triassic of South Wales. *Ichnos*, 5, 23–41.
- Lott, G.K. and Warrington, G. (1988) A review of the latest Triassic succession in the UK sector of the Southern North Sea Basin. Proceedings of the Yorksbire Geological Society, 47, 139–47.
- Lott, G.K., Sobey, R.A., Warrington, G. and Whittaker, A. (1982) The Mercia Mudstone Group (Triassic) in the western Wessex Basin. *Proceedings of the Ussher Society*, 5, 340-6.
- Lovell, J.P.B. (1971) Petrography and correlation of sandstones in the New Red Sandstone (Permo-Triassic) of Arran. *Scottish Journal of Geology*, 7, 162–9.
- Lovell, J.P.B. (1981) Intertidal sediments in the Auchenhew Beds (Triassic) of Arran. Scottish

Journal of Geology, 17, 223-4.

- Lowe, D.J., Crofts, R.G. and Dean, M.T. (1990) Field Guide to Permo-Triassic Sections in the Nottingham Area, 13th International Sedimentological Congress, Nottingham, U.K., 1990, Field Guide No. 11, 28 pp.
- Lucas, S.G. (1998) Global Triassic tetrapod biostratigraphy and biochronology. Palaeogeography, Palaeoclimatology, Palaeoecology, 143, 345–82.
- Lucas, S.G. and Hunt, A.P. (1993) Tetrapod biochronology of the Chinle Group (Upper Triassic), western United States. In *The Nonmarine Triassic* (eds S.G. Lucas and M. Morales), *New Mexico Museum of Natural History and Science Bulletin*, **3**, 327–9.
- Macchi, L. (1981) Sedimentology of the Penrith Sandstone and Brockrams (Permo-Triassic) of Cumbria, North-west England. Unpublished PhD thesis, University of Hull, 236 pp.
- Macchi, L. (1990) A Field Guide to the Continental Permo-Triassic Rocks of Cumbria and North-west Cheshire, Liverpool Geological Society, 88 pp.
- Macchi, L. and Meadows, N.S. (1987) *The Permo-Triassic of Cheshire and Cumbria*, Poroperm Excursion Guide No. 12, Poroperm-Geochem Limited, Chester, 140 pp.
- MacDonald, J.G. and Herriot, A. (1983) MacGregor's Excursion Guide to the Geology of Arran, Geological Society of Glasgow, Glasgow, 210 pp.
- Mackie, W. (1897) The sands and sandstones of Eastern Moray. *Transactions of the Edinburgh Geological Society*, 7, 148–72.
- Mackie, W. (1902a) The occurrence of barium sulphate and calcium fluoride as cementing substances in the Elgin Trias. *Report of the British Association for the Advancement of Science*, **1901**, 649–50.
- Mackie, W. (1902b) The Pebble-band of the Elgin Trias and its wind-worn pebbles. *Report of the British Association for the Advancement of Science*, **1901**, 650–1.
- MacQuaker, J.H.S. (1984) Diagenetic modifications of primary sedimentological fabric in the Westbury Formation (Upper Triassic) of St. Audrie's Bay, North Somerset. *Proceedings* of the Ussher Society, 6, 95–9.
- MacQuaker, J.H.S. (1994) Palaeoenvironmental significance of 'bone-beds' in organic-rich mudstone successions: an example from the Upper Triassic of south-west Britain. Zoological Journal of the Linnean Society,

112, 285-308.

- MacQuaker, J.H.S. (1999) Aspects of the sedimentology of the Westbury Formation. In *Fossils of the Rhaetian Penarth Group* (eds A. Swift and D.M. Martill), The Palaeontological Association, London, pp. 39–48.
- MacQuaker, J.H.S., Farrimond, P. and Brassell, S.C. (1985) Biological markers in the Rhaetian black shales of South West Britain. Organic Geochemistry, 10, 93–100.
- Mader, D. (1985) Braidplain, floodplain and playa lake, alluvial-fan, aeolian and palaeosol facies composing a diversified lithogenetical sequence in the Permian and Triassic of south Devon (England). In Aspects of Fluvial Sedimentation in the Lower Triassic Buntsandstein of Europe (ed. D. Mader), Springer-Verlag, Berlin, pp. 15–64.
- Mader, D. and Laming, D.J.C. (1985) Braidplain and alluvial-fan environmental history and climatological evolution controlling origin and destruction of aeolian dune fields and governing overprinting of sand seas and river plains by calcrete pedogenesis in the Permian and Triassic of south Devon (England). In Aspects of Fluvial Sedimentation in the Lower Triassic Buntsandstein of Europe (ed.D. Mader), Springer-Verlag, Berlin, pp. 519–28.
- Mader, D. and Yardley, M.J. (1985) Migration, modification and merging in aeolian systems and the significance of the depositional mechanisms in Permian and Triassic dune sands of Europe and North America. *Sedimentary Geology*, 43, 85–218.
- Marie, J.P. P. (1975) Rotliegendes stratigraphy and diagenesis. In *Petroleum and the Continental Shelf of Northwest Europe* (ed.A.W. Woodland), Applied Science Publishers, London, pp. 205–11.
- Martill, D.M. (1999) Bone beds of the Westbury Formation. In *Fossils of the Rhaetian Penarth Group* (eds A. Swift and D.M. Martill), The Palaeontological Association, London, pp. 49–64.
- Matley, C.A. (1912) The Upper Keuper (or Arden) Sandstone Group and associated rocks of Warwickshire. *Quarterly Journal of the Geological Society of London*, 68, 254–80.
- May, VJ. and Hansom, J.H. (in press) *Coastal Geomorphology of Great Britain*, Geological Conservation Review Series, Joint Nature Conservation Committee, Peterborough.

- Mayall, M.J. (1979) The clay mineralogy of the Rhaetic transgression in Devon and Somerset – environmental and stratigraphical implications. *Proceedings of the Ussher Society*, 4, 303–11.
- Mayall, M.J. (1981) The Late Triassic Blue Anchor Formation and the initial Rhaetian marine transgression in south west Britain. *Geological Magazine*, **118**, 377–84.
- Mayall, M.J. (1983) An earthquake origin for synsedimentary deformation in a late Triassic (Rhaetian) lagoonal sequence, southwest Britain. *Geological Magazine*, **120**, 613–22.
- McKeever, P.J. (1991) Trackway preservation in eolian sandstones from the Permian of Scotland. *Geology*, **19**, 726–9.
- McKeever, P.J. (1994) The behavioral and biostratigraphical significance and origin of vertebrate trackways from the Permian of Scotland. *Palaios*, 9, 477–87.
- McKeever, P.J. and Haubold, H. 1996. Reclassification of vertebrate trackways from the Permian of Scotland and related forms from Arizona and Germany. *Journal of Paleontology*, **70**, 1011–22.
- McKerrow, W.S. and Atkins, F.B. (1989) *Isle of Arran*, The Geologists' Association, London, 104 pp.
- McLean, A.C. (1978) Evolution of fault-controlled ensialic basins in northwestern Britain. In Crustal Evolution in Northwestern Britain and Adjacent Regions (eds D.R. Bowes and B.E. Leake), Seel House Press, Liverpool, pp. 325-41.
- McMillan, A.A. and Brand, P.J. (1995) Depositional setting of Permian and Upper Carboniferous strata of the Thornhill Basin, Dumfriesshire. *Scottish Journal of Geology*, **31**, 43–52.
- McQuillin, R. and Binns, P.E. (1973) Geological structure in the Sea of the Hebrides. *Nature Physical Sciences*, 241, 2–4.
- Meadows, N.S. and Beach, A. (1993) Structural and climatic controls on facies distribution in a mixed fluvial and aeolian reservoir: the Triassic Sherwood Sandstone Group in the Irish Sea. In *Characterization of Fluvial and Aeolian Reservoirs* (eds C.P. North and D.J. Prosser), *Geological Society of London Special Publication No.* 73, pp. 247–64.
- Meadows, N.S., Trueblood, S.P., Hardman, M. and Cowan, G. (eds) (1997) *Petroleum Geology of the Irish Sea and Adjacent Areas*. Geological Society, London, 408 pp.

- Metcalfe, A.T. (1884) On further discoveries of vertebrate remains in the Triassic strata of the south coast of Devonshire, between Budleigh Salterton and Sidmouth. *Quarterly Journal* of the Geological Society of London, 40, 257–62.
- Meyer, H.O.A. (1965) Revision of the stratigraphy of the Permian evaporites and associated strata in north-western England. *Proceedings of the Yorksbire Geological Society*, 35, 71–89.
 Miall, A.D. (1996) *The Geology of Fluvial Deposits*, Springer, Berlin, 586 pp.
- Milner, A.R., Gardiner, B.G., Fraser, N.C. and Taylor, M.A. (1990) Vertebrates from the Middle Triassic Otter Sandstone Formation of Devon. *Palaeontology*, 33, 873–92.
- Mitchell, G.H., Pocock, R.W. and Taylor, J.H. (1961) Geology of the country around Droitwich, Abberley and Kidderminster. *Memoir of the Geological Survey of Great Britain*, Sheet 182 (England and Wales), HMSO, London, 137 pp.
- Moore, C. (1867) Abnormal conditions of Secondary deposits when connected with the Somersetshire and South Wales Coal Basin; and on the age of the Sutton and Southerndown Series. Quarterly Journal of the Geological Society of London, 23, 449-568.
- Morbey, S.J. (1975) The palynostratigraphy of the Rhaetian Stage, Upper Triassic in the Kendelbachgraben, Austria. *Palaeontographica*, *Abteilung B*, **152**, 1–75.
- Morton, G.H. (1891) The Geology of the Country around Liverpool, Including the North of Flintshire, 2nd edn, Phillips, London, 287 pp.
- Morton, N. (1971) The definition of standard Jurassic stages. Mémoires du Bureau des Recherches Géologiques et Minéralogiques, 75, 83-93.
- Morton, N. (1992) Dynamic stratigraphy of the Triassic and Jurassic of the Hebrides Basin. In Basins on the Atlantic Seaboard: Petroleum Geology, Sedimentology and Basin Evolution (ed.J. Parnell), Geological Society of London Special Publication No. 62, 97-110.
- Morton, N. (1999) Middle Hettangian (Lower Jurassic) ammonites from Isle of Raasay, Inner Hebrides, and correlation of the Hettangian-lowermost Sinemurian Breakish Formation in the Skye area, NW Scotland. Scottish Journal of Geology, **35**, 119–30.

- Murchison, R.I. (1839) *The Silurian System*, John Murray, London, 768 pp.
- Murchison, R.I. (1841) First sketch of some of the principal results of a second geological survey of Russia. *Philosophical Magazine*, 19, 417–22.
- Murchison, R.I. and Harkness, R. (1864) On the Permian rocks of the north west of England and their extension into Scotland. *Quarterly Journal of the Geological Society of London*, 20, 144-65.
- Murchison, R.I. and Strickland, H.E. (1840) On the upper formations of the New Red Sandstone system in Gloucestershire, Worcestershire, and Warwickshire; etc. *Transactions of the Geological Society*, *London, Series 2*, 5, 331–48.
- Murray, J.W. and Wright, C.A. (1971) The Carboniferous Limestone of Chipping Sodbury and Wick, Gloucestershire. *Geological Journal*, 7, 255–70.
- Mykura, W. (1965) The age of the lower part of the New Red Sandstone of South-West Scotland. Scottish Journal of Geology, 1, 9–18.
- Naylor, H., Turner, P., Vaughan, D.J. and Fallick, A.E. (1989a) The Cherty Rock, Elgin: a petrographic and isotopic study of a Permo-Triassic calcrete. *Geological Journal*, 24, 205–21.
- Naylor, H., Turner, P., Vaughan, D.J., Boyce, A.C. and Fallick, A.E. (1989b) Genetic studies of red bed mineralization in the Triassic of the Cheshire Basin, northwest England. *Journal* of the Geological Society, London, 146, 685–99.
- Newell, A.J. (1992) Sedimentological Controls on Vertebrate Taphonomy in Triassic Fluvial Environments. Unpublished PhD thesis, University of Bristol, 351 pp.
- Newell, A.J. (2001) Bounding surfaces in mixed aeolian-fluvial system (Rotliegend, Wessex Basin, SW UK). Marine and Petroleum Geology, 18, 339-47.
- Newman, P.J. (1999) The geology and hydrocarbon potential of the Peel and Solway basins, East Irish Sea. *Journal of Petroleum Geology*, 22, 305–24.
- Newton, E.T. (1887) On the remains of fishes from the Keuper of Warwick and Nottingham. *Quarterly Journal of the Geological Society* of London, 43, 537–40.
- Newton, E.T. (1899) On a megalosauroid jaw from Rhaetic beds near Bridgend (Glamorganshire). *Quarterly Journal of the*

Geological Society of London, 55, 89-96.

- Nicholson, H.A. (1868) An Essay on the Geology of Cumberland and Westmoreland, Robert Hardwicke, London, 93 pp.
- Nicholson, R. (1978) The Camas Malag Formation: an interbedded rhythmite/ conglomerate sequence of probable Triassic age, Loch Slapin, Isle of Skye. *Scottisb Journal of Geology*, 14, 301–9.
- Oates, M.J. (1978) A revised stratigraphy for the western Scottish Lower Lias. *Proceedings of the Yorkshire Geological Society*, 42, 143-56.
- Old, R.A., Hamblin, R.J.O., Ambrose, K. and Warrington, G. (1991) Geology of the country around Redditch. *Memoir of the British Geological Survey*, Sheet 183 (England and Wales), HMSO, London, 83 pp.
- Old, R.A., Sumbler, M.G. and Ambrose, K. (1987) Geology of the country around Warwick. *Memoir of the British Geological Survey*, Sheet 184 (England and Wales), HMSO, London, 93 pp.
- Orbell, G. (1973) Palynology of the British Rhaeto-Liassic. Bulletin of the Geological Survey of Great Britain, 44, 1-44.
- Owen, R. (1842) Description of an extinct lacertian reptile, *Rbynchosaurus articeps* Owen, of which the bones and footprints characterise the new Red Sandstone at Grinshill, near Shrewsbury. *Transactions of the Cambridge Philosophical Society*, 7, 355-369.
- Owen, R. (1871) Monograph of the fossil mammals of the Mesozoic formations. *Palaeontographical Society (Monographs)*, 24, 1–115.
- Owens, B. (1972) A derived Lower Tournaisian miospore assemblage from the Permo-Triassic deposits of South Devon, England. Septième Congrès International de Stratigraphie et de Géologie du Carbonifère, Krefeld, 23–28 August 1971, Compte Rendu, 1, 359–65.
- Palmer, C.P. (1972) The Lower Lias (Lower Jurassic) between Watchet and Lilstock in North Somerset (United Kingdom). Newsletters in Stratigraphy, 2, 1–30.
- Paton, R.L. (1974) Lower Permian pelycosaurs from the English Midlands. *Palaeontology*, 17, 541–52.
- Paton, R.L. (1975) A Lower Permian temnospondylous amphibian from the English Midlands. *Palaeontology*, 18, 831–45.
- Pattison, J. (1970) A review of the marine fossils from the Upper Permian rocks of Northern

Ireland and north-west England. Bulletin of the Geological Survey of Great Britain, 32, 123–65.

- Pattison, J., Smith, D.B. and Warrington, G. 1973. A review of late Permian and early Triassic biostratigraphy in the British Isles. In *The Permian and Triassic Systems and their Mutual Boundary* (eds A. Logan and L.V. Hills), *Canadian Society of Petroleum Geologists Memoir*, 2, 220–60.
- Peach, B.N., Horne, J., Woodward, B., Clough, C.T., Harker, A. and Wedd, C.B. (1910) The Geology of Glenelg, Lochalsh and the southeast part of Skye. *Memoir of the Geological Survey of Great Britain*, Sheet 71, (Scotland), HMSO, Edinburgh, 206 pp.
- Peacock, J.D. (1966) Contorted beds in the Permo-Triassic aeolian sandstones of Morayshire. Bulletin of the Geological Survey of Great Britain, 24, 157–62.
- Peacock, J.D. (1977) Excursion to Elgin district 9th July 1975. In *The Moray Firth Area Geological Studies*, Inverness Field Club, Inverness, pp. 108–9.
- Peacock, J.D., Berridge, N.G., Harris, A.L. and May, F. (1968) The geology of the Elgin district (Sheet 95). *Memoir of the Geological Survey of Great Britain*, Sheet 95, (Scotland), HMSO, Edinburgh, 165 pp.
- Pearson, D.A.B. (1970) Problems of Rhaetian stratigraphy with special reference to the lower boundary of the stage. Quarterly Journal of the Geological Society of London, 126, 125-50.
- Pengelly, W. (1866) On certain joints and dykes in the Devonian limestones on the southern shore of Torbay. *Geological Magazine*, *Decade 1*, 3, 19–22.
- Penn, J.S.W. and French, J. (1971) The Malvern Hills. *Geologists' Association Guide*, 4, 36 pp.
- Perkins, J.W. (1971) *Geology Explained in South and East Devon*. David and Charles, Newton Abbot, 192 pp.
- Phemister, J. (1960) Scotland: the Northern Highlands, 3rd edn, British Regional Geology Series, No. 2, HMSO, Edinburgh, 120 pp.
- Phillips, J. (1848) The Malvern Hills, compared with the Palaeozoic districts of Abberley, Woolhope, May Hill, Tortworth, and Usk. Memoir of the Geological Survey of Great Britain, 2, 1–330.
- Phipps, C.B. and Reeve, F.A.E. (1967)

Stratigraphy and geological history of the Malvern, Abberley and Ledbury Hills. *Geological Journal*, **5**, 339–68.

- Piper, D.J.W. (1970) Eolian sediments in the basal New Red Sandstone of Arran. Scottish Journal of Geology, 6, 295–308.
- Plant, J.A., Jones, D.G. and Haslam, H.W. (eds) (1999) The Cheshire Basin. *Memoir of the British Geological Survey*, British Geological Survey, Keyworth, 263 pp.
- Pocock, R. and Wray, D.A. (1925) The geology of the country around Wem. *Memoir of the Geological Survey of Great Britain*, Sheet 138, (England and Wales), HMSO, London, 122 pp.
- Pollard, J.E. (1975) A problematic trace fossil from the Tor Bay Breccias of south Devon. *Proceedings of the Geologists' Association*, 86, 105-7.
- Pollard, J.E. and Lovell, J.P.B. (1976) Trace fossils from the Permo-Triassic of Arran. Scottish Journal of Geology, 12, 209–25.
- Pollard, J.E. and Steel, R.J. (1978) Intertidal sediments in the Auchenhew Beds (Triassic) of Arran. Scottish Journal of Geology, 14, 317-28.
- Poole, E.G. (1978) Stratigraphy of the Withycombe Farm Borehole, near Banbury, Oxfordshire. Bulletin of the Geological Survey of Great Britain, HMSO for the Institute of Geological Sciences, London.
- Poole, E.G. (1979) The Triassic-Jurassic boundary in Great Britain. *Geological Magazine*, 116, 303–11.
- Poole, E.G. and Whiteman, A.J. (1966) Geology of the country around Nantwich and Whitchurch. *Memoir of the Geological Survey of Great Britain*, Sheet 122 (England and Wales), HMSO, London, 154 pp.
- Powell, J.H., Glover, B.W. and Waters, C.N. (2000) Geology of the Birmingham area. *Memoir of the British Geological Survey*, Sheet 168 (England and Wales), The Stationery Office for the British Geological Survey, London, 132 pp.
- Price, G.D. (1996) Significance of infiltrated clays within the Lower Permian Yellow Sands of north-east England. *Geological Journal*, 31, 189–95.
- Pryor, W.A. (1971) Petrology of the Permian Yellow Sands of northeastern England and their North Sea Basin equivalents. Sedimentary Geology, 6, 221–54.
- Pugh, W. (1960) Triassic salt: discoveries in the

Cheshire-Shropshire Basin. Nature, 187, 278–9.

- Purvis, K. and Wright, V.P. (1991) Calcretes related to phreatophytic vegetation from the Middle Triassic Otter Sandstone of South West England. Sedimentology, 38, 539–51.
- Radley, J.D. and Carpenter, S.C. (1999) The late Triassic strata of Manor Farm, Aust, South Goucestershire. *Proceedings of the Bristol Naturalists' Society*, 58, 57–67.
- Raymond, L.R. (1961) The petrology of the Permian rocks of northeast Yorkshire and southeast Durham, the Lower Magnesian Limestone. Proceedings of the Geological Society of London, 1589, 93-5.
- Rees, J.G. and Wilson, A.A. (1998) Geology of the country around Stoke-on-Trent. *Memoir of the British Geological Survey*, Sheet 123 (England and Wales), The Stationery Office for the British Geological Survey, London, 152 pp.
- Reynolds, S.H. (1906) On the erosion of the shores of the Severn estuary. *Proceedings of the Bristol Naturalists' Society*, 4th Series, 1, 204-8.
- Reynolds, S.H. (1929) *The Geology of the Bristol District*, The Geologists' Association, London, 27 pp.
- Reynolds, S.H. (1938) A section of Rhaetic and associated strata at Chipping Sodbury, Glos. *Geological Magazine*, **75**, 97–102.
- Reynolds, S.H. (1946) The Aust Section. Proceedings of the Cotteswold Naturalists' Field Club, 29, 29–39.
- Reynolds, S.H. and Vaughan, A. (1904) The Rhaetic Beds of the South Wales direct line. *Quarterly Journal of the Geological Society* of London, 60, 194–213.
- Rhys, G.H. (1974) A proposed standard lithostratigraphic nomenclature for the southern North Sea and an outline structural nomenclature for the whole of the (UK) North Sea. *Report of the Institute of Geological Sciences*, 74(8), 1–14.
- Rice, R.C. (1939a) The Trias of N.W. Wirral. Proceedings of the Liverpool Geological Society, 17, 349-60.
- Rice, R.C. (1939b) Contorted bedding in the Trias of N.W. Wirral. *Proceedings of the Liverpool Geological Society*, **17**, 361–70.
- Richardson, L. (1901) Mesozoic geography of the Mendip Archipelago. Proceedings of the Cotteswolds Naturalists' Field Club, 14, 59-73.

- Richardson, L. (1903a) The Rhaetic rocks of north-west Gloucestershire. Proceedings of the Cotteswold Naturalists' Field Club, 14, 127-74.
- Richardson, L. (1903b) Rhaetic rocks of northwest Gloucestershire. Proceedings of the Cotteswold Naturalists' Field Club, 14, 251-6.
- Richardson, L. (1903c) The Rhaetic and Lower Lias of Sedbury Cliff, near Chepstow (Monmouthshire). Quarterly Journal of the Geological Society of London, 59, 390-5.
- Richardson, L. (1904) Notes on the Rhaetic rocks around Charfield, Gloucestershire. *Geological Magazine*, 41, 532–5.
- Richardson, L. (1905) The Rhaetic and contiguous deposits of Glamorganshire. *Quarterly Journal of the Geological Society of London*, 61, 385–422.
- Richardson, L. (1906) On the Rhaetic and contiguous deposits of Devon and Dorset. *Proceedings of the Geologists' Association*, 19, 401-9.
- Richardson, L. (1907) The Inferior Oolite and contiguous deposits of the Bath and Doulting district. Quarterly Journal of the Geological Society of London, 63, 383–436.
- Richardson, L. (1911) The Rhaetic and contiguous deposits of west, mid and east Somerset. *Quarterly Journal of the Geological Society* of London, 67, 1–72.
- Richardson, L. (1947) The upper limit of the Rhaetic series and the relationship of the Rhaetic and Liassic series. *Proceedings of the Cotteswold Naturalists' Field Club*, 29, 143-4.
- Richter, D. (1966) On the new Red Sandstone neptunian Dykes of the Tor Bay area (Devonshire). Proceedings of the Geologists' Association, 77, 173–86.
- Ridgeway, J.M. (1974) A problematical trace fossil from the New Red Sandstone of south Devon. *Proceedings of the Geologists' Association*, **85**, 511–8.
- Riley, H. and Stutchbury, S. (1840) A description of various fossil remains of three distinct saurian animals, recently discovered in the Magnesian Conglomerate near Bristol. *Transactions of the Geological Society of London, Series 2*, 5, 349–57.
- Robinson, P.L. (1957) The Mesozoic fissures of the Bristol Channel area and their vertebrate fossils. Journal of the Linnean Society (Zoology), 43, 260–82.

- Rock-Color Chart Committee (1991) Rock Color Chart. Geological Society of America, Boulder, Colarado 14 pp.
- Rose, G.N. and Kent, P.E. (1955) A Lingula-Bed in the Keuper of Nottinghamshire. *Geol*ogical Magazine, 92, 476–80.
- Ruffell, A. (1991) Palaeoenvironmental analysis of the late Triassic succession in the Wessex Basin and correlation with surrounding areas. *Proceedings of the Ussber Society*, 7, 402-7.
- Runcorn, S.K. (1965) A Symposium on Continental Drift.I. Palaeomagnetic comparisons between Europe and North America. *Philosophical Transactions of the Royal* Society, Series A, 258, 1–11.
- Sarjeant, W.A.S. (1967) Fossil footprints from the Middle Triassic of Nottinghamshire and Derbyshire. *Mercian Geologist*, 2, 327–41.
- Sarjeant, W.A.S. (1974) A history and bibliography of the study of fossil vertebrate footprints in the British Isles. *Palaeogeography*, *Palaeoclimatology*, *Palaeoecology*, 16, 265–378.
- Savage, R.J.G. (1977) The Mesozoic strata of the Mendip Hills. In *Geological Excursions in the Bristol District* (ed.R.J.G. Savage), University of Bristol, Bristol, pp. 85–100.
- Savage, R.J.G. and Large, N.F. (1966) On Birgeria acuminata and the absence of labyrinthodonts from the Rhaetic. Palaeontology, 9, 135-41.
- Schweitzer, H.J. (1986) The land flora of the English and German Zechstein sequences. In The English Zechstein and Related Topics (eds G.H. Harwood and D.B. Smith), Geological Society of London Special Publication No. 22, 31-54.
- Scrivener, R.C. (1983) Geological notes and local details for 1:10,000 Sheet SX98SW (Exeter, Devon). Geological Report for the DoE: Land Use Planning. British Geological Survey, Exeter.
- Scrivenor, J.B. (1948) The New Red Sandstone of south Devonshire. *Geological Magazine*, 85, 317–32.
- Sedgwick, A. (1832) On the New Red Sandstone Series in the basin of the Eden, and northwestern coasts of Cumberland and Lancashire. *Transactions of the Geological Society of London, Series 2*, 4, 383–407.
- Sedgwick, A. and Murchison, R.I. (1829a) On the geological relations and internal structure of the Magnesian Limestone, and the lower por-

tion of the New Red Sandstone Series in their range through Nottinghamshire, Derbyshire, Yorkshire, and Durham, to the southern extremity of Northumberland. *Transactions* of the Geological Society of London, Series 2, 3, 37–124.

- Sedgwick, A. and Murchison, R.I. (1829b) On the geological relations of the secondary strata of the Isle of Arran. *Transactions of the Geological Society of London*, Series 2, 3, 21–36.
- Sellwood, B.W., Durkin, M.K. and Kennedy, WJ. (1970) Field meeting on the Jurassic and Cretaceous rocks of Wessex. *Proceedings of* the Geologists' Association, 81, 715–32.
- Selwood, E.B., Edwards, R.A., Simpson, S., Chester, J.A., Hamblin, R.J.O., Henson, M.R., Riddolls, B.W. and Waters, R.A. (1984) Geology of the country around Newton Abbot. *Memoir of the British Geological Survey*, Sheet 339 (England and Wales), HMSO, London, 212 pp.
- Sherlock, R.L. (1911) Relationship of the Permian to the Trias in Nottinghamshire. Quarterly Journal of the Geological Society of London, 67, 75–117.
- Sherlock, R.L. (1926) A correlation of the British Permo-Triassic rocks. Part 1. Northern England, Scotland and Ireland. *Proceedings* of the Geologists' Association, 37, 1–72.
- Shipman, J. (1881) Notes on the Triassic rocks of Cheshire and their equivalents at Nottingham. Annals and Report of the Nottingham Naturalists Society, 1880, 14-30.
- Short, A.R. (1904) A description of some Rhaetic sections in the Bristol District, with considerations on the mode of deposition of the Rhaetic Series. Quarterly Journal of the Geological Society of London, 60, 170–93.
- Shotton, F.W. (1937) The Lower Bunter Sandstone of north Worcestershire and east Shropshire. *Geological Magazine*, 74, 534–53.
- Shotton, F.W. (1956) Some aspects of the New Red desert in Britain. *Liverpool and Manchester Geological Journal*, 1, 450–65.
- Silberling, N.J. and Tozer, E.T. (1968) Biostratigraphic classification of the marine Triassic in North America. Special Paper of the Geological Society of America, 110, 1–63.
- Simms, M.J. (1990) Triassic palaeokarst in Britain. Cave Science, 17, 93-101.
- Simpson, J.B. and Richey, J.E. (1936) The geolo-

gy of the Sanquhar Coalfield and the adjacent basin of Thornhill. *Memoir of the Geological Survey of Scotland* (Sheet 15), HMSO, Edinburgh, 47 pp.

- Simpson, S. (1969) Geology. In *Exeter and its Region* (ed.F. Barlow), University of Exeter, Exeter, pp. 5–26.
- Smith, A.G., Smith, D.G. and Funnell, B.M. (1994) Atlas of Mesozoic and Cenozoic Coastlines, Cambridge University Press, Cambridge.
- Smith, B. (1910) The Upper Keuper Sandstone of east Nottinghamshire. Geological Magazine, Decade 5, 7, 302-11.
- Smith, B. (1912) The Green Keuper basement beds in Nottinghamshire and Lincolnshire. *Geological Magazine*, Decade 5, 9, 252–7.
- Smith, B. (1924) On the West Cumberland Bockram and its associated rocks. *Geological* Magazine, 61, 289–308.
- Smith, D.B. (1970) The Permian and Trias. In The Geology of Durham County (ed.G.A.L. Johnson), Transactions of the Natural History Society of Northumberland, Durham, and Newcastle upon Tyne, 41, 66–91.
- Smith, D.B. (1974) Permian. In The Geology and Mineral Resources of Yorkshire (eds D.H. Rayner and J.E. Hemingway), Yorkshire Geological Society, Occasional Publication 2, Leeds, pp. 115–44.
- Smith, D.B. (1979) Rapid marine transgression and regressions of the Upper Permian Zechstein Sea. Journal of the Geological Society, London, 136, 155-6.
- Smith, D.B. (1994) Geology of the country around Sunderland. *Memoir of the British Geological Survey*, Sheet 21 (England and Wales), HMSO, London, 161 pp.
- Smith, D.B. (1995) Marine Permian of England, Geological Conservation Review Series No. 11, Chapman and Hall, London, 205 pp.
- Smith, D.B. and Francis, E.A. (1967) Geology of the country between Durham and West Hartlepool. *Memoir of the Geological Survey* of Great Britain, Sheet 27 (England and Wales), HMSO, London, 354 pp.
- Smith, D.B. and Taylor, J.C.M. (1992) Permian. In Atlas of Palaeogeography and Lithofacies (eds J.C.W. Cope, J.K. Ingham and P.F. Rawson), Memoir of the Geological Society, London, 13, 87–96.
- Smith, D.B., Brunstrom, R.G.W., Manning, P.I., Simpson, S. and Shotton, F.W. (1974) A

Correlation of the Permian Rocks in the British Isles. Geological Society of London, Special Report No. 5, 45 pp.

- Smith, D.B., Harwood, G.M., Pattison, J. and Pettigrew, T.H. (1986) A revised nomenclature for Upper Permian strata in eastern England. In *The English Zechstein and Related Topics* (eds G.M. Harwood and D.B. Smith), *Geological Society of London Special Publication No.* 22, pp. 9–17.
- Smith, E.G. and Warrington, G. (1971) The age and relationships of the Triassic rocks assigned to the lower part of the Keuper in north Nottinghamshire, north-west Lincolnshire and South Yorkshire. Proceedings of the Yorkshire Geological Society, 38, 201–27.
- Smith, M.A. (1912) The Green Keuper basement beds in Nottinghamshire and Lincolnshire. *Geological Magazine*, Decade 5, 9, 252–7.
- Smith, S.A. (1990) The sedimentology and accretionary styles of an ancient gravel-bed stream: the Budleigh Salterton Pebble Beds (Lower Triassic), southwest England. Sedimentary Geology, 67, 199–219.
- Smith, S.A. and Edwards, R.A. (1991) Regional sedimentological variations in Lower Triassic fluvial conglomerates (Budleigh Salterton Pebble Beds), southwest England: some implications for palaeogeography and basin evolution. *Geological Journal*, 26, 65–83.
- Sneh, A. (1988) Permian dune patterns in northwestern Europe challenged. Journal of Sedimentary Petrology, 58, 44–51.
- Somerville, I.D., Brenchley, P.J., Cullen, B., Eagar, R.M.C., Shanklin, J.K. and Thompson, D.B. (1986) Geology around the university towns: Liverpool. *Geologists' Association Guide*, 6, 36 pp.
- Spencer, P.S. and Benton, M.J. (2000) Procolophonoids from the Permo-Triassic of Russia. In *The Age of Dinosaurs in Russia* and Mongolia (eds M.J. Benton, M.A. Shishkin, D.M. Unwin and E.N. Kurochkin), Cambridge University Press, Cambridge, pp. 160-76.
- Spencer, P.S. and Issac, K P. (1983) Triassic vertebrates from the Otter Sandstone Formation of Devon, England. *Proceedings of the Geologists' Association*, 94, 267–9.
- Starkey, R.E. (1988) Phosgenite from Lossiemouth, Grampian Region: confirmation of the first Scottish occurrence. Scottish Journal of Geology, 24, 15–19.

- Steel, R.J. (1971) New Red Sandstone movement on the Minch Fault. Nature, Physical Sciences, 234, 158–9.
- Steel, R.J. (1974a) New Red Sandstone floodplain and piedmont sedimentation in the Hebridean province, Scotland. *Journal of Sedimentary Petrology*, 44, 336–57.
- Steel, R.J. (1974b) Cornstone (fossil caliche) its origin, stratigraphic, and sedimentological importance in the New Red Sandstone, western Scotland. *Journal of Geology*, 82, 351–69.
- Steel, R.J. and Thompson, D.B. (1983) Structures and textures in Triassic braided stream conglomerate ('Bunter' Pebble Beds) in the Sherwood Sandstone Group, North Staffordshire, England. Sedimentology, 30, 341–67.
- Steel, R.J. and Wilson, A.C. (1975) Sedimentation and tectonism (?Permo-Triassic) on the margin of the North Minch Basin, Lewis. Journal of the Geological Society, London, 131, 183–202.
- Steel., R.J., Nicholson, R. and Kalander, L. (1975) Triassic sedimentation and palaeogeography in Central Skye. Scottish Journal of Geology, 11, 1–13.
- Steele, R.P. (1981) Aeolian Sands and Sandstones. Unpublished PhD thesis, University of Durham, 189 + 322 pp.
- Steele, R.P. (1983) Longitudinal draa in the Permian Yellow Sand of North-east England. In *Eolian Sediments and Processes* (eds M.E. Brookfield and T.S. Ahlbrandt), *Developments in Sedimentology*, 38, 543–50.
- Stevenson, C.R. and Warrington, G. (1971) Jurassic and Cretaceous rocks of Wessex: highest Keuper deposits. *Proceedings of the Geologist's Association*, 82, 297–9.
- Stevenson, I.P. and Mitchell, G.H. (1955) Geology of the country between Burton Upon Trent, Rugeley and Uttoxeter. *Memoir* of the Geological Survey of Great Britain, Sheet 140 (England and Wales), HMSO, London, 178 pp.
- Stewart, A.D. (1978). Gruinard Bay (Torridonian). In *The Lewisian and Torridonian Rocks of North-west Scotland* (eds A.J. Barber, A. Beach, R.G. Park, J. Tarney and A.D. Stewart), *Geologists' Association Guide*, 21, 57–9.
- Stone, P. (1996) Geology in South-west Scotland: An Excursion Guide, British Geological Survey, Keyworth, 214 pp.

- Stoneley, H.M. (1956) Hiltonia, a new plant genus from the Upper Permian of England. Annals and Magazine of Natural History, 9, 713-20.
- Stoneley, H.M. (1958) The Upper Permian flora of England. Bulletin of the British Museum (Natural History), Geology Series, 3, 295-337.
- Storetvedt, K.M. and Steel, R.J. (1977) Palaeomagnetic evidence for the age of the Stornoway Formation. Scottish Journal of Geology, 13, 263–9.
- Storrie, J. (1883) The fossils at Penarth. Transactions of the Cardiff Naturalists' Society, 10, 92-3.
- Storrie, J. (1895) Notes on the tooth of a species of *Mastodontosaurus*, found with some other bones near Lavernock. *Transactions of the Cardiff Naturalists' Society*, 26, 105–6.
- Storrs, G.W. (1993) Terrestrial components of the Rhaetian (uppermost Triassic) Westbury Formation of southwestern Britain. In The Nonmarine Triassic (eds S.G. Lucas and M. Morales), New Mexico Museum of Natural History and Science Bulletin, 3, 447–51.
- Storrs, G.W. (1994) Fossil vertebrate faunas of the British Rhaetian (latest Triassic). Zoological Journal of the Linnean Society, 112, 217–60.
- Storrs, G.W. (1999) Tetrapods. In Fossils of the Rhaetian Penarth Group (eds A. Swift and D.M. Martill), The Palaeontological Association, London, pp. 223–38.
- Storrs, G.W. and Gower, D.J. (1993) The earliest possible choristodere (Diapsida) and gaps in the fossil record of semi-aquatic reptiles. *Journal of the Geological Society, London*, 150, 1103–7.
- Storrs, G.W., Gower, D.J. and Large, N.F. (1996) The diapsid reptile, *Pachystropheus rhaeticus*, a probable choristodere from the Rhaetian of Europe. *Palaeontology*, 39, 323–49.
- Strahan, A. and Cantrill, T.C. (1902) The geology of the South Wales Coalfield. Part III. The country around Cardiff. *Memoir of the Geological Survey of England and Wales*, Sheet 263, HMSO, London, 147 pp.
- Strahan, A. and Cantrill, T.C. (1904) The geology of the South Wales Coalfield. Part VI. The country around Bridgend. *Memoir of the Geological Survey of England and Wales*, Sheet 262, HMSO, London, 120 pp.

Strickland, H.E. (1841) On the occurrence of the

Bristol Bone-Bed on the Lower Lias near Tewkesbury. *Proceedings of the Geological Society of London*, 3, 585–8.

- Swift, A. (1995) A review of the nature and outcrop of the 'White Lias' facies of the Langport Member (Penarth Group: Upper Triassic) in Britain. Proceedings of the Geologists' Association, 106, 247–58.
- Swift, A. and Martill, D.M. (1999) Fossils of the Rhaetian Penarth Group. The Palaeontological Association, London, 312 pp.
- Swinnerton, H.H. (1910) Organic remains in the Trias of Nottingham. Geological Magazine, Decade 5, 8, 229.
- Swinnerton, H.H. (1914) Periods of dreikanter formation in South Notts. Geological Magazine, Decade 6, 1, 208–11.
- Swinnerton, H.H. (1918) The Keuper basement beds near Nottingham. Proceedings of the Geologists' Association, 29, 16–38.
- Sykes, J.H. (1977) British Rhaetic bone beds. Mercian Geologist, 6, 197–239.
- Symonds, W.S. (1855) Notice of fossils from the Keuper Sandstone of Pendock,
 Worcestershire. Quarterly Journal of the Geological Society of London, 11, 450-1.
- Symonds, W.S. (1860) On the physical relations of the reptiliferous sandstone of Elgin. *Edinburgb New Philosophical Journal*, 12, 95-101.
- Talbot, M.R., Holm, K. and Williams, M.A.J. (1994) Sedimentation in low-gradient desert margin systems: a comparison of the Late Triassic of northwest Somerset (England) and the late Quaternary of east-central Australia. *Geological Society of America Special Paper*, 289, 97–117.
- Tawney, E.B. (1866) On the western limit of the Rhaetic beds in South Wales and on the position of the 'Sutton Stone'. Quarterly Journal of the Geological Society of London, 2, 69–89.
- Taylor, B.J., Burgess, I.C., Land, D.H., Mills, D.A.C., Smith, D.B. and Warren, P.T. (1978) Northern England, 4th edn (reprinted), British Regional Geology Series, No.7, HMSO for the Institute of Geological Sciences, London, 121 pp.
- Taylor, F.M. (1968) Permian and Triassic Formations. In *The Geology of the East Midlands* (eds P.C. Sylvester-Bradley and T.D. Ford), Leicester University Press, Leicester, pp. 149–73.
- Taylor, F.M. (1974) Permian and Lower Triassic

landscapes of the East Midlands. Mercian Geologist, 5, 89–100.

- Thomas, T.M. (1968) The Triassic rocks of the west-central section of the Vale of Glamorgan, with particular reference to the 'boulder' breccias at Ogmore-by-Sea. *Proceedings of the Geologists' Association*, 79, 429-39.
- Thompson, D.B. (1969) Dome-shaped aeolian dunes in the Frodsham Member of the socalled "Keuper" Sandstone Formation (Scythian-?Anisian: Triassic) at Frodsham, Cheshire (England). Sedimentary Geology, 3, 263–89.
- Thompson, D.B. (1970a) Sedimentation of the Triassic (Scythian) red pebbly sandstones in the Cheshire Basin and its margins. *Geological Journal*, 7, 183–216.
- Thompson, D.B. (1970b) The stratigraphy of the so-called Keuper Sandstone Formation (Scythian-?Anisian) in the Permo-Triassic Cheshire Basin. *Quarterly Journal of the Geological Society of London*, **126**, 151–81.
- Thompson, D.B. (1985) Field Excursion to the Permo-Triassic of the Cheshire-East Irish Sea-Needwood and Stafford Basins. Poroperm-Geochem Limited, Chester, 164 pp.
- Thompson, D.B. (1986) Permo-Triassic rocks of the Wirral and adjacent areas. In *Geology* around the University Towns: Liverpool (eds I.D. Somerville, P.J. Brenchley, B. Cullen, R.M.C. Eagar, J.K. Shanklin and D.B. Thompson), *Geologists' Association Guide*, 6, 27-33.
- Thompson, D.B. (1991) Triassic rocks of the Cheshire Basin. In *Geology of the Manchester Area* (eds R.M.C. Eagar and F.M. Broadhurst), *Geologists' Association Guide*, 7, 57–81.
- Thompson, D.B. (1995) A Guide to the History and Geology of Quarrying at Localities along the Natural History Trail in Corbet Wood, Grinsbill, North Shropshire, Clive and Grinshill Conservation Committee, Shrewsbury, 55 pp.
- Thompson, D.B. (1998) The background to the finding of footprints and other trace fossils of ?Scythian, ?Anisian age in the Sherwood Sandstone Group (Triassic) at Hilbre, Wirral, East Irish Sea Basin. The North-West Geologist, 8, 5-45.
- Tozer, E.T. (1967) A standard for Triassic time. Bulletin of the Geological Survey of Canada, 156, 1–103.
- Tozer, E.T. (1979) Latest Triassic ammonoid fau-

nas and biochronology, western Canada. Geological Survey of Canada Paper, 79–1B, 127–35.

- Tozer, E.T. (1984) The Trias and its ammonoids: the evolution of a time scale. *Geological Survey of Canada*, *Miscellaneous Report*, **35**, 171 pp.
- Tresise, G.R. and Sarjeant, W.A.S. (1998) The Tracks of Triassic Vertebrates. Fossil Evidence from North-West England, The Stationery Office, London, 204 pp.
- Trueman, A.E. (1920) The Liassic rocks of the Cardiff district. Proceedings of the Geologists' Association, 33, 245–84.
- Trueman, C.N. and Benton, M.J. (1997) A geochemical method to trace the taphonomic history of reworked bones in sedimentary settings. *Geology*, **25**, 263–6.
- Tucker, M.E. (1974) Exfoliated pebbles and sheeting in the Triassic. *Nature*, **252**, 375–6.
- Tucker, M.E. (1977) The marginal Triassic deposits of South Wales: continental facies and palaeogeography. *Geological Journal*, 12, 169–88.
- Tucker, M.E. (1978) Triassic lacustrine sediments from South Wales: shore-zone clastics, evaporites and carbonates. *Special Publications* of the International Association of Sedimentologists, 2, 205–24.
- Tucker, M.E. and Burchette, T.P. (1977) Triassic dinosaur footprints from South Wales: their context and preservation. *Palaeogeography*, *Palaeoclimatology*, *Palaeoecology*, 22, 195–208.
- Tucker, R. and Tucker, M.E. (1981) Evidence of synsedimentary tectonic movements in the Triassic halite of Cheshire. *Nature*, 290, 495–6.
- Turner, B.R. and Smith, D.B. (1997) A playa deposit of pre-Yellow Sands age (upper Rotliegend/ Weissliegend) in the Permian of northeast England. Sedimentary Geology, 114, 305–19.
- Turner, P. (ed.) (1980) Continental Red Beds. Developments in Sedimentology, 29, Elsevier, Amsterdam, 522 pp.
- Turner, P., Vaughan, D.J. and Whitehouse, K.I. (1978) Dolomitization and the mineralization of the Marl Slate (N.E. England). *Mineralium Deposita*, 13, 245–58.
- Tyrrell, G.W. (1928) The geology of Arran. Memoir of the Geological Survey of Great Britain, parts of sheets 13 and 21 (Scotland), HMSO, Edinburgh, 292 pp.

- Underhill, J.R., Gayer, R.A., Woodcock, N.H., et al. (1988) The Dent fault system, northern England – reinterpreted as a major obliqueslip-fault zone. Journal of the Geological Society of London, 145, 303-16.
- Ussher, W.A.E. (1875) On the subdivisions of the Triassic rocks, between the coast of West Somerset and the south coast of Devon. *Geological Magazine*, *Decade 2*, **2**, 163–8.
- Ussher, W.A.E. (1876) On the Triassic rocks of Somerset and Devon. Quarterly Journal of the Geological Society of London, 32, 367-94.
- Ussher, W.A.E. (1878) On the chronological value of the Triassic strata of the south-western counties. *Quarterly Journal of the Geological Society of London*, 34, 459–70.
- Ussher, W.A.E. (1902) The geology of the country around Exeter. *Memoir of the Geological Survey*, Sheet 325, (England and Wales), HMSO, London, 122 pp.
- Ussher, W.A.E. (1913) The geology of the country around Newton Abbot. *Memoir of the Geological Survey of Great Briain*, Sheet 339, (England and Wales), HMSO, London, 149 pp.
- Ussher, W.A.E. and Lloyd, W. (1933) The geology of the country around Torquay, 2nd edition. *Memoir of the Geological Survey of Great Britain*, Sheet 350, (England and Wales), HMSO, London, 169 pp.
- Versey, H.C. (1925) The beds underlying the Magnesian Limestones of Yorkshire. Proceedings of the Yorkshire Geological Society, 20, 200-14.
- Versey, H.C. (1939) The petrography of the Permian rocks in the southern part of the Vale of Eden. Quarterly Journal of the Geological Society of London, 95, 275–98.
- Vicary, W. (1864) On the pebble-bed of Budleigh Salterton. With a note on the fossils, by J.W. Salter. Quarterly Journal of the Geological Society of London, 20, 283–327.
- Visscher, H. (1971) The Permian and Triassic of the Kingscourt Outlier, Ireland. Geological Survey of Ireland, Special Paper, 1, 1–114.
- Wagner, R.H. (1983) A lower Rotliegend flora from Ayrshire. Scottish Journal of Geology, 19, 135–55.
- Walker, A.D. (1961) Triassic reptiles from the Elgin area: *Stagonolepis*, *Dasygnathus* and their allies. *Philosophical Transactions of the Royal Society*, *Series B*, 244, 103–204.
- Walker, A.D. (1964) Triassic reptiles from the

Elgin area: Ornithosuchus and the origin of carnosaurs. Philosophical Transactions of the Royal Society, Series B, 248, 53-134.

- Walker, A.D. (1969) The reptile fauna of the 'Lower Keuper' Sandstone. Geological Magazine, 106, 470-6.
- Walker, A.D. (1973) The age of the Cuttie's Hillock Sandstone (Permo-Triassic) of the Elgin area. Scottish Journal of Geology, 9, 177–83.
- Walker, M.J.C., Gray, J.M. and Lowe, J.J. (1985) Field Guide, Isle of Mull, Inner Hebrides, Scotland, Quaternary Research Association, Cambridge, 89 pp.
- Walker, T.R. (1967) Formation of red beds in modern and ancient deserts. Bulletin of the Geological Society of America, 78, 353–68.
- Wallace, T.D. (1902) The sandstones of the Moray Firth area. Transactions of the Inverness Science Society, 6, 119–41.
- Wang, G. (1993) Xiphosurid trace fossils from the Westbury Formation (Rhaetian) of Southern Britain. *Palaeontology*, 36, 111–22.
- Ward, O. (1840) On footprints and ripple marks of the New Red Sandstone at Grinshill, Shropshire. *Report of the British Association* for the Advancement of Science, **1839**, 75–6.
- Wardlaw, B.R. (2000) Notes from the SPS Chair. Permophiles, 36, 1-2.
- Warrington, G. (1967) Correlation of the Keuper Series of the Triassic by miospores. *Nature*, 214, 1323–4.
- Warrington, G. (1970a) The stratigraphy and palaeontology of the 'Keuper' Series of the central Midlands of England. Quarterly Journal of the Geological Society of London, 126, 183–223.
- Warrington, G. (1970b) The "Keuper" Series of the British Trias in the northern Irish Sea and neighbouring areas. *Nature*, **226**, 254–6.
- Warrington, G. (1971) Palynology of the New Red Sandstone sequence of the south Devon Coast. *Proceedings of the Ussher Society*, 2, 307–14.
- Warrington, G. (1973) Miospores of Triassic age and organic-walled microplankton from the Auchenhew Beds, south-east Arran. *Scottish Journal of Geology*, 9, 109–16.
- Warrington, G. (1974a) Palynology of the Triassic. In Geology of the Country around Stratford-upon-Avon and Evesham (eds B.J. Williams and A. Whittaker), Memoir of the British Geological Survey of Great Britain, Sheet 200, (England and Wales), HMSO,

London, pp.19-21.

- Warrington, G. (1974b) Studies in the palynological biostratigraphy of the British Trias. I. Reference sections in West Lancashire and North Somerset. *Review of Palaeobotany* and Playnology, 17, 133–47.
- Warrington, G. (1974c) Trias. In *The Geology* and Mineral Resources of Yorkshire (eds D.H. Rayner and J.E. Hemingway), Yorkshire Geological Society, pp. 145–60.
- Warrington, G. (1974d) Les évaporites du Trias britannique, Bulletin de la Société géologique de France, 16 (6), 708–23.
- Warrington, G. (1981). The indigenous micropalaeontology of British Triassic shelf sea deposits. In *Microfossils from Recent and Fossil Shelf Seas* (ed.J.W. Neale and M.D. Brasier), The British Micropalaeontological Society/Ellis Horwood, Chichester, pp. 61–70.
- Warrington, G. (1984) Late Triassic palynomorph records from Somerset. Proceedings of the Ussher Society, 6, 29–34.
- Warrington, G. (1996) Chapter 18E. Permian spores and pollen. In *Palynology*, *Principles* and Applications (eds J. Jansonius and D.C. McGregor), American Association of Stratigraphic Palynologists Foundation, 2, 607–19.
- Warrington, G. (1997a) The Lyme Regis borehole, Dorset – palynology of the Mercia Mudstone, Penarth and Lias groups (Upper Triassic – Lower Jurassic). Proceedings of the Ussber Society, 9, 153–7.
- Warrington, G. (1997b) The Penarth Group-Lias Group succession (Late Triassic-Early Jurassic) in the East Irish Sea Basin and neighbouring area: a stratigraphical review. In Petroleum Geology of the Irish Sea and Adjacent Areas (eds N.S. Meadows, S.P. Trueblood, M. Hardman and G. Cowan), Geological Society of London Special Publication No. 124, pp. 33-46.
- Warrington, G. and Ivimey-Cook, H.C. (1990) Biostratigraphy of the Late Triassic and Early Jurassic: a review of type sections in Southern Britain. Cabiers de l'Université Catholique de Lyon, Séries Scientifique, 3, 207-13.
- Warrington, G. and Ivimey-Cook, H.C. (1992) Triassic. In Atlas of Palaeogeography and Lithofacies (eds J.C.W. Cope, J.K. Ingham and P.F. Rawson), Memoir of the Geological Society, London, 13, 97–106.

- Warrington, G. and Ivimey-Cook, H.C. (1995) The Late Triassic and Early Jurassic of coastal sections in west Somerset and South and Mid-Glamorgan. In *Field Geology of the British Jurassic* (ed. P.D. Taylor), Geological Society, London, pp. 9–20.
- Warrington, G. and Pollard, J.E. (1985) Late Triassic miospores from Gribun, Western Mull. Scottish Journal of Geology, 21, 218–21.
- Warrington, G. and Scrivener, R.C. (1980) The Lyme Regis (1901) Borehole succession and its relationship to the Triassic sequence of the east Devon coast. *Proceedings of the Ussber Society*, **5**, 24–32.
- Warrington, G. and Scrivener, R.C. (1988) Late Permian fossils from Devon: regional geological implications. *Proceedings of the Ussher Society*, 7, 95–6.
- Warrington, G. and Scrivener, R.C. (1990) The Permian of Devon, England. *Review of Palaeobotany and Palynology*, 66, 263–72.
- Warrington, G.R. and Thompson, D.B. (1971) The Triassic rocks of Alderley Edge, Cheshire. *Mercian Geologist*, 4, 69–72.
- Warrington, G. and Whittaker, A. (1984) The Blue Anchor Formation (late Triassic) in Somerset. Proceedings of the Ussber Society, 6, 100-7.
- Warrington, G. and Williams, B.J. (1984) The North Curry Sandstone Member (late Triassic) near Taunton, Somerset. Proceedings of the Ussher Society, 6, 82-7.
- Warrington, G., Audley-Charles, M.G., Elliott, R.E., Evans, W.B., Ivimey-Cook, H.C. et al., (1980) A Correlation of Triassic Rocks in the British Isles. Geological Society of London, Special Report, 13, 78 pp.
- Warrington, G., Cope, J.C.W. and Ivimey-Cook, H.C. (1994) St. Audrie's Bay, Somerset, England: a candidate Global Stratotype Section and Point for the base of the Jurassic System. *Geological Magazine*, **131**, 191–200.
- Warrington, G., Wilson, A.A., Jones, N.S., Young, S.R. and Haslam, H.W. (1999) Stratigraphy and sedimentology. In *The Cheshire Basin* (eds J.A. Plant, D.G. Jones and H.W. Haslam), British Geological Survey, Keyworth, p. 10.
- Waters, R.A. and Lawrence, D.J.D. (1987) Geology of the South Wales Coalfield, Part III, the country around Cardiff. *Memoir of the British Geological Survey*, Sheet 263 (England and Wales), HMSO, London, 114 pp.

- Watson, D.M.S. (1909) The 'Trias' of Moray. Geological Magazine, Decade 5, 6, 102-7.
- Watson, D.M.S. and Hickling, G. (1914) On the Triassic and Permian rocks of Moray. Geological Magazine, Decade 6, 1, 399–402.
- Waugh, B. (1965) A preliminary electron microscope study of the development of authigenic silica in the Penrith Sandstone. Proceedings of the Yorkshire Geological Society, 35, 59-69.
- Waugh, B. (1970a) Formation of quartz overgrowths in the Penrith Sandstone (Lower Permian) of northwest England as revealed by scanning electron microscopy. *Sedimentology*, 14, 309–20.
- Waugh, B. (1970b) Petrology, provenance and silica diagenesis in the Penrith Sandstone (Lower Permian) of Northwest England. Journal of Sedimentary Petrology, 40, 1226–40.
- Waugh, B. (1978) Authigenic K-feldspar in British Permo-Triassic sandstones. Journal of the Geological Society, London, 135, 51-6.
- Wedd, C.B., Smith, B., Simmons, W.C. and Wray, D.A. (1923) The geology of Liverpool with Wirral and part of the Flintshire Coalfield. *Memoir of the Geological Survey of the Great Britain*, Sheet 96, (England and Wales), HMSO, London, 183 pp.
- Westoll, T.S. (1948) Guide to excursion C16. 18th International Geological Congress, Great Britain (1948), pp. 14–29.
- Westoll, T.S. (1951) The vertebrate-bearing strata of Scotland. 18th International Geological Congress, Great Britain (1948), 9(11), 5-21.
- Whitaker, W. (1869) On the succession of beds in the 'New Red' on the south coast of Devon, and on the locality of a new specimen of *Hyperodapedon*. Quarterly Journal of the Geological Society of London, 25, 152–8.
- White, E.I. (1950) A fish from the Bunter near Kidderminster. Transactions of the Worcestersbire Naturalists' Club, 10, 185–9.
- Whitehead, T.H. and Eastwood, T. (1927) Geology of the southern part of the South Staffordshire Coalfield (south of the Bentley Faults). *Memoir of the Geological Survey*, HMSO, London, 218 pp.
- Whitehead, T.H. and Pocock, R.W. (1947) Dudley and Bridgnorth. *Memoir of the Geological Survey of Great Britain*, Sheet 167 (England and Wales), HMSO, London, 226 pp.
- Whittaker, A. (1978) The lithostratigraphical correlation of the uppermost Rhaetic and lower-

most Liassic strata of the Somerset and Glamorgan areas. *Geological Magazine*, **115**, 63–7.

- Whittaker, A. (1980) Kempsey no.1. Geological Well Completion Report. Report of the Deep Geology Unit, Institute of Geological Sciences, 80/1.
- Whittaker, A. (1985) Atlas of Onshore Sedimentary Basins in England and Wales: Post-Carboniferous Tectonics and Stratigraphy. Blackie, Glasgow and London, 71 pp.
- Whittaker, A. and Green, G.W. (1983) Geology of the country around Weston-super-Mare. *Memoir of the Geological Survey of Great Britain*, Sheet 279 and parts of 263 and 295 (England and Wales), HMSO, London, 147 pp.
- Whittaker, A., Holliday, D.W. and Penn, I.E. (1985) Geophysical Logs in British Stratigraphy, Geological Society Special Report No. 18, Blackwell Scientific Publications.
- Whittard, W.F. (1949) Geology of the Aust-Beachley district, Gloucestershire. *Geological* Magazine, 86, 365–76.
- Whittard, W.F. and Smith, S. (1944) Unrecorded inliers of Silurian rocks near Wickwar, Gloucestershire, with notes on the occurrence of a stromatolite. *Geological Magazine*, 81, 65–76.
- Wickes, W.H. (1904) The Rhaetic bone beds. Proceedings of the Bristol Naturalists' Society, New Series, 10, 213–27.
- Wignall, P.B. (2001) Sedimentology of the Triassic–Jurassic boundary beds in Pinhay Bay (Devon, S.W. England). Proceedings of the Geologists' Association, 112, 349–60.
- Williams, D. (1973) The Sedimentology and Petrology of the New Red Sandstone of the Elgin Basin, North-east Scotland.
 Unpublished PhD thesis, University of Hull.
- Wills, L.J. (1910) On the fossiliferous Lower Keuper rocks of Worcestershire. Proceedings of the Geologists' Association, 21, 249–331.
- Wills, L.J. (1935) An outline of the palaeogeography of the Birmingham country. *Proceedings of the Geologists' Association*, 46, 211–46.
- Wills, L.J. (1947) A monograph of British Triassic scorpions. Palaeontographical Society (Monographs), 137 pp.
- Wills, L.J. (1948) The Palaeogeography of the Midlands. University Press of Liverpool in

association with Hodder and Stoughton, London, 144 pp.

- Wills, L.J. (1970a) The Triassic succession in the Central Midlands in its regional setting. Quarterly Journal of the Geological Society of London, 126, 225–85.
- Wills, L.J. (1970b) The Bunter Formation at the Bellington Pumping Station of the East Worcestershire Waterworks Company. *Mercian Geologist*, 3, 387–97.
- Wills, L.J. (1976) The Trias of Worcestershire and Warwickshire. *Report of the Institute of Geological Sciences*, 76/2, 1–211.
- Wills, L.J. and Campbell Smith, W. (1913) Notes on the flora and fauna of the Upper Keuper Sandstones of Warwickshire and Worcestershire. *Geological Magazine*, **50**, 461–2.
- Wilson, A.A. (1990) The Mercia Mudstone Group (Trias) of the East Irish Sea Basin. Proceedings of the Yorkshire Geological Society, 48, 1-22.
- Wilson, A.A. (1993) The Mercia Mudstone Group (Trias) of the Cheshire Basin. Proceedings of the Yorkshire Geological Society, 49, 171–88.
- Wilson, D., Davies, J.R., Fletcher, C.J.N. and Smith, M. (1990) Geology of the South Wales Coalfield, Part VI, the country around Bridgend. *Memoir of the British Geological Survey*, Sheets 261 and 262 (England and Wales), HMSO, London, 62 pp.
- Woodward, A.S. (1893) Palaeichthyological Notes. Annals and Magazine of Natural History, Series 6, 12, 281–7.
- Woodward, H.B. (1888) Notes on the Rhaetic Beds and Lias of Glamorganshire. *Proceedings of the Geologists' Association*, 10, 529–38.
- Woodward, H.B. (1893) The Jurassic Rocks of Britain, Vol. III, the Lias of England and Wales (Yorkshire excepted). *Memoir of the Geological Survey of the United Kingdom*, HMSO, London, 399 pp.
- Woodward, H.B. and Ussher, G.W. (1899) Excursion to Seaton, Sidmouth, Budleigh Salterton, and Exeter. *Proceedings of the Geologists' Association*, 16, 133–53.
- Woodward, H.B. and Ussher, W.A.E. (1906) The geology of the country near Sidmouth and Lyme Regis. *Memoir of the Geological Survey* of Great Britain, Sheets 326 and 340, (England and Wales), HMSO, London, 96 pp.
- Woodward, H.B. and Ussher, W.A.E. (1911) The geology of the country near Sidmouth and

References

Lyme Regis, 2nd edn, *Memoir of the Geological Survey of Great Britain*, Sheets 326 and 340, (England and Wales), HMSO, London, 102 pp.

- Woodward, H.B. and Young, G.W. (1906) Excursion to Lyme Regis, Easter, 1906. Proceedings of the Geologists' Association, 19, 320-40.
- Worssam, B.C. and Old, R.A. (1988) Geology of the country around Coalville. Memoir of the British Geological Survey, Sheet 155 (England and Wales), HMSO, London, 161 pp.
- Wright, T. (1860) On the zone of Avicula contorta, and the Lower Lias of the South of England. Quarterly Journal of the Geological Society, London, 16, 374–411.
- Wright, V.P. and Mayall, M. (1981) Organism-sediment interactions in stromatolites: an example from the Upper Triassic of South West Britain. In *Phanerozoic Stromatolites* (ed.C. Monty), Springer-Verlag, Berlin, pp. 74–84.

- Wright, V.P., North, C.P., Hancock, P.L., Curtis, M. and Robinson, D. (1988) Pedofacies variations across an alluvial basin: a case study from the Upper Triassic of SW Britain. Abstracts from the 9th I.A.S. Regional Meeting of Sedimentology, Leuven, Belgium, pp. 227-8.
- Wright, V.P., Marriott, S.B. and Vanstone, S.D. (1991) A 'reg' palaeosol from the Lower Triassic of south Devon: stratigraphy and palaeoclimatic implications. *Geological Magazine*, **128**, 517–23.
- Younger, P.L. and Milne, C.A. (1997) Hydrostratigraphy and hydrogeochemistry of the Vale of Eden, Cumbria, UK. *Proceedings* of the Yorkshire Geological Society, **51**, 349–66.
- Ziegler, P.A. (1982) Geological Atlas of Western Europe, Elsevier, Amsterdam, 130 pp.
- Ziegler, P.A. (1990) Geological Atlas of Western and Central Europe, Elsevier, Amsterdam, 240 pp.

Glossary

This glossary provides brief explanations of the technical terms used in the introductions to the chapters and in the 'conclusions' sections of the site reports. These explanations are not rigorous scientific definitions but are intended to help the general reader. Detailed stratigraphical terms are omitted as they are given context within the tables and figures. Words in **bold** type indicate an internal reference to another glossary entry.

- Abrasion: the process of wearing away parts of fossils or rocks by sediment-laden water or air. The process produces an increasingly smoothed and rounded outline shape.
- Acritarchs: cyst-like microfossils that are probably the remains of algae.
- Aeolian: descriptive of sediments deposited by wind.
- Aestivation: a state of dormancy or torpor during the summer or periods of drought.
- Agate: a banded form of chalcedony.
- Age: a time unit (cf. chronostratigraphy), usually taken to be the smallest standard division of geological time, of shorter duration than an epoch.

Agglomeration: a mass accumulation.

- Aklé dune: a network of sinuous sediment ridges made up of crescentic sections.
- Alabaster: a fine-grained, white or pale coloured, massive form of gypsum.
- Albian Age: a geological time division (age; cf. chronostratigraphy) ranging from 112 to 97 million years ago; part of the Late Cretaceous Epoch.
- Algal mats: large sheets of thin layers of singlecelled plants that help to stabilize the surface of the underlying sediment.
- Alkali feldspar: a group of silicate minerals (see silica) rich in potassium, aluminium and sodium.

- Alluvial fan complex: a fan- or cone-shaped mass of sediment deposited by a stream or river at the point where it emerges from a valley onto an open plain.
- **Alluvium** (adj. alluvial): **sediment** deposited by rivers.
- Ammonite: an extinct cephalopod, a relative of the living Nautilus, characterized by a coiled, chambered, shell. Ammonites lived in marine environments and were common throughout the Mesozoic Era.
- Amphibian: a dominantly terrestrial group of animals that lay their eggs in water, for example frogs, toads and salamanders.
- **Amygdale**: rounded cavities found in **lavas** that have been infilled with minerals.
- Amygdaloidal: a rock that contains many amygdales.
- Angular unconformity: an unconformity characterized by an angular discordance between bedding planes either side of the unconformity surface; or where undeformed younger rocks overlie folded stratigraphically older rocks.
- **Anhydrite**: a mineral (CaSO₄) formed by evaporation, often associated with **gypsum**.
- Anisian Age: a geological time division (age; cf. chronostratigraphy), part of the Mid Triassic Epoch.

Anomodont: a suborder of extinct herbivorous

reptiles, which ranged from Late Permian to Late Triassic times.

Anoxic: without oxygen.

Anticline: a convex-up fold.

- **Apatite**: a calcium **phosphate** mineral found in the bones of vertebrates.
- Aphanitic: an igneous rock composed of crystals that are invisible to the naked eye.
- Aragonite: a form of calcium carbonate commonly found in the shells of invertebrates. It is less stable than calcite and is more soluble in cold water than in warm. It is often replaced by other minerals, such as calcite, in fossils.

Archipelago: a group of islands.

- Archosaur: a group of animals that include crocodiles, dinosaurs, pterosaurs and the-codonts.
- Arenaceous: descriptive of clastic sediments made up of sand-sized particles (see sandstone).
- Argillaceous: descriptive of fine-grained clastic sediments made up of silt- or clay-sized particles.
- Arkose: an arenaceous rock that contains at least 25% feldspar.
- Arthropod: a jointed-limbed, invertebrate animal with an external skeleton, for example insects, crabs and shrimps.
- Articulated: relating to the skeletons or fossils with all the hard parts connected or in life position.
- Artinskian Age: a geological time division (age; cf. chronostratigraphy), the penultimate part of the Early Permian Epoch.
- Asselian Age: a geological time division (age; cf. chronostratigraphy), the first part of the Early Permian Epoch.
- Assemblage: a collection of plants and animals that are characteristic of a certain environment and/or period of geological time.
- Associated bones: used to describe a skeleton where all of the bones are present but jumbled together (cf. articulated).
- Asymptotic: the curved base of a cross-bed foreset.
- Aureole metamorphism: the halo of metamorphic rocks found around an igneous intrusion.
- **Backwash**: the movement of water back down a beach after a wave breaks.
- **Bar**: a linear feature of built-up **sediment** found in the sea or in rivers.

Barchan dune: a crescent-shaped dune.

- **Barite** (also spelt barytes): a whitish, heavy mineral (BaSO₄).
- **Basalt**: a fine-grained **igneous** rock formed by a **volcanic** eruption.
- **Basin**: an area of low-lying ground that acts as a focus for **sediment** deposition.
- Bed: the smallest lithostratigraphical unit, a single layer of sediment bounded by bedding planes. Also used informally to indicate a stratum in a sedimentary rock succession.
- **Bedform:** the shape of the surface of a bed of granular **sediment**, produced by the flow of air or water over the sediment, e.g. **ripples**.
- Bedding plane: planar feature in sedimentary rocks representing an original surface of deposition. Conspicuous bedding planes may indicate a short interruption in, or change in character of, sediment deposition.
- **'Beef'**: a fibrous form of **calcite**, which frequently has the appearance of a series of 'nested' cones stacked one inside the other.
- Belemnite: an extinct type of cephalopod, a relative of modern squids. Belemnites had a long, bullet-shaped internal cone of calcium carbonate.
- Berm: a ridge of sediment developed on a beach.

Bifurcating: dividing into two.

- **Bi-modal**: having two statistical modes ('peaks'), for example a sample of **sediment** with two dominant grain sizes.
- **Bioclastic**: consisting largely of broken shell or bone debris.
- **Biogenic**: describes **sediments** that have been produced by animals, for example **coral** reefs.
- **Biostrome**: a sheet-like mass of organic material that forms rock, for example stromatolites.

Biotite: a type of mica.

- **Bioturbation**: the mixing of layers of unconsolidated **sediment** by the action of animals or plants, especially 'churning' by burrowing animals.
- **Birdseye structure**: a sedimentary structure characterized by irregular cavities infilled with minerals such as **sparry calcite**. These features are frequently found in **limestones** and are indicative of **intertidal** environments.
- **Bisaccate**: a pollen grain with two clearlydefined air sacs.

Bitumen: naturally occurring hydrocarbons.

- **Bituminous**: descriptive of **sediments** that contain large quantities of **bitumen**.
- **Bivalve**: an aquatic invertebrate with two hard **calcareous** shells (valves). The valves are generally mirror images of each other, for example cockles.
- **Body fossil**: a **fossil** composed of the preserved remains of the body of an animal.
- **Bone bed**: a sedimentary **bed** that contains a high proportion of bones, teeth and scales.
- **Boulder**: sedimentary particle with a diameter of more than 256 mm.
- Bounding surfaces: erosional surfaces in cross-bedded sedimentary rocks formed by the migration of dunes and other bedforms, associated with aeolian sediments.
- **Brachiopod**: also known as 'lampshells'. Marine animals that have two shells, which are typically dissimilar to each other (cf. **bivalves**) and live attached to the sea floor by a muscular stalk.
- **Braided channel**: a stream or river characterized by interlinking channels separated by islands and sandbanks.
- Braidplain: an area that supports a system of braided channels.
- **Branchiopod**: a small **crustacean** with flattened limbs used in swimming, often called 'gill-footed shrimps'.
- **Breccia**: a sedimentary rock consisting of angular pebbles (cf. conglomerate).
- **Brecciation**: the process of breaking rocks into angular fragments, which form a **breccia**.
- **Breccio-conglomerate**: a **sedimentary** rock consisting of both angular and rounded pebbles.
- Bryophyte: a group of plants that includes mosses and liverworts.
- Calcarenite: a calcareous, clastic sediment with sand-sized grains.
- **Calcareous**: containing large quantities of calcium **carbonate** (CaCO₃).
- **Calcification**: the process of increasing the proportion of calcium **carbonate** in a rock or **fossil**.
- **Calcirudite:** a coarse-grained **sediment** (with a grain size greater that 2 mm diameter) that has been cemented by calcium carbonate $(CaCO_3)$.
- **Calcite**: calcium carbonate (CaCO₃), the dominant component of **limestones**.

Calcrete: a 'fossil soil' (palaeosol) rich in calci-

um carbonate, indicative of arid or semi-arid environments.

- Caliche: nodules of carbonate that form in soils in seasonally arid environments.
- **Canyon**: a deep, narrow gorge that generally has a river at the bottom.
- Capitanian Age: a geological time division (age; cf. chronostratigraphy), the last part of the Middle Permian Epoch.
- **Capitosaur:** an extinct **amphibian** known only from **Triassic** strata. These animals had flat skulls up to 1 m long and small limbs.
- Carbonaceous: containing large quantities of carbon.
- **Carbonate:** a mineral that contains the carbonate ion $(CO_3)^{2-}$.
- Carboniferous Period: a geological time division (period; cf. chronostratigraphy) from 362 to 291 million years ago. It preceded the Permian Period.
- Carnian Age: a geological time division (age; cf. chronostratigraphy); part of the Late Triassic Epoch.
- **Celestite** (formerly **celestine**): a mineral, strontium sulphate ($SrSO_4$), generally associated with **sedimentary rocks**.
- **Cement:** the mineralogical 'glue' that holds **sedimentary** particles together.
- **Cephalopod:** a group of marine **molluscs** that includes extinct **ammonites** and **belemnites**, and living pearly nautilus, cuttlefish, squid and octopus.
- **Chalcedony**: a variety of **quartz** that is composed of microscopic crystals or fibres.
- Chalk: a poorly lithified, porous white limestone. Stratigraphically, *the Chalk* (a proper noun with a capital letter) is used synonymously with the Upper Cretaceous Series, which formed during the Late Cretaceous Epoch.
- Changhsingian Age: a geological time division (age; cf. chronostratigraphy); part of the Late Permian Epoch.
- **Channel-fill:** sediments deposited within a stream or river channel.
- Channel lag: a layer of coarse-grained sediment found at the bottom of channels. See winnowed lag deposits.
- Charophyte: single-celled planktonic plantlike organism.
- Chert: a form of silica characterizd by microscopic crystals.
- Chlorite: a mineral with a greenish colour that often occurs as small flakes in sedimentary

rocks.

- Choristodere: an extinct aquatic reptile that looked superficially crocodile-like.
- Chronostratigraphy: the correlation and subdivision of rock units on the basis of relative age – a hierarchy of sequential units to which the layers of sedimentary rocks are allocated, through the study and interpretation of their stratigraphy. The hierarchy of principal chronostratigraphical units is system, series and stage, which are related, respectively, to the geological time units of period, epoch and age. Rocks of the Jurassic System (a chronostratigraphical unit) were laid down in the Jurassic Period (a geological time unit). Cirripedes: barnacles.
- Clast (adj. clastic): a sedimentary particle, a fragment of a pre-existing rock or fossil (bioclast).
- Clay: very fine-grained sediment with a grain size less than 0.0039 mm.
- Cleithrolepid fish: a primitive group of rayfinned fish.
- Climbing ripple lamination: ripples formed when sediment is deposited on the upstream and downstream sides of the bedform.
- **Cobble:** a piece of rock with a diameter of between 64 and 256 mm. Generally rounded or subrounded in shape.
- **Conchoidal**: a curved fracture surface with concentric ribs ('shell-like').
- **Concretions**: masses or accumulations of minerals or mineralized **sediments** that form around a nucleus after deposition of the sediments.

Confluence: the joining point of two rivers.

- **Conglomerate:** a sedimentary rock consisting of rounded pebbles (cf. breccia).
- **Conjugate veins**: two sets of **veins** formed at the same time but orientated at different angles.
- **Contact metamorphism**: the alteration of rocks caused by contact with hot **igneous** rocks.
- **Contemporaneous**: occurring at the same time.
- Contorted bedding: beds that are highly deformed.

Coprolite: preserved and fossilized droppings.

- Coquina: a bioclastic limestone composed of cemented shelly material.
- **Coral**: aquatic invertebrate animals that secrete a calcium **carbonate** external skeleton. They

may live as individuals or in large colonies.

Cornstone: a limestone composed of large pellets of sediment.

Correlation: the tracing and identification of a **stratigraphical** unit away from its type area

by comparing lithologies and/or faunas.

Corrensite: a chlorite-rich vermiculite.

Coset: a stack of sets.

Cresentic dune: see barchan dune.

- Cretaceous Period: a geological time period (cf. chronostratigraphy) ranging from 145.6 to 65 million years ago. The last period of the Mesozoic Era.
- **Crevasse splay**: a small fan-shaped accumulation of **sediment** formed when a river breaks through its banks or levee.
- **Crinoid:** a primitive marine invertebrate related to living sea urchins. The animals generally have a long stalk attached to a solid surface, the stalk supports a flower-like arrangement of tentacles, hence the informal name 'sea lily'.
- Crocodile: a semi-aquatic living archosaur.
- Cross-bed, cross-lamination, cross-stratification: a series of inclined bedding planes deposited by currents (rivers, wind or coastal). Large-scale features are named 'cross-stratification', smaller-scale features are known as 'cross-bedding'; 'cross-laminations' are the finest-scale forms.
- **Crustacean**: a subdivision of the arthropod group that includes lobsters, shrimps, barnacles and woodlice.
- Cryptalgal: laminations of algae and sediment.
- Crystalline: composed of many crystals.
- Cyclic sedimentation: a repeated sequence of sedimentary units.
- Cyclothem: the series of sediments produced by cyclical sedimentation.
- **Debris flow:** a flow of water and **sediment**; even large **boulders** can be carried in flows of this kind.
- Decalcification: the removal of calcium carbonate from sediments.

Deflation: blowing away of fine sand by wind.

- **Deflation layer** or **lag**: the coarse-grained material selectively left behind, and concentrated, when finer material is blown away.
- **Deformation**: changes in shape or volume of rock after its formation; including folding and faulting.
- Delta (adj. deltaic): a fan-shaped or irregular mass of sediment deposited when a river

enters a lake or the sea.

Dendritic: with a tree-like shape.

- Desiccation cracks: cracks formed when wet sediment dries out.
- Detrital minerals: minerals derived from preexisting rocks.
- **Devonian Period**: a geological time **period** (cf. **chronostratigraphy**) ranging from 408 to 362 million years ago. The period precedes the **Carboniferous**.
- **Diachronous**: descriptive of a rock body that appears to be continuous, but was deposited at different times in different places, so that the rock body is not everywhere the same age.
- Diagenesis (adj. diagenetic): processes (chemical, pressure, temperature) that alter the mineralogy and texture of sediments and fossils when they are close to the Earth's surface; the term excludes metamorphic alteration.
- **Dinantian**: a stratigraphical term that relates to the Lower Carboniferous Series in Europe.
- **Dinoflagellate**: a single-celled **planktonic** organism related to algae that have two flagella (tails) that are used in movement.
- **Dinosaur:** an extinct large terrestrial **reptile** that lived between the **Triassic** and **Cretaceous periods**.
- **Dip**: the angle between a surface and a horizontal plane.
- **Dipnoan**: describing a group of bony fishes that include the living **lungfish**.
- **Disarticulate**: the process of breaking a skeleton (invertebrate or vertebrate) into its constituent parts.

Disconformity: see unconformity.

- **Dissolution cavity**: a small hole in rock formed when rock is unevenly dissolved.
- **Distal**: in the downstream direction; away from the source.
- **Dolerite:** a medium-grained **igneous** rock that generally occurs in **dykes** and **sills**.
- **Dolomicrite**: a fine-grained **limestone** composed primarily of **dolomite**.
- **Dolomite**: a calcium **carbonate** mineral with magnesium chemically incorporated in the crystal, its chemical formula is CaMg(CO₃)₂. Also a rock that contains more than 15% magnesium **carbonate**.
- **Draa**: a large **dune** that often has smaller dunes on its crest. Thought to be formed when **dunes** coalesce.

- **Dreikanter:** a fragment of rock that has been shaped by sandblasting by wind. The term is German, and means literally 'three-edger'. Dreikanter have a characteristic shape with three sides separated by sharp edges.
- Dune: a ridge of sediment that occurs in several forms: barchan, draa and seif.
- **Dune field**: an extensive area covered with large numbers of **dunes**.
- **Dyke**: vertically orientated bands of rock. The term is generally applied to **igneous** rocks which have 'intruded' or 'cut through' preexisting rocks, although **sedimentary** (Neptunian) forms occur.
- Dyke swarm: a collection of dykes.
- Early Permian Epoch: a geological time division (epoch; cf. chronostratigraphy), the first part of the Permian Period, comprising the Asselian, Sakmurian, Artinskian and Kungurian ages.
- Early Triassic Epoch: a geological time division (epoch; cf. chronostratigraphy), the first part of the Triassic Period equivalent to the former Scythian Epoch, comprising the Induan and Olenekian ages
- **Ebb currents/flow**: the movement of the tide out to sea.
- Echinoderm: a group of animals with calcite plates, including sea urchins and crinoids.

Echinoid: sea urchin.

- **Ecosystem**: a physical environment complete with its interacting fauna and flora.
- **Epichnal ridges**: trace 'fossil' ridges that stand proud of the **sediment** or **bedding plane** surface.
- Epoch: a unit of geological time (cf. chronostratigraphy), of shorter duration than a period and itself divisible into ages (e.g. the Late Triassic Epoch).
- **Epidote**: a group of complex **silica**-rich minerals.
- Era: one of five major divisions of geological time. The Permian Period precedes the Mesozoic,Era, which comprises the Triassic, Jurassic and Cretaceous periods.

Erg: a sand sea.

- **Erosion**: the wearing away of the land's surface by mechanical processes such as the flow of water, ice or wind.
- **Estuarine**: relating to estuaries, where a river opens into the sea or lake.
- Euhedral: fully developed crystal forms.

Evaporite: a sediment that results from the

evaporation of saline water.

- **Evapotranspiration**: the combined loss of water from soil, water bodies and plants.
- **Exfoliation weathering**: a weathering process that results in the separation of thin sheets of rock (also called 'onion skin weathering').
- Fabric: the arrangement or pattern of clasts within sediments and sedimentary rocks.
- Facies: the total characteristics of a rock, including the rock type, any sedimentary structures (for example **bedding**), and **fossils**. Together these features indicate a characteristic environment of deposition.
- Fan: a low-lying accumulation of sediment with a roughly triangular outline. See alluvial fan complex.
- Fault: a fracture within a rock along which there has been displacement due to tectonic deformation (e.g. earthquakes).
- Fauna: animals often referring to the characteristic animal assemblage of a region or time period.
- Feldspar: a group of complex silica-rich minerals.
- Felsite: a very fine-grained igneous rock.
- Fenestrae: cavity structures, which are generally infilled with crystals, also called **birdseye** structures.
- Fenestral: a rock containing many fenestrae. Ferric oxide: a form of iron oxide (Fe_2O_3).
- Ferricrete: a 'fossil' soil (palaeosol) that contains large quantities of iron minerals as nodules or glaebules.
- Ferroan calcite: calcite that contains substantial quantities of iron within the crystalline structure.
- **Ferrous oxide**: a form of iron oxide (FeO₂). **Ferruginous**: iron-rich.
- Fining-upwards: a series of sedimentary beds that show a gradual decrease in grain size up
 - through the rock succession.
- Fissile: splits easily.
- Fissure: a naturally occurring opening in a rock.
- Flaggy: descriptive of sedimentary rocks that split easily into thick sheets or flagstones.
- Flame structure: structures with an irregular flame-like shape, formed when an unconsolidated layer of sediment is covered by a layer of denser sediment. The dense material pushes down into the underlying sediment, which is squeezed upwards in 'flames'.

Flaser bedding: cross-laminated sandstones

that contain mudstone streaks.

Flash flood: a short-lived but rapid rise in water level in a river caused by heavy rainfall and surface runoff.

Flint: a variety of chert.

- Floodplain: the level surface next to a river that is water covered during times of flood.
- Flora: plants often referreing to the characteristic plant assemblage of a region or time period.
- Flowstone: calcium carbonate rock deposited in caves.
- Fluid escape/injection structures: deformation of sediments caused when water is forced out of the sediments during compaction, producing swirls and triangular forms and deformed bedding.
- Fluorite: a mineral, calcium fluoride, CaF2.
- Flute marks/casts: structures formed by small eddies that carve depressions in the surface of a sediment deposit. The cavities are asymmetrical in outline, with the deeper or thicker part at the upstream end, and are generally preserved on the base of the overlying bed as a 'cast' of the depression.
- Fluvial, fluviatile: pertaining to rivers.
- Fluviolacustrine: an environment dominated by rivers and lakes.
- Fold: a flexure in rocks.
- Foraminifera: single-celled aquatic animals that have a protective external shell, often with an elaborate form, and usually composed of carbonate or agglutinated sand grains. These micro-organisms are usually less than one millimetre in diameter (a few are larger).
- Foreset: steeply dipping surfaces of cross-bedded strata.
- Formation: a stratigraphical term used to describe the basic unit in lithostratigraphy; a mappable unit dominated by one lithology; may include members.
- Fossil: the preserved remains of animals and plants.

Fossiliferous: containing abundant fossils.

- **Freestone**: a quarry term used to describe rocks that are easily quarried.
- Friable: crumbly.
- **Fulgurite**: thin, irregular and elongate tubes of fused **sediment** caused when a lightning strike melts unconsolidated sediment.
- Galena: lead sulphide (PbS), the most important ore of lead.

- **Gastropod**: a **mollusc** with a spiral shell; for example a snail.
- **Geochemistry**: the application of chemistry to geological processes and phenomena.

Geomorphology: the study of landforms.

- **Glacial**: relating to the processes in and around glaciers and ice caps. A period of the Earth's history characterized by 'ice age' conditions.
- Glaebule: a concretion found in palaeosol profiles.
- **Glauconite**: a green-blackish or yellowish mineral that occurs as small granules in marine **sedimentary** rocks.

Goethite: a hydrated iron oxide mineral.

- Graded beds: beds that show a change in grain size through the bed. Normal graded bedding is a fining upwards sequence. In reverse graded bedding, the grain size coarsens upwards.
- Grain supported: a sedimentary texture where the constituent grains are in contact, with little sediment infilling the spaces.
- Grainflow lamination: thin structureless sandstone layers.
- Grainstone: a type of limestone with very little matrix.
- Granite: a coarse-grained igneous rock.
- **Granule**: a rock fragment with a diameter of between 2 and 4 mm.
- **Granulite**: a metamorphic rock with a granular texture, with a preferred orientation of the crystals.
- **Gravel:** sedimentary particles with a diameter from 2 mm to greater than 256 mm (granule to boulder) size range.
- Greensand: a lithostratigraphical unit of the Cretaceous System. A greensand is a sedimentary rock that contains a green mineral called glauconite.
- **Greywacke:** an **arenaceous sediment** composed of fine- to coarse-grained, angular to subangular **clasts** that are mainly composed of rock fragments.

Gritstone: a coarse-grained sedimentary rock.

Groundwater: water that occupies cavities and fissures in the Earth's crust.

- Gutter casts: casts (sediment infills) of small channels that often cut across low-lying muddy plains or mud flats.
- **Gypsum**: a calcium sulphate (CaSO₄.2H₂O) mineral often associated with **evaporite** deposits; the hydrous form of **anhydrite**.

Haematization: the processes that lead to the

increase in quantities in haematite.

- Haematite: an iron oxide (Fe₂O₃) often used as a source of iron ore.
- Half-graben: a sedimentary basin formed when a large block of crust tips down. The downfaulted side is generally fault guided.
- Halite: 'common' salt (NaCl) formed as an evaporite mineral.
- Hanging gully or valley: a gully or valley that enters a larger valley part way up the valley side.
- Hardground: a horizon of cementation occurring in **limestones**, often encrusted by invertebrates.

Hercynian: descriptive of a mountain building episode that occurred during the Carboniferous and Permian periods.

Hettangian Age: a geological time division (age; cf chronostratigraphy), the first part of the Jurassic Period.

- High flow regime: high-energy or high-velocity conditions in fluvial systems.
- Hopper crystal: cube-shaped crystals with indented stepped faces.
- Horizon: a single bed or layer of a sedimentary rock.
- Hornfels: a medium- to fine-grained rock produced by thermal metamorphism.
- **Hypersaline**: descriptive of water with a particularly high salt content.
- Ichnogenera: a name given to groups of trace fossils.
- Ichnotaxon (plural: ichnotaxa): a name given to groups of trace fossils
- Ichthyosaur: extinct sea-living reptiles that lived during the Mesozoic Era, with an outline shape similar to living dolphins.
- Igneous: rocks produced by volcanic activity or intrusive igneous processes from magma (molten rock).

Illite: a clay mineral.

- **Imbrication**: a fabric found in coarse-grained **sedimentary** rocks. The flat or elongate clasts are stacked up, leaning on each other.
- Induan Age: a geological time division (age; cf. chronostratigraphy), the first part of the Early Triassic Epoch.

Indurated: a well-cemented sedimentary rock. Inlier: a small outcrop of older rocks complete-

- ly surrounded by **stratigraphically** younger strata.
- Interbedded: alternations between two types of lithology.

Interdune: the lowlying area between dunes.

- **Intertidal**: the region of the shoreline between the high and low tide lines.
- Intraformational: formed within the confines of a sedimentary basin.
- Intrusive igneous: igneous rocks formed when large masses of molten rock are emplaced or pushed up into the Earth's crust.
- Iron pan: a thin layer of concentrated iron that form in soils and may be preserved in palaeosols and other sedimentary units.
- **Ironstone**: a **sedimentary** rock that contains a substantial proportion of iron, often in the form of siderite (an iron **carbonate**).

Isolate ripple: a single ripple.

Isthmus: a narrow piece of land that connects two larger areas of land.

Jasper: a red variety of chalcedony.

- Joint: a fracture in rocks, along which there has been no movement (cf. fault).
- Jurassic Period: a geological time division (period, cf. chronostratigraphy) between 199 and 145.6 million years ago. It follows the Triassic Period.

- Karst: a landscape of weathered and eroded limestone.
- Kungurian Age: a geological time division (age; cf. chronostratigraphy), the last part of the Early Permian Epoch.
- Labyrinthodont: a group of primitive amphibians that lived during the Permian and Triassic periods.

Lacustrine: pertaining to lakes.

- Ladinian Age: a geological time division (age; cf. chronostratigraphy), part of the Middle Triassic Epoch.
- Lag deposit: a concentrate of coarse-grained sediments that accumulates at the bottom of a channel, formed by winnowing. See also winnowed lag.
- Lagoon: an area of shallow water, generally salt water, cut off from the sea by a narrow ridge of land.

Laminated: descriptive of a bed with a fabric composed of laminae – thin layers of rock.

- Laminations: millimetre-scale layers of sediment.
- Late Permian Epoch: a geological time division (epoch, cf. chronostratigraphy), the ultimate part of the Permian Period, consisting

of the Wuchiapingian and Changhsingian ages, which correspond with part of the former Tatarian age.

- Late Triassic Epoch: a geological time division (epoch, cf. chronostratigraphy), the ultimate part of the Triassic Period consisting of the Carnian, Norian and Rhaetian ages
- Lava: an igneous rock formed during volcanic eruptions.
- Lee faces: the downstream faces of ripples and dunes.
- Lenticular bedding: small lenses of cross-bedded sandstone in argillaceous sediments.
- Leucoxene: a white mineral rich in titanium and iron.
- Lias: a lithostratigraphical division that equates largely to the Lower Jurassic Series, rocks that formed during the Early Jurassic Epoch.
- Limestone: sedimentary rock composed primarily of calcium carbonate (CaCO₃).

Linear dune: elongate sand dunes.

- Linguoid ripple or bar: curved ripples or bars, the concave surface of the upstream ripple faces.
- Linsen bedding: see lenticular bedding.
- Litharenite: an arenaceous rock composed of lithic clasts.
- Lithic fragments: rock clasts found within sedimentary rocks.
- Lithification: the process of turning sediments into rock.
- **Lithographical**: a very fine-grained **limestone** that was used in the production of lithographical illustrations.
- Lithofacies: a facies characterized by a particular rock type.
- **Lithology**: the general characteristics of a **sediment**, including texture and composition.
- Lithostratigraphy: the determination of the stratigraphical relationships between rocks based on their lithology.
- Littoral: the environment found between the limits of the high and low tides.
- Liverwort: a primitive plant, (bryophyte).
- Loess: accumulations of wind-borne dust.
- Longshore drift: the movement of beach material along the coast caused by waves breaking obliquely to the shoreline.
- Lunate ripple or bar: curved ripples or bars, the convex surface of the ripple faces upstream.
- **Lungfish**: fish that are able to breathe air using an air sac or lung.

Kaolinite: a clay mineral.

Macrofossil: a fossil that is easily seen by the naked eye.

Magnetite: an iron mineral (Fe₃O₄).

- Malachite: a complex copper-carbonate mineral with a bright green colour banded with black.
- Mammal-like reptiles: a group of animals that have both mammal and reptile-like characteristics. They lived from Late **Permian** to Early **Jurassic** times.
- Marginal: 'coastal' or 'beach'; refers to sediments deposited on the margin between the sea, or a large lake, and land.
- Marl: a very fine-grained calcium carbonaterich mud or clay.
- Massive: sedimentary layers that have no internal structures.
- Mass movement: the downslope movement of surface materials, often assisted by water.
- Matrix: the sediment, usually very fine grained, which infills the spaces between the larger grains.

Meander: a wide loop in the course of a river. Megalosaurus: a carnivorous dinosaur.

Member: a stratigraphical term referring to a group of several beds; members may be defined within formations.

Mesozoic Era: a geological time division (era; cf. chronostratigraphy) comprising the Triassic, Jurassic and Cretaceous periods, ranging from 251 to 65 million years ago.

- Metamorphic rock: rocks altered by the action of heat and/or pressure.
- Mica: sheet-like minerals rich in silica.

Micaceous: containing large quantities of mica.

Micrite: very fine-grained calcium carbonate sediment that acts as an infilling matrix in calcareous rocks.

Microcline: a type of feldspar.

Microfossil: a microscopic fossil.

- **Microgranite**: a type of **granite** with characteristically small crystals.
- Microquartz: an arrangement of microscopic quartz crystals.
- Microspar: an arrangement of microscopic crystals.
- Middle Triassic Epoch: a geological time division (epoch, cf. chronostratigraphy), part of the Triassic Period consisting of the Anisian and Ladinian ages.
- Middle Permian Epoch: a unit of geological time (epoch, cf. chronostratigraphy), part of the Permian Period consisting of the Roadian, Wordian and Capitanian ages.

'Millet-seed' sandstone: sandstone composed of well-sorted, rounded and frosted grains.

- **Mineralogy**: the study of minerals, the mineral constituents of a rock.
- **Miospore**: a microscopic **fossil** produced by land plants (spores, pollen).
- Moinian: a stratigraphical division of the Scottish Precambrian strata.
- Mollusc: a group of invertebrate animals with shells that includes gastropods, bivalves, ammonites and belemnites.
- Monosaccate: descriptive of a pollen grain with one air sac.
- **Moraine:** the jumbled mass of poorly sorted **sediments** deposited by glaciers.
- Mottled: descriptive of a sediment that has irregular patches of colour.

Moulds: an impression produced by an original form. The counterpart of a 'mould' is a 'cast'.

Mud crack: cracks in mud produced by the drying out of wet sediment.

Mudstone: a very fine-grained rock.

Muscovite: a type of mica.

Neoselachian shark: modern shark.

- Neptunian dyke: a cross-cutting, often vertical or sub-vertical feature formed when sediments infill fissures in pre-existing rocks. The infilling process is thought to have taken place under water.
- Nodule: a spherical or oval rounded concretion.
- Norian Age: a geological time division (age; cf chronostratigraphy) part of the Late Triassic Epoch.
- Olenekian Age: a geological time division (age; cf. chronostratigraphy), the last part of the Early Triassic Epoch.
- Olivine: a complex group of silica-rich minerals that also contain magnesium, iron and calcium.
- Onion skin weathering: see exfoliation weathering.
- **Onlap:** associated with **unconformities**, **beds** that successively overlap each other.
- **Oolith**: a small, generally sand-sized, spherical **concretion** made of calcium **carbonate**.
- Oolitic: describes rocks composed of ooliths.
- **Ophiuroid**: a type of **echinoderm**, a brittle star.
- **Ordovician Period**: a geological time division (**period**; cf. **chronostratigraphy**) ranging from 510 to 439 million years ago.

Orthoclase: a type of feldspar.

- Ostracod: a microinvertebrate animal (crustacean) with two shells.
- **Overgrowth**: the deposition of secondary minerals around original minerals and **clasts**, often by the **cementing** minerals.
- **Palaeoclimate**: ancient (occurring in geological time) climate.
- Palaeoenvironment: ancient (occurring in geological time) environment.
- Palaeogeography: ancient (occurring in geological time) geography.
- Palaeokarst: ancient (occurring or formed in geological time) karst landform assemblage.
- Palaeoshoreline: ancient (occurring in geological time) shoreline.
- Palaeoslope: ancient (occurring in geological time) slope.
- Palaeosol: ancient or 'fossilized' soil.
- **Palaeontology**: the study of **fossil** animals and plants.
- **Palaeowind**: ancient (occurring in geological time) wind.
- **Palygorskite**: a fibrous type of **clay** mineral found in **sedimentary** rocks.
- **Palynology**: the study of **fossil** terrestrial spores, pollen and aquatic algal cysts, geological dating and reconstructions of **palaeoenvironments**.
- **Palynomorph**: ancient terrestrial spores, pollen and aquatic algal cysts, studied by palynologists.
- Paper shale: shales with particularly thin laminations.

Parallel bedding: see planar bedding.

Pareiasaur: an extinct group of reptiles that lived during Middle and Late Permian times.

- **Peat**: a partially decomposed mass of vegetation, found in many bogs and marshes.
- **Pebble**: a fragment of rock with a diameter of between 4 and 64 mm.
- **Pediment:** a plain of eroded bedrock, occasionally covered by a thin layer of **sediment**, characteristic of sedimentary **basins** in arid and semi-arid areas.
- **Pedodiagenetic:** diagenetic processes associated with the formation of soil profiles.

Pedogenic: processes relating to the development of soil profiles.

Pelycosaur: a group of carnivorous and herbivorous extinct **reptiles**, some of which had a large fin or sail on the back, which lived from Late **Carboniferous** to **Early Permian** times.

- **Penecontemporaneous**: happening at almost the same time.
- **Period**: a major division of geological time, of shorter duration than an **era** and itself divisibe into **epochs**.
- **Permian Period**: the **period** of geological time (cf. **chronostratigraphy**) ranging from 291 to 251 million years ago.
- **Petrography**: the study of rocks in hand specimen and under the microscope.
- Petrology: the study of rocks.
- **Phosgenite**: a rare mineral composed primarily of lead (Pb₂(CO₃)Cl₂).
- **Phosphate:** a chemical salt containing phosphorus. Calcium phosphate is, a mineral frequently associated with the preservation of bones and shells.
- **Phosphatic:** rocks containing large quantities of **phosphate**.
- **Phosphatize**: the process of becoming enriched with **phosphate**.
- Phyllopod: see branchiopod crustacean.
- Phytoplankton: plant plankton.
- **Piedmont**: the gentle slope between the steep mountain slopes and gentle plain.
- **Pisoids**: large **ooliths**, with a diameter of between 3 and 6 mm.
- **Pisolitic**: descriptive of rocks that contain many **pisoids**.
- **Pitchstone**: a glassy **igneous** rock with a dull surface and flat fracture surfaces.

Plagioclase: a type of feldspar.

- **Planar cross-bedding**: a type of **cross-bedding** in which the lower surfaces of the **sediment** layers, deposited by a current, are flat surfaces of erosion, parallel to each other.
- **Plankton**: aquatic micro-organisms that drift about in the water column.
- Playa lake: shallow lakes that tend to dry out regularly, the underlying and resulting sediments frequently contain large quantities of evaporite minerals.
- Plesiosaur: extinct marine reptiles with long necks that lived during the Mesozoic Era.
- **Polymodal**: a distribution with many peaks, for example a sample of **sediment** with many grain size categories.

Porcellanous: porcelain-like.

Porphyritic: porphyry-like.

- **Porphyry**: a medium-grained **igneous** rock that contains large crystals of minerals such as **feldspar**.
- **Potassium feldspar**: a type of **feldspar** rich in potassium.

Precipitation: the formation of minerals from chemical-laden waters.

Primary current lineation: laminations formed under high-energy conditions, characterized by low ridges only a few grains thick.

- **Procolophonid**: a group of extinct reptiles that lived during the **Permian** and **Triassic periods**.
- **Prosauropod**: a group of primitive, partially bipedal, sauropod-like **dinosaurs**.
- Proximal: near the source.
- **Pseudomorph**: a mineral crystal that has the shape of another type of mineral, for example formed as a result of dissolution of the original mineral and replacement.
- **Pyrite**: iron sulphide (FeS₂), commonly preserving **fossils** and found scattered in some **sedimentary** rocks.
- **Pyroclastics: clastic** rocks formed by **volcanic** eruptions.
- Quartz: silicon dioxide (SiO₂), the most common mineral in the Earth's crust.
- Quartz-feldspar-porphyry: a variety of porphyry rich in quartz and feldspar.
- Quartzite: an arenaceous rock that is composed primarily of quartz.
- Rain prints: small craters formed when rain drops hit unconsolidated sediments.
- **Raised beach**: a shoreline elevated above the present levels either by a fall in sea level or by a relative positive movement of the land.
- Rare Earth Elements (REE): the metallic elements with atomic numbers between 57 to 71, commonly used by geochemists to interpret geological processes.
- **Re-activation surface:** erosion surfaces occurring within cross-bedded units caused by changes in direction of the currents.
- **Recumbent folds**: fold structures that have been tilted or inclined.
- **Red Beds: sedimentary** rocks, usually of continental origin, or derivation, with red colour reflecting a content of iron oxide; may have formed in arid conditions.
- **Reg**: a desert characterized by bare stony surfaces.
- **Regression**: the withdrawal of water (usually the sea) from a landmass.
- **Reptile**: an animal that has scales and lays eggs, for example lizards, snakes and crocodiles.

Reworking: natural excavation (for example by

rivers) of **fossils** from **sediments**, which are often reburied after further transportation; sediments may also be reworked.

- Rhaetian Age: a geological time division (age, cf chronostratigraphy) part of the Late Triassic Epoch.
- Rhizocretions: elongate, commonly vertical, concretions that form around the roots of plants, found in palaeosols.
- Rhyncosaur: an extinct reptile group common in the Triassic period.
- Rhyolite: a fine-grained or glassy volcanic rock.
- **Ripple**: a small-scale undulation in **sediment** produced by the movement of air or water over the sediment surface.
- **Rip-up clasts**: fragments of **sediment** that have been eroded from river banks and re-deposited in the succeeding sedimentary layers.
- Roadian Age: geological time division (age; cf. chronostratigraphy), the first part of the Middle Permian Epoch.
- Rudaceous: coarse-grained rocks, breccias and conglomerates.
- **Rutile**: a mineral, TiO₂, common in **igneous** rocks and found as thin threads in **quartz** crystals.
- Sabkha: salt encrusted, supratidal or intertidal surfaces, or coastal flats bordering lagoons. Inland forms frequently support sand dunes.
- Sakmarian Age: a geological time division (age; cf. chronostratigraphy); the second division in the Early Permian Epoch.
- Sandflow lamination: see grainflow lamination.
- Sandstone: a sedimentary rock composed of grains between 0.0625 mm and 2 mm in diameter.

Sanidine: a type of feldspar.

- Satin spar: fibrous gypsum, usually forming veins.
- Scatter bone bed: a bone bed characterized by scatters of vertebrate material throughout a mudstone unit.
- Schist: a metamorphic rock characterized by a parallel alignment of the coarsely crystalline minerals.

Schorl: black tourmaline.

- Scolecodont: fossil polychaete worm jaw elements.
- Scree: an accumulation of rock fragments formed by the mechanical weathering of outcrops. The rock debris generally forms

cones or slopes beneath cliffs.

- Scrin: very thin, often impersistent mineral veins.
- Scythian Epoch: see Early Triassic Epoch. Sediment: particles of pre-existing rock.
- Sedimentary basin: a large-scale depression that acts as a focus for sediment accumulation
- Sedimentary log: a graphic or pictorial representation of a sedimentary sequence.
- Sedimentary rock: a rock composed of sediments, deposited by wind, water or ice.
- Sedimentology: the study of sediments and sedimentary rocks.
- Seif dune: a knife-edged, longitudinal dune aligned parallel to prevailing wind direction. Selenite: transparent plates of gypsum.
- Septarian nodule: a nodule with an internal structure of mineral (for example calcite) veins, which produces a polygonal pattern of veins.
- Series: a chronostratigraphical unit, of lesser extent than a system, but itself divisible into stages.
- Serir: desert plain strewn with rounded pebbles.
- Set: an individual bed of cross-bedded sediment.
- Shale: very fine-grained rocks that split along well-developed thin layers.
- Sheet flood: the surface movement of thin sheets of water.
- Sheeting: a weathering process that produces thin layers of the parent rock aligned parallel to the ancient land surface under arid conditions. It is seen commonly in modern deserts.
- **Shelf**: the area between dry land and the deep ocean.
- Silica: silicon dioxide (SiO₂), also known as quartz.
- Siliceous: composed of silica or silica rich.
- Silicrete: a palaeosol rich in silica.
- Sill: horizontal sheets of intrusive igneous rocks.
- Silt: a fine-grained sedimentary rock, between clay (0.0039 mm) and sand (0.0625 mm) in grain size.

Siltstone: a rock made of silt.

- Silurian Period: a geological time division (period, cf. chronostratigraphy) ranging from 439 to 408 million years ago.
- **Slickensided**: descriptive of a rock that displays a polish and linear grooves and ridges pro-

duced when two surfaces move past each other, commonly associated with **faulting**.

Slump: contorted structures produced by the mass-movement of unconsolidated sediments.

Smectite: a type of clay mineral.

- **Soft sediment deformation**: deformation of **sediments** before they have been **lithified**, caused by water loss or **tectonic** activity.
- **Sorting**: the distribution of grain sizes. A wellsorted rock will have a narrow range of grain sizes.

Sparry: crystalline.

- **Spenodontian**: a primitive, lizard-like **reptile**. The *Tuatara* from New Zealand is the only living representative of this group.
- **Sphalerite**: the main ore of zinc (ZnS). Often found associated with **galena**.
- **Spherulitic**: globular masses of needle-like crystals, which are generally arranged in radiating patterns.
- Stage: a chronostratigraphical unit, usually taken to be the smallest standard unit.
- **Star dune**: a sand **dune** with a complex starshaped morphology.

Stratified: layered.

- **Stratigraphy**: the study of the temporal and spatial relationships between **strata**.
- Stratotype: the type section of a stratigraphical unit.
- Stratum (pl. strata): a bed, or single layer, of a sedimentary rock.
- Striated: ornamented with linear ridges or scratches.
- Stringers: very thin veins or beds, often laterally impersistent.
- **Stromatolite**: layers of blue-green algae and **sediment**, which grow upwards, producing domal structures.
- Stylolite: an irregular suture formed in limestone and some evaporites due to high pressures dissolving the calcium carbonate rock on a large scale. A diagenetic feature, marked by thin layers of insoluble material.

Sub-tidal: below the tides.

- Succession: a sequence of strata; a younger bed succeeds an older one in a continuous succession.
- Sun crack: cracks formed when wet sediment dries out.

Supersaline: see hypersaline.

Supratidal: above the tides.

Swash: the movement of water up a beach after a wave breaks.

- Synsedimentary deformation: deformation of sediments that occurs while the sediments are being deposited.
- System: a chronostratigraphical unit, made up of series.

Tabular cross-bedding: cross-bedding characterized by flat angled surfaces within the bed. Talus: an alternative name for scree.

- **Taphonomy:** in **palaeontology**, the study of the changes that affect organisms after death and during their transfer to the fossil record, including the physical and chemical interactions that affect the organism from burial to discovery as a **fossil**.
- **Tap root**: the major, often longest, root of a plant growing downwards from the stem.
- **Tectonic**: an adjective used to relate a phenomenon to a structural concept, often associated with large-scale earth movements.
- Temnospondyl: an extinct group of amphibians that lived from Carboniferous to Early Jurassic times.

Theropod: a group of bipedal carnivorous dinosaurs, for example *Tyrannosaurus rex*.

Throw: the amount of movement on a fault.

Thrust fault: a fault characterized by movement or rocks under lateral compression along a low angle fault plane.

Tourmaline: a complex silica-rich mineral.

- **Trace bone bed**: thin, often single layers of grains and patches of vertebrate material.
- **Trace fossil**: sedimentary structures produced by biological activity, for example burrows and footprints.

Trackway: a connected series of footprints.

- **Transgression**: the inundation of a landmass by a body of water, usually the sea.
- **Triassic Period**: a geological time division (**period**, cf. **chronostratigraphy**) ranging from 251 to 199 million years ago, the first part of the **Mesozoic Era**. It is preceded by the **Permian Period**.

Tridactyl: with three toes.

Tritylodont: an extinct terrestrial reptile.

- Trough cross-bedding: cross-bedding characterized by trough-shaped surfaces within the bed.
- Tuff: igneous rocks formed by explosive volcanism.
- Type section/locality: the sedimentary rock succession or locality used to define an interval or point in geological time.

- **Unconformity**: a break in the relationship between successive **strata** resulting from a lack of deposition during an intervening phase of **tectonism** and **erosion**; the unrepresented time interval may be substantial and there is often an angular discordance in the layers either side of the unconformity surface.
- Uni-modal: a distribution with one peak, for example a sample of sediment with one dominant grain size.
- Upper stage plane beds: thin laminations deposited under high-energy flow conditions.
- Upthrow: upwards vertical movement associated with a fault.

Vadose: descriptive of the water below the ground surface, but above the water table.

- Vein: thin sheets of minerals cutting through rocks.
- Vein quartz: opaque white quartz formed in veins.
- Ventifact: fragment of stone abraded by the wind into a characteristic shape. See dreikanter.
- Vermiculite: a group of layered minerals.
- Volcanic: igneous rocks formed when volcanoes erupt (e.g. lava).
- **Vug**: a cavity in a rock that may be partially or totally infilled with minerals.
- **Wadi**: a gorge-like valley formed in arid or semiarid environments.

Watertable: the upper limit of groundwater.

- Wave-cut platform: a smooth rock 'bench' along a coast produced by ocean waves cutting landwards.
- Wavy bedding: thin cross-laminated beds that alternate with mudstone.
- Weathering: the breaking down of rocks through the effects of exposure to the weather; the term does not infer any transportation of the weathered rock material.
- Winnowed lag: a concentration of coarsegrained sediments produced when a current of wind or air removes the finer-grained component.
- Wordian Age: a geological time division (age; cf. chronostratigraphy), the middle part of the Middle Permian Epoch.
- Wuchiapingian Age: a geological time division (age; cf. chronostratigraphy), the first part of the Late Permian Epoch.

Note: Page numbers in **bold** and *italic* type refer to **tables** and *figures* respectively

Abberley Breccia 76 acritarchs 19, 22, 118, 130, 225, 231 Acrodus 185-6, 187, 230, 236, 241, 246-7, 253, 260, 268 A. minimus 265 Adamanian 107, 116 aestivation burrows 89 aetosaur 107 Agkistracanthus 226 akle see dunes Aldergrove Beds 256-7 see also Blue Lias algae 58, 75-6, 248, 265, 266, 268-9, 271 Avon 253-6, 256-7 South Wales 190, 203-5 Alisporites sp. 124 Allt na Teangaidh burn 124-6 Alphington Breccia 83-4 Exeter area 82-5 see also Crediton Breccia Alpine marine sequence 8, 26 Alston block 14 ammonoids 3, 8, 116, 118, 221, 258, 261 amphibians 3, 6-7, 25-7, 76 capitosaurid 215 Mercia Mudstone Group 25-6, 176, 187, 191, 230-1 Sherwood Sandstone Group 206, 212 temnospondyl 212, 215 Tor Bay Breccia 89-90 see also under genus names

Anchisauripus 199-201 Anglesey-Isle of Man-Rhinns of Galloway Uplift 14 Anglo-Brabant landmass 20-1 angulata Beds 229 angulata zone 118 anhydrite 18-19, 60-1, 63-4 Triassic 136, 187-8, 205, 209 Anisian 9-11, 19, 25-6, 82, 118.131 Auchenhew Mudstone Formation 127, 129 Bromsgrove Sandstone Formation 19, 176, 186 Colwick site 73 English Midlands 167, 173, 174.176 Frodsham site 158 Helsby Sandstone Formation 148 King's Cave to Drumadoon site 129 Ladram Bay to Sidmouth site 215 miospores 139, 148-9, 186, 212 Moray Firth 112 Northwich Halite Formation 149 Otter Sandstone Formation 24-6, 82-3, 205-6, 212-15 Red Brow Cutting site 159, 162 **Sneinton Formation 172**

Tarporley Siltstone Formation 19, 159 The Wirral 136, 139, 142-3 Anisian (upper) to Ladinian (lower), Donguz Gorizont 215 Annandale 16–17 annelids 25, 176, 225 Appleby 62-3, 67, 70 Appleby Group, Brockram 57-61 **Collyhurst Sandstone** Formation 59 Saltom Bay site 58-61 Archarenicola rhaetica 249 Arden Sandstone Formation 9-11, 26, 190, 205 Carnian 174, 176, 186 fauna 26, 186-8 Shrewley site 186–9 see also Butcombe Sandstone Member, North Curry Sandstone Member, Dane Hill Sandstone Member, Weston Mouth Sandstone Member Ardnamurchan 116-17 Arenicolites sp. 159, 162, 265 Areta intrusstriata 256-7 Armathwaite Dyke 62 Armorica 18-22, 175, 182, 206, 209 Arran, Isle of 17, 41, 116-19, 226 Auchenew Mudstone

Formation 117-19 Brodick Breccia 117-19 Corrie Shore site 41-7 **Derenenach Mudstone** Formation 117-18 Glen Dubh Sandstone Formation 117-19 King's Cave to Drumadoon site 116-18, 126-30 Lag a'Bheith Formation 117-19 Lamlash Sandstone Formation 117-19 Levencorroch Mudstone Formation 117-19 Westbury Formation 116-19 arthropods 128-30, 168 Artinskian 6 Ashow Group 16 Askrigg block 14 Asselian 6 Bow Breccia 83 Cadbury Breccia 83 Tor Bay Breccia 83, 88-93 Watcombe Breccia 83 Asselian-Sakmarian, Oddicombe Breccia 83 Asteracoenia gibbosa 257 Auchenhew Mudstone Formation 117-18 Anisian 127, 129 King's Cave to Drumadoon site 126-30 Aust Cliff Breccia 244-9 Aust Cliff site 108, 222-5, 241-9 **Carboniferous** Limestone 244, 249 Lias 241-9 planorbis Zone 242, 244 Pre-planorbis Beds 242, 244 Lilstock Formation 241-9 Cotham Crazy Marble 244-9 Cotham Landscape Marble 244-9 Cotham Member 241-9 Mercia Mudstone Group 241-9 **Blue Anchor Formation** 241-9 **Twyning Mudstone** Formation 241-9

Westbury Formation 241-9 black shales 241-9 Pecten Limestone 241-9 'Rhaetic' Bone Bed 222, 241-9 Avicula contorta zone 266 Avon, Aust Cliff site 108, 222-5, 241-9 Barnhill site 251-3 Wetmoor site 253-6 Axmouth Bone Bed see Culverdale Bone Bed Axmouth to Lyme Regis Undercliffs NNR 266, 270 Aylesbeare Mudstone Group 83-4, 103, 205-6, 212 Exmouth Mudstone and Sandstone Formation 83-4, 99-100, 205-6 Induan 83 Littleham Mudstone Formation 83-4 Orcombe Rocks site 100-3 Babbacombe Downs 93-4 Bacton Group 167-8 Bakevillia basin 7, 18, 73 Bakevillia binneyi 60

Balmeanach Farm 124-6 Baltic 222 Banff Fault zone 14–15 Barbers Hill Quarry 169 barchan see dunes, lunate barite 141, 153-4, 165, 236 Moray Firth 36, 38-41, 112, 114 Barnhill site 226 **Carboniferous** Limestones 251-3 Lias 252 Lilstock Formation 251-3 Westbury Formation 251-3 Barr Beacon Beds 77-8, 82 see also Hopwas Breccia, Quartzite Breccia, **Bridgnorth Sandstone** Formation, Collyhurst Sandstone Formation, Penrith Sandstone Barrowmouth Bay 59, 133 **Barrowmouth Mudstone** Formation 57 see also St Bees Shale Formation

Barry Island site 26, 108, 189, 195-8 **Carboniferous** Limestone 195-8 Mercia Mudstone Group 190-1, 195-8 Norian 210 Westbury Formation 197 Barton 95 basal bone beds 237-41 Aust Cliff site 241-9 Barnhill site 252-3 Culverhole Point site 266-9 Penarth Group 220, 226, 241-9 St Audries Bay site 261 Westbury Formation 222, 241-9, 266-9 Wetmoor site 254-6 basalts 5, 16, 41, 47-9, 82-4 Beacon Edge 66 Beatrice Fault 15 Beeston Castle 152-4 Belah Bridge 73-6 Belah Dolomite 63-4, 72-3, 75 Hilton Beck site 69-71 River Belah site 73-6 Vale of Eden 63-4 see also Brotherton Formation, D-bed gypsumanhydrite, Seaham Formation, Stenkrith Brockram Belah Scar 73-6 Bendrick Rock 197, 198-202 Berry Head 86-7 Bickerton Hill site 108, 149, 152 - 4**Bulkeley Hill Sandstone** Formation 152-4 Helsby Sandstone Formation 152 - 4**Tarporley Siltstone** Formation 152-4 Wilmslow Sandstone Formation 152-4 **Bickerton-Bulkeley Fault** 152 - 4Birgeria 226, 230, 260 B. acuminata 247 Birmingham 78-9, 175 bitumen, Marl Slate 55 bivalves 3, 11, 25-7

Mercia Mudstone Group 25-7, 176, 186, 188 pectinid 222, 225 Penarth Group 27, 124, 222, 225, 229-31, 235-6, 247, 249, 250, 253, 256, 260-1, 263-6, 270-1 Permian 25, 59-61, 71, 75 Sherwood Sandstone Group 159, 176, 212, 214 Black Rock Limestone, Lulsgate site 256-7 Blackeler's Quarry 93 Blue Anchor Formation 11, 19, 26-7, 131, 147, 190-1, 205-6, 219-23 Aust Cliff site 241-9 Barry Island site 191, 195-8 Blue Anchor Point site 262-6 Culverhole Point site 266-9 **Derenenach Mudstone** Formation 118 English Midlands 167-8, 168, 174, 176 Grey Marls facies 26-7, 212, 221 Lavernock to Penarth site 227-32 Rydon Member 221, 229, 231, 258-62, 262-6 St Audries Bay site 258-62 Scrooby Top Quarry site 234-7 Wainlode Cliff site 234-7 Western Highlands and Islands 118 Westbury Garden Cliff site 239-41 Williton Member 231, 258-62, 262-6 Blue Anchor Point site 226, 262-6 Lias 262-3, 265 Lilstock Formation 262-6 Westbury Formation 262-6 Blue Ben Syncline 258 Blue Lias 10, 116, 118, 175-6, 219, 221 Lulsgate site 256-7 Pinhay Bay site 269-70, 269-74, 274 **Bollin Mudstone Formation** 131, 148

Grinshill Quarries site 162-6 bone beds 11, 220-5, 231, 237, 241, 248, 254-6 Barnhill site 253 Blue Anchor Point site 263-5 Lavernock to Penarth site 227-32 Manor Farm 249 Rhaetic 11, 190, 221-5, 241-9 Stormy Down site 233-4 Wainlode Cliff site 236-7 Westbury Formation 222-5, 229, 230-1, 236-7, 239-41 Westbury Garden Cliff site 239-41 Bow Breccia 82-4 Asselian 83 Crediton Trough 82-5 brachiopods 3, 11, 20, 25-6, 142, 174, 225 articulate 5 inarticulate 19, 55, 168, 173, 231, 239, 247 Lingula 19, 55, 168, 173, 239 Brachyrbinodon taylori 115 breccias 7, 16-19, 41, 52 see also Brockram, and named formations breccio-conglomerates see brockram Bridgend 190 Bridgnorth River 175, 182-3 Bridgnorth Sandstone Formation 13, 76-7, 174 English Midlands 76-7 Kinver Edge site 77, 79-82 Osebury Rock site 77-9 Wollaston Ridge Quarry site 180 - 2see also Collyhurst Sandstone Formation, Penrith Sandstone, Yellow Sands Bristol region 9, 12-13, 26, 176, 188-9, 191, 205, 225, 268 'bristovi limestone' 228-31 Brixham 86-7 Broadclyst Sandstone Member 25, 252

Broadford Beds 116, 118 Eyre Burn site 123 Bröckelschiefer Member 10, 167 see also Bunter Shale Formation brockram 57-76, 136 Burrells Quarry site 64-6 Hilton Beck site 69-71 River Belah site 74-6 Saltom Bay site 57-61 Vale of Eden Basin 61-4 see also Collyhurst Sandstone Formation, Penrith Sandstone, Yellow Sands Brockton Quarry site 108, 179-80 Cannock Chase Formation 179-80 Brodick see Corrie Shore site Brodick Breccia 41-7, 117 Corrie Shore site 43-7 King's Cave to Drumadoon site 126-7 **Bromsgrove Sandstone** Formation 13, 19, 24-6, 174-6, 183-6, 215 Burcot Member 176, 184-6 Burcot site 183-6 Finstall Member 176, 185 Sugarbrook Member 176, 185 **Brooks Mill Mudstone** Formation 148 **Brotherton Formation 64** see also Seaham Formation. Belah Dolomite, Stenkrith Brockram, D-bed gypsumanhydrite Brough Sowerby borehole 70 bryozoa 3, 247, 251, 256-7 Buckie Fault Zone 15 Bude Formation 82-3 Crediton Trough 82-5 **Budleigh Salterton Pebble** Beds 18-19, 24-5, 103, 175, 189 Devon 82-4, 205-6, 207-12, 212-15 Olenkian 83-4 Budleigh Salterton site 108, 100, 206, 207-12, 213 Littleham Mudstone

Formation 207-8, 212 **Otter Sandstone Formation** 207-12, 213 Budleighensis River 13, 175, 178, 180, 206, 211 **Bulkeley Hill Sandstone** Formation 131, 148-9 Bickerton Hill site 152-3, 152 - 4see also Wilmslow Sandstone Formation Bunter Pebble Beds see **Chester Pebble Beds** Formation, Kidderminster Formation, Nottingham Castle Formation, Cannock **Chase Formation Bunter Sandstone Formation** 8-11, 63, 167 Bunter Shale Formation 10, 167 Burcot Member 176, 184-6 Burcot site 108, 176, 183-6 **Bromsgrove Sandstone** Formation 183-6 Wildmoor Sandstone Formation 183-6 **Burghead Sandstone** Formation 12-15, 14-16, 31-3 111-14 Burghead site 107-12 Lossiemouth Shore and Quarries site 112-15 Masonshaugh Quarries site 38-41 Burghead site 33, 38, 107-14 Hopeman Sandstone Formation 109-12 Lossiemouth Sandstone Formation 109-12 Old Red Sandstone 107, 109 see also Masonshaugh **Ouarries** site Burrells Quarry site 32, 62, 64-6 Eden Shales 63 Penrith Brockram 64-6 Penrith Sandstone 64-6 burrows 89, 126, 128, 140-2, 162, 265 Crime Rigg Quarry site 55 Culverhole Point site 267-9 Orcombe Rocks site 102-3

Penarth Group 222, 229-30, 240, 268-9, 271 Saltern Cove site 88-90 Shrewley site 185-6, 188 see also tetrapods Burton Point site 108, 132, 137-9 **Chester Pebble Beds** Formation 137-9 **Kinnerton Sandstone** Formation 137-9 Burwardsley Hill 153 Butcombe Sandstone Member 26, 188, 199, 205 see also North Curry Sandstone Member, Dane Hill Sandstone Member, Arden Sandstone Formation, Weston Mouth Sandstone Member Bwlch Cae Halen 192, 194 Bwlch Gwyn 192, 194 **Byley Mudstone Formation** 131, 148 Cadbury Breccia 82-3, 95 Crediton Trough 82-5 Permo-Carboniferous 83, 95 see also Tor Bay Breccia calcarenite 109-10, 191-4, 196-8, 203 Calcinema periana 75-6 calcispheres 71, 75 calcite 54-7, 63, 64-6, 67-9, 87, 88, 92, 94-5, 109-11, 112-14, 116, 126, 128, 246 sheets 209-10, 213 veins 74, 87, 114, 194

Calcothill Farm 77 calcrete 19, 24-5, 63, 209 **Budleigh Salterton site 209** Burcot site 185-6 Eyre Burn site 122-5 Gribun Shore and Crags site 124-6 Gruinard Bay site 119-21 Ladram Bay to Sidmouth site 213-15 Moray Firth 109-10, 112, 114, 116 see also cornstone, palaeosol **Calder Sandstone Formation** 131-3

Caledonoid structural trend 12, 14-16 Camas Malag Formation 117 Cambrian clasts 78-9, 121, 180 Camelotia 226 Cannock Chase Formation 174-6, 180-2, 184 Brockton Quarry site 179-80 Hulme Quarry site 174-9 Capitanian 6 Carboniferous 6-8, 14, 16, 41, 45, 57-8, 76, 77, 79, 82-3, 85, 89, 131-2, 191-4 Bude Formation 82-3 clasts 16, 82, 84, 102, 180, 205-6 Coal Measures 54, 176-7 Corrie Shore site 41-2, 45 Enville Breccia 76, 80 Gully Oolite 191-4 Hapland Burn site 47-8 Saltom Bay site 58, 60 **Carboniferous** Limestones 12-13, 22, 26, 58, 69, 72, 74, 94-5, 97, 136, 169, 189-205, 222, 227, 249-251, 251-3, 257 Aust Cliff site 241-5 Barnhill site 251-3 Lulsgate site 256-7 Vale of Eden 62, 64 Cardinia 251 Carlisle Basin 64 Carlton Formation 167, 174 Carnian 5-6, 9-10, 26, 107, 118, 131, 206 Arden Sandstone Formation 176, 187-8 **Burghead Sandstone** Formation 107, 112, 116 Burghead site 107, 111-12 **Butcombe Sandstone** Member 26, 188, 205 Dane Hill Sandstone Member 188, 205 English Midlands 167, 174 Lossiemouth Sandstone Formation 26, 31-3, 107, 112-16 North Curry Sandstone Member 26, 205 Schilsfandstein 188

Weston Mouth Sandstone Member 26, 188, 205 Wilkesley Halite Formation 149 Carron Basalt Formation, Hapland Burn site 47-9 Carron Water and Hapland Burn SSSI 47 Castle Rock, Nottingham Castle site 169 Celtic Sea Basin 20-1 cephalopods 5 Ceratodus 25, 226, 230, 241 C. latissimus 247 Changhsingian 6, 52 Charnwood Forest 221 Charton Bay 220, 274 Chelichnus bucklandii 37-41, 51 C. duncani 37-41, 51 C. gigas 37-40, 51 C. spp. 36-41, 84 C. titan 37-41, 51 Chelston cuvette 85 **Chercombe Bridge Limestones** 94 Cherty Rock 33, 112-14, 116 Clashach to Covesea site 33 Lossiemouth Shore and Quarries site 112-14, 116 Rhaetian 116 Cheshire 9, 26, 108, 130-2, 131-2, 147-9, 153, 226 Bickerton Hill site 152-4 Burton Point site 137-9 Dee Cliffs site 149–52 Frodsham site 154-8 Hilbre Island and Hilbre Point site 139-43 Red Brow Cutting site 158-62 Cheshire Basin 12-14, 18-22, 24-6, 66, 108, 131-2, 147-67 Blue Anchor Formation 147 - 9**Bollin Mudstone Formation** 148 - 9**Brooks Hill Mudstone** Formation 148 **Bukeley Hill Sandstone** Formation 148-9 **Byley Mudstone Formation** 148-9 **Chester Pebble Beds**

Formation 137-9, 148-9 Grinshill Quarries site 162-6 Helsby Sandstone Formation 148-9 Manchester Marls Formation 148 Mercia Mudstone Group 147-9 Northwich Halite Formation 148-9 Penarth Group 147-9 Sherwood Sandstone Group 148-9 Tarporley Siltstone Formation 148-9 Wilkesley Halite Formation 148-9 Wilmslow Sandstone Formation 148-9 Wych Mudstone Formation 148-9 **Chester Pebble Beds** Formation 131-2, 134-6, 137-9, 142-9 Burton Point site 137-9 Dee Cliffs site 149-52 Chipping Sodbury Quarry see Barnhill site Chirotherium 25, 142, 159, 162, 166, 199, 201 Chiselbury Bay 213 Chit Rocks 213 Chlamys 260 C. (Pecten) valoniensis 124, 247 C. valoniensis 247 Chondrites burrows 230 choristoderes 224, 241, 247, 265 Churston Cove 87 Clarkly Hill 109–10 Clashach to Covesea site 31-8 Cherty Rock 33 Hopeman Sandstone Formation 1-9, 31-8, 33-8, 109 Claverley Road Cutting site 108, 176, 182-3 Clent Breccia 182 Wildmoor Sandstone Formation 182-3 Cleiteadh nan Sgarbh 128-9 Clent Breccia 7-8, 76-8

Claverley borehole 182 Kenilworth Sandstone Formation 77 Sling Common site 77-8 Clopton Fault 12–13 Clyde Belt 11-14 Coal Measures 54, 55, 176-7 see also Namurian, Westphalian, Stephanian Cochlichnus 159 coelacanth 225-6 Cold Knap Point 195 **Collyhurst Sandstone** Formation, East Irish Sea Basin 59, 76-7, 82, 131 Colwick Formation see **Sneinton Formation** Colwick site 108, 168, 172-4 Nottingham Castle Formation 172-4 Sneinton Formation 172-4 Congleton 148 conifers 25, 76, 176, 187, 225 conodonts 5, 225 Contorta Shales 220-2, 270 see also Westbury Formation, Rhaetavicula contorta shales copper mineralization 102-3, 152-4 coprolites 11, 222-5, 239, 249, 253, 262-6, 268-9 coquinas 234 corals 3-6, 11, 142 Penarth Group 225, 257, 261, 271 Corncockle Muir 51 cornstone 119-21 see also calcrete, palaeosol Cornubia 18-22, 221 Corrie Sandstone 41-7, 80 Corrie Shore site 32, 41-7, 80 Brodick Breccia 41-7 Carboniferous succession 41 - 2Coryton Breccia 87, 96-7 Coryton's Cove site 96-7 see also Heavitree Breccia, Newton St Cyres Breccia Coryton's Cove site 32, 85-6, 96-7 Dawlish Sandstone Formation 96–7 Teignmouth Breccia 96-7

'Cotham Marble' 220, 225, 244-9, 254-6, 274 Crazy Marble 244, 248, 266-9 Landscape Marble 244, 248, 253-6, 269, 269-74 Lulsgate site 256-7 Stormy Down site 233-4 Cotham Member 190, 219-21, 225-6, 248, 253-6 Aust Cliff site 241-9 Barnhill site 251-3 Blue Anchor Point site 262-6 Cotham Marble, Cotham Crazy Marble 244, 248, 253-6, 266-9, 269-74 Culverhole Point site 266-9 Hapsford Bridge site 249-51 Lavernock to Penarth site 228-32 Pinhay Bay site 269-74 St Audries Bay site 259-62 Stormy Down site 233-4 Wainlode Cliff site 235-7 Westbury Garden Cliff site 241 Wetmoor site 253-6 Covesea village 34, 35 Cowbridge 190 Cowraik Quarry site 32, 62, 66-7 Penrith Sandstone 66-7 Crab Ledge 213 Crackington Formation 83 Cranborne Fault 211 Cranborne-Fordinbridge High 211 Crediton Breccia 83-4 Crediton Trough 82-5 miospores 83 see also Alphington Breccia, Yellowford Formation Crediton Trough 82-5, 95, 205, 211 Bow Breccia 82-5 Bude Formation 82-5 Cadbury Breccia 82-5 Crediton Breccia 82-5 **Creedy Park Sandstone** 82-5 **Dawlish Sandstone** Formation 82-5, 83-4

Knowle Sandstone 82-5 Newton St Cyres Breccia 82-5 Shute Sandstone Formation 82-5 Thorverton Sandstone 82-5 Yellowford Formation 82-5 Creedy Park Sandstone 83-4 Crediton Trough 82-5 Kazanian 83 see also Whipton Formation Cretaceous 124, 212-13, 266 Crime Rigg Quarry site 32, 52-7 Don Group 52-7 crinoids 3, 5, 247 **Cropwell Bishop Formation** 168 crustaceans 25-6, 186-8, 224-5 branchiopods 176, 180, 212, 214, 235-7, 247 Penarth Group 234, 271 Crystal Cove Fault Zone 88-9 Culverdale Bone Bed 220, 266-9 Culverhole and Charton Bay 220, 267 Culverhole Point site 226, 266-9, 271 Blue Anchor Formation 220, 266-9 Cretaceous 266 Lilstock Formation 220, 266-9 Westbury Formation 220, 266-9 Cumbria 32, 57-61, 62, 130-6, 226 Cowraik Quarry site 32, 62, 66-7 Fleswick to St Bees site 108, 132 - 6George Gill site 32, 62, 67-9 Hilton Beck site 32, 62, 69-71, 70-1 Saltom Bay site 32, 57-61 Stenkrith Beck site 32, 62, 71-3 see also Carlisle Basin, Vale of Eden Basin Cumbrian Coast Group 57 Hilton Beck site 70-1

St Bees Evaporite Formation 57 St Bees Sandstone Formation 57, 60 St Bees Shale Formation 57, 59,60 Saltom Bay site 57-61 Saltom Dolomite 58-61 Stenkrith Beck site 71-3 Cummingstown 107 Cummingstown Beds see Hopeman Sandstone Formation **Cutties Hillock Sandstone** Formation 33, 38 cyanobacteria 25, 225 Cyatharofenia dendroidia 257 Cylindricum 128-9 D-bed gypsum-anhydrite 70-1, 72-5 see also Eden Shales, Stenkrith Brockram Dalatias 230, 260 Dane Hill Sandstone Member 188 see also Arden Sandstone Formation, Butcombe Sandstone Member, North Curry Sandstone Member, Weston Mouth Sandstone Member Dartmoor 84, 95 Darwinula 269 D. liassica 236 Dasyceps 25, 76 Dawlish Sandstone Formation 83-4.87 **Broadclyst Sandstone** Member 25 Coryton's Cove site 96-7 Crediton Trough 82-5 Dawlish site 98-100 Exeter area 83-5 fossils 25, 84, 100 Orcombe Rocks site 100-1 see also Hopeman Sandstone Formation, Teignmouth Breccia Dawlish site 32, 85-7, 96-100 Aylesbeare Mudstone Group 99-100 Exmouth Mudstone and

Sandstone Formation 98-100 **Dawlish Sandstone** Formation 98-100 Exe Breccia 85, 98-100 Teignmouth Breccia 100 Dee Cliffs site 108, 140, 149-52 **Chester Pebble Beds** Formation 149-52 **Delamere Pebbly Sandstone** Member 131, 148-9 Bickerton Hill site 152-4 Densoisporites 102 Dent-Pennine Fault system 14 Derbyshire 168, 174-5 Derenenach Mudstone Formation 117-18 Arran 117-18 Devon 7, 9, 16, 25-6, 32, 175-6, 205-6 **Budleigh Salterton site** 207 - 12Coryton's Cove site 32, 86, 96-100 Culverhole Point site 220, 266-9 Dawlish site 32, 86, 98-110 Ladram Bay to Sidmouth site 212-15 Oddicombe Beach site 32, 86, 93-6 Orcombe Rocks site 32, 86, 100 - 3Penarth Group 219-20, 225-6 Pinhay Bay site 269-74 Roundham Head site 32, 86, 90 - 3Saltern Cove site 32, 86, 87-90 Shoalstone site 32, 86-7 stratigraphy 8, 16-17, 19, 82-6, 219-20 Devonian 14, 61, 113, 116 Chercombe Bridge Limestones 94 clasts 45, 89-94, 97, 169, 205-7 East Ogwell Limestones 94 igneous 88-9, 93-4 limestones 84-5, 88-90, 93-4,97 Meadfoot Beds 88

Moray Firth 15, 31, 33 Oddicombe Beach site 87-8 Paignton cuvette 84-5 Petit Tor Limestone 93-4 reworked fossils 77, 102 Teignhead cuvette 84-5 Torquay Limestone 86-7 **Ugbrooke Sandstone** 94 Vale of Eden 61 Dictytriletes 102 Dicynodon see Gordonia dicynodonts 25, 36-8, 51 Dimyopsis 231 Dinantian 14, 191-4 Dinas Powis 189 dinoflagellate cysts 11, 27, 225, 231, 260-1, 269 dinosaurs 3-5, 26-7, 191, 195, 198-202 megalosaurid 226, 232, 234, 247 Penarth Group 224-6, 232, 234, 242, 247-9, 251 prosauropod 199, 201, 251 theropod 199, 201, 221, 234, 249 Diplocraterion burrows 240, 258, 265, 269 Diplocraterion luniforme 159, 162 Dipteronotus 25 D. cypbus 214 Dod Rock 243 Doddiscombleigh 85 dolerites 68, 78, 93-4, 166 dolomites 18, 55, 58-9, 61-2, 69-71, 74, 196-8, 102, 203-5, 227, 234 Aust Cliff site 239-41 Colwick site 173 Crime Rigg Quarry site 54-7 Eden Shales 63-4 Haves Point to Bendrick Rock site 198-202 Radcliffe Formation 168 Raisby Formation 54-5 Saltom Bay site 58-61 Sully Island site 203 Vale of Eden 61-2, 63-4, 70-1 'Dolomitic Conglomerate' 26, 190-1, 243 Hayes Point to Bendrick Rock site 198-202

Sully Island site 202-5 Don Group, Crime Rigg Quarry site 52-7 Marl Slate 52-7 Raisby Formation (Lower Magnesian Limestone) 52-7 Yellow Sands 52-7 Doncaster 168 Donguz Gorizont, Anisian (upper) to Ladinian (lower) 215 see also Otter Sandstone Formation, Upper Bandsandstein, Voltzia Sandstone Dorset Basin 12-13, 25, 82 **Dowsing Dolomitic Formation** 167-8, 173 see also Radcliffe Formation, Muschelkalk Dowsing Fault 13 **Droitwich Halite Formation** 174 Droppingstone Farm 153 Drumadoon-Tormore SSSI 126 **Dudgeon Saliferous Formation** 167 Dumfries Basin 14-15, 41, 49-50, 131-2 Dumfries Sandstone see Locharbriggs Sandstone Formation Dune Sands see Bridgnorth Sandstone Formation dunes 16-18, 22-4, 100-3, 136 aklé 47-8 crescentic see dunes, lunate draa 22-4 Bridgnorth Sandstone Formation 76-82, 181-2 Corrie Shore site 45-7 Crime Rigg Quarry site 52-7 **Dawlish Sandstone** Formation 84 English Midlands 76-7, 80 Frodsham site 156-8 Kinver Edge site 79-82 Locharbriggs North Quarry site 49-52

Osebury Rock site 78-9 ergs, Burrells Quarry site 63 Corrie Shore site 41-7 Cowraik Quarry site 66-7 George Gill site 67-9 longitudinal 22-4 Crime Rigg Quarry site 52-7 lunate 22-4 Corrie Shore site 45-7 Coryton's Cove site 97 George Gill site 67-9 Grinshill Quarries site 166 Hapland Burn site 47-8 Hayes Point to Bendrick Rock site 199 Kinver Edge site 80 Moray Firth 34-8, 38-41, 115 Penrith Sandstone 62-3 River Belah site 73-6 Roundham Head site 92-3 migration 23-4 **Bridgnorth Sandstone** Formation 78-9 Corrie Shore site 45-7 Cowraik Quarry site 66-7 Crime Rigg Quarry site 55-7 Dawlish site 98-100 Dee Cliffs site 152 Frodsham site 157 George Gill site 67-9 Kinver Edge site 80-2 Locharbriggs North Quarry site 49-52 Moray Firth 37, 115 Osebury Rock site 78-9 Thurstaston Common site 143-6 seif see dunes, longitudinal star 22-4 Moray Firth 33, 35-8, 38-41 stellate see dunes, star transverse 22-4 **Budleigh Salterton site** 211 Clashach to Covesea site 34-8 Cowraik Quarry site 66-7 **Dawlish Sandstone**

Formation 84, 99 Dawlish site 98-100 English Midlands 76-7. 80 Frodsham site 154-8 Grinshill Quarries site 162-6 Locharbriggs North Quarry site 49-52 Dungeon see The Dungeon site Dunrobin 116 Durham 10, 18, 52, 76 County, Crime Rigg Quarry site 52-7 Durisdeer Formation 47-9 **Durness Limestone Formation** clasts 121-3 East Delamere Fault 13 East Irish Sea Basin 12-14, 18, 59, 64, 76-7, 80, 130-2, 132-5, 136-66 and Cheshire Basin 136-66, 154 St Bees Shales 14 East Malvern Fault 12-13, 79 East Midlands-Southern North Sea Basin 13 East Ogwell Limestones 94 echinoids 3, 5, 11, 222, 225, 231 Eden Shales 63-4, 131-2, 136 Belah Dolomite 69-71 Burrells Quarry site 63 Hilton Beck site 69-71 Hilton Plant Beds 64, 69-71 River Belah site 73-6 Stenkrith Beck site 71-3 Stenkrith Brockram 63-4 Vale of Eden 63-4, 69-71 Edwalton Formation 168, 174 Egford Bridge 249-50 Eilean Leac na Gainimh 123 Elderberry Cove 86-7 **Eldersfield Mudstone** Formation 174 Elgin 26, 31, 33 Elginia 25, 38 Ellerholme 69-71 English Channel 11-12, 82, 95 English Midlands 7-10, 16-17, 19-21, 76-82, 166-8, 176-8, 205

Ashow Group 16 Barr Beacon Beds 76-7 Bridgnorth Sandstone Formation 76-7 Brockton Quarry site 179-80 Burcot site 183-6 Claverley Road Cutting site 182 - 3Hopwas Breccia 76-7 Hulme Quarry site 176-9 Kinver Edge site 79-82 Osebury Rock site 78-9 Quartzite Breccia 76-7 Shrewley site 186–9 Sling Common site 77-8 Wollaston Ridge Quarry site 180 - 2see also named counties Enville Breccia 7, 76, 80-2 Kinver Edge site 80 Eocyclotosaurus 215 Eotrapezium 253 E. ewaldi 256 Equisetites? 173 Erpetosuchus granti 115 Esk Bed, Grinshill Quarries site 164-6 Eskdale Group 9 Euestberia 25, 175, 186, 214, 225 Euestheria Bed, Culverhole Point site 266-9 Hapsford Bridge site 250 Pinhay Bay site 270-1 Wainlode Cliff site 235–7 Westbury Garden Cliff site 239-41 Euestheria cf. minuta 180 E. minuta 186-8, 247, 251, 271 E. minuta var. brodieana 234, 236-7 evaporites 19-22 Budleigh Salterton site 209 Cumbrian Coast Group 58-61 Hayes Point to Bendrick Rock site 198-202 Mercia Mudstone Group 21-2 Rotliegendes 17-18 Sherwood Sandstone Group 19

South Wales 190, 197-8, 198-202, 202-5 Vale of Eden, Belah Dolomites 63-4, 69-71 Eden Shales 63-4, 69-71 Exe Breccia 83 Dawlish site 85, 98-100 Orcombe Rocks site 100-1 Exe Estuary SSSI 100 Exeter 84, 97 Exeter area 84-103, 205 Alphington Breccia 83-5 **Dawlish Sandstone** Formation 83-5 Exeter Breccia 83-5 Heavitree Breccia 83-5 Knowle Sandstone 82-5 Monkerton Formation 83-5 Thorverton Sandstone 82-5 Whipton Formation 25, 82-5 Exeter Breccia 83 see also Dawlish Sandstone Formation Exeter Group 8, 82-103, 212 Alphington Breccia 83-4 Bow Breccia 82-3, 84-5 Cadbury Breccia 82-3, 95 Coryton Breccia 96-8 Crediton Breccia 83 Creedy Park Sandstone 83-4 **Dawlish Sandstone** Formation 25, 82-5, 92, 96-101 Exeter Breccia 83-5 Heavitree Breccia 83-4 Knowle Sandstone 12-14, 82-6 Livermead Beds 83-4, 87, 93 Monkerton Formation 83-4 **Ness Formation 85** Newton St Cyres Breccia 82-5, 97 Oddicombe Breccia 83-5, 93-6 Shute Sandstone Formation 82-5 Teignmouth Breccia 96-8 Thorverton Sandstone 82-3 Tor Bay Breccia 84, 87-93, 90-3,95 Watcombe Breccia 83-4, 95 Whipton Formation 25,

82-5

Exmouth Mudstone and Sandstone Formation 83, 205–6 Dawlish site 98–100 Orcombe Rocks site 100–3 see also Aylesbeare Mudstone Group Eyre Burn site 108, 117–18 Broadford Beds 123 Durness Limestone Formation clasts 121–3 Stornoway Formation 121–5 Torridonian Sandstone Formation 121 Eyre Point 123

Falcisporites zapfei 60 Farndon 149-52 Faroe Rift 20-1 Fee see Bollin Mudstone Formation ferns 176 Findarassie 113 Finstall Member 176, 185 fishes 3, 5-6, 10, 20, 25-6, 168, 173, 175-6, 186-8 actinopterygians 226, 246, 260, 265, 268-9 Aust Cliff site 224, 242-9 Blue Anchor Formation 2, 191, 265 ganoid 31 Otter Sandstone Formation 82, 206, 212-15 Penarth Group 223-6, 229-30, 232-4, 236, 239-49, 251, 253-6, 260-9, 271 see also named fish species and genera fissures 12, 26, 251-3 Cotham Member 230 Devonian Limestones 93-6 Neptunian dykes, Shoalstone, site 86-7 Orcombe Rocks site 102 South Wales 190 **Twyning Mudstone** Formation 244-8 Fleswick Cycle 60, 133-4, 136 Fleswick to St Bees site 108, 131-6 North Head Member 133

St Bees Sandstone Formation 132-6 see also Saltom Bay site fluorite 38-41, 113-15 fluvial transport 13-14, 16-22, 24-5 footprints see vertebrates, trace fossils foraminifera 3, 75, 225, 231, 261 Formby 142 France 7, 18-21, 175 Friars Point 195-8 Frodsham site 108, 149, 154-8 Anisian 158 Frodsham Soft Sandstone Member 148-9, 154-8 Tarporley Siltstone Formation 154-6 Frodsham Soft Sandstone Member 131, 148-9 Frodsham site 154-8 The Dungeon site 146 Frome 249-50 fulgurites 41, 43, 45-7 fullerenes 5 Gairloch 116-17 galena 4, 39-41, 114, 233 Gallantry Bank 153 Gam Svita 215 gastropods 3, 225, 234, 255, 260, 271 Geikia 25, 38 George Gill site 32, 61-4, 67-9 George Gill Brockram 68-9 Penrith Sandstone (higher) 67-9 Germany 6-9, 16-19, 26, 38 Glamorgan 12-13, 189-91, 190-205 Barry Island site 195-8 Hayes Point to Bendrick Rock site 198-202 Lavernock to Penarth site 226-32 Stormy Down site 232-4 Sully Island site 202-5 Sutton Flats site 191-4 Glen Dubh Sandstone Formation 117-18, 126-30 Glen Parva Formation 174 Gliscopollis meyeriana 231

Glomospira sp. 75 Gloucestershire 26, 175-6, 226 Wainlode Cliff site 234-7 Westbury Garden Cliff site 237-41 goethite 115, 247-8 Gondwana 3-4, 11-12, 18 Gordonia 25, 36-8 gorgonopsians 5 Grallator 199-201, 204 granites 13-14, 78, 84, 95 Great Glen Fault Zone 14-15, 38-41, 111, 115 Great and Little Ulverstone 243 Green Beds see Retford Formation Greenland 19 Grey Marls 19, 26-7, 212, 221 see also Blue Anchor Formation, Rydon Member Gribun Shore and Crags site 108, 117-18, 124-6 Mercia Mudstone Group 124-6 Moinian 124-5 Penarth Group 124-6 Stornoway Formation 124-6 Grinshill Flagstones see **Tarporley Siltstone Formation** Grinshill Quarries site 108, 148-9, 162-6 **Bollin Mudstone Formation** 162 - 6Helsby Sandstone Formation 148, 162-6 **Tarporley Siltstone** Formation 148, 162-6 Esk Bed 164-6 Wilmslow Sandstone Formation 163 Grinshill White Sandstones see Helsby Sandstone Formation Gruinard Bay site 108, 117-21 Stornoway Formation 119-21 Torridonian Sandstone Formation 119, 121 Guadalupian 6-7 Gulch Quarry 176-7 Gully Oolite, Sutton Flats site 191-4 Gunthorpe Formation 168

Gwent 190 gypsum 19, 59, 70–1, 72–3, 74, 102–3, 159, 162, 173, 187–8, 196–7, 244–9, 262–5 Penarth Group 227–9, 236, 241, 244–9, 262, 265–6, 267 *Gyrolepis* 25, 214, 222, 226, 236, 241, 253, 256, 260, 268 *G. alberti* 265 *G. sp.* 233 *G. tenuistriatus* 265

haematite 22 Aust Cliff site 247-8 Budleigh Salterton site 209 Cowraik Quarry site 66 Dawlish site 98-9, 99 Moray Firth 36, 109-11 Oddicombe Beach site 94 Osebury Rock site 78-9 Roundham Head site 92 Sully Island site 203, 205 Wollaston Ridge Quarry site 181 see also iron Haffield Breccia 13, 76, 78-9 Osebury Rock site 78-9 see also Clent Breccia Haisborough Group 167-8 **Dowsing Dolomitic** Formation 167-8, 173 **Dudgeon Saliferous** Formation 167 Keuper Anhydritic Member 167 Keuper Halite Member 167 Main Röt Halite Member 167-8 Muschelkalk Halite Member 167 Triton Anhydrite Formation 167 Upper Röt Halite Member 167 see also Mercia Mudstone Group Halibut Horst Fault 15 halite 9, 16-22, 24, 61, 176, 190, 201, 205-6 pseudomorphs after 172-3, 187, 190, 244, 246-7 Cheshire Basin 146-7, 160-2, 168

Scotland 118, 128-30 see also named halite formations/members Hapland Burn site 32, 41, 47-9 **Carron Basalt Formation** 47-9 Durisdeer Formation 47-9 Locherben Breccia Formation 47-9 Thornhill Sandstone Formation 47-9 Hapsford Bridge site 226, 249-51 Lilstock Formation 249-51 Cotham Member 249-51 Langport Member 249-51 Westbury Formation 250-1 black shales 249-51 Hapsford Mills see Hapsford Bridge site Haptodus 25, 76 Haramiya 226 haramiyids 226, 265 Hardegsen Unconformity 9, 148, 154, 167, 168 Harlequin Formation 174 Haven Cliff 267 Hayes Point to Bendrick Rock site 108, 189-91, 197, 198-202 'Dolomitic Conglomerate' 198-202 evaporites 198-202 Heavitree Breccia 83-4, 96-7 Exeter area 83-5 see also Newton St Cyres Breccia, Coryton Breccia heavy minerals 69, 74, 77, 79 Moray Firth 109-10, 116 Hebrides 7, 116-26, 226 Hebrides Platform 20-1 Hebrides-Sea of Hebrides-North Minch Basin 16 Heck Sandstone Formation 168 Helmsdale Fault 14-15 Helsby Sandstone Formation 24-5, 131-2, 136, 139, 143 Anisian 25, 136, 139, 148, 165-6 Bickerton Hill site 152-4 **Delamere Pebbly Sandstone**

Member 148-9, 152-4 Frodsham Member 131, 148-9 Frodsham site 154-8 Frodsham Soft Sandstone Member 154-8 Grinshill Quarries site 162-6 The Dungeon site 146 Thurstaston Hard Sandstone Member 131, 143-9 Thurstaston Soft Sandstone Member 131, 143-6, 148-9 Hercynian orogeny 11-12 Hereford and Worcester 174-5, 226 Burcot site 183-6 Osebury Rock site 77, 78-9 Sling Common site 77-8 Hettangian 10, 26, 131, 221, 258, 262, 269 High Peak 212-15 High Stenkrith 72 High Tor Limestone 191-4 Sutton Flats site 191-4 Highland Boundary Fault 13-15 Hilbre Island see Hilbre Island and Hilbre Point site Hilbre Island Breccia 140-1 Hilbre Island and Hilbre Point site 108, 132, 139-43 Hilbre Island Breccia 140-1 **Ormskirk Sandstone** Formation 139-43 Hilton Beck site 32, 61-4, 67, 69-71 Brockram 69-71 Eden Shales 69-71 Belah Dolomite 69-71 Hilton Plant Beds 69-71 Penrith Sandstone 69-71 St Bees Sandstone Formation 70-1 Hilton Plant Beds 63-4 Hilton Beck site 69-71 Holy Austin Rock 80-2 Hopeman Harbour 34, 36 Hopeman Sandstone Formation 25, 31-41, 84, 107-9 Burghead site 109-12 Clashach to Covesea site

31-8 Masonshaugh Quarries site 38-41 Sandstone units 1-9, 34-6 Hopwas Breccia 76-8, 82, 174 see also Barr Beacon Beds, Quartzite Breccia, Bridgnorth Sandstone Formation, Collyhurst Sandstone Formation, Penrith Sandstone horsetails 25, 173, 187 Hull 8-10 Hulme Quarry site 108, 176-9 **Cannock Chase Formation** 176-9 facies A-E 177-9 Permian 176 Hybodus 226, 230, 236, 246-7, 260, 268-9 H. cf. cloacinus 260 Hymenozontriletes 102 Hyperodapedon 107 H. gordoni 115 Hypsiprymnopsis 226, 262 H. rhaeticus 265

Iapetus suture 15 ichthyodorulites 225-6 ichthyosaurs 11, 226, 241, 242, 247, 249 Illawarra magnetic reversal event 6, 52 Induan 10, 112, 118, 131, 167, 174 Aylesbeare-Mudstone Group 83 Induan–Olenkian 4, 118, 131, 167, 174 Indus River 22 Inferior Oolite 250 Inkborrow Fault 12–13 Inner Hebrides Trough 123 Insect Limestone, Lilstock Formation 235-7 Wainlode Cliff site 235-7 Westbury Garden Cliff site 239-41 insects 188, 206, 212, 214, 225, 236, 244 Inverugie 109 Ireland 18-22 iridium 6 Irish Sea Basins 12-14, 18-21,

24, 57, 226 Brockram 57-61 Sherwood Sandstone Group 11 iron 22, 252 George Gill site 67-8 Hilton Beck site 69 Locharbriggs North Quarry site 49 Moray Firth 36, 111-12, 114 Orcombe Rocks site 103 Osebury Rock site 79 see also haematite Ischigualasto Formation 107 Islay, Isle of 116 Isopodichnus 159, 162 Jackson's Bay 195, 197 jobnstoni Beds 229 Jurassic 116, 117-18, 124, 258 see also Lias, Blue Lias, and named stages kaolinite 19, 214, 235, 261 Kapes 25, 215 Karoo 31 karst 26, 95, 252-3 Kazanian 6 Alphington Breccia 83-4 Crediton Breccia 83 Creedy Park Sandstone 83 Whipton Formation 83-4 Yellowford Formation 83 Kazanian-Tatarian. **Barrowmouth Mudstone** Formation 57 **Dawlish Sandstone** Formation 83-4 Heavitree Breccia 83-4 Irish Sea Basins 57 Newton St Cyres Breccia 83 St Bees Shale Formation 57 Keele Beds 7 Kendelbachgraben 219 Kenilworth Sandstone Formation 8, 25, 76, 78 Kennford Heavitree basin fan 85 Keuper 8-11, 167 Keuper Anhydritic Member 167 Keuper Halite Member 167 Keuper Marls 9-11 Keuper Sandstone see

Bromsgrove Sandstone Formation Keys Basin 130-2 Kidderminster Formation 13, 18-19, 78-82, 175-6, 183 Kinver Edge site 80-2 Sling Common site 77 Wollaston Ridge Quarry site 180 - 2King Street Fault 13 Kingkerswell 95 King's Cave to Drumadoon site 108, 117-19, 126-30 Mercia Mudstone Group 126-30 Auchenhew Mudstone Formation 126-30 Lag a'Bheith Formation 117-18, 127-30 Sherwood Sandstone Group 126-30 Brodick Breccia 126-7 Glen Dubh Sandstone Formation 117-18, 126-30 Lamlash Sandstone Formation 126-30 Kingscourt Outlier 8, 10, 15 **Kinnerton Sandstone** Formation 131-2, 147-9 Burton Point site 137-9 Permo-Triassic 132 Kintyre 116-17 Kinver Edge site 32, 77, 79-82 Bridgnorth Sandstone Formation 77, 79-82 Enville Breccia 80 **Kidderminster Formation** 80-2 Kirkby Stephen 62-3, 70, 72 **Kirklinton Sandstone** Formation 131 Kish Bank Basin 14 Klausipollenites schaubergeri 60 Knowehead Quarry 49-50 Knowle Basin 12-14 Knowle Sandstone 82, 86 Crediton Trough 82-5 Exeter area 82-5 see also Bow Breccia, **Thorverton Sandstone** Kungurian 6

Ladinian 9-11, 112, 118, 131, 206, 207-12, 212-15 English Midlands 167, 174 Mercia Mudstone Group 9-11, 13, 83 Ladram Bay to Sidmouth site 108, 206, 209, 212-15 **Budleigh Salterton Pebble** Beds 212-15 contorta zone 220-1 Mercia Mudstone Group 213-14 Otter Sandstone Formation 212-15 Lag a'Bheith Formation 117-18 King's Cave to Drumadoon site 127-30 Lake District 18-22, 61 Lamlash Sandstone Formation 117-18 King's Cave to Drumadoon site 126-30 lamprophyric and basaltic lavas 82-3 Lancashire 18, 26, 130-2 Langport Member 190, 221, 225 Culverhole Point site 266-9 Hapsford Bridge site 249-51 Lavernock to Penarth site 228-32 Lilstock Formation 190, 219-21, 225-6 Pinhay Bay site 269-74 Rhaetavicula cotorta shales 233 St Audries Bay site 258-62 Slump Bed 270-4 Stormy Down site 233-4 Sun Bed 270-4 Wetmoor site 254 Langstone Breccia see Exe Breccia Langstone Rock 98-9 Langwathby borehole 70 Larkton Hill 152-4 Laurasia 4, 11-12 Lavernock Point 189 Rhaetian transgression 221 - 2Lavernock Shales 229 Lavernock to Penarth site 226,

227-32 **Blue Anchor Formation** 227-32 bone beds 227-9 Lias 227-9 Lilstock Formation 227-32 Mercia Mudstone Group 227-32 Westbury Formation 220-1, 227-32 Leary Rock 244 Lebachia (= Walchia) 25, 76 Leicestershire 167, 174, 176, 188, 226 Lenton Sandstone Formation 167-8 Leonardian 6 Lepidopteris martinsi 71 Lepidosteus 214-15 Lepidotes 268 Leptonectes 226 Leptopleuron 26, 31, 112 L. lacertinium 115 Levencorroch Mudstone Formation 117-18 Lewis, Isle of 16, 116-18 Lias 9-11, 148, 190-2, 195, 206, 221, 250 Aust Cliff site 241-9 Barnhill site 252 Blue Anchor Point site 262-3, 265 Lavernock to Penarth site 227-9 Wainlode Cliff site 235 Westbury Garden Cliff site 238 Wetmoor site 254–5 Lickey Quartzite clasts 78 Liebea squamosa 75-6 Lilstock 220 Lilstock Formation 116, 118, 131, 206, 219-21, 225-6, 248 Aust Cliff site 241-9 Barnhill site 251-3 Blue Anchor Point site 262-6 Cotham Member 190, 219-21, 225-6, 233-4, 241-56, 269-74 Culverhole Point site 266-9 English Midlands 167, 174 Hapsford Bridge site 249-51

Insect Limestone 235-7 Langport Member 219-21, 225-6 Lavernock to Penarth site 227-32 Lulsgate site 256-7 Mull 116-18, 124-6 Pinhay Bay site 269-74 St Audries Bay site 258-62 Stormy Down site 232-4 Wainlode Cliff site 234-7 Westbury Garden Cliff site 238-41 Wetmoor site 253-6 Lincolnshire 18, 167, 225-6 Lingula 19, 55, 168, 173, 239 Lingulichnus 24 Lioestheria 214 Liostrea 231 L. bristovi 229, 231 Lissodus 226, 230 Little Eye 140 Little Halibut Fault 15 Little Hilbre Island 142 Littleham Cove 100 Littleham Mudstone Formation 83-4,206 **Budleigh Salterton site** 207-8, 212 Dawlish site 100-3 Orcombe Rocks site 100 Littleworth Beds 174 Littoral Triassic see 'Dolomitic Conglomerate' Livermead Beds 83-4, 87 Neptunian dykes 87 Paignton cuvette 84 Permo-Carboniferous 83, 93 Roundham Head site 90-3 Liverpool Bay 140, 154 liverworts 247, 251 Llantrithyd 190 Locharbriggs North Quarry site 32, 41, 49-52 Locharbriggs Sandstone Formation 25, 49-52 Locharbriggs South Quarry 49-50 Locherben Breccia Formation 47-9 Hapland Burn site 47-9 Lochmaben Basin 14-15, 41 Lockeia siliquaria 249

London Platform 12, 174, 221 London-Brabant Massif 16-17, 18 - 22Longford-Down Basin 15 Lopingian 6-7 Changhsingian 6 Ochoan 6 Tatarian 6 Unter Bunterstein 6 Wuchiapingian 6 Zechstein 6 Lossiemouth East Quarry 112-15 Lossiemouth Fault Zone 14-15, 38-41 Lossiemouth Sandstone Formation 31-3, 108, 111-12 Burghead site 109-12 Carnian 26, 107, 112-16 reptilian fauna 26, 31, 38-41, 107, 109, 112, 114-15 Stagonolepis 31, 33, 107, 114-15 Lossiemouth Shore and Quarries site 33, 108, 112-16 Cherty Rock 112-14, 116 Lossiemouth Sandstone Formation 112-16 Lounthwaite borehole 70 Lower Bunter see Bridgnorth Sandstone Formation Lower Keuper Sandstone 9-10, 173-4 Basement Beds 9-11 Building Stones 9-11 Waterstones 9-11 see also Sneinton Formation Lower Magnesian Limestone see Raisby Formation Lower Marls see Exmouth Mudstone and Sandstone Formation Lower Mottled Sandstone see **Bridgnorth Sandstone** Formation, Kinnerton Sandstone Formation, Lenton Sandstone Formation Lower Petrified Forest 107 Lower Sandstone 190 Lulsgate site 226, 256-7 Blue Lias (Aldergrove Beds)

256-7 Carboniferous Black Rock Limestone 256-7 Lilstock Formation 256-7 'Cotham Marble' 256-7 Westbury Formation 256-7 lungfish 25, 187-8, 226 Lycopodites 251 Lyme Bay Basin 12-13 Lyme Regis 206, 266, 269, 270 Lyriomyophoria 253, 256 Magnesium Limestone see Saltom Dolomite magnetostratigraphy 10, 261 Maidencombe Cove 94-5 Main Röt Halite Member 167-8 Maleri Formation fauna 107 Malpas 148 Malpas Sandstone 131 Malvern Axis 13 Malvern Hills 78-9 Malvernoid structural trend 12, 15 mammals 4, 26, 226, 231, 262, 265 Man, Isle of 14, 130-2 Manchester Marl Formation 131-2, 136, 139, 147-8 see also Kinnerton Sandstone Formation manganese 165 Manor Farm 248-9 **Blue Anchor Formation 248** Lilstock Formation 248 Mercia Mudstone Group 248 **Twyning Mudstone** Formation 248 Pre-planorbis Beds 249 Westbury Formation 248-9 Mansfield 25 Marginal Triassic see 'Dolomitic Conglomerate' Marl Slate 52-7 Crime Rigg Quarry site 52-7 Marldon cuvette 83-5 Masonshaugh Quarries site 32, 38-41 barite 38-41 **Burghead Sandstone** Formation 38-41, 107-12 fluorite 38-41

Hopeman Sandstone Formation 38-41 see also Burghead site Massif Central 18-22 Mastodonsaurus 26 M. lavisi 215 Matchborough Hill 188 Mauchline Basin 7, 16, 25, 41 Meadfoot Beds 88-90 Saltern Cove site 88-90 ?Megalosaurus 226, 234 Mells Stream 249-50 Mendip Hills 12-13, 26 Mendips High 211, 221, 249 Mercia Mudstone Group 9-14, 19-22, 25-7, 189-91, 226-9, 231-2, 261, 266-7 Arden Sandstone Formation 9-11, 26, 174, 186-9 Auchenhew Mudstone Formation 117-18, 126-30 Aust Cliff site 241-9 Blue Anchor Formation 11, 19, 26–7, 117–18, 189–91 England 167, 174, 191, 205-6, 235-41, 244-6, 253-6, 260-9 South Wales 219-26, 226-32, 232-4 Blue Anchor Point site 260-6**Bollin Mudstone Formation** 131, 148, 162-6 **Bromsgrove Sandstone** Formation 13, 19, 24-6, 174-6, 183-6, 215 **Byley Mudstone Formation** 131, 148 Carlton Formation 167, 174 Ceratodus 25 Colwick site 172-4 Culverhole Point site 267-9 **Delamere Pebbly Sandstone** Member 152-4 **Derenenach Mudstone** Formation 117-18 Dipteronotus 25 'Dolomitic Conglomerate' 26, 167-8, 173, 190-1, 198-203, 243 **Dowsing Dolomite** Formation 167-8, 173 **Droitwich Halite Formation** 174

East Irish Sea Basin 14, 131-2, 154-66 Edwalton Formation 168, 174 **Eldersfield Mudstone** Formation 174 Esk Bed 164, 166 Frodsham site 156 Glen Parva Formation 174 Grey Marls 26-7, 212, 221 Gribun Shore and Crags site 124-6 Grinshill Quarries site 162-6 Harlequin Formation 174 Hayes Point to Bendrick Rock site 198-202 Helsby Sandstone Formation 131-2, 136, 143-6, 154-8,162-6 Keuper 8-11, 19 Ladinian 9-11, 13, 83 Ladram Bay to Sidmouth site 213-14 Lag a'Bheith Formation 117-18, 126-30 Lavernock to Penarth site 227 - 32Levencorroch Mudstone Formation 117-18 Mull 116-18, 124-6 Northwich Halite Formation 131 Radcliffe Formation 167, 167-8 **Red Brow Cutting site** 158 - 62**Redcliffs Sandstone** Formation 189 Retford Formation 167 Rhynchosaurus 25-6 Rydon Member 258-62, 262-6 St Audries Bay site 258-60 Shrewley site 186-9 Sneinton Formation 167-8, 172 - 4South Wales Basin 189-205 Stafford Halite Formation 174 Stanwix Shales 131 Stormy Down site 233-4, 236-7 Stornoway Formation

119-21, 121-3, 124-6 Sully Island site 202-5 Tarporley Siltstone Formation 19, 26, 131-2, 146-7,156, 158-62, 162-6 The Dungeon site 146-7 Trent Formation 174 **Twyning Mudstone** Formation 174, 235-7 Upper Marls 167, 205, 205-6 Wainlode Cliff site 234-7 Westbury Garden Cliff site 237-41 Western Highlands and Islands 116-18 Weston Mouth Sandstone Member 26, 188, 205-6 Wetmoor site 253-6 Wilkesley Halite Formation 131 Williton Member 231, 258-62 Wych Mudstone Formation 131 see also Haisborough Group Mercian Highlands 76 Merseyside, The Dungeon site 108, 146-9 Thurstaston Common site 108, 143-6 micrite 230, 249-51, 260-1, 262-6, 267 Microlestes antiquus 231 microplankton, organic-walled 225, 231, 260-1, 265 Mid North Sea High 14, 17-22 Minch Fault 117 Minches Basin 16 miospores 26, 176 Arden Sandstone Formation 25, 187 Auchenhew Mudstone Formation 129 Blue Anchor Formation 231, 260-1, 265 **Bromsgrove Sandstone** Formation 176, 186 **Butcombe Sandstone** Member 26 Carnian 26 Crediton Breccia 83 Creedy Park Sandstone 83 Dawlish Sandstone

Formation 100 Exeter Group 212 Gribun Shore and Crags site 124-6Helsby Sandstone Formation 25, 136, 139, 148 Lag a'Bheith Formation 117, 129 Langport Member 231 Lavernock to Penarth site 231 Newton St Cyres Breccia 83 North Curry Sandstone Member 26 Penarth Group 124 St Audries Bay site 260-2 Saltom Bay site 60 The Wirral 136, 139, 142-3 Weston Mouth Sandstone Member 25 Modiolus 231, 271 M. billanus 256-7 Moffat Basin 14-15, 41 Moinian 118, 124 Monkerton Formation 83-4 Exeter area 83-5 Tatarian 83-4 Moray Firth Basin 14-16, 20-1, 25-6, 31-41, 107-16, 226 Burghead site 107-12 **Burghhead Sandstone** Formation 31-3 Cherty Rock 33, 112-14, 116 Clashach to Covesea site 31-8 **Cutties Hillock Sandstone** Formation 33, 38 Hopeman Sandstone Formation 31-41 Lossiemouth Sandstone Formation 26, 31-3 Lossiemouth Shore and Quarries site 112-16 Masonshaugh Quarries site 38-41 reptile footprints 25-6, 31-3, 38-41, 107, 109, 112, 115-16 Morecombe Bay 154 Morvern 116-17 Muensteria 265 Mull, Isle of 16, 116-18

Gribun Shore and Crags site 124–6 Murchison 6, 8, 41, 117, 163–4, 253–4 murchisonite 84, 96–7, 99 Muschelkalk 8, 10, 18–21, 146–7, 168, 173 see also Lower Keuper Sandstone, Dowsing Dolomitic Formation, Radcliffe Formation Muschelkalk Halite Member 167 Myriacanthus 226 Mytilus 256

Naiadita lanceolata 247, 251 Nanny's Rock 80-2 Nantwich 150 'Natica' oppelii 234 nautiloids 3 Navan-Silvermines Fault 15 Nechells Breccia 76 Needwood Basin 12, 108 Nell's Point 189, 195-8 Nemacanthus 226, 246-7 N. monilifer 230 Neptunian dykes 77 Orcombe Rocks site 102 Shoalstone site 86-7 **Ness Formation 85** Teignhead cuvette 85 Netherlands 7, 16-17 Netherton Formation 85 Teignhead cuvette 85 New Red Sandstone 7-11 Newark Basin 175 Newark Supergroup 221 Newton Abbot 94 Newton, Glamorgan 194 Newton St Cyres Breccia 82-5, 97 Norfolk 18 Norian 9-11, 21, 26, 118, 131 **Blue Anchor Formation** 221 - 2'Dolomitic Conglomerate' 26, 198-202 English Midlands 167, 174 red marls 261 Norian to Rhaetian, Hayes Point to Bendrick Rock site 201 North Curry Sandstone

North Head Member 60 Fleswick to St Bees site 133-5 North Sea 10, 16-21, 26, 166-74, 225-6 Northern Ireland 16, 118, 226 Northwich Halite Formation 131, 148-9 Anisian 149 Norton 235 Nottingham Castle Formation 24-5, 166-9 Colwick site 172-4 Nottingham Castle site 169 Scrooby Top Quarry site 171 - 2Styrrup Quarry site 169-71 Nottingham Castle site 108, 168-9 Nottinghamshire 9, 25-6, 52, 166-74, 175-6, 226 Colwick site 172-4 Nottingham Castle site 168 Scrooby Top Quarry site 171-2 Styrrup Quarry site 168-71 Ochoan 6 Oddicombe Beach site 32, 85-7, 93-6 Devonian 94-6 Petit Tor Limestone 94-6 Oddicombe Breccia 87, 93-6 sandstone dykes 87, 93-4 Watcombe Formation 93 Oddicombe Breccia 83-5, 87 Asselian-Sakmarian 83 Teignhead cuvette 84-5 Ogmore-by-Sea see Sutton Flats site Old Red Sandstone 8, 45, 78, 107, 189 Olenekian 5-6, 83-5, 112, 118, 131, 167, 174, 215 Ollerton-Newark 166-8 onionskin weathering 19, 197, 199, 201-2 ophiuriods 231, 247, 260 Orbicula townsbendi 247 Orbiculoidea 231 Orcombe Rocks site 32, 85-7, 100-3

Member 26, 187, 205

Aylesbeare Mudstone Group 100 - 3Exmouth Mudstone and Sandstone Formation 100 - 3Littleham Mudstone 100 **Dawlish Sandstone** Formation 100-1 Exe Breccia 100-1 Ordovician 13, 58, 77, 205-7 Orecombe Point 100-3 **Ormskirk Sandstone Formation** 131-2 Hilbre Island and Hilbre Point site 139-43 Ornithosuchus longidens 115 Osebury Rock site 32, 77 Bridgnorth Sandstone Formation 78-9 Haffield Breccia 78-9 Silurian 78 ostracods 3, 5, 25, 75, 214 Penarth Group 231, 236, 244, 247, 256, 269 Ostrea 236, 240, 251, 269 Ostrea Beds 229 Oswestry 175 Otozoum 199, 201 Otter River 209, 211 Otter Sandstone Formation 24-6, 82-3, 189, 205-6 Anisian 24-6, 82-3, 206, 212, 215 **Budleigh Salterton site** 207-12, 213 insects 207, 212, 214 Ladram Bay to Sidmouth site 212-15 Otterton Point 212 ?Ovalipollis pseudoalatus 124 Oxfordshire 8, 26 Oyster Cove see Waterside cove oysters 222, 225, 271 Pachystropheus 222, 240-1, 247, 265 P. rhaeticus 226 Paignton cuvette 83-5, 93 Devonian 84-5 Livermead Beds 84 Permo-Carboniferous 83-5, 93 Tor Bay Breccia 84, 93 palaeomagnetism 10, 22, 51,

120-1, 261 palaeontology 19, 25-6, 76, 191 Arden Sandstone Formation 186-8 Aust Cliff site 246-8 Barnhill site 253 Blue Anchor Point site 265 **Bromsgrove Sandstone** Formation 25, 176, 185 Culverhole Point site 268-9 English Midlands 76 Gribun Shore and Crags site 124-6 Grinshill Quarries site 162-6 Hapsford Bridge site 251 Hayes Point to Bendrick Rock site 199-201 Hilbre Island and Hilbre Point site 142 Hilton Beck Breccia 71 King's Cave to Drumadoon site 128-9 Ladram Bay to Sidmouth site 212, 214-15 Lossiemouth Shore and Quarries site 31, 35-7, 107, 109, 112, 114-15 Orcombe Rocks site 102-3 Penarth Group 225-6, 230 - 1Permian 25, 36-41, 59-60 Pinhay Bay site 271 Red Brow Cutting site 159, 161-2 River Belah site 75 St Audries Bay site 260-1 Saltern Cove site 99 Saltom Bay site 59-60 Saltom Dolomite 59-60 Sherwood Sandstone Group 25 Shoalstone site 89 Stormy Down site 233-4 Triassic 25-7 Vale of Eden Basin 71, 75 Wainlode Cliff site 236-7 Westbury Garden Cliff site 239 - 41Western Highlands and Islands 124 Wetmoor site 254, 256 'Palaeosaurus' 226

palaeosol 19, 24-5 **Budleigh Salterton site** 209-12 Gribun Shore and Crags site 124-6 Penrith Sandstone 63 Sherwood Sandstone Group 19, 168, 169-70, 209-11 Scotland 109-12, 114-16, 119-21 Sully Island site 205 Vale of Eden Basin 63 see also calcrete Palaeospinax 226 palygorskite 119-21 palynology, Hilton Beck site 70 - 1palynomorphs 8, 10, 20, 26-7, 116, 149, 191 Devon 206 Kazanian-Tatarian 57 Lag a'Bheith Formation 130 Nottinghamshire 25, 168 Penarth Group 231, 250, 265, 268, 271 Vale of Eden 25 Western Highlands and Islands 116 Whipton Formation 25 Pangaea 3-6, 19 Panthalassa 19 Paper Shales 221 see also Cotham Member pareiasaur 25, 36-8 Paris Basin 11 Park Hall Country Park 176-9 Pavs de Brav fault 11 Peckforton Hills 152-4 Pecten 236, 240, 269 Pecten Limestone, Aust Cliff site 241-9 Barnhill site 252-3 Wainlode Cliff site 235-7 Westbury Garden Cliff site 239-41 pelycosaurs 25, 50, 76 'Penarth Alabaster' 227 Penarth Group 8-9, 11, 100, 131, 147, 167-8, 176, 219-74 Lilstock Formation 131, 174, 190-1, 205-6, 219-21, 224-33, 249-51, 258-62, 269-74 Mull, Isle of 116, 124-6

Rhaetic Sandstone 167 Westbury Formation 131. 174, 190-1, 197, 205-6, 219-34, 241-53, 258-74 Winterton Formation 167 see also named Penarth Group sites Pennines 7, 14, 17-22, 69, 167 - 72Penrith 62, 66 Penrith Brockram 61-4 Burrells Quarry site 64-6 George Gill site 67 Hilton Beck site 69-71 Vale of Eden 61-4 Penrith Sandstone 25, 61-4, 82 Burrells Quarry site 64-6 Cowraik Quarry site 66-7 fauna 25, 63 George Gill site 67-9 Hilton Beck site 69-71 River Belah site 73-6 Rötliegendes 61-4 Vale of Eden Basin 61-4 Perm 6 Permo-Carboniferous 3, 7, 18 ?Haffield Breccia 76-9 Cadbury Breccia 83, 95 Clent Beccia 76-9 Livermead Beds 86, 93 Mauchline Basin 25, 41 Tor Bay Breccia 89, 90-3, 95 Permophorus costatus 60 Peterlee 56 Petit Tor Limestone 93-5 Pewsey Basin 12 Pewsey Fault 211 phosgenite 114 phosphates 11, 222, 238, 241, 254-6 phosphatic nodules 246, 253 phytosaur 226 Pinhay Bay site 205, 226, 268, 269 - 74Blue Lias 269-70, 274 Lilstock Formation 269-74 Westbury Formation 269-74 Pinmill Brow 154, 156 Pinney Bay see Pinhay Bay site ?Placunopsis alpina 124 placodonts 226 plankton 231, 260 Planolites 124, 142, 159,

161-2, 265 planorbis zone 10, 28, 116, 219, 226, 229, 244, 258 plants 6-7, 16, 18, 20, 25-6, 78. 124. 225 Arden Sandstone Formation 187-8 Blue Anchor Formation 191. 231 **Bromsgrove Sandstone** Formation 25, 176 Cotham Member 236-7 Gribun Shore and Crags site 124-6 Hapsford Bridge site 251 Helsby Sandstone Formation 25 Hilton Plant Beds 70-1 Kenilworth Sandstone Formation 25, 78 Langport Member 225, 271 Mauchline Basin 41 Orcombe Rocks site 102-3 Otter Sandstone Formation 206 Rhaetian 191, 231 Stormy Down site 233 Vale of Eden 25, 63-4 Western Highlands and Islands 117-18, 124 Westbury Formation 231-2, 233, 236, 247-9 Platte River system 171 Play Canyon 177 plesiosaurs 224, 226, 231, 240-1, 242, 247, 249, 253 Plesiosaurus 247 Pleurophorous elegantus 247, 249 Pleurophorous Limestone 263 Plicatula 231 Polesworth River 175 Polyacrodus 226 Portsdown Fault 211 Pre-planorbis Beds 10, 221 Aust Cliff site 244, 246 Lulsgate site 256 Manor Farm 249 Pinhay Bay site 269-74 Preston 142 Protocardia 253, 256, 260 Protocardium 236, 240 Psephoderma 226 Pseudotetrasauropus 199,

201. 204 Pseudovoltzia liebeana 71 Psiloceras planorbis 221, 258, 261 see also Pre-planorbis Beds pterosaurs 4 Pullastra Beds 239-41 Westbury Garden Cliff site 239-41 Pyle 190 pyrite 114, 222-4, 235-6, 238-41, 246, 252-3, 260, 267 'Quarella Stone' 232-4 Quartzite Breccia 77-8, 82 Raasay, Isle of 16, 116-18 Eyre Burn site 121-5 Radcliffe Formation 167-8, 174 Raddoch Wells 109-10 radiometric dates 7-8, 26, 41, 82-4, 107 Raisby Formation 52-7 Crime Rigg Quarry site 52-7 Raw Head 153 Red Brow Cutting site 108, 146, 149, 158-62 **Tarporley Siltstone** Formation 158-62 **Redcliffs Sandstone Formation** 189 reptiles 3-5, 7, 25-7, 107, 226, 230 archosaurs 21, 26, 115, 199, 201, 212, 266, 269 rauisuchian 25, 215 Aust Cliff site 221-5 Barry Island site 199-201 Blue Anchor Group 230-1 **Bromsgrove Sandstone** Formation 176 choristoderes 222, 226, 239 dicynodont 25, 36-8, 51 gorgonopsians 5 Grinshill Quarries site 162-4, 166 haramiyids 226 Mercia Mudstone Group 25-7, 148-9, 176, 191, 199-201 Moray Basin 25-6, 31-3, 38-41, 107, 109, 112, 115-16

pareiasaurs 25, 37-8 pelycosaurs 25, 51, 76 Penrith Sandstone 25 phytosaur 226 procolophonid 25-6, 115, 212, 215 pterosaurs 4 rhynchosaurs 25-6, 107, 115, 142, 148, 163, 166, 215 Tor Bay Breccia 89-90 Triassic 25-7, 176, 191, 195, 206 Westbury Formation, bone beds 221-5, 260 see also dinosaurs Reptiliferous Sandstone see Hopeman Sandstone Formation Retford Formation 167-8 Rhaetavicula 260 R. (Pteria) contorta 118, 124, 222, 232-4, 247, 249, 251 Rhaetavicula contorta shales 232-4 see also Contorta Shales, Westbury Formation Rhaetian 4-5, 9-11, 21, 26-7, 131, 198-202, 219 Cherty Rock 33, 112-16 English Midlands 167, 174 Mull 116, 124-6 palynomorphs 191, 206 see also Penarth Group 'Rhaetic' Bone Bed 11, 220, 222, 241-9, 266-9 see also basal bone beds Rhaetogonyaulax rhaetica 231 Rhät 219, 237 Rhinns of Galloway 14 Rhizocorallium 265, 271 rhizocretions 120, 209, 213-15 Rbynchosauroides 25, 142, 166 rhynchosaurs 26, 107, 115, 215 Rhynchosaurus 25-6, 148, 163 R. articeps 166 R. spenceri 215 Ricciisporites tuberculatus

124, 231 Rinkøbing-fyn High 17 River Belah site 32, 61-4, 73-6 Brockram 73-6 Eden Shales 73-6 Penrith Sandstone 73-6 River Calder 133 River Eden 72 River Exe 12 River Severn 226, 235-7, 237-41, 243 River Teme 78 Roadian 6 Rockall Rift 20-1 Rogenstein Member 167 see also Bunter Shale Formation Roman Hill Quartzite clasts 69 Roman Well 109 Rotliegendes 6-7, 16-18, 61-4. 167 Basin 16-18 Roundham Head site 32, 85-7, 90-3 Livermead Beds 93 Tor Bay Breccia 85-6, 90-3 Rudha na' Leac 123 Rum, Isle of 116-17, 121 rutile 68, 69 Rutiodon Assemblage Zone 107, 116 Rydon Member 231 Blue Anchor Point site 262-6 St Audries Bay site 258-62 see also Tea Green Marls St Audries Bay site 226, 258-62 Lilstock Formation 258-62 Mercia Mudstone Group 241-9 **Blue Anchor Formation** 241-9, 258-62 Williton Member 258-62 Westbury Formation 258-62

Saltom Dolomite 57-61, 58-9 Sandwith Cycle 60 St Bees Head SSSI 58, 133-6 St Bees Sandstone Formation 24-5, 57, 131-2, 132-6 Fleswick to St Bees site 132 - 6Hilton Beck site 70-1 North Head Member 133-5 Saltom Bay site 57-61, 133 Stenkrith Beck site 71-3 Vale of Eden Basin 63-4 St Bees Shale Formation 14, 57, 59, 60, 131-3, 136 Saltom Bay site 57-61, 133 Vale of Eden Basin 64, 108, 131 see also Manchester Marl Formation, Eden Shales St Bees South Head 133-6 St Mary's Well Bay 189, 227-32 Sakmarian 6 Knowle Sandstone 86 Thorverton Sandstone 86 Salcombe Hill Cliff 214 Saliferous Marls 11, 167-8 Saltern Cove site 32, 85-90 burrows 88-90, 103 Lower Devonian 88-90 Meadfoot Beds 88-90 St Bees Sandstone Formation 63-4 Tor Bay Breccia 87-90 Saltom Bay site 32, 57-61, 133 Appleby Group 57-61 Brockram 57-61 St Bees Evaporite Formation 57-61 Saltom Dolomite 58-61 St Bees Sandstone Formation 57-61 St Bees Shale Formation 57-61, 133 Whitehaven Sandstone Formation 57-61 Saltom Cycle 60 Saltom Dolomite 59-61 Saltom Bay site 58-61 Saltom Siltstone 60 Saltopus elginensis 115 'Sand Ridge' 180-2 Sandwith Cycle 60

bone beds 220, 261

St Bees Evaporite Formation

Saltom Bay site 57-61

marine transgression 59-61

St Audries Slip 258

57, 59-61, 136

Fleswick Cycle 60

Saltom Cycle 60

Sargodon 253, 256, 260 S. tomicus 265 Saurichthys 230, 234, 253, 268 S. apicalis 265 Savitrisporites 102 Scalpay, Isle of 117, 123 Schizodus obscurus 60, 71, 75-6 School Brae, Lossiemouth 112 Scleromochlus taylori 115 scolecodonts 260 scorpions 25, 176 cf. Scovenia? tradica 159, 162 Scoyenia ichnofacies 142 Scrooby Top Quarry site 108, 168 Nottingham Castle Formation 171-2 Scythian see Induan, Olenekian Seaham Formation 64, 71, 76 EZ3 cycle 64, 71, 167 see also Belah Dolomite, Brotherton Formation, Stenkrith Brockram, D-bed gypsum-anhydrite Sedbury Cliff 246 seif see dunes, longitudinal Selby 168 selenite 236, 244, 252, 267 Severn Bridge 243 Severn-Bristol Channel Basin 12-13 Severn-Mendip, Norian 26 Severnichthys 22 Shadforth 54 sharks 185-8, 225, 230, 236, 241, 246-7, 249, 251, 253, 268 Sherburn Hill Quarries 53-7 Sherwood Sandstone Group 9-11, 13, 18-20, 83, 100, 131-2, 149, 167-8, 174, 189, 206 **Bromsgrove Sandstone** Formation 13, 19, 24-6, 174, 176, 183-6, 215 **Budleigh Salterton Pebble** Beds 18-19, 24-5, 82-3, 189, 205-15 **Bulkeley Hill Sandstone** Formation 131, 152-4 Bunter 8-11, 63, 167-8

Burcot Member 176, 184-6 Calder Sandstone Formation 131-3 **Cannock Chase Formation** 174-9, 180-2, 184 **Chester Pebble Beds** Formation 131, 134-6, 141-52 Colwick site 172-4 East Irish Sea Basin 12-14, 18, 59, 64, 76-7, 130-2,136-66 Finstall Member 176, 185-6 Frodsham Soft Sandstone Member 148-9, 154-8 Glen Dubh Sandstone Formation 117, 126-7 **Kidderminster Formation** 13, 78-82, 174, 180-2, 182 - 3**Kinnerton Sandstone** Formation 137-9 **Kirklinton Sandstone** Formation 131 Lamlash Sandstone Formation 117-18, 126-30 Lenton Sandstone Formation 167 Malpas Sandstone 131 Nottingham Castle Formation 167-8, 168-71, 169, 171-2, 173-4 **Ormskirk Sandstone** Formation 131, 139-43 Otter Sandstone Formation 82-3, 189, 205-6, 207-12,212-15 St Bees Sandstone Formation 24-5, 57-61, 63, 70-3, 131-6 Saliferous Marls 11, 167-8 Scrooby Top Quarry site 171 - 2Stornoway Formation 16, 116-18 Sugarbrook Member 176, 183-6 Thurstaston Common site 143-6 Thurstaston Hard Sandstone Member 143-6 **Thurstaston Soft Sandstone** Member 143-6 Vale of Eden 63-77, 82

Wildmoor Sandstone Formation 13, 174, 182-3, 183-6 Wilmslow Sandstone Formation 25, 131-2, 136, 139,143-9, 152-4, 163 see also Bacton Group Shetland Platform 20-1 Shoalstone site 32, 85-7 Neptunian dykes 86-7 Shrewley site 108, 176, 186-9 Arden Sandstone Formation 186-9 Shrewsbury 163-4 Shropshire 76, 162-6, 182-3, 206 Claverley Road Cutting site 182-3 Grinshill Quarries site 162-6 Shurnock 188 Shute Sandstone Formation 83-4 Crediton Trough 82-5 see also Monkerton Formation Siberia basalts 5 Sidmouth see Ladram Bay to Sidmouth site silica 36, 38-41, 49, 55, 62-3, 65-6, 67-9, 73-4, 85, 87, 94, 109, 112, 114, 116, 120, 124, 144 Silurian 78-9, 180, 181, 254 Sinemurian 26, 116, 258 Sipbonites 128-9, 265 Sker Point 194 Skolithos 24, 142, 162, 240 Skye, Isle of 16, 116-18 Sling Common site 32, 77–8 Clent Breccia 77-8 **Kiderminster Formation** 77-8 'Slump Bed' Pinhay Bay site 271 - 4Smith Bank Fault 15 Sneinton Formation 167-8, 172 - 4Colwick site 172-4 Solland Conglomerate fan 85 Solway Basin 12, 14-15, 130 - 2Somerset 12, 25-6, 82, 205-6, 226, 231

Basin 176, 187-8, 189-90, 211 Blue Anchor Point site 262-6 Hapsford Bridge site 249-51 Penarth Group 219-20, 225, 231 St Audries Bay site 220, 258-62 South Head, St Bees 133, 136 South Staffordshire Basin 76, 183-9 Hopwas Breccia 77 Quartzite Breccia 77 South Staffordshire Coalfield Basin, Barr Beacon Beds 77 South Wales 12, 26-8, 107, 189-205, 221, 226-34 Penarth Group 219-26, 226-34 Southern North Sea 9, 13, 16-22, 24, 38, 166-9 Southern Uplands Basins 14-16, 41-52, 131 Spernell Borehole 188 'Sphaerodus' 260 sphalerite 114 Sphenacodon 25, 76 sphenodontids 26, 115 Sphenopteris cf. bipinnata 71 Spirorbis 176 Spynie 31, 112 Stafford Basin 11-12, 76, 108, 174-5 see also Staffordshire, Staffordshire-Worcestershire Basin, South Staffordshire Basin, North Staffordshire Stafford Halite Formation 174 Staffordshire 26, 174-82 Hulme Quarry site 176-9 Kinver Edge site 79-82 Wollaston Ridge Quarry site 180 - 2Staffordshire-Worcestershire Basin 76-7, 183-9 Stagonolepis 31, 107 S. robertsoni 115 Stainmore Depression 76 Stanwix Shales 131 starfish 5 Stenkrith Beck site 32, 61-4,

71-3 Cumbrian Coast Group 71-3 Eden Shales 71-3 St Bees Sandstone Formation 71-3 Stenkrith Brockram, 71-3 Eden Shales 63-4 Stenkrith Beck site 71-3 Vale of Eden 63-4 see also Belah Dolomite, Dbed gypsum-anhydrite, Seaham Formation. **Brotherton Formation** Stephanian 7, 17, 85, 87, 89, 93 **Enville Beds** 7 Keele Beds 7 Sling Common site 77 Stormy Down Lime and Cement Works 233 Stormy Down site 226, 232-4 Lilstock Formation 232-4 Mercia Mudstone Group 233-4 Westbury Formation 232-4 Stornoway Formation 16, 116-18 Eyre Burn site 121-5 Gribun Shore and Crags site 124-6 Gruinard Bay site 119-21 Stotfield Cherty Rock see **Cherty Rock** Strangford Basin 15 Stranraer Basin 14-15, 41 Stratford River 175 stromatolites 191, 203, 205, 225, 255, 256-7, 265, 266, 268-9, 271 'Strobilites bronni' 71 Stubensandstein 107 Styrrup Quarry site 108, 168, 169-71 Nottingham Castle Formation 169-71 Sugarbrook Member 176, 185 see also Tarporley Siltstone Formation, Sneinton Formation Suisnish Hill 123 Sully Beds 229 Sully Island site 108, 189-91, 202-5

'Dolomitic Conglomerate' 202-5 evaporites 202-5 'Sun Bed' 220, 270, 272 Sutton Flats site 108, 189-94 calcrete 191-4 Dinantian 191-4 Gully Oolite 191-4 High Tor Limestone 191-4 Swanbridge 202 syndepositional faults 12-13 Corrie Shore site 45 River Belah site 73 Saltom Bay site 60 Synechodus 226 Taeniaesporites labdacus 60

Tarporley Siltstone Formation 131-2, 143, 148-9, 159-60, 162 Bickerton Hill site 152-4 Esk Bed 164-6 fauna and plants 19, 26, 148, 159-62, 162-6 Frodsham site 154-6 Frodsham Soft Sandstone Member 146-7, 154-6 Grinshill Quarries site 162-6 **Red Brow Cutting site** 158-62 The Dungeon site 146-7 Tatarian 6, 57 **Dawlish Sandstone** Formation 83-4 Exeter Breccia 83 Hopeman Sandstone Formation 84 Monkerton Formation 83-4 Shute Sandstone Formation 83-4 Taunton 268 Tea Green Marls 221, 229 see also Derenenach Mudstone Formation, Blue Anchor Formation, Rydon Member Teesside 168 Teesside Group, Seaham Formation 64, 71, 167 Teichichnus 124 Teignhead cuvette 83-5, 95 **Ness Formation 85** Netherton Formation 85

Oddicombe Breccia 84-5 Watcombe Breccia 84 Teignmouth Breccia 85, 87 Coryton's Cove site 96-7 Dawlish site 100 Sakamarian-Ufimian 83 see also Newton St Cyres Breccia, Heavitree Breccia, **Dawlish Sandstone** Formation Terrestrisuchus 27 Tertiary 124, 126-7, 129, 166 Tethys 8, 19 tetrapods 6, 10, 78, 176 Ladram Bay to Sidmouth site 213-15 Penarth Group 226 Sling Common site 78 Tetrasauropus 199, 201, 204 Thalassinoides 269 T. cf. suevicus 159, 162 The Dungeon site 108, 132, 146-7 Helsby Sandstone Formation 146 Frodsham Soft Sandstone Member 146 **Tarporley Siltstone** Formation 146-7 Wilmslow Sandstone Formation 146-7 The Trip to Jerusalem, Public House 169 Thecodontosaurus 26, 191, 251 theropods 199, 201, 234, 249 Thornhill Basin 14-15, 41, 47-9 Carron Basalt Formation 41 Carron Water 47-9 Hapland Burn site 47-9 Thornhill Sandstone Formation 47-9 Hapland Burn site 47-9 Thorverton Sandstone 82-3 Crediton Trough 82-5 Exeter area 82-5 Sakmarian 83 see also Bow Breccia, **Knowle Sandstone** Thurstaston Common site 108, 132, 143-6 Helsby Sandstone Formation 143-6

Wilmslow Sandstone Formation 143-6 Thurstaston Fault 146-7 Thurstaston Hard Sandstone Member 143-6, 148-9 Thurstaston Common site 143-6 Thurstaston Road Cutting see Thurstaston Common site **Thurstaston Soft Sandstone** Member 143-6, 148-9 Thurstaston Common site 143-6 Tiverton cuvette 85, 211 Tongue 116 Torbay 84, 87, 88-90, 95, 205 Tor Bay Breccia 87, 88-93, 95 Paignton cuvette 84, 86, 93 Permo-Carboniferous 83, 89 Roundham Head site 85-6, 90-3 Saltern Cove site 88-90 see also Cadbury Breccia Torquay 85, 95 Torquay Limestone 86-7 fissures, Shoalstone site 86-7 Torridonian Sandstone Formation 118-19, 169 Eyre Burn site 121 Gruinard Bay site 119, 121 tourmaline 77, 84, 140-1, 185 Tower Wood 152 trace fossils 19, 118, 168, 187, 225 Arden Sandstone Formation 187-8 Aust Cliff site 248-9 Blue Anchor Point site 265 Culverhole Point site 269 **Dawlish Sandstone** Formation 84 Gribun Shore and Crags site 124 Grinshill Quarries site 162-6 Helsby Sandstone Formation 25 Hilbre Island and Hilbre Point site 132, 139-41, 141 **Kidderminster Formation** 175

King's Cave to Drumadoon site 128-30 Moray Firth 38 Orcombe Rocks burrows 102 - 3**Ormskirk Sandstone** Formation 141-2 **Red Brow Cutting site** 159-62 St Audries Bay site 260-1 Saltern Cove site 88-90 Sherwood Sandstone Group 25 **Tarporley Siltstone** Formation 159-62, 162-6 Westbury Garden Cliff site 240 - 1Wildmoor Formation 175 Wilmslow Sandstone Formation 25 travertine 203-5 Treharne's Point 189 Trent Formation 174 Tricuspes 226 tridactylous footprint 159 trilobites 5 Triton Anhydrite Formation 167 tuffs 16, 41, 58 Tutcheria 231 Tutnall 185-6 Tuvalian Substage 107, 116 **Twyning Mudstone Formation** 174, 235-7 Aust Cliff site 241-9 Manor Farm 248 Norian 248 Wainlode Cliff site 235-7 Westbury Garden Cliff site 239-41 **Ugbrooke Sandstone** 94 Ufimian 6, 52 Ullmannia cf. frumentaria 71 U. bronni 71 Unter Buntsandstein 6-7, 215

see also Otter Sandstone Formation, Voltzia Sandstone, Donguz Gorizont

Upper Inferior Oolite 249–50 Upper Keuper Sandstone see Arden Sandstone Formation Upper Marls 167, 205–6

Upper Mottled Sandstone see Wilmslow Sandstone Formation, Wildmoor Sandstone Formation Upper Röt Halite Member 167 Upper Sandstone 190, 206 Utsira High 20-1 Vale of Eden Basin 14, 16-17, 25, 61-76, 82, 108 amphibians, Penrith Sandstone 25, 63 Belah Dolomite 63 Brockram 57, 60, 61-4 Burrells Quarry site 61-4, 64-6 Cowraik Quarry site 61-4, 66-7 Eden Shales 63 George Gill site 61-4, 67-9 Hilton Beck site 61-4, 69-71 Hilton Plant Beds 63 Penrith Sandstone 25, 61-4, 76-7, 82 River Belah site 61-4, 73-6 Rotliegendes 61-4 St Bees Sandstone Formation 63-4 St Bees Shale Formation 64 Sherwood Sandstone Group 63 Stenkrith Beck site 61-4, 71-3 Stenkrith Brockram 63-4 Vale's Rock 80-2 Vallis Vale 249-51 Vallisia 226 V. coppi 250-1 vanadium 103 Variscan Orogeny 11-12, 14-15, 61 vermiculite 261 vertebrates 5-7, 16, 25-6, 162, 214-15, 222 footprints 7, 16, 20, 24-5, 25-6, 41, 99, 100, 107, 201 East Irish Sea Basin 132, 140-3, 162, 166 Hopeman Sandstone Formation 25, 31-3, 36-8, 38-41 Lossiemouth Shore and Quarries site 107, 109,

112, 114-15 Penarth Group sites 219-74, 232-4, 236, 239-41, 241-9, 252-3, 254-6, 260-1 tracks 38, 51, 84, 142, 159, 162, 173, 188, 265 South Wales 190, 199-201, 204 Vesicaspora fuscus 231 Viking Graben 13, 20-1 volcanics 88-9, 221 Permian 3, 5, 7-8, 16-17, 47-9, 82-4 clasts 77, 80, 92, 96, 99 tuffs 16, 41, 58 Voltzia Sandstone 215

Wainlode Cliff site 226, 234-7 Lias 235 Lilstock Formation 234-7 Mercia Mudstone Group 234-7 **Blue Anchor Formation** 234-7 **Twyning Mudstone** Formation 234-7 Westbury Formation 234-7 Walchia see Lebachia Wales 18-22 see also South Wales Wardour Basin 12-13 Wardour Fault 211 Warrington 8-10, 22, 25-7, 31 Devon 82, 97, 100, 205, 212, 266 Triassic 117, 123, 124, 130, 139, 148-9, 166-8, 173-5, 189 Penarth Group 219, 221, 260, 262, 265, 266 Warwickshire 8, 26, 76, 176, 226 Basin 16, 78, 188 coalfield 16-17 Shrewley site 186-9 Watchet 230, 258, 261 Watchet Beds 219-20, 229-30 Watcombe Breccia 83-5, 95 Oddicombe Beach site 93 Teignhead cuvette 83-4 Waterside Cove 88 Waterstones 9-10, 148, 162, 172-3, 175 see also Tarporley Siltstone

Formation, Sneinton Formation, Sugarbrook Member Weethly Fault 13 Weissliegendes 6, 38, 52 Welsh Highlands 76-8 Wem-Red Rock Fault system 12-14, 147-9 Wessex Basin 12, 82, 188, 209, 211-13 Wessex and English Channel Basin system 12, 82, 188, 209, 212-13 west Cumbria Basin 57-61, 107-8, 130-6 Fleswick to St Bees site 132-6 Saltom Bay site 32, 57-61 see also Cumbria Western Highlands and Islands 7, 116-26 West Kirby 140 West Shropshire Basin 76-7 Westbury Formation 116, 118, 131, 206, 219-26 Aust Cliff site 241-9 Barnhill site 251-3 Barry Island site 197 black shales 190, 220, 222, 225, 230, 236, 250 Blue Anchor Point site 262-6 bone beds 222-5, 229, 263-6, 266-9 'bristovi limestone' 227-32 Contorta Shales 220-2, 270 Culverhole Point site 266-9 English Midlands 167, 174 Euestberia Bed 235-7 Hapsford Bridge site 250-1 Lavernock to Penarth site 226-32 Lower Sandstone 190 Lulsgate site 256-7 Manor Farm 248-9 Mull 116-18, 124-6 Pecten Limestone 235-7 Pinhay Bay site 269-74 Pleurophorus Limestone 263 St Audries Bay site 258-62 Stormy Down site 232-4 Upper Sandstone 190 Wainlode Cliff site 234-7

Westbury Garden Cliff site 222, 238-41 Wetmoor site 253-6 see also basal bone beds Westbury Garden Cliff site 222, 226, 237-41 Lias 238 Lilstock Formation 238-41 Mercia Mudstone Group 237, 239 **Blue Anchor Formation** 239 - 41**Twyning Mudstone** Formation 23-41 Westbury Formation 238-41 black shales 239-41 Pecten Limestone 239-41 Pullastra Beds 239-41 'Rhaetic' Bone Bed 239-41 Westbury-on-Severn see Westbury Garden Cliff site Weston Mouth Sandstone Member 26, 205-6 Westphalian 7, 16-17, 54, 82 Whitehaven Sandstone Formation 57-8 Wetmoor Lower Woods 254-6 Wetmoor site 226, 253-6 Lias 254-5 Lilstock Formation 253-6 Mercia Mudstone Group 254-6 **Blue Anchor Formation** 254-6 Silurian Wenlock Limestone 254 Westbury Formation 253-6 Wetmoor Wood Nature Reserve 254 Whin Sill clasts 67-8 Whipton Formation 25, 83-4 Exeter area 82-5 see also Creedy Park Sandstone White Lias 221, 225, 233, 266

see also Langport Member Whitehaven Sandstone Formation 57-61 Saltom Bay site 57-61 Whitmore Bay 195, 196 Wick Fault Zone 15 Wickwar SSSI 254 Wigan-Warrington half-graben 154-8 Wildmoor Sandstone Formation 13, 25, 174-6 Burcot site 183-6 Claverley Road Cutting site 182 - 3see also Cannock Chase Formation Wilkeslev Halite Formation 131, 148-9 Williton Member 231 Blue Anchor Point site 262-6 St Audries Bay site 258-62 see also Blue Anchor Formation, Sully Beds Wilmslow Sandstone Formation 131-2, 136, 139, 142,148-9 Bickerton Hill site 152-4 Grinshill Quarries site 163 The Dungeon site 146-7 Thurstaston Common site 143-6 trace fossils 25 see also Bulkeley Hill Sandstone Formation Winterton Formation 167 Wirral see The Wirral Wolfcampian 6 Wollaston Ridge Quarry site 108, 176, 180-2 **Bridgnorth Sandstone** Formation 180-2 **Kidderminster** Formation 180-2 Woodfield House 182 Woodhope Formation 168,

173

see also Sneinton Formation Worcester Basin 12-13, 19-22, 76, 78-82, 108, 183-9, 190, 206 Arden Sandstone Formation 176 Bridgnorth Sandstone Formation 13, 78-9 Haffield Breccia 13, 78-9 **Kidderminster Formation** 78-82 Osebury Rock site 78-9 Worcester Graben 11, 79, 211 Worcester Horst 79 Worcestershire 26, 175-6, 183-6, 186-9, 206 Wordian 6, 52 Wordian-Ufimian, Hilton Plant Beds 63-4 Wuchiapingian 6, 52 Wych Farm 212 Wych Mudstone Formation 131, 148 Yellow Sands 25, 52-7, 84

Crime Rigg Quarry site 52–7 Yellowford Formation 83 Crediton Trough 82–5 *see also* Crediton Breccia Yorke rock *197* Yorkshire 9, 18, 52, 167, 226 Bröckelschiefer 10, 167

Zanclodon cambrensis 234 Zechstein 6-7, 25, 52, 167 Crime Rigg Quarry site 52–7 Don Group 52–7 Marl Slate 54–7 Raisby Formation 52–7 Eden Shales 63, 71–6 Belah Dolomite 63, 73–6 Hilton Plant Beds 71 transgression 7, 18, 38, 57, 61, 63–4, 73–6 Vale of Eden 63–4, 71, 74