

LOWER WILDMOOR BEDS.**?Trias, Sherwood Sandstone Group.**

Type-locality: Wildmoor Boreholes, SO 953760, Bromsgrove, Worcestershire.

Wills L.J., 1970, p.228; 1976, pp.18, 45. Palaeotrias, English Bunter Series, Wildmoor Regional Stage, above the Slings Shingle Beds and below the Upper Wildmoor Beds. New name for the Pebble Beds of Hull 1869. Thick red sandstones and conglomerates, Miocyclothem BSIIA, BSII B, BSIII, mainly flood sequence.

Warrington G. et al. 1980, table 4, cols. 12 and 13, renamed Kidderminster Formation.

LOXBEARE LAVAS.**Permian, ?Rotliegende.**

Tiverton Valley, Devon, see: Exeter Volcanics.

LUCCOMBE BRECCIAS.**?Permian, New Red Sandstone.**

Type-locality: Vale of Porlock, north Devon.

Thomas A.N., 1940, pp.26-30. Local base of the Permo-Trias red bed sequence. Contains fragments of the underlying Devonian rocks, often shaly, up to 304.8 m in thickness.

Laming D.J.C., 1968, pp.23-25, fig. 1, local base New Red Sandstone, 'Keuper' Sandy Limestone above.

!MAGNESIAN BRECCIA.**New Red Sandstone.**

Type-locality: [None given but the deposit can be found at Bristol, in the Mendips, and at Cowbridge, Glamorganshire.]

Smith W., 1815, named on the map.

Warburton H., 1817, pp.205-209. Lateral margin of the Red Marl against Carboniferous Limestone. Compared in age with the Magnesian Limestone of Durham.

Buckland W., and Conybeare W.D., 1822, pp.210-316, rename this unit the Dolomitic Conglomerate.

MAGNESIAN CONGLOMERATE.

See: Calcareous Conglomerate 1.

MAGNESIAN LIMESTONE.*Permian, Zechstein.**

(Magnesian Limestone Group, Magnesian Limestone Series, Newer Magnesian Limestone, Sunderland Limestone, Yellow Magnesian Limestone.) See also: Lower, Middle, and Upper Magnesian Limestone.

Type-locality: Sunderland, Durham; and Northumberland.

Smith W., 1815, named on the map.

Winch N.J. 1817, pp.1-101. Above the Coal Measures and below Red Marl and Sandstone. Magnesian limestone, 100.6 m. [paper gives analyses, no concise description but six pages of observations]

Buckland W., 1817, pp.116, pl.5, [first reference for Cumberland and Westmorland, above Coal Measures, below New Red Sandstone.]

Conybeare W.D. and Phillips W., 1822, Frontispiece, map, text page vii, synoptic table, book 2, pp.300, as Newer Magnesian Limestone equated with the Zechstein of Germany. Granular, sandy streaks, glimmering lustre, yellow, oolitic, interbedded with red clay or marl.

Sedgwick A., 1829, pp.81, et seq. As Magnesian Limestone or Yellow Magnesian Limestone or the Great middle deposit of Magnesian Limestone; small-grained dolomite, compact earthy. Nottingham to Durham. Part of the New Red Sandstone Series. [Generally accepted as the first description with stratigraphical implications of the north-east England Magnesian Limestone.]

Woolacott D., 1912, pp.241-313, table p.253, subdivides the unit into Lower, Middle and Upper Magnesian Limestone.

Smith D.B. et al. 1974, table 3, col.10 as ?Belah Dolomite; col.11, as ?Roosecote or Gleaston Dolomites; cols.14-17, 33, 34, subdivided into Lower and Upper Magnesian Limestone; cols.15, 16, 33 also include Middle Magnesian Limestone.

Arthurton R.S. and Wadge A.J., 1981, latest description of the Magnesian Limestone of the Eden Valley.

Smith, D.B., Harwood G.M., Pattison, J. and Pettigrew, T.H., 1986. See Lower, Middle and Upper Magnesian Limestone.

MAIN DOLOMITE.

Permian, Zechstein

Type-locality: Leman Gas Field, southern North Sea.

Smith D.B. et al. 1974, table 3, col.20. Above the Werra Dolomite and below the Basal Anhydrite, equates with the Kirkham Abbey Formation of Yorkshire.

MAIN REGIONAL SEAL.

Trias, Mercia Mudstone Group.

Type-locality: Saleway Borehole, 3 miles south-east of Droitwich, SO 928 601, (I.C.I.Ltd.).

Wills L.J., 1970, pp.272-273. English Keuper Series, Neotrias, Droitwich Regional Stage, Middle Keuper Marls. [Lithological term with stratigraphical implications ?] Blocky red marl with two pockets of halite above thick rock salt.

Wills L.J., 1976, pp.23, 29, 164, 173, impervious layer of mudstone separating Lower and Upper Evaporite Zones. Miocyclothem KMVIII.

MAKER PENINSULAR LAVAS.

Permian, ?Rotliegende.

South Devon, see: Exeter Volcanics.

***MALPAS SANDSTONE.**

Trias, Sherwood Sandstone Group.

Type-locality: Malpas, north Shropshire; also Wilkesley Borehole.

Stephens J.V., 1961, p.39, the renamed Upper Keuper Sandstone of Pugh 1960.

Poole E.G. and Whiteman A.J., 1966, pp. 11, 18-19, 36-37, 133-134. Wilkesley Borehole from 1526.7 m down to 1632.3 m, giving a thickness of 105.5 m. Above the Building Stones, below the Keuper Marl (Red Marls) or Waterstones if developed. Massive bright red fine-medium grained sandstone, current bedded, moderately soft, with a high percentage of millet seed grains. Relatively few bands of mudstone or sandy mudstone; not less than 182.9 m in thickness.

Warrington G. et al. 1980, table 4, col.10, p.34. at the base of the Mercia Mudstone Group.

MANCHESTER MARLS.

Permian, Zechstein.

Type-locality: south Manchester and Stockport.

Binney E.W., 1839, pp.44-47, as red and variegated marls with magnesian limestone; descriptive term. Above Lower New Red Sandstone [later Collyhurst Sandstone] and below Upper New Red Sandstone [later Triassic Pebble Beds]. Pp.54, 55, fossils include *Rissoa*, *Turbo*, *Natica*, *Avicula*, *Arca*, *Axinus* and *Lucina* sps. Thickness stated as 128 m.

Binney E.W., 1846, p.12, as Permian marls and limestones, maximum thickness now given as 64.0 m.

Binney E.W., 1855, pp. 224-230, as Upper Permian marls and limestones, further description of the red marls and limestones about Manchester including the Ardwick and Bedford Limestones; fossils include *Bakevella*, *Schizodus*, *Pleurophorus* replacing *Avicula*, *Arca* etc. (Binney, E.W., 1939).

Hull E., 1862, pp.17-22, referred to as Upper Permian marls and limestones including the limestone at Bedford Colliery (north Manchester), 50 mm in thickness; total thickness given as 21.8 m. Fossils include *Turbo*, *Bakevella*, *Schizodus* and *Tragos*. Term Manchester Marls is not used.

Geinitz H.B., 1890, p.552; 1899, pp.48-57, Red marls with thin dolomite layers. Fossiliferous.

Tonks L.H., Jones R.C.B., Lloyd W. and Sherlock R.L., 1931, pp.4, 5, 7, 159, 160, 165-167, 174. [Probably the first use of the term with detailed description of the rocks and fauna.] Thickness given as up to 175 m, usually between 47.2 and 61 m. Conglomerate at the base.

Wray D.A. and Cope F.W. 1948, p.5, thickness up to 248 m but then contains sandstones. May rest directly on the Carboniferous beds in the Formby area.

Wills L.J., 1956, p.108, includes the Stockport Breccia at the base, locally.

Pattison J., 1970, pp.123-165, latest description of the fauna.

Smith D.B. et al. 1974, table 3, col.13, p.17, 45-100 m. Red continental siltstones and mudstones. Red and grey epicontinental clastics with beds of marine carbonate, 0-25 m at base. Between the Stockport Conglomerate

and Chester Pebble Beds (top). Fauna suggests Zechstein cycles I-III ? below the Lower Mottled Sandstone facies.

MANSFIELD RED SANDSTONE.

Permian, Zechstein.

(Mansfield Sandstone, Mansfield Stone.)

Type-locality: Rock Valley Quarry, Mansfield. [SK 542613, Metal Box Factory, north-east side of the Mansfield Inner Ring Road.]

Sedgwick A., 1829, pp.83-84. Part of the Great middle deposit of Yellow Magnesian Limestone. Dull red, sandy dolomite, used as a building stone. Analysis of the rock gives silica as 20%; thickness given as 15.2 m.

Aveline W.T., 1861, 1879, pp.10 and 11. Refers to the Chesterfield Road Quarry, [now infilled]. Silica analysis in 1879 edition quoted as 50%. Upper part of the local Magnesian Limestone developed as a red flagstone.

Hickling G., 1906, pp.125-131, described the footprints found in Rock Valley Quarry.

Smith D.B. et al. 1974, p.18, as Mansfield Sandstone, sandy variety of the local Lower Magnesian Limestone spanning both Lower and Upper Subdivisions.

MANSFIELD WHITE SANDSTONE.

Permian, Zechstein.

(Mansfield Sandstone, Mansfield Stone.)

Type-locality: Gregory's Quarry, Nottingham Road, Mansfield, Nottinghamshire. SK 534600.

Aveline W.T., 1861, 1879, pp.10, 11. Upper part of the Magnesian Limestone, probably a similar horizon to the Mansfield Red Sandstone. White weathering sandy variety of dolomitic limestone; silica content analysed at 50%. Local building stone.

Smith D.B. et al. 1974, p.18, as Mansfield Sandstone, sandy variety of the local Lower Magnesian Limestone, spanning both Lower and Upper Subdivisions.

!'MARGINAL DEPOSITS'.

See: Dolomitic Conglomerate.

***MARL SLATE.**

Permian, Zechstein.

Type-locality: Durham and Yorkshire; north-east England.

Sedgwick A., 1829, pp.75-80. Part of the New Red Sandstone Series between the Lower Red Sandstone and the Yellow Magnesian Limestone (top); correlated with the Kupferschiefer of Germany. Thinly bedded compact limestone, coarse flagstone alternating calcareous sands and marl, 2.7 m thick; including plant, brachiopod and fish remains.

King W., 1850, 253pp., 28 pls; first description of the fossils.

Woolacott D., 1912, pp.253, 260-261, useful review and occurrence at Cullercoats Bay, Tynemouth, Durham limestone escarpment.

Gibson W., Pocock T.I., Wedd C.B. and Sherlock R.L., 1908, pp.103-4, 107, extension of the term for the calcareous flags and grey marls of Nottinghamshire and Derbyshire between the Basal Breccia and Magnesian Limestone. [See also Permian Lower Marl.]

Sherlock R.L., 1926, pp.12-15, as Marl Slate, restricted to the Durham area; or as grey beds or "Marl Slate" (Permian Lower Marls) for the Yorkshire north Nottinghamshire area; and limestone, central Nottinghamshire.

Smith D.B. et al. 1974, table 3, cols.14-19, 33, 34, above the Yellow Sands or Breccia and below the Lower Magnesian Limestone or the Permian Lower Marls or in part lateral equivalent of the Permian Lower Marls.

MARLDON GROUP.

?Carboniferous, ?Permian, New Red Sandstone.

Type-locality: Tor Bay to Torquay, south Devon.

Laming D.J.C., 1966, pp.940-959, tables 1 and 2; 1968, pp.23-25, fig.1. Local base of the Lower New Red Sandstone, above Culm Measures, below the Teignmouth Group, ?Carboniferous. Includes the Tor Bay Breccias, Vicarage Hill Breccias, Livermead Beds, Watcombe Beds, Chelston and Paignton Breccias. Red sandstones and breccias.

MARSDEN LIMESTONE.**Permian, Zechstein.**

See: Middle Magnesian Limestone.

MAUCHLINE SANDSTONE.*?Carboniferous, ?Permian, New Red Sandstone.**

Type-locality: Ballochmyle Quarries, Mauchline, Ayrshire.

Binney E.W., 1856, p.138. Soft red sandstones at Mauchline above Carboniferous beds. [Description only, not named.]

Harkness R. 1856, p.254. [Simultaneous publication of a description with Binney, still not named.]

Geikie A., 1869, pp.22-23, Permian, Mauchline quarries and the Lugar Water section, Ayrshire; describes a tripartite group: Red sandstones and volcanic rocks (top) Brick red sandstones [?Mauchline Sandstones of subsequent authors ?] Porphyritic metaphyres and tuffs. [Mauchline Volcanic Group. ?]

Horne J. and Gregory G.W., 1916, pp.375-376. ?Permian, New Red Sandstone. Red sandstones with wind-rounded sand grains; rare marl beds. [Term used but no description.]

Eyles V.A., Simpson J.B. and MacGregor A.G., 1947, pp.8, 11, 18, 100-103, 105, 107, 113, 120-121; brick red sandstones in massive beds with abundant wind rounded quartz grains with cross-bedding of dune type; thickness up to 457.2 m.

Mykura W., 1967, pp.23-98, considers plants in underlying Mauchline Volcanic Group to be Upper Carboniferous; Mauchline Sandstone therefore ?Upper Carboniferous.

Smith D.B. et al. 1974, table 4, col.2, Mauchline Basin, Ayrshire, interdigitates with Mauchline Volcanics at the base, aeolian sands, 450+ m, p.23, Wagner now reports finding additional fossils including Pecopterids from the Mauchline Volcanic Group, not known in Stephanian, concluding Lower Permian age for the formation.

McLean A.C. and Deegan C.E., 1978, extends the formation into the Clyde Basin.

Brookfield M.E., 1978, pp.143, 145, although no details of the Mauchline Sands are given, the age of other sand deposits in southern Scotland are based on these sands and the underlying volcanics.

Lovell J.P.B., 1983, p.331, gives a thickness up to 450 m.

MAUCHLINE VOLCANIC GROUP.*?Permian, New Red Sandstone.**

Type-locality: Tarbolton, Ayrshire and surrounding the Mauchline Basin.

Eyles V.A., Simpson J.B. and MacGregor M.C., 1949, pp.100-105. Above Carboniferous or older rocks and below the Mauchline Sandstone. Basaltic lava flows, usually thin, interclated with and locally overlain by beds of tuff and sediment (sandstone and marl), 91.4 to 167.6 m; overlying Basal tuffs and sediments, the latter probably persistent although usually thin; up to 39.6 m in thickness.

Geikie A., 1869, pp.22-23, described as porphyritic metaphyres and tuffs.

Wagner R.H. 1966 argues strongly for a Stephanian age for the volcanics based on interbedded sediments with plant remains.

Mykura W., 1967, pp.23-98, plants described confirming Upper Carboniferous age.

Smith D.B. et al. 1974, table 4, col.2, Mauchline Basin, Ayrshire. Basalts 90-235 m, resting on basal tuffs and clastics (3-80 m) and interdigitating with the base of the Mauchline Sandstone. Wagner reported, p.23, to have found pecopterids not found in the Stephanian now preferring a Lower Permian age for the Volcanics.

Brookfield M.E. 1978, p.145 considers that these volcanics indicate a Permian age for the overlying sandstones with similar relationships elsewhere in south Scotland, e.g. the Thornhill Basin.

Wagner R.H. 1983, pp.133, describes a pterophyll-sphenophyte assemblage and compares it with a Lower Rotliegende assemblage from East Germany suggesting an Autunian age for the Mauchline Volcanics.

Lovell J.P.B., 1983, p.331, thickness may be up to 300 m.

MERCIA MUDSTONE GROUP.*Trias.**

Type-locality: West Midlands (Kingdom of Mercia), particularly Warwickshire, Worcestershire, Staffordshire and Cheshire Basin(s); British Isles generally.

Warrington G. et al. 1980, table 4, pp.12, 13, 40. [First formal description and introduction of the term.] Above the Sherwood Sandstone Group and below the Penarth Group. Includes the following Formations and Members (alphabetically): Arden Sandstone, Blue Anchor, Colwick, Droitwich Halite, Edwalton, Hambledon, Harlequin, Kirklington, Mythop Halite, Northwich Halite, Glen Parva, Singleton, Stanwix

Shales, Trent, Wilkesley Halite, Woodthorpe. Dated as late Scythian to Norian on miospores. In part renamed Keuper Marls, or Keuper Marls and Waterstones; or Droitwich (Regional) Stage. Dominantly red (brown) and less commonly green and grey mudstones, and sub-ordinant siltstones with thick halite-bearing units in basinal areas. Thin beds of gypsum and anhydrite are widely developed at particular horizons. Sandstones (often dolomitic) are also present. Playa or sabkha environment envisaged, wind blown dust may have contributed to the sediment; miospores; 1350-2000 m thick.

Warrington G. 1974, p.158, postscript notes to the Triassic Chapter indicates the impending formal appearance.

Evans W.B. and Wilson A.A. 1975, term used in the extensive marginal notes on the Blackpool 1:50 000 geological map.

!MERCIAN SYSTEM.

Permian and Trias, New Red Sandstone.

Type-locality: British Isles.

Jukes-Brown A.J., 1886, p.232. Dyas and Trias, alternative name for the New Red Sandstone.

!MESOTRIAS.

Trias.

Termier H. and Termier G., 1952. Chronostratigraphical Term suggested to replace Muschelkalk, Anisian and Ladinian.

Wills L.J. 1970, p.227, fig.1, applies term to the British Isles as a chronostratigraphic unit to include the lithostratigraphic term, English Keuper Sandstone Formation. Includes ?Upper Mottled Sandstone, Building Stones and Waterstones. [Synonym of the Bromsgrove Regional Stage.?

!MIDDLE BUNTER.

?Trias.

(Middle Bunter Sandstone.)

Type-locality: England and Wales.

Audley-Charles M.G., 1970, p.24. Various Pebble Bed Formations. [The term is attributed by Audley-Charles to Richardson L., 1929, pp.198-199, 202-203. Similarly, Hull E., 1869, p.10. e.g. Budleigh Salterton; term Middle Bunter, implied, but not used by these authors.]

Wills L.J., 1976, p.28, table 1, as Middle Bunter Sandstone or Bunter Pebble Beds, Worcestershire.

MIDDLE CONGLOMERATE.

Trias, ?Sherwood Sandstone Group.

Type-locality: Alderley Edge, Cheshire.

Taylor B.J., Price R.H. and Trotter F.M., 1963. Middle of three conglomerate horizons towards the base of the Lower Keuper sandstone. Above the Basal Conglomerate, below the Top Conglomerate. Red Conglomerate.

Warrington G., 1965, p.113, 122, referred to as the Wood Mine Beds.

Thompson D.B., 1966; 1970a, p.32; 1970b, p.184, as Wood Mine Conglomerates.

Thompson D.B., 1970b, p.184; 1970c, pp.172, 174, 176, 177 in part as Delamere Pebbly Sandstone Member or Delamere Member.

!MIDDLE EVAPORITE BED.

Permian, Zechstein.

(Middle Evaporites, Middle Evaporite Group, Middle Halite, Middle Salt.)

Type-locality: Eskdale No.2, Borehole, east Yorkshire.

Stewart F.H., 1951, pp.445-475. Between the Upper Magnesian Limestone and the Carnallitic Marl (top).

Raymond L.R., 1953, pp.5-23, now written as Middle Evaporite Group.

Smith D.B., 1974, p.135, unit renamed Boulby Halite.

Smith D.B. et al. 1974, table 3, col.17, as Billingham Main Anhydrite and Boulby Halite.

!MIDDLE KEUPER MARL.

Trias, Mercia Mudstone Group.

(Middle Keuper Marls, Middle Marl 2, Middle Keuper Mudstones.)

Type-locality: Wilkesley Borehole.

Pugh W. 1960, pp.278-279. Between the Lower and Upper Keuper Saliferous Series.

Sherlock R.L., 1921, p.18, as Middle Marl, red marl 9.14 m between the Bottom and Top Beds, Cheshire and Shropshire Salt Basin, part of the Keuper Marl.

Poole E.G. and Whiteman A.J., 1966, red, brown, grey and green mudstone in part silty and sandy with thin sandstone bands; nodules and irregular patches of anhydrite are common throughout, and salt pseudomorphs, small scale current bedding and turbulent bedding, suncracks and ripple marks are common. Veins of salt and fibrous gypsum are also present. 327.1 m thick at Wilkesley.

Audley-Charles M.J., 1970, pp.19-47, as Middle Keuper Mudstones.

Evans W.B., 1970, pp.107-108, 609.6 m near Middlewich, marine microplankton and miospores indicate a Landinian age for the unit.

Wills L.J., 1970, pp.271, 273, 276 as Middle Keuper Marls, Saleway Borehole, 3 miles south-east of Droitwich, SO 928601 (I.C.I.Ltd.). English Keuper Series, Neotrias, Droitwich Regional Stage, Miocyclothem IX-XI including the Arden Sandstone Horizon.

Wills L.J., 1976, p.164 et seq. referred to in part as Sub-, and Supra-Arden Keuper Marls.

Warrington G. et al. 1980 use 'undifferentiated Mercia Mudstone Group'.

***MIDDLE MAGNESIAN LIMESTONE.**

Permian, Zechstein.

(Marsden Limestones, Middle Limestone, Tunstall Limestone.)

Type-localities: Tunstall, Humbledon and Boldon Hills, Claxheugh, Fox Cover Quarry, north end of Marsden Bay and the Durham coast from Hendon to Seaham Harbour.

Woolacott D., 1912, pp.253-262. Above the Lower Magnesian Limestone, below the Upper Magnesian Limestone. Unbedded fossiliferous limestone, bedded magnesian limestone, Tunstall and Marsden Limestones respectively.

Smith D.B. et al. 1974, table 3, cols. 15, 16. Above the Lower Magnesian Limestone and below the Permian Middle Marls or Hartlepool Anhydrite. May be the lateral equivalent of the upper part of the Lower Magnesian Limestone in Nottinghamshire, east Yorkshire and the West Sole Gas Field, up to 116 m thick

Magraw D., 1975, pp.392-414; 1978, pp.157-185, Middle Magnesian Limestone of Durham subdivided into Algal Beds, Velvet Beds Limestone and Breccia, Fore- reef Breccia, North Marsden Bay Limestone. In Northumberland 21 m only, equivalent to the Hartlepool Anhydrite and Dolomites. [The terms Marsden Limestone, Tunstall Limestone and the localities listed appear on p.253 of Woolacott's 1912 paper. D.B. Smith (personal comm.) comments that the Middle Magnesian Limestone does not occur in Marsden Bay or on the coast between Hendon and Seaham.]

Smith D.B., Harwood G.M., Pattison J. and Pettigrew T.H., 1986, p.14, Middle Magnesian Limestone of County Durham, Tyne and Wear, Cleveland, and northern North Yorkshire renamed Ford (Magnesian Limestone) Formation, EZ1bCa.

!MIDDLE MARL(S) 1.

Permian, Zechstein.

See: Permian Middle Marls.

MIDDLE PERMIAN.

See: Calcareous Conglomerate 2.

!MIDDLE PERMIAN MARL.

Permian, Zechstein.

See: Permian Middle Marls.

MIDDLE POTASH.

Permian, Zechstein.

See: Boulby Halite.

!MIDDLE RHAETIC.**Trias, Penarth Group.**

Type-locality; West Glamorgan.

Strahan A. and Cantrill T.C., 1904, p.13. Located between the Lower, and Upper (Rhaetic) Sandstones [Quarella Stone] or Cotham Beds; equivalent to the *Avicula contorta* Beds of Wright. Black Shales with *Avicula contorta*.

Tucker M.E., 1977, pp.169-188, marine strata [black shales] passing laterally into continental facies [sandstones].

MIDDLE SALT.

See: Middle Evaporite Bed.

!MIDDLE SERIES.**?Permian, New Red Sandstone.**

Type-locality: Enville, Shropshire.

Hull E., 1869, p.13. ?Lower Permian, between Lower and Upper Series. Calcareous conglomerate and trappoid breccias, sandstones and marls. [Superceded by Corley Group, Enville Group, ?Alberbury Breccia.]

MIDDLESBROUGH BEDS.**Permian, Zechstein.**

Type-locality: ?Middlesbrough [None given]

Woolacott D., 1912, p.253. Top part of the Magnesian Limestone above the Upper Yellow Limestone. Red beds [marls?] with thin limestones [dolomites?], salt etc.. [Implies beds above the Upper Magnesian Limestone, so understood by subsequent authors.]

MILVERTON CONGLOMERATES.**?Trias, New Red Sandstone.**

Type-locality: Milverton and Wiveliscombe, Devon.

Laming D.J.C., 1968, pp.23-25, fig.1. Upper New Red Sandstone, above Wiveliscombe Beds and un-named marls and below the Nynhead Sandstone. [?Synonym of the Budleigh Salterton Pebble Beds.]

Warrington G. et al 1980, p.45, stated not to be a mappable unit, therefore not given formal status, noted table 4, col.17.

Durrance E.M. and Laming D.J.C. 1982, p.152, equated with the Uffculme Conglomerates above the Aylesbeare Group and below the White Ball Sands of north-east Devon.

MOIRA BRECCIA.*?Carboniferous, ?Permian, New Red Sandstone.**

Type-locality: Moira, south Derbyshire; also in north Leicestershire.

Fox-Strangways C., 1907. ?Permo-Trias. Calcareous conglomerate.

Smith D.B. et al. 1974, p.17, similar to the Permian Breccias of north Nottinghamshire and south Yorkshire; ?Lower Permian. p.27, 'may be contemporary' with Quartzite Breccia, Barr Beacon Beds, Hopwas Breccia and Stockport Breccia.

Wills L.J., 1976, p.32, age defined as ?Protobunter.

Warrington G. et al. 1980, p.36, ?Permo-Trias.

Charsley T.J., 1982, p.4, compares the unit with his Huntley Formation of east Staffordshire.

MONKERTON MEMBER.**?Permian, New Red Sandstone.**

Type-locality: Monkerton, north-east of Exeter, from Hill Barton to the M5 Motorway.

Bristow C.R. et al. 1984b; 1985, t.2. Top Member of the Teignmouth Breccia Formation, above the Heavitree Breccia and below the Brampford Speke Sandstone. Clayey, dominantly fine-grained, locally medium to coarse-grained sandstone, sandy mudstone, silty mudstone and thin breccia. Up to 40 m thick.

MOTTLED SANDSTONE.

See: Lenton Sandstone Formation.

!MOULDING SANDS GROUP.

Trias, Sherwood Sandstone Group.

Type-locality: Worcestershire.

Wills L.J., 1948, Above the Pebble Beds Group and below the Bromsgrove or Keuper Sandstone Group. Renamed Upper Mottled Sandstone of Hull 1869. Fine-grained sandstones with interbedded thin marls; moulding sands.

Wills L.J., 1970, referred to as Upper Wildmoor Beds, or as Wildmoor or Bromsgrove Moulding Sands.

Warrington G. et al. 1980, table 4, cols. 12, 13, renamed as Wildmoor Sandstone Formation; cols. 9 and 10, as Wilmslow Sandstone Formation.

!MUSCHELKALK.

Trias.

(Muschelkalk Equivalent.)

D'Omalius d'Halloy, 1808, 1834. Between the Bunter and the Keuper (top); first reference defining the Trias of Germany.

Sedgwick A., 1829, p.121, not yet observed in Britain.

Rose G.N. and Kent P.E., 1955, pp.476-480, Muschelkalk may be represented by the Waterstones of Eakring, Nottinghamshire, based on the presence of *Lingula*, possible feather-edge from the North Sea into eastern England. [First reference for the occurrence of Muschelkalk in England.]

Geiger M.E. and Hopping C.A., 1968, p.1-36, named as Muschelkalk equivalent; they trace the Muschelkalk across the North Sea into eastern England with facies changes, Waterstones.

Balchin D.A. and Ridd M.E., 1970, pp.96-98, as Muschelkalk Equivalent from base of the Waterstones to mid-point of Carlton Formation of Nottinghamshire and Lincolnshire; based mainly on gamma-ray log; Tetney Lock Borehole.

Rhys G.H. 1974, table 3, between Rot and Keuper, includes the Dowsing Dolomite Formation and Muschelkalk Halite.

Warrington G. et al. 1980, pp.3-11; [although not stated as such, if the terms Bunter and Keuper are not appropriate in British stratigraphy, Muschelkalk likewise should not be used there being no lithostratigraphic equivalent.]

MUSCHELKALK HALITE MEMBER.

Trias, New Red Sandstone.

(Muschelkalk Halite.)

Type-locality: Well no. 49/21-2, southern North Sea.

Geiger M.E. and Hopping C.A., 1968, pp. 1-36. Above the Rot Halite, below the Keuper Halite. Halite and mudstone, 40 m.

Rhys G.H., 1974, table 3, fig.4, part of the Haisborough Group, Dowsing Dolomitic Formation, towards the top of the Formation above the Rot Halite Member; lateral equivalent of the ?Muschelkalk. Halite, transparent, interbedded with beds of mudstone and some anhydrite.

Warrington G. et al. 1980, table 4, col.28, as Muschelkalk Halite Member. [Member should be renamed.]

***MYTHOP HALITE FORMATION.**

Trias, Mercia Mudstone Group.

(Mythop Halite, Mythop Salts.)

Type-locality: Boreholes, north of Blackpool, Lancashire.

Evans W.B. and Wilson A.A., 1975. Blackpool 1:50 000 geology map, I.G.S., [extensive marginal notes, memoir not yet published, 1987.] Upper part of the Singleton Mudstones, above the Rossall Salts. Thin salt beds with interbedded mudstone, Haselgebirge type in the south.

Warrington et al. 1980, table 4, col.8, as Mythop Halite Formation.

!NAIADITES LIMESTONE.**Trias, Penarth Group.**

Type-locality: Bristol.

Short A.R., 1904, pp.171-173, 184-185. Rhaetic, above the *Pecten* Limestone and below the Clay Beds. Thin bedded limestone and calcareous shales, ripple marks, sun-cracks, worm trails, *Naiadites*; about 0.61 m in thickness. [Now generally considered as part of the Cotham Beds.]

NECHELLS BRECCIA.*?Permian, New Red Sandstone.**

Type-locality: Borehole at Nechells Gas Works, north-east Birmingham. (99.8 m down to 206.3 m.)

Boulton W.S., 1924, pp.343-373. ?Lower Permian. Above the Hamstead Beds (Upper Carboniferous?) and below the Keuper Sandstone. Breccias, calcareous near the base, with red sandstones, about 106.7 m thick. Some of the blocks contain Cambrian fossils, Cambrian Quartzites, from ?Lickey Hills. Compare with the Clent, Kenilworth, Enville Breccias.

Boulton W.S., 1933, pp.53-83, expands the original description.

Smith D.B. et al 1974, table 5, col.24, east side of the south Staffordshire Coalfield. ?Lower Permian, 200+ m; equivalent of the Clent, Alberbury Breccias etc.

Lexicon 3aVIII p.237 provisionally includes the term in the Carboniferous.

!NEOTRIAS.**Trias, Mercia Mudstone Group.**

Termier H. and Termier G., 1952. Above Mesotrias and below the Rhaetic; chronostratigraphic term, to replace the Keuper.

Wills L.J., 1970, p.227, fig. 1, to include the Carnian, Norian, Rhaetian; Keuper Marls, Arden Sandstone, Tea Green Marls. 0-457.2 m. [First use of the term in the British Isles area.]

NESS BEDS.**?Permian, Lower New Red Sandstone.**

Type-locality: Ness Beach and Bundle Head, Shaldon, Devon, SX 936713.

Laming D.J.C., 1966, pp.940-959, tables 1, 2. Medium-fine earthy breccias, sandy breccias, limestone, quartz and porphyry fragments.

Laming D.J.C., 1968, pp.23-25, fig. 1, indicates the stratigraphic position to be above the Oddicombe Breccia and below that of Teignmouth, 67 m thick. ?Carboniferous, ?extends into the Haldon Hills.

Smith D.B. et al 1974, table 6, col.26, Teignmouth-Oddicombe area, Lower Permian, lateral equivalent of the Netherpton Formation, may pass laterally into the top of the Oddicombe Breccias.

NETHER ALDERLEY RED SANDSTONE MEMBER.**Trias, Sherwood Sandstone Group.**

Type-locality: Artists Lane, Quarry at Brynlow, Nether Alderley; Over Alderley; Cheshire. Also at Fools Nook, south of Macclesfield.

Thompson D.B., 1970b, p.184; 1970c, p.172, 174, 177. Part of the Lower Keuper Sandstone, lateral equivalent of the upper part of the of the Frodsham Member. Above the Delamere Member or in places the lower part of the Frodsham Member, and below the Waterstones. Includes the Brynlow Conglomerate [renamed Top Conglomerate, Taylor B.J., et al. 1963] at the base. The unit is the renamed Keuper Building Stone of this area. 1970c, p.176, includes the Finlows Sandstone. Red pebbly sandstone facies, pebbles rare, granules rare, includes mica and clay bands. Sandstones are red, pink, medium to fine-grained, well-sorted and cross-bedded. Interbedded thin beds of fine-grained argillaceous micaceous, ripple-marked sandstone. Mudcracks, footprints, *Euestheria* is recorded. Occasional marlbands, dark red micaceous shales; 35 m thick.

Thompson D.B., 1970a, p.32, as Brynlow and other Sandstones.

Warrington G. and Thompson D.B., 1971, p.69, 71, above the West Mine Sandstone and below the Waterstones in the Alderley area; 39.6 m thick.

NETHERTON BRECCIA.**?Carboniferous, ?Permian, New Red Sandstone.**

(Netherpton Formation.)

Type-locality: Netherton, Newton Abbott, south Devon; also at Buckland Barton.

Selwood E.B., et al. 1984, pp.91-93, 103. Oversteps and overlaps the Oddicombe Breccia and below the Teignmouth Breccia. Similar to the Watcombe Breccia. Fragments of slate and sandstone with lenses and beds containing coarse- and medium-grained clasts of sandstone, limestone and scattered porphyry.

Henson M.R., 1966, named as the Netherton Formation.

Smith D.B. et al. 1974, table 6, col.26, Teignmouth-Oddicombe area, south Devon. Permian, Lower, above the Oddicombe Breccia, below that of Teignmouth Lateral equivalent of the Ness Formation; 45 m thick.

NEWARK GYPSUM.

Trias, Mercia Mudstone Group.

(Gypsum-A.)

Type-locality: Newark, Nottinghamshire.

Sherlock R.L., 1928, p.63. Within the upper part of the Keuper Marls, above the Tutbury Gypsum. Gypsum seams with interbedded red marl.

Sherlock R.L., 1926, p.10, as Gypsum-A.

Sherlock R.L. and Hollingworth S.E., 1938, p.21, Upper of two horizons in the Keuper Marls, 18.3 m below the Tea Green Marls. Made up of a number of seams [of gypsum] including blue rock [anhydrite] separated by mudstone. Individual seams named locally by quarry-men.

Elliott R.E., 1961, pp.200, fig.2, p.222, referred to as Cropwell Gypsum.

!NEW RED MARL.

Trias, Mercia Mudstone Group.

(New Red Marls, Newer Red Marl, Red Marl, Red Marls.) See also: Keuper Marl(s), Keuper Marl(s) Group, Keuper Marl(s) Series.

Type-locality: ?north-east England, ?Midlands of England.

Sedgwick A., 1829, pp.37-124. Upper part of the New Red Sandstone Series, below the Lias. [Named but not described.]

Aveline W.T., 1861, 1879, p.20, as Red Marls or Keuper Marls, part of the Keuper Series.

Hull E., 1869, pp.10, 99, [probably the best early description and formal use of the term.] Usually shortened to Red Marl(s). Above the Lower Keuper Sandstone and below the Penarth Beds. Red and grey shales and marls, sometimes micaceous with beds of rock salt and gypsum, with *Estheria*; equivalent to the Marnes Irisees of France. Description of the Midland counties of England.

***NEW RED SANDSTONE.**

?Upper Carboniferous, Permian, Trias.

(New Red Sandstone Series, New Red Sandstone System, New Red Series, Newer Red Sandstone.)

Type-locality: Bed of the R. Tees, 1 mile west of Croft Bridge, thence to the sea; also at Hurworth, Neasham, Sockburn, and the coast from Seaton to Hartlepool. (Durham and Northumberland, now all in Cleveland.) [Later described from localities throughout the British Isles.]

Winch N.J., 1817, pp.1-101, pl.1, as Red marl, or new red sandstone. (sic.), above the Magnesian limestone. Comparable to the Old Red Sandstone, at least 215.8 m.

Buckland W., 1817, pp.105-116, pl.5, term New red sandstone (sic.), extended to the Vale of Eden, Appleby northwards, west of the Melmerby-Murton escarpment, also at St. Bees Head, Cumberland, here unconformity on older rocks clearly seen. p.106, 114, refers to 'more recent red sandstone than the old red sandstone'.

Conybeare W.D. and Phillips W., 1822, written as Red Marle or New Red Sandstone; pp.279-300, Red Marle; frontispiece map as New Red Sandstone, giving precedence for the term and implying new term for 'Red Ground'-for all rocks between the Carboniferous and the Trias. Red Marle is the name given to the red rock or red ground (Smith W, and earlier authors), Tees to Durham. Clay, sandstone, conglomerate, gypsum. [This work often quoted as the first reference to the term.]

Buckland W. and Conybeare W.D., 1822, pp.211, 290, 297-300, 314-315, as Newer Red Sandstone, previously red ground or red marl. In south-west Coal District of England, 61 m thick, about one-quarter the thickness of the New Red Sandstone of north-east England. Dolomitic Conglomerate, Red sandstone, red marl.

Sedgwick A. and Murchison R.I., 1829, pp.21-36, New Red Sandstone of Arran. [First use of the term in Scotland.]

Sedgwick A., 1829, pp.37-124, New Red Sandstone of north-east England. Title implies beds above the Magnesian Limestone, but p.37, all formations included between the Coal Measures and Lias, New Red

Sandstone and red marl (sic.), p.121 includes 1-Lower Red Sandstone, 2-Marl Slate and Compact Limestone, or Compact and Shelly Limestone, 3-Yellow Limestone, 4-Lower Red Marl and Gypsum. 5-Upper thin bedded limestone, 6-Upper red sandstone, 7-Upper red marl and gypsum. [Complete sequence New Red Sandstone Series but paper only describes in detail nos. 1-3 above.]

Sherlock R.L., 1926, p.30, as New Red Series.

Craig G.Y., 1965, pp.383-400. New Red Sandstone especially useful as a label for the equivocal Scottish representatives of the Permian and Triassic Systems. Brodick, Isle of Arran. Term includes: Lamlash and Auchenhew Beds; Elgin-Burghead, Hopeman, Lossiemouth Sandstones; Skye, Ardnamurchan, Mull, Applecross undifferentiated; south-west Scotland, Mauchline including volcanics, Sanquhar, Moffat, Stranraer, Annan, Dumfries. Penrith Sandstone and St. Bees Sandstone possible for the northern margin of the Carlisle Basin.

Laming D.J.C., 1968, pp.23-25, fig.1, continues the use of the term in south-west England.

Warrington G. et al. 1980, pp.21-26. New Red Sandstone widespread on northwest Scotland mainland, islands and adjacent basins. usually above Precambrian or Cambrian; Carboniferous on Morven, east Arran or ORS, west Arran. Overlain by Jurassic or 'Rhaetic' deposits, Mull, Arran. *Psiloceras planorbis* not found; late Triassic bivalves from Mull, ?late Trias on Rhum, non-definitive fossils on Morven and Lewis. Largely continental fans and floodplain deposits.

Lovell J.P.B., 1983, pp.325-342 ?abandons this term for Scotland, preferring Sherwood Sandstone and Mercia Mudstone Groups. [Still a useful term for those red beds above Carboniferous Beds and below the Penarth Group the age of which is uncertain.]

!NEW RED SERIES.

See: New Red Sandstone above.

!NEW RED SHALE FORMATION.

?Trias, base.

Type-locality: Phillips Group Well 52/5-1x, southern North Sea, Hewett Gas Field.

Rhys G.H., 1974, p.5, fig.4, name initially used by the southern North Sea Operators group of Companies, now to be replaced by the Bunter Shale Formation, above the Zechstein deposits. Includes the Brockelschiefer Member and the Hewett Sandstone.

NEWER MAGNESIAN LIMESTONE.

See: Magnesian Limestone.

NEWER RED SANDSTONE.

See: New Red Sandstone.

***NORTH CURRY SANDSTONE MEMBER.**

Trias, Mercia Mudstone Group.

Type locality: Ridge east-north-east of Knapp and North Curry, Somerset, ST 305252-ST 340270. (redesignated Warrington G., and Williams B.J., 1984.)

Warrington G. et al. 1980, pp.45, 60, table 4, col.17. Above the Somerset Halite Member within undifferentiated Mercia Mudstone Group. New name for the Upper Keuper Sandstone of Ussher 1908; possibly the same geological horizon as the Arden Sandstone Member.

Warrington G. and Williams B.J., 1984, pp.82-87. Grey-green mudstones and siltstones with locally thick beds of white to pale brown sandstone; 2.5 to 7.5 m thick. Fossils include branchiopods, fish, amphibians, reptiles, plants, palynomorphs and trace fossils. Miospores indicate a Carnian age. Fossils allow correlation of this unit with the Weston Mouth Sandstone Member and the Arden Sandstone Member.

NORTHFIELD BRECCIAS.

?Permian, Rotliegende.

Type-locality: Northfield, Birmingham.

King W.W., 1893, pp.25-37. Compared in age with the Clent Breccia; above the Precambrian or Carboniferous and below the Pebble Beds. Quartzite breccia.

Wills L.J. and Shotton F.W., 1938, p.181. Quartzite Breccia, above Carboniferous and Precambrian beds and below the Trias. Similar to the Clent Breccias. Tessall Lane, Northfield, Birmingham.

Wills L.J., 1976, pp.28, 29. Local base of the Trias. [Possible confusion here between Wills' Northfield Breccia and his Tessall Lane Breccia ?]

NORTH MARSDEN BAY LIMESTONE.

Permian, Zechstein.

Type-locality: North Marsden Bay and off the Durham Coast.

Magraw D., 1975, pp.397-414. Above the Velvet Bed Limestone and Breccias and below the Upper Magnesian Limestone, part of the Middle Magnesian Limestone. 0-122 m thick.

Magraw D., 1978, p.161, these beds considered to be the lateral equivalent of the Hartlepool Anhydrite.

NORTH TAWTON LAVAS.

Permian, ?Rotliegende.

Crediton Valley, see: Exeter Volcanics.

***NORTHWICH HALITE FORMATION.**

Trias, Mercia Mudstone Group.

Type-locality: Meadow Bank Mine, I.C.I.Ltd, Winsford, Cheshire. Wilkesley Borehole SJ 6286 4144; southern part of the Cheshire Basin.

Warrington G. et al. 1980, pp.34, 60, table 4, cols. 9, 10. Within undifferentiated Mercian Mudstone Group, below the Wilkesley Halite Formation; new name for the Lower Keuper Saliferous Beds; up to 290 m thick.

***NOTTINGHAM CASTLE FORMATION.**

Trias, Sherwood Sandstone Group.

Type-locality: Nottingham Castle Rock, SK 569394. Many quarries and natural exposures from Nottingham to Doncaster.

Warrington G. et al. 1980, table 4, cols. 23-25, 27, pp.50, 61. Top formation of the group, above the Lenton Sandstone Formation and below the Woodthorpe or Retford Formations (Mercia Mudstone Group); renamed Bunter Pebble Beds of eastern England. Red-brown medium to coarse sandstones with scattered pebbles; marl beds and marl clasts not uncommon; up to 300 m thick. [Type locality has uncharacteristic buff coloured pebbly sandstones.]

!NOTTINGHAM GROUP.

Trias, Mercia Mudstone Group.

Type-locality: Throughout Nottinghamshire, Lincolnshire and south Yorkshire.

Balchin D.A. and Ridd M.F., 1970, pp.91, 100, pl.14. Renamed Keuper Series including the Formations of Elliott 1961—(Woodthorpe, Waterstones, Radcliffe, Carlton, Harlequin, Edwalton, Trent and Parva.), plus the Regional Gamma Ray Marker.

Warrington G. et al. 1980, p.51, reject term [presumably because of the absence of a type-locality and Nottingham situated more on the Sherwood Sandstone Group; replaced by Mercia Mudstone Group ?]

NYNEHEAD SANDSTONE.

?Trias, New Red Sandstone.

Type-locality: Milverton, north Devon.

Laming D.J.C., 1968, pp.23-25, fig. 1. Above the Milverton Conglomerate and below the Upper Marls. [Similar age to the Otter Sandstone.?] Warrington G. et al. 1980, table 4, col.17, as 'Nynehead Sandstone' thin, p.44-45, not given formal formation status, 'not a mappable unit'.

ODDICOMBE BRECCIAS.

?Permian, New Red Sandstone.

Type-locality: Oddicombe Beach, Torquay, SX 926660, south Devon.

Laming D.J.C., 1966, tables 1 and 2. Limestone breccias and sandstone, 350.5 m.

Laming D.J.C., 1968, pp.23-25, fig.1, above the Watcombe Beds and below the Teignmouth Breccias or Ness Beds, ?Upper Carboniferous.

Smith D.B. et al. 1974, table 6, col.26, above the Watcombe Formation and below the Netherton ? Formation or Ness Formation, 350 m, thick, Lower Permian.

Selwood E.B. et al. 1984, pp.91-3, 102, ?late Carboniferous, Lower Permian, above the Watcombe Breccia below the Netherton Breccia. Contains large clasts of Devonian limestone as well as those of sandstone and slate. Matrix haematite stained silty sand. Cross-bedded sandstones and sandstone dykes occur locally. No thickness is given.

***ORMSKIRK SANDSTONE FORMATION.**

?Trias, Sherwood Sandstone Group.

Type-locality: ?North of Ormskirk, Lancashire.

?Inst. Geol. Sci. UK. 1980? NERC. 1:50 000 Geology Map, Ormskirk, explanatory notes.

Warrington G. et al. 1980, p.32, name replaces: Keuper Sandstone, Helsby Sandstone Formation, for this area. [Ormskirk map and memoir not yet published, 1987]

OSTREA BEDS.

(*Ostraea* Beds.)

See: Pre-*planorbis* Beds.

***OTTER SANDSTONE FORMATION.**

Trias, Sherwood Sandstone Group.

(Otter Sandstone.)

Type-locality: Mouth of the River Otter, east of Budleigh Salterton, base at SY 0632 8162, south Devon Coast.

Henson M.R., 1970, (p.175). Above the last cobble bed of the Budleigh Salterton Pebble Beds or the last ventrifact layer and below the Upper Marls. Replaces Upper Sandstone and Marl (Ussher 1876) and Otter Sandstone (Laming 1968.) A number of medium-grained micaceous sandstone members rarely cemented, thin and impersistent silt and clay lenses, impersistent; sandstones with large and small scale cross-stratification, desiccation cracked mud lenses, cut and fill channel lenses, small gravel horizons.

Laming D.J.C., 1968, pp.23-25, fig.1, Upper Sandstone and Marl of Ussher replaced by Otter Sandstone; above Budleigh Salterton Sandstone (Fm) and below Upper Marls.

Walker A.D., 1969, describes *Rhynchosaurus* from this unit.

Warrington G., 1971, pp.307-314, reviews the fossils.

Paton R.L., 1974, pp.253-289, redescription of the vertebrates.

Warrington G. et al. 1980, p.43, table 4, col.18, upper part of the Sherwood Sandstone Group of Devon. Anisian on fossil evidence; 118 m thick.

Selwood E.B. et al. 1984, pp.91, 92, 97-98, 107, cross-bedded uncemented sandstones with intercalated mudstone and conglomerate east and west sides of the Otter River; muscovite abundant, 118.8m thick.

Bristow C.R. et al., 1985, p.61 et seq. records a thickness of 143 m.

PAIGNTON BRECCIAS.

?Carboniferous, ?Permian, New Red Sandstone.

Type-locality: Marldon Road Quarry, Paignton, south Devon, SX 883610.

Laming D.J.C., 1966, table 1, p.943. Part of the Marldon Group, above the Livermead Beds, local top of the New Red Sandstone; possibly the lateral equivalent of the Chelston Breccias. Massive limestone breccia with sandstone interbedded near the top, 91.4 m thick.

Laming D.J.C., 1968, pp.23-25, fig.1, approximately equivalent in age to the Watcombe Beds or Vicarage Hill Beds; Tor Bay area.

!PALAEOTRIAS.

?Trias, Sherwood Sandstone Group.

Termier H. and Termier G., 1952. Chronostratigraphical term for the Lower Trias, the Buntsandstein.

Wills L.J., 1970, p.227, first use of the term in the British area; considered to be the equivalent of the Scythian, Bunter.

!PARVA FORMATION.**Trias, Mercia Mudstone Group.**

Type-locality: Glen Parva, 4 miles south of Leicester, and Wolds Hill Brick-pit, south of Cotgrave, and Fox Holes Borehole, Owthorpe.

Elliott R.E., 1961, pp.200, 222-223. Top formation of the Keuper Series, above the Trent Formation and the Windmill Skerry and below a non-sequence and sharp boundary at the base of the Rhaetic. The base is below the last occurrence of fish remains and below a prominent green bed including salt pseudomorphs; comprises the previous Tea Green Marls and a metre or so of red and green marls below, of the area. Mainly green-grey mudstones without lamination but with limonite spherulites and pyrite, no gypsum. The formation contains fish remains (scales) and at the base laminated red mudstones and salt pseudomorphs.

Balchin D.A. and Ridd M.E., 1970, pp.91-101, pl.14, include the formation in their Nottingham Group.

Warrington G. et al. 1980, table 4, cols.11, 23, pp.58, allocates the lower part of the formation to the Glen Parva Formation and the upper part to the Blue Anchor Formation. Area of occurrence extended into Derbyshire and Staffordshire. (Needwood Basin.)

!PASSAGE BEDS.**(1) Trias, Upper. (2) Permian, Zechstein.**

Type-locality: West Midlands.

Butler A.J. and Lee L., 1943. Keuper Series, above the Keuper Sandstone and / or Waterstones and below the Keuper Marls. Usually logged in borehole records as the basal beds of the Keuper Marl. Interbedded (red) sandstones and marls, marls variously coloured.

Wills L.J., 1976, pp.38, 102, 108, 120, lower part of miocyclothem KMI, top of the Keuper Sandstone to the base of the Keuper Marls; 6.1-9.1 m thick.

Magraw D., 1975, pp.402, 403; 1978, p.161, beds above the Marl Slate and below the Lower Magnesian Limestone, 2.4 m, Permian, Zechstein.

Smith D.B., Harwood M.G., Pattison J. and Pettigrew T., 1986, pp.13, consider that the junction between the Marl Slate and their Raisby Formation (Lower Magnesian Limestone) is not gradational and Magraw's term should be abandoned.

!PEBBLE BEDS.**?Permian, ?Trias, Sherwood Sandstone Group.**

(Conglomerate Sub-division, Pebble Bed Group.)

Type-locality: Midland counties of England: Bridgnorth, Newport, Market Drayton, Cannock Chase, Cheadle, Leek, Ashbourne, Nottingham, Sherwood Forest; Shrewsbury to Holt (Cheshire), Wirral, Liverpool, Manchester.

Hull E., 1960, pp.22-34; 1869, pp.10, 44. Also as Conglomerate Division, typically between the Lower, and Upper Red and Mottled Sandstones, middle division of the British Bunter, harder [than the Lower Mottled Sandstone ?] reddish brown sandstone with quartzose pebbles passing into conglomerates, in places with a basal calcareous breccia if the Lower Mottled Sandstone is absent and Pebble Beds rest directly on older rocks.

Wills L.J., 1948, referred to as Pebble Bed Group, Lower Trias; calcareous breccia as Clent Group.

Wills L.J., 1970, p.228, Pebble Beds as City Road Beds, Lower Wildmoor Beds, macrocyclothem BSIIA BSIIIB, BSIII; calcareous breccia as Quartzite Breccia BSI.

Warrington G. et al. 1980, table 4, part or all of the Sherwood Sandstone Group. Introduces new locality names: Cannock Chase, Chester, Kidderminster, Nottingham Castle, Polesworth, Budleigh Salterton, Milverton, and Uffculme, Pebble Bed Formations. Calcareous breccias separated as Clent Breccias, Quartzite Breccia etc.

!PECTEN LIMESTONE.**Trias, Penarth Group.**

(Upper and Lower *Pecten* Limestones.)

Type-locality: Bristol District.

Short A.R., 1904, pp.171-179, 184. Above the Black Shales below the *Naiadites* Beds. P.179, Upper and Lower *Pecten* Limestones separated by 2.4 m of Black Shales at Aust. [Now considered as part of the Westbury Formation.] Two or three bands of shelly limestone with *Pecten valoniensis*, separated by black shales, beds up to 254 mm in thickness.

Kent P.E., 1968, pp.174, 176, part of the Black Shales (Westbury Beds?), near the top, below the Cotham Beds. Dark argillaceous limestone varying from nodular to bedded and shelly, characterised particularly by *Pecten (Chlamys) valoniensis*, thin.

Warrington G., 1974a, p.157, thin nodular grey limestone in the Westbury Beds of Nottinghamshire.

PEEL SANDSTONES.

?Carboniferous, ?Permian, ?Trias, New Red Sandstone.

Type-locality: North east of Peel, north Isle of Man.

Boyd-Dawkins Sir. W.B., 1895, pp.592-593. Permian, above the Ordovician slates and sandstones and below the magnesian conglomerates—the Slack Conglomerate and Breccias; p.596, age based on lithological comparison with similar lithologies in north-west England and north-east Ireland. Fine-grained dark red sandstones mottled grey, reddish grey and buff; sometimes coarse grained with thin and irregular conglomerates; false bedded, ripple marks and thin layers of red marl; estimated thickness, 130 m.

Conybeare W. and Phillips J., 1822, frontispiece map shows these rocks as New Red Sandstone.

Lamplugh G.W., 1903, p.263, faulted against Manx Slates; considers these sandstones to be Carboniferous, red and mottled sandstones with partings of red marl, bands of pebbly conglomerate and lenticles of concretionary limestone.

PEGMATITANHYDRIT.

Permian, Zechstein.

(Pegmatite Anhydrite.)

Rhys G.H., 1974, table 2, fig.3. Shell/Esso well 49/26-4, southern North Sea. Z4, above the Roter Salzton, below the Aller Halite; same age as the Upper Anhydrite [now Sherburn Formation] and Upgang Formation of east Yorkshire. Anhydrite, red and pink in type-section well but grey with coarse halite crystals pseudomorphing gypsum elsewhere; 1-2 m in thickness.

Smith D.B. et al. 1974, table 3, col.20, as Pegmatite Anhydrite, above the Red Salt Clay and below Salt IV, Leman Gas Field; col.35, Z4, Aller Series.

***PENARTH GROUP.**

Trias.

(Penarth Beds, Penarth Series.)

Type-locality: Penarth Head and St. Mary's Well Bay and near Lavernock Point, south Glamorgan. Generally throughout the British Isles.

Bristow W.H., 1864, p.104, Rhaetic. [Paper read by Murchison R.I.].

Bristow, W.H. and Dawkins Sir. W.B. 1864, pp.236-239. [Abstr.?.]

Etheridge R., 1872, pp.39, 41, 46-64; also as Penarth Series. Top of the Red Marls to bottom of the *Ostrea liassica* Limestone. Black shales with interstratified sandstones, impure limestones, bone-beds etc; up to 30.5 m.

Warrington G. et al. 1980, table 4, cols.2-4,10-14, pp.13-15, 41, as Penarth Group. Above the Mercia Mudstone Group below the *Psiloceras planorbis* Zone of the Lias, includes the Westbury and Lilstock Formations. Argillaceous, calcareous and locally arenaceous formations of predominantly marine origin.

PENRITH BROCKRAM.

?Permian.

Type-locality: Kirkby Stephen and River Eden, Westmorland.

Burgess I.C., 1965, pp.91-101; p.93. Lower Permian, upper part of the Penrith Series; formerly known as Rotten Breccia, or Upper Brockram. Brockram 0-30.5 m, blocks of reddened sandstone and chert in a red sandstone matrix of Penrith Sandstone type.

***PENRITH SANDSTONE.**

?Permian, ?Rotliegende.

(Penrith Formation, Penrith Series, Copper Red Sandstone.)

Type-locality: Penrith, Westmorland. Generally around the Carlisle Basin.

Murchison R.I. and Harkness R., 1864, pp.148-154. Above Carboniferous or older beds, below red mudstones, Middle Permian; renamed Inferior Sandstone or Lower Red Sandstone of Sedgwick 1832. Thick mass of rocks, usually red in colour with Breccias (Brockram) at the base succeeded by red sandstones and at the top, Rotten Breccias (Upper Brockram). Sandstones made up of quartz crystals which retain facets of the original quartz crystal, coarse, fine-grained breccia, some white beds, 610 m in thickness. New Red Sandstone, including the Lazonby Stone.

Hickling G., 1909, pp.1-30, compares footprints with those from Mansfield, Nottinghamshire.

Sherlock R.L., 1926, p.30, as Copper Red Sandstone, includes secondary quartz and footprints; top of the Lower New Red Sandstone, Permian, north-west England; Part of the New Red Series.

Burgess I.C., 1965, p.93, as Penrith Formation, Penrith Series which includes the breccias (Brookrams) and Cherty Rock. [Lazonby Stone.]

Smith D.B. et al. 1974, table 3, col.10, local base above Brookram ?450 m in thickness; Vale of Eden area.

Arthurton R.S., Burgess I.C. and Holliday D.W., 1978, p.200, Vale of Eden, below the Hilton Plant Beds, includes the Brookram; pp.190-192, Appleby-Hilton area, 400+ m, medium- or coarse-grained reddish-brown sandstone, frosted quartz grains, large scale cross-bedding, aeolian origin, winds from the east or south-east, footprints. Includes the Lazonby Stone, quartz cemented upper layers.

Arthurton R.S. and Wadge A.J., 1981, pp.3, 30, 68, 105-107, 129, 134, 139, 142, 148, 156-7, 159 for the latest description from the type area.

***PERMIAN.**

Upper Palaeozoic.

Type-locality: area east of the R. Volga; gypsum beds of Arzames, Kazan, rivers Piana, Kama and Oufa; salt beds of Solikamsk, Sergrefsk, Tletsch, all Orenbourg Government Department, province of Perm, Russia.

Murchison R.I., 1841, pp.417-22. Above the Carboniferous, below the Trias. Mainly red beds; Marls, schists (sic.), limestones, sandstones, conglomerates.

Murchison R.I., Verneuil E. and Keyserling A., 1845, pp.137-170, applies the term to British rocks, comprising the Lower New Red Sandstone.

King W.W., 1850 description of Permian fossils from north-east England.

Murchison R.I., 1854, pp.289-316, lower part of the British New Red Sandstone, above the Coal Measures, below the Trias.

Likharev B.K., 1966, subdivides Permian into marine stages- Asselian, Sakmarian, Artinskian, Kungurian-Lower Permian; Ufimian, Kazanian, Tatarian-Upper Permian. Rotliegende and Zechstein respectively ?.

Smith D.B. et al. 1974, subdivision of marine rocks as Likharev 1966, marginalbasinal areas as Germany-Rotliegende and Zechstein, continental areas ?Permian, ?New Red Sandstone, Lower.

PERMIAN BASAL BRECCIA.

?Permian, ?Zechstein.

Type-locality: Grives Wood and at Kimberley, Nottingham.

Aveline W.T., 1862, p.11, as conglomerate below the Magnesian Limestone. [Above the Coal Measures.] Brecciated calcareous conglomerate containing pebbles of chert, quartz and sandstone, 0.3-0.6 m in thickness.

Aveline W.T., 1880, as above but on p.12, refers to the Breccia.

Wilson E., 1881, pp.122-3, rock extends over 400 square miles.

Gibson W. 1908, pp.103-4, best seen L.M.S.Rly. cutting, Kimberley.

Swinerton H.H., 1948, up to 2.44 m thick in the Mansfield area.

Taylor F.M., 1965, p.184, as Basal Breccia, above Coal Measures, below Dolomitic Siltstones or Permian Lower Marl.

Edwards W.N., 1967, pp.120-121, as Basal Permian Breccia.

Smith D.B. et al. 1974, table 3, col.14, as breccia.

PERMIAN BASEMENT BEDS.

Permian, ?Zechstein.

Type-locality: Kimberley, Nottinghamshire.

Lamplugh G.W. and Gibson W., 1910, p.26. Base of the Nottinghamshire Permian beds, above Coal Measures, comprising the Basal Breccia and Marl Slate [Permian Lower Marl]; below the Magnesian Limestone. [Constituent terms now generally used.]

***PERMIAN LOWER MARL.**

Permian, Zechstein.

(Lower Permian Marl, Grey Beds, Grey Marl, Grey Shale.)

Type-locality: southern Yorkshire. [Extends south into north Nottinghamshire, to Kimberley; also adjoining parts of north Derbyshire.]

Edwards W.F., Mitchell G.H. and Whitehead T.H., 1950, pp.3, 36, 82, as Lower Permian Marl. Between the Marl Slate or Yellow Sands or Carboniferous Deposits and the Lower Magnesian Limestone. Yellow or grey marls and marly limestone with a basal bed of hard sandy limestone, m or so; p.82, 3.1 m.. Lithology and fauna distinct from the Marl Slate; plant remains dominant.

Wilson E., 1876, fig.1, p.535, as Lower Permian Sandstone, Shales, Lignite and Limestone.

Wilson E., 1881, possibly referred to as Marl Slate ? not listed pp.100, 121-124, but original reference for the Middle and Upper Permian Marl!

Sherlock R.L., 1926, p.12, referred to as 'Marl Slate', grey shales with limestone (not magnesian) sands and breccia; p.12, 14 as Grey Beds.

Edwards W., 1951, pp.97, 198, 199. Attributes the term to Gibson and Hill, 1921-2 who used the term (Lower Permian Marl) on six-inches to one mile maps Derbyshire 19, 26, 31. Soft grey marls with abundant marine fauna and may show traces of galena. Up to 30.5 m in the Mansfield area; marginal facies includes siltstones, purple, brown or grey with abundant plant remains, from Cinderhill to Burton Joyce, Nottinghamshire.

Smith D.B., 1974, as Permian Lower Marl in part lateral equivalent of the lower part of the Lower Magnesian Limestone of mid-east Yorkshire above the Basal Breccias and below the Lower Magnesian limestone.

Smith D.B. et al. 1974, table 3, col.14, as Lower Marl, p.18 as Permian Lower Marls on spore evidence slightly younger than the Marl Slate of Yorkshire, above the basal breccia and below the Lower Magnesian Limestone, central Yorkshire and north Nottinghamshire, 0-50 m thick.

[This unit is not normally recognised north of central Yorkshire, it was included as Marl Slate by Sedgwick 1829 and later authors but recognised as a distinct unit by Wilson 1876 and later authors; The nonsense of the terminology (Lower Permian Marls of Upper Permian age) was recognised by Sherlock R.L. 1926 and again by Edwards W.N. 1967 and corrected by Smith D.B. 1974 and Smith D.B. et al 1974 in both papers beginning to introduce alternative geographically based nomenclature.]

Smith D.B., Harwood G.M., Pattison J. and Pettigrew T., 1986, pp.10, a facies of the Wetherby Member, Cadeby Formation.

!PERMIAN MARL.

Permian, Zechstein.

Type-locality: Bulwell area of Nottingham.

Lamplugh G.W., Gibson W., Sherlock R.L. and Wright W.B., 1908, p.9, 28. Above the Magnesian Limestone and below the Lower Mottled Sandstone, formerly referred to as Red Marl or by Wilson as Upper Permian Marls and Calcareous Sandstone. Red Brown Marls with hard thin dolomitic sandstones.

Smith D.B. et al. 1974, table 4, col.14, as Permian Middle Marls.

***PERMIAN MIDDLE MARLS.**

Permian, Zechstein.

(Middle Marl, Middle Marls, Middle Permian Marls.)

Type-locality: Yorkshire.

Wilson E., 1881, pp.100, 191, as Middle Permian Marls or Middle Marl(s); pl.VIII as Middle Permian Marl and Sandstone. Between the Lower and Upper Magnesian Limestone. Red brown marls with thin dolomite seams, 9.1-15.2 m thick.

Smith D.B. et al. 1974, table 3, col.14, central Yorkshire and north Nottinghamshire, between Lower and Upper Magnesian Limestone, 2-62 m, including anhydrite at the base and the Harworth Breccia close to the top; col.15, south Durham between the Lower Magnesian Limestone and the Seaham Formation, 3-50 m, lithologically subdivided; possible lateral equivalent of the Hayton or Hartlepool Anhydrite, Kirkham Abbey Formation and Fordon Evaporites (top), east Yorkshire and the southern North Sea.

Smith D.B., Harwood G.M., Pattison J. and Pettigrew T., 1986, pp.15, Unit renamed as the Edlington Formation.

!PERMIAN SERIES.

Permian System.

Type-locality: Midland counties of England.

Hull E., 1869, p.10. Lower and Upper Permian, including the Lancastrian and Salopian Permian.

***PERMIAN UPPER MARLS.**

Permian, Zechstein.

(Upper Permian Marl(s), Upper Permian Marl and Calcareous Sandstone, Upper Marls Upper Marls.) See also: Brotherton Beds.

Type Locality: Yorkshire.

Wilson E., 1881, pp.100, 188, as Upper Permian Marl or Upper Red Marl(s). Plate VIII as Upper Permian Marl and Calcareous Sandstone. [?Synonym of Brotherton Beds, Green 1872.] Red marls with thin dolomite seams.

Versey H.C., 1925 B, pp.215-225, as Upper Marl. [Presumably this was in conformity with the Durham area and Woolacott 1912.]

Smith D.B., 1974, p.116, as Permian Upper Marls, including the Uppang Formation and Upper Anhydrite in central Yorkshire; in mid-east Yorkshire above the Upper Anhydrite; generally above the Upper Magnesian Limestone and below the Lower Mottled Sandstone. [The complexity of this term can be seen by comparison with the next publication published in the same year, and Magraw 1978, below.]

Smith D.B. et al. 1974, table 3, col.12 east Irish Sea basin, above evaporite beds and below the St. Bees Sandstone; col.14, central Yorkshire and north Nottinghamshire above the Upper Magnesian Limestone and below the Lower Mottled Sandstone; col.15, south Durham above the Seaham Formation below the Sherwood Sandstone (Group); up to 130 m thick. Includes various lithological subdivisions and the Billingham Main Anhydrite, Boulby Halite, Rotten Marl= Carnallitic Marl, Uppang Formation, Upper Anhydrite, ?Upper Halite, ?Sleights Siltstone, ?Top Anhydrite, ?Saliferous Marl. (top).

Magraw D., 1978, pp.157-184, table p.174, refers to the Upper (Permian) Marls off Durham and south Northumberland coast.

Smith D.B., Harwood G.M., Pattison J. and Pettigrew T., 1986, pp.16, unit renamed Roxby Formation.

PLAINS SKERRY.

Trias, Mercia Mudstone Group.

Type-locality: Mapperley Plains, Nottingham; southside of Gunthorpe Wier, East Bridgford; Thorneywood Brick Pit, SK 4596 3414; boreholes south Nottinghamshire generally.

Elliott R.E., 1961, p.218. Keuper Series, top of the Carlton Formation. Dolomitic siltstone or fine-grained sandstone, grey-green with thinly bedded alternating red marl. Distinguished on sedimentary characteristics-small and normal type ripple-marks, slump-structures and salt pseudomorphs and hopper structures.

Balchin D.A. and Ridd M.F., 1970, pp.91-101, pl.14, include the term as part of their Nottingham Group.

PLANT BEDS.

See: Hilton Plant Beds.

PLATTENDOLOMIT.

Permian, Zechstein.

(Platy Dolomite.)

Rhys G.H., 1974, table 2, fig.3. Shell/Esso well 49/26-4, southern north Sea. Z3, considered to be the lateral equivalent of the top part of the Upper Magnesian Limestone of Yorkshire. referred to also as the Platy Dolomite, 48 m in thickness.

Smith D.B. et al. 1974, table 3, col.20, Leman Gas Field, as Platy Dolomite, col.35, north-west Europe, as Plattendolomit, Z3 base, Leine Series, above grey salt clay and below Main Anhydrite.

POLESWORTH FORMATION.

?Trias, Sherwood Sandstone Group.

Type-locality: Polesworth, Warwickshire. East Warwickshire and west Leicestershire.

Warrington G. et al. 1980, table 4, col.14, pp.38, 61. Above ?Lower Permian Breccias or older rocks and below the Bromsgrove Sandstone Formation; renamed Bunter Pebble Beds of the area, 0-50 m thick.

PONTEFRACT ROCK.

?Upper Carboniferous.

See: Lexicon Fasc.3aVIII.

POLTIMORE MUDSTONE MEMBER.

?Permian, New Red Sandstone.

Type-locality: Poltimore, Exeter, Devon. (SX 966970)

Bristow C.R., 1983, p.9; Bristow C.R. et al., 1985. Upper part of the Dawlish Sandstone Formation, above the Belfield Sandstone and below the Broadclyst Sandstone Members. Red clay or sandy clay and clayey fine-grained sandstone, 15 m thick.

POSBURY LAVAS.

Permian, ?Rotliegende.

South of Crediton, Exeter, see: Exeter Volcanics.

POSCOMBE LAVAS.

Permian, ?Rotliegende.

South-west Exeter, see: Exeter Volcanics.

***PREESALL HALITE FORMATION.**

Trias, Mercia Mudstone Group.

(Preesall Salt.)

Type-locality: Between Preesall and the River Wyre, Lancashire. ?Boreholes north of Blackpool, eg. Coat Walls Farm, Leny Hall, Morecombe Bay.

Thompson F.J., 1912, pp.105-106, gives a short description.

Sherlock R.L., 1921, pp.72-80, describes rock salt at Preesall.

Evans W.B., 1970, pp.110-112, as Preesall Salt. Keuper Marl, within the Kirkham Mudstones. Rock Salt and mudstone.

Evans W.B. and Wilson A.A. 1975, referred to in the marginal notes as Preesall Salt Formation, dominantly halite with few mudstone partings, maximum thickness 185 m thinning to the south; collapse breccia in central area. [Memoir not yet published, 1987.]

I.G.S. 1975, p.13, 4.47 m (top only) recorded in the Coat Walls Farm borehole.

Eastwood T. and Evans W.B. 1976, top of the sequence, locally known as the Biggar Salt, 100 m, brecciation.

Warrington G. et al. 1980, table 4, col.8, as Preesall Halite Formation, 0-200 m thick.

!PRE-PLANORBIS BEDS.

Trias, ?Penarth Group.

(*Ostrea* Beds.)

Type-locality: ?Westbury-on-Severn, Gloucestershire.

Richardson L., 1904. Lias, base above Black Shales, below Blue Lias with *Psiloceras planorbis*. Limestone with *Ostrea liassica*.

Warrington G. et al. 1980, p.45, below the *Psiloceras planorbis* Zone, therefore Triassic, included in the Lilstock Formation.

!PROTOBUNTER.

?Permian, ?Trias.

Type-locality: Central Midlands.

Wills L.J., 1976, pp.27, 32, 33. Permo-Trias, nearer to the Trias, hence Protobunter, above the Bridgnorth Dune Sandstone and below the Shingle Beds; includes the Quartzite Breccia, Longbridge Sandstone, Tessall Breccia, Southalls Sandrock, High Habberley Breccia, Bellington Breccias and ?Hopwas Breccia. Sandy breccias, conglomerates usually of local development.

QUARELLA STONE.

Trias, ?Penarth Group.

Type-locality: Quarella Quarries, West Glamorgan.

Strahan A. and Cantrill T.C., 1904, pp.51, 52. Above the Black Shales and below clayey limestones and Cotham Stone; renamed Upper Sandstone (Tawney 1866, Tucker 1977) or as Upper Rhaetic (Richardson 1911). Hard and soft white and pale green sandstone with a little red mottling; about 10.7 m in thickness.

Francis E.H., 1959, p.160 et seq. Description of the rock and the contained bivalves and gastropods.

Warrington G. et al. 1980, p.48, Penarth Group, Lilstock Formation; local arenaceous development in the Lilstock Formation, not included in table 4, col.16.

QUARTZITE BRECCIA.**?Permian, New Red Sandstone.**

Type-locality: Nechells Borehole, 115.8-140.2 m, east side of Birmingham.

Boulton W.S., 1933, pp.63-64, 78-79, probably as a lithological term in this paper. Base of the Bunter, above the Nechells Breccia and below Pebble Beds. Possible erosion surface above the Quartzite Breccia. Loose sandstone with large angular (Cambrian, Lickey) quartzite blocks, 2.1-30.5 m in thickness.

Wills L.J., 1948, pp.70-72, 74, 79; possibly the first stratigraphical use of the term.

Smith D.B. et al. 1974, table 3, col.24, south Staffs. coalfield area, 30+ m thick; similar in age to the Bridgnorth Dune Sandstone.

Wills L.J., 1976, pp.27, 28, 29-33, 77, 87-98, [as a general group name?]; Protobunter sandstones with large angular fragments of Cambrian Quartzite, may interdigitate with Shingle Beds, but usually below. May be difficult to find sharp junctions with Permian Breccias below or Pebble Beds above. Similar in age to Tessell Lane Breccia and Longbridge Sandstone.

QUARTZITE SHINGLE BEDS.**?Permian, New Red Sandstone.**

See: Shingle Beds.

QUESLETT SHINGLE BED.**?Permian, New Red Sandstone.**

See also: Shingle Beds.

Type-locality: Queslett, Birmingham, also at Rubery, Barr Beacon, Sutton Park.

Wills L.J., 1970, p.228, fig.1. [name only] Bunter ?Permian, above Quartzite Breccia and below Pebble Beds.

Boulton W.S., 1933, pp.53-83, possibly the first description but considers the deposit to be the basal part of the Pebble Beds.

Wills L.J., 1956, pp.110-113, fig.17, as one of a number of basal [to Pebble Beds] shingle beds.

Wills L.J., 1976, pp.28, 36, 75, 77, marker horizon base of BSI macrocyclothem base of the Pebble Beds [City Road Beds.]. 9.1 m thick at Queslett but up to 40.8 m recorded in boreholes [ICI no.27g] Small quartzite pebbles in loose sandstone.

!QUICKSAND.**?Permian.**

Type-locality: North Yorkshire; West Garforth (Leeds), Glass Houghton (Castleford), Scriven (Knaresborough), Conisbrough, Shireoaks Colliery Shaft.

Wilson E., 1881, pp.97-101. Above reddened Coal Measures and below the Lower Magnesian Limestone or Marl Slate, ?Lower Permian. White or yellow cross-bedded sandstone, unconsolidated.

Lebour G.A., 1886, named lithologically as the Yellow Sands.

RADCLIFFE FORMATION.**Trias, Mercia Mudstone Group.**

Type-locality: Lower half of the section at Radcliffe river cliff, a few yards north of a right-angled bend of the river Trent, SK 4646 3398; also in the cutting below the main floor of Dorket Head brick pit, Arnold, old Colwick Wood Quarry, SK 4600 3397, and boreholes at Barleigh, Leahurst and Lees Barn.

Elliott R.E., 1961, p.216. Keuper Series, above the Waterstones and below the Carlton Formation. Well bedded 'platy appearance' to the red shales, varved, laminae common, some massive mudstones, pink tints, hopper outlines, miniature ripples, 'waterstone' lithology in the lower part; general absence of dolomite, slip layers, hopper and salt pseudomorphs, about 12.2 m thick.

Balchin D.A. and Ridd M.F., 1970, pp.91-101, pl.14, part of their Nottingham Group; regional gamma ray log marker at the top, traceable in Nottinghamshire, Lincolnshire, and Yorkshire.

Warrington G. et al. 1980, table 4, cols. 11, 23-24, extends the occurrence of the Formation into the central Midlands; part of the Mercia Mudstone Group. up to 13 m thick.

RADDON LAVAS.**?Rotliegende.**

Edwards R.A. 1984, pp.51-55, from Raddon Quarry, Exeter, interbedded with the Thorverton Sandstone.

See: Exeter Volcanics.

!RAILWAY QUARRY SANDSTONES.

?Trias, Sherwood Sandstone Group.

Type-locality: 0.5 mile north of Caspidge Farm, ?Worcestershire, SO 985710. Also between 222.2 m and 241.1 m in the Sugarbrook Borehole.

Wills L.J., 1976, p.117. Part of the Basement Beds Group, Bromsgrove Regional Stage. Massive brown sandstone with calcareous pellet rock layers.

RAISBY (MAGNESIAN LIMESTONE) FORMATION.

Permian, Zechstein.

(Raisby Formation)

Type-locality: Raisby Quarries, County Durham, NZ3435. Elsewhere in County Durham, Tyne and Wear, Cleveland and northernmost Yorkshire.

Smith D.B., Harwood G.M., Pattison J. and Pettigrew T., 1986, pp.13, 14, table 1. EZ1aCa, above the Marl Slate and below the Ford Formation. Renamed Lower Magnesian Limestone of the above area and lateral equivalent of the Wetherby Member (Cadeby Formation) of Yorkshire. Cream, brown and grey fine-grained dolomite but with thick grey fine-grained limestone in the lower part, medium to thick-bedded and only slightly fossiliferous in the upper half where overlain by oolitic dolomite of the Ford Formation; abundant replacive gypsum and anhydrite in the subsurface with some slumping; bioturbation in the lower part; generally from 20-50 m thick, 73 m in eastern Durham. Fossils include *Agathammina pusilla*, *Horridonia horrida* and *Bakevellia binneyi*.

RED AND VARIEGATED MARLS WITH MAGNESIAN LIMESTONE.

Permian, Zechstein.

Binney E.W., 1839, pp.37, 44-47, see: Manchester Marls.

!RED EARTH AND OCHRE.

New Red Sandstone.

Type-locality: [Somerset ?]

Strachey J, 1719, p.968. Between Coal Clives and Yellow Earth [Coal Measures and Oolitic Limestone ?]

Buckland W. and Conybeare W.D., 1822, pp.211, referred this term to the Newer Red Sandstone.

!RED GROUND.

New Red Sandstone.

Smith W., 1815, named on the map. Rocks between the Carboniferous and Lyas (sic.) synonym of Red Earth and Ochre, in part.

Winch N.J., 1817, pp.1-101, referred this term to the New Red Sandstone.

!RED-LAND LIMESTONE.

Permian.

Type-locality: North-east England.

Smith W., 1821, named on the map.

Sedgwick A., 1829, pp.37-124, referred the term to the Yellow Magnesian Limestone.

!RED MARLS.

Permian or Trias, New Red Sandstone.

(Red Marl, Red Marle, Red Marl and Sandstone, New Red Marls.) See also: New Red Marl.

Type-locality: None given; ?subsequent designation by Buckland and Conybeare 1822. South-west Coal District. [Gloucestershire, Glamorganshire, Monmouthshire]

Smith W. 1815, named on the map.

Conybeare W.D. and Phillips W., 1822, p.278, as Red Marle. From the Tees in Durham to the southern coast of Devonshire. Reddish marle or clay; sandstone occasionally calcareous; contains masses of gypsum and the great rock salt formation of England. Also referred to as Red Ground and Red Rock.

Winch N.T., 1817, pp.1-101, referred to also as Red Marl and Sandstone.

Buckland W. and Conybeare W.D, 1822, pp.210-316, as Red Marls and Newer Red Marls. Between the Red Sandstone and the Lias, Upper New Red Sandstone. Red marl becoming green at the top, nodules, gypsum, strontian sulphate.

Hull E., 1869, p.10, as New Red Marl of the Keuper.

Warrington G. et al. 1980, renamed in part, Mercia Mudstone Group.

[Confusion on use of the term lithologically and stratigraphically.]

!RED MARL, SANDSTONE AND CONGLOMERATE.

?Permian, ?Trias, New Red Sandstone.

Type-locality: South Devon coast, Axmouth, Sidmouth to Babbacombe Bay, Torquay.

Beche de la H.T., 1822, pp.40-47; p.46-47. Beds below the Lias.

Conybeare W.D. and Phillips W., 1822. Referred to the New Red Sandstone.

!RED ROCK.

See: Red Ground or Red Marl(e).

!RED SALT CLAY.

Permian, Zechstein.

See: Roter Saltzton.

!RED SANDSTONE.

Permian, Trias, New Red Sandstone.

Type-locality: Chew Stoke, Chew Magna, Bristol.

Buckland W. and Conybeare W.D., 1822, pp.211, 297-298. Above the Dolomitic Conglomerate and below the Red Marl, part of the New Red Sandstone, middle section. Friable red, white or yellow sandstone or conglomerate, the latter with dolomite.

!RED SHALES.

Trias, New Red Marl.

Type-locality: Southern Arran.

Gregory J.W., 1915, pp.177-182, 186. Part of the Upper Division; above the Levenorroch Marls and below Greenish Grey Marl. Red Shales with green layers and thin sandstones, 18.3 m thick.

!RED UNDERLYER.

Permian, Rotliegende.

See: Rotliegende.

REGIONAL GAMMA RAY LOG MARKER.

Trias, Mercia Mudstone Group.

Type-locality: Boreholes in Lincolnshire and Nottinghamshire. Also stated (p.94) to be recognised in boreholes from north Yorkshire.

Balchin D.A. and Ridd M.F., 1970, pp.94, 96-97, fig.3, pl.14. At the top of the Radcliffe Formation or within undifferentiated Keuper Marl. Equated with the feather-edge development of the Muschelkalk. Distinctive Gamma Log Record.

Warrington G. et al. 1980, p.51, located within undifferentiated mudstones.

!REPTILIFEROUS SANDSTONES.

Trias, New Red Sandstone.

Type-locality: Elgin, Scotland.

Symonds W.S., 1860, pp.95-101. Red sandstones with reptile fragments, unconformable above Old Red Sandstone.

Harkness R., 1864, pp.429-443. Lower Trias, sandstones including Karroo reptiles remains.

Judd J.W., 1873, 1886 give further description of the Reptiliferous Sandstones of the Elgin area.

Traquair R.H., 1895, reptiles from Elgin.

Boulenger G.A., 1903, 1904 in part as *Gordonia* Beds and *Stagonolepis* Beds.

Huene F., 1910 in part as *Gordonia* Sandstones and *Stagonolepis* Sandstones.

Peacock J.D., Berridge N.G., Harris A.L. and May F., 1968, in part as Sandstones of Cutties Hillock and Hopeman.

Warrington G. et al. 1980, table 4, col.1, subdivided and renamed as Hopeman, Burghead, and Lossiemouth Sandstone Formations.

Benton M.J. and Walker A.D., 1985, p.216, redescribe these sandstones and their fauna as Burghead, Cutties Hillock, Hopeman, and Lossiemouth Sandstone Formations.

***RETFORD FORMATION.**

Trias, Mercia Mudstone Group.

Type-locality: Thrumpton Goods Yard, SK 710805, East Retford, Nottinghamshire.

Warrington G. et al. 1980, cols.24, 25, pp.51, 61. Local base of Mercia Mudstone Group, above the Nottingham Castle Formation (Sherwood Sandstone Group) and below the Colwick Formation or undifferentiated mudstones. Lateral equivalent of the Woodthorpe Formation. Mainly green-grey mudstones with thin conglomerate at the base.

Aveline W.T., 1861, 1879, initial description as soft blue sandstones and blue clays.

Lamplugh G.W., Hill J.B., Gibson W., Sherlock R.L. and Smith B., 1911, pp.4, 25-27, 33-35, 68, 71, now named as Green Beds (of the Waterstones.).

Swinerton H.H., 1918, pp. 16-28, considered the Green Beds to be part of the Keuper Basement Beds (of Nottinghamshire.).

Elliott R.E., 1961, pp.197-234, notes Swinerton's conclusions, but excludes these beds from his Woodthorpe Formation.

***RHAETIC.**

Trias.

(Rhaetian.)

Type-locality: Rhaetian Alps, Lombardy.

Buch L. von, 1828, p.82. Above the Keuper, below the Lias; 914-1219 m in thickness.

Moore C., 1861, p.495, first applies term to British rocks, the *Avicula contorta* Beds.

Bristow W.H., 1864, pp.236-9, introduces the term Penarth Beds for British rocks.

George T.N., 1969, pp.139-166. Recommends rejection of the term 'Rhaetic' as a lithostratigraphic term for British rocks; biostratigraphical term only.

Rhys G.H., 1974, table 3, southern North Sea Rhaetic rocks now mainly referred to as the Winterton Formation.

Warrington G. et al. 1980, pp.8-13, Rhaetic of British Isles not comparable lithologically with the type-locality; no diagnostic ammonites found. Vertebrates give a broad comparison; therefore Rhaetic lithological term replaced by Penarth Group having historic precedence, Rhaetian retained as a chronostratigraphic unit.

!RHAETIC BEDS.

See: Rhaetic Formation.

!RHAETIC BLACK SHALES.

Trias, Penarth Group.

(Rhaetic Black Shales and Limestone.)

See: *Avicula contorta* Beds, *Avicula contorta* Shales, or Black Shales.

!RHAETIC BONEBED.

Trias, Penarth Group.

Type-locality: Westbury-on-Severn and Aust, Gloucestershire.

Buckland W. and Conybeare W.D., 1822, p.301. Above the New Red Sandstone, base of the Lias. Thin beds of greenish siliceous grit with abundant bones and teeth of fish and reptiles occurring in black shales.

Short A.R., 1904, pp.170-193; pp.179-182. Base of the Rhaetic Series, may be absent. Pockets or layers of sandy pyritic sediment with vertebrate teeth and bones, scales. Up to 0.3 m thick, often only 50 mm.

Arkell W.J., 1933, writes that bonebeds occur commonly at various horizons within the Westbury Beds, including the base, and therefore the term is not strictly stratigraphical.

!RHAETIC FORMATION.

Trias, Penarth Group.

(Rhaetic Beds.)

Type-locality: sections in south Devon, Somerset, Gloucester and Worcestershire.

Moore C., 1861, p.495. Includes the White Lias and the *Avicula contorta* Beds (shales, group).

Bristow W.H., 1864, pp.236-239, prefers the term Penarth Beds.

Warrington G. et al. 1980, renames the unit Penarth Group.

!RHAETIC GREY MARL.

Trias, ?Mercia Mudstone Group.

Type-locality: Leicestershire.

Harrison W.J., 1876, pp.212-218. Below the base of the Black Shales, including the bonebed. Grey Marl with fish scales and an insect wing; marl beds are 4.9 m thick. [Sully Beds ?, Tea Green Marl ?]

!RHAETIC SANDSTONE MEMBER.

Trias, Penarth Group.

See also: Lower, and Upper Sandstone.

Type-locality: Conoco well no.49/21-2, southern North Sea.

Rhys G.H., 1974, table 3, pp.4-5, fig.5. Part of the Winterton Formation. Sandstone, white to light grey, very fine to medium-grained, slightly calcareous with beds of mudstone, light grey-green and light brown, 45 m thick.

Warrington G. et al. 1980, table 4, col.28.

[New term required for the lithostratigraphic unit.]

ROBGILL MARLS.

?Permian, ?Trias, New Red Sandstone.

Type-locality: Kirtle Bridge; Red Scar south of Palmersgill Bridge, Kirtle Water between Merkland and Cove; Robgill Bridge; all near Annan, Dumfriesshire.

Horne J. and Gregory G.W., 1916, pp.380-381. ?Trias, part of the Annan Sandstone Series, above the Allerbeck Sandstone and below the Woodhouse Tower Sandstone. Red mudstones and thin sandstones, up to 21.3 m thick.

Barrett B.H., 1942, p.169, considers that the Allerbeck Sandstone and the Woodhouse Tower Sandstone are the same formation and both can be correlated with the Lower part of the St. Bees Sandstone. Robgill Marls are therefore the same as the St. Bees Shales.

***ROGENSTEIN MEMBER.**

?Permian, ?Trias, Bacton Group.

Rhys G.H., 1974, table 3, fig.4, pp.4-5. Well no.49/21-2, southern North Sea. Top of Bunter Shale Formation. Mudstone, red and grey with beds of siltstone, red, a few thin beds of dolomite, buff to light grey, and a trace of anhydrite, white to transparent oolitic red calcareous, in pink to red silty calcite matrix mainly concentrated in two prominent beds in lower part; 103 m thick. [First reference for the British Isles area.]

Warrington G. et al. 1980, table 4, col.28. repeats this term.

ROKER (DOLOMITE) FORMATION.

Permian, Zechstein.

(Roker Dolomite, Roker Formation, Roker Limestone.)

Type-locality: Roker Sea Cliffs, Sunderland, NZ407592, (Smith D.B. et al. 1986).

Woolacott D., 1912, p.253). Alternative name for the Upper Magnesian Limestone or Upper Yellow Limestone or Upper Limestone. [See: Upper Magnesian Limestone of the Sunderland area.]

Trechmann C.T., 1925, pp.135-145, referred to as Hartlepool and Roker Dolomites.

Smith D.B., Harwood G.M., Pattison J. and Pettigrew T., 1986, pp.14, 15, table 1. Amended name for the Hartlepool and Roker Dolomite to allow single type-section and avoid duplication with Hartlepool (Anhydrite) Formation; EZ2Ca. Well bedded, small scale cross-bedding, sparsely fossiliferous cream

shallow water peritidal oolitic dolomite with subordinate beds of fine-grained dolomite. Thickness up to 80 m. Fossils includes *Schizodus obscurus*, *Liebia squamosa*, gastropods, ostracods and plant debris.

ROMSLEY GROUP.

?Permian, New Red Sandstone.

See also: Bowhills Group.

Type-locality: ?Romsley, Worcestershire/

Newall-Arber E.A., 1916, pp.36-42, 46-49. Above the Keele Series, below the Clent Group; new name for the Calcareous Conglomerate.

Whitehead T.H., 1922, p.171, as Enville Group. [Calcareous conglomerate not known at Romsley; see also Lexicon Fasc.3aVIII, p.287.]

***ROOSECOTE ANHYDRITE.**

Permian, Zechstein.

Type-locality: Roosecote Borehole, SD 230687, 3 km ESE of Barrow-in-Furness, 125 m-135 m; south Cumberland and north Lancashire.

Smith D.B. et al. 1974, table 3, col.11, p.39. Top part of the St. Bees Evaporites, Sulphate mineral usually anhydrite, 0-9 m.

***ROOSECOTE DOLOMITE.**

Permian, Zechstein.

Type-locality: Roosecote Borehole, SD 230687, 3 km ESE of Barrow-in-Furness, 135 m-136 m; south Cumberland and north Lancashire.

Smith D.B. et al. 1974, table 3, col.11, p.40. Upper part of the St. Bees Evaporites, below the Roosecote Anhydrite. Carbonate member, 0-1 m thick.

***ROSSALL HALITE FORMATION.**

Trias, Mercia Mudstone Group.

(Rossall Salts.)

Type-locality: Boreholes, north of Blackpool.

Evans W.B. and Wilson A.A., 1975, as Rossall Salts. Mercia Mudstone Group, lower part of the Singleton Mudstones. Thin salt beds with interbedded mudstone, haselgebirge structure in the south.

Warrington et al. 1980, table 4, col.8, as Rossall Halite Formation, base of Singleton Mudstone Formation. [No thickness given.]

ROT.

?Trias, Haisborough Group.

Geiger M.E. and Hopping C.A., 1968, pp.1-36. Includes the Rotsalinar, above the Hardeggen Disconformity and below the Muschelkalk, part of the Dowsing Dolomitic Formation. [First application to British North Sea area.]

Warrington G., 1974a, fig.40, p.149, top of the German Bunter including the Rotsaliner, possibly the lateral equivalent of the Keuper Halite of Yorkshire. [?Error for Rot Halite]

Rhys G.H., 1974, table 3, above the Middle Bunter Sandstone, below the Muschelkalk. Base of Dowsing Dolomitic Formation including the Rot Halite Member.

ROT HALITE MEMBER.

?Trias, Haisborough Group.

(Rotsalinar.)

Rhys G.H., 1974, table 3, fig. 5, pp.4-5. Well no. 49/21-2, southern North Sea. Dowsing Dolomitic Formation, 12 m from the base of the formation. Halite with beds of light grey shale and red and green mudstone. Some anhydritic dolomite, 19 m thick. [First use in the British North Sea area.]

Riddler G.P. 1981, pp.341-346, this unit has unmistakable response on geophysical borehole logs, and is a useful marker horizon. Traced over a wide area of north Yorkshire, Cleveland and north Humberside. Links with the Rot Halite Member (Rotsalinar) of the North Sea. Above red-brown mudstones and a thin anhydrite/dolomite seam there is up to 50 m of clean halite, with thin grey-green siltstone beds. Overlain by the Muschelkalk Halite Member. Part of the Dowsing Formation.

ROTER SALZTON.**Permian, Zechstein.**

Rhys G.H., 1974, table 2, fig.3. Shell/Esso well 49/26-4, southern North Sea. Z4 base, the lateral equivalent of the Carnallitic Marl of east Yorkshire, 9 m thick. [First use in the British North Sea area.] Smith et al. 1974, table 7, col.35, col.20 as Red Salt Clay ?.

ROTHERHAM ROCK.**?Upper Carboniferous, New Red Sandstone.**

(Red Rock of Rotherham, Rotherham Red Rock.)

See: Lexicon vol. 3aVIII, p.273.

ROTLIEGENDE.*Permian.**

(Red-underlyer, Rothe-todte-liegende, Rothes-todtes-liegende, Rothesliegende, Rothliegende, Rotliegendes, Rotliiegend.)

Name derived from German mining term; attributed by Buckland to Werner. Red sandstones above and below the Coal Measures, including the beds later called the Old Red Sandstone. [Old term used by miners.]

Buckland W. and Conybeare W.D., 1822, p.315, first comparison with the German sequence written as, p.315, Rothes-todtes-liegende above the Coal Measures red beds containing salt and gypsum, synonym of the Newer Red Sandstone.

Sedgwick A., 1829, p.121, restricts the term to British rocks of north-east England above the Coal Measures and below the Marl Slate, Zechstein, now the equivalent of his Lower Red Sandstone.

Beche de la, H.T., 1829, p.161, red beds of Babbacombe and Tor Bays-Exeter Red Conglomerate, Heavitree Conglomerate.

Murchison R.I., 1841, pp.417-422, included the unit in the lower part of the Permian System, below the Zechstein.

Hull E., 1869, p.10, as Rothe-todte-liegende, including the Lancastrian, and Salopian Permian.

Smith D.B. et al. 1974 as Lower Permian, table 7, col.35, as Rotliegendes.

[The Rotliegende is dated with respect to the Zechstein or Upper Coal Measures in Great Britain with the possible exception of the Bridgnorth Sandstone Formation.]

ROTSALINAR.**Trias, Haisborough Group.**

See: Rot Halite Member.

!ROTTEN BRECCIA.**?Permian, Rotliegende,**

Type-locality: Kirkby Stephen, Westmorland; also the Vale of Eden.

Binney E.W., 1855, pp.209-269. ?Description only.

Harkness R., 1862, pp.205-218. Blocks of dolomitised Carboniferous Limestone in red sandstone. [later as Upper Brockram]

Meyer H.O., 1965, pp.71-89, renames term, Penrith Brockram.

!ROTTEN MARL.**Permian, Zechstein.**

See also Carnallitic Marl.

Type-locality: South Durham, Middlesborough.

Bird W.J., 1887, p.566; 1890, note 27. Rotten Marl is the usual cover for the rock salt bed of south Durham.

Wilson E. 1881, not listed, but presumably part of his Upper Permian Marl.

Armstrong G. et al. 1951 introduces the term Carnallitic Marl at this stratigraphical horizon.

Smith D.B., 1974, term is listed p.137.

Smith D.B. et al. 1974, table 3, cols.14-16, up to 20 m thick, usually above evaporites (Boulby Halite) and below the Upgang Formation; cols. 17 and 18 as Carnallitic Marl.

ROUGEMONT LAVAS.*Permian, base.**

Type-locality: Northernhay and Castle Hill, Exeter, Devon.

Ussher W.A.E., 1902, p.61. Basaltic volcanics above the Culm Measures, ?base of the Permian sequence at Exeter.

Hobson B., 1892, pp.496-507. Petrographic description from named localities; bibliography.

Tidmarsh W.G., 1932, pp.712-775, included as part of a major review of the Exeter volcanics.

Knill D.C., 1969, p.115, petrographic description.

Smith D.B. et al. 1974, table 6, col.29, Exeter area, ?Permian, partly on Culm Measures. partly within the Heavitree and Alphington Breccias.

ROXBY FORMATION.**Permian, Zechstein.**

Type-locality: Staithes S20 Borehole, Boulby, Cleveland, NZ760180. Other Localities in north Nottinghamshire, Yorkshire, Cleveland, and Durham.

Smith D.B., Harwood G.M., Pattison J. and Pettigrew T., 1986, p.16, table 1. Above the Brotherton Formation (Yorkshire outcrop), Littlebeck Formation, Yorkshire subsurface, or the Sherburn Formation in Durham. Below and gradational with the Sherwood Sandstone Group particularly in the south. Renamed Permian Upper Marl(s), Upper Permian Marl(s), Upper Marl(s) and Saliferous Marl(s). Red brown mudstones, siltstones and subordinate sandstones. Commonly with anhydrite and gypsum; up to 120 m thick.

RUYTON SANDSTONE.**?Trias, Sherwood Sandstone Group.**

Type-locality: Oswestry, Shropshire; Tedsmore, Shelrock and Grig Hill Quarries.

Wedd C.B. et al. 1929, pp.1, 149, 154. Above the Upper Mottled Sandstone and below the Keuper Sandstone. At the Bunter / Keuper junction. Dull red or yellow freestone, beds up to 1.5 m in thickness.

Warrington G. et al. 1980, not listed in table 4.

RYDON MEMBER.**Trias, Mercia Mudstone Group.**

Type-locality: Between Blue Anchor [Point] and St Audrie's Bay, Somerset, ST 040436 to ST103431. Named after Rydon Village near St. Audrie's Bay.

Mayall M.J., 1981, pp.377-384. Lowest and main Member of the Blue Anchor Formation, above undifferentiated red Mercia Mudstone Group [?Glen Parva Formation in places] and below the Williton Member. Grey, black, green, and rare red-brown dolomitic mudstones and dolomites, particularly at the top. In addition there are silty laminated beds with desiccation cracks, gypsum, halite pseudomorphs and celestite. Thickness at the type locality is 34 m. The microplankton recorded from the top of the Blue Anchor Formation (Orbell G., 1973; Warrington G., 1974b;) may be from the Williton Member.

ST. BEES EVAPORITES.*Permian, Zechstein.**

(Saint Bees Evaporites.)

Type-locality: Borehole 59, Sandwith Series, Inst. Geol. Sci. No. NX91SE/190, St. Bees, west Cumbria.

Arthurton R.S. and Hemingway J.E., 1972, p.568 et seq.. Above the Permian Basal Breccia or reddened Coal Measures and below the St. Bees Shales, includes the Saltom, Sandwith, and Fleswick (evaporite) Cycles (top). EZ2-4. Comprises the lower part of the St. Bees Shales of Smith 1924. Evaporites, carbonates, red, grey quartz siltstones and clay mudstones.

Smith B., 1924, pp.289-308, as the lower part of the St. Bees Shales.

Warrington G. et al. 1980, listed table 4, col. 7.

ST. BEES SANDSTONE FORMATION.*?Permian, ?Trias, New Red Sandstone.**

(Saint Bees Sandstone, Shawk Sandstone.) See also: Corby Sandstone.

Type-locality: St. Bees Head, Cumberland. Elsewhere in the Carlisle Basin-Swarthy Hill; Dalston-Wetheral; Brampton; Tordoff Point; Kirtle Water, Annan.

Murchison R.I. and Harkness R., 1864, pp.144-165. Upper Permian, above the Magnesian Limestone or its equivalents (Middle Permian) and below the Trias. Brick red sandstones, cross-bedded.

- Sedgwick A., 1832, pp.383-407, described as New Red Sandstone or Corby Sandstone.
- Binney E.W., 1857, pp.117-118, includes an early description of the sandstones at Shawk. [Shawk Sandstone]
- Harkness R., 1862, pp.205-218, as sandstone at St. Bees. [? first reference.]
- Holmes T.V., 1881, pp.29-38, assigns the stratigraphical position as above the Lower Gypseous Shales and Penrith Sandstone and below the Upper Gypseous Shales.
- Goodchild J.G., 1893, pp.1-24, argues for a Triassic age for the unit.
- Boyd-Dawkins 1895, pp.598-600 compares 'Triassic' sandstones of the Point of Ayre, Isle of Man, with those of St. Bees Head.
- Horne J. and Gregory J.W., 1916, pp.374-386, for description of the 'St. Bees Sandstone' north of the Solway Firth; Trias in age.
- Sherlock R.L., 1926, p.30, as Shawk Sandstone, north-west England, New Red Sandstone, local equivalent of the St. Bees Sandstone.
- Burgess I.C., 1965, extends the areal description; pp.93, 97, brick-red or red-brown fine-grained, cross-bedded sandstones, 45.7 m thick.
- Smith D.B. et al. 1974, table 3, col.9, Permian or Triassic.
- Rose W.C.C. and Dunham K.C., 1977, p.x, p.60, 750 m, part of the Sherwood Sandstone Group.
- Arthurton R.S., Burgess I.C. and Holliday D.W., 1978, p.201, 500 m, part of the Sherwood Sandstone Group; dull red fine-grained sandstone, compact, often well cemented, even bedded up to 2 m thick separated by red micaceous shales or mudstones, mudstone clasts, mainly angular grains, some aeolian type, or cross-bedding at Calder Bridge. May include breccias in west Cumbria.
- Warrington G. et al. 1980, table 4, col.7, as St. Bees Sandstone Formation, 150-600 m thick. Lower part of the Sherwood Sandstone Group of Cumbria.
- Arthurton R.S. and Wadge A.J., 1981, pp.83-85, latest description for the Vale of Eden area.

ST. BEES SERIES.

?Permian, ?Trias.

(Saint Bees Series.)

Type-locality: Kirkby Stephen, Westmorland.

Burgess I.C., 1965, p.97. Includes the Stenkrith Brockram, St. Bees Shales and St. Bees Sandstone. Above Carboniferous or older beds, below the Trias. Red breccias, sandstones and shales, 82.3 m. [Term has not been applied elsewhere in Cumbria.]

***ST. BEES SHALES.**

Permian, Zechstein.

(Saint Bees Shales.)

Type-locality: St. Bees Head, Cumberland.

Smith B., 1924, pp.289-308. ?Upper Permian, above the Magnesian Limestone and below the St. Bees Sandstone. Red-brown mudstones and shales with dolomite and gypsum beds.

Holmes T.V., 1881, pp.29-38, as Lower Gypseous Shales.

Dixon E.E.L., Maden J., Trotter F.M., Hollingworth S.E. and Tonks L.H., 1926, pp.4, 21, chocolate red, dull red, shales or marl with gypsum; sandy shales, flaggy sandstones with mica and mudstone clasts in the upper part; local breccia at the base; below the St. Bees Sandstone, Permian or Triassic; 60.1 m thick.

Meyer H.O.A., 1965, pp.71-89, includes A, B, C, D evaporite beds at Kirkby Thore; B, C, D Beds at Lazonby; from the Magnesian Limestone to the St. Bees Sandstone.

Burgess I.C., 1965, pp.93-98, Kirkby Stephen, Stenkrith Breccia at the base.

Arthurton R.S. and Hemingway J.E., 1972, p.568, base redefined above gypsum/anhydrite beds A-D, now called the St. Bees Evaporites. Red siltstones and silty mudstones commonly micaceous and a few fine-grained calcareous sandstones. West Cumbria.

Smith D.B. et al. 1974, table 3, col.9, 11, up to 200 m with breccias in the east and possibly thin evaporites in the west. Col.10, as Eden Shales.

Arthurton R.S., Burgess I.C. and Holliday D.W., 1978, p.200, term further restricted, now to west Cumbria only. Upper evaporite-free part of the St. Bees Shales of Smith. Term replaced by Eden Shales for the Vale of Eden.

Arthurton R.S. and Wadge A.J., 1981, p.73-82, description of the Eden Shales, Vale of Eden.

ST. CYRES BEDS.**?Permian, New Red Sandstone.**

(Saint Cyres Beds.)

Type-locality: Crediton, Devon.

Hutchins P.F., 1963, pp.107-128; pp.110, 117, 125. Local top of the Lower New Red Sandstone, above the Crediton Beds. Red sandstones with pebbles of potash feldspar (sanidine), tourmalinised slate and lavas, untourmalinised lavas and Culm sediments.

Laming D.J.C. 1968, fig.1, top of the Creedy Group; ?top beds of Laming's Crediton Conglomerates.

Edwards R.A. 1984, p.15, t.2; Bristow C.R. et al., 1985, p.36; prefer the new term Shute Sandstone. Murchisonite feldspar rich breccias, compares with the Heavitree Breccia.

SAGO PUDDING SANDSTONE.**Trias, New Red Sandstone.**

Elgin area, Morayshire.

Lovell J.P.B., 1983, p.328, 334, attributes term to Williams D., 1973, unpublished Ph. D. thesis, University of Hull. Above the Lossiemouth Sandstone and below the Cherty Rock. No description, 0.5 m thick.

!SALIFEROUS MARL (1).**Trias, Mercia Mudstone Group.**

Type-locality: Point of Ayre, Isle of Man.

Boyd-Dawkins, Sir, W.B. 1895, pp.600-601. Top of the Trias, the greater part of the Keuper Marls, above Triassic sandstones; compared with the Preesall Salt of Fleetwood, Lancashire. Red marls with halite, 10 m thick, and gypsum; total thickness at least 91 m thick.

!SALIFEROUS MARL FORMATION.**Permian, Zechstein.**

(Saliferous marl (2).)

Type-locality: Yorkshire, north-east England; redefined by Stewart 1963: Fordon no.1, borehole, Yorkshire.

Murchison R.I., 1839, p.29. Top of the New Red Sandstone Series. Red marl with salt.

Stewart F.H., 1951b, pp.557-572; as upper evaporite bed (sic.).

Raymond L., 1953, pp.285, 292-294, subdivided into two parts at Whitby: Lower Anhydrite Series or Upper Halite of the Upper Evaporite Group and Upper Sandy Series which interdigitates with the Bunter above. Total thickness up to 179 m.

Stewart F.H., 1963, p.3, table 1, top of Permian sequence, above the Upper Evaporites. [?Upper Evaporite Bed.] 173.1 m in Fordon Borehole.

Smith D.B., 1974, named on table 3, col.7, for east Yorkshire and col.18, for West Sole Gas Field, southern North Sea; top of the Permian sequence, below the Sherwood Sandstone Group or Bunter Sandstone.

Smith D.B. et al. 1974, table 3, cols. 17 and 18. Top of the Permian sequence, above the Sleights Siltstone and Top Anhydrite and below the (col.17) Sherwood Sandstone (Group) or (col.18) the Bunter Sandstone.

Warrington G. et al. 1980, table 4, cols. 26, 27, similar in age to the Permian Upper Marls to the west or the Brockelschiefer to the east; base of the Trias, part of the Sherwood Sandstone Group.

Smith D.B., Harwood G.M., Pattison J. and Pettigrew T., 1986, p.16. Term renamed Roxby Formation.

!SALIFEROUS MARLS AND SANDSTONE.**Trias, Mercia Mudstone Group.**

Type-locality: Gloucestershire, Worcestershire and Warwickshire.

Murchison R.I. and Strickland H.E., 1837, p.332. Keuper or Marnes Irisees, above the Bunter Sandstone, below the Lias. Saliferous marls above sandstone, green marls near the top. [Black Shales above are noted but not differentiated.]

!SALOPIAN PERMIAN.**Permian, Rotliegende.**

(Lower Permian Salopian type.)

Type-locality: Enville and Bridgnorth, Shropshire. Also in Worcestershire, Warwickshire, Staffordshire and Denbighshire.

Hull E., 1869, pp.12-26. ?Lower Permian, generally above Coal Measures or older rocks, below Lower Red and Mottled Sandstone or Bunter Pebble Beds. Lower, Middle and Upper Series (Salopian Permian) at the type locality, 457.2 m thick. Lower-purple, red, brown, white sandstones often calcareous and mottled with carbonaceous spots. Interstratified with red marls, about 259 m. thick. Middle-calcareous conglomerates and trappoid breccias, separated by sandstones and marls, up to 79.9 m thick. Upper-red and purple sandstones and marls. Elsewhere breccias at Wars Hill, Stagbury Hill, Church Hill, Woodbury and Abberley Hills, Berrow Hill, Clent and Lickey Hills, Measham (Moira?), Rushton Spencer; Red sandstones in the Shrewsbury District, Oswestry and Wrexham.

Cantrill T.C., 1895, pp.528-548, Hull's Lower Series contains coal seams similar to Halesowen Group,—Upper Carboniferous.

King W.W., 1899, pp.97-128, only Clent and similar breccias Permian.

Boulton W.S., 1933, pp.53-83, the last of three papers which subdivides the Midlands breccias into local units.

Wills L.J., 1976, pp.1-18, latest description of the Permian local breccias, sandstones etc.. originally in Hull's Salopian Permian.

!SALT CLAY.

Permian, Zechstein.

Type-locality: East Yorkshire.

Stewart F.H., 1954, pp.185-236. Part of the Upper Permian Marl. Red mudstones with halite.

Smith D.B. et al. 1974, p.21, the term implies a lithological correlation with the Salztun Beds of Germany; p.40, therefore renamed unit Sleights Siltstone.

Smith D.B., Harwood G.M., Pattison J. and Pettigrew T., 1986, pp.11, 12, as Sleights Siltstone, situated between the Sneaton Halite and the Littlebeck Anydrite.

!SALT I, II, III, IV.

Permian, Zechstein.

(Rock Salt 1, 2, 3, 4.)

Type-locality: Leman Gas Field, southern North Sea.

[Earliest references are in Company confidential reports.]

Brunstrom R.G.W. and Walmsley P.J., 1969, p.873 as Rock Salt 1, 2, 3, 4.

Smith D.B. et al. 1974, table 3, col.20. Successive salt beds I-IV (top), within the Zechstein sequence. Halite, anhydrite in the roof of Salt II. Salt II is possibly equated with the Fordon Evaporites, Salt III with the Boulby Halite and Salt IV with the Upper Halite of East Yorkshire Sequence. ?

Rhys G.H., 1974, table 2, fig. 3, prefers north-west German terminology for the southern North Sea area, Leine, Aller and Upper Halite. [Salt I = Stassfurt Evaporites ?]

SALTOM CYCLE.

Permian, Zechstein.

Type-locality: Borehole 59, Sandwith Series (IGS. No. NX91SE/190), St. Bees, Cumberland.

Arthurton R.S. and Hemingway J.E., 1972, fig.4, p.574 et seq.. Base of the St. Bees Evaporites usually above a Basal Breccia and below the Sandwith Cycle, EZ2?, includes the Saltom Siltstone and Saltom Dolomite. Quartz siltstones, clay mudstones, dolomite and gypsum, 7 m thick.

Smith D.B. et al. 1974, table 3, col.9 not listed. [written as grey clastics and Salton (sic) Dolomite ?]

Arthurton R.S., Burgess I.C. and Holliday D.W., 1978, pp.190, 198, considered to be the base of EZ1 or similar in age to the Marl Slate and Lower Magnesian Limestone of Durham. May be incomplete with absence of anhydrite member.

***SALTOM DOLOMITE.**

Permian, Zechstein.

(Saltom Dolomite.)

Type-locality: Borehole 59, Sandwith Series, (IGS No. NX91SE/190), St. Bees, Cumberland.

Arthurton R.S. and Hemingway J.E., 1972, fig.4, p.576. Top of the Saltom Cycle above the Saltom Siltstone and below the Sandwith Dolomite (Sandwith Cycle) separated by a possible non-sequence (absence of an anhydrite phase.) Shelly dolomite, algal mat dolomite, birds eye dolomite, 2 m thick including *Bakevella* and *Schizodus*.

Smith D.B. et al. 1974, table 3, col.9 as Salton Dolomite, 0-22 m, [2 m?] part of the St. Bees Evaporites, EZ1 or EZ2, equated with the Lower Magnesian Limestone of Durham, p.12, [quoting Parrison J., 1970] includes *Bakevella binneyi*, *Permophorus costatus* and *Schizodus obscurus*.

***SALTOM SILTSTONE.**

Permian, Zechstein.

Type-locality: Borehole 59, Sandwith Series (IGS No. NX91SE/190), St. Bees, Cumberland.

Arthurton R.S. and Hemingway J.E., 1972, fig.4, p.574. Base the Saltom Cycle, above the Basal Breccia and below the Saltom Dolomite. EZ2?, similar in age to the Hilton Plant Beds, and to the Lower Permian Marl of Nottinghamshire. Grey and dark grey even laminated or blocky siltstones, may show slump structures and contain clasts from the Basal Breccia; includes *Bakevella* sp. and plant remains; fibrous gypsum; 5 m thick.

Smith D.B. et al. 1974 table 3, col.9, as grey clastics, 0-6 m thick.

SAMPFORD PEVERELL BRECCIAS.

?Permian, New Red Sandstone.

Type-locality: Tiverton, Devon.

Laming D.J.C., 1968, pp.23-5, fig.1. Above the Tidcombe Sands or Chevithorne Breccias and below 'marls' and the Uffculme Conglomerates.

Smith D.B. et al. 1974, table 6, col.32, Tiverton Basin, 350 m thick. Above the Chevithorne Breccias or Tidcombe Sands and below the Aylesbeare Group. Nearest lateral equivalent the Exminster Breccias.

!SANDSTONES OF CUTTIES HILLOCK (QUARRY WOOD) AND HOPEMAN. Trias, New Red Sandstone.

(Sandstones of Cutties Hillock, Hopeman and Cummingtonstone.)

Type-locality: Quarry Wood, Cutties Hillock, west of Elgin. Also at Knock of Alves, Carden Hill; Cummingtonstone (Cummingtonstone) to Covesea Lighthouse, Hopeman, west of Elgin.

Peacock J.D., Berridge N.G., Harris A.L. and May F., 1968, pp.54, 57-63. Previously referred to the Old Red Sandstone sequence; later separated from the Old Red Sandstone as Reptiliferous Sandstone or Elgin Sandstone; top of the local red bed sequence. Sandstones with reptile remains, 60.1 m thick.

Westoll T.S., 1951 describes fauna from the Sandstones of Cutties Hillock and Hopeman-Cummingtonstone.

Walker A.D., 1973, pp.177-183, Redescription of the Permo-Triassic reptiles.

Warrington G. et al. 1980, table 4, col.1, p.58, renamed as Hopeman Sandstone Formation.

Lovell J.P.B., 1983, p.328, as Hopeman Sandstone, up to 60 m.

Benton M.J. and Walker A.D., 1985, p.216, renamed this unit as the Cutties Hillock Sandstone Formation.

!SANDSTONES OF SPYNIE, LOSSIEMOUTH AND FINDRASSIE.

?Trias, New Red Sandstone.

Type-locality: Lossiemouth, Morayshire.

Peacock J.D., Berridge N.G., Harris A.L. and May F., 1968, pp.54, 67-70. Largely isolated exposures, age inferred. Largely aeolian sandstones at Lossiemouth 21.3 m, Spynie 27.4 m, Findrassie 6.1 m, base not seen.

Warrington G. et al. 1980, table 4, col.1, p.60, renamed as Lossiemouth Sandstone Formation.

Lovell J.P.B., 1983, p.328, as Lossiemouth Sandstone, unconformably above the Burghhead Beds, below Sago Pudding Sandstone; up to 20 m thick.

***SANDWITH ANHYDRITE.**

Permian, Zechstein.

Type-locality: Borehole 59, Sandwith Series, (IGS. No. NX91SE/190), St. Bees, Cumberland.

Arthurton R.S. and Hemingway J.E., 1972, fig.4, pp.578-580. Top part of the Sandwith Cycle, above the Sandwith Dolomite and below the Fleswick Dolomite and Siltstone. Mottled anhydrite, nodular anhydrite, varved anhydrite, fibro-radiate anhydrite, up to 6 m in thickness.

Smith D.B. et al. 1974, table 3, col.9, 0-20 m thick.

Arthurton R.S., Burgess I.C. and Holliday D.W., 1978, pp.189-206, possibly equated with the B-Bed of the Vale of Eden or the Hartlepool Anhydrite of Durham.

SANDWITH CYCLE.**Permian, Zechstein.**

Type-locality: Borehole 59, Sandwith Series, (IGS No. NX91SE/190), St. Bees, Cumberland.

Arthurton R.S. and Hemingway J.E., 1972, fig.4, pp.578. The second evaporite cycle from the base of the St. Bees Evaporites, above the Saltom Cycle, below the Fleswick Cycle, 6.8m thick. Includes the Sandwith Dolomite and the Sandwith Anhydrite (top); EZ3?

Arthurton R.S., Burgess I.C. and Holliday D.W., 1978, pp.198-199, top of EZ1 equated with the Middle Magnesian Limestone and the Hartlepool Anhydrite of Durham.

SANDWITH DOLOMITE.*Permian, Zechstein.**

Type-locality: Borehole 59, Sandwith Series, (IGS. No. NX91SE/190), St. Bees, Cumberland.

Arthurton R.S. and Hemingway J.E., 1972, fig.4, p.578. Lower part of the Sandwith Cycle, above the Saltom Dolomite (Saltom Cycle) and below the Sandwith Anhydrite. Shelly dolomite, 1-2 m in thickness, with algal mat dolomite at the top in some sections.

Smith D.B. et al. 1974, table 3, col.9, 0-3 m thick.

Arthurton R.S., Burgess I.C. and Holliday D.W., 1978, p.198, includes *Bakevella binneyi*, *Schizodus obscurus*, *Permophorus costatus*, equated with the Middle Magnesian Limestone of Durham.

SEAHAM FORMATION.*Permian, Zechstein.**

(Seaham Beds.)

Type-locality: Seaham Harbour, Co. Durham; Cleveland generally.

Smith D.B., 1971a, pp.1-12; pp.3, 5, as Seaham Beds. Above the Seaham Residue and below the Billingham Main Anhydrite. Renamed Concretionary Limestone, upper set [not the lower]. Concretionary dolomitic limestone, particularly at the type locality, 30-31.5 m thick; or hard thin-bedded and flaggy brown (grey weathering) partially collapse-brecciated crystalline limestone with calcite concretions, *Schizodus*, *Liebea*, *Calcinema permiana*.

Smith D.B. et al. 1974, table 3, cols.15, 16, up to 33 m thick; similar in age to the Upper Magnesian Limestone of Yorkshire, above the Permian Middle Marl and below the Billingham Main Anhydrite in south Durham; top part of the Upper Magnesian Limestone on the Durham Coast, also local top of Permian sequence.

Magraw D., 1978, pp.157-183, considers the beds to be the Concretionary Limestone at the top of the Upper Magnesian Limestone, renamed as the Upper Nodular Beds.

SEAHAM RESIDUE.*Permian, Zechstein.**

Type-locality: Seaham Promenade and south of Featherbed Rocks, Durham.

Smith D.B., 1971a, pp.3, 5. Part of the Upper Magnesian Limestone, above the Hartlepool and Roker Dolomite and below the Seaham Beds. Beds of clay, quartz and heavy insoluble minerals with angular fragments of limestone and dolomite up to 1 m in length. Beds contorted by flow vary in thickness up to 9 m thick.

Smith D.B. et al. 1974, table 3, col.16, Durham Coast, part of the Upper Magnesian Limestone, 1-9 m thick. Lateral equivalent of the Fordon Evaporite Formation in east Yorkshire or the Permian Middle Marls in south Durham.

SEATON CAREW FORMATION.**Trias, Mercia Mudstone Group.**

Type-locality: Seaton Carew, north Yorkshire.

Warrington G. et al. 1980, p.51. Base formation, below the Esk Evaporite Formation above sandstones of the Sherwood Sandstone Group. Up to 4 m thick. States description by Smith in press, [?not published before Dec. 1987].

SECOND BED.

See: Bottom Bed.

SEVERNSIDE EVAPORITE BED.**Trias, Mercia Mudstone Group.**

(Celestine Bed, Celestine Horizon.)

Type-locality: Boreholes, north of Bristol.

Nickless E.F.P. et al. 1975, pp.B62-B64. [considered footnote p.62, to be an informal term]. Upper part of the Keuper Marl or (at Yate) unconformably on Carboniferous rocks, usually Coal Measures. Celestite with green-grey marl within red marl.

Sherlock R.S. and Hollingworth S.E., 1938, gives a description of celestine at Yate, Bristol, said (p.81) to be equivalent stratigraphical horizon to the Newark Gypsum of Nottinghamshire.

Welch F.G.A. and Kellaway G., 1959, 1961, named as Celestine Bed or Celestine Horizon without description.

Nickless E.F.P., et al. 1976, gives further description and as an ?informal stratigraphical unit.

Warrington G. et al. 1980, p.48, 10-15 m below the Blue Anchor Formation. [not included in table 4].

!SHAWK SANDSTONE.**New Red Sandstone.**

See: St. Bees Sandstone.

SHERBURN (ANHYDRITE) FORMATION.**Permian, Zechstein.**

(Sherburn Formation.)

Type-locality: Sherburn Mine, no.2 shaft, Sherburn-in-Elmet, north Yorkshire. SE 5166 3440; found elsewhere in Yorkshire and Humberside.

Smith D.B., Harwood G.M., Pattison J. and Pettigrew T., 1986, pp.15, 16, table 1. EZ4A, above the Upgang Formation and below the Sneaton Formation; new name for the Upper Anhydrite. Gypsum at the type-locality, pale grey and alabastrine passing laterally eastwards into finely crystalline anhydrite, distinguished by many courses of upright fibrous pseudomorphs, in anhydrite, halite or sylvite, probably after gypsum. Abundant uneven laminae of dolomite or magnesite. Generally 2-4 m thick but up to 15 m in Yorkshire and Humberside.

SHERWOOD SANDSTONE GROUP.*?Permo-Trias.**

Type-locality: Sherwood Forest, Nottinghamshire; found throughout the British Isles.

Warrington G. et al. 1980, table 4, pp.12, 37-39, [first formal description of the term]. Above Permian or older beds, and below the Mercia Mudstone Group. Renamed Bunter Sandstone of England and arenaceous lower part of the English Keuper because of the lack of direct correlation with the Bunter or Keuper of Germany. Absence of biostratigraphical control, some units lateral equivalent of other units possibly Permian in age in turn correlated laterally with rocks of definite Permian age. Includes: Basement Beds, Bridgnorth Sandstone Formation, Bromsgrove Sandstone Formation, Budleigh Salterton Pebble Beds Formation, Building Stones, Cannock Chase Formation, Chester Pebble Beds Formation, Kidderminster Formation, Lenton Sandstone Formation, Nottingham Castle Formation, Polesworth Formation, Wildmoor Sandstone Formation. Red, Yellow and Brown sandstones, commonly showing colour mottling. Pebbles are scattered throughout much of the sequence in the Midlands and are locally concentrated at specific levels. Pebbles rare to the north in Lancashire and Yorkshire with finer-grained sand; deposits mostly fluvial with numerous fining upward cycles but aeolian units in part, 1500 m thick but much thinner against land areas and where overstepped.

Smith D.B. et al. 1974, term used at the top of the Permo-Triassic sequences table 3 cols.15, 17, but not described.

Warrington G., 1974a, p.158, postscript notes to Triassic chapter, indicate its impending formal appearance.

Evans W.B. and Wilson A.A., 1975, term used in the extensive marginal notes.

!SHINGLE BEDS.**?Permian, ?Trias, New Red Sandstone.**

(Bunter Shingle Beds, Quartzite Shingle Beds.)

Type-locality: West Midlands, England.

Wills L.J., 1970, pp.228, 234-8; 1976, pp.1-14. ?Group name to include named Shingle, or Quartzite Shingle Beds e.g. Welcombe, Queslett and Sling Shingle Beds, and the Bellington Breccio-Conglomerate. Base of Macrocylothem BSI and of the Bunter; most convenient and reliable marker unit for defining the base of the Trias in the Midlands. Above the Quartzite and other Breccias; below the Pebble Beds. Small quartzite pebbles in coarse sand matrix, lithology distinct from the breccias and the overlying Pebble Beds; 90% quartzite or quartz.

Boulton W.S., 1933, pp.53-83, refers to a coarse gravelly bed at the base and part of the Bunter.

SHUTE SANDSTONE.

?Permian, New Red Sandstone.

Type-locality: Shute, north of Exeter, Devon.

Edwards R.A., 1984c; Bristow C.R. et al., 1985. Lateral equivalent of the Heavitree Breccias and of the Monkerton Member of the Exeter District. Above the Yendacott Breccias and below the Brampton Speke Sandstone Member. Breccias with murchisonite fragments or poorly sorted sandstone and siltstone, reddish brown in colour; up to 60 m in thickness.

SILVERPIT FORMATION.

Permian, ?Rotliegende.

Type-locality: Total well 44/22-1, southern North Sea.

Rhys G.H., 1974, table 2, fig.2. Above Carboniferous sandstones and shales, interdigitates with Leman Sandstone Formation to south and west, Z1 above. Mudstone, silty, hard, dense, calcareous, halite in the lower part; 323 m thick.

Smith D.B. et al. 1974, table 3, cols. 18-20, as various red-brown or grey- white clastics.

***SILVERTON BRECCIAS.**

?Permian, New Red Sandstone.

Type-locality: Silverton-Thorverton area, Devon.

Laming D.J.C., 1968, pp. 23-25, fig.1. Lower New Red Sandstone, above Cadbury Breccia or Culm Measures, below the Clyst Sands; ?lateral equivalent of the Heavitree Breccias.

Smith D.B. et al. 1974, table 6, col.30, above the Killerton Park Lavas or Culm Measures and below the Clyst Sands, ?600 m thick, Silverton-Bradninch area.

SILVERTON LAVAS.

Permian, ?Rotliegende.

Type-locality: Silverton, Devon.

Ussher W.A.E., 1902. Described as part of the Exeter Volcanics.

Hobson B., 1892, pp.496-507, petrological description of lavas from named localities; bibliography.

Tidmarsh W.G., 1932, pp.714, 724. Petrological and mineralogical description.

Laming D.J.C., 1968, pp.23-25, fig.1, position indicated on the fig. by symbols only.

Smith D.B. et al. 1974. table 6, col.30. Within the lower part of the Clyst Sands, lateral equivalent of part of the Silverton Breccia.

***SINGLETON FORMATION.**

Trias, Mercia Mudstone Group.

(Singleton Mudstones.)

Type-locality: Boreholes, north of Blackpool, Lancashire; also known in south Cumbria.

Evans W.B. and Wilson A.A., 1975. Extensive marginal notes on the map, as Singleton Mudstones. Above the Hambleton Mudstones and below the Kirkham Mudstones; includes the Rossall and Mythop Salts (top); Scythian on miospore evidence. Structureless or ill-bedded red-brown mudstone, gypsum veins, with thin halite seams at the base and close to the top, miospores; 137-310 m thick.

Dunham K.C. and Rose W.C., 1949, pp.11-40, an early description, but the unit is not named.

Eastwood T. and Evans W.B., 1976, extends the formation into the Barrow-in- Furness area; three impersistent salt levels recorded, 150-180 m thick.

Arthurton R.S., Burgess I.C. and Holliday D.W., 1978, p.204, first full description of the formation.

Warrington et al. 1980, table 4, col.8, 120-150 m thick.

***SLEIGHTS SILTSTONE.**

Permian, Zechstein.

Type-locality: Eskdale no.3 (Sleights) Borehole (NZ 872078) 4 km south-west of Whitby, Yorkshire, 1093.9 m to 1096.7 m depth; elsewhere in east Yorkshire and the West Sole Gas Field, southern North Sea.

Smith D.B. et al. 1974, table 3, cols. 17, 18, p.40. Base of the Eskdale Group, above the Upper Halite or Upper Anhydrite and below the Top Anhydrite or at the base of the Saliferous Marl. Renamed Salt Clay of Stewart to avoid correlation with the Saltzon Beds of Germany. Barren red siltstone with or without interstitial halite.

Armstrong G., Dunham K.C., Harvey C.O., Sabine P.A. and Waters W.F., 1951, fig.2, first recorded as halite impregnated mudstone (Salt Clay) at about this level but not named or described.

Stewart F.H., 1954, pp.185-236, referred to the horizon as the Salt Clay.

Smith D.B., 1974, p.116, top of EZ4, base of EZ5, on p.140 suggests similar depositional environment as the Carnallitic Marl.

SLING SHINGLE BEDS.

?Permian, ?Trias, New Red Sandstone.

Type-locality: Sling Common (SO 957781); Marlbrook (SO 979748); Brockhill; Barnt Green Railway Cutting;— the Bromsgrove-Droitwich area of Worcestershire.

Wills L.J., 1970, p.228; 1976, pp.28, 36, 42-45. Palaeotrias, English Bunter Series, Wildmoor Stage (base); above the Clent Breccia and below the Lower Wildmoor Beds; Macrocylothem BSI. Mainly flood sequence loose gravels and small pebbles with a little sand or grit. Pebbles smooth, 90% quartz or quartzite, occasional boulders 20x15x10 inches?, waterworn and smooth. Pebbles may be abraded by sand; up to 21.6 m thick.

Boulton W.S., 1933, pp.53-83, general description but not named.

!SMALL GRAIN DOLOMITE.

Permian, Zechstein.

(Small Grain Limestone.)

Type-locality, Nottinghamshire, Derbyshire, Yorkshire.

Sedgwick A., 1829, p.83. A variety of the Yellow Magnesian Limestone particularly towards the top. Granular dolomite.

Smith D.B., Harwood G.M., Pattison J. and Pettigrew T., 1986, pp.13, renamed Sprotbrough Member (Cadeby Formation).

SNAR BRECCIA FORMATION.

?Permian, New Red Sandstone.

Type-locality: Glendowran Burn, Snar Valley, north-east of Sanquhar, NS870210- 881200.

Brookfield M.E., 1978, pp.139-140. Overlying Ordovician strata within the isolated Snar Basin, a tectonic depression; one formation only. Coarse to fine-grained dominantly tabular red breccias with well rounded clasts of greywacke, argillite, and chert in a matrix of granular silty sand. At least 500 m thick.

Lovell J.P.B., 1983, p332, isolated formation, may be late Permian or even early Triassic in age. [?evidence]

SNEATON (HALITE) FORMATION.

Permian, Zechstein.

(Sneaton Formation.)

Type-locality: Sneaton E4 Borehole, Sneaton, north Yorkshire between 1228.7m and 1263.4 m.

Smith D.B., Harwood G.M., Pattison J. and Pettigrew T., 1986, pp.12, 16. EZ4H, located above the Sherburn Formation and below the Sleights Siltstone Formation. Halite, comprising five lithological units, A-E, including the Sneaton Potash Member (Upper Halite), C, at type-locality between 1243.0 and 1248.2 m. Up to 55 m thick north-east Yorkshire and Humberside.

See also Smith D.B., 1971b, p.223 for an early description.

SOLLAND CONGLOMERATE MEMBER.

?Carboniferous, ?Permian, New Red Sandstone.

Type-locality: Bow, Crediton, Devon.

Laming D.J.C., 1968, pp.23-25, fig. 1. Lower New Red Sandstone, at or close to the base of the Creedy Group; in part above the Cadbury Breccia and below the Knowle Sandstone. [Named but not described.]

SOMERSET HALITE FORMATION.*Trias, Mercia Mudstone Group.**

Type-locality: Burton Row Borehole, Brent Knoll, Somerset, ST 3356 5208, 653 m- 797 m depth.

Warrington G. et al. 1980, table 4, cols.17, (?19, as mudstone and halite), pp.45, 46 and 61. Mercia Mudstone Group, within un-named marls but below the North Curry Sandstone Member. Similar in age to the 'mudstone and halite' sequence central Dorset (col.19); and the Droitwich Halite Formation. Sequence may be extended into the Wessex Basin on evidence from the unpublished record of the Winterton Kingston Borehole. Halite bearing mudstones, 154 m in thickness.

Lees G.M. and Cox P.T., 1937, pp.174-183 postulated the occurrence of halite in Somerset.

!SOMERSETIAN.**Trias, Penarth Group.**

Type-locality: Somerset.

Richardson L., 1911, p.73. Rhaetian; to include the Westbury, Cotham, and Langport Beds. [Synonym of Rhaetian; proposed when the paper was read but withdrawn on publication, see footnote p.73.]

SOUTHALLS SAND ROCK.**?Permian, ?Trias, New Red Sandstone.**

Type-locality: Southall's Ltd., Birmingham; also J. Lucas Ltd., Sparkhill.

Wills L.J., 1970, p.228; 1976, pp.28, 29-33, 77. Protobunter, below the City Road Beds or Shingle Beds, similar in age to the Longbridge Sandstone, Quartzite Breccia, Barr Beacon Beds etc.; may be above Northfield Breccia. Bright red marls and sandstones, 20.7 m+ thick, similar in lithology to the Hockley Moulding Sands (Upper Mottled Sandstone).

SOUTHERNDOWN BEDS.**?Trias, ?Lias.**

(Southerndown Limestone)

Type-locality: Ogmere-by-Sea, Glamorgan.

Tawney A., 1866. Above the Sutton Stone, below Lias. May rest directly on Carboniferous Limestone. Well bedded limestones with interbedded clays, contains Rhaetic Fossils.

Ager D.V., 1986, top part of the Sutton Formation above the Sutton Stone, Lias in age.

SPENCECOMBE LAVAS.**Permian, Rotliegende.**

Crediton Valley, Devon, see: Exeter Volcanics.

STACK CONGLOMERATES AND BRECCIAS.**?Permian, New Red Sandstone.**

(Stack Series.)

Type-locality: Trae Fogog and Stack Point, Peel, Isle of Man.

Boyd-Dawkins Sir, W.B. 1895, pp.593-594. Above the Peel Sandstones, below Triassic sandstones and marls. Age based on lithological comparisons with sequences in north-west England and north-east Ireland. Conglomerate with limestone, haematite, jasper, sandstone and marl pebbles and blocks. Subordinate layers of marl and sandstone are present. The pebbles are embedded in a bright red magnesian paste or with white calcareous base.

SPROTBROUGH MEMBER.**Permian, Zechstein.**

Type-locality: Boat Lane Quarry, Sprotbrough, south Yorkshire, SE 535016. Most of Yorkshire, Humberside, Nottinghamshire.

Smith D.B., Harwood G.M., Pattison J. and Pettigrew T., 1986, pp.12, 13. EZ1bCa, above the Wetherby Member; or the Hayton (Anhydritic) Formation in the east (subcrop); or above the lower dolomite bed of the Hampole Beds or above the Hampole Discontinuity. Below the Edlington Formation. New name for the Upper Subdivision of the Lower Magnesian Limestone or Small Grained Dolomite. Upper Member of the Cadeby Formation. Pale cream oolitic dolomite with large scale cross-bedding and sparse bivalve fauna. To the west and south, passes laterally into parallel bedded inner shelf oolitic dolomites and eastwards into fine-grained pale buff dolomite of the outer shelf, slope and basin floor environments. Locally interbedded with evaporites or their residues and quartz sand throughout the Member in the south. Up to 40 m thick

thickening eastwards towards the shelf margin. Generally sparsely fossiliferous but with local bryozoan, brachiopod, molluscan fauna.

***STAFFORD HALITE FORMATION.**

Trias, Mercia Mudstone Group.

(Upper Evaporite Bed (2).)

Type-locality: Stafford and Bagots Park Boreholes; generally within the Stafford Needwood and Worcester Basins.

Warrington G. et al. 1980, table 4, col.11, p.40. Mercia Mudstone Group, top of Harlequin Formation and base of the Edwalton Formation of this area; referred to as the Wilkesley Halite, Cheshire Basin; and the Droitwich Halite of the Worcestershire Basin ?. Referred to previously as the Upper Evaporite Bed or the rock salt of Stafford. Halite bearing mudstones up to 65 m thick.

Sherlock R.L., 1921, includes a description of the Stafford Borehole and the rock salt of Stafford.

Wills L.J., 1970, refers to the Upper Evaporite Bed.

Wills L.J., 1976, refers to the Upper Evaporite Zone.

STAGONOLEPIS BEDS, STAGONOLEPIS SANDSTONE.

See: Lossiemouth Sandstone Formation.

***STAINTONDALE GROUP.**

Permian, Zechstein.

Type-locality: Staintondale, Yorkshire, Fisons Ltd. Borehole F2, SE 973984; Also proved in boreholes throughout Yorkshire.

Smith D.B. et al. 1974, table 7, col.34, pp.8, 39. EZ4, above the Teesside and below the Eskdale Groups; includes the Carnallitic Marl, Rotten Marl, Uppgang Formation, Upper Anhydrite, Upper Halite Formation with the Upper Potash; ex-Saliferous Marls in part.

Rhys G.H., 1974, table 2, the unit equals the major part of Z4, in the southern North Sea.

STANWIX SHALES.

Trias, Mercia Mudstone Group.

(Stanwix Marls.)

Type-locality: Stanwix, north of the R. Eden, Carlisle; redesignated by Dixon et al. 1926: Etterby Scar, River Eden; Beaumont, R. Eden; Westlinton.

Holmes T.V., 1899, pp.7, 33 et seq.. Above the Kirklington Sandstone, local top of the red bed sequence. Shaley beds red and greenish grey in colour and varying considerably in hardness; 7 m thickness proved.

Dixon E.E.L., Maden J, Trotter F., Hollingworth S.E. and Tonks L.H., 1926, as Stanwix Marls except p.4, Stanwix Shales. Above the Kirklington Sandstone and below the Lias, excluding the Rhaetic if present. Renamed Upper Gypseous Shales of Holmes 1881. Red marls, poorly sorted silt and mud, without stratification or well laminated mudstones and silty mudstones, commonly micaceous alternating red and green. Dolomitic sandstone may be present, salt in Abbey Town Borehole, 1000 ft thick south of Carlisle.

Arthurton R.S., Burgess I.C. and Holliday D.W., 1978, pp.202-203, as Stanwix Shales, 170 m, gypsum, salt in Kelsick Moss Borehole 150 m above the top of the St. Bees Sandstone.

Warrington G. et al. 1980, table 4, col.7, as ('Stanwix Shales') p.35, informal term?, prefers undifferentiated Mercia Mudstone Group, about 300 m.

STASSFURT HALITE.

Permian, Zechstein.

Rhys G.H., 1974, table 2, fig.3, Shell/Esso well 49/26-4, southern North Sea. Mid-Z2, lateral equivalent Fordon Evaporites of east Yorkshire. Halite with potash salts at the top, 3-15 m.

Smith D.B. et al. 1974, table 7, col.35. ?part of the Stassfurt Evaporites.

***STENKRITH BROCKRAM.**

Permian, ?Rotliegende.

Type-locality: Stenkrith Park and above Frank's Bridge, River Eden, Kirkby Stephen, Westmotland.

Burgess I.C., 1965, pp.91-101. Base of the St. Bees Shales, renamed Hard Breccia of Harkness 1862. Sub-angular, sub-rounded, pale grey undolomitised fragments of Carboniferous Limestone, up to 18.3 m.

Smith D.B. et al. 1974, p.14, deposited in a marginal area, ?Upper Permian.

***STOCKPORT CONGLOMERATE.**

Permian, ?Zechstein.

(Stockport Breccia)

Type-locality: Stockport, Cheshire.

Wills L.J., 1956, pp.103, 108,109. Part of Palstage 4, as Stockport Breccia. Breccia or conglomerate at the base of the Manchester marls, including Charnian pebbles.

Taylor B.J., Price R.H. and Trotter F.M., 1963. Pebble bed at the base of the Manchester Marls.

Smith D.B. et al. 1974, table 3, col.13, at the top of the Collyhurst Sandstone and below the Manchester Marls of south-east Lancashire and north Cheshire. Possibly of similar age to the Permian Breccia of north Nottinghamshire and south Yorkshire; Moira and Hopwas Breccias.

STOODLEIGH LAVAS.

Permian, Rotliegende.

Tiverton Valley, Devon: see Exeter Volcanics.

STORNOWAY FORMATION.

?Trias, New Red Sandstone.

(Stornoway Beds.)

Type-locality: Stornoway, Isle of Lewis, Scotland.

Stevens A., 1914, pp.51-63 [as Stornoway Beds]. Isolated occurrence bounded by faults. Red mudstones, sandstones and conglomerates, up to 304.8 m thick.

Steel R.J., 1971; Steel R.J. and Wilson A.C. 1975; Storetveit K.M. and Steel R.J., 1977, pp.263-269, postulate a late Permian to Triassic age. Outcrops represent the western margin of an extensive Triassic basin some 4000 m thick, the North Minch Basin.

Warrington G. et al. 1980, p.25, not a formal stratigraphical unit; too large, too many variations. [Stornoway Group?]

Lovell J.P.B., 1983, p.325, general absence of fossil evidence.

STRAIGHT POINT SANDSTONE.

?Permian, New Red Sandstone.

Type-locality: Straight Point, Exmouth, south Devon.

Bristow C.R. et al. 1985, t.2. Part of the Aylesbeare Formation, above the Exmouth Mudstone and Sandstone and below the Littleham Mudstone. [?not a formal stratigraphical unit] Reddish-brown fine-medium grained sandstones with interbedded red mudstones. Thickness is variable, up to 19 m.

!STRATFORD-WARWICK KEUPER SANDSTONE.

Trias, Sherwood Sandstone Group.

(Stratford Keuper Sandstone, Warwick Keuper Sandstone.)

Type-locality: Stratford and Warwick, Warwickshire.

Wills L.J., 1976, pp.28, 149, 155. Bromsgrove Regional Stage, English Keuper Sandstone, including the Welcombe Breccia (Basal Welcombe Breccia) and (?Protobunter-Wills 1970) Welcombe Shingle Beds. Renamed Keuper Sandstone of Richardson 1928. Grey or buff sandstones, medium to fine-grained, fairly numerous bands of grey or chocolate marl up to 2.7 m. Bands or streaks of marl breccia; these and the sandstones may be calcreted. Large grains of feldspar and large rounded grains of quartz are present as well as pink, green and black rock including chert. There are coarser sandstones in the lower half with 5 mm quartz pebbles, 0.3–2.1 m bands of conglomerate the basal bed being of coarse water worn pebbles up to 178 mm in diameter, the Welcombe Shingle Beds. Above this bed may occur angular pebbles wind faceted, the (Basal) Welcombe Breccia. Total thickness is 27-64 m; 67.8 m in Hatton Borehole.

!SUB-ARDEN KEUPER MARLS.

Trias, Mercia Mudstone Group.

Type-locality: Warwickshire, Worcestershire.

Wills L.J., 1976, pp.28, 101, 164. Droitwich Regional Stage, English Keuper Marls including at the top the Lower Evaporite Beds.

Wills L.J., 1970, p.228, refers to these beds as Middle Keuper Marls (lower part) and the Lower Evaporite Zone, and Lower Keuper Marls, 121.9-304.8 m thick.

SUGARBROOK BASAL MEMBER.

Trias, Sherwood Sandstone Group.

Type-locality: Sugarbrook no.1 Borehole, Bromsgrove, SO 961682, 282-287.4 m depth.

Wills L.J., 1970, pp.228, 247, 249; 1976, pp.28, 38, 71. Mesotrias, Droitwich Regional Stage (base), above the Upper Wildmoor Beds (Bunter) and below the Basement Beds Group (Burcot Breccia). Miocyclothem KSI, 3 microcyclothem. Chocolate marl, race and catbrain on massive non-pebbly sandstone with some pebbles, with some pellet rock bands and two or three thin bands of marly sandstone, 23.6 m thick.

!SULLY BEDS.

Trias, ?Penarth Group.

Type-locality: Sully Island, Glamorgan, south Wales; also at Lavernock and at Watchet.

Richardson L., 1905, pp.394-395. Basal Rhaetic below the Rhaetic Bonebed, above the Tea Green Marls, renamed Grey Marls of Etheridge, 1864. Green-grey marls resting on an eroded surface of Tea Green Marls, with Rhaetic fish fossils, conglomerate at the base, 0-4.3 m in thickness.

Ivimey-Cook H.C., 1974, Sully or bristovi Beds, limestones at the top of Etheridge's Grey Marls placed in the base of the Westbury Beds.

Warrington G. et al. 1980, fig.1, p.14, lower part at the top of the Blue Anchor Formation, upper part at the base of the Westbury Formation.

Mayall M.J. 1981, renamed Rydon Member.

Whittaker A. and Green G.W., 1983, pp.37-39, 52. Lower part of Etheridge's Grey Marl placed in the Blue Anchor Formation, upper part in the Westbury Beds; term Sully Beds abandoned.

SUN BED.

Trias, Penarth Group.

Type-locality: Dorset, Somerset, Avon.

Richardson L., 1906, pp.401-409. Top of the Cotham Beds or White Lias, below the (Blue) Lias. Grey calcareous shales and limestones with polygonal cracks. [Not restricted to one horizon.?

SUNDERLAND LIMESTONE.

Permian, Zechstein.

Winch N.J., 1817, p.3, see: Magnesian Limestone.

!SUPERMEDIAL.

Permian to Cretaceous.

Type-locality: British Isles.

Conybeare W.D. and Phillips W., 1822, Introduction, p.vii. Above the Medial and below the Superior. Synonym of the continental term Floetz. Rocks above the Coal Measures and up to the base of the Tertiary. New Red Sandstone, Jurassic and Cretaceous.

Ure A., 1829. Rocks between coal bearing strata and the Blue Lias. [Synonym of the New Red Sandstone.]

!SUPRA-ARDEN KEUPER MARLS.

Trias, Mercia Mudstone Group.

Type-locality: Saleway Borehole, Droitwich; also Stratford, Warwick, Bromsgrove and Birmingham.

Wills L.J., 1976, pp.28, 101, 164. Droitwich Stage, Keuper Marls Formation including the Upper Evaporite Zone. Top of the second Keuper Macrocycle, miocyclothem KMXI-XV. Above the Arden Sandstone or Arden Sandstone Horizon and the Rhaetic. Red Marls and Tea Green Marls, 45.7 m thick.

Wills L.J., 1970, p.228, refers to these beds in the upper part of the Middle Keuper Marls Group, Upper Evaporite Group and Upper Keuper Marls Group.

SUTTON FORMATION.

?Trias, ?Lias.

(Southerndown Series, Sutton Series.)

Type-locality: Ogmores-by-Sea, Glamorganshire.

Ager D.V., 1986, pp.29-35; pre-empting Hodges P. (in press.) Comprises Sutton Stone [Member] at the base and Southerndown Beds [Member] above. Sutton Stone contains Lias ammonites.

SUTTON STONE.

?Trias, ?Lias.

Type-locality: Sutton to Southerndown, south Glamorganshire coast.

Tawney A., 1866, p.69. On Carboniferous Limestone; includes Rhaetic fossils but no *Avicula contorta*. Dolomitic limestone, conglomeratic in part, passing laterally into red mudstone? or black mudstone? or paper shales?.

Bristow H.W., 1867, p.199 considers the terms synonymous, Lias or Infra-Lias; Sutton Freestone a variety of the Cotham Limestone?.

Warrington G. et al. 1980, table 4, col.16, as marginal facies?.

Ager D.A., 1986, lower part of the Sutton Formation, conglomerate, originates as a result of Liassic cyclonic storm.

***TARPORLEY SILTSTONE FORMATION.**

Trias, Mercia Mudstone Group.

Type-locality: Tarporley, Cheshire.

Warrington G., et al. 1980, table 4, cols.9, 10, pp.33, 62. Base of the Mercia Mudstone Group, above the Helsby Sandstone Formation (Sherwood Sandstone Group) and below un-differentiated Mercia Mudstone Group; compared with the Waterstones of Cheshire. Reptiles indicate Anisian age, possibly the oldest recorded age for the base of the Mercia Mudstones. Siltstones with interbedded red-brown mudstones, up to 270 m thick.

Walker A.D., 1969, pp.470-476, describes reptiles from Waterstones facies and highest beds of the Keuper Sandstone, Anisian age.

!TEA GREEN MARL.

Trias, Mercia Mudstone Group.

(Tea Green and Grey Marls, Grey and Tea Green Marls.)

Type-locality: Garden Cliff, Westbury-on-Severn, Gloucestershire.

Etheridge R., 1865, p.221. [Tea Green and Grey Marls.] Above the Red Marls, below black shales or *Avicula contorta* Beds. Green-grey shales; peculiar hue of the freshly fractured shales when exposed and the constancy of their condition.

Richardson L., 1905, pp.386-387, refers to Etheridge's use of the Tea Green Marls; as defined by Woodward H.B., 1876, the Tea Green Marls should be restricted to the beds between the red marl and grey marls below the Black Shales [Rhaetic]. The grey marls are subsequently in this paper called the Sully Beds.

Warrington G. et al. 1980, pp.34, 43, 55, Tea Green Marls, Grey Marls and Sully Beds renamed as the Blue Anchor Formation.

I.G.S., 1980, uses the old terms.

Mayall M.J., 1981, p.377, indirectly places this unit in his Rydon Member, the lowest division of the Blue Anchor Formation.

Whittaker A. and Green G.W., 1983, pp.38-41, 47-53, continued use of the term Tea Green Marl for the lower part of the Blue Anchor Formation; Grey Marls for the top.

Warrington G. and Whittaker A., 1985, p.100, Tea Green Marl as the base and the Grey Marls as the top of the Blue Anchor Formation respectively.

***TEESSIDE GROUP.**

Permian, Zechstein.

Type-locality: Middlesbrough, Tees-side; widespread in north and east Yorkshire, and particularly the Yorkshire coastal districts.

Smith D.B. et al. 1974, table 7, col.34, pp.8, 39. Above the Aislaby Group, below the Staintondale Group, EZ3, includes the Upper Magnesian Limestone, Billingham Main Anhydrite, Boulby Halite (and Boulby Potash)

Rhys G.H. 1974, table 3, represents Z3 of the southern North Sea sequence.

TEIGNHEAD GROUP.**?Carboniferous, ?Permian, New Red Sandstone.**

Type-locality: Teignmouth to Exe Estuary, south Devon.

Laming D.J.C., 1966, table 1, 2. Above the Marldon Group, below the Exe Group; includes the Oddicombe Breccias, Ness Beds and Teignmouth Breccias. Red breccias with limestone, quartzite and sandstone blocks, red sandstones and marls.

Laming D.J.C., 1968, pp.23-25, fig.1 illustrates the stratigraphical relationships of the Formations within the Group.

TEIGNMOUTH BRECCIAS.*?Carboniferous, ?Permian, New Red Sandstone.**

Type-locality: Cliffs from Teignmouth north-east to near Dawlish, SX 957747.

Ussher W.A.E., 1902, as Teignmouth and Dawlish Breccias.

Ussher W.A.E., 1913, as Teignmouth type breccias.

Omerod G.W. 1875, as Murchisonite Bed.

Laming D.J.C., 1966, tables 1 and 2. Lower New Red Sandstone, top of the Teignhead Group, above the Ness Beds or Oddicombe Breccia, and below Dawlish Sands. Coarse to fine breccia, quartzite, limestone, porphyry fragments, 807.7 m thick.

Smith D.B. et al. 1974, table 6, col.26-Teignmouth to Oddicombe area, top of the local New Red Sandstone sequence, Netherton or Ness Beds below: col.26- Haldon Hills to Exe Estuary base of the local sequence in part on Culm Measures or above the Dunchideock Volcanics; top in part lateral equivalent Exminster Breccia and below the Exminster Breccias, up to 1000 m thick.

Selwood E.B., et al. 1984, pp.91-93, 103-104, as Teignmouth Breccia, greatest extent of outcrop of the ?Permian Breccias. Locally conformable on Devonian and Carboniferous rocks. Elsewhere above or interdigitates with the Oddicombe and Netherton Breccias. The Dawlish Sands occurs above. Varied suite of fragments [7 are listed], fine-coarse grained, fining upwards planar bedded units with erosional bases. Coarsest breccia at the base, sandstones at the top. Dunchideock Lavas at the base in the Exeter area.

Bristow C.R. et al., 1984a; 1984b; 1985, pp.31-42, t.2, two main subdivisions, feldspar free Alphington Breccia at the base, Heavitree Breccia with K-feldspar above. North of Exeter, the Monckerton Breccia may be present. Alluvial fan type deposits.

TESSALL BRECCIA.**?Permian, New Red Sandstone.**

(Tessall Lane Breccia.)

Type-locality: Tessall Lane, Northfield, Birmingham.

Wills L.J. and Shotton F.W., 1938, p.181, as Tessall Lane Breccia at the base of the Bunter. Sandstone with large blocks of angular quartzite.

Wills L.J., 1970, p.228, fig.1, as Tessall Breccia, above Northfield, Warley and Nechells Breccias and below Queslett Shingle Beds; lateral equivalent of the Longbridge Sandstone, Quartzite Breccia and Southalls Sandrock.

Wills L.J., 1976, pp.28, 29-33, age given as Protobunter, followed by further description.

THORNHILL SANDSTONES.**?Permian, New Red Sandstone.**

Type-locality: Thornhill, Dumfriesshire, Scotland.

Simpson J.B. and Richey J.E., 1936, p.87 as Permian sediments, Thornhill. Red beds, mainly sandstones above the Upper Carboniferous. Geikie A. et al. 1877, pp.26, 31-38, describes the sandstones at Thornhill in 3 sections:

Brick red sandstones with occasional shales and clays.

Brick red sandstones full of volcanic debris and bands of volcanic tuff.

Beds of Porphyrite with tuffs and bands of red sandstone interstratified with ashy breccia at the base.

Volcanic debris throughout the brick red sandstones in the north. Lithology identical to the sandstones of [Mauchline] Ayresshire.

Smith D.B. et al. 1974, table 4, col.3, above 'red clastics containing many breccias' and below 'water laid sandstones and breccias', 150 m thick; ?aeolian.

Brookfield M.E., 1978, pp.128-134, as Thornhill Sandstone Formation. The New Red Sandstone of the Thornhill Basin divided into 4 units: Carron Basalt, Durisdeer, Thornhill Sandstone and the Locherben Breccia

Formations. Upper part of Simpson and Richey's 1936 sequence. Type-locality redefined as Crichope Linn, southern part of the basin. Overlies Carboniferous beds or the Durisdeer Formation or interbedded with the latter. Fine-grained well sorted laminar quartzose sandstone in massive, tabular and wedge-shaped cross stratified units.

Lovell J.P.B., 1983, p.331, aeolian sandstones over 70 m thick; local top of the New Red Sandstone sequence.

THORVERTON LAVAS.

Permian, ?Rothliegende.

West of the Exe Valley, Thorverton, Exeter, see: Exeter Volcanics.

THORVERTON SANDSTONE.

?Permian, New Red Sandstone.

Type-locality: Thorverton, Exeter, Devon.

Edwards R.A. 1984, p.15, t.2. Above Cadbury Breccias or Thorverton Lavas (Exeter Volcanics). Overlain in part by, and interdigitates at the top with the Yendacott Breccia. Reddish-brown fine or very fine-grained sandstones with clay and basaltic lava at the base. Up to 140 m thick.

THURSTASTON BED.

?Trias, Sherwood Sandstone Group.

Type-locality: Thurstaston, Wirral, Cheshire.

Thompson D.B., 1970c, p.173. Representative of the Alderley Conglomerate Member in the west of the Cheshire Basin; new name for the Bunter Hard Bed or Hard Bed, Wedd et al. 1923. Red conglomerate and sandstone, one fining upward cycle only.

***THURSTASTON MEMBER.**

?Trias, Sherwood Sandstone Group.

(Thurstaston Soft Sandstone Member.)

Type-locality: Thurstaston, Wirral, Cheshire; also at Runcorn, Helsby, Delamere, Styal and Alderley-all in Cheshire.

Thompson D.B., 1970b, p.184; 1970c, p.173-177. Base of the Lower Keuper Sandstone Formation; above the Bunter Upper Mottled Sandstone Formation and below the Delamere Red Pebbly Sandstone Member, includes the Thurstaston Bed; mainly in the north-west of the Cheshire Basin. Lateral equivalent of the Alderley Conglomerate Member, [Engine Vein Conglomerates] and Beacon Lodge Sandstones in the north-east of the Cheshire Basin. Warrington G. et al. 1980, table 4, col. 9, as Thurstaston Member, part of the Helsby Sandstone Formation.

TIDCOMBE SANDS.

?Permian, New Red Sandstone.

Type-locality: Tiverton area, Devon.

Laming D.J.C., 1968, pp.23-25, fig.1. Lower New Red Sandstone, part of the Tiverton Group.

Smith D.B. et al. 1974, table 6, col.32, Tiverton Basin, ?500 m thick, above and the base partly lateral equivalent of the Chevithorne Breccias; the top partly lateral equivalent of the Sampford Peverell Breccias or below the Aylesbeare Group.

TILE HILL MARL GROUP.

?Carboniferous-Permian, New Red Sandstone.

(Tile Hill Beds Tile Hill Mudstone Formation.)

Type-locality: Tile Hill, Warwickshire.

Eastwood T., Gibson W., Cantrill T.C. and Whitehead T.H., 1923, pp.80, 87, as Tile Hill Beds. New Red Sandstone, highest part of the Corley Group. [Red] Flaggy beds and marly sandstones with conglomerates, red or greyish, green 'fish eyes'.

Shotton F.W., 1929, p.171, as Tile Hill Marl Group, redefined, excluding the Allesley Conglomerate. Red marls with thin red soft sandstones; 274 m in thickness.

See also Lexicon Fasc. 3aVIII, p.322-323. [First reference is Eastwood et al. 1923.]

Old R.A., Sumbler M.G. and Ambrose K., 1987, p.13, 15, as Tile Hill Mudstone Formation. Renamed Tile Hill Marl Group of Shotton, 1929. The mudstones are red-brown, well bedded, locally silty and with green reduction spots. It includes impersistent sandstones and a local conglomerate at Beechwood. Thickness varies from 150 to 280 m.

TIVERTON GROUP.**?Permian, Lower New Red Sandstone.**

Type-locality: Tiverton, Devon.

Laming D.J.C., 1968, pp.23-25, fig.1. Base of the New Red Sandstone of this area ?Carboniferous or Permian; includes the Chevithorne Breccias, Tidecombe Sands and Sampford-Peverell Breccias.

TODT-LIEGENDE.**Permian.**

See: Rotliegende.

TOMLIN CYCLE.**Permian, Zechstein.**

Type-locality: Borehole 59, Sandwith Series, (IGS. No. NX91SE/190), St. Bees, Cumberland.

Arthurton R.S. and Hemingway J.E., 1972, p.582. Base of the redefined St. Bees Shales; above the Fleswick Cycle (St. Bees Evaporites) and below un-named St. Bees Shales. Cycle incomplete made up of siltstones, dolomite and anhydrite; 2.4 m thickening to the west?. [Members not named.].

TOP ANHYDRITE.**Permian, Zechstein.**

Type-locality: Eskdale boreholes, east Yorkshire.

Armstrong G. et al. 1951, pp.667-689. Anhydrite, part of the Upper Permian Marl.

Smith D.B. et al. 1974, table 3, col.17, 18, 34, east Yorkshire and southern North Sea; part of the Eskdale Group, above the Sleights Siltstone and below the Saliferous Marls or Halite, EZ5; up to 1.3 m thick.

Smith D.B., 1974, table 2, the equivalent of the Grensanhydrit, Z5, top.

Smith D.B., Harwood G.M., Pattison J. and Pettigrew T. 1986, p.16, Top Anhydrite renamed the Littlebeck (Anhydrite) Formation.

TOP CONGLOMERATE.**Trias, ?Sherwood Sandstone Group.**

Type-locality: Brynlow Quarry, Alderley Edge, Cheshire.

Taylor B.J., Price R.H. and Trotter F.M., 1963. Top unit of three conglomerates within the Lower Keuper Sandstone of the Alderley Edge area; above the Middle Conglomerate and below the top beds of the Lower Keuper Sandstone. Red Conglomerate.

Thompson D.B., 1966; 1970a, p.32, renamed the unit Brynlow Conglomerate.

Thompson D.B., 1970c p.172, to be found at the base of the Nether Alderley Sandstone Member.

TOP ROCK.**Trias, Mercia Mudstone Group.**

(Top Rock Salt, Northwich Top Bed, Top Bed, First Bed.)

Type-locality: Northwich boreholes, Cheshire.

Sherlock R.L., 1921, p.22. Keuper, 8.5 m above the Bottom Bed; two thinner salt beds above. Halite, 27.6 m .

Evans W.B., 1970, pp.107-108, as the second lowest salt horizon of the Lower Keuper Saliferous Beds.

TOR BAY BRECCIAS.**?Carboniferous, New Red Sandstone.**

Type-locality: Roundham Head, Paignton, SX 896599, Tor Bay, Devon.

Laming D.J.C., 1966, tables 1 and 2. Local base of the Lower New Red Sandstone, lateral equivalent of the Livermead Beds. Limestone Breccia with interbedded aeolian sands.

Laming D.J.C., 1968, pp.23-25, fig.1, now shown below the Livermead Beds, part of the Marldon Group.

TRAPPOID BRECCIA.

See: Breccia Group, Clent Breccia Group, Warley Breccia.

TRANSITION BEDS.**Trias, ?Lilstock Formation.**

Orbell G., 1973, fig.4, pp.21, 22, reference to the Upton Park borehole, (Worsom B.C. 1963) between 172.57 m and 170.99 m. Rhaetic, above the Westbury Beds, below the Cotham Beds. Grey shales with *Eotrapezium ewaldi*, *Protocardia* sp. and *Chlamys valoniensis*. Fauna indicates more marine environment than overlying Cotham Beds although lithology more characteristic of the latter. Worsom B.C. (1963) places the Westbury Cotham boundary at 172.57 m above the grey shales. Boundary for the top of the Westbury Beds now lowered to 170.99 m.

Warrington G. et al. 1980, p.41, first reference Orbell 1973.

TRENT FORMATION.*Trias, Mercia Mudstone Group.**

Type-locality: Trent Valley from Burton to Newark; British Gypsum Quarries south of Newark, Cropwell Bishop (disused), Windmill Hill marl pit SK 4644 3358, and the Fox Holes and other south Nottinghamshire boreholes.

Elliott R.E., 1961, pp.200, 221-222. Keuper Series, above the Edwalton Formation and Hollygate Skerry and below the Parva Formation. Windmill Skerry at the top ?. Red-brown mudstones with gypsum including macroanhydrite and 'fish eyes'. Massive bedding, gypsum up to 20% in thick masses, veins and beds, of economic value, [includes the main commercial seams]; thickness of the Formation is 42.7 m.

Balchin D.A. and Ridd M.F., 1970, pp.91-101, fig.3, pl.14, include the unit in their Nottingham Group.

Warrington G. et al. 1980, table 4, cols. 11, 23, up to 88 m in thickness, extends the areal distribution of the formation into the Needwood Basin.

Taylor S.R., 1983, p.13, fig. 3, subdivides the Formation; Hawton Member at top, Fauld Member below, undifferentiated Trent Formation at the base.

TRIAS.*Mesozoic, base.**

Alberti F. von, 1834. Lowest Mesozoic System to include the Bunter, Muschelkalk and Keuper, above the Zechstein, below the Lias. [Rhaetic added later.] Red sandstones and conglomerates with finer evaporitic beds towards the top.

Sedgwick A., 1829, pp.37-124, applies the terms Bunter and Keuper to the British New Red Sandstone noting the absence of the Muschelkalk.

Hull E., 1869, p.10, base of the Trias in the United Kingdom below the Lower Mottled Sandstone or Pebble Beds if the latter are absent, eg. Budleigh Salterton.

Arkell W.J., 1933. Excludes the the British Rhaetic from the Triassic System.

Warrington G. et al. 1980, base [in Britain] should be defined on the basis of a marine stage, eg. base of the Scythian. The top defined by the *Psiloceras planorbis* Zone therefore includes the Rhaetic. Lithological units include the Sherwood Sandstone (upper part at least), Mercia Mudstone and Penarth Groups. [Original German tripartite division included the Bunter, Muschelkalk and Keuper (top). The Rhaetic was later added at the top as a fourth unit. In the UK. only the Bunter and the Keuper were recognised initially (Hull, 1869, below). With the addition of the Rhaetic or Penarth Group a tripartite subdivision is achieved if not the original one! See under Bunter, Keuper and Rhaetic for reasons why these terms are now abandoned and Warrington et al. 1980 terms preferred.]

!TRIAS SERIES.**Mesozoic, base.**

Type-locality: Midlands of England.

Hull E., 1869, p.10, table. To include the Bunter, Keuper and Rhaetic—Trias. Formations: Lower Mottled Sandstone, Bunter Sandstone or Bunter Pebble Beds, Upper Mottled Sandstone, Lower Keuper Sandstone, Newer Red Marl, Rhaetic Beds. Probably the equivalent of the Gres Bigarre and Gres des Vosges of France. Muschelkalk considered [then] to be absent in Britain.

TRITON ANHYDRITIC FORMATION.*Trias, Haisborough Group.**

Type-locality: well no. 49/21-2, southern North Sea; named after Triton Knoll, lat.53°24'30"N, long. 0°53'E. Admiralty Chart 2182A.

Rhys G.H., 1974, table 3, fig.5, pp.4-5. Top formation of the Haisborough Group, above the Dudgeon Saliferous Formation (Permian) and below the Winterton Formation (Un-named Group). Includes as the greatest thickness, the Keuper Anhydritic Member. Mudstone light to grey green at top, mainly red to red-brown below. Beds of anhydrite, white to light grey to transparent, crystalline, particularly concentrated in the

Keuper Anhydritic Member; beds of dolomite, buff, lavender and green-white occur in the upper part; 214 m in thickness.

Warrington G. et al. 1980, table 4, col.28 includes the same term.

TUNSTALL LIMESTONE.

Permian, Zechstein.

See: Middle Magnesian Limestone.

TUTBURY GYPSUM.

Trias, Mercia Mudstone Group.

(Gypsum B.)

Type-locality: Tutbury, Staffordshire; located also in southern Nottinghamshire, southern Derbyshire and east Staffordshire.

Sherlock R.L., 1928, p.63. Within the upper part of the (Keuper) Red Marls, below the Newark Gypsum; referred to briefly in Sherlock 1926 as Gypsum-B. Thin beds of gypsum with marl.

Sherlock R.L. and Hollingworth S.E., 1938, p.63. Lower of two evaporite horizons in the Midlands.

Taylor S.R., 1983, ?referred to as the Tutbury Sulphate Bed.

TUTBURY SULPHATE BED.

Trias, Mercia Mudstone Group.

Type-locality: Fauld Mine, Staffordshire.

Taylor S.R., 1983, p.13, part of the Fauld Member, Trent Formation. Major sulphate seam, 2–3 m thick in the west. [?Synonym of Tutbury Gypsum above.]

TWYFORD BEDS.

Trias, Penarth Group.

Type-locality: Twyford no.1 borehole) near Reading, Berkshire, supplemented by the Twyford no.2 borehole. (Horton A., et al. 1987)

Warrington G. et al. 1980, table 4, col.22, p.41 as 'Twyford Beds' and states forthcoming description in Chipping Norton memoir, Horton A. et al. 1987. ?Part of the Penarth Group. Arenaceous and rudaceous marginal facies of Westbury and Cotham Formations. ?Including the White Lias.

Donovan D.T., Horton A. and Ivimey-Cook H.C., 1979, pp.165-173, as arenaceous marginal Rhaetic beds'.

Horton A., et al. 1987, p.18, fig.12, p.19, fig.13, p.20, marginal facies of the Penarth Group against the London Platform. [First full description of the term; not used in Donovan et al. 1979, although the character of the beds is mentioned.] Above eroded surface of Mercia Mudstone Group and below *Psiloceras planorbis* Zone. Coarse sandstone, conglomeritic sandstone, dolomitic and calcitic sandstones and siltstones and a few dolomitic siltstones. Clay partings are rare. Sediments are poorly sorted and possess a calcareous cement. Thickness not given, at least 10 m ?; unfossiliferous.

UFFCULME CONGLOMERATES.

?Trias, Sherwood Sandstone Group.

Type-locality: Tiverton, Devon.

Laming D.J.C., 1968, pp.23-25, fig.1. ?Base of the Trias, lateral equivalent of the Milverton and ?Budleigh Salterton Pebble Beds. Un-named marls [?Littleham Beds] below and White Ball Sands above.

Warrington G. et al. 1980, p.44, "not accorded formal status in this report as it is not clear whether the rocks concerned constitute mappable units distinct from analagous formations defined in the south Devon coastal section."

!UPGANG ANHYDRITE.

Permian, Zechstein.

Rhys G.H., 1974, table 2. Middle part of Staintondale Group above the Upgang Fotion and below the Upper Halite; said to be English equivalent of the upper part of the Pegmatitanhydrit of southern North Sea sequences. [=Upper Anhydrite ?, no Upgang Anhydrite recorded in east Yorkshire sequences.]

UPGANG FORMATION.*Permian, Zechstein.**

Type-locality: Eskdale no.6 (Upgang) borehole, NZ 880117, 2 km WNW of Whitby, Yorkshire, 1214.9 m depth; widespread throughout north Nottinghamshire, Yorkshire, Durham and southern North Sea.

Smith D.B. et al. 1974, table 3 cols. 14, 15, 17; table 7, col.34, p.40. Middle part of the Staintondale Group, above the Carnallitic Marl and below the Upper Anhydrite; part of the Permian Upper Marls. An impure carbonate member [?formation], generally magnesite in east Yorkshire. [Less than 1 m ?].

Smith D.B., 1974, p.116, base of EZ4, p.137, rarely exceeds 60 cm but is extremely persistent as a sandy oolitic or pseudo-oolitic dolomite grading eastwards into an impure deposit composed mainly of magnesite.

Rhys G.H. 1974, table 2, grouped with Upgang [sic, =?Upper] Anhydrite becoming lower part of the Pegmatitanhydrit [=Upper Anhydrite] in the southern North Sea.

UPPER ANHYDRITE.**Permian, Zechstein.**

Type-locality: Middlesbrough, Lower Tees-side.

Sherlock R.L., 1921, pp.105-106. Described as part of the Upper Magnesian Limestone sequence. Anhydrite including potash salts, 9.5 m thick.

Smith D.B. et al. 1974, table 3 cols.14, 15; table 7, col.34, middle part of the Staintondale Group or part of the Permian Upper Marls, above the Upgang Formation and below un-named Permian Upper Marl with halite. Potash salts only, found at depth in north-east Yorkshire coastal area.

Smith D.B., 1974, pp.116, 138, most striking feature is the abundance of swallow tailed anhydrite, halite, sylvine and rinneite pseudomorphs after coarse fibro-radiate gypsum.

Smith D.B., Harwood G.M., Pattison J. and Pettigrew T., 1986, p.15, 16, anhydrite renamed the Sherburn Formation.

!UPPER BROCKRAM.**?Permian, Rotliegende.**

See also: Brockrams, Rotten Breccia and Penrith Breccia.

Type-locality: Vale of Eden, north-west England.

Goodchild J.G., 1893, pp.1-24. Above the Lower Brockram and the Penrith Sandstone. Breccia.

Smith D.B. et al. 1974, table 3, col.10, as Brockram.

Arthurton R.S., Burgess I.C. and Holliday D.W., 1978, lateral facies of the Penrith Sandstone.

!UPPER BUNTER.**?Trias, Sherwood Sandstone Group.**

(Upper Bunter Sandstone.)

Audley-Charles M.G., 1970, p.24). Includes the upper part of the Bunter Sandstone or St. Bees Sandstone or all of the Upper Mottled Sandstone. Attributes the term to Richardson 1929 but although implied the term does not appear in that publication. Similarly Hull 1869, for the Upper Red and Mottled Sandstone.

[See also Lower Bunter.]. Used informally by many authors, eg.: Wills L.J., 1976, table 1, p.28, instead of, or as well as, the Upper Mottled Sandstone.]

!UPPER DIVISION.**?Trias, New Red Sandstone.**

(Upper Series.)

Type-locality: Southern Arran.

Gregory J.W., 1915, p.184, both terms used. Upper Division of the New Red Sandstone or Triassic part of the New Red Sandstone. Stratigraphical equivalent of the English Keuper; Upper Red Sandstone of Gunn 1903. Lower Division is the Permian part. Includes the following formations: Bennan Shales, Auchenheav Sandstones and Shales, Levenorroch Marls, Red Shales with Green Layers and Greenish Grey Marl.

!UPPER EVAPORITE BED. 1.**Permian, Zechstein.**

(Upper Evaporite Group. 1.)

Type-locality: Eskdale boreholes, north-east Yorkshire.

Stewart F.H., 1951b, pp.557-572. Part of the Upper Permian Marls above the Carnallitic Marl and below the Saliferous Marl. Anhydrite and halite, 62.5 m thick.

Raymond L.R., 1953, referred to as the Upper Evaporite Group.

Stewart F.H., 1954b, pp.1-44, gives the thickness as 47-62.5 m and equates the horizon with the 4th Evaporite Bed of Thuringia, the Pegmatitanhydrit- Grenzanhydrit.

Smith D.B. et al. 1974, table 3, col.17, possibly listed here as Upgang Formation, Upper Anhydrite, Upper Halite, Sleights Siltstone and Top Anhydrite.

!UPPER EVAPORITE ZONE.

Trias, Mercia Mudstone Group.

(Upper Evaporite Bed 2, Upper Evaporite Group 2.)

Type-locality: Saleway Borehole, 3 miles south-east of Droitwich, SO 928 601, (ICI. Ltd.).

Wills L.J., 1970, pp.271, 273, 276. English Keuper Series, Neotrias, Droitwich Regional Stage, above the Middle Keuper Marl Group and below the Upper Keuper Marl Group; referred to as the Upper Keuper Saliferous Beds, Upper Anhydrite (Evaporite) zone in the Stowell Park Borehole, equivalent of the Newark, Cropwell Bishop and Tutbury Gypsum Beds. Red marls with beds of massive gypsum; miocyclothem KM XIV-XII.

Wills L.J., 1976, p.164 et seq. as Upper Evaporite Zone, part of the Supra- Arden Keuper Marls; upper part of the 1st Keuper Macrocylothem.

Warrington G. et al. 1980, table 4, possibly included in cols.12-14 as mudstone above the Arden Sandstone.

!UPPER GYPSEOUS SHALES.

Trias, Mercia Mudstone Group.

Type-locality: Carlisle Basin, Abbey Town and Bowness.

Holmes T.V., 1881, pp.286-297. Permian [on presence of gypsum] above the Kirklington Sandstone and below the Rhaetic or Liassic Beds. Red marls and gypsum at least 213 m thick, at Abbey Town.

Goodchild J.G. 1893, pp.1-24, renames the unit Stanwix Shales.

Dixon E.E.L., Maden J., Trotter F.M., Hollingworth S.E. and Tonks L.H., 1926. p.11, also as Stanwix Shales.

***UPPER HALITE.**

Permian, Zechstein.

(Upper Halite including the Upper Potash.)

Type-locality: Eskdale Boreholes, north-east Yorkshire.

Stewart F.H., 1951b, pp.557-572. Part of the Upper Permian Marl, above the Upper Anhydrite and below un-named marls. Rock salt.

Armstrong G., Dunham K.C., Harvey C.O., Sabine P.A. and Waters W.F., 1951, pp.667-689, provides expanded descriptive notes, and includes the Upper Potash.

Smith D.B. et al. 1974, table 3, col.17, lateral equivalent and above the Upper Anhydrite, below the Sleights Siltstone; col.18, West Sole Gas Field, southern North Sea as un-named evaporites, mainly chlorides.

Rhys G.H. 1974, table 2, considers the unit to be the equivalent of the Aller Halite, Z4 (in part), southern North Sea; fig.3, Shell/Esso well 49/26-4, the log of this well names Upper, and Lower Members totalling 59 m.

Smith D.B. 1974, p.167, 138, may also include the Upper Potash, top of EZ4.

Smith D.B., Harwood G.M., Pattison J, and Pettigrew T., 1986, p.16, term renamed Sneaton (Halite) Formation, including the Sneaton Potash Member.

!UPPER KEUPER.

Trias, Mercia Mudstone Group.

Audley-Charles M.G., 1970, p.24. Argillaceous top of the Keuper, including Keuper Marl or Red Marls, Tea Green marls, Arden Sandstone or Upper Keuper Sandstone, and Stanwix Shales.

[The term is attributed to Richardson 1929 but although the term is implied it is not actually printed; similarly Hull 1869. See also Lower Bunter; common prefix for lithological terms, see below.]

!UPPER KEUPER MARL.

Trias, Mercia Mudstone Group.

(Upper Keuper Marls, Upper Keuper Marl Group. Upper Keuper Mudstones.)

Type-locality: Leicestershire and elsewhere in the British Isles.

Harrison W.J., 1876, pp.212-218. Beds above the Upper Keuper Sandstone and below the Rhaetic Black Shales. Equivalent to the upper part of the Red Marls or New Red Marl with Grey Beds at the top. Red, grey and blue marls with gypsum.

Matley C.A., 1912, pp.252-280, above the Arden Sandstone, below the Black Shales, referred to as the Upper Keuper Marl Group.

Audley-Charles M.J., 1970, pp.19-28; p.24, as Upper Keuper Mudstones.

Evans W.B., 1970, p.108, Wem-Audlem outlier, above the Upper Keuper Saliferous Beds and below the Tea Green Marls.

Wills L.J., 1970, redefined pp.271, 273, Saleway Borehole, 3 miles south-east of Droitwich, SO 928601 (ICI. Ltd.); English Keuper Marl Series, Neotrias, Droitwich Regional Stage, above Upper Evaporite Group and below the Rhaetic and Tea Green Marls; red marls almost devoid of gypsum 36.9 m thick. Miocyclothem XV (incomplete).

Wills L.J., 1976, pp.28, 101, 164 et seq., included as part of the Supra- Arden Keuper Marls.

Warrington G. et al. 1980, prefers undifferentiated Mercia Mudstone Group.

!UPPER KEUPER SALIFEROUS MARLS.

Trias, Mercia Mudstone Group.

(Upper Keuper Saliferous Beds, Upper Saliferous Band, Upper Saliferous Formation.) See also: Upper Evaporite Zone.

Type-locality: Wilkesley Borehole, Cheshire.

Pugh W., 1960, pp.278-279. Upper of two thick rock salt and marl sequences within the Keuper Marl Series.

Poole E.G. and Whiteman A.J., 1966, as Upper Keuper Saliferous Beds, first full description, centre part of the Cheshire Basin, 396.2 m thick.

Audley-Charles M.J., 1970, pp.19-48; p.24, as Upper Saliferous Band.

Evans W.B., 1970, records 274.3 m of rock salt.

Warrington G., 1970, pp.183-224, as Upper Saliferous Formation, between Middle and Upper Keuper Marl Formations.

Wills L.J., 1970, pp.225-286, referred to as the Upper Evaporite Group.

Wills L.J., 1976, as the Upper Evaporite Zone.

Warrington G. et al. 1980, table 4, cols. 11, 12, renamed the Wilkesley Halite Formation; col.12, as the Stafford Halite Formation.

!UPPER KEUPER SANDSTONE.

Trias, Mercia Mudstone Group.

Type-locality: Forest of Arden, Warwickshire and Dane Hills Leicestershire; also in Worcestershire, Gloucestershire and Somerset.

Phillips J., 1848, pp.1-330. Within the Red Marls (Keuper Marls). Thinly bedded dolomitic siltstones and sandstones with inter-bedded grey-green and red marl.

Matley C.A., 1912, pp.252-280, suggests an alternative name, the Arden Sandstone Group.

Pugh W., 1960, uses Upper Keuper Sandstone for sandstone development above the Building Stones and below the Red Marls, in the Wilkesley Borehole. [not as Phillips J. 1848.]

Stephens J.V. 1961, p.39, renames the Upper Keuper Sandstone of Pugh W., 1960, from the Wilkesley Borehole as the Malpas Sandstone.

Warrington G. et al. 1980, p.40 subdivided geographically as Dane Hills Sandstone Member, Arden Sandstone Member, North Curry Sandstone Member and Hollygate Skerry Member.

!UPPER LIMESTONE.

Permian, Zechstein.

(Upper Thin Bedded Limestone.) See: Upper Magnesian Limestone or Upper Yellow Limestone.

***UPPER MAGNESIAN LIMESTONE.**

Permian, Zechstein.

(Upper Limestone, Brotherton Beds, ?Brotherton Limestone) See also: Concretionary Limestone, Flexible Limestone, Fulwell Limestone, Middlesbrough (Red) Beds, Roker Limestone.

Type-locality: Durham coast-Marsden to Roker; Marsden and Fulwell Quarries; Cleadon and Building Hills; Hendon; all in County Durham; Brotherton, Yorkshire.

Woolacott D., 1912, pp.241-313. Includes from the base: 1. Flexible Limestone, 2. Concretionary Limestone, 3. Upper Yellow Limestone, 4. Upper red beds with thin limestones, salts etc.. Alternative geographical names for 2. Fulwell Limestone, 3. Roker Limestone and 4. Middlesborough Red Beds.

Sedgwick A., 1829, described as the top part of 'the great middle deposit of Yellow Magnesian Limestone etc. and marls.

Howse R., 1857, pp.33-52, 304-12, 463-473, as the Upper Limestone.

Kirkby G.W., 1861, pp.287-325 named as the Upper Limestone. Robertson 1948, above the Middle Magnesian Limestone in much of Co. Durham; above the Lower Anhydrite and Lower Salt to the south, Tees-side and Yorkshire; below the main anhydrite.

Smith D.B. et al. 1974, table 3, cols. 14, 16-18; table 7, col.34. In south Durham, col.15, name replaced by Seaham Formation ?, at the Durham coast, col.16, Seaham Formation is at the top of the unit along with the Concretionary Limestone (base) Hartlepool and Roker Dolomite and the Seaham Residue. In East Yorkshire the unit occurs above the Fordon Evaporites and below the Billingham Main Anhydrite and may be equivalent to the Seaham Formation. In central Yorkshire and north Nottinghamshire the unit is placed above the Permian Middle and Upper Marls, possible synonym of Seaham Formation. Thickest development on the Durham coast, up to 243 m.

Magraw D., 1978, p.161, subdivisions include Concretionary Limestone, Hartlepool and Roker Beds, Upper Nodular Beds.

Smith D.B., Harwood G.M., Pattison J. and Pettigrew T., 1986, p.15, unit renamed the Brotherton (Magnesian Limestone) Formation.

!UPPER MARLS 1.

Trias, Mercia Mudstone Group.

Type-locality: East Warwickshire and Leicestershire.

Brodie P.B., 1870, pp.10-34. Red marls above the Upper Keuper Sandstone.

Ussher W.A.E., 1875, pp. 164-165. Red Marls above the Upper Sandstones, and below the Rhaetic Beds. Red loamy siltstones at the base succeeded by red variegated calcareous marls, locally containing beds of gypsum and dolomitic siltstone or fine-grained sandstone. [Term thus expanded for the Devonshire area.]

Matley C.A., 1912, pp.252-280, uses the term as Brodie but with fuller description.

Warrington G. et al. 1980, p.43, assigns the unit to undifferentiated Mercia Mudstone Group.

!UPPER MARLS 2.

Permian, Zechstein.

See: Permian Upper Marls.

UPPER MEMBER.

Permian, Zechstein.

See: Aller Halite.

!UPPER MOTTLED SANDSTONE.

?Trias, New Red Sandstone.

(Upper Red and Mottled Sandstone.)

Type-locality: west Midlands; Stourport, Birmingham, Wolverhampton, Hawkstone and Grinshill; also in Cheshire and Liverpool.

Hull E., 1860, pp.22-34; 1869, pp.10, 61-66. [Usually as Upper Red and Mottled Sandstone but term is shortened by Hull and subsequent authors.] Upper part of the Bunter Sandstone, above the Pebble Beds, below the Keuper Basement Beds. Moulding Sands, without pebbles or cross-bedding, 152.4-182.9 m. [implies fine-grained red sandstone with interbedded marl.]

Wills L.J., 1970, p.228. Mioclothem BSIV, Wildmoor Regional Stage, English Bunter Series, drought sequence. Terms used include named unit and Hockley Moulding Sand, Upper Wildmoor Beds, Bromsgrove Moulding Sands.

Warrington G. et al. 1980, table 4, renamed in cols.9, 10 as Wilmslow Sandstone Formation; cols.12, 13, as the Wildmoor Sandstone Formation.

!UPPER NEW RED SANDSTONE.**?Trias, New Red Sandstone.**

Type-locality: Mendips. Somerset; ?Isle of Arran, Scotland.

Murchison R.I., 1839. Calcareous conglomerate and the New Red Marl unconformably above Carboniferous Limestone.

Binney W.E., 1839, pp.37, 38-44, above red and variegated marls with magnesian limestone and below Upper Red Marls. Loose red sandstone at least 137 m. [later referred to as Pebble Beds.]

Binney W.E., 1846, p.12, as Bunter Sandstone.

Ussher W.A.E., 1875, pp.163-8, south Devon sequence including the Upper Sandstone and Upper Marl.

Gregory G.W. 1915, pp.174-187. Upper Division of the New Red Sandstone. Lower Division ?Permian on Arran.

Tyrell G.W., 1928, ?Triassic part of the New Red Sandstone on Arran.

Laming D.J.C., 1966, tables 1 and 2, including the Otter Sandstone and Upper Marls.

!UPPER NEW RED SERIES.**?Permian, ?Trias, New Red Sandstone.**

Type-locality: north-west England.

Goodchild J.G., 1893, pp.22-24. Permo-Trias, upper part of the New Red Series, includes Gypsiferous Marls (Bunter Marls), St. Bees Sandstone, Kirklington Sandstone and Stanwix Marls.

UPPER NODULAR BEDS.**Permian, Zechstein.**

Type-locality: Cullercoates to Seaham, Durham coast and offshore area.

Magraw D. 1975, pp.397-414, Zechstein, top of the Magnesian Limestone. Nodular and concretionary limestones, 15-20 m.

Smith D.B. et al. 1974, table 3, col.16, as Seaham Formation ?

Magraw D., 1978, p.161, table 1, top of the Upper Magnesian Limestone above the Hartlepool and Roker Dolomites. Limestone, grey, grey-brown, crystalline, with irregular nodules, originally thinly bedded. Calcite lined cavities with radial recrystallisation. Fossils include *Liebea squamosa*(J. de C. Sowerby), *Naticopsis minimus* (Brown), *Permophorus costatus* (Brown), *Schizodus obscurus* (J. de C. Sowerby) and ostracods. P.173, unit not definitely cored off-shore may only be of local extent.

[There appears to be some disagreement between Smith and Magraw on the terminology at the top of the Upper Magnesian limestone.]

UPPER PECTEN LIMESTONE.**Trias, Penarth Group.**See: *Pecten* Limestones.**UPPER PERMIAN.****Zechstein.**

Murchison R.I., Verneuil E. de and Keyserling A. von 1845, pp.137-70. Zechstein part of the Permian System, above the Rotliegende, below the Trias.

King W.W., 1899, pp.97-128; Breccia Group of the central Midlands, allocated to the Upper Permian.

Smith D.B. et al. 1974, table 7, col.34, p.8, of north-east England, subdivided into Don, Aislaby, Teesside, Staintondale and Eskdale Groups; east Yorkshire.

!UPPER PERMIAN LIMESTONE.**Permian, Zechstein.**

Type-locality: Market Weighton Borehole, Yorkshire.

Sherlock R.L., 1921, p.108. Synonym of the Upper Magnesian Limestone. Limestones pale grey and cream with anhydrite, 43 m thick.

!UPPER PERMIAN MARL(S).**Permian, Zechstein.**

(Upper Permian Marl and Calcareous Sandstone.) See: Permian Upper Marl.

UPPER POTASH.**Permian, Zechstein.**

See: Upper Halite and Upper Potash.

!UPPER RED BEDS WITH THIN LIMESTONES, SALTS ETC..

See: Upper Magnesian Limestone.

!UPPER RED MARLS AND GYPSUM.**Trias, Mercia Mudstone Group.**

(Upper Red Marls.)

Type-locality: ?Nottinghamshire to Durham.

Sedgwick A., 1829, pp.64, 109-110, 121. Top of the New Red Sandstone, above the Upper Red Sandstone, part of the Keuper. Gypseous red marls.

Binney E.W. 1839, pp.37-38, Manchester area, above the Upper New Red Sandstone and below drift. Dull red marls with streaks and patches of yellow and green, calcareous, 183 m in thickness.

Binney E.W. 1846, p.12, now records gypsum, saliferous marls (244 m) and Waterstones (134 m).

!UPPER RED SANDSTONE.**Permian, Zechstein.**

(Upper Red Sandstones.)

Type-locality: Nottinghamshire to Durham.

Sedgwick A., 1829, pp.27-124. Part of the New Red Sandstone Series between the Thin Bedded Grey Limestone and the Upper Red Marls and Gypsum, later, Bunter Sandstone. Yellow to red sandstones and conglomerates.

Binney E.W., 1855, pp.209-269, applied the term to north-west England. [later St. Bees Sandstone.]

Gunn W., 1903, upper part of the New Red Sandstone of Arran. Consists of fluviatile sandstones and marls, ?Keuper in age. [The Upper Division of Gregory 1916.]

!UPPER RHAETIC.**Trias, Penarth Group.**

Type-locality: Garden Cliff, Westbury-on-Severn, Gloucestershire.

Richardson L., 1911, pp.1-74. Includes beds above the Westbury Beds and below the Lias; Cotham Beds, White Lias, Sun Bed; Rhaetian.

George T.N., et al. 1969, pp.139-166, advocates abandonment of the term for British rocks.

Warrington G. et al. 1980, p.2, 12, superseded by Lilstock Formation, Penarth Group.

!UPPER SALIFEROUS BAND.

See: Upper Keuper Saliferous Marls.

!UPPER SANDSTONE.**Trias, Penarth Group.**

See: Quarella Stone.

!UPPER SANDSTONES.**Trias, Mercia Mudstone Group.**

Type-locality: Otterton Point and to the east, south Devon coast.

Ussher W.A.E., 1875, pp.164-165. Above the Pebble Beds and Conglomerates and below the Upper Marls. Red, yellow, buff or grey sandstones cemented in part, calcareous nodules, thin impersistent bands and pockets of dark red clay. Conglomerates at Otterton Point.

Laming D.J.C., 1966, table 1, renamed Otter Sandstones.

Henson M.R., 1970, pp.175-176, renamed Otter Sandstone Formation.

Warrington G. et al. 1980, table 4, col.18, as Otter Sandstone Formation.

UPPER SANDY SERIES.**?Permian, ?Zechstein.**

Type-locality: Boreholes in north-east Yorkshire.

Raymond L., 1953, p.285. Above the Upper Halite, below and merging with the Bunter Sandstone. Red Sandstone and marl.

!UPPER SERIES.

See: Upper Division.

UPPER SUBDIVISION.*Permian, Zechstein.**

Type-locality: Doncaster area, south Yorkshire; redefined as the Hampole Quarries, Doncaster, by Smith 1968.

Mitchell G.H. et al., 1947, pp.114-115. Upper part of the Lower Magnesian Limestone, above the Lower Subdivision and below the Middle Permian Marl. Grey, white, cream or buff, crystalline, often saccharoidal limestone largely composed of dolomite rhombs and cellular dolomite, porous, originally oolitic. Wedge bedding is characteristic, fossils generally uncommon, locally abundant.

Sedgwick A., 1829, p.83, as "small grain dolomite".

Smith D.B., 1968, pp.463-477, redefines the base with reference to his Hampole Beds. Base of the Upper Subdivision now above the Hampole Beds. Type-locality now redefined as the Hampole Quarries.

Smith D.B. et al. 1974, listed in table 3, col.14, 0-30 m thick.

Smith D.B., Harwood G.M., Pattison J. and Pettigrew T., 1986, p.13, term renamed Sprotbrough Member, part of the Cadeby Formation.

UPPER WERRAANHYDRIT.**Permian, Zechstein.**

Rhys G.H., 1974, table 2, fig.3. Shell/Esso well 49/26-4, southern North Sea. Top of Z1, above the Werra Halite and below the Hauptdolomit; equated with the top part of the Hayton Anhydrite of east Yorkshire, top of the Don Group; 44 m thick. [First reference for the North Sea area.]

Smith D.B. et al. 1974, table 7, col.35, top of the Werra Series.

!UPPER WILDMOOR BEDS.**?Trias, Sherwood Sandstone Group.**

Type-locality: Wildmoor Boreholes, Bromsgrove area, Worcestershire.

Wills L.J., 1970, p.228. Palaeotrias, English Bunter Series, Wildmoor Regional Stage, above the Lower Wildmoor Beds and below the Sugarbrook Basal Member (English Keuper Series). renamed Upper Mottled Sandstone, Hull 1869. Drought sequence, miocyclothem BSIV, fine red sandstones with very thin interbedded marl.

Wills L.J., 1976, the unit is also called the Hockley Moulding Sands or the Bromsgrove Moulding Sands.

!UPPER YELLOW LIMESTONE.**Permian, Zechstein.**

See also: Roker Formation, Upper Magnesian Limestone.

Type-locality: Roker foreshore, Sunderland.

Howse R., 1857, pp.33-52, 304-312, 463-473. Above the Magnesian Limestone [Later, Lower and Middle Magnesian Limestone]. Magnesian limestone and marls.

Woolacott D., 1912, p.253, Zechstein, considered to be part of the Upper Magnesian Limestone, above the Concretionary Limestone and below the Upper Red Beds with thin limestone, salts, etc..

Magraw D., Clarke A.M. and Smith D.B., 1963, pp.153-208, renamed Hartlepool and Roker Dolomite.

Smith D.B. et al. 1974, table 3, col.16, as Hartlepool and Roker Dolomite, and ?Seaham Residue, Seaham Formation.

UTON LAVAS.

South of Crediton, Devon, see: Exeter Volcanics.

VELVET BEDS LIMESTONES AND BRECCIAS.

Permian, Zechstein.

Type-locality: Seaham Borehole and Durham Coast.

Magraw D., 1975, pp.398, 404. Lower part of the Middle Magnesian Limestone, above the Frenchmans Bay Limestone and below the North Marsden Bay Limestone; 0-19m thick.

Magraw D., 1978, table 1, as above but suggests the beds may be the lateral equivalent of the Hartlepool Anhydrite, the Hartlepool Anhydrite Residue of Smith 1970 (Gash Breccias of Hickling and Holmes 1931) and the lower part of the Fore-Reef Breccia suite.

VICARAGE HILL BRECCIAS.

?Carboniferous, ?Permian, New Red Sandstone.

Type-locality: Vicarage Hill, Cockington, Devon. SX 897638.

Laming D.J.C., 1966, table 2. Lower New Red Sandstone, part of the Marlton Group, close to the base. Rubbly quartzite breccias, ?61 m.

Laming D.J.C., 1968, pp.23-25, fig.1, ?lateral equivalent of the Chelston Breccia and the Livermead Beds.

VOLCANIC GROUP.

See: Breccia Group.

WARLEY BRECCIA.

?Permian, New Red Sandstone.

Type-locality: Warley Hill, Birmingham; also Perry Hill and the Handsworth railway cutting.

King W.W., 1899, pp.117-118. Unconformable above Enville Beds (Upper Carboniferous) and below the Calcareous Conglomerate or Trias. Trappoid breccia interbedded with thick breccia-sandstones and some marls; about 23 m thick.

Boulton W.S., 1933, pp.53-83. Redescribes the breccia at Warley Hill.

Wills L.J., 1948, pp.66-70, part of the Clent Group of Breccias.

Wills L.J., 1970, p.228, ?Protobunter, similar in age and lithology to the Nechells, Northfield Breccia.

!WARMANBIE SANDSTONE.

?Trias, New Red Sandstone.

(Warmbie Sandstone).

Type-locality: Warmanbie Quarry, Annan, Dumfriesshire, Scotland.

Horne J. and Gregory G.W., 1916, p.378. New Red Sandstone, Upper part of the Annan Sandstone Series, above the Annanlea Sandstone and below thinly bedded sandstones and marls of Kirkclinton. Irregularly bedded sandstones and interbedded shales.

Pringle 1935, p.87, as Warmbie Sandstone.

Barrett B.H., 1942, pp.161-179, Annan Red Sandstone is underlain by the St. Bees Shales (Robgill Marls); this unit thus part of the St. Bees Sandstone.

!WARWICK KEUPER SANDSTONE.

Trias, Sherwood Sandstone Group.

See: Stratford and Warwick Keuper Sandstone.

!WATCHET BEDS.

Trias, ?Penarth Group.

Type-locality: Blue Anchor Point, near Watchet, Somerset coast.

Richardson L., 1911, p.15. Local new name for part of the White Lias, above Langport Beds and below the Blue Lias. [?Similar to the Pre-planorbis Beds of other areas.] Shales, marls, and thin limestones, blueish-grey or brown-yellow, about 2.4 m in thickness. Fauna recorded included: *Ostrea liassica* and *Modiola langportensis*.

Whittaker A., 1978, pp.63-67, considers all but the lowest 0.1 to 0.36 m of these beds be placed lithologically with the Blue Lias (Lower Lias).

Warrington G. et al. 1980, p.60, name abandoned, included as part of the Lilstock Formation.

***WATCOMBE FORMATION.**

?Carboniferous, ?Permian, New Red Sandstone.

(Watcombe Beds, Watcombe Breccia.)

Type-locality: Watcombe Cove, Torquay, Devon, SX 926673.

Laming D.J.C., 1966, table 2, as Watcombe Beds. Top of the Marlton Group, above the Chelston and Vicarage Hill Breccias below local unconformity and the Oddicombe Breccia. Fine-grained brown sandstone with quartz porphyry, limestone, slate, siltstone, and quartzite breccia bands; 122 m thick.

Smith D.B. et al. 1974, table 6, col.26, as Watcombe Formation, Teignmouth- Oddicombe area, local base of the sequence, Devonian below. Unit is succeeded by Oddicombe Breccias.

Selwood E.B., et al. 1984, pp.91, 92, 102, referred to as the Watcombe Breccia ?late Carboniferous; situated below the Oddicombe Breccia. Fragments of slate and sandstone with lenses and beds of coarse to medium grained clasts of sandstone, limestone and porphyry. Sandstone lenses are common. Thick reddish brown mudstones occur locally. No thickness is given.

!WATERSTONES.

Trias, Mercia Mudstone Group.

(Waterstones Formation, Waterstones Group.)

Type-locality: Ormskirk, Lancashire.

?Smith W., 1815, named on the map.

Binney E.W., 1839, pp.31. Base of the Upper New Red Marls, becoming arenaceous passing into the Upper Sandstone. [Term Waterstones not used]. Brownish sandstones, micaceous, with marl partings.

Binney E.W., 1846, p.12, attributes the name to Ormerod 1842-43.

Hull E., 1860, pp.22-34; 1869, beds above the Keuper Sandstone and below the New Red Marl; p10, 66, brownish laminated, micaceous sandstones and flags, ripple marks, with beds of sandy marl. Malpas, West Felton, Delamere Forest, Wirral, Lymm.

Elliott R.E., 1961, p.215, as Waterstones Formation of south Nottinghamshire, above the Woodthorpe Formation, below the Radcliffe Formation; in places local Keuper base. Alternating light to medium brown mudstones, laminae with thinly bedded yellow, green-grey fine-grained sandstone; medium to thick bed of sandstone may occur; parallel bedding, ripple-marks, micaceous, mudcracks, halite pseudomorphs, mudstone clasts, footprints, fish, *Lingula*.

Thompson D.B., 1970, pp.170-171, rapid interbedding of pink sandstone, siltstone and shale with abundant mica, small scale cross-stratification and mudcracking, halite pseudomorphs. Situated above the Frodsham Member, top drawn above the last 0.5 m sandstone band which is succeeded by 10 m or more of interbedded siltstone, shale or mudstone.

Balchin D.A. and Ridd M.F., 1970, fig.3, pl.14, referred to part of their Nottingham Group.

Wills L.J., 1970, pp.228, 248, 251-2, as Waterstones Group; three miocyclothem, composed of varied, multicoloured series of thin sandstones, siltstones, shales, mudstones, each with massive brown sandstones at the base. Miocyclothem KM1, KSX, KSXI; 26.8 m in the Sugarbrook no.1 borehole, Bromsgrove. Part of the Bromsgrove Regional Stage (top), Mesotrias. Also the lower part of the Droitwich Stage (15 m), red and grey thin bedded sandstones, siltstones, shales and mudstones, varves, ripples, suncracks, cavernous, underlain by massive brown sandstone, 21.6 m Miocyclothem KMI.

Wills L.J., 1976, pp.28, 102, 108, 120. Upper part of the Bromsgrove Stage, Lower part of the Droitwich Stage, below the Sub-Arden Marls.

Warrington G. et al. 1980, table 4, term abandoned in favour of local terms; cols.9, 10, Shropshire, Cheshire and south Lancashire, as Tarporley Siltstone Formation; cols. 23-25, Nottinghamshire, as Colwick Formation. See also pp.51 and 57 for description of new terms. [Waterstones in Cheshire differ lithologically from those of the East Midlands and hence the suggested need for change; the term, however, is well entrenched in the literature and will be difficult to supercede.]

WELCOMBE BRECCIA.

?Trias, New Red Sandstone.

(Welcome Breccia, Basal Welcombe Breccia.)

Type-locality: Welcombe Fields Borehole, Stratford, SP 212 562.

Wills L.J., 1970, pp.228, 257. English Keuper Series, Bromsgrove Regional Stage, local base, above the Welcombe Shingle Bed and below the Stratford Keuper Sandstone. Sandy red marl with scattered angular hematite covered pebbles up to 76 mm in diameter; those near the base wind etched, angular and quite distinct from those in the underlying conglomerate, 0-0.3 m in thickness.

WELCOMBE SHINGLE BEDS.

?Trias, New Red Sandstone.

(Welcome Shingle Beds)

Type-locality: Welcombe Fields Borehole, Stratford, SP 212562, 186.5-189.6 m depth.

Wills L.J., 1970, p.228; 1976, pp.28, 31, 151, 157, 159. Palaeotrias, English Bunter Series, Wildmoor Regional Stage, unconformably above the Enville Beds (Upper Carboniferous) and below a disconformity and the Welcombe Breccia; useful marker horizon. Usually the Pebble Beds and the Calcareous Breccia are absent from this area. Shingle conglomerate, mainly quartzite, in coarse sand, miocyclothem BSI, mainly flood sequence; up to 13.7 m thick, August Hill Borehole, Stratford; 2.4 m Tiddington; 3 m commonly.

WERRAANHYDRIT.

Permian, Zechstein.

(Werra Anhydrite, Werra anhydrit.)

Rhys G.H., 1974, table 2. Shell/Eso well 49/26-4, Southern North Sea. The unit is subdivided into Lower Werraanhydrit, Werrahalite and Upper Werraanhydrit; above the Zechsteinkalk and below the Hauptdolomit; possibly the lateral equivalent of the Hayton Anhydrite of east Yorkshire, Don Group. A lenticular anhydrite with a dolomitic mesh, thickest near the shelf margin, with ?impersistent halite band near the top; 492 m in thickness including the Werra Halite. [First reference for the North Sea area].

Smith D.B. et al. 1974, table 3, cols. 20, 35, Leman Gas Field, southern North Sea; north-west Europe (col.35), as Werra Anhydrit. Above the Zechstein Limestone and below the Main Dolomite.

WERRADOLOMIT.

Permian, Zechstein.

(Werra Dolomite)

Rhys G.H., 1974, table 2, a marginal equivalent of the Werraanhydrit, [?not recorded in the southern North Sea. ?First reference in the North Sea area.]

WERRAHALITE.

Permian, Zechstein.

(Werra Halite.)

Rhys G.H., 1974, table 2, fig.3. Shell/Eso well 49/26-4, southern North Sea, but proved in only a small number of wells in this area. Between the Lower and Upper Werraanhydrit; ?lateral equivalent of the Hayton Dolomite (in part) of the east Yorkshire sequence. Halite, transparent, pinkish in places, 23 m in thickness. [First reference in the North Sea area.]

Smith D.B. et al. 1974, table 3, cols. 20 included in the Werra Anhydrite; col.35, close to the top of the Werra Anhydrit which may correspond to the top of the Hayton Anhydrite.

***WESTBURY FORMATION.**

Trias, Penarth Group.

(Westbury Beds.)

Type-locality: Garden Cliff, Westbury-upon-Severn, Gloucestershire. Generally in England and Wales, ?Arran, Scotland.

Ramsay A., 1864, pp.xl-lx. Lower Rhaetic, synonym for Black shales, *Contorta* Shales. [in name only.]

Wright T., 1860, p.387, term used only with reference to the section at Wilmcote, Stratford-upon-Avon in the sense: 'by comparison with the section at Westbury', e.g., the Westbury Formation.

Phillips J., 1871, pp.107-109, refers to the Wilmcote section, Stratford-upon-Avon giving the thickness there as 8 m.

Richardson L., 1911, pp.1-74, renamed Lower Rhaetic, Black Shales and *Avicula Contorta* Beds of various authors. Above the Sully Beds or Tea Green Marls and below the Cotham Beds.] Black shales with thin sandy bonebeds often with limestones with abundant bivalves; 0.3-14.3 m thick. Laterally becomes arenaceous in the Bridgend (Glamorgan) area, the Lower Sandstone.

Warrington G. et al. 1980, table 4, cols. 2-4, 10-14, as Westbury Formation, base of the Penarth Group, in east Warwickshire and west Leicestershire up to 14 m in thickness.

Whittaker A. and Green G.W., 1983, p.38, above the Grey Marl and below the Cotham Beds.

WEST MINE SANDSTONES.

Trias, Sherwood Sandstone Group.

(West Mine Beds.)

Type-locality: West Mine, Alderley Edge, Cheshire.

Thompson D.B. 1966; 1970a, p.32; 1970b, p.184; 1970c, p.176. Part of the Lower Keuper Sandstone of the Alderley Edge area, above the Wood Mine Conglomerates and below the Brynlow Conglomerate, or the Nether Alderley Sandstone member. Part of, or lateral equivalent, of the Frodsham Soft Sandstone Member of the north west part of the Cheshire Basin. Soft red and mottled fine to medium-grained sandstones with thin marl bands; 17 m in thickness.

!WESTON CYCLE.

Trias, Mercia Mudstone Group.

Type-locality: Weston Mouth, east of Sidmouth, south Devon coast.

Jeans C.V., 1978, pp.549-638. Part of the Upper [Keuper] Marls, above the Dunscombe Cycle and Mudstone II and below the Bindon Cycle and Mudstone III. A carbonate, sandstone, carbonate cycle.

Warrington G. et al. 1980, p.43, considered not readily distinguished from the Dunscombe Cycle; terms not stratigraphically based, referred to [in part?] as the Weston Mouth Sandstone Member.

Warrington G. and Scrivenor R.C., 1980, consider the Dunscombe Cycle to be part of a land-slipped block, and is the same as the Weston Cycle.

***WESTON MOUTH SANDSTONE MEMBER.**

Trias, Mercia Mudstone Group.

Type-locality: Eastern end of Higher Dunscombe Cliff, SY 1580 8790, south Devon. May be represented to the east in the Winterborne Kingston Borehole.

Warrington G. et al. 1980, table 4, cols. 18, ?19, pp.43, 46, 62. Within undifferentiated Mercia Mudstone Group. Equivalent of 'Hard Greenish Band' of Woodward and Ussher 1906; Weston Cycle of Jeans 1978 [see above]. Unit of grey dolomitic mudstones and sandstones with *Euestheria* and invertebrate trace fossils.

Warrington G. and Scrivenor R.C. 1980, detailed description and discussion of Jeans C.V. 1978.

WETHERBY MEMBER.

Permian, Zechstein.

Type-locality: Disused railway cutting, Wetherby Railway Station, Wetherby, west Yorkshire, SE387496. The formation is found throughout the greater part of Yorkshire, in Humberside, Derbyshire, and Nottinghamshire.

Smith D.B., Harwood G.M., Pattison J. and Pettigrew T., 1986, pp.10-13. Renamed Compact Limestone, Lower Magnesian Limestone and Lower Subdivision. EZ1a Ca, lower part of the Cadeby Formation, above the Marl Slate, or if not developed, the Basal Breccia or Yellow Sands or Carboniferous strata, to include the lowest dolomite of the Hampole Beds or up to the Hampole Discontinuity. Below the Sprotbrough Member. Includes the Lower Marl [Permian Lower Marl] Parallel bedded pale buff altered dolomite, channel structures, small scale cross-bedding, minor erosion surfaces, some algal lamination, scattered bivalves and bioturbation. Several major variations in near shore peritidal, open shelf, restricted shelf, shelf margin, basin floor, and lagoonal environments. Contains some quartz sand especially in the south. Fossils dependent upon facies, include *Bakevella binneyi*, *Liebea squamosa*, *Permophorus costatus* and *Schizodus obscurus*, ramose bryozoa. Offshore facies in addition, brachiopods, gastropods, foraminifera. Terrigenous conifers and pteridosperms most abundant in the marl facies.

WHIPTON FORMATION.

?Permian, New Red Sandstone.

Type-locality: Stream section 9435 9419 to 9445 9406, western boundary of Northbrook School, near Whipton village, Exeter, Devon.

Bristow C.R. et al. 1984b, p.8; Scrivenor R.C., 1984, p.19; Bristow C.R. et al. 1985, pp.29-31, t.2. Base of the Exeter New Red Sandstone, above the Crackington Formation (Carboniferous) or Exeter Volcanics, and below the Alphington Breccia (Teignmouth Breccia Formation. Poorly sorted, commonly clay-rich sandstone with breccia, mudstone and siltstones; 60 m thick but thinning to the west, becoming fine-grained.

WHITE BALL SANDS.**Trias, New Red Sandstone.**

Type-locality: Tiverton area, south Devon.

Laming D.J.C., 1968, pp.23-25, fig.1. Upper New Red Sandstone, above the Uffculme Conglomerates and below the Upper Marls. Equivalent to the Nynhead and Otter Sandstones.

WHITE HOUSE BRECCIA.**?Trias, New Red Sandstone.**

Type-locality: Burcot Lane, near White House, SO 972717, Bromsgrove, Worcestershire. Also located in the Sugarbrook Borehole No.1, Bromsgrove.

Wills L.J., 1970, pp.226, 248; 1976, p.117. English Keuper Sandstone, Bromsgrove Regional Stage, base of the Building Stones Group, some 61 m above the base of the Keuper at Burcot. Coarse torrent bedded sandstones and bands of breccia and angular quartz and feldspar, and marl. Compares with the Burcot Breccia. [Possible confusion here with the Burcot Breccia ?]

!WHITE LIAS.**Trias, Penarth Group.**

Type-locality: south Midlands of England.

Townend J., 1813, pp.106, 130. Alternating limestones and shales. [This author is probably quoting from unpublished tables of Smith W. 1799 and 1812 now in the library of the Geological Society, London.]

Smith W., 1815. Above the Red Ground and below the Blue Lias, base of the Jurassic.

Moore C., 1861, p.495, includes the White Lias in the Rhaetic Formation, above the *Avicula contorta* Beds and below the Blue Lias.

Richardson L., 1906, pp.1-74, excludes the White Lias from the Rhaetic.

Arkell W.J., 1933. Describes the White Lias as part of the Rhaetic, basal part of the Jurassic, reviews nomenclature problem- ?Trias or Jurassic; all beds above the Black Shales (Westbury Beds), beds above the Cotham Beds, or beds above the Langport Beds; all below the Lias.

Warrington G., 1974a, p.158, as Langport (White Lias) facies, top of the Cotham Beds, nodular limestone with Sun Bed at the top.

Warrington G. et al. 1980, p.60, name abandoned, unit now the top Member of the Lilstock Formation, Penarth Group, where 'White Lias Facies' is developed.

!WHITEMOOR SANDSTONES AND MARLS.**?Carboniferous, ?Permian, New Red Sandstone.**

Type-locality: Kenilworth, Warwickshire.

Richardson L. and Fleet W.F., 1926, pp.283-305. Part of the Enville Series, above the Kenilworth Breccias, 39.6 m in thickness. Red marls and thin sandstones.

Shotton F.W., 1929, pp.167-220, basal beds of his Ashow Group.

!WILDMOOR BEDS.**Trias, Sherwood Sandstone Group.**

See: Lower Wildmoor Beds, Upper Wildmoor Beds, Wildmoor Sandstone Formation, Wildmoor Regional Stage.

WILDMOOR REGIONAL STAGE.**?Trias, New Red Sandstone.**

(Wildmoor Stage, Birmingham Bunter.)

Type-locality: Wildmoor quarries and boreholes, north of Bromsgrove, Worcestershire. Also, the Bellington Boreholes, south-east of Kidderminster.

Wills L.J., 1970, pp.228, 234; 1976, p.238. English Bunter Series, below the English Keuper Series and the Bromsgrove Regional Stage. Includes from the base, the Welcombe, Queslett and Sling, Shingle Beds; the City Road Beds and the Lower Wildmoor Beds; Upper Mottled Sandstone subdivided into the Hockley and Bromsgrove Moulding Sands and the Upper Wildmoor Beds. Renamed Bunter Sandstone of Hull 1869. Miocyclothem BSI, BSIIA, BSIIIB, BSIII, BSIV, about 282 m thick.

***WILDMOOR SANDSTONE FORMATION.**

?Trias, Sherwood Sandstone Group.

Type-locality: Wildmoor Quarries, about SO 960765, north of Bromsgrove, Worcestershire. Also widespread throughout Worcestershire, Hereford, south Staffordshire and west Warwickshire.

Warrington G. et al. 1980, table 4, cols. 12, 13, pp.38, 62. Above the Kidderminster Formation and below the Bromsgrove Sandstone Formation. The base may be indistinct, taken above the last pebbly layer of the Kidderminster Formation; renamed Upper Mottled Sandstone of the central Midlands. [Fine-grained red-brown sandstones with very thin marl seams.] Up to 150 m thick.

Wills L.J. and Sarjeant W.A.S., 1970, pp.387-398, record the presence of trace fossils.

***WILKESLEY HALITE FORMATION.**

Trias, Mercia Mudstone Group.

Type-locality: Wilkesley Borehole, Shropshire, SJ 6286 4144. Generally in the south Cheshire Basin.

Warrington G. et al. 1980, table 4, cols.9, 10, pp.34, 63. ?Carnian, within undifferentiated mudstones. New name for the Upper Keuper Saliferous Beds, Pugh 1960, Poole and Whiteman 1966. Halite with thin red mudstones, up to 400 m in south Cheshire, north Shropshire. Miospores recorded.

WILLITON MEMBER.

Trias, Mercia Mudstone Group.

Type-locality: St. Audries Bay, ST 103431; also found at Blue Anchor ST 045438 and east of the harbour at Watchet, ST045438.

Mayall M.J., 1981. Top part of the Blue Anchor Formation, above the Rydon Member and below the Westbury Formation (Penarth Group). Above an erosion surface with *Diplocraterion* burrows which have caused brecciation of the sediments. Previously known as the Sully Beds (part). Grey shales with units of flaser and lenticular bedded sands and silts. Silt streak beds with desiccation cracks at the top at Watchet and Blue Anchor. Thin intraformational conglomerate at the base; well bioturbated throughout. Bivalves include *Gervillia*, *Protocardium*, *Eotrapezium*, *Modiolas* and *Chlamys*. Microplankton recorded by Orbell G.M. 1973, and Warrington G. 1974, probably from this Member. Thickness varies from 0 to 3 m.

***WILMSLOW SANDSTONE FORMATION.**

?Trias, Sherwood Sandstone Group.

Type-locality: Wilmslow to Alderley Edge and Tilston, north Cheshire, e.g. SJ 4621 5147.

Warrington G. et al. 1980, table 4, cols.9, 10, pp.31, 63. Above the Chester Pebble Beds Formation and below the Helsby Sandstone Formation. Renamed Upper Mottled Sandstone of the Cheshire Basin. [Fine-grained red-brown sandstones with very thin marls seams], up to 425 m recorded in south Cheshire and north Shropshire.

Taylor B.J., Price R.H. and Trotter F.M., 1963, pp.61-62—description of the Upper Mottled Sandstone of the Wilmslow Area.

WINDMILL SKERRY.

Trias, Mercia Mudstone Group.

Type-locality: Windmill Hill marl pit, Cotgrave, south Nottinghamshire, SK 4644 3358; Hollygate Lane south, Candleby Lane north-central, and Fox Hole Boreholes.

Elliott R.E., 1961, pp.222. Keuper Series, within the lower part of the Trent Formation. Two or three thin beds of greenish sandstone or sandy mudstone within moderately brown siltstone, 3 m.

Balchin D.A. and Ridd M.F., 1970, pl.14, fig.3, include the Trent Formation and this unit as part of their Nottingham Group.

Warrington G. et al. 1980, term not included in the tables.

***WINTERTON FORMATION.**

Trias, ?Penarth Group.

Type-locality: well no, 49/21-2, southern North Sea. Named after Winterton Ridge, lat. 52°50', long. 2°00', Admiralty Chart 2182A.

Rhys G.H., 1974, table 3, fig.5, pp.4-5. Top formation of the Trias, (unnamed group), above the Triton Anhydritic Formation and below the Lias (Jurassic). Includes the Rhaetic Sandstone Member. Shale, dark grey, non-calcareous and mudstone, light grey-green and light brown. Total thickness is 76 m.

Warrington G. et al. 1980, table 4, col.28, p.50, in part at least equated with the Penarth Group.

WIVELISCOMBE BEDS.**?Permian, New Red Sandstone.**

Type-locality: Milverton and Wiveliscombe, Devon.

Laming D.J.C., 1968, pp.23-25, fig.1. Lower New Red Sandstone, local base of the red bed sequence below un-named marls and the Milverton Conglomerates. Red sands and breccias.

!WOODHOUSE TOWER SANDSTONE.**?Trias, New Red Sandstone.**

Type-locality: Woodhouse Tower, north of Annan Lea, Annan, Dumfriesshire. Also seen in Kirkpatrick and Boneham Tower Quarries; at Kirtle Bridge Mill, Markland, and Stapleton Tower.

Horne J. and Gregory G.W., 1916, pp.379-80. Part of the Annan Sandstone Series, above the Robgill Marls and below the Annanlea Sandstone. Coarse grained sandstone with interbedded shale; no mica, channelling or mudstone clasts.

Barrett B.H., 1942, pp.161-179, Robgill Marls equated with the St. Bees Shales this unit therefore the base of the St. Bees Sandstone north of the Solway Firth. Stratigraphically equivalent to the Allerbeck Sandstone.

WOOD MINE CONGLOMERATES.**Trias, Sherwood Sandstone Group.**

(Wood Mine Beds.)

Type-locality: Wood Mine, Alderley Edge, Cheshire.

Thompson D.B., 1966; 1970A, p.32; 1970b, p.184; 1970c, p.176. Within the Lower Keuper Sandstone, the middle of three conglomerate bands. Above the Beacon Lodge Sandstones and below the West Mine Sandstones. Renamed Middle Conglomerate of Taylor B.J. et al. 1963. A development of the Delamere Pebbly Sandstone Member in the north-east of the Cheshire Basin. Red conglomerates and coarse sandstones; 42 m in thickness.

Taylor B.J., Price R.H. and Trotter F.M., 1963, as Middle Conglomerate.

Warrington G., 1965, p.113, 122, as Wood Mine Beds, mineralised conglomerates and coarse sandstones containing copper minerals and barite.

WOODTHORPE FORMATION.**Trias, Mercia Mudstone Group.**

Type-locality: Woodthorpe, Nottingham, SK 4583 3437; also roadcutting at Redhill; and summit of Glade Hill and Hazel Hill, Bestwood; located in the Edwalton, Clipston, Stoke-Bardolph, Leahurst south and Wilford Hill south boreholes. Re-exposed in the abandoned railway-cutting, adjacent to the water-treatment plant, Colwick Road, ex. Suburban Railway.

Elliott R.E., 1961, p.211. Keuper Series, basal formation, above the Bunter Pebble Beds and below the Waterstones Formation; possible unconformities above and below the unit. Rhythmic alternation of buff and yellow-green sandstones and red mudstones. The lowest sandstones may contain small irregular pebbles. At least 6 rhythms up to 3 m each. Annelid tracks, footprints, *Schizoneura* (?artifacts), vugs and geodes are present lined with calcite, total thickness about 15.2 m.

Balchin D.A. and Ridd M.F., 1970, fig.3, pl.14, include the formation in their Nottingham Group.

Warrington G. et al. 1980, table 4, col.23, base of the Mercia Mudstone Group, above the Nottingham Castle Formation and below the Colwick Formation. Passes northwards into the argillaceous Retford Formation.

WYTCH FARM BRECCIAS.**?Permian, New Red Sandstone.**

Type-locality: Wytch Farm X14 well. [Dorset]

Collier V.S. and Harvard D.J., 1981, p.498, fig. 4, p.501. Unconformable above low-grade metamorphic basement and below the Aylesbeare Group. Age is based on structural evidence. Angular clasts of pale grey-green mudstone and well foliated pale grey phyllite with quartz pebbles and very little matrix; more than 61 m thick.

!YELLOW EARTH.**?Zechstein.**

Strachey J., 1719, p.968. Between Red Earth and Ochre, and Lias Limestone and Marl.

Conybeare W.D. and Phillips W., 1822, considered to be the top part of the Newer Red Sandstone. [?Possibly renamed by Smith 1815, the Magnesian Limestone.]

YELLOW MAGNESIAN LIMESTONE.

See: Magnesian Limestone.

***YELLOW SANDS.**

?Permian, ?Rotliegende.

Type-locality: Durham and south Northumberland, possibly north Yorkshire.

Daglish J. and Forster G.B., 1864, pp.206, 209, 213. Above the Coal Measures and below the Magnesian Limestone, local term. Friable yellow sand, thickness variable; major aquifer.

Sedgwick A., 1829, p.67, as "yellow, incoherent, coarse siliceous sand," part of the Lower Red Sandstone, derived from denuded Carboniferous rocks and Rotliegende in age.

Hutton W., 1830, p.60, subdivides the Lower Red Sandstone into a lower variegated red, yellow and purple compact sandstone and an upper light buff incoherent sand to be known as the Yellow Sand. Considered both to be the same age, Rotliegende, and unconformable on Coal Measures.

Howse R., 1857, p.235; 1890, p.251; Lower red part contains Carboniferous plants and the overlying Yellow Sands rests unconformably upon it. Yellow sands might be equivalent to the German Weissliegende.

Green A.H., 1872, pp.99-101, as Quicksand.

Howell H.H., 1881, term used on Geological Survey Maps but not described.

Lebour G.A., 1902, pp.370-391, more detailed description, including mode of deposition.

Woolacott D., 1912, pp.252, 257, located at Claxheugh, Cullercoates Bay, Tynmouth High Downs Quarry; false-bedded, layering poor, mainly quartz grains but many others including felspar, mica, garnet, zircon, tourmaline; larger fragments are rounded, aeolian ?. Yellow only when weathered, otherwise grey poorly cemented, but often compact near the top, unfossiliferous, up to 45.7 m thick.

Hodge M.B., 1932, pp.410-458, reviews the subject and extend petrographic knowledge.

Smith D.B. et al. 1974, table 3, cols. 14, 16, 17, north Nottinghamshire to Durham; Durham coast and east Yorkshire, usually above a thin breccia or on Carboniferous beds. Marl Slate is above. ?Lower Permian, p.17 as Yellow Sands or Basal Permian Sands, former has historic precedence, p.8, Yellow Sands and Basal Breccia; thickness up to 60 m.

Smith D.B., 1974, p.116, as Basal Permian (Yellow) Sands and Breccias. [Note comment on historic precedence above !]

YENDACOTT BRECCIA.

?Permian, New Red Sandstone.

Type-locality: Yendacott, Thorverton, Devon.

Edwards, R.A., 1984, p.39. Above, and interdigitates with the top of the Thorverton Sandstone. Red breccia, with more varied clasts than the Cadbury Breccia, clayey, fine-grained, Culm sandstone fragments, quartz porphyry, pink lava fragments; thickness up to 300 m.

***ZECHSTEIN.**

Permian, Upper.

Type-area: Thuringia, north-west Germany.

Lehmann J.G., 1756. Part [?upper] of the Yellow Earth.

Sedgwick A., 1829, p.121, first applies the term to British rocks, part of the New Red Sandstone.

***ZECHSTEIN CYCLES.**

Permian, Upper.

(Zechstein Groups, Zechstein Series.)

Smith D.B., 1970a, p.67, Zechstein cycles EZ1-EZ4 equated with corresponding lithological units. [First use with British stratigraphy.] EZ1-Marl Slate, Lower Magnesian Limestone, Middle Magnesian Limestone. EZ2-Upper Magnesian Limestone except the Seaham Beds. EZ3-Seaham Beds, Billingham Main Anhydrite, Middle Halite. EZ4-Upper Anhydrite, Sneaton Halite.

Smith D.B. et al. 1974, table 7, col.35, North-west Europe; Zechstein 1-5 (top), including the Werra, Stassfurt, Leine, Aller, and Ohre Series. Col.34, East Yorkshire, Don, Aislaby, Teesside, Staintondale and Eskdale Groups. Stratigraphical application of European Zechstein sedimentary cycles to Britain, see EZ1-4 above.

Smith D.B., 1974, table 2, p.116, use of the symbols EZ1-5, (English Zechstein), based on east Yorkshire boreholes, Durham and Yorkshire coasts; names as above, Don-Eskdale Groups.

- Rhys G.H. 1974, table 2, Shell/Esso well 49/26-4 as main log, southern North Sea. Permian, Upper, compares with Don-Eskdale Groups of the east Yorkshire sequences, defined above. Z1 includes Kupferschiefer, Zechsteinkalk, Lower Werraanhydrit, Werra Halite, Upper Werraanhydrit; Z2-Hauptdolomit, Basalanhydrit, Stassfurt Halite, Deckanhydrit; Z3-Grauer Salzton, Plattendolomit, Hauptanhydrit, Leine Halite Z4-Roter Salzton, Pegmatitanhydrit, Aller Halite; ?Z5-Grenzanhydrit.
- Smith D.B., Harwood G.M., Pattison J. and Pettigrew T., 1986, p.9-16, scheme extended to include subcycles, units and lithologies, i.e. EZ1b Ca, Cadeby Formation, Sprotborough Member; EZ5A Littlebeck (Anhydrite) Formation.

ZECHSTEIN KALK.

Permian, Zechstein.

(Zechstein Limestone)

- Rhys G.H., 1974, table 2, Shell/Esso well 49/26-4, southern North Sea. Zechstein, Z1, above the Kupferschiefer (Marl Slate) and below the Lower Werraanhydrit (Hayton Anhydrite); considered as the lateral equivalent of the Lower Magnesian Limestone of Yorkshire. Dolomite, calcitic, to limestone, dark grey to brown-grey, argillaceous in parts, 5 m in thickness.
- Smith D.B. et al. 1974, table 3, cols.20, 35, Leman Gas Field, southern North Sea and North-west Europe sequence. Above the Copper Shale and below the Werraanhydrit, or between the Kupferschiefer and Werradolomit, Z1.

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