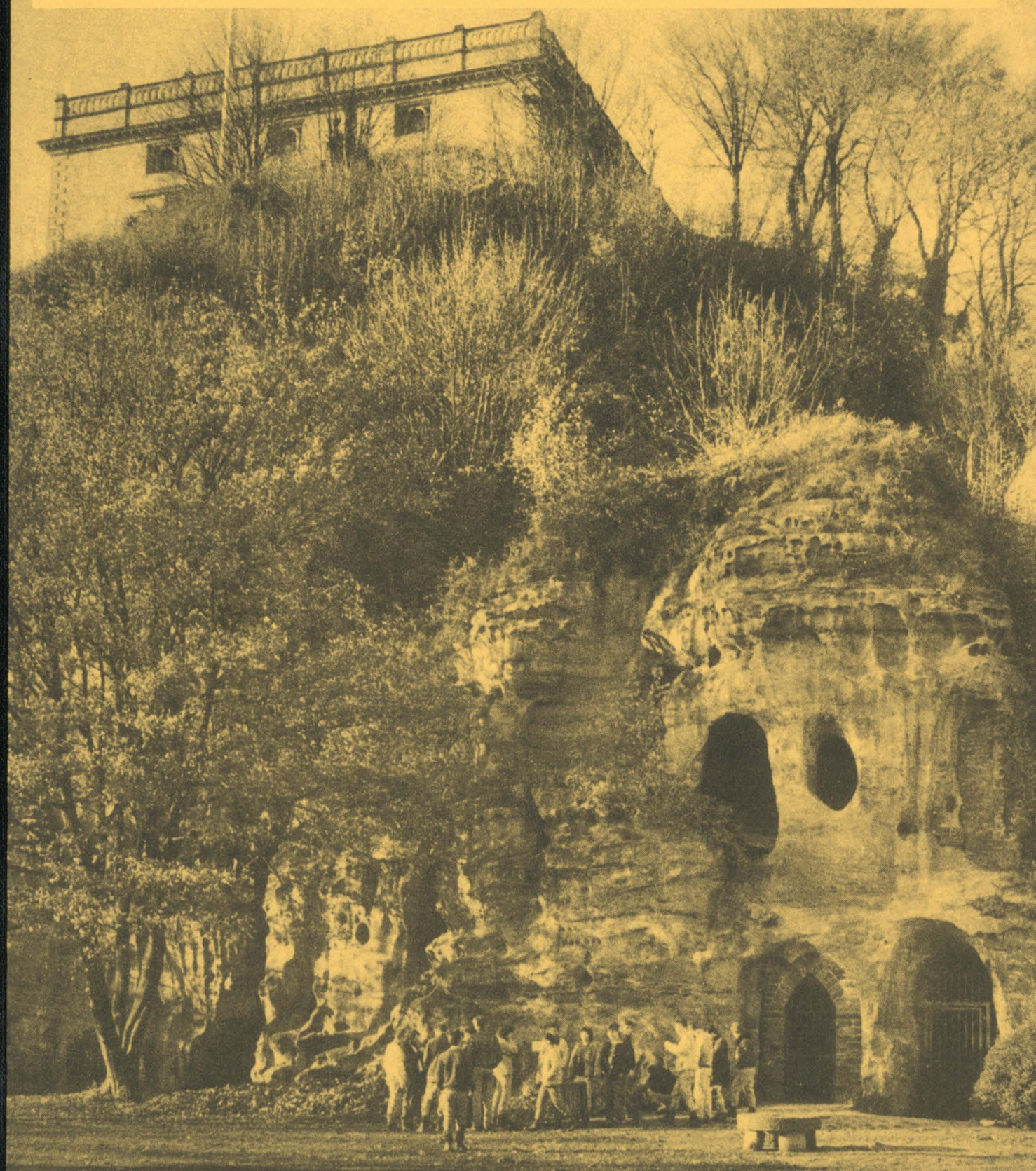
THE *Mercian Geologist*



A LEXICON OF NEW RED SANDSTONE STRATIGRAPHY

Compiled by F.M. TAYLOR

and published by the East Midlands Geological Society

Vol. 11, Nos. 1 & 2

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THE EAST MIDLANDS GEOLOGICAL SOCIETY

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CONTENTS

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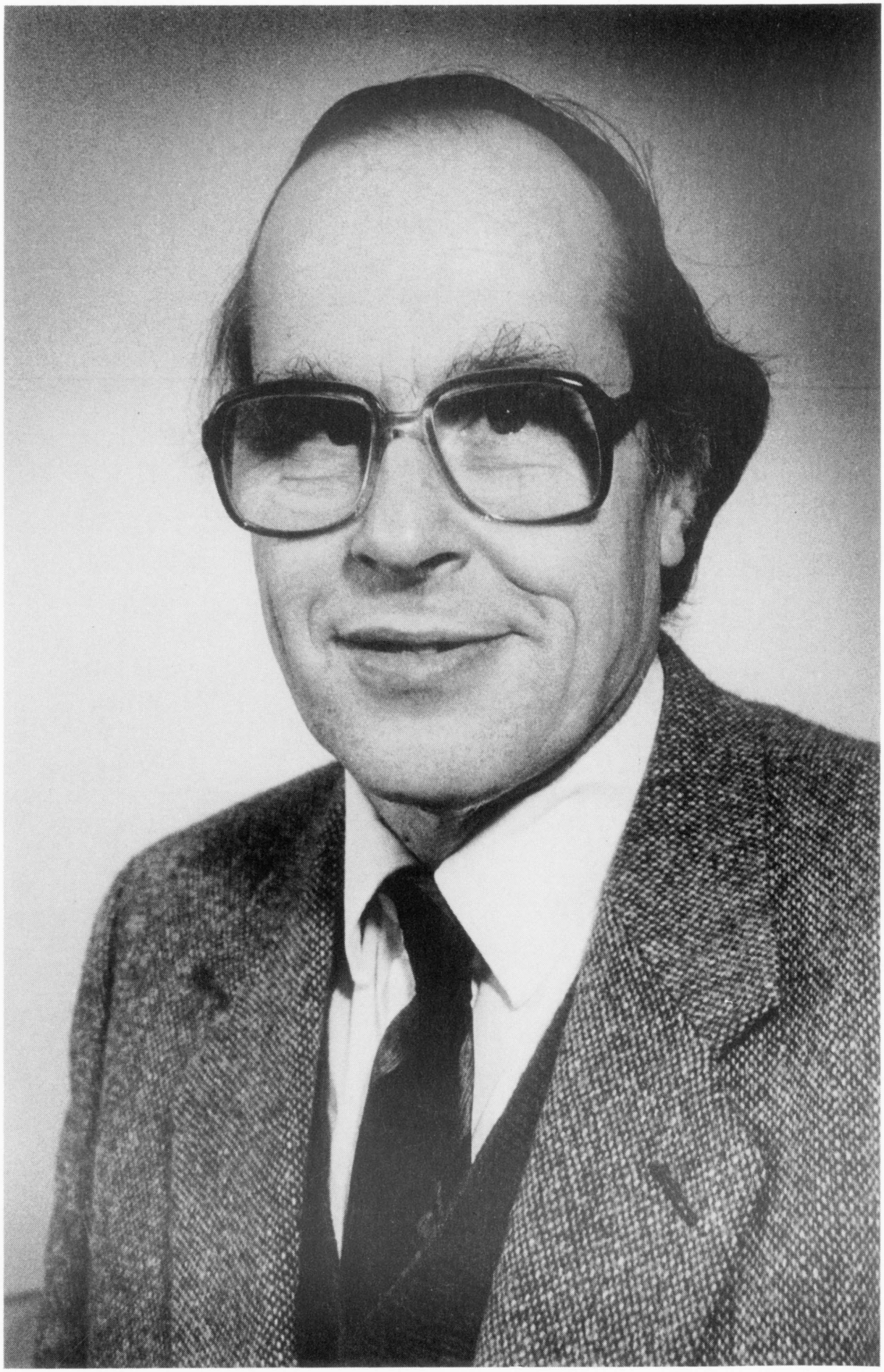
EDITORIAL PREFACE

Although the Council of the East Midlands Geological Society regrets that, for financial reasons, the International Geological Congress were not able to publish this Lexicon the Society is pleased and proud to do so. All members I am sure will feel that it is most appropriate that the E.M.G.S. should have stepped into the breach because much of the Society's field work and publications have centred on the New Red Sandstone. In addition it is a fitting tribute to the author, for whose hard work and inspiration the Society will always be indebted.

For those members brought up on terms such as Bunter Sandstone and Keuper Marl the modern nomenclature of Sherwood Sandstone and Mercia Mudstone Groups have a comforting familiar ring. Similarly at formation level the Lenton Sandstone, Nottingham Castle and Colwick Formations are but three examples, based on local type-exposures, which are now widely recognised in the Midlands. Nottinghamshire exposures were critical to the controversy between Trechman and Sherlock, earlier this century, about the relationship between the Permian and Triassic—an ongoing debate to which Dr. Taylor has added detailed evidence in the pages of the Mercian Geologist. Also it was in Nottinghamshire that R.E. Elliott (a former President) pioneered stratigraphical and mapping techniques which have subsequently been widely applied to the Mercia Mudstone Group. Similarly the late Sir Peter Kent (a former trustee) added much to our knowledge of the Rhaetian in the East Midlands and elsewhere.

Many other members of the Society have contributed to our knowledge of the New Red Sandstone, none more so than Dr. Taylor himself. It is thus wholly appropriate that he should write and the E.M.G.S. should publish this lexicon which, with apologies to Rudyard Kipling, might be dubbed, "How the N.R.S. got its names".

Frank Taylor (following the tradition of H.H. Swinnerton) was one of a small group of adult education tutors whose enthusiastic teaching led, in 1964, to the formation of a local geological society. It was he who gave the Society's first public lecture and led one of its first field excursions. A founder member, secretary from Feb. 1967 to Feb. 1970, President for the succeeding three years and Editor (a thankless task) for ten years from Feb. 1973 to Feb. 1983, Frank has been mentor and guide throughout the Society's existence. As with generations of university students members have learned to respect his astringent comments and his professionalism and to rely heavily on him for advice. Even though he resigned from the Council when he gave up the editorship he is still, in effect, the Society's business manager dealing with the distribution of this journal, a service for which the present editor is most grateful.



Dr. F.M. Taylor, B.Sc., Ph.D., F.G.S., M.I.Geol.

A LEXICON OF NEW RED SANDSTONE STRATIGRAPHY

written to conform with the

INTERNATIONAL LEXICON OF STRATIGRAPHY

Volume 1, EUROPE.

Part 3a, England Wales and Scotland.

Section IX.

New Red Sandstone: Upper Carboniferous (in part), Permian and Triassic.

Compiled by F.M. TAYLOR.

and published by the East Midlands Geological Society

INTRODUCTION

The International Lexicon of Stratigraphy (Lexique Stratigraphique Internationale) has been published in separate sections by the International Geological Congress through the Centre Nationale de la Recherche Scientifique, Paris, since the early 1950's. The work was arranged as an alphabetical list of stratigraphical terms applicable to the separate continents. Volume 1 represented Europe and parts of the volume were numbered on a National basis, part 3a, England, Wales and Scotland. Individual sections were published stratigraphically. Volume 1, part 3a, contains sections I–XIII, listed below. For financial reasons, the I.G.C. are no longer able to continue printing the individual sections and therefore the current section has been offered to the East Midlands Geological Society for publication as a separate part of the Mercian Geologist. The I.G.C. numbering system has been retained although the format has had to be changed somewhat, including the page size of the volume.

The present volume should have been the penultimate section, the last being part 3a section I, the General Introduction. The list of the separate parts of Vol.1, part 3a, with the names of the Recorders responsible for the compilation of the entries is given below:

3aI	General Introduction	Not yet published.
3aII	Precambrian	J.G.C. ANDERSON.
3aIII	Cambrian	C.J. STUBBLEFIELD.
3aIV	Ordovician	W.F. WHITTARD.
3aV	Silurian	W.F. WHITTARD.
3aVI	Devonian	S. SIMPSON.
3aVII	Lower Carboniferous	T.N. GEORGE and W.W. BLACK.
3aVIII	Upper Carboniferous	F.M. TROTTER.
3aIX	New Red Sandstone including the Upper Carboniferous (in part), Permian and Trias.	F.M. TAYLOR.
3aX	Jurassic	D.T. DONOVAN and J.E. HEMINGWAY.
3aXI	Cretaceous	J.M. HANCOCK.
3aXII	Paleogene	D. CURRY.
3aXIII	Neogene and Pleistocene	K.P. OAKLEY.

Entries for the New Red Sandstone stratigraphical units were started initially by J.E. Richey, S. Simpson, F.W. Shotton, C.J. Stubblefield and as Recorder for the Jurassic part, W.H. Whittard (Rhaetic terms). The first few records, prepared about 1970, were unfortunately mislaid and have only recently been discovered. In the meantime the present Compiler commenced compilation and has since used the early records as a valuable check on his results. Whilst acknowledging the work of the above, responsiblilty for the accuracy of the records as listed

remains with Dr. F.M. Taylor, who would be pleased to receive any corrections or additions of terms that may have been missed.

A number of changes have been made concerning the format of this part of the Lexicon. Firstly it differs from previously published sections in that a lithological term, New Red Sandstone, is used as the main title and includes therefore names from three Systems; the red beds of the Upper Carboniferous above the Keele Group; and from the Permian and Triassic Systems. Some terms from the Upper Carboniferous may also be found in part 3a, VIII, of the Lexicon.

In the alphabetical list which follows the first form (or commonly used later form) of the term is given in bold capitals with synonyms included within () brackets on the line(s) below. The present accepted age of the term is also given on the first line in bold lower case type; a ? indicates that there is no fossil or radiometric evidence available for the suggested age, either from the unit itself or adjacent strata.

The type locality of the term is given as indicated by the original author or as redesignated by a subsequent author; the general geographical extent is then listed which may be the only entry here for the larger stratigraphical units.

In order to save a considerable amount of space the bibliographic detail is given in full at the end of the alphabetical stratigraphical section. Only the author's name(s), dates and page numbers are given in the text. Author's names are followed by the stratigraphical information if this differs from the first line entry. Lists of sub-units within the term start with the oldest and end with the youngest, at the top of the sequence. This is followed by the lithological and palaeontological information, which is abridged if the original description is of great length. The absence of stratigraphical, lithological and or palaeontological information should mean that none was provided by the original author. Major changes affecting the name are listed in date order subsequent to the original publication(s).

An * indicates a recommended term in the following standard references:

Smith D.B. et al. 1974. A correlation of Permian rocks in the British Isles. *Special Rept. no.5, Geol. Soc. London.* [All terms in the tables included in this reference are spelt with capital letters.]

Warrington G. et al. 1980. A correlation of Triassic rocks in the British Isles. *Special Rept. no. 13, Geol. Soc. London.*

Rhys G.H., 1974. A proposed standard lithostratigraphic nomenclature for the southern North Sea and an outline structural nomenclature for the whole of the (UK) North Sea. *Rept. no. 74/8, I.G.S.*, tables 2-3, figs. 2-5, pp.4-5, uses German terms for some southern North Sea Permian and Triassic units. Only the first British reference is given; readers should consult the appropriate part of the Lexicon for the original reference and type-locality.

An ! mark before a name indicates that the term is no longer used or that it is recommended that it should not be used.

For readers unfamiliar with the Permo-Triassic literature of the Midlands it should be remembered that Edward Hull commenced revision of Permo-Triassic terms in 1859 and brought all the information together in his publication of 1869. The Triassic and Permian rocks of the Midlands Counties of England, *Mem. G.S.G.B.*, which is considered as the definitive work at that time. Most of his earlier publications are difficult to locate. Confusion can arise because Wills L.J., 1976, was largely written before Wills L.J., 1970, and that terms appearing in the 1970 paper are justified in the paper eventually published in 1976.

Comments enclosed within [] are the opinion of the Recorder of this part of the Lexicon.

ALPHABETICAL LIST OF NEW RED SANDSTONE TERMS

A-BED. **Permian, Zechstein.**

(A Bed, 'A' Bed, A-Bed Anhydrite, A-Bed Evaporite, 'A' Gypsum and anhydrite with grey marl, 'A' Gypsum Horizon.)

Type-locality: Boreholes in the Kirkby Thore and Long Martin area, Vale of Eden, Westmorland.

Sherlock R.L. and Hollingworth S.E., 1938. Written as 'A' Gypsum and anhydrite with grey marl. [Subsequent authors have each varied the spelling and abbreviation of this term; Arthurton's 1971 is preferred.] The

unit is found a few metres above the top of the Penrith Sandstone, base of the Hilton Plant Beds or the St. Bees Shales [later Eden Shales], below the B, C, and D-Beds. Gypsum and anhydrite, with grey marl, 0-12 m.

Arthurton R.S., 1971, p.1, as A-Bed in the description of the Langwathby Borehole. Situated in the lower part of the Eden Shales, below grey plant-bearing clay-mud and quartz siltstone and above dull red siltstone and sandstone. Grey brown nodules of anhydrite set in a matrix of red and grey laminated siltstone and silty mudstone. Anhydrite may be replaced by gypsum..

Smith D.B. et al. 1974, table 3, col.10, as A-Bed Anhydrite, base of the Eden Shales.

Arthurton R.S. and Wadge A.J., 1981, pp.74, 77, 128, the A-Bed consists of a number of thin lenticular beds compared with the single layers of the B, C or D-Beds. Full bibliography is given on p.82.

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

Type-locality: Lower slopes of Abberley Hills, north end of the Malvern Ridge, near Kidderminster, Worcestershire. Continues also to the south at Woodbury Hill, Rosemary Rock, and Berrow Hill.

Phillips J., 1848, pp.160-162. At the base of the New Red Sandstone, unconformable on Silurian and older rocks, below the Calcareous Conglomerate. Quartzite pebble conglomerate with angular trappoid blocks up to 0.6 m diam. Some calcareous cement and red marl. [Thickness not given but probably less than 30.5 m.]

Ramsay A.C., 1855. pp.188-205, suggests Permian age, ice origin, demonstrates further sedimentary characteristics and describes the fragments.

Wills L.J., 1948, p.67, part of the Clent Group, [see: Clent Breccias] haematite covered quartz pebbles with Malvernian fragments.

***AISLABY GROUP.** **Permian, Zechstein.**

Type-locality: Eskdale No.2 borehole, NZ 858082, Aislaby, Whitby; throughout E. Yorkshire with possible extension into the rest of Yorkshire, Durham and possibly into the southern North Sea.

Smith D.B. et al. 1974, table 7, col.34, pp. 8, 38. EZ2, above the Don Group, below the Teesside Group; including the Kirkham Abbey Formation and Fordon Evaporite Formation.

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

Type-locality: Alberbury, Shropshire.

Murchison R.I. 1839, pp.48-49, as calcareous breccias at Alberbury.

Ramsay A.C., 1855, p.204, local base of the New Red Sandstone. [No description or thickness given.]

Eastwood T., 1922, p.27, above Upper Carboniferous Erbistock Beds and below the Lower Mottled Sandstone. Possible lateral equivalent of the Clent, Haffield etc. Breccias. Reddish, purplish calcareous, large proportion of Carboniferous Limestone blocks.

Pocock R.W. et al. 1938, pp.130-153 description; thickness given as 34 m.

Smith D.B. et al. 1974, table 5, col.22, West Shropshire, thin?.

Lexicon, 3aVIII, p.10.

ALDERGROVE BEDS. **Upper Trias-Lias.**

Type-locality: Aldergrove, Somerset.

Palmer C.P., 1972, pp.7, 9-11, 26. The complete unit is Rhaeto-Liassic in age, beds A1-A24, below A25 which contains *Psiloceras planorbis*. These are the Pre-*planorbis* Beds of other authors; A1-3 are the Watchet Beds of Richardson 1911 and A8 is the *Ostrea* Bed of Etheridge 1872. Shales, paper shales and limestones, 7.68 m thick.

Warrington G. et al. 1980, p.45, basal part, below the first appearance of *Psiloceras planorbis,* is Triassic.

ALDERLEY CONGLOMERATE MEMBER. **?Trias, Sherwood Sandstone Group.**

Type-locality: Western part of Alderley area, Cheshire. Elsewhere in the north-east area of the Cheshire Basin.

Thompson D.B., 1970b, p.184; 1970c, p.173, 174, 177. Keuper, base of the Keuper Sandstone Formation, lowest Member, above the Upper Mottled Sandstone and below the Delamere Red Pebbly Sandstone Member. Lateral equivalent, but not continuous, with the Bunter Hard Bed; or Thurstaston Bed [Sandstone] of the

north-east part of the Cheshire Basin. Red pebbly coarse sandstone, 10 fining upwards cycles at Alderley, impersistent, variable in thickness, up to 34 m. In Haymans Farm borehole 10 cycles recognised but no pebbles. At Styal, one cycle of red pebbly sandstone lithofacies, 5 m thick found, with thick development of soft sandstone lithofacies.

Taylor B.J., Price R.H. and Trotter F.M., 1963, referred to as Basal Conglomerate.

Warrington G., 1965, p.113, 122, as Engine Vein Beds mineralised lower red conglomerate at Alderley Edge.

Thompson D.B., 1966; 1970a, p.32; 1970b, p.184, referred to as the Engine Vein Conglomerates; p.184, consituent part of the Alderley Conglomerate Member.

'ALGAL BED'. **Permian, Zechstein.**

Type-locality: Trow Point, Central Durham Coast.

Magraw D., 1978, pp.161, 176. Lowest part of the Middle Magnesian Limestone, resting on the Lower Magnesian Limestone and below the Velvet Beds Limestones and Breccias. [Middle Magnesian Limestone, in part.] Limestone, irregularly laminated, with small nodules; early stage of reef formation, 0.15 m thick. [N.B. Term used p.176 without caps, informal term ?]

Smith D.B., 1958 p.73; 1967, pp.119 and 120, fig.22; 1972, pp. 75, 76, refer to algal nodules and stromatolites. [Concentrated also at the top of the Middle Magnesian Limestone in some localities.]

***ALLER HALITE.** **Permian, Zechstein.**

Rhys G.H., 1974. table 2, fig.3. Shell/Esso well, southern North Sea, 49/26-4. Z4, above the Pegmatitanhydrit and below the Grenzanhydrit; equated with the Upper Halite including the Upper Potash of east Yorkshire; subdivided into:

Upper Member-red brown mudstone with potash salts and halite.

Lower Member-potash salts in top 6 m, lower part halite with traces of potash salts with anhydrite.

Total thickness is 59 m.

Smith D.B. et al. 1974, table 3, cols. 18, 19—as Halite; col. 20 as Salt IV; col.35, as Aller Halite, part of the Aller Series of Germany.

!ALLERBECK SANDSTONES. **?Trias, New Red Sandstone.**

Type-locality: Quarry north of Kirtle Bridge, Annan, Dumfriesshire. Also right bank of Kirtle Water, south of kennels, near Allerbeck Cottage; and the Logan and Catgill Burns.

Horne J. and Gregory G.W., 1916, p.382. Lower part of the Annan Sandstone Series, above Carboniferous Limestone Series or ?Dumfries Sandstone if developed, below the Robgill Marls. Soft sandstones and shales. [Generally considered that the Annan Red Sandstone Series is the same formation as the St. Bees Sandstone, with the Allerbeck Sandstone as the local basal deposit.]

Barrett B.H., 1942, pp.161-179, pl.14, considers that the Allerbeck Sandstone occurs above the Robgill Marls and that the term is a synonym of the Woodhouse Tower Sandstone.

ALLESLEY CONGLOMERATE. **?Upper Carboniferous, ?Permian, New Red Sandstone.**

(Allesley Conglomerates.)

Type-locality: Allesley, Warwickshire.

Eastwood T., Gibson W., Cantrill T.C. and Whitehead T.H., 1923, pp.77, 86, 87, as Allesley Conglomerates. Part of the Corley Group, ?Upper Carboniferous; or part of the Enville Group, ?Permian. Red sandstones with conglomerates. At the top, silicified tree trunks—*Cordaites brandlingi* (Witham), see Buckland W., 1836, p.439.

Shotton F.W., 1927, pp.604, 606, as Allesley Conglomerate, highest of three conglomerate bands, thin. poorly developed.

[See also the Arley and Exhall Conglomerates and the Corley Conglomerate.]

Lexicon 3aVIII, p.10.

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

Type-locality: Alphington, Devon. Also the village of Shillingford and the south-west of Exeter.

Bristow C.R. et al. 1984a, Scrivenor R.C. 1984, Bristow C.R. et al. 1985, p.32. Base of the Teignmouth Breccia Formation, above the Whipton Formation and below the Heavitree Breccia. Mudstone rich breccia with fragments of Culm Measures, chert, slate, quartz porphyry and hornfels; up to 240 m thick. [Lacks K-feldspar fragments.]

Smith D.B. et al. 1974, table 6, col.29, as Heavitree and Alphington Breccia.

!ANNAN RED SANDSTONE SERIES. **?Trias, New Red Sandstone.**

(Annan Sandstone, Annan Series.)

Type-locality: Annan to Gretna, north of the Solway Firth.

Horne J. and Gregory G.W., 1916, pp.374-386. Unconformable on Carboniferous, overlain by glacial deposits. [Usually correlated, lithologically, with the St. Bees Sandstone of Cumbria.]

Interbedded red sandstones and shales comprising:

Allerbeck Sandstone, Robgill Marls, Woodhouse Tower Sandstone, Annanlea Sandstone and Warmanbie Sandstone (top).

Harkness R., 1862, pp.205-218, as Upper Sandstone, in continuity with the similar [St. Bees] sandstone south of the Solway.

Craig G.Y., 1965, described as St. Bees Sandstone, New Red Sandstone, ?Trias.

Smith D.B. et al. 1974, p.25, refers to water-laid footprint bearing sandstones and mudstones of Annandale high in the sequence which may be Upper Permian; not listed in the tables.

Brookfield M.E. 1978, not mentioned.

Warrington G. et al. 1980, table 4, col.7, E. Dumfries and Galloway, north and west Cumbria, as St. Bees Sandstone Formation, ? on St. Bees Shale and Eden Shale Formations, ?Kirklinton Sandstone Formation above.

Lovell J.P.B. 1983, p.333-4, follows Smith D.B. et al. 1974, preferring[?] a Permian age but still compares the sequence with the Carlisle Basin and the Vale of Eden and not with the sandstones elsewhere in S.W. Scotland.

!ANNANLEA SANDSTONE. **?Trias, New Red Sandstone.**

Type-locality: Annanlea Quarry, Annan. Also, Cove, South Woodhead and Corsehill Quarries.

Horne J. and Gregory G.W., 1916, pp.374-386. Middle part of the Annan Red Sandstone Series, above the Woodhouse Tower Sandstone and below the Warmanbie Sandstone. Compact light red sandstone, sharp angular grains of quartz, felspar and white mica. Regularly and thinly bedded with interbedded red shale, up to 0.6m thick; some cross-bedding, channelling, no dune-bedding or quartz pebbles, some mudstone clasts. Sandstone may be white, about 36.6 m. [The Annan Red Sandstone is generally considered to be the lateral equivalent of the St. Bees Sandstone. This unit is therefore a local development within that unit.]

***ARDEN SANDSTONE MEMBER.** **Trias, Mercia Mudstone Group.**

(Arden Sandstone, Arden Sandstone Horizon, Arden Sandstone Group.)

Type-locality: Arden Forest, Warwickshire. Re-designated by Warrington G. et al. 1980 at Rowington, SP 201691, and Shrewley, SP 212674, in the same area. Elsewhere in Worcestershire and Gloucestershire, e.g., Burgshill Quarry; Elderfield; Ripple, 3 miles north of Tewksbury; Inkberrow 12 miles north-east of Worcester.

Matley C., 1912, pp.252-280. Named as Upper Keuper (Arden) Sandstone Group or as Arden Sandstone. Keuper Series, Keuper Marls, renamed Upper Keuper Sandstone Phillips 1848. Coarse grained grey-buff dolomitic sandstone with interbedded red grey mudstone layers. 6.0-9.0 m; mudcracks, footprints.

Wills L.J., 1970, p.271, Saleway borehole, Droitwich, as Arden Sandstone Horizon, 0.3 m dark grey shaley marl, mudcracks, footprints; KMX, Droitwich Regional Stage, Middle Keuper Marls.

Warrington G. et al. 1980, table 4, cols. 12, 13, 14, 15, pp.40, 55. as Arden Sandstone Member, Mercia Mudstone Group. Possibly equivalent to the Dane Hills Sandstone Member (Leicestershire), or the Hollygate Skerry (Nottinghamshire).

ARDWICK LIMESTONE. **Permian, Zechstein.**

Type-locality: Ardwick, Manchester.

Binney E.W., 1855, 1857; pp.209-269; 107-120. Part of the Upper Permian marls and limestones of the Manchester area. [Later Manchester Marls.] Dolomitic seam(s) up to 0.6 m in thickness separated by red shales; synonym of the Bedford Limestone. [These limestones presumably different from those recorded by Binney 1846, p.16 from the same area within red shales containing Upper Carboniferous plants—*Neuropteris, Pecopteris, Sphenopteris, Lycopodites, Lepidophyllum, Asterophyllites;* see also Lexicon 3aVIII p.23, Ardwick Group.]

ARLEY AND EXHALL CONGLOMERATES. **?Upper Carboniferous, ?Permian, New Red Sandstone.**

Type-locality: Arley, Exhall, Warwickshire.

Gibson W., 1914, p.20, conglomerate at Arley similar to that of Exall.

Eastwood T., Gibson W., Cantrill T.C. and Whitehead T.H., 1923, pp.77, 82-84. ?Permian, part of the Corley (Enville) Group. Coarse red brown sandstones with conglomerates, up to 30.1 m.

Shotton F.W. 1927, pp.606, 614, lowest of three bands in the Enville or Corley Series.

Lexicon 3aVIII p.23.

***ASHOW GROUP.** **?Permian, New Red Sandstone.**

(Ashow Formation.)

Type-locality: Warwickshire Coalfield.

Shotton F., 1929, pp.170, 179-181. ?Upper Carboniferous to Lower Permian. Located above the Kenilworth Breccias and below the Kidderminster Conglomerate. Mainly red sandstones with marls and thin sandstones (Whitemoor Marls of Richardson and Fleet 1926) at the base. Total thickness is about 192 m; includes *Dasyceps bucklandi, Walchia piniformis, W. cf. imbricata, Oxyodon ?sp.*

Smith D.B. et al. 1974, table 5, col.25, Warwickshire Coalfield, Permian, above the Kenilworth Breccia Group and below Kidderminster Conglomerate Formation, 190 m in thickness.

Wagner R.H. 1983, pp.151-2, compares flora and reptile tracks from the Mauchline Volcanic Group with occurrences in the English Midlands and suggests an Autunian (Lower Permian) age for beds above the Keele Beds.

Old, R.A., Sumbler M.G. and Ambrose K. 1987, pp.13, 17, as Ashow Formation. Top formation of the Enville Group, overlies the Kenilworth Sandstone Formation. In the Warwick area, overlain unconformably by the Bromsgrove Sandstone Formation. Predominantly argillaceous with several thick sandstones; 170 m in thickness.

Lexicon 3aVIII p.24.

ASTLEY COURT LIMESTONE. **?Upper Carboniferous, ?Lower Permian, New Red Sandstone.**

Type-locality: Astley Court, Warwickshire, not found 'in-situ'.

Eastwood T., Gibson W., Cantrill T.C. and Whitehead T.H., 1923, pp.77, 80,84, 88, 90. Estimated position 61.0 m above the Arley-Exall Conglomerate, ?Coventry Colliery ?Shaft, Keresley, Warwickshire. *Spirobis* limestone, found in blocks, 203 mm thick, at the surface of type-locality.

See also the Lexicon 3aVIII, p.27.

AUCHENCAT BRECCIA FORMATION. **?Permian, New Red Sandstone.**

Type-locality: Lower reaches of the Auchencat Burn, Moffat, NT076104-079104.

Brookfield, M.E. 1978, pp.137. Relationship of this formation to the Corehead Sandstone Formation in the Moffat Basin is obscured by faulting; possibly younger. Red sandy breccia, breccia sandstone and fine-grained sandstones the latter with aeolian bedding. Thickness of 50 m recorded at the type-locality.

[Part of the Moffat Basin New Red Sandstone, base not seen ?]

Lovell J.P.B., 1983, p.333, partly unconformable on, and partly faulted against, Lower Palaeozoic rocks.

***AUCHENHEW MUDSTONE FORMATION.** **Trias, Mercia Mudstone Group.**

(Auchenhew Beds, Auchenhew Sandstones, Auchenhew Shales.) See also: Bennan Shales.

Type-locality: Stream and coastal section around Auchenhew, southern Arran, Scotland, NS 010210.

Warrington G. et al., 1980, table 4, col.3, pp.26, 55. Above the Lag a'Bheith Formation, below the Levencorroch Mudstone Formation. Renamed Auchenhew Sandstones and Shales of Tyrell 1928.

Gregory J.W., 1915. pp.174-187, as Auchenhew Sandstones, Auchenhew Shales and Benan Shales.

Tyrell G.W., 1928. pp.77, 96-103, described as Auchenhew Sandstones and Shales which includes the Bennan Shales of Gregory.

Craig G.Y., 1965, as Auchenhew Beds (in part), as this term also includes Tyrell's Lag a'Beith Mudstones and Cornstones.

Warrington G. et al. 1973. pp.112-113, sparse miospore assemblage indicates late Scythian to Anisian age.

Lovell J.P.B., 1983, p.328, 329, sequence about 200 m thick.

!*AVICULA CONTORTA* BEDS. **Trias, Penarth Group.**

(*Avicula contorta* Series, *Avicula contorta* Shales, *Avicula contorta* Zone.) See also: *Contorta* Zone, Westbury Formation.

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

Portlock J.E. 1843, p.126, pl.XXVA, fig.16, as *Contorta* Zone.

Wright T., 1860. pp.376, 377, 378. Moore C., 1861, p.483. Upper Keuper, between the top of the Keuper Marl and base of the *Ammonites planorbis* Beds (top). Previously known as the Lower Marl (De la Beche 1826,); Lower Marls (Conybeare and Phillips 1822.) Black shales with *Avicula contorta,* with sandstones, limestones and bonebeds, 24.4 m thick at Westbury. [Position of the White Lias in Wright's paper is uncertain, could be included in the Jurassic. Thickness suggests that the later named Cotham Beds is included.]

Egerton P, Sir, 1841, p.409, fish remains indicate Triassic rather than Jurassic age.

Tate R., 1867, pp.364-369, suggests a Jurassic age for these beds.

Wilson E., 1891, table p.546, listed as *Avicula contorta* Shales.

Richardson L., 1911, pp.5, 9, renamed as Westbury Beds.

AYLESBEARE GROUP. **?Permo-Trias, New Red Sandstone.**

Type-locality: Aylesbeare, south Devon; also exposed from the Exe Estuary to Budleigh Salterton, Exeter, and Silverton-Bradninch areas, S. Devon.

Smith D.B., et al. 1974, table 4, cols. 28-30, pp.27-31, 38. Term includes the Exmouth and Littleham Formations. Generally found above the Langstone Beccia or Clyst Sands and below the Budleigh Salterton Pebble Beds; 200 to 520 m in thickness.

Bristow C.R. et al. 1984a; 1985, status changed to formation.

AYLESBEARE MUDSTONE FORMATION. **?Permian, New Red Sandstone.**

Type-locality: Cliff sections between Exmouth and Budleigh Salterton.

Bristow C.R. et al. 1984a), p.8; Edwards R.A., 1984a, pp.9-17, 1984b; 1984c, pp.10-22. Bristow C.R. et al. 1985. New status for Aylesbeare Group Smith D.B. et al. 1974, with redesignated type-locality. Above the Dawlish Sandstone Formation and below the Sherwood Sandstone Group. Comprises the Exmouth Mudstone and Sandstone, Straight Point Sandstone and Littleham Mudstone [Members?]. Equivalent to the Lower Marls of Ussher W.A.E. 1902, and Exmouth and Littleham Beds of Laming D.J.C. 1966. Reddish brown clays and mudstones with impersistent mostly thin sandstone beds particularly at the base; 300 to 400 m in thickness.

B-BED. **Permian, Zechstein.**

('B' Bed, B-Bed Anhydrite, B-Bed Evaporite, 'B' Gypsum-Anhydrite, 'B' Gypsum Horizon)

Type-locality: Boreholes in the Kirkby Thore and Long Marton area, Vale of Eden, Westmorland. Generally found throughout the Vale of Eden and northwards into the Carlisle Basin.

Sherlock R.L. and Hollingworth S.E., 1938, described as 'B' Gypsum-Anhydrite. Towards the base of the Hilton Plant Beds, St. Bees Shales, [later Eden Shales]; above the A-Bed and below the C-Bed. Gypsum and anhydrite, 3.0-6.1 m thick.

Arthurton R.S., 1971, p.4, as B-Bed, Langwathby Borehole, within grey mudstones and siltstones with plant remains. Varved, layered, mottled and algal mat anhydrite, 4.88 m thick.

Smith D.B. et al. 1974, table 3, col.10, as B-Bed Anhydrite; p.15, as B-Bed evaporite, 5-7 m thick.

Arthurton R.S. and Wadge A.J., 1981, pp.74-82, B-Bed has the widest lateral extent of the Vale of Eden evaporite beds. [Full bibliography on p.82.]

***BACTON GROUP.** **?Trias, New Red Sandstone.**

Type-locality: Conoco well 49/21-2, Phillips well 52/5-1X, southern North Sea. Unit named after Bacton Village, Norfolk coast, lat.52*51'N, long.1*28'E, Admiralty chart, 2182A.

Rhys G.H., 1974, table 3, fig.4, pp.4-5. Lowest group of the southern North Sea Trias above Permian Zechstein deposits and below the Haisborough Group; includes the Bunter Shale Formation with Brockelschiefer and Bunter Sandstone Formation with Rogenstein Member.

Warrington G. et al. 1980, table 4, col.28, p.50, equivalent to the Sherwood Sandstone Group ?.

BALLANTRAE BRECCIA GROUP. **?Permian, New Red Sandstone.**

Type-locality: Ballantrae, Ayrshire, NX083832.

Brookfield M.E., 1978, p.140. Above Ordovician rocks infilling of a small cuvette extending into the Firth of Clyde; in places below the Corseclays Sandstone Formation. Well sorted graded red breccias with thin silty sandstone lenses more common towards the top. Clasts mainly of chert but also of serpentine, greywacke, argillite and gabbro.

Lovell J.P.B., 1983, pp.331, 332-3, lack of information on age; as Brookfield, 1978.

!BALLYMICHAEL SANDSTONE. **?Permian, New Red Sandstone.**

Type-locality: Ballymichael Glen, southern part of the Isle of Arran, Scotland.

Gregory J.W., 1915, p.187. Lower Series (Lower Division); above the Lamlash Sandstone, below the Bennan Shales. Light coloured yellow, carious sandstone.

Tyrell G.W., 1928, p.77, 85, renamed as the Glen Dubh Sandstone.

***BARR BEACON BEDS.** **?Trias, New Red Sandstone.**

Type-locality: Barr Beacon, Great Barr, Walsall; extends from Aldridge to the south of Barr Beacon, Staffordshire.

Landon J., 1890, pp.124-125. Unconformably above the Upper Carboniferous; basal beds of the Bunter Pebble Beds. Red sandstones with thin layers of breccia, about 30.5 m thick.

Boulton W.S., 1933, pp.66-69. Above Enville Beds, Carboniferous, below Bunter Pebble Beds. ?local base of the Bunter, compare with the High Habberley Breccia, Hopwas and similar breccias. Red and yellow false-bedded sand rock with strings of fine quartz breccia.

Smith D.B. et al. 1974, table 5, col.24, 30 m thick, above Clent or Nechells Breccias, below Kidderminster Conglomerates. Local equivalent of the Quartzite, or Hopwas Breccias.

Wills L.J., 1976, p.29, age given as Protobunter, Upper Permian or Lower Trias, comparable in age with the Quartzite Breccia.

***BASALANHYDRIT.** **Permian, Zechstein.**

(Basal Anhydrite.)

Rhys G.H., 1974. table 2, fig.3. Shell/Esso well 49/26-4, southern North Sea. Z2 in part, above the Hauptdolomit and below the Stassfurt Halite. Anhydrite commonly dolomitic, white to light grey, with some intercalations of argillaceous dolomite, light grey to light brown. The top 50 m is more dolomitic than the lower part, 10 m in thickness.

Smith D.B. et al. 1974, as Basal Anhydrite, table 3, col.20, Leman Gas Field, southern North Sea; table 7, col.35, North West Europe, base of Stassfurt Evaporites, Z2; or base of the Fordon Evaporites of East Yorkshire.

!BASAL BRECCIA.

See: Brockram, Permian Basal Breccia, Quartzite Breccia, Keuper Conglomerate.

BASAL BRECCIAS AND SANDSTONES. **?Permian, New Red Sandstone.**

Brookfield M.E., 1978, pp.136-137. Not formally designated but considered to be a distinct set of beds beneath the Corehead Sandstone Formation. Basal part of the Moffat Basin New Red Sandstone, but exposed in only 2 localities. Massive unsorted breccias with massive clasts of greywacke and argillite overlain by fine-grained sandstones and breccias. Thin silty lenses common in the sandstones; a total of 5 m seen.

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

Type-locality: Alderley Edge, Cheshire.

Taylor B.J., Price R.H. and Trotter F.M., 1963. Lowest of three conglomerate horizons, at the base of the Lower Keuper Sandstone. Above the Lower Mottled Sandstone, below the Middle Conglomerate. Red Conglomerate.

Warrington G., 1965, p.113, 122, referred to as Engine Vein Beds.

Thompson D.B., 1966; 1970a, p.32; 1970b, p.184, as Engine Vein Conglomerates.

Thompson D.B., 1970b, p.184; 1970c, p.173, 174, 176, 177, as a constituent part of the Alderley Conglomerate Member.

BASAL KEUPER CONGLOMERATE.

See: Keuper Conglomerate.

BASAL PERMIAN BRECCIA.

See: Permian Basal Breccia.

BASAL PERMIAN SANDS. **?Permian, ?Rotliegende, New Red Sandstone.**

See also: Yellow Sands.

Type-locality: Yorkshire.

Versey H.C., 1925a, pp.200-214. ?Rotliegende, above Carboniferous Beds or Permian Basal Breccia and below the Marl Slate. Redistributed aeolian sands, up to 21.3 m in thickness.

Smith D.B., 1974, described pp.116, 120, as Basal Permian Sands or Basal Permian Sands and Breccia.

Smith D.B. et al. 1974, p.17. prefers 'Yellow Sands', a term having historic precedence. Lateral equivalent of the Permian Basal Breccia.

!BASAL RED SANDSTONES. **?Permian, New Red Sandstone.**

Type-locality: Road section, west of Stogumber, Minehead, west Somerset.

Thomas A.N., 1940, p.3, also referred to as Red Sandstones, p.12, as Red Sandstones and Basal Breccias, synonym of Lower Sandstones of Ussher W.A.E., 1908, pp.3, 40-44. Base of local Carboniferous-Permian red bed sequence, below the Breccio-Conglomerates. Well bedded, soft weathering red sandstones with breccia bands at the base.

!BASAL TUFFS AND CLASTICS. **?Permian, New Red Sandstone.**

See: Mauchline Volcanic Group.

!BASAL WELCOMBE BRECCIA.

See: Welcombe Breccia.

!BASEMENT BEDS. **Trias, Sherwood Sandstone Group.**

(Keuper Basement Beds, Basement Beds Group.)

Type-locality: Central Midlands; redesignated by Wills 1970, Sugarbrook No.1 Borehole, Stoke Prior, Bromsgrove, SO 961682. Sections described near Stourbridge, Stourport, Wolverhampton; at the Hawkstone, Peckforton, Longley and Simmonds Hills (Delamere Forest); the Wirral, Liverpool, and Ormskirk; Castle Donington, Derby and Nottingham.

Hull E., 1860, pp.22-34; 1869, pp.10, 66-98. Above the Upper Mottled Sandstone, and below the Building Stones, lower part of the Lower Keuper Sandstone. Irregularly bedded sandstones with calcareous conglomerate or breccia; with beds of marl and mottled calcareous beds similar to the cornstones of the Old Red Sandstone, up to 41.8 m thick, usually less than 15.2 m.

Wills L.J., 1970, pp.228, 249-250, recorded as Basement Beds Group, 64.3 m thick; KSII-KSIV Miocyclothems, incl. 7 microcyclothems. Thick massive brown sandstones with scattered angular pebbles and a few bands of pebbly sandstone interbedded with 8 bands of chocolate marl, (up to 3.7 m thick), sometimes with calcareous race (sic). Lowest sandstone (Burcot Breccia) coarse and pebbly. Pebbles of felspar and quartz.

Warrington G. et al. 1980, table 4 as ?basal beds of the Helsby, and Bromsgrove Sandstone Formations.

BEACON LODGE SANDSTONE MEMBER. **?Trias, Sherwood Sandstone Group.**

Type-locality: Beacon Lodge, Alderley Edge, Cheshire.

Thompson D.B. 1966; 1970a, p.32; 1970b, p.184; 1970c, p.176. Lower part of the Lower Keuper Sandstone, above the Engine Vein Conglomerate and below the Wood Mine Conglomerate. Lateral equivalent in the north-west part of the Cheshire Basin of the Thurstaston Soft Sandstone Member. Soft red and yellow mottled sandstone, 12 m thick. [?Presumably, lithofacies D.]

BEDFORD LIMESTONE. **Permian, Zechstein.**

Type-locality: Bedford (Colliery), Manchester.

Binney E.W., 1839, p.48. Limestones at Bedford overly Lower New Red Sandstone [Collyhurst Sandstone] and above the Coal Measures.

Binney E.W., 1855, pp.236-239, records *Bakevellia, Schizodus*, and *Tragos sps.* Part of the Upper Permian marls and limestones of the Manchester area. [later Manchester Marls.] Dolomite seam(s) up to 0.6m in thickness. Synonym of the Ardwick Limestone.

***BELAH DOLOMITE.** **Permian, Zechstein.**

Type-locality: R. Belah and boreholes in the Kirkby Thore and Long Marton area, Vale of Eden, Cumbria.

Meyer H.O.A., 1965, pp.74, 79. [Description but not named.] Above un-named mudstones and the C-Bed and immediately below the D-Bed. Part of ?Hilton Plant Beds or lower part of the St. Bees Shales. Impure dolomitic limestone, 3.0 m thick.

Arthurton R.S., 1971, pp.1, 3. [First use of the name but no description.]

Smith D.B. et al. 1974, table 3, col.10, Vale of Eden, 0-6 m, ?the equivalent of the Fleswick Dolomite of west Cumberland.

Arthurton R.S. and Wadge A.J., 1981, description pp.75, 76, and including a faunal summary.

BELFORD SANDSTONE MEMBER. **?Permian, New Red Sandstone.**

Type-locality: Belford, Exeter, Devon.

Bristow C.R. et al. 1985. Preliminary reports in Bristow C.R. 1983, p.8; Scrivenor R.C. 1983, p.11. Middle part of the Dawlish Sandstone Formation of the Exeter area, above the Bussell's Mudstone and below the Poltimore Mudstone. Fine, medium and coarse-grained sandstone, 80 m thick.

BELLCRAIG BRECCIA FORMATION. **?Permian, New Red Sandstone.**

Type-locality: Bellcraig Lynn, Moffat, NT106013-113014.

Brookfield M.E., 1978, p.139. Located at the edge of the Moffat Basin, either above Ordovician or Carboniferous rocks, possible similar in age to part of the Auchencat Formation; no clear relationships with the other red beds of the Moffat Basin. Coarse to fine-grained cross-stratified red breccias and sandstones. Angular clasts of grewacke and argillite, with absence of siltstone or mudstones. Some aeolian sand grains in the middle.

Lovell J.P.B., 1983, p.333, lists the formation as Brookfield, 1978.

BELLINGTON BRECCIA CONGLOMERATE. **?Trias, Sherwood Sandstone Group.**

(Bellington Breccia.)

Type-locality: Bellington Boreholes, 3 miles east of Kidderminster, Worcestershire.

Wills L.J., 1976, pp.37, 65, 72. Bunter, base, Lower part of miocyclothem BSI. ?Protobunter; above the Bridgnorth Dune Sandstone and below the Bunter Pebble Beds, equivalent to the High Habberley Conglomerate (Breccia). Coarse sand with conglomerates and breccias, about 17.1 m thick.

!BENNAN SHALES. **?Trias, New Red Sandstone.**

Type-locality: Bennan, southern Isle of Arran, Scotland.

Gregory J.W., 1915, pp.174-187. Upper Series [Upper Division], lowest unit, below the Auchenhew Sandstone and above the Ballymichael Sandstone. Shales with sharp yellow and blue sandstones, 45.7 m.

Tyrell G.W., 1928, pp.77, 96, merged unit with the Auchenhew Sandstones and Shales.

BIGGAR SALT. **Trias, Mercia Mudstone Group.**

See: Preesall Halite Formation.

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

(Billingham Formation, Billingham Main Anhydrite.)

Type-locality: Billingham boreholes, Billingham Mine, Teesdale, Yorkshire. Found also throughout central and east Yorkshire and in south Durham.

Dunham K.C., 1948, pp.217-227, as Main Anhydrite at Billingham. Within the Upper Permian Marls. 7 m in thickness, elsewhere up to 15 m.

Dunham K.C., 1960, pp.267-275; Main Seam at Billingham probably part of the Middle Evaporite Bed.

Smith D.B. et al. 1974, table 3, cols. 15, 17, 18, as Billingham Formation. S. Durham, Central and east Yorkshire, and West Sole Gas Field, southern North Sea. Above Upper Magnesian Limestone (Seaham Formation) and below Boulby Halite or Rotten (Carnallitic) Marl; col.20, as Main Anhydrite, part of the Teesside Group. 3-25 m in thickness.

Smith D.B., Harwood G.M., Pattison J. and Pettigrew T., 1986, pp.15. Unit renamed Billingham (Anhydrite) Formation; to distinguish it from the Upper Anhydrite now renamed as the Sherburn (Anhydrite) Formation; EZ3A.

!BINDON CYCLE. **Trias, Mercia Mudstone Group.**

Type-locality: South Devon Coast, east of Sidmouth, at or near Weston Mouth.

Jeans C.V., 1978, pp.549-639. Keuper Marl Series, uppermost of three sedimentary cycles, above the Weston Cycle and below the Rhaetic; includes the Tea Green Marls. Sandstone-siltstone-mudstone-carbonate cycle of deposition.

Warrington G. et al. 1980, p.43, as the Blue Anchor Formation. Jean's cyclic concept does not constitute a formal lithostratigraphic nomenclature. [Concept is sedimentological, not stratigraphical?; see also Richardson 1906—Tea Green Marl of this area.]

BIRMINGHAM KEUPER SANDSTONE. **Trias, Sherwood Sandstone Group.**

Type-locality: J. and E. Sturge Ltd., Birmingham, Boreholes number 207, 207/1948, SP 058797.

Wills L.J., 1976, p.134, 141, 146-148. Keuper Sandstone Series, above the Upper Mottled Sandstone and below Passage Beds and Keuper Marl Series, Bromsgrove Regional Stage. Keuper Basement Beds, Building Stones and Waterstones of the Birmingham area.

BLACK SHALES. **Trias, Penarth Group.**

See also: *Avicula Contorta* Beds, Westbury Formation.

Type-locality: Penarth, Glamorgan; initially described from south Wales but later from throughout the British Isles.

Portlock, J.E., 1843. Black shales with *Avicula contorta.*

Etheridge R. and Bristow H.W., 1873. [Name used, but only inferred description.] Above the Tea Green and Grey Marls and below the White Lias. Black shales with *Avicula contorta, Protocardium rhaeticum* and thin bonebeds

Short A.R., 1904, pp.171-174, 176, 177, 179, 182-4. Black shales with *Avicula contorta* and thin bonebeds; total thickness up to 3.1 m; located above the Bonebed and below the Pecten Limestones.

Strahan A. and Cantrill T.C., 1904, pp.35-49. [First complete description of the term.]

Richardson L., 1911, pp.1-74. Black Shales renamed Westbury Beds.

Warrington G. et al. 1980, table 4, p.62, as Westbury Formation.

***BLUE ANCHOR FORMATION.** **Trias, Mercia Mudstone Group.**

Type-locality: Between Blue Anchor [Point] and St. Audrie's Bay, Somerset; ST 040436 to ST 105431; generally, throughout Great Britain. Redesignated by Warrington G. and Whittaker A. 1984 at Blue Anchor, ST 03854378.

Warrington G. et al. 1980, table 4, cols.10-20, 22-26, pp.34, 55. Top formation of the Mercia Mudstone Group, above the Glen Parva Formation or undifferentiated Mercia Mudstone Group and below the Penarth Group, or transitional to the latter if 'grey marls' are present. Tea Green Marl facies.

Etheridge R., 1865, pp.221, the original reference as Tea Green Marls.

Elliott R.E., 1961. pp.197-234, included the Tea Green Marl as the upper part of the Parva Formation, south Nottinghamshire.

Stevenson C.R. and Warrington G., 1971, pp.297-300, late Triassic (Rhaetian) palynomorphs from the south coast England.

Mayall G., 1981, formation at the type locality subdivided into the Rydon and Williton Members.

Warrington G. and Whittaker A. 1984, pp.100-107. Accepts the Rydon and Williton Members of Mayall M.J. 1981, p.106, late Norian to Rhaetic; sulphate evaporites present, supra- and intertidal- sabkas deposits, 4.34-5.18 m thick.

!BONEBED. **Trias, Penarth Group.**

See: Rhaetic Bonebed.

!BOTTOM BED. **Trias, Mercia Mudstone Group.**

(Bottom Rock, Second Bed.)

Type-locality: Marston Coal borehole, Northwich, Cheshire; north Cheshire Basin generally.

Sherlock R.L., 1921. p.22. Keuper Marls Series, below the Top or First Bed; the second of 4 prominent halite seams with thinner seams occurring below. Halite, 8.5 m thick.

Evans W.B., 1970. p.107, lowest bed of the Lower Keuper Saliferous Beds, Northwich, and Middlewich, Cheshire.

Warrington G. et al. 1980, table 4, cols.9, 10, ?base of the Northwich Halite Formation.

***BOULBY HALITE.** **Permian, Zechstein.**

(Boulby Halite and Boulby Potash.)

Type-locality: Boulby Potash Mine, Staithes, north Yorkshire, S20 borehole. Also recorded from the Hayton and Eskdale Boreholes, E. Yorkshire; present in central and east Yorkshire, with possible extension into the southern North Sea.

Smith D.B., 1974, pp.116, 135-137. EZ3 top; above the Billingham Main Anhydrite and below the Carnallitic or Rotten Marl; the renamed Middle Evaporite Group (Bed); table 2, p.116, listed as Boulby Halite and Boulby Potash. Up to 90 m in undisturbed sections in the Whitby area. Includes the Middle or Boulby Potash and some anhydrite.

Stewart F.H., 1951, pp.445-475, referred to as the Middle Evaporite Bed or middle evaporite bed. [Petrological description, informal stratigraphical term?]

Smith D.B. et al. 1974, table 3, cols. 15, 17, 18, 34, top of the Teesside Group, EZ3, S. Durham, E. Yorkshire and West Sole Gas Field, southern N. Sea. 0-90 m; col.35, equates with the Leine Halite.

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

(Bow Beds, Bow Conglomerates.)

Type-locality: Bow, Crediton Valley, Devon.

Hutchins P.F., 1963, pp.107-128, as Bow Beds. Upper Carboniferous or Permian. Above Cadbury Beds, below the Crediton Beds. Pebbles of untourmalinised lavas and of Culm sediments. Red stained sandstones and shales; lava flows. [Thickness not given.]

Laming D.J.C., 1968, fig.1, pp.23-5, as Bow Breccias, Lower New Red Sandstone, part of the Creedy Group including the Solland Conglomerate Member. Lateral equivalent in part of the Clyst Sands.

Edmonds E.A. et al., 1968, as Bow Conglomerates.

Smith D.B. et al. 1974, table 6, col.31, Crediton, as Bow Breccias, 200 m?, above the Cadbury Breccias and above the Knowle Sandstones.

***BOWHILLS GROUP.** **?Permian, New Red Sandstone.**

(Bowells Conglomerate, Bowhills Formation.)

Type-locality: Bowhills, near Romsley, Shropshire. Extends into west Worcestershire and south-west Staffordshire.

Whitehead T.H., Eastwood T. and Pocock R.W., 1947. pp.91, 94-101. Upper Carboniferous or Permian; above the Keele Group (Up. Carboniferous) and below the Enville Breccia; equivalent to the Calcareous Conglomerate Group. Originally the middle (and ?upper) part of Hull's 1869 tripartite Salopian Permian, then Romsley Group, Arber 1916, or Corley Group, Boulton 1924. Highly calcareous red sandstones and conglomerates separated by less calcareous red sandstones and marls. Lenses or wedge shaped outcrops of the coarser beds. Pebbles include cherts, limestones, sandstones, quartzites, subangular or angular. Similar to the Clent Breccias with calcareous cement. Whitehead T.H., pp.94-95 comments that Newall-Arber (1916) proposed the term Romsley Group for the middle part of the Salopian Permian (calcareous conglomerates) and Clent Group for the upper, breccias. The use of 'Romsley' was inappropriate as the calcareous conglomerates are probably not developed there. The term Corley Beds (Boulton 1924) for the calcareous conglomerates was also unsatisfactory as the term (in the form of Corley Group) had already been used, as a local synonym of Enville Group, for all the pre-Triassic red-beds above the Keele Series in Shropshire and Warwickshire. These groups would include the Clent Breccias. Shotton 1929 confirms this interpretation by including his Kenilworth Breccfia, a local equivalent of the Clent Breccia, in the Corley Group. The Corley Group should not therefore be restricted to the Calcareous conglomerates. The term Hamstead Group (Lichfiedd area, Barrow et al. 1919) might also be a possibility but the term has precedence for the Oligocene of the Isle of Wight. A new term is therefore desirable and the locality of Bowhills, near Romsley is proposed, new spelling for Murchison's 1839 term.

Murchison R.I., 1839, as Bowells Conglomerate [original spelling] Newall-Arber 1916 as Romsley Group. Boulton 1924 as Corley Group.

Whitehead T.H. and Eastwood T., 1927, as Calcareous Conglomerate.

Smith D.B. et al. 1974, table 5, col.23, p.26, below Enville Breccia, lateral equivalent of Gibbet Hill Group, ?Westphalian D.

Ramsbottom W.H.C., et al 1978, pl.3, as Bowhills Formation, ?Permian.

Lexicon 3aVIII, p.46.

BRAMPFORD SPEKE SANDSTONE MEMBER. **?Permian, New Red Sandstone.**

Type-locality: Exe Valley river cliffs at Brampford Speke, Exeter, Devon, SX 926985.

Bristow C.R. et al. 1985, p.45. Preliminary notice in Bristow C.R. 1983, Scrivenor R.C. 1983, p.8, Edwards R.A. 1984, p.47, t.2. Base of the Dawlish Sandstone Formation above the Monkerton Member (Teignnouth Breccia Formation) and below the Bussell's Mudstone Member. Medium to coarse-grained cross-bedded red sandstone with interbedded breccia and mudstone lenses. Sandstones are well sorted. Member is up to 200 m thick.

!BRECCIA GROUP. **?Permian, New Red Sandstone.**

(Volcanic Breccia.)

See: Bowhills Group, Enville Breccia, Lexicon 3aVIII p.50.

BRECCIO-CONGLOMERATE. **?Permian, New Red Sandstone.**

Type-locality: Stogumber to Vellow, Minehead, N. Devon.

Ussher W.A.E., 1908, pp.3, 42-44. Thomas A.N., 1940. p.3, also referred to as Breccias and Conglomerates; p.12 as Breccio-Conglomerate and Breccias; p.14. Above Basal Red Sandstone and below Red Marls. Red brown rubbly breccia containing angular and subangular fragments of Devonian Grit, slate and vein quartz. At Vellow, beds of well worn gravel and conglomerates occur, the latter containing rounded pebbles of Carboniferous Limestone as well as well rounded pebbles of Devonian grit; ?12.2 m thick.

***BRECKELLS MUDSTONE FORMATION.** **Trias, Mercia Mudstone Group.**

(Breckells Mudstone.)

Type-locality: Coatwalls Farm and Hacken Hall Farm Boreholes, Blackpool, Lancashire.

Evans W.B. and Wilson A.A., 1975. in marginal notes as Breckells Mudstone. Local top formation of the Mercia Mudstone Group, Kirkham Mudstones below, Ladinian-Carnian miospores. Red mudstones, structureless, few grey-green bands, gypsum nodules common with a few halite veins, isolated halite crystals and one thin vein of halite. Brecciated at the top?, former halite horizon here ?. Miospores. Thin calcite veins. [Blackpool Memoir not yet published—1987].

Warrington G. et al. 1980, table 4, col.8, p.33, as Breckells Mudstone Formation. Miospores range up to early Carnian age, up to 250 m thick.

***BRIDGNORTH SANDSTONE FORMATION.** **?Permian, New Red Sandstone.**

(Bridgnorth or Dune Sandstone, Bridgnorth Dune Sandstone, Bridgnorth Dune Sandstone Group, Bridgnorth Sandstone, Bridgnorth Sandstone Group, Dune Bedded Sandstone, Dune Sandstone, Dune Sandstone Group.)

Type-locality: Bridgnorth, Shropshire; generally throughout west Shropshire, south-west Staffordshire and west Worcestershire.

Wills L.J., 1948, pp.70-73, as Bridgnorth Sandstone or Dune Sandstone with and without Group as suffix. Above the Enville Breccia and below Pebble Beds including basal shingle or breccia. In part equivalent to the Lower Mottled Sandstone, Hull 1869. Equivalent sandstones—Barr Beacon Beds, Littleworth Beds on east side of south Staffordshire coalfield. High Habberley Breccia is above the Bridgnorth Dune Sandstone. Possibly of the same age as the Hopwas or Moira Breccias. Dune bedded red and mottled sandstones.

Smith D.B. et al. 1974, table 3, cols.22, 23. As Bridgnorth Sandstone Formation, 275-300 m, aeolian, underlies Kidderminster Conglomerates and above Lower Permian Breccias—Alberbury, Enville Breccias. p.26, refers all forms of the term to Bridgnorth Sandstone Formation. ?Permian.

Wills L.J., 1976, 211pp. Some of the above breccias now considered to overlie the Bridgnorth Sandstone. (Protobunter).

BROADCLYST SANDSTONE MEMBER. **?Permian, New Red Sandstone.**

Type-locality: Broadclyst, Exeter, Devon.

Bristow C.R. et al. 1985, table 2. Early notice in Bristow C.R. 1983, p.10. Top of the Dawlish Sandstone Formation, above the Poltimore Mudstone Member and below the Exmouth Mudstone and Sandstone Member (Aylesbeare Mudstone Formation). Friable red sandstones, poorly sorted, cross-bedded and with thin red clays or mudstones. Ripple-marks, annelid and crustacean tracks and *Posidonia* may be found.

BROCKELSCHIEFER MEMBER **?Permian, ?Trias, New Red Sandstone.**

(Brockelschiefer.)

Rhys G.H., 1974. table 3, fig.4, pp.4-5. Conoco Group well 49/21-2; Phillips Group well 52/5-1X, southern North Sea. Bacton Group, Bunter Shale Formation - lowest Member, base of the Formation. Above Zechstein salts. [No English equivalent.] Interbedded siltstone and silty mudstone, red-brown, calcareous, micaceous, with beds of fine sandstone in the lower part; 28 m in thickness. [First reference for the North Sea area.]

Warrington G. et al. 1980, table 4, col.28, pp.49-50. Local base of Trias, and Bunter Shale Formation, 28 m thick; base may be at the same horizon as the base of Saliferous Marl unit, Eskdale Group, Smith D.B. et al. 1974. [Thus Upper Permian ?]

!BROCKRAMS. **?Permian, Rotliegende.**

(Lower Brockram, Upper Brockram.) See also: Stenkrith Brockram.

Type-locality: Vale of Eden but elsewhere in North-west England including Cumberland, Westmorland, north Lancashire and the Isle of Man. (Cumbria.)

Goodchild J.G., 1885, pp.43-48. Referred to in part as Brockram. Base of the Penrith Sandstone, glacial origin. Breccia with striations, fragments of underlying Carboniferous rocks.

Goodchild J.G., 1893. pp.1-24. New Red Series (Sandstone), Lower Brockram below, Upper Brockram above the Penrith Sandstone. Brockram may occur marginally to the Penrith Sandstone. Red Breccias; glacial theory now discounted.

Smith D.B. et al. 1974, table 3, cols.9, 10, 11, pp.13, 14. as brockram, breccia or Basal Breccia, marginal or basal facies, Lower and Upper Permian; informal term.

Arthurton R.S., Burgess I.C. and Holliday D.W., 1978. Breccias below and interbedded with the Penrith Sandstone, Upper and Lower Brockram, Upper - any breccia above the Lower; Lower- Basal Breccia and interdigitating with the lower part of the Penrith Sandstone.

Arthurton R.S. and Wadge A.J., 1981. pp.70, 148, 157, term used only lithologically.

!BRODICK BEDS. **?Upper Carboniferous or Permian, New Red Sandstone.**

Type-locality: Brodick Bay, Isle of Arran, Scotland.

Craig G.Y., 1965. p.387. Base of the Scottish New Red Sandstone, above Upper Devonian or Carboniferous Beds and below the Lamlash Beds. Combines the Corrie Sandstone and Brodick Breccia of Tyrell. Red sandstones and breccias with thin volcanics at the base; about 500 m thick.

Tyrell G.W., 1928. p.77, as Corrie Sandstone and Brodick Breccia.

Warrington G., 1973. Miospores of Triassic age and organic-walled microplankton from the Auchenhew Beds, south-east Arran. Scot. Jl. Geol. vol.9, pp.109-116, Carboniferous/Permian, breccias, conglomerates, red sandstones, latter with large scale cross-bedding and lenses of poorly sorted material. ?Root systems 'dikaka' (Piper 1970). Lavas at the base considered to be Permian (Leitch 1941), Upper Carboniferous (Craig 1965). [Includes the Corrie Sandstone, as Craig.]

Smith D.B. et al. 1974, p.22 reverts to Tyrell's units, Corrie Sandstone and Brodick Breccia.

Lovell J.P.B. 1983, p.328, as Craig G.Y. 1965.

***BRODICK BRECCIA.** **?Lower Permian, New Red Sandstone.**

Type-locality: Southern shore of Brodick Bay and Machrie Water, Isle of Arran, Scotland.

Gregory J.W., 1915. p.187. ?Lower Series (Division), above Brodick Freestone and below Lamlash Sandstone. Layers of coarse quartz breccia with faceted pebbles and coarse wind rounded sand grains; the layers alternating with coarse red false-bedded sandstone. Coarse quartz and quartzite breccia with horizons rich in basalt and agate pebbles. Thick lenticles of red dune-bedded sandstone.

Tyrell G.W., 1928. p.77, Strathwillan shore, Brodick, southern part of Brodick Bay, Glen Dubh, Machrie. ?Permian, above Corrie Sandstone, below Lamlash and Machrie Sandstones. Coarse quartz and quartzite breccia with horizons rich in basalt and agate pebbles. Thick lenticles of red dune-bedded sandstone.

Craig G.Y., 1965. p.387, part of the Brodick Beds. Contain pebbles of vein quartz, Highland metamorphic rocks, Carboniferous sediments, agates, basalt, derived from north or north-west; aeolian sands.

Smith D.B. et al. 1974, table 4, col.3, ?Permian, thickness not known, Corrie Sandstone below, Lamlash and Machrie Sandstone above; p.22, includes blocks of lavas of the Mauchline Basin.

Lovell J.P.B., 1983, p.328, as Craig G.Y. 1965.

!BRODICK FREESTONE. **?Permian, New Red Sandstone.**

Type-locality: Brodick Bay, Corrie, Cock of Arran; Isle of Arran, Scotland.

Gregory J.W., 1915. pp.174-187. Lower Series (Division) ?, local base Permo-Trias. Brodick Breccia above. False-bedded brick red sandstone with very rounded wind worn grains.

Tyrell G.W., 1928. p.77, as Corrie Sandstone.

Smith D.B. et al. 1974, table 4, col. 1, as Corrie Sandstone.

!BROMSGROVE GROUP. **Trias, Sherwood Sandstone Group.**

See also: Keuper Sandstone.

Type-locality: Bromsgrove, Worcestershire; generally in the west Midlands.

Wills L.J., 1948. p.82-87. Keuper Series, Keuper Sandstone Group. Building Sands Group below; Keuper Marl Group above. Equivalent of the Voltzia-Sandstein, Muschelkalk, Lettenkohle. Red, brown-red, buff or grey sandstone with thin conglomerate or breccia at the base and interbedded marl particularly at the top, up to 137.2 m.

Wills L.J., 1910. p.264, records *Acrodus* in the lower part, and *Yuccites, Voltzia, Schizoneura paradoxa, Mesophonus, Dipteronotus, Ceratodus, Euestheria, Mastodonsaurus giganteus* in the upper part.

Wills L.J., 1970. pp.225-286, as Bromsgrove Regional Stage or Bromsgrove Stage.

!BROMSGROVE MOULDING SANDS. **Trias, Sherwood Sandstone Group.**

See also: Upper Mottled Sandstone, Upper Wildmoor Beds, Wildmoor Sandstone Formation)

Type-locality: Wildmoor Quarries, Bromsgrove, Worcs.

Wills L.J., 1948. Top of the Bunter, equivalent of the Upper Mottled Sandstone, above Pebble Beds, below Passage Beds or Building Stone Groups.

Smith D.B. et al. 1974, table 4, cols. 12, 13, p.62, as Wildmoor Sandstone Formation.

Wills L.J., 1976. p.28, t1, p.46. synonym for Upper Wildmoor Beds or the Upper Mottled Sandstone.

!BROMSGROVE REGIONAL STAGE. **Trias, ?Sherwood Sandstone Group.**

(Bromsgrove Stage.)

Type-locality: Boreholes at Sugarbrook Pumping Station, 2 miles south of Bromsgrove, Worcestershire. Central Midlands.

Wills L.J., 1970. pp.228, 234, 247. Mesotrias, English Keuper Series, English Keuper Sandstone, alternative name for the Keuper Sandstone or Lower Keuper Sandstone (Hull 1869). Written also as Keuper Sandstone Series. New name for Bromsgrove Group. Includes: Stratford-Warwick Keuper Sandstone, Keuper Sandstone, Basal Welcombe Breccia, Waterstones Group, Building Stones Group, Basement Beds Group, Sugarbrook Basal Member; 248.3 m thick.

Wills L.J., 1976. p.28, 101 et seq. 108 et seq. Sugarbrook boreholes detailed sequence. Includes Sugarbrook Basal Member, Basement Beds, Building Stones and the lower part of the Waterstones.

Warrington et al. 1980, Group renamed Bromsgrove Sandstone Formation.

***BROMSGROVE SANDSTONE FORMATION.** **Trias, Sherwood Sandstone Group.**

Type-locality: Bromsgrove, north Worcestershire. Also Hereford, Staffordshire, Warwickshire, Leicestershire, Gloucestershire and Oxfordshire.

Warrington G. et al. 1980. table 4, cols. 12-15, p 39. Above Wildmoor Sandstone Formation or Polesworth Formation and below undifferentiated Mercia Mudstone Group. Miospores indicate late Scythian, Anisian and early Ladinian Stages. The renamed Keuper Sandstone of the Central Midlands or Bromsgrove (Regional) Stage, Wills 1970. Includes Basement Beds, Building Stones and Waterstones (lower part). Up to 500 m reddish-brown fine-medium-coarse sandstones with interbedded marls, dolomitic in part, thick sandstone units in parts, mainly arenaceous. Fossils: annelids, inarticulate brachiopods, bivalves, arachnids,

ostracods, branchiopods, fish (dipnoi, selachii, perleidids, palaeoniscids), amphibia (capitosauroid labyrinthodonts), reptiles (lepidosaurs, archosaurs, sauropterygians), flora (sphenopsids, coniferopsids, with miospores), microplankton. Fossils mainly from higher levels.

!BROTHERTON BEDS. **Permian, Zechstein.**

(Brotherton Limestone.)

Type-locality: Brotherton. Yorkshire.

Kirkby J.W., 1861. p.289. Above the Lower Red Marl and Gypsum [later Permian Middle Marl] and below the Upper Red Sandstone. Synonym of the Upper Limestone. [?includes Permian Upper Marls.] Thin flaggy limestone usually hard and compact and yellow or greyish in colour. Surface planes a little apart (sic.) and coated with red green and purple clays or marls. [Thickness not given].

Green A.H., 1872. pp.99-101. Zechstein, above Upper Magnesian Limestone or including the Upper Magnesian Limestone at the base. Red marls with thin limestones.

Woolacott D., 1912. pp.241-313, as' Upper red beds with thin limestones, salts, etc.' or the Middlesborough (red) beds with salt.

Smith D.B., Harwood G.M., Pattison J. and Pettigrew T., 1986, pp.15, unit renamed Brotherton (Magnesian limestone) Formation and redefined. [Thus avoiding confusion with Brotherton Limestone, Middlesborough Beds, Upper Magnesian Limestone Upper Limestone and Permian Upper Marl.]

BROTHERTON (MAGNESIAN LIMESTONE) FORMATION. **Permian, Zechstein.**

(Brotherton Formation.)

Type Locality: Brotherton, north Yorkshire, SE 4825.

Smith D.B., Harwood G.M., Pattison J. and Pettigrew T., 1986, p.15, table 1. Renamed Upper Magnesian Limestone or Brotherton Beds of north Yorkshire. EZ3Ca, above the Edlington Formation and below the Roxby Formation (Yorkshire) or the Billingham Formation or its residue or if absent the Carnallitic or Rotten Marl (Durham). Uppermost 12 m grey uniformly fine-grained thin-bedded limestone, ripple marks. Lowest beds (8 m) [not seen] said to be dolomite, (Edwards W.N. et al. 1940). Thickness 20 m but thickens eastwards being 65 m in subsurface records from Humberside and east Yorkshire, being dark grey to black in deep boreholes. Basal beds are argillaceous. The formation is oolitic, oncolitic or with thin beds of grey, red and purple mudstone in some surface exposures and boreholes. Uppermost 1-2 m with algal laminae and interbedded nodular anhydrite in easternYorkshire. Fossils include *Calcinema permiana, Liebea squamosa* and *Schizodus obscurus.*

BRYNLOW CONGLOMERATE. **Trias, Sherwood Sandstone Group.**

See also: Top Conglomerate.

Type-locality: Brynlow quarries and Artist's Lane, Alderley Edge; in addition Quarry Bank Mill, Styal; all in Cheshire.

Thompson D.B., 1966, 1970a p.32. Upper of three conglomerate bands within the Lower Keuper Sandstone of Alderley Edge, above the West Mine Sandstones and below the Brynlow and other Sandstones. Red Conglomerate, 10 m in thickness.

Taylor B.J., Price R.H. and Trotter F.M., 1963, referred to as the Top Conglomerate.

Thompson D.B., 1970c, p.172, at the base of the Nether Alderley Red Sandstone Member [?other Sandstone above].

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

(Brynlow and other sandstones). See also: Finlows Sandstone.

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

Thompson D.B., 1966; 1970a, p32. Top of the Lower Keuper Sandstone in the Alderley Edge area. Above the Brynlow Conglomerate, below the Waterstones. Fine-medium sandstones, about 30 m thick.

Thompson D.B. 1970b, p.184; 1970c, p.172, 174, 177, as Nether Alderley Red Sandstone Member or Nether Alderley Member.

***BUDLEIGH SALTERTON PEBBLE BEDS FORMATION.** **?Trias, Sherwood Sandstone Group.**

(Budleigh Salterton Pebble Beds).

Type-locality: Budleigh Salterton Cliffs, S. Devon coast.

Ussher W.A.E., 1876. pp.367-394, as Budleigh Salterton Pebble Beds. Base of the local Trias and compared stratigraphically with the Pebble Beds of the Midlands. Red current bedded coarse sandstones with rounded quartzite pebbles.

Henson M.R., 1970. pp.447-457, base at SY 0585 8155, erosion surface of lowest cobble bed. Includes a modern description; top defined as the base of the overlying Otter Sandstone Formation.

Warrington G. et al. 1980, p.42, 44, table 4, col.18. in pt. as Budleigh Salterton Pebble Beds Formation. ?Contemporaneous with other pebble beds previously referred to as 'Bunter', lower part of the Sherwood Sandstone Group of this area. Between Littleham Mudstone and Otter Sandstone Formation (top). 26-32 m in thickness. Includes the Budleigh Salterton Sandstones of Audley-Charles, 1970.

Selwood E.B., et al. 1984. pp.91, 92, 96, 106-7. Separated from the Littleham Formation and Otter Sandstone Formation by non-sequences. Cobbles, boulders, and pebbles are set in a gravelly matrix. Cross-bedded sandstones are commonly found in the top beds with erosion surface at the base of the units. Mudstone clasts are common. Colour brown or reddish brown and up to 31.4 m thick.

Bristow C.R. et al. 1985, pp.56-61.

!BUDLEIGH SALTERTON SANDSTONES. **?Trias, New Red Sandstone.**

Type-locality: Budleigh Salterton, Devon, west of the River Otter, east of the Pebble Bed Cliffs.

Audley-Charles M.G., 1970. p.41. Above the Budleigh Salterton Pebble Beds and below the Otter Sandstone; renamed Lower Keuper Sandstone or Upper Sandstone of Ussher. Red sandstones without pebbles.

Warrington G. et al. 1980, pp.42, 44, include these sandstones in the top part of their Budleigh Salterton Pebble Beds Formation.

!BUILDING STONES. **Trias, Sherwood Sandstone Group.**

(Building Stones Group, Building Stones Formation, Keuper Building Stones, Keuper Building Stones Group.)

Type-locality: Worcestershire and elsewhere in the west Midlands.

Hull E., 1860, 1869; pp.22-34; pp.10, 66. Middle part of the Lower Keuper Sandstone situated above the Basement Beds and below the Waterstones. Red-brown, fine-grained sandstones often with a dolomitic cement, and thin red marl partings; a major freestone, about 121.9 m thick.

Wills L.J., 1910. pp.211-246, sandstones without mica, often with irregular bedding, fossil list.

Wills L.J., 1970. pp.38, 228, 248, 250-251, as Building Stones Group. Massive brown sandstones or buff and grey medium sandstones with interbedded marl. Miocyclothems KSV-IX; at least 20 microcyclothems, 133.5 m. Sugarbrook No.1 borehole, part of the Bromsgrove Regional Stage, Mesotrias.

Warrington G., 1970. p.211, as Building Stones Formation.

Warrington G. et al. 1980, as Bromsgrove Formation (in part).

Charsley T.J., 1982. p.2, in part assigned to the Hollington Formation, Alton area, east Staffordshire and Derbyshire.

***BULKELEY HILL SANDSTONE FORMATION.** **?Trias, Sherwood Sandstone Group.**

Type-locality: Bulkeley Hill, Cheshire, SJ 524555.

Warrington G., et al. 1980. table 4, col.9, p.56. Sherwood Sandstone Group, above Wilmslow Sandstone and below Helsby Sandstone Formations; in west Cheshire, transitional between the two formations, previously referred to as the Keuper Sandstone Passage Beds.

Poole E.G. and Whiteman A.J., 1966. pp. 17, 29-34, description of the Keuper Sandstone Passage Beds.

!BUNTER. **?Trias, New Red Sandstone.**

See also: Lower, Middle, and Upper Bunter.

Sedgwick A., 1829. pp.37-124. Overlies the Magnesian Limestone in Britain and Germany; lithology with mineralogical similarities. The sandy upper part of the New Red Sandstone. [Sedgwick inadvertently included here, the later named 'Keuper Sandstone', as this unit is not developed to any great extent in north-east England. First reference for the Bunter of the British Isles.]

Hull E., 1869. p.10, above the Upper Permian, Zechstein, and below the Keuper; includes the Lower Mottled Sandstone, Pebble Beds and Upper Mottled Sandstone.

Warrington G., et al., 1980, pp.8-15, as used by Hull, and others, the term became the equivalent of Lower Trias, a geochronological term, for which usage there is no evidence. The original comparison was lithological with the German Bunter which is now seen to be a superficial resemblance. Recommended that the term is no longer used either on its own or as a prefix. See also Muschelkalk and Keuper.

!BUNTER CONGLOMERATE. **?Trias, New Red Sandstone.**

See also: Pebble Beds.

Type-locality: Vellow, Woolston, Sampford Brett, all near Minehead, north Devon.

Thomas A.N., 1940. pp.1-43; p.3, as Conglomerates-Bunter, p.12 as Conglomerates with breccia bands and breccio-conglomerates, p.15-18. Above ?Permian Red Marls and below the 'Keuper' Sandstone. Pebbles of Carboniferous Limestone and local Devonian grits, slates and limestone up to 0.6 m in diameter; possibly 152.4 m thick.

[The term is used informally by many authors for Bunter Pebble Beds, e.g. in this area, Ussher W.A.E., 1908. pp.46-51 as Bunter Pebble Beds and Bunter Conglomerates, 31 m thick. The term may be superceded in part by the Milverton Conglomerate.]

!BUNTER HARD BED. **?Trias, New Red Sandstone.**

Type-locality: Thurstaston Hill, Wirral, Cheshire.

Wedd C.B., Smith B., Simmons W.C., and Wray D.A., 1923. p.82. Close to the top of the Upper Mottled Sandstone. Silicified red mottled sandstone with thin marls.

Thompson D.B., 1970b, p.173; 1970c, p.184, renamed Thurstaston Bed, represented by one fining upwards cycle, the sole representative of the Alderley Conglomerate in the west of the Cheshire Basin.

!BUNTER MACROCYCLOTHEMS, BUNTER MIOCYCLOTHEMS, BUNTER MICROCYCLOTHEMS.
?Trias, Palaeotrias.

Type-locality: Wildmoor boreholes, Worcestershire.

Wills L.J., 1976. p.34 et seq.. Major, minor and indeterminate flood-drought (coarse-fine) sedimentary cycles, of the Bunter Pebble Beds (Wildmoor Regional Stage.) [Sedimentological, not stratigraphical ?]

!BUNTER MARLS. **?Trias, New Red Sandstone.**

See also: Bunter Shale.

Type-locality: North-west England.

Goodchild J.G., 1893. p.11. ?Permian, above the Penrith Sandstone, below the St. Bees Sandstone. Gypseous shales including plant beds.

!BUNTER PEBBLE BEDS.

See: Pebble Beds.

!BUNTER SANDSTONE. **?Trias, Sherwood Sandstone Group.**

(Bunter Sandstein, Buntsandstein.). See also: Pebble Beds.

Type-locality: England, north Midlands and north east.

Conybeare W.D. and Phillips W., 1822. Overlies Zechstein salts, underlies (in UK.) Keuper. ?Lower Trias. Mineralogically similar to the German Buntersandstein. Red sandstones with or without pebbles between the Keuper and the Lower New Red Sandstone.

Hull E., 1869. p.10, as Buntersandstein, to include Lower Mottled Sandstone, Pebble Beds and Upper Mottled Sandstone or any arenaceous rocks between the Permian and the Keuper.

Smith D.B. et al. 1974. Trias above Saliferous Marls or Bunter Shale. Table 4, col.35, Northwest Europe, as Buntersandstein.

Rhys G.H. 1974, as Bunter Sandstone Formation, top part of the Bacton Group.

Warrington G. et al. 1980, As Sherwood Sandstone Group (in part). Table 4, col.28 as Bunter Sandstone Formation, southern North Sea. subdivided into Lamlash Beds, Bridgnorth Sandstone Formation, Budleigh Salterton Pebble Beds Formation, Cannock Chase Formation, Chester Pebble Bed Formation, Kidderminster Formation, Kinnerton Sandstone Formation, Lamlash Sandstone Formation, Lenton Sandstone Formation, Milverton Conglomerates, Nottingham Castle Formation, Polesworth Formation, St. Bees Sandstone Formation and Wilmslow Sandstone Formation.

!BUNTER SANDSTONE FORMATION. **?Trias, New Red Sandstone.**

Type-locality: Conocco Well 49/21-2, Southern North Sea.

Rhys G.H., 1974. table 2, fig.3. Top formation of the Bacton Group, above the Bunter Shale Formation, below the Dowsing Saliferous Formation. Sandstone red orange, occasionally white to colourless, fine-grained, grading to siltstone in the lower and upper parts, becoming coarse grained in the middlepart. Anhydritic and dolomitic cement and traces of anhydrite, many beds ofmudstone, red, grey, and rarely green, silty and sandy in part, occasionally dolomitic. 321 m in thickness.

Warrington G. et al. 1980, table 4, col.28, as above. [accepts the term for the North Sea area.]

!BUNTER SERIES. **?Trias, New Red Sandstone.**

(?Bunter Sandstone Series.)

Type-locality: Midland Counties of England.

Hull E., 1869. p.10. Includes the Lower Red and Mottled Sandstones, Bunter Pebble Beds and Upper Red and Mottled Sandstones.

Wedd C.B., Smith B., King W.B.R. and Wray D.A., 1929, p.149, as above with the Ruyton Sandstone (=Upper Mottled Sandstone and Building Stones.).

Warrington G. et al. 1980, as Sherwood Sandstone Group (in part), see also Bunter Sandstone.

!BUNTER SHALE FORMATION. **?Trias, New Red Sandstone.**

(Bunter Marls, Bunter Shale, Bunterscheifer.)

Type-locality: Conoco well 49/21-2, southern North Sea.

Rhys G.H., 1974, table 2, fig.3. Permo-Trias, lowest formation of the Bacton Group, occurring above the Zechstein deposits and below the Bunter Sandstone Formation. The formation includes the Brockelschiefer and Rogenstein Members. [Replaces the term New Red Shale Formation in most areas.]

Smith D.B. et al. 1974, table 3, col.20, Leman Gas Field, southern North Sea between Salt IV and Bunter Sandstone.

Warrington G. et al. 1980, table 4, col.28, pp.49-50. Term accepted for the North Sea area. to include the top of the Permian, Z4, and the Bunter Sandstone Formation ?Trias. cf. Bunter Marls.

!BUNTER SHINGLE BEDS. **?Permian or ?Trias.**

See: Shingle Beds.

BURCOT BRECCIA. **?Trias, Sherwood Sandstone Group.**

Type-locality: Sugarbrook no.1 borehole, Bromsgrove. SO 961682, 253 to 258.2 m; and at Burcot, SO 984712 and Fairfield, SO 951754.

Wills L.J., 1970. p.249-250. Mesotrias, Droitwich Regional Stage, Basement Beds Group. KSI,II, base of the group. Base of the English Keuper if the Sugarbrook Basal Member is absent. Coarse pebbly sandstone, 5.2 m; pebbles are composed of felspar and quartz, up to 19 mm diam. The matrix is made up of red and buff coarse sandstone.

Wills L.J., 1976, gives further detail: Pikespool, Burcot, rather coarse sandstone with layers of fine breccia having angular pebbles of wind polished quartz up to 38 mm and of unweathered felspar up to 38 mm; Fairfield locality is similar. (SO 947753—see above GR.) and also at Holy Cross, Clent, (SO 923790).

***BURGHEAD SANDSTONE FORMATION.** **?Trias, New Red Sandstone.**

(Burghead Beds, Burghead Sandstone, Burghead Sandstones.)

Type-locality: Coastal section at Burghead, Elginshire. NJ 108694—120692. also at Clarkly Hill and Inverugie.

Warrington G. et al., 1980. pp.22, 56, table 4, col.1. Above the Hopeman Sandstone Formation or the Old Red Sandstone, and below the Lossiemouth Sandstone Formation. Unfossiliferous and dominantly water laid sandstone, pink and brown. Pebble bands are located within the sandstone, up to 75 m thick.

Westoll T.S., 1951. p18. as Burghead Sandstone, water laid, pebbly, about 70.1 m thick. [New name, but no real description, presumably unfossiliferous.]

Craig G.Y., 1965. as Burghead Sandstones, pink, brown with pebble bands.

Peacock J.D., Berridge N.G., Harris A.L. and May F., 1968. pp.5, 54, 63-67, as Burghead Beds, Upper Permian and Triassic Sandstones with pebbly bands, 72.5 m thick.

Lovell J.P.B., 1983, p.328, 334, as Burghead Beds.

Benton M.J. and Walker A.D. 1985, p.216, without giving evidence tentatively suggest an Ansian-Carnian age.

BUSSELL'S MUDSTONE MEMBER. **?Permian, New Red Sandstone.**

Type-locality: Bussell's Farm Borehole, Exeter, Devon, SX 95299873.

Bristow C.R. et al. 1985; preliminary detail in Bristow C.R. 1938, p.8 and in Scrivenor R.C. p.10. Part of the Dawlish Sandstone Formation above the Brampford Speke Sandstone and below the Belfield Sandstone Member. Brown mudstone and fine-grained argillaceous sandstone beds or, locally, non-argillaceous sandstone thickness given as 34.70 m.

***BUTCOMBE SANDSTONE MEMBER.** **Trias, Mercia Mudstone Group.**

(Butcombe Sandstone).

Type-locality: Butcombe, Somerset, north of the Mendips. Also in the Dundry borehole.?

Green G.W. and Welch F.B.A., 1965. p.71. Mid-way within the Keuper Marl, similar in age to North Curry Sandstone Member. Sandstone with bivalves and fish remains.

Warrington G. et al. 1980, table 4, col.16, p.48, as Butcombe Sandstone Member. Within the Mercia Mudstone Group. Contains miospores of late Triassic (Carnian) age. [Inst. Geol. Sci. UK. records.]

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

Type-locality: Tiverton and Thorverton, Devon.

Laming D.J.C., 1968. pp.23-25, fig.1. Local base of the Lower New Red Sandstone sequence, overlain by the thin Clyst Sands and unnamed marls. [No description is given.]

C-BED. **Permian, Zechstein.**

(C Bed, C-Bed Anhydrite, 'C' gypsum and anhydrite, 'C' gypsum horizon.)

Type-locality: Boreholes in the Kirkby Thore area, Vale of Eden, Westmorland.

Sherlock R.L. and Hollingworth S.E., 1938. p.12, as 'C' gypsum and anhydrite. Part of the St. Bees Shales, within the Hilton Plant Beds, between B and D Beds. Gypsum and anhydrite 0-3 m.

Arthurton R.S., 1971. p.13, Langwathby Borehole, between grey plant-bearing mudstones and red siltstones and anhydrite (top). The evaporite is layered, nodular, aphanitic and/or felted lath anhydrite; as C-Bed.

Smith D.B. et al. 1974, table 4, col.10, as C-BED ANHYDRITE, 0-3 m, part of the Eden Shales, Upper Permian. Vale of Eden. Cumbria.

Arthurton R.S. and Wadge A.J., 1981. p.74, 75. 78-79) Description and full bibliography; as C-Bed.

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

(Cadbury Beds.)

Type-locality: Cadbury, Crediton, Devon; restricted to the northern margin of the Crediton Basin east of North Tawton.

Hutchins P.F., 1963. pp.107-128, as Cadbury Beds. Base of the New Red Sandstone in the Crediton area, above Culm Measures and below the Bow Breccias. Earthy red breccia containing mainly Culm debris; heavy minerals include brown and green zircon, tourmaline, rutile, staurolite.

Edmonds E.A. et al. 1968, pp.146-148, as Cadbury Breccias.

Laming D.J.C., 1968. pp.23-25, fig.1, located below the Silverton Breccias and Clyst Sands. Part of the Creedy Group, local base.

Smith D.B. et al. 1974, table 6, col.31, p.30, as Cadbury Breccias, thin.

Edwards R.A. 1984, p.15, t.2, p.22-23, above the Crackington Formation (Carboniferous) and below the Thorveton Sandstone Formation. Comprises mainly Culm sandstone debris; up to 4 m thick.

CADEBY (MAGNESIAN LIMESTONE) FORMATION. **Permian, Zechstein.**

(Cadeby Formation.)

Type-locality: Cadeby Quarry, Yorkshire, SE5200 and adjacent areas; found throughout Yorkshire except the extreme north, Humberside, Derbyshire and Nottinghamshire.

Smith, D.B., Harwood G.M., Pattison J. and Pettigrew T., 1986, pp.9-13. Renamed Lower Magnesian Limestone of the above areas. EZ1Ca, above the Marl Slate and below the Edlington Formation or Hayton Formation subsurface areas of Humberside and East Yorkshire. Base may be taken as the lowest marine carbonate stratum overlying basal Permian continental deposits [Permian Basal Breccia or Yellow Sands] or Carboniferous beds if the Marl Slate is absent. Includes the Wetherby and Sprotbrough Members, and the Hampole Beds. Thickness at the type-locality about 60 m but increases to the east (100+ m) and thins to the south and west. Junction of the two Members at the top of the lower dolomite of the Hampole Beds or at the discontinuity if the latter are absent. [See Members for lithological description.]

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

See: Doweel Breccia Formation.

!CALCAREOUS CONGLOMERATE. (1) **?Carboniferous-Jurassic, New Red Sandstone.**

(See also: Dolomitic Conglomerate).

Type-locality: Gloucestershire and Somerset. (Mendips).

Weaver T., 1822. p.348. Lower part of Gypseous and Saliferous Series, Magnesian Limestone. Rounded and angular fragments of limestones and sandstones cemented by calcareous matter (dolomite), with cavities. Magnesian limestone, passes (laterally) into New Red Sandstone.

Warburton H., 1817. pp.205-209, as Magnesian Conglomerate, Magnesian Breccia or Magnesian Limestone, correlates these with the Magnesian Limestone of north-east England.

Buckland W. and Conybeare W.D., 1824. pp.210-316, renamed as the Dolomitic Conglomerate.

!CALCAREOUS CONGLOMERATE. (2) **?Permian, New Red Sandstone.**

(Calcareous breccia, Calcareous Conglomerate Group.)

Type-locality: Western margin of the south Staffordshire coalfield; elsewhere in the south and central Midlands, Lickey Hills, Clent Hills, Bowhills, Alberbury, Coton, Cardeston.

Murchison R.I., 1839. pp.46-54. Part of the New Red System, above the Lower New Red Sandstone (Rotliegende) and below the Saliferous Marls and Sandstones. Equivalent to the Dolomitic Conglomerate and Magnesian Limestone. Large fragments of quartz, Carboniferous and other limestones set in a calcareous cement. Up to 18.3 m in thickness.

Yates J., 1813?, p.399, as Calcareous Breccia.

King W.W., 1899. p.103, sandstones, conglomerates and breccias mainly of Carboniferous Limestone, with calcareous cement. Uses the term lithologically indicating three beds of calcareous conglomerate in some localities separated by marls and calcareous sandstones; part of the Middle Permian.

Hardaker W.H., 1912. p.651, erroneously attributes the stratigraphical term, Calcareous Conglomerate Group to King 1899; first use Hardaker 1912.

Whitehead T.H., 1922. pp.171-173); Upper Carboniferous, lower part of the Enville Beds. Calcareous sandstones and breccias with red marl, 61-121.9 m.

Boulton W.S., 1924. p.360, renames Hardaker's 1912 Hamstead Beds as Calcareous Conglomerate Group at the base and Corley Beds (non-calcareous breccias) above.

Whitehead T.H., Eastwood T, and Pocock R.W., 1947, name replaced by Bowhills Group.

Smith D.B. et al. 1974, table 5, col.24, as Calcareous Conglomerate, below Clent and Nechells Breccias. ?lateral equivalent of the Gibbet Hill Group. col.23 as Bowhills Group.

[See also Lexicon Fasc.3aVIII p.57.]

CALVERTON BRECCIA. **?Trias, New Red Sandstone.**

Type-locality: ?Calverton, Nottinghamshire. [?Calverton Colliery Shaft]

Wills L.J., 1956. pp.103, 108. Part of the Lower Mottled Sandstone; similar in lithology and age to the Stockport Breccia. Breccia. [This unit is not recorded in the publications of Aveline, Lamplugh or Taylor; no Lower Mottled Sandstone at the surface at Calverton, Nottinghamshire.]

CAMAS MALAG FORMATION. **?Trias.**

Type-locality: Loch Slapin, Isle of Skye, Scotland.

Nicholson R., 1978. pp.301-309. Rythmite-conglomerate sequence.

Warrington G. et al. 1980, p.25, ?Informal term only, of local application.

***CANNOCK CHASE FORMATION.** **?Trias, Sherwood Sandstone Group.**

Type-locality: Cannock Chase, Staffordshire.

Warrington G., et al. 1980. table 4, col. 11, p.56. Permo-Trias, Sherwood Sandstone Group (base), above the Hopwas or similar Breccia and below 'sandstone' (ex. Keuper or Bromsgrove Sandstone ?). ?Divisible into 2 unnamed members. Equivalent to the Bunter Pebble Beds of Staffordshire and overlying pebble free sandstones and below the Keuper Sandstone. Conglomerates similar to those of the Kidderminster and Polesworth Formations to the south and southeast.

!CANNON BALL ROCK. **Permian, Zechstein.**

See: Concretionary Limestone.

***CARDIUM* SHALES.** **Trias, Penarth Group.**

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

Etheridge R., 1865. pp.225. Rhaetic, part of the Black Shales, 2 m above their base at the type-locality, 2.1 m in thickness and overlain by *Contorta* Shales. Dark brown shales with abundant *Protocardium (Cardium) rhaeticum.*

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

See: Doweel Breccia Formation.

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

Type-locality: Thorneywood Brick Pit, Nottinghamshire, SK 4596 3414. Also at Carlton Hill Brick Pit, SK 4603 3412 and south Nottinghamshire boreholes.

Elliott R.E., 1961. p.217. Keuper Series, includes the Plains Skerry. Located between the Radcliffe Formation and the Harlequin Formation (top). Poorly laminated and massive red-brown mudstones and siltstones. Flow type breccias. Thick greenish bands are common, fine sandstone, dolomitic (Plains Skerry) 21.3 m; ?fibrous gypsum?

Balchin D.A. and Ridd M.F., 1970. pp.91-101, fig.3, pl.14, part of their Nottingham Group.

Warrington G. et al. 1980, table 4, cols. 11, 23, 24, up to 40 m, south Nottinghamshire, south Derbyshire, north-west Leicestershire, central Staffordshire.

***CARNALLITIC MARL.** **Permian, Zechstein.**

(Rotten Marl)

Type-locality: East Yorkshire, Eskdale no.3, and other Eskdale Boreholes.

Fleck A., 1950. pp.S10, S12, S13. Above the Middle Salt [later Middle Evaporite Bed] and below the second anhydrite bed below the Saliferous Marls [later Upper Evaporite Bed.] Red marl with carnallite in the east, variable in thickness, up to 23.2 m.

Armstrong G., Dunham K.C., Harvey C.O., Sabine P.A. and Waters W.F., 1951. pp. 667-689, between Middle and Upper Evaporite Beds.

Rhys G. 1974, table 2, term 'Roter Saltzton', preferred for the southern North Sea.

Smith D.B. et al. 1974, table 3, cols. 17, 18, 34, 9-20 m, central and east Yorkshire and the southern North Sea. Lowest bed of the Staintondale Group, equivalent to the Rotten Marl of Tees-side, central and southern Yorkshire. Found below the Upgang Formation and above the Boulby Halite.

CARRON BASALT FORMATION. **?Permian, New Red Sandstone.**

Type-locality: Carron Water, Thornhill, northeast of Carronbridge Station, NS885017-888022.

Brookfield M.E., 1978, p.131. Overlies Carboniferous deposits within the Thornhill Basin; below the Durisdeer Sandstone Formation. Olivine basalt flows with red breccias and sandstones lacking aeolian grains. 20 m exposed at the type-locality.

CASTLEDIKES SANDSTONE. **?Permian, New Red Sandstone.**

Type-locality: Castledikes, south of Dumfries, Scotland.

Harkness R., 1850. pp.395-396. Local variety of the New Red Sandstone, ?top of the Dumfries Sandstone. Red sandstones overlying red conglomerates ?Craigs Breccia. [Harkness describes the rocks at Castledikes, term Castledikes Sandstone not actually used.]

Smith D.B. et al. 1974, table , col. 5, p.24, 90 m thick , Dumfries Basin. The sandstone represents the local top of the sequence being overlain by Quaternary deposits. Possibly synonym of the Lamlash and Machrie Sandstones, or the St. Bees Sandstone.

Brookfield M.E., 1978, p.114 and fig.2, p.121, considers this unit to be part of the Doweel Breccia Formation.

CAWSAND LAVAS.

See: Exeter Volcanics, Tidmarsh W.G. 1932, area south of Exeter.

CELESTINE BED, CELESTINE HORIZON.

See: Severnside Evaporite Bed.

CEMETARY SHALES.

See: Waterstones.

CHEADLE BRECCIAS. **?Trias, Sherwood Sandstone Group.**

Type-locality: Cheadle, Staffordshire.

Wills L.J., 1956. p.108. Base of the Bunter Pebble Beds of the Cheadle area; compares this unit with the Stockport Breccia.

Charsley T.J., 1982. p.4, part of the Huntley Formation.

CHELSTON BRECCIA. **?Carboniferous, New Red Sandstone.**

Type-locality: Huxtable Hill, Chelston, Devon, SX 902639.

Laming D.J.C., 1966. table 2, p.943, Tor Bay area. Lower New Red Sandstone, Carboniferous/Permian, part of the Marldon Group. The unit comprises massive limestone breccia, 152.4 m thick not unlike the Oddiscombe Breccias.

Laming D.J.C., 1968. pp.23-25, fig.1, the unit is below the Watcombe Beds and the Vicarage Hill Breccias; local base of the New Red Sandstone; in part lateral equivalent of the Vicarage Hill Breccias, Tor Bay.

CHERTY ROCK. **?Trias, New Red Sandstone.**

(Cherty Rock of Stotsfield.) See also: Lazonby Stone, part of the Penrith Sandstone.

Type-locality: Stotsfield, Morayshire.

Gordon G., 1859. as Chert Rock and Galena of Stotsfield. Upper part of the Old Red Sandstone of Moray. Silicified sandstones with galena, no thickness given.

Watson D.M.S. 1909, resting on Old Red Sandstone, Permo-Trias in age.

Peacock J.D., Berridge N.G., Harris A.L. and May F., 1968. p.54, Upper Trias and trangressive onto the Burghead Beds. Sandy limestones, calcareous sandstones, silicified sandstones and chert nodules; 4.6 m thick at Inverugie and older than the *E. raricostatum* zone; pp.70-71 for full description.

Warrington G. et al. 1980, table 4, col.1, 0-10 m thick; p.22, may be of secondary origin thus not assigned formal stratigraphical status.

Lovell J.P.B., 1983, p.328, above Sago Pudding Sandstone, top of the sequence, about 5 m thick.

Benton M.J. and Walker A.D. 1985, p.216, ?Norian-Rhaetian, above Burghead and Lossiemouth Sandstones.

***CHESTER PEBBLE BEDS FORMATION.** **?Trias, Sherwood Sandstone Group.**

Type-locality: Chester and its vicinity; the Cheshire Basin extending northwards in northwest England.?

Warrington G., et al. 1980. table 4, col.9, 10, pp.31, 56. ?Permo-Trias, situated above the Kinnerton Sandstone Formation and below the Wilmslow Sandstone Formation. The unit is probably the lateral equivalent of the St. Bees Sandstone Formation. Previously referred to as the Bunter Pebble Beds of the Cheshire Basin. Up to 365 m thick—central and north Cheshire, Clwyd, south Merseyside and greater Manchester; up to 300 m, in south Cheshire and north Shropshire.

Smith D.B. et al. 1974, table 3, col.13, Permian and Triassic of southeast Lancs. and northeast Cheshire.

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

Type-locality: Tiverton, Devon.

Laming D.J.C., 1968, fig.1, pp.23-25. Lower New Red Sandstone. Breccias with some volcanics.

Smith D.B. et al. 1974, table 6, col.32, Tiverton Basin. The unit is the base of the local red bed sequence and is 1000 m thick. Below are the Culm Measures and above, the Tidecombe Sands, in part lateral equivalent at the top; elsewhere overlain by the Sampford Peverell Breccias; Permian.

CITY ROAD BEDS. **?Trias, Sherwood Sandstone Group.**

Type-locality: Mitchell and Butler's City Road borehole 65/1948.

Wills L.J., 1970. pp.225-285. Palaeotrias, English Bunter Series, Wildmoor Regional Stage. The unit is situated above the Queslett Shingle Bed and below the Upper Mottled Sandstone and is equivalent to the Pebble Beds of Hull 1869. Similar to the Lower Wildmoor Beds. Comprises miocyclothems BSII, III, mainly flood sequences, coarse to medium dull red-brown sandstones and pebbly sandstones. The pebbles are angular-rounded with a few bands of shingle in the lower part; 68.8-109.1 m thick.

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

(Clarborough Beds.)

Type-locality: Old gypsum pit, Clarborough, north Nottinghamshire, SK 740834.

Smith E.G., 1963. p.41. Part of the Keuper Marl. Brief description in an earlier part of the Summ. Progr. G.S.G.B. (1957), 1958, pp.32-33.

Smith E.G., Rhys G.H. and Goosens R.F., 1973. pp.4, 184-192, 194-196, 225, 239, as Clarborough Beds, 3.1-12.2 m, mudstones and silty beds with gypsum, dolomitic siltstones and fine sandstones.

Warrington G. et al. 1980, table 4, col.25, pp.51, 56, as Clarborough Formation; south Yorkshire and north Nottinghamshire, disused gypsum pit at Clarborough, Notts. SK 7396 8336, part of the Mercia Mudstone Group, 4-9 m, dolomitic green-grey sandstones with interbedded marls impregnated with gypsum. The miospores indicate late Ladinian, early Carnian age. Possibly equivalent to East Bridgford gypsum, top of the Carlton, and base of the Harlequin Formations.

!CLAY BEDS. **Trias, Penarth Group.**

Type-locality: Bristol.

Short A.R., 1904. pp.184-185. Rhaetic, above the *Naiadites* Limestones and below the Cotham Marble. Blue, brown, yellow or greenish grey clayey beds, with white bands; p.171, 0.6 m thick; p.173, 1 m without fossils. [Usually considered as part of the Cotham Beds.]

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

(Clent Beds, Clent Breccia Group, Clent Group.)

Type-locality: Clent Hills, Warwickshire and Staffordshire.

King W.W., 1893. pp.24-37. Above Enville Beds and overlain by Bunter Pebble Beds. Mainly Precambrian quartzites without calcareous cement; 0-182.9 m thick.

Newall-Arber E.A., 1916. pp.36-42, 46-49 described under the term Clent Group.

Boulton W.S., 1924. p.364, as Clent Beds, above his Corley Beds and below the Pebble Beds.

Wills L.J., 1948. Clent Group, to include local breccias at Abberley, Clent, Enville, Haffield, Hopwas, Kenilworth, Moira (in part), Nechells, Northfield, Stagborough, Stratford, Warley, Warshill, all of about the same age. Angular fragments resting with unconformity on underlying rocks, poor grading, pebbles stained with haematite comprising a high proportion of Precambrian fragments (Uriconian, Caldecote, Charnian). The matrix may be sand, chips of igneous rocks or clay, or absent.

Smith D.B. et al. 1974, table 5, col.24, between the Calcareous Conglomerate and Quartzite Breccia, Barr Beacon Beds or Hopwas Breccias. Possibly the equivalent of the Kenilworth Breccia, col.24. 200 m ?Lower Permian, west of the South Staffordshire coalfield.

Charsley T.J., 1982. p.4, compares the Clent Group with his Huntley Formation.

[See also Lexicon Fasc. 3a, p.73.]

CLYST SANDS. **?Permian, Lower New Red Sandstone.**

Type-locality: Clyst St. Mary, Devon; also found at Exeter, Thorverton, Crediton, all in Devon.

Laming D.J.C., 1968. pp.23-5, fig.1. Part of the Exe Group, above and in lateral continuity with various Breccias—Cadbury, Silverton, Heavitree, Kennford, and below undifferentiated marls. Lithology and stratigraphical position compares with the Dawlish Sands. Volcanic rocks occur near the base.

Smith D.B. et al. 1974, table 5, cols. 27, 29-31. Lateral equivalent and above local breccias-Exminster, Heavitree and Alphington, Silverton and Crediton. Below the Aylesbeare Group where devoloped; up to 400 m thick. Haldon Hills, Exe Estuary, Exeter, Silverton-Bradninch and the Crediton Valley, Devon. Local volcanic rocks are included—Silverton Lavas.

***COLLYHURST SANDSTONE.** **?Permian, New Red Sandstone.**

Type-locality: Collyhurst, north Manchester but also south-east Lancashire and north-east Cheshire.

Binney E.W., 1839, p.37, 47-48; 1844, p.244, description of the Collyhurst section; 1846, p.12. All references as the Lower New Red Sandstone. Unconformable above the Coal Measures and below the Magnesian marls. Variable colour and consistency; dark red with yellow and green patches; upper part evenly fine-grained and used as a moulding sand, lower part with iron grains; 36.6m in thickness, thickening to the west and without pebbles. [No mention of marl although this must be present in the moulding sand.]

Hull E., 1869, pp.11, 26, as Lancastrian Permian.

Tonks L.H. et al. 1931, pp.159-165, containing abundant beds of 'millet seed' grains. Variable in thickness east of the Pendleton Fault, up to 284 m.

Wray D.A. and Cope F.W. 1948, p.5, 715 m in the Formby No.1 borehole but variable thickness in this area being absent in other boreholes.

Taylor B.J. et al. 1963, Stockport area includes the Lower Stockport Marl close to the top.

Smith D.B. et al. 1974, table 3, cols. 12, 13. Includes the Stockport Marl in the type area; aeolian, compare with the Lower Mottled Sandstone in lithology. Local base of the Permian sequence, Stockport Conglomerate and Manchester Marls above. The formation is extended (col.13) into the eastern Irish Sea, here up to 715 m thick including two mudstone units.

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

Type-locality: Disused quarry, [railway cutting?] Colwick, Nottingham, SK 601397.

Warrington G. et al. 1980. table 4, cols. 23-25, pp.51, 57. Situated above the Woodthorpe or Retford Formations and below the Radcliffe Formation or undifferentiated Mercia Mudstones. Renamed Waterstones Formation of Elliott 1961. 0-50 m thick.

Elliott R.E., 1961, original description.

!COMPACT LIMESTONE.

See: Lower Magnesian Limestone, Wetherby Member.

CONCRETIONARY LIMESTONE. **Permian, Zechstein.**

(Cannon Ball rock.) See also: Fulwell Beds.

Type-locality: Marsden and Fulwell Quarries; Marsden and Building Hills; Coastal section from Marsden to Roker.

Woolacott D., 1912. p.268. Part of the Upper Magnesian Limestone above the Flexible Limestone and below the Upper Yellow Limestone. Bedded limestone with cellular and globular masses, marly limestones; up to 91.4 m thick. Sphaeroidal masses termed the Cannon Ball Rock.

Smith D.B., 1971a. pp.5, 7, lower group of concretionary dolomite, lower part of the Upper Magnesian Limestone- laminated, slumping, fish, invertebrates, 45-116 m thick, Whitburn to South Shields. [The upper group of concretionary limetones is called the Seaham Beds.]

Smith D.B. et al. 1974, table 3, col.16, Durham Coast, base of the Upper Magnesian Limestone, 25-115 m thick.

Magraw D., 1975. p.405, Flexible Limestone included at the base, also the Cannon Ball Rock. Off south Northumberland Coast, 48.5 m thick, off the Durham Coast- 55-61 m.

!CONGLOMERATES AND PEBBLE BEDS. **?Trias, Sherwood Sandstone Group.**

Type-locality: Budleigh Salterton, Devon.

Ussher W.A.E., 1875. pp.163-168; 1876, pp.367-394, as Budleigh Salterton Pebble Beds. Above the Lower Marls and below the Upper Sandstones. Red sandstones and conglomerates, 61 m thick. [Term superceded by the Budleigh Salterton Pebble Beds.]

!CONGLOMERATE FORMATION. **?Trias, Sherwood Sandstone Group.**

Type-locality: Central Midlands of England.

Warrington G., 1970. pp.183-223. Keuper Series, lowest formation; lower part of the Keuper Sandstone Group. Above the Upper Mottled Sandstone Formation and below the Building Stones Formation. Probably equivalent to the Basement Beds of Hull 1869, or Keuper Basement Beds (auctt.). Fresh water fluviatile environment —description as Hull 1869?

Warrington G. et al. 1980, lower part of the Bromsgrove Formation ?

!CONGLOMERATE SUBDIVISION. **?Trias, Sherwood Sandstone Group.**

See also: Pebble Beds.

Type-locality: Midlands and northwest England.

Hull E., 1869. 127pp. Above the Lower, and below the Upper, Red and Mottled Sandstone. Breccia, conglomerate, shingle and coarse sand. Pebbles are mainly of quartzite but also limestone, grits, slate, greenstone, jasper, locally derived, angular and rounded. Pebbles are often scattered, sand is current-bedded. [usually referred to by either of the synonyms.]

!*CONTORTA* SHALES. **Trias, Penarth Group.**

See also: *Avicula contorta* Shales.

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

Etheridge R., 1865. p.225. Rhaetic, subdivision of the Black Shales above the *Cardium* Shales below the ?White Lias. Dark grey shales with thin bands of sandstone, 0.8 m thick with abundant *Avicula contorta.*

Wright T., 1860. pp.376, 377, part of his *Avicula contorta* Beds.

Warrington G. et al. 1980, in part as the Westbury Formation.

!*CONTORTA* ZONE. **Trias, Penarth Group.**

See: *Avicula contorta* Shales.

!COPPER RED SANDSTONE. **Permian, New Red Sandstone.**

See: Penrith Sandstone.

!COPPER SHALE. **Permian, Zechstein.**

See: Kupferschiefer.

!CORBY SANDSTONE. **?Permian, New Red Sandstone.**

Type-locality: Corby, Vale of Eden, Cumbria.

Murchison R.I., and Harkness R., 1864. pp.144-165. Above the Hilton Plant Beds; local top of the New Red Sandstone sequence. Red sandstone and shale or marl. [Usually superceded by the St. Bees Sandstone.]

COREHEAD SANDSTONE FORMATION. **?Permian, New Red Sandstone.**

Type-locality: East of Corehead Farm, Moffat, NY078125.

Brookfield M.E., 1978, p.137. Overlying red Basal Breccias and Sandstones of the Moffat Basin, possibly older than the Auchencat Breccia Formation. Red aeolian sandstones with alternations of finely laminated cross-stratified coarser sandstone. Grains are subangular to subrounded. 30 m of this formation recorded at the type-locality.

Lovell J.P.B., 1983, p.333, as Brookfield, 1978.

CORLEY BEDS. **?Permian, New Red Sandstone.**

Type-locality: Corley, Warwickshire.

Boulton W.S., 1924. pp.343-373. Lower part of the Geological Survey of Great Britain's unit, termed 'Enville Beds'. Above the Keele Beds (Upper Carboniferous), below the Clent Beds; to replace the term Calcareous Conglomerate. Red sandstones and shales with calcareous cement. [Term best restricted to the Corley area, ?considered as a synonym of Vernon's Corley Conglomerates and Sandstones, below.]

CORLEY CONGLOMERATE. **?Permian, New Red Sandstone.**

Type-locality: Corley, Warwickshire.

Shotton F.W. 1927, pp.604, 612. The middle and thickest of three conglomerate bands within the Enville or Corley Series. [Term restricted compared with that of Vernon 1912 or Boulter 1924, see below.] Coarse red-brown sandstones with conglomerates.

CORLEY CONGLOMERATES AND SANDSTONES. **?Permian, New Red Sandstone.**

(?Corley Beds, Corley Conglomerates.)

Type-locality: Corley, Warwickshire.

Vernon R.D., 1912. pp.587-638, as Corley Conglomerates. Permian, above the Keele Beds, below the Kenilworth Breccia. Composed largely of fragments of Carboniferous Limestones and others foreign to the Warwickshire Coalfield. 22.6 m thick in two bands separated by red calcareous sandstones, marl and breccia.

Eastwood T., Gibson W., Cantrill T.C. and Whitehead T.H., 1923. p.84. as Corley Conglomerates and Sandstones, ?Upper Carboniferous, ?Permian. Coarse brown and massive sandstones with conglomerates.

Boulton W.S., 1924. p.364, suggests the name Corley Beds.

Shotton F.W. 1927, p.604, separates the conglomerates into three well defined bands—Arley and Exhall, Corley, and Allesley Conglomerates.

[Not Corley Series as inferred by Shotton F.W., 1929. p.169. See also Lexicon 3aVIII, p.87.]

!CORLEY GROUP. **?Permian, New Red Sandstone.**

(Corley (Enville) Group, Corley Series, Corley or Enville Series.) See also: Enville Group.

Type-locality: Corley, Warwickshire.

Whitehead T.H. 1922, p.171; Eastwood T., Gibson W., Cantrill T.C. and Whitehead T.C., 1923. pp.3, 77. Above the Keele Group (Upper Carboniferous) and below the ?Trias. Includes the Tile Hill Beds, p.80; and the Astley Court Limestone, pp.88, 90. Red sandstones and conglomerates with marls and thin *Spirobis* limestones. 518.2 m + thick. Synonym of Enville Group.

Boulton W.S., 1924, uses the term for beds above but conformable to the Keele Group.

Shotton F.W., 1929. p.170, as Corley Series or Corley or Enville Series, 1066.8 m thick including the Ashow Group, Kenilworth Breccia, Gibbet Hill and Tile Hill Marl, Groups. An unnamed group at the base includes the Arley-Exhall, Corley and Allesley Conglomerates and the Spirobis Limestone at Astley Court.

[Shotton has now extended the upper limit of Eastwood's et al. 1923 term. The term used as a synonym of Enville Group. The Lexicon vol.3a fasc.VIII pp.87-88 adds further confusion by inventing the term Corley Series for Corley Beds. Enville Group is preferred, Corley restricted to Corley Conglomerates.]

CORNCOCKLE SANDSTONE FORMATION. **?Permian, New Red Sandstone.**

Type-locality: Corncockle, Lochmaben, east of Dumfries, NY085870.

Brookfield M.E., 1978, pp.123-125. Above or interbedded with the Hartfield Breccia Formation, or directly on Lower Palaeozoic strata. Part of the Dumfries Sandstone of Harkness 1850 or the Dumfries Sandstone Series of Horne and Gregory 1916. Fine to medium-grained well sorted aeolian, red, quartz sandstone with some feldspar and with footprints, described by Haubold H., 1971. Some 30 m exposed at the type-locality but the Lochmaben Basin has been estimated at 900 m deep. (Bott M.P.H. and Masson-Smith D. 1960).

Lovell J.P.B., 1983, p.331, 332, aeolian sands, several hundred metres thick.

CORRIE SANDSTONE. **?Permian, New Red Sandstone.**

Type-locality: Corrie, Brodick Bay north side, Cock of Arran, all Isle of Arran, Scotland.

Tyrrell G.W., 1928. p.77. Base of the Arran New Red Sandstone, part of the Lower Series. Brodick Breccia above, unconformable on Carboniferous or older rocks. False-bedded brick red sandstone with rounded wind-worn grains.

Smith D.B. et al. 1974, table 4, col.1, 300 m+, Lower Permian, below the Brodick Breccia and unconformably above water laid sandstones; breccias and lavas near base.

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

Type-locality: [?Coryton, south Devon coast.]

Durrance E.M. and Laming D.J.C. 1982, p.152-153. Above the Teignmouth Breccias and below the Dawlish Sands. Similar in age to the Heavitree Breccias containing the same murchisonite feldspar crystals.

CORSECLAYS SANDSTONE FORMATION. **?Permian, New Red Sandstone.**

Type-locality: West of Corseclays Farm, Ballantrae, Ayreshire, NX093848-095858.

Brookfield M.E., 1978, pp.140-141. Above the Ballantrae Breccia Formation or directly on Ordovivian strata. Part of the Ballantrae Basin sequence. Orange, tabular, fine-grained laminated micaceous sandstones and fine-grained sandy breccias. A thickness of 15 m seen at the type-locality but New Red Sandstone of this basin estimated at over 1000 m by Smith D.B., 1972.

COTGRAVE SKERRY. **Trias, Mercia Mudstone Group.**

Type-locality: Wilford Brick Pit, SK 4568 3355 or Edwalton Brick Pit SK 4589 3363, Nottinghamshire.

Elliott R.E., 1961. pp.200, 219, 220. Trias, Keuper Series, base of the Edwalton Formation. Greenish-grey dolomitic siltstone or fine sandstone with interbedded red-brown marl; gypsum nodules diagnostic. The main bed is 1.8 m thick and forms a prominent escarpment.

Warrington G. et al. 1980, p.52, as Cotgrave Skerry Member ?

COTHAM MARBLE. **Trias, Penarth Group.**

(Cotham Stone, Crazy Cotham Limestone, Crazy Cotham Marble, False Cotham Marble.)

Type-locality: Cotham, Bristol and southwards to the Dorset Coast.

Owen E., 1754. as Cotham Stone.

Etheridge R. 1865. pp.225, Rhaetic, notes the term Cotham Marble.

Stoddart W.W., 1868. pp.203-204; above the Keuper Marls and below the White Lias; Bed or impersistent layer of nodules of hard compact fine-grained limestone with smooth lower surface and mammillated upper surface frequently showing arborescent markings in vertical section.

Short A.R., 1903. pp.135-149, lists 7 varieties.

Richardson L., 1911. pp.1-74, establishes the stratigraphical position at the top of the Cotham Beds, Rhaetic.

Hamilton D., 1961. pp.324-333, algal origin for some of the observed structures.

Mayall M.J. and Wright V.P. 1981, p.655, Cotham Marble described as a stromatollitic limestone with algal mat and algal tuft structures.

***COTHAM MEMBER.** **Trias, Penarth Group.**

(Cotham Beds.)

Type-locality, Cotham, Bristol.

Richardson L., 1911. pp.1-74. Above the Westbury Beds and below the Langport Beds; lowest subdivision of the Upper Rhaetic. Greenish-yellow marls and thin limestones with the Cotham Marble at or near the top; ostracods abundant, *Euestheria minuta, Pseudomonotis fallax* and insect remains. 0.8—5.8 m in thickness.

Arkell W.J., 1933. pp.97-116 includes a full description of the Cotham Beds.

Warrington G., 1974a. Cotham Beds of north Nottinghamshire, Yorkshire and Lincolnshire, Fordon and Whitwell-on-the-Hill borehole 9 m, pale chocolate brown mudstone or pale grey-green finely laminated soft soapy textured mudstone (illite, chorite), laminated sandstone, mica covered bedding planes with dolomite.

Warrington G. et al. 1980, pp.41, 57, 60. Part of the Penarth Group, Lilstock Formation, as Cotham Member, replacing Cotham Beds, including the Cotham Marble. Bristol area redesignated for the type-locality, but England and south Wales generally. Nodular limestone containing [at top?] algal coated fragments.

COVENTRY SANDSTONE FORMATION. **?Upper Carboniferous, ?Permian.**

Type-locality: ?Coventry, Warwickshire.

Old R.A., Sumbler M.G. and Ambrose, K., 1987, p.13, 15. Lowest part of the Enville Group, below the Tile Hill Mudstones. Conformably above the Keele Group. Includes the Arley, Exhall, Corley and Allesley Conglomerates. New name Shotton's 1929 un-named group below his Tile Hill Group. Predominantly a arenaceous formation [with conglomerates] between two predominantly mudstone for mations. 350 m thick in the type area.

CRAB ROCK. **?Permian, New Red Sandstone.**

Type-locality: Furness, north Lancashire.

Murchison R.I. and Harkness R., 1864. pp.144-165. Local base of the New Red Sandstone of the Furness district, Lancashire; local base of the Penrith Sandstone. Limestone breccia.

Rose W.C.C. and Dunham K.C., 1977. 177p, comment that the term is of local use only.

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

Type-locality: Dumfries, south Scotland.

Harkness R., 1850. pp.389-399. Part of the Dumfries Sandstone, below the Castledikes Sandstone. Red breccias and sandstone. Local variety to the south of Dumfries.

Smith D.B. et al. 1974, table 4, col.5, p.24, above the Dumfries Sandstone and below the Castledikes Sandstone.

Brookfield M.E., 1978, p.114, fig.2, and p.121, considers this unit to be part of the Dowell Breccia Formation.

CRAZY COTHAM LIMESTONE.

See: Cotham Marble.

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

(Crediton Beds, Crediton Conglomerates.)

Type-locality: Crediton, Devon.

Hutchins P.F., 1963. pp.107-128.

Laming D.J.C., 1968. pp.23-25, fig.1, lateral equivalent of the Clyst Sands, above the Knowle Sandstones and Bow Conglomerate, part of the Creedy Group, of the Crediton-Bow area, Lower New Red Sandstone.

Smith D.B. et al. 1974, table 6, col.31, lateral equivalent of the Clyst Sands, ?250 m, above the Knowle Sandstone and Bow Breccias, top of the Crediton Permian sequence.

Edwards R.A., 1984, p.15, subdivides the Crediton Breccias into Thorveton Sandstone and Yendacott Breccia.

CREEDY GROUP. **?Upper Carboniferous and Permian, New Red Sandstone.**

Type-locality: Bow-Crediton Valley, Devon.

Laming D.J.C., 1968. pp.23-5. fig. 1. Lower New Red Sandstone, Carboniferous to Permian. Includes: Cadbury Breccias, Solland Conglomerate, Bow Conglomerates, Knowle Sandstones, Crediton Conglomerates, Clyst Sands. [None of these terms are described lithologically by Laming.]

CROPWELL GYPSUM. **Trias, Mercia Mudstone Group.**

Type-locality: Cropwell Bishop, Nottinghamshire.

Elliott R.E., 1961. p.200, fig.2, 222. Keuper Series, part of the Trent Formation. Nodular bedded gypsum, concretionary, fibrous, with interbedded marl.

Balchin D.A. and Ridd M.F., 1970, pl.14, part of the Trent Formation, upper part of their Nottingham Group. [?The equivalent of the Newark Gypsum; no real intention by Elliott to formalise the term ? Picked up by Balchin and Ridd.]

!CUMMINGSTONE BEDS. **?Permian, New Red Sandstone.**

(Cummingstone Sandstone, Hopeman-Cummingstone Sandstones.) See also: Hopeman Sandstone Formation.

Type-locality: Cummingstone Quarries, Elginshire, between Burghead and Covesea.

Watson D.M.S., 1909. pp.103-107; Hickling G., 1909. On Devonian Old Red Sandstones. Moderately coarse false-bedded sandstone with occasional thin beds of pebbles.

Watson D.M.S. and Hickling G., 1914. pp.399-402, footprints described.

Westoll T.S., 1951. pp.5-21, as Hopeman-Cummingstone Sandstones.

Craig G.Y., 1965. pp.384-416, as Hopeman and Cutties Hillock Sandstone.

Peacock J.D., Berridge N.G., Harris A.L. and May F., 1968. as Sandstone of Hopeman or Sandstone of Cutties Hillock and Hopeman, Cummingstone Village ?underlain by Burghead Beds.

Warrington G. et al. 1980 as Hopeman Sandstone Formation.

CUTTIES HILLOCK SANDSTONE FORMATION. **Permian, New Red Sandstone.**

(Cuttie's Hillock Beds, Cutties Hillock Beds, *Gordonia* Beds, *Gordonia* Sandstones, Reptiliferous Sandstones, in part.) See also: Sandstones of Cutties Hillock and Hopeman.

Type-locality: Cutties Hillock, Millstone Quarry, NJ 185638, situated on Quarry Wood Ridge, west of Elgin. Also found at Knock of Alves and Carden Hill, Elgin. Cutties Hillock, Millstone Quarry, NJ 185638.

Benton M.J. and Walker A.D., 1985, pp.209, 213, 216, 228. Late Permian, unconformable above Old Red Sandstone and below the Hopeman Sandstone Formation. Argues for the retention of the name for the inland exposures, rejecting Warrington G. et al. 1980, retaining Hopeman Sandstone Formation for the coastal exposures. At the base, pebbly sandstones with dreikanter pebbles, 4 m thick, overlain by light brown and yellow sandstone with large scale cross-bedding. Reptiles from the sandstones include *Elginia, Gordonia* and *Geikia* with footprint tacks. Fauna indicates a late Permian to early Triassic age.

Symonds W.S., 1860, as Reptiliferous Sandstones (part).

Harkness R., 1864, as Reptiliferous Sandstone (part).

Judd J.W., 1873, 1886, as Reptiliferous Sandstone (part).

Boulenger. A., 1904, as Gordonia Beds.

Watson D.M.S., 1909. pp.103-107. Permian, above the Old Red Sandstone. Coarse false bedded sandstone with wind-rounded grains and discontinuous layers of wind-faceted pebbles.

Huene F., 1913, as Gordonia Sandstones.

Westoll T.S., 1951, as Sandstones of Cutties Hillock and Hopeman-Cummingstone (in part.).

Craig G.Y., 1965. pp.384-416, as Hopeman and Cutties Hillock Sandstone.

Peacock J.D., Berridge N.G., Harris A.L. and May F., 1968. as Sandstones of Cutties Hillock or Sandstones of Cutties Hillock (Quarry Wood) and Hopeman, between 30.5 m and 45.7 m thick.

Walker A.D., 1973. pp.177-183, describes Lower Trias reptiles, from the Cutties Hillock exposures.

Warrington G. et al. 1980, table 4, col.1, p.22, as part of their Sandstone Formation.

Lovell J.P.B., 1983, p.334, unit referred to as Hopeman Sandstone.

D-BED. **Permian, Zechstein.**

(D-Bed Anhydrite, D-Bed, 'D' Gypsum, 'D' Gypsum Horizon.)

Type-locality: Kirkby Thore (boreholes), Vale of Eden.

Sherlock R.L. and Hollingworth S.E., 1938. p.12. Named as the 'D' Gypsum or 'D' Gypsum Horizon. Towards the top of the St. Bees Shales (later Eden Shales), above the Hilton Plant Beds, 61 m below the base of the St.Bees Sandstone. Gypsum and anhydrite 0-1.2 m thick.

Arthurton R.S., 1971. p.15, referred to as the D-Bed. 2.59 m in thickness, within red and grey mudstones, dolomitic above. The unit may contain clastic material within the layered aphanitic anhydrite, term described with reference to the Langwathby borehole.

Smith D.B. et al. 1974 table 3, col.10, as D-Bed Anhydrite, 0-3 m, part of the Eden Shales.

Arthurton R.S. and Wadge A.J., 1981. pp.74-76, 78-82, as D-Bed.

***DANE HILLS SANDSTONE MEMBER.** **Trias, Mercia Mudstone Group.**

(Dane Hill Sandstone Group.)

Type-locality: Dane Hills, Leicestershire; railway cutting, SK 558 042.

Warrington G. et al. 1980. table 4, col.14, pp.40, 57. Within undifferentiated Mercia Mudstone Group. Lateral equivalent of the Arden Sandstone but no known lateral continuation. Synonym of the Upper Keuper Sandstone of Plant 1856, and Dane Hills Sandstone Group, Horwood 1913. Dolomitic sandstones, siltstones and marls.

DAWLISH SANDSTONE FORMATION. **?Permian, New Red Sandstone.**

(Dawlish Sands.)

Type-locality: Cliffs, south and north of Dawlish, SX 967 770.

Laming D.J.C., 1966. pp.940-959, tables 1 and 2. Base of the Exe Group. (Lower New Red Sandstone). Aeolian and fluviatile sands, quartz porphyry breccia near the base, 35 m thick.

Ussher W.A.E., 1902, as Lower Sandstone.

Ussher W.A.E., 1913, as Dawlish Sandstone.

Laming D.J.C., 1968. pp.23-25, fig.1, between Teignmouth and Langstone Breccias, ?Permian of the Haldon Hills.

Smith D.B. et al. 1974, table 6, col.27, Haldon Hills to the Exe Estuary, up to 520 m, lateral equivalent of the Langstone Breccias; below the Clyst Sands and Exminster Breccias and above the Teignmouth Breccias.

Selwood E.B., et al. 1984. pp.91-93, 104, as Dawlish Sandstone, ?late Lower Permian; interdigitates with and above the Teignmouth Breccias and below the Exe Breccias. Uncemented, fluviatile and aeolian, cross-bedded sandstones with breccia lenses. [No thickness given.]

Bristow C.R. 1983; Scrivenor R.C. 1983; renamed the Dawlish Sands as the Exeter Formation to include the Exminster Formation and the Clyst Sandstone. [Quickly superceded by:]

Bristow C.R. et al. 1984a, pp.5, 6, 1984b, p.17; Edwards R.A., 1984, pp.8-10; Bristow C.R. et al. 1985; as Dawlish Sandstone Formation, (ex. Exeter Formation), above the Heavitree Breccias and below the Exmouth Mudstone and Sandstone Formation. In places directly on the Crackington Formation (Carboniferous) or the Monkerton Member (Teignmouth Breccia Formation). Possible five Members in the north extending into the Crediton Basin; less obvious in the south: Brampton Speke Sandstone (base), Bussell's Mudstone, Belfield Sandstone, Politmore Mudstone and Broadclyst Sandstone (top).

DECKANYDRIT. **Permian, Zechstein.**

Rhys G.H., 1974. table 2, fig. 3. Shell/Esso well 49/26-4, southern North Sea. Zechstein, Z2 top,—top of the Fordon Evaporite Formation of Yorkshire. 2 m thick. [First reference for the North Sea area; equates with the Basalanhydrit, northwest Europe?]

***DELAMERE MEMBER.** **Trias, Sherwood Sandstone Group.**

(Delamere Red Pebbly Sandstone Member.)

Type-locality: The Delamere Hills, Cheshire; good sections also available at Helsby Hill and at Manley Hill.

Thompson D.B., 1970b, p.184; 1970c, pp.172-4, 176, 177. Part of the Keuper Sandstone Formation, usually above the Thurstaston Member and below the Frodsham Member. New name for the Keuper Sandstone Passage Beds of Poole & Whiteman, 1966. Unit found mainly in the north-west of the Cheshire Basin but represented by the Wood Mine Conglomerates in the Alderley Edge area. Red pebbly sandstone lithofacies; conglomerates, pebbly sandstones, sandstones. Small layers of Waterstones and soft sandstone lithofacies may be present. Red bed fining upward cycles are 3-6 m thick in the east but less regular in the west; 40-70 m thick.

Warrington G., 1965, p.113, 122, in the Alderley Edge area as Wood Mine Beds.

Poole E.G. and Whiteman A.J., 1966. 154pp., as Keuper Sandstone Passage Beds.

Thompson D.B. 1966; 1970a, p.32; 1970b, p.184, in the Alderley Edge area as Wood Mine Conglomerates.

Warrington G. et al. 1980, table 4, col.9, as Delamere Member, part of the Helsby Sandstone Formation.

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

Type-localty: Windy Harbour borehole near Denstone, Staffordshire. Also in small stream just west of Upper Tean (SK 0069 3946-0050 3931); Broadgate Hall Drumble, 2 km WSW of Hollington (SK 0392 3848-0446 3755); Brookfarm Drumble, 1300 m SE of Snelston (SK 1586 4264-1601 4218); road cutting 750 m east of Snelston (SK 1586 4322-1598 4321).

Charsley T.J., 1982. pp.2, 10-11. Lower part of Mercia Mudstone Group; formerly the Waterstones of Hull E., 1869. Middle Trias, Anisian, on palynomorph evidence. Mainly red-brown siltstones interlayed with very fine to fine-grained sandstone and mudstones. Ripple marks, micaceous surfaces, mudcracks, pseudomorphs after halite and calcite encrusted vughs are characteristic. Some homogeneous or structureless siltstones, mudstone intraclasts and flake breccias may be present. Other features include injection structures, concave curled surfaces, convolutions, small scale penecontemporaneous faults and

(?)invertebrate trails. In general the sequence gets finer upwards. 51.59 m in the borehole but up to 57 m elsewhere.

***DERENENACH MUDSTONE FORMATION.** **Trias, Mercia Mudstone Group.**

Type-locality: Stream section north of Derenenach Farm, NR 934334, Isle of Arran, Scotland.

Warrington G. et al. 1980. table 4, col.3, p.57. ?Top formation of the Mercia Mudstone Group, below the Black Shales ?Westbury Formation, above the Levencorroch Mudstone Formation; term possibly equatable with the Blue Anchor Formation, Tea Green Marls; the upper part of Tyrell's Levencorroch Marls and cornstones. Green-grey mudstones or marls, thin.

!DOLOMITIC CONGLOMERATE. **?Carboniferous-Jurassic, New Red Sandstone.**

See also: Calcareous Conglomerate.

Type-locality: None given but found in Glamorgan and Somerset, (Avon).

Buckland W. and Conybeare W.D., 1822. footnote p.212, 291-297. Rocks marginal to the First Series [Upper Palaeozoic]; considered to be the time equivalent of the yellow Magnesian Limestone of north-east [of Emgland]. Conglomerate, fragments up to 1 m and more in diameter. Locally derived material cemented with dolomite or calcite. [Littoral or marginal facies of Permian and Mesozoic rocks against the Carboniferous Limestone.] Basal part of New Red Sandstone. Carboniferous to Trias. Dolomitic conglomerate, breccias, fragments mainly ORS and Carboniferous.

Tucker M.E., 1977. pp.169-188. [?term retained informally in south Wales.]

Warrington G. et al. 1980, p.45, a diachronous formation, Carboniferous to Lias, term therefore replaced by the informal 'marginal deposits'- table 4, cols. 16, 17.

***DON GROUP.** **Permian, Zechstein.**

Type-locality: Valley of the River Don, between Cadeby Colliery (SK512996) and Sprotbrough, SK538015, Yorkshire.

Smith D.B. et al. 1974. pp.8, 39, table 3, col.34. EZ1, basal group of the English Zechstein, Aislaby Group above. Includes: Marl Slate, Lower Magnesian Limestone and at the top the Hayton Anhydrite. [Yellow Sands may also be included?]

Smith D.B., 1974. pp.116, excludes the Yellow Sands, pp.123-131.

DOWEEL BRECCIA FORMATION. **?Permian, New Red Sandstone.**

Type-locality: Old railway cutting, south of Doweel Farm, Dumfries, NX935739- 941740.

Brookfield M.E., 1978, p.118-121. Above the Locharbriggs Sandstone Formation, renamed upper part of the Dumfries Sandstone of Harkness 1850 and the Dumfries Sandstone Series of Horne and Gregory 1916. Formation includes the Caerlaverock and Cargen Members representing two alluvial fans in the south and around Dumfries respectively. The formation includes the Craigs Breccia and Castledyke Sandstone of Smith D.B. et al., 1974. Red course to fine-grained moderately to well sorted sandy breccias, interbedded in places with fluviatile sandstones, breccias and aeolian sandstone.

Lovell J.P.B., 1983, p.332, best seen west of Dumfries, is partly contemporaneous with, and partly younger than the Locharbriggs Sandstone.

DOWSING DOLOMITIC FORMATION. **Trias, New Red Sandstone.**

Type-locality: Southern North Sea, well no. 49/21-2, lat.53*26'N, long.1*07'E, Admiralty Chart 2182A. Named after the Outer Dowsing Buoy.

Rhys G.H., 1974. table 3, fig.5, pp.4-5. Haisborough Group, lowest formation, below the Dudgeon Saliferous Formation and above the Bunter Sandstone Formation (Bacton Group). Includes the Muschelkalk Halite and Rot Halite Members. Mudstone, red, orange-red, brown red and light green, silty in parts; with beds of dolomite, light grey-green and light grey-buff, cryptocrystalline, and anhydrite, white to transparent; prominent Muschelkalk Halite and Rot Halite Members. 217 m thick.

Warrington G. et al. 1980, term included in table 4, col.28.

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

Type-locality: Saleway borehole, Droitwich, Worcestershire. (Wills 1970).

Warrington G. et al. 1980. pp.40, 57, table 4, col.12. Mercia Mudstone Group, within undifferentiated mudstones below the Arden Sandstone Member. Halite bearing mudstone sequence, 182 m thick p.57, >45 m col.12.

Wills L.J., 1970. describes the Droitwich salt deposits.

!DROITWICH REGIONAL STAGE. **Trias, Mercia Mudstone Group.**

(Droitwich Stage.)

Type-locality: Saleway borehole, 7 miles SSW of Bromsgrove, SO 928 601 ICI Ltd., Central Midlands.

Wills L.J., 1970. pp.228, 234, 266; 1976, pp.28, 101 as Droitwich Stage. Neotrias, English Keuper Series, English Keuper Marls Formation. Miocyclothems KM1-15, Macrocyclothems I,II,III. New nomenclature for the Keuper Marls of Hull 1869, including the Tea Green Marls, Supra- and Sub-Arden Keuper Marls, Arden Sandstone (Group) Main Regional Seal, Upper and Lower Evaporite Groups, Waterstones Group top [previously referred to as Passage Beds, but excludes the Rhaetic. Red marls, with sandstones particularly at the base, locally developed evaporite minerals; becoming grey-green at the top.

***DUDGEON SALIFEROUS FORMATION.** **Trias, ?Mercia Mudstone Group.**

Type-locality: Southern North Sea, Conoco Group well no.49/21-2. lat. 53*15'30"N, long. 1*14'E, Admiralty Chart no.2182A, named after the Dudgeon Light Vessel.

Rhys G.H., 1974. pp.4-5, table 3, fig.5. Middle formation of the Haisborough Group, above the Dowsing Dolomitic Formation and below the Triton Anhydritic Formation, including the Keuper Halite Member at the top. Mudstone red, orange-red, brown-red and light green, with a few silty beds; with thin beds of anhydrite, white to transparent crystalline and some of dolomite, light grey-green to buff; scattered thin beds of halite in the lower part, thick Keuper Halite Member in the upper part.

Warrington G. et al. 1980, term included in table 4, col.28.

***DUMFRIES SANDSTONE.** **?Permian, New Red Sandstone.**

(Dumfries Sandstone Series.)

Type-locality: around Dumfries: Closeburn Quarry, Corncockle Muir, Locharbriggs. Often extended throughout the south-west part of Scotland.

Harkness R., 1850. described p.397, as sandstones of Dumfries. New Red Sandstone, ?Permian. Thick bedded sandstone and overlying flaggy strata, below conglomerate and fine-grained soft sandstone.

Murchison R.I. and Harkness R., 1864. pp.205-218, 1864, compares this unit lithologically with the Penrith Sandstone and assign a Lower Permian age.

Hickling G.A., 1909. pp.1-30, describes footprints from the Dumfries Sandstone.

Horne J. and Gregory J.W., 1916. pp.383-384, as Dumfries Sandstone Series; cross-bedded red sandstones and interbedded quartz-breccias, fragments up to 1 m diameter some rounded, mostly faceted; in railway cutting south-west of Dumfries. False-bedding dune type, compares with Mauchline Sandstone. Sandgrains rounded in part; manganese dioxide and a little mica; footprints and pyrolusite at Corncockle Muir.

Smith D.B. et al. 1974, table 4, col.5, as Dumfries Sandstone, aeolian sandstone at the sides and base of the basin, fluviatile in the centre, 1000 ft, [? m, Smith's thicknesses usually given in m.] Lower Permian.

Brookfield M.E., 1978, pp.112-121, restricts the terminology of the Dumfries Sandstones to the geographically isolated basins. For Dumfries see the Locharbriggs Sandstone and Doweel Breccia Formations. Elsewhere in south west Scotland see Corncockle Sandstone, Hartfield Breccia, Kettleholm Breccia, and Lockerbie Breccia Formations at Lochmaben; the Carron Basalt, Durisdeer, Thornhill Sandstone, and Locherben Breccia Formations of the Thornhill Basin; Corehead Sandstone, Auchencat Breccia, and Bellcraig Breccia Formations from Moffat; Snar Breccia in the Snar Vally; Ballantrae Breccia and Corseclays Sandstone Formations at Ballantrae; and Loch Ryan Breccia Formation at Stranraer.

Warrington G. et al. 1980, table 4, col.7, uses Cumbrian terms (Penrith Sandstone).

Lovell J.P.B., 1983, p.331-334, as Brookfield, 1978.

!DUNE-BEDDED SANDSTONE, DUNE SANDSTONE, DUNE SANDSTONE GROUP.

?Permian, Rötliegende.

See: Bridgnorth Sandstone Formation.

!DUNSCOMBE CYCLE. **Trias, Mercia Mudstone Group.**

Type-locality: S. Devon coast, east of Sidmouth—Weston Mouth.

Jeans C.V., 1978, pp.549-639. Part of the Upper (Keuper) Marls. Carbonate-sandstone-carbonate cycle.

Warrington G. et al. 1980, p.43, rejects the term as a stratigraphical unit, the unit is clearly a sedimentological term. Sandstone renamed the Weston Mouth Sandstone Member.

Warrington G. and Scrivener R.C. 1980, p.24-32, consider that the section of the cliff containing this 'cycle' is part of a land-slipped block and is probably the same as the Weston Cycle (Weston Mouth Sandstone Member.).

DUNCHIDEOCK VOLCANICS. **Permian, ?Rotliegende.**

Type-locality: Haldon Hills and Exe Estuary, Devon.

Ussher W.A.E., 1892, pp.247-250; 1902. Part of the Exeter Volcanics. At or close to the base of the New Red Sandstone of the Exeter area.

Tidmarsh W.G., 1932. pp.721-723, mineralogical and petrological description.

Miller J.A., Shibata K. and Munro M., 1962. pp.394-396. K-Ar radiometric age given as about 280 MY.

Miller J.A. and Mohr P.A., 1964. p.117. Refers to Dunchideock basalt and compares it in age to the Killerton Park lavas.

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

Smith D.B. et al. 1974, table 6, col.27. Haldon Hills to Exe Estuary, Carboniferous-Permian, radiometric age 280 MY, between Culm Measures and Teignmouth Breccias, local base of the Permian sequence.

!DUNROBIN PIER CONGLOMERATE. **Trias, ?Penarth Group.**

Type-locality: Reefs, near Dunrobin Pier, Morayshire, Scotland.

Judd J.W., 1873. p.145 and table 1. Rhaetic, ?zone of *Avicula contorta* Wright, above Reptiliferous Sandstones; similar beds not insitu on the southern shore of the Moray Firth but with fossils. Series of conglomerates, sandstones and grits sometimes calcareous, table 1, 15.2 m thick.

Warrington G. et al. 1980, table 4, col.1, pp.22-23, informal term, no fossils, lithological comparison only with Moray, Mull and Morven.

DUNSMOOR LAVA, north Clyst Valley.

See: Exeter Volcanics.

DURISDEER FORMATION. **?Permian, New Red Sandstone.**

Type-locality: Hapland Burn, Durisdeer, Thornhill, NS888023-889025.

Brookfield M.E., 1978, pp.131-132. Above the Carron Formation and below the Thornhill Sandstone Formation. Tabular red sandy breccias with wind faceted basalt clasts and with fine-medium tabular aeolian sandstones. Grewacke and argillite clasts are rare. 70 m are exposed at the type-locality.

Lovell J.P.B., 1983, p.331, as Brookfield, 1978.

!DYAS. **Permian.**

Marcou M.J., 1859. pp.5-37, 116-146. Rothes-todes-Liegende and Zechstein.

Geinitz H.B. 1861, 1861A. pp.121-146. [First application to British rocks.]

Sherlock R.S., 1948. pp.12, 13, advocates application to UK. [Murchison's 'Permian' not accepted initially in Germany, Dyas refers to rocks above the Upper Carboniferous and below the Trias.]

EAST BRIDGFORD GYPSUM. **Trias, Mercia Mudstone Group.**

See: Harlequin Formation; Clarborough Formation.

***EDEN SHALE FORMATION.** **Permian, Zechstein.**

(Eden Shales.)

Type-locality: Eden Valley, Cumbria, Langwathby and Lownthwaite boreholes. [?Hilton borehole.]

Arthurton R.S., 1971, pp.1-8. Previously known as the St. Bees Shales, Smith B. 1924, for the Eden Valley area. Includes A, B, C, D-Beds or evaporite members, Belah Dolomite (5.5 m) and Langwathby Bed. Red siltstones and mudstones wth gypsum including 5 evaporite beds and the Belah Dolomite. At least 114.5 m (base not seen)

Smith D.B. et al. 1974, table 3, col.10, red and grey-green mudstones, dolomite, gypsum, anhydrite, 160 m thick.

Warrington G. et al. 1980, listed table 4, col.7, as Eden Shale Formation.

Arthurton R.S. and Wadge A.J., 1981. Penrith Mem. G.S.G.B., pp.73-82, for the latest description; states p.74, [?incorrectly] that Arthurton 1971 proposed Hilton Borehole as type-locality.

EDLINGTON FORMATION. **Permian, Zechstein.**

Type-locality: New Edlington Clay Pits, South Yorkshire, SK529987.

Smith D.B., Harwood G.M., Pattison J. and Pettigrew T., 1986, p.15, table 1. Renamed Permian Middle Marls of Yorkshire, or Middle Permian Marls, or Middle Marls. Above the Cadeby Formation, below the Brotherton Formation. Red-brown mudstones and subordinate pale grey-green siltstones and sandstones with veins of fibrous gypsum, scattered nodules of alabastrine gypsum and some pseudomorphs after halite; about 8 m thick, thickening up to 55 m to the east between York and Retford, thinning further east where it may pass into the Hayton, Kirkham Abbey and Fordon Formations. Upper boundary with the Brotherton Formation generally sharp; indistinct in places.

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

Type-locality: Edwalton Hill Brick Pit, SK 4589 3363, or Wilford Brick Pit, SK 4568 3355; temporary exposures and boreholes around Cotgrave Colliery.

Elliott R.E., 1961, pp.219-220. Keuper Series above the Harlequin Formation and below the Trent Formation includes the Cotgrave (base) and Hollygate Skerries (top). Red mudstones and siltstones and thick (0.3-1.5 m) or very thick (up to 6.1 m) yellowish, green-grey and brown beds. Massive bedding, fine grained sandstones at the top and bottom, 48.8 m including the skerries.

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

Warrington G. et al. 1980, table 4, cols.11, 23, S. Staffs, S. Derbyshire, NW. Leicestershire (South Nottinghamshire ?). Stafford Halite Member part of the Formation in south Staffordshire.

!ELGIN SANDSTONES. **Permian and Triassic, New Red Sandstone.**

Type-locality: Lossiemouth to Elgin, Elginshire.

Gordon G., 1859, pp.14-58. Local Old Red Sandstone, top beds. Red, yellow and white sandstones. [Simultaneous publication of description of sandstones of the Elgin area but not named as such, with:]

Huxley T.H., 1859, pp.44O. [named but not described.]

Murchison R.I., 1859, pp.419-430, description under title of 'On the sandstones of Morayshire (Elgin etc.)', but title of the paper shortened by the editor to 'Elgin Sandstones'. separates the upper part of the O.R.S. of Moray transfering the sandstones to the Permian or Trias.

Newton E.T., 1893, pp.431-503, description of vertebrates.

Watson D.M.S., 1909. pp.103-107, in part as Cutties Hillock Sandstone (Trias) Lossiemouth Beds (Permian), Cummingstone Beds (Permian), in three isolated outcrops.

Watson D.M.S. and Hickling G., 1914. pp.399-402, in part as Cutties Hillock Beds and Cummingstone Beds [no Lossiemouth Beds]. Yellow and white sandstones and conglomerates, strongly false-bedded

Peacock J.D., Berridge N.G., Harris A.L. and May F., 1968. pp.54-76, in part as Sandstones of Cutties Hillock and Hopeman.

Warrington G. et al. 1980, table 4, col.1, pp.22, 58, 59, 60 renamed after the isolated outcrops as Hopeman, Burghead and Lossiemouth Sandstone Formations.

Benton M.J. and Walker A.D., 1985, p.216, described and renamed as Cutties Hillock, Hopeman, Burghead and Lossiemouth Sandstone Formations.

ENGINE VEIN CONGLOMERATES. **Trias, Sherwood Sandstone Group.**

(Engine Vien Beds.)

Type-locality: Engine Vein Mine, Alderley Edge, Cheshire.

Thompson D.B., 1966; 1970a, p.32. Lowest of three conglomerates horizons at the base of the Lower Keuper Sandstone at Alderley Edge. Renamed Basal Conglomerate of Taylor B.J. et al., 1963. Above the Lower Mottled Sandstone, and below the Wood Mine Beds. Red Conglomerate and coarse sandstone, 30.5 m thick.

Taylor B.J., Price R.H. and Trotter F.M. 1963, referred to as the Basal Conglomerate.

Warrington G., 1965. p.113, 122, as Engine Vein Beds, lowest mineralised conglomerate of the Lower Keuper Sandstone including copper minerals and barite.

Thompson D.B. 1970b, p.184, constituent part of the Alderley Conglomerate Member in the north-east part of the Cheshire Basin; lateral equivalent of the Thurstaston Sandstone in the north-west.

Warrington G., 1970. p.186. Scythian age, local name for the Basal Keuper Conglomerate.

Thompson D.B., 1970c, p.173, 174, 177, as Alderley Conglomerate Member; p.176, as Engine Vein Conglomerate.

!ENGLISH BUNTER SERIES. **?Trias, Sherwood Sandstone Group.**

See: Bunter Series.

!ENGLISH KEUPER MARL. **Trias, Mercia Mudstone Group.**

(English Keuper Marl Formation.)

See: Keuper Marl Group.

!ENGLISH KEUPER SANDSTONE. **Trias, Sherwood Sandstone Group.**

See: Keuper Sandstone.

!ENGLISH KEUPER SERIES. **Trias, New Red Sandstone.**

See: Keuper Series.

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

See also: Breccia Group.

Type-locality: Enville, Shropshire.

King W.W., 1899. pp.103, 104-5.), as breccias of the Enville District. Above the Calcareous Conglomerate and below the Pebble Beds. Breccia, fragments up to 0.3 m long, igneous rocks, up to 68.6 m in thickness.

Whitehead T.H., 1922. p.171., described as Breccia Group.

Smith D.B. et al. 1974, table 3, col.23, as Enville Breccia, ?100 m thick, between Bowhills Group and Bridgnorth Sandstone, Lower Permian, SW. Staffs and W. Worcestershire, compare with other Lower Permian Breccias—Clent, Nechells, etc.

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

(Enville Beds, Enville (Corley) Group, Enville Series.)

Type-locality: Enville, Staffordshire.

Newell-Arber E.A., 1916. pp.36-42, 46-49, as Enville Series. ?Stephanian, above the Keele Series and includes the Romsley and Clent (top) Groups; equivalent to the Middle and Upper Salopian Permian of Hull 1869. Mainly red beds, calcareous conglomerates and trappoid breccias, some marls.

Whitehead T.H., 1922, p.171, as Enville Beds to include the Calcareous Conglomerate Group and Breccia Group (Romsley and Clent Groups of Arber).

Eastwood T., Gibson, W., Cantrill T.C. and Whitehead T.H., 1923, p.77, as Corley (Enville) Group in table; in the text as Enville Group, for all pre-Triassic red beds that succeed the Keele Group. The subdivision [which?] is represented in Warwickshire by the Corley Group and in south Staffordsire by the Hampstead Beds (Hardaker 1912). On pages 79 to 80 there is a description of the Corley Group. Red sandstones & conglomerates at Arley, Exhall and Maxstokes Corley, and Allesley- ?Upper Carboniferous.

Boulton W.S., 1924, pp.343-373, use Corley Beds for conformable red beds on Carboniferous and Enville Beds where unconformity can be demonstrated.

Eastwood T., Whitehead T.H. and Robertson T., 1925. pp.4, 33, 57, referred to as Enville Beds, or Enville (Corley) Group or Corley Group, 518.2+ m, including Arley-Exhall Conglomerate, Corley Conglomerate, Allesley Conglomerates and Tile Hill Beds, ?the equivalent of the Hamstead Beds of the Lichfield area.

Shotton F.W., 1929. p.169, prefers Enville Series to Corley Series for the sequence as a whole to prevent confusion with Corley Conglomerates. Includes all red beds above the Keele Group including an un-named group at the base suceeded by Tile Hill Group, Gibbet Hill Group, Kenilworth Breccia Group and Ashow Group (top).

Lexicon Fasc. 3aVIII, pp.112-113.

Smith D.B., et al. 1974, term not used; Shotton's Group including Gibbet Hill, Kenilworth Briccia [base is the base of the Permian] and Ashow Groups in Warwickshire; Enville Breccia in south-west Staffordshire and west Worcestershire; Alberbury Breccia in Shropshire.

Ramsbottom W.H.C. 1978, p.51 as Enville Formation for south Staffordshire and p.52 for the Warwickshire Coalfield, not subdivided, partly Westphalian, partly Permian. Enville Breccias as the base of the Permian.

Old R.A., Sumbler M.G. and Ambrose K. 1987, p.13, as Enville Group comprising Coventry Sandstone [un-named group of Shotton 1929], Tile Hill Mudstone, Kenilworth Sandstone [base is the base of the Permian] and Ashow Formations. Total thickness about 900 m. [The statement p.13, that Shotton 1929 included only the beds above the Tile Hill Beds, in the Enville Group appears to be incorrect. Much confusion exists between the various forms of this term and those of the Corley Group. Enville Group best restricted to the Staffordshire and Warwickshire Coalfield areas for red beds above the Keele Group and below the Trias and younger beds. Use of the term Corley to be restricted to the Corley Conglomerates.]

!EO-EPIRIC SERIES. **Permian, Zechstein.**

Type-locality: Northeast England.

Sherlock R.L., 1948. Zechstein, lower part of the Epiric System.

!EPIRIC SYSTEM. **Upper Permian and Triassic.**

Type-locality: British Isles.

Sherlock R.L., 1948. Zechstein and Trias—excluding the Rhaetic. 'Permian' rocks belong to the Carboniferous or Trias. Epiric includes Upper Permian and Trias, excluding the Rhaetic. Lower 'Permian' to Upper Carboniferous and Rhaetic of UK. to Jurassic; Includes the Eo-epiric Series.

***ERBISTOCK BEDS.** **?Carboniferous, ?Permian, New Red Sandstone.**

(Erbistock Group.)

Type-locality: Erbistock, Denbighshire. (Clwyd).

Lamplugh G.W., 1912, p.13. Conformable on Carboniferous beds, unconformably below ?Trias. Red and purple sandstones, calcareous, with conglomerate beds and bright red marls.

Wills L.J., 1928, p.122, Erbistock Beds subdivided into 3 units only one of which is named; total thickness given as 205.7 m.

Pocock R.W., Whitehead T.H., Wedd C.B. and Robertson T., 1938, pp.153-159, includes the Alberbury Breccia and red beds said to be Keele Beds.

Smith D.B. et al. 1974, table 4, col. 21, below the Alberbury Breccia, in a similar stratigraphical position to the Gibbet Hill Group.

Lexicon Fasc. 3aVIII, pp.113-114.

***ESK EVAPORITE FORMATION.** **Trias, Mercia Mudstone Group.**

Type-locality: Boulby Mine, Staithes, No.20, pilot borehole, NZ 760 180; Eskdale no.4 borehole, NZ 905 178.

Warrington G. et al. 1980, pp.51, 57, table 4, col.26. Near the base of the Mercia Mudstone Group, renamed Keuper Halite of Raymond 1953. Mudstone with halite or mudstone with collapse structures after halite solution, 0-60 m in thickness.

***ESKDALE GROUP.** **Permian, Zechstein.**

Type-locality: Eskdale no.3 borehole, Whitby, Yorks, NZ 872 078 and coastal districts from Whitby, southwards.

Smith D.B., et al. 1974, pp.8, 39, table 7, col.34. EZ5, highest Zechstein group, above the Staintondale Group, below the Sherwood Sandstone Group, includes the Sleights Siltstone, Top Anhydrite and Saliferous Marl.

Smith D.B., 1974, pp.116, 140-141, includes the Lower Mottled Sandstone of Yorkshire, by diachronous passage.

***ESTHERIA* BED.** **Trias, Penarth Group.**

(*Estheria* Zone.)

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

Wright T., 1860, p.378. In the higher part of the *Avicula contorta* Beds. [later called Cotham Beds.] Nodular limestone with abundant *Estheria minuta*, 0.3 m in thickness.

Etheridge R., 1865. described p.227, as *Estheria* Zone.

Kellaway G.A., 1932, p.296, records the beds in temporary sections at Southmead, Bristol.

EXHALL CONGLOMERATE.

See: Arley and Exhall Conglomerates.

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

(?Heavitree Breccia, ?Exminster Breccias.)

Type-locality: Langstone Cliff, Exmouth, Devon.

Henson M.R., 1970. Description pp.172-173 but not named.

Selwood E.B. et al. 1984. pp.91, 92, 104. ?Late Lower Permian, interdigitates and above the Dawlish Sandstone; below Exmouth Sandstones and Mudstones. Contains a varied suite of fragments, similar to the Teignmouth Breccias. Clasts generally less than 0.15 m in length. Sandstones with large dune-bedding structures present. [No thickness given.]

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

Type-locality: Exmouth, south Devon.

Laming D.J.C., 1966, tables 1, 2, pp.942-3, 949. ?Lower Permian, Lower New Red Sandstone, includes the Dawlish Sands and Exmouth Beds. Red siltstones, sandstones and occasional breccias.

Laming D.J.C., 1968. pp.23-25, fig.1. including the Dawlish Sands, Langstone Breccias, Exmouth Sandstones and Littleham Beds. Area extended to include the Haldon Hills.

!EXETER FORMATION. **?Permian, New Red Sandstone.**

Type-locality: Cliffs about Dawlish.

Bristow C.R. 1983; Scrivenor C.R. 1983; Williams B.G. 1983. Above the Teignmouth Breccia, and below the Aylesbeare Mudstone Formations. Renamed Lower Sandstone of Ussher W.A.E., 1902; Dawlish Sands, Ussher W.A.E., 1913. Subdivided into five members: Brampton Speke Sandstone, Bussell's Mudstone, Belfield Sandstone, Poltimore Mudstone and Broadclyst Sandstone Members (top). Mainly red sandstones with impersistent breccias and mudstones.

Bristow C.R. et al. 1984a; Bristow C.R. et al. 1985, modified old name now preferred—Dawlish Sandstone Formation.

!EXETER RED CONGLOMERATE. **?Permian, New Red Sandstone.**

Type-locality: Babbacombe and Tor Bays, Devon; Exeter, Heavitree, Devon. St. Mary's Church and Watcombe; Tor Mohain; Paignton.

De la Beche H.T., 1819, pp.161-163. Rothe-Todte-Liegende. Fine-grained conglomerate of small fragments of carboniferous limestone (sic), old red sandstone (sic), sandstone, shale, quartz, greywacke and red quartziferous porphyry, cemented by a red paste generally argillaceous and frequently very compact. Large grained conglomerates—fragments weigh up to 1 ton (1016 kg) red sandstones and marls interbedded. [This term has been superceded by locality based terms introduced by Laming 1966, 1968 and Henson 1970, 1972; Bristow C.R. et al. 1985,—Tor Bay, Paignton Vicarage Hill, Chelston, Oddicombe, Teignmouth, Langstone, Heavitree, Kennford, Cadbury, Silverton, Breccias; also Livermead, Watcombe, Ness and Netherton Beds; Exmouth Sandstone and Clyst Sands.]

!EXETER VOLCANICS. **Permian, Rotliegende.**

(Exeter Traps.)

Type-locality: Killerton Park, Silverton, Dunchideock, and Exeter, Devon.

Conybeare W. and Phillips G., 1822. pp.294-298. Description but not named collectively.

Ussher W.A.E., 1902. pp.19-21, 55-85. Amygdaloidal basalts, porphyries, trap rocks.

Hobson B., 1892, petrographic description of the Exeter Traps.

Tidmarsh W.G. 1932. pp.712-775. Redescription including mineralogical and petrological details. Term split into geographically based terms- Dunchideock, Knowle, Pocombe and Stoodleigh Lavas to the south-east of Exeter; Killerton Park, Heazille, Dunsmoor and Thorverton Lavas, Exe, Culm and Clyst areas; Uton, Posbury, Spencecombe, Knowle Hill, North Tawton and Hatherleigh Lavas, Crediton area; Loxbeare, Holmead, Maker Peninsula and Cawsand Lavas, south Devon. In addition, the lavas are subdivided into the Hatherleigh and Pocombe [petrographic] Series which include a number of mineralogical types.

Miller J.A., Shibata K. and Munro M., 1962, pp.394-396, K-Ar radiometric age given as about 280 my.

Miller J.A. and Mohr P.A., 1964. pp.105-126. K-Ar radiometric age of volcanic rock of the Exeter area stated to be about 280 my.

Knill D.C., 1969, pp.115-138, revised petrological description.

Cosgrove M.E., 1972, geochemical description.

Smith D.B. et al. 1974, table 6, cols. 27, 29 and 30, as Dunchideock Volcanics, Rougemont, Silverton and Killerton Park Lavas.

Bristow C.R. et al. 1984a, used to date overlying deposits.

!EXMINSTER BRECCIAS. **?Permian, New Red Sandstone.**

(Exminster Conglomerates, Exminster Sandstones.)

Type-locality: Exe Estuary.

Worth M.E. 1890, as Exminster Conglomerates.

Ussher W.A.E., 1902. pp.21-23, as Breccias at Exminster or Exminster sandstones and breccias, overlying trap rock. Small sub-angular fragments of igneous and grit rocks; boulders of quartz porphyry; in a red brown clayey and loamy matrix. Similar to Breccias at Dawlish and Teignmouth.

Smith D.B. et al. 1974, table 6, col.27, p.28, Haldon Hills to Exe Estuary, Devon, ?Permian, 410 m, local top of New Red Sandstone sequence, lateral equivalent of the Clyst Sands, above the Dawlish Sands and Teignmouth Breccias.

Bristow C.R. et al. 1984a; 1985, included as part of the Dawlish Sandstone Formation.

***EXMOUTH MUDSTONE AND SANDSTONE FORMATION.** **?Permian, New Red Sandstone.**

(Exmouth Beds, Exmouth Sandstones and Mudstone Formation, Exmouth Sandstones.)

Type-locality: South Devon coast, east of Exemouth.

Henson M.R., 1970. pp.173-174, as the Exmouth Formation. ?Trias, between Langstone Breccias and Littleham Mudstones (top). [Fluviatile characteristics indicate age!] Fluviatile sandstones and mudstones.

Laming D.J.C., 1966, pp.940-959, tables 1, 2, as Exmouth Beds, top of the Exe Group, 457.2 m, fluviatile sandstones and siltstones, breccia near the base. Cliffs east of Exemouth.

Laming D.J.C., 1968. pp.23-25, fig.1, listed as Exmouth Sandstones.

Henson M.R., 1972. pp.447-457, extends the formation to the Haldon Hills.

Smith D.B. et al. 1974, listed table 3, col.28, ?Permian.

Selwood E.B. et al. 1984, as Exmouth Sandstone and Mudstone, pp.91, 92, 94, 104-105; ?Upper Permian, above the Exe Breccia and below the Littleham Mudstone. Lower division of Ussher's 'Lower Marls'; thick cross-bedded sandstone interbedded with reddish-brown mudstone; 255 m thick.

Bristow C.R., 1983, p.10; Williams B.J., 1983; Bristow C.R. et al. 1984b, p.25; Bristow C.R. et al. 1985, p.48, as Exmouth Mudstones and Sandstones, name revised to emphasise the dominant mudstone lithology, particularly away from the coast. Above the Broadclyst Sandstone or Exmouth Breccias and below the Straight Point Sandstones or Littleham Mudstones, base of the Aylesbeare Formation. Mainly red mudstones and silty mudstones with lenticular cross- bedded sandstones. 255 m in thickness.

FALSE COTHAM MARBLE.

See: Cotham Marble.

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

Type-locality: Fauld Mine, near Burton-on-Trent, Staffordshire. Also known at Gotham mine, East leake Mine and boreholes between East leake and Newark, Nottinghamshire.

Taylor, S.R., 1983, pp.13, fig.3. Close to the top of the Trent Formation, below the Hawton Member. Includes the Tutbury Sulphate Bed. Reddish-brown dolomitic siltstones and mudstones, with a major nodular sulph ate seam, the Tutbury Bed. Thin sandy beds present locally. [No thickness given]

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

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

Thompson D.B., 1966; 1970c, p.176. Top beds of the Lower Keuper Sandstone in the Alderley Edge area. Possible synonym of the Brynlow Sandstones. Fine to medium brown-red sandstones.

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

Thompson D.B., 1970b, p.184; 1970c, pp.172, 174, 177 as ?part of the Nether Alderley Red Sandstone Member, or Nether Alderley Member.

!FIRST BED.

See: Top Rock (Top Bed).

***FLESWICK ANHYDRITE.** **Permian, Zechstein.**

Type-locality: Borehole 59, Sandwith Series, IGS(UK) no.NX 91 SE/190, St. Bees, Cumberland.

Arthurton R.S. and Hemingway J.E., 1972, fig.4, p.581. Within the St. Bees Evaporites, top of the Fleswick Cycle, above Fleswick Dolomite and Siltstone and below the St. Bees Shales. Nodular and layered anhydrite, 3.2 m thick.

Smith D.B. et al. 1974, table 3, col.9, part of St. Bees Evaporites.

Arthurton R.S., Burgess J.C. and Holliday D.W., 1978, p.199, ?equivalent to the Seaham Residue of north-east England, EZ2.

***FLESWICK CYCLE.** **Permian, Zechstein.**

Type-locality: Borehole 59, Sandwith Series, IGS(UK) no.NX 91 SE/190, St. Bees, Cumberland.

Arthurton R.S. and Hemingway J.E., 1972, fig.4., pp.580-581. At the top of the St. Bees Evaporites, EZ2?, above the Sandwith Cycle and below the Tomlin Cycle (St. Bees Shales). Includes the Fleswick Dolomite and Siltstone and Fleswick Anhydrite (top), 6.2 m thick.

***FLESWICK DOLOMITE AND SILTSTONE.** **Permian, Zechstein.**

Type-locality: Borehole 59, Sandwith Series, IGS(UK) no.NX 91 SE/190, St. Bees, Cumberland.

Arthurton R.S. and Hemingway J.E., 1972, fig.4, p.580. Part of the St. Bees Evaporites, lower part of Fleswick Cycle, above the Sandwith Anhydrite and below the Fleswick Anhydrite. Red siltstones with dolomite, some nodular anhydrite breccia at the base, 3 m thick.

Smith D.B. et al. 1974, table 3, col.9, part of the St. Bees Evaporites.

Arthurton R.S., Burgess I.C. and Holliday D.E., 1978, p.199, ?equivalent to the Hartlepool and Roker Dolomites of north-east England, ?EZ2.

FLEXIBLE LIMESTONE. **Permian, Zechstein.**

See also: Fulwell Beds.

Type-locality: Fulwell Quarry; also at Marsden Bay and Hendon, Co. Durham.

Woolacott D., 1912, pp.253, 266. Lower part of the Upper Magnesian Limestone below the Concretionary Limestone and above the Middle Magnesian Limestone. Thinly bedded, 3.7 m in thickness, whose laminae are flexible. Interlocking grains or air spaces account for the flexibility; fish remains occur.

Magraw D., Clarke A.M. and Smith D.B., 1963, p.178, base of the Concretionary Limestone, south-east Durham, a bituminous shaly dolomite, Northumberland coast 1.2 m, off the Durham coast, 2 m. [D.B.Smith (personal comm.) now considers that there are a number of flexible limestones within the Concretionary Limestone Formation.]

FORD FORMATION. **Permian, Zechstein.**

Type-locality: Ford Quarry and Claxheugh Rock, Sunderland, NZ362572; and elsewhere in County Durham, Tyne & Wear, Cleveland and northernmost Yorkshire.

Smith D.B., Harwood G.M., Pattison J. and Pettigrew T., 1986, p.14, table 1, renamed Middle Magnesian Limestone of the above localities, EZ1bCa, above the Raisby Formation and below the Edlington Formation in the west and the Hartlepool Formation in the east. Reef and back-reef facies of great lithological and thickness variations. Reef: massive buff and brown altered dolomite with bryozoan framework with dominant algal encrustations, laminae and stromatolites near the top. Back-reef of bedded buff mainly fine-grained altered dolomite, slump structures and foraminiferal-brachiopod-molluscan fauna. Minor basin floor facies. Maximum thickness of the formation up to 150 m. Low reef includes *Fenestella retiformis, Synocladia virgulacea, Horridonia horrida, Pterospirifer alatus, Euconospira antrina, Bakevellia ceratophaga, Peripetoceras freieslebeni.*

***FORDON EVAPORITE FORMATION.** **Permian, Zechstein.**

Type-locality: Fordon no.1 borehole, north east Yorkshire, TA058757, 1891.3 to 2286.7 m; East Yorkshire, West Sole Gas Field, southern North Sea.

Smith D.B. et al. 1974, pp.8, 39, table 3, cols. 17, 18, 34. EZ2 top, above the Kirkham Abbey Formation and below the Upper Magnesian Limestone [Brotherton Formation]. Thick and varied sequence of evaporites, up to 390 m thick.

Stewart F.H., 1963, pp.1-44, as Lower Evaporites.

Smith D.B., 1974, pp.116, 133, top EZ2, partly equivalent of the middle marls (s.s.) top Permian Middle Marls.

Smith D.B., Harwood G.M., Pattison J. and Pettigrew T., 1986, p.11, fig.2, E Z2E, lateral equivalent of the Edlington and Kirkham Abbey Formations.

FORE-REEF BRECCIA. **Permian, Zechstein.**

Type-locality: Seaham Borehole only.

Magraw D., 1978, p.175. Part of the Middle Magnesian Limestone above the Velvet Beds Limestone and Breccia and below the North Marsden Bay Limestone. Dolomitic limestone, brecciated and 26 m thick.

!FOX BED. **Permian, Zechstein.**

Type-locality: None given.

Binney E.W. 1846, p.17, Magnesian Limestone of Derbyshire but without Magnesia.

***FREEHAY MEMBER.** **Trias, Sherwood Sandstone Group.**

Type-locality: Freehay, 2 km southeast of Cheadle,Staffordshire, quarries around the village; Freehay Quarry, SK 017 413, Mobberley Quarry, SK 012 409, Muddale Quarry, SK 036414.

Charsley T.J., 1982, pp.2, 5. Sherwood Sandstone Group, Hawksmoor Formation, lowest member. Conglomerates with subordinate sandstones, often pebbly. Sporadic mudstone bands and intraformational mudstone clasts. Conglomerates are either clast supported or matrix supported; in places the two types alternate on a small scale in foreset cross-beds. The mudstones commonly occur as impersistent lenses which are moderately well cemented compared to the conglomerates causing them to stand out as resistant ribs in many quarry sections. Thickness is up to 56 m.

FRENCHMANS BAY LIMESTOMES. **Permian, Zechstein.**

Type-locality: Coastal exposures, Frenchmans Bay, Co. Durham.

Magraw D., 1975, fig.1, p.398. Equivalent of the Lower Magnesian Limestone [in part ?], between the Marl Slate and Velvet Beds Limestones and Breccias.

Magraw D., 1978, table 1, pp.175-6, prefers the usual term Lower Magnesian Limestone.?

***FRODSHAM MEMBER.** **Trias, Sherwood Sandstone Group.**

(Frodsham Beds, Frodsham Facies, Frodsham Soft Sandstone Member.)

Type-locality: Frodsham, Cheshire; found elsewhere in the north-west of the Cheshire Basin.

Strahan A., 1881, pp.396-402, as Frodsham Beds or as Frodsham Facies. Part of the Lower Keuper Sandstone. Mottled Sandstone Facies.

Thompson D.B., 1966; 1969, pp.263-289; 1970b, p.184, 1970c, pp.171, 174, 176, 177, as Frodsham Soft Sandstone Member or as Frodsham Member. Located from the Wirral to Alderley; Liverpool to Threapswood (south of Malpas). Top of the Lower Keuper Sandstone in the north-east of the Cheshire Basin. Represented by the Netherley Alderley Member and the West Mine Soft Sandstones in the Alderley Edge area. Soft sandstone lithofacies, 20-55 m thick.

Thompson D.B. 1970a, p.32; 1970b, p.184, in the Alderley area in part represented by the West Mine Soft Sandstones.

Warrington G. et al. 1980, table 4, col.9, as Frodsham Member, top member of the Helsby Sandstone Formation, Sherwood Sandstone Group.

FULWELL BEDS. **Permian, Zechstein.**

(Fulwell Concretionary Beds, Fulwell Limestone, Fulwell Fish Bed.)

Type-locality: Fulwell Quarries, Fulwell Hill, Sunderland, Co. Durham.

Kirkby J.W., 1864, p.346, figs.1 & 2; 1867, pp.63-87. Near the base of the Upper Magnesian Limestone. Concretionary Limestone or Cannon Ball Rock, includes the Fulwell Fish Bed.

Woolacott D., 1912, p.253, as Fulwell Limestone, alternative name for Concretionary Limestone of previous authors, lower part of the Upper Magnesian Limestone. [Later authors generally revert to Concretionary Limestone.]

***GIBBET HILL CONGLOMERATE.** **?Carboniferous, ?Permian, New Red Sandstone.**

Type-locality: Gibbet Hill, Kenilworth, Warwickshire.

Shotton F.W., 1929, p.175. Within the Gibbet Hill Group, Corley or Enville Series. Red conglomerate with fragments of Silurian sandstones and Carboniferous cherts, 15.2 m in thickness.

See also Lexicon Fasc. 3aVIII, p.147.

Old R.A., Sumbler M.G., and Ambrose K. 1987, p.16. Close [25 m] to the base of the Kenilworth Sandstone Formation, impersistent.

***GIBBET HILL GROUP.** **?Carboniferous, ?Permian, New Red Sandstone.**

Type-locality: Gibbet Hill, Kenilworth, Warwickshire.

Shotton F.W., 1929, pp.170, 173-177. Part of the Corley or Enville Series, above the Tile Hill Group and below the Kenilworth Breccia Group. Red conglomerates, sandstones and marls, 137.2 m in thickness.

Smith D.B. et al. 1974, table 5, col.25, between Keele Beds and Ashow Group.

See also Lexicon Fasc. 3aVIII, p.147.

Old R.A., Sumbler M.G. and Ambrose K., 1987, p.16. Top considered to be indistinct with the overlying Kenilworth Breccia Group of Shotton 1929. Considered as the base of the Kenilworth Sandstone Formation. Gibbet Hill Conglomerate close to the base.

***GLEASTON DOLOMITE.** **Permian, Zechstein.**

Type-locality: Gleaston no.4 borehole, SD 654701, Gleaston, Barrow-in-Furness, south Cumberland, 183-202 m depth.

Smith D.B., et al. 1974, p.39, table 3, col.11. Part of the St. Bees Evaporites passing laterally into grey plant bearing clastics. Dolomite carbonate member, 0-20 m thick. [Lowest dolomite in the sequence, the equivalent of the Magnesian Limestone, Dunham & Rose 1949.]

***GLEN DUBH SANDSTONE FORMATION.** **?Permian, Sherwood Sandstone Group.**

(Glen Dubh Sandstone.)

Type-locality: Southern slopes of Glen Dubh, Isle of Arran, Scotland, NR 995 340 redesignated by Warrington et al. 1980; and at Whiting Bay and Ballymichael Glen.

Tyrell G.W., 1928, pp.77, 85-94, as Glen Dubh Sandstone. Top of the Lower Series above the Lamlash and Machrie Sandstones and below the Lag a'Bheith Marls and Cornstones. White, yellow or pink massive calcareous sandstone. Thickly bedded, careous but with smooth weathered surfaces, blocky outcrops. A few lenticles of conglomerates.

Smith D.B. et al. 1974, table 4, col.1, Glen Dubh Sandstone, th?, Trias or Permian, above the Lamlash and Machrie Sandstones.

Warrington G. et al. 1980, table 4, col.3, as Glen Dubh Sandstone Formation, top of the Sherwood Sandstone Group, above the Lamlash Sandstone Formation and below the Lag a'Bheith Formation (Mercia Mudstone Group.) p.58, type- area: Eastern Arran, southern slopes of Glen Dubh, NR 995 340; renamed Glen Dubh Sandstone of Tyrell 1928; may show lateral passage into the top beds of the Lamlash Sandstone Formation.

Lovell J.P.B., 1983, p.328, term listed.

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

Type-locality: Glen Parva, Leicestershire, SP 580980, (old brick works.)

Warrington G. et al. 1980, table 4, cols. 11 and 23, p.58. Above the Trent, and below the Blue Anchor, Formations. That part of Elliott's 1961 Parva Formation occurring below the Tea Green Marls (sic) and above the Trent Formation. Red-brown marls and fish scales with thick interbedded green beds.

!*GORDONIA* BEDS, *GORDONIA SANDSTONES*.

See: Cutties Hillock Sandstone Formation.

GRAUER SALZTON. **Permian, Zechstein.**

Rhys G.H., 1974, table 2, fig.3. Shell/Esso well 49/26-4, southern North Sea. North Sea equivalent of the Upper Magnesian Limestone. Grey salt clay. [First use of the term in the southern North Sea.]

!GREEN BEDS. **Trias, Mercia Mudstone Group.**

(Green Keuper Basement Beds.)

Type-locality: Oxton to Bothamsall, Nottinghamshire.

Lamplugh G.W., Hill G.B., Gibson W., Sherlock R.L. and Smith B., 1911, p.26. Above the Pebble Beds and below the Waterstones. Micaceous ripple-marked pale clays, clays, and sandy shales of green-grey, grey-blue or sometimes reddish tints, with occasional streaks of gritty sand, calcareous nodules in places and obscure fragments of carbonised organic matter (probably plants), 6.1-7.6 m thick.

Smith B., 1912, pp.252-257, extends outcrop to Retford, ?up to 26.2 m in boreholes at Scunthorpe. Blue colour in fresh exposures turning green on exposure; lists detailed sections.

Warrington G., 1970, p.187, 198, records Middle Trias spores from this formation in borehole 2, Ompton, Eakring, Nottinghamshire.

Warrington G. et al. 1980, table 4, cols.24, 25, pp.51, 61, renamed as the Retford Formation.

!GREENISH GREY MARLS. **Trias, Mercia Mudstone Group.**

Type-locality: Derenenach Farmhouse, southern Arran, Scotland.

Tyrell G.W., 1928, pp.76, 96-103. ?Keuper, highest part of the Levencorroch marls and cornstones. [sic.] [Possibly the equivalent of the Tea Green Marls of England and Wales.]

Warrington G. et al. 1980, included in with the Derenenach Mudstone Formation.

GRENZANHYDRIT. **Permian, Zechstein.**

Rhys G.H., 1974, table 2, fig.3. Shell/Esso well 49/26-4, southern North Sea. Z4 top, the lateral equivalent of the Top Anhydrite and the Sleights Siltstone, Yorkshire; part of the Eskdale Group. 1 m thick. [First use in the southern North Sea.]

!GREY BEDS (1). **Permian, ?Rotliegende, ?Zechstein.**

(Grey Marls (2), Grey Shales.)

Type-locality: [None given; refers to localities in south Yorkshire and Nottinghamshire.]

Sherlock R.L., 1926, p.14. Includes the Yellow Sands, clays, shales and dolomitic limestones below the Lower Magnesian Limestone. Previously referred to as Marl Slate. [referred to elsewhere in this paper as Lower Permian Marls or Lower Marl.]

!GREY BEDS (2). **Permian.**

Type-locality: Haverigg Haws borehole, Cumbria.

Hollingworth S.E., 1942, pp.141-151. ?Zechstein, ?Rotliegende; found between the Lower and Upper Brockrams. [Elsewhere referred to as Hilton Plant Beds.]

Rose W.C.C. and Dunham K.C., 1977, p.x, table, between Brockrams; grey mudstones and siltstones with fragmentary plant remains below thick limestone; a few dolomitic layers, 0-21 m.

!GREY MARLS (1) **Trias, Mercia Mudstone and Penarth Groups.**

(Grey Marls and Tea Green Marls.) See also: Tea Green Marls.

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

Etheridge R., 1865, pp.220, 221. Above Upper (red) Marls and below the Black Shales (Rhaetic). Grey marls with conchoidal fracture including a 0.3 m fish bed at the top; 4.3 m in thickness.

Whittaker A. and Green G.W., 1983, pp.39-41, 49-52, At Lilstock, north Somerset, the top part of the Grey Marls as the Blue Anchor Formation.

!GYPSEOUS AND SALIFEROUS SERIES. **New Red Sandstone.**

Type-locality: Tortworth (Gloucestershire) and in Somerset.

Weaver T., 1822, pp.317, 347. Includes the New Red Sandstone, Calcareous Conglomerate, Magnesian Limestone.

!GYPSEOUS MARLS. **?Trias, New Red Sandstone.**

Type-locality: Northwest England.

Goodchild J.G., 1893, pp.1-24. New Red Series, above the Penrith Sandstone and below the St. Bees Sandstone. Red marl with gypsum.

Smith B., 1924, pp.289-308, renamed as St. Bees Shales.

Arthurton R.S. and Hemingway J.E., 1972, pp.565-591, as St. Bees Evaporites.

!GYPSUM—A. **Trias, Mercia Mudstone Group.**

See: Newark Gypsum.

!GYPSUM—B. **Trias, Mercia Mudstone Group.**

See: Tutbury Gypsum.

!HABBERLEY BRECCIA. **?Permian, New Red Sandstone.**

See: High Habberley Breccia.

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

Type-locality: Haffield, Malverns, Worcestershire.

Wills L.J., 1948, p.67. Part of the Clent Breccia Group, above Carboniferous rocks and below Pebble Beds. Stratified breccia.

Smith D.B. et al. 1974, table 5, col.21, sole representative of Permian (?) rocks in the Malvern area, between Westphalian beds and Kidderminster Conglomerate Formation (top), ?60 m thick.

***HAISBOROUGH GROUP.** **Trias, ?Mercia Mudstone Group.**

Type-locality: Conoco Group Well no.49/21-2, southern North Sea, lat. 52* 56'N, long. 1*43'E. Admiralty Chart 2182A, named after Haisborough Sands.

Rhys G.H., 1974, fig. 5, pp.4-5. Above the Bacton Group and below an unnamed group comprising the Winterton Formation. The Haisborough Group includes: Dowsing Dolomitic Formation, Dudgeon Saliferous Formation, Keuper Anhydrite Member, Keuper Halite Member, Muschelkalk Halite Member, Rot Halite Member, Triton Anhydritic Formation. Total thickness for the group is 707 m.

Warrington G. et al. 1980, table 4m col.28, p.50, possible equivalent of the Mercia Mudstone Group.

***HAMBLEDON MUDSTONES FORMATION.** **Trias, Mercia Mudstone Group.**

(Hambledon Mudstones.)

Type-locality: Boreholes recorded on the Blackpool 1:50 000 map.

Evans W.B. and Wilson A.A., 1975. Scythian, (miospores) Mercia Mudstones Group base, above the St. Bees Sandstone (Sherwood Sandstone Group) and below the Singleton Mudstones. Grey mudstones with thin intercalated siltstone bands. Breccia near base, mudcracks, current ripples, cross-lamination, mudclasts, pseudomorphs after halite common. *Euestheria*, trails, plant debris, miospores; 20-35 m thick.

Warrington G. et al. 1980, table 4, col.8, as Hambleton Mudstone Formation, 0-35 m in thickness.

HAMPOLE BEDS. **Permian, Zechstein.**

Type-locality: Hampole Limeworks Quarry, western end, 515 097, northwest of Doncaster, Yorkshire, extending from Nuthall, Nottingham to Ripon, Yorkshire.

Smith D.B., 1968, pp.463-477. Part of the Lower Magnesian Limestone, between the Lower and Upper Subdivision. 0-2 m of fenestrate dolomites with interbedded marl.

Smith D.B. et al. 1974, table 3, EZ1, col.14, central Yorkshire and north Nottinghamshire.

Smith D.B., Harwood G.M., Pattison J. and Pettigrew T., 1986, pp.13. Only Hampole Discontinuity mentioned. [Inferred that the lowest Bed are included in the Wetherby Member, upper beds part of the Sprotbrough Member!. At Cadeby Quarry, 4 m of multicoloured dolomites and mudstone the latter with plant fragments. Not generally found south of Mansfield and north of Ripon. ?Not now recognised as a formal stratigraphical division.]

!HAMSTEAD BEDS. **?Carboniferous, ?Permian, New Red Sandstone.**

(Hamstead Group, Hamstead Quarry Series.)

Type-locality: Hamstead, 4 miles north-west of Birmingham, Warwickshire.

Hardaker W.H., 1912, pp.639-683. Conformably above grey Productive Coal Measures the Hamstead Colliery Series, and unconformably below the basement beds of the Trias. Compares with the Middle and Upper Permian of King, 1899. Red, rarely green, calcareous sandstones and purple, occasionally green, mudstones with plant remains, footprints and trails, 61.2 m in thickness, subdivided into seven sub-groups.

Newall-Arber E.N., 1916, p.41, comments on the flora, ?Carboniferous.

Barrow G., Gibson W, Cantrill T.C., Dixon E.E.L. and Cunnington C.H. 1919, as Hamstead Group, ?Upper Carboniferous.

Boulton W.S., 1924, pp.359-362, rejects Hardaker's subdivisions, equivalent of the Calcareous Conglomerate Group, renames beds Corley Beds overlain unconformably by Nechells or Hopwas Breccia. See also Lexicon, 3aVIII, p.163.

HARD BED. **?Trias.**

See: Bunter Hard Bed.

!HARD BRECCIA. **?Permian, New Red Sandstone.**

(Hard Brockram.)

Type-locality: Kirkby Stephen, Westmorland.

Harkness R., 1862, pp.205-218. Above Carboniferous and older rocks, below the Penrith Sandstone. Breccia with dolomitic cement.

Murchison R.I. and Harkness R., 1864, p.156, as Hard Brockram, Permian, Upper, between Hilton Plant Beds and St. Bees Sandstone (top), dolomitised brockram, local building stone. [? synonym of the Hard Breccia.]

Burgess I.C. 1965, renamed the unit Stenkrith Brockram.

!HARD GREENISH BAND. **Trias, Mercia Mudstone Group.**

Type-locality: Between Weston Mouth and Ravine to the west (0.5 mile west of Littlecombe shore.)

Woodward H.B. and Ussher W.A.E., 1906, p.14. Keuper, within the Upper Marls. Hard greenish band conspicuous in the red marls.

Warrington G. et al. 1980, referred to as the Weston Mouth Sandstone Member.

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

See also: Clarborough Formation.

Type-locality: Harlequin Brick Pit, east of Radcliffe-on-Trent (infilled). Also the Hall Farm boreholes, Kneeton, R. Trent cliffs at Old Hall, Tort Hall and below Gibbett Hill, Radcliffe-on-Trent.

Elliott R.E., 1961, p.218. Keuper Series, above the Carlton Formation and below the Edwalton Formation. The Cotgrave Skerry occurs at the top; includes the East Bridgford Gypsum. Thinly laminated dark mudstone (particularly at the base) and unlaminated massive mudstones (particularly at the top). Pseudomorphs after halite and mudcracks common. Coarse dolomitic siltstones or fine sandstones often impregnated with gypsum may be present, forming skerries. Structures include ripple marks, thin green or yellowish green layers <0.3 m., vein type breccias, and fish eyes. The top is marked by 3 m of silty chocolate coloured mudstone with conchoidal fracture; 45.7 m thick in total. A prominent fibrous gypsum band occurs at East Bridgford.

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

Warrington G. et al. 1980, table 4, col.11, 23. Up to 90 m thick, extended westwards into the Needwood Basin—Derbyshire and Staffordshire.

HARTFIELD BRECCIA FORMATION. **?Permian, New Red Sandstone.**

Type-locality: Kinnel Water, Hartfield Farm, Lochmaben, Dumfries, NY068925- 068918.

Brookfield M.E., 1978, pp.125-127. Above Lower Palaeozoic strata and below the Corncockle Sandstone Formation; lithologically similar to the Locharben Breccia Formation with which it may have originally been continuous. Breccias, interbedded with aeolian and fluviatile sandstones. Clasts composed of basalt and greenish buff sub-greywacke. Part of the Lochmaben Basin sequence.

Lovell J.P.B., 1983, p.331, rest directly on Silurian rocks and pass upwards into the Corncockle Sandstone.

HARTLEPOOL ANHYDRITE. **Permian, Zechstein.**

(Hartlepool Formation.)

Type-locality: West Hartlepool and Durham Coast.

Trechmann C.T., 1913, pp.184-218. Within the Magnesian Limestone; below the Upper Magnesian Limestone. Anhydrite with some gypsum and dolomite, up to 82.3 m in thickness.

Trechmann C.T., 1925, p.139, fuller description.

Smith D.B. and Francis E.A. 1967, fig. 23. Equivalent of the Hayton Anhydrite of Yorkshire, above the Middle, and below the Upper Magnesian Limestone.

Smith D.B. et al. 1974, table 3, col.16, 0-152 m, above the Middle Magnesian Limestone and below the Concretionary Limestone (base of the Upper Magnesian Limestone).

Magraw D., 1975, p.159, part of the Middle Magnesian Limestone, south Northumberland and Durham coast, 0-37.2 m, p.176, possibly the lateral equivalent of the Seaham Formation. [Upper Magnesian limestone.]

Smith D.B., Harwood G.M., Pattison J. and Pettigrew T., 1986, table 1. Referred to as the Hartlepool (Anhydrite) Formation in table, and in text p.14.

***HARTLEPOOL AND ROKER DOLOMITE.** **Permian, Zechstein.**

(Hartlepool and Roker Dolomites, Hartlepool Series, Hartlepool or Roker Series, Highest Limestone.)

Type-locality: Coastal section at Roker, Sunderland or at Hartlepool.

Trechmann C.T., 1913, pp.204, 208, 211, as Hartlepool or Roker Series, Hartlepool Series, Highest Limestone; above the Concretionary Limestones. Dolomites, 30.5 m in thickness.

Trechmann C.T., 1925, p.142, described under the name Hartlepool and Roker Dolomites.

Magraw D., Clarke A.M. and Smith D.B., 1963, pp.397-414, part of the Upper Magnesian Limestone. Dolomite, oolitic with gypsum, 112 m in thickness.

Smith D.B., 1971a, pp.1-12, white-buff or cream granular soft dolomite, oolitic in part, with gastropods, bivalves, and plants; 21-211 m thick. Slump structures and stromatolitic carbonates at Black Hall Rock, Co. Durham.

Smith D.B. et al. 1974, table 3, col.16, part of the Upper Magnesian Limestone; above the Concretionary Limestone, and below the Seaham Residue, 90 m thick. ?Lateral equivalent of the Kirkham Abbey Formation of Yorkshire.

Magraw D., 1978, pp.159-161, part of the Upper Magnesian Limestone above the Concretionary Limestone and below the Upper Nodular Beds. Dolomitic limestone generally cream coloured, often soft and powdery, oolitic or pisolitic beds present; 61-67 m in thickness.

Smith D.B., Harwood G.M., Pattison J. and Pettigrew T., 1986, p.14, table 1, renamed Roker (Dolomite) Formation.

***HARWORTH BRECCIA.** **Permian, Zechstein.**

Type-locality: Harworth (Colliery borehole), south Yorkshire.

Versey H.C., 1925b, pp.219-220. Within the 'Middle' Permian Marls. Rounded or subangular pebbles from 7 to 100 mm in length set in red marl with gypsum. Dolomite growth on pebbles common. [Ref. includes detailed description of the pebbles.]

Smith D.B. et al. 1974, table 3, col.14, top part of Permian Middle Marl, central Yorkshire and north Nottinghamshire.

HATHERLEIGH LAVAS. **Permian, ?Rotliegende.**

Crediton Valley, Devon, see: Exeter Volcanics.

HAUPTANHYDRIT. **Permian, Zechstein.**

Rhys G.H., 1974, table 2, fig. 3. Shell/Esso well 49/26-4, southern North Sea. Z3, above the Plattendolomit and below the Leine Halite, equated with the Billingham Main Anhydrite, 6 m in thickness. [First reference for the southern North Sea area.]

Smith D.B. et al. 1974, table 3, col.18, West Sole Gas Field, as Billingham Main Anhydrite; col.20, Leman Gas Field, as Main Anhydrite.

HAUPTDOLOMIT. **Permian, Zechstein.**

(Hauptdolomit-stinkschiefer.)

Rhys G.H., 1974, table 2, fig. 3. Shell/Esso well, 49/26-4, southern North Sea. Z2 base, above the Upper Werraanhydrit and below the Basalanhydrit, equivalent of the Kirkham Abbey Formation, east Yorkshire. [First use in the southern North Sea area.]

Smith D.B. et al. 1974, table 3, col.18, West Sole Gas Field, listed as the Kirkham Abbey Formation; col.19, Ann Gas Field as Limestone c.18 m; col.20 Leman Gas Field, as main Dolomite.

***HAVERIGG HAWS ANHYDRITE.** **Permian, Zechstein.**

Type-locality: Haverigg Haws borehole, SD 147 786, Barrow-in-Furness, Lancashire, 482-484 m depth.

Smith D.B., et al. 1974, table 3, col.11, p.39. Part of the St. Bees Evaporites, above the Gleaston Dolomite or undifferentiated St. Bees Evaporite Formation and below clastics and the Roosecote Dolomite of the St. Bees Evaporites. Sulphate mineral generally anhydrite, 0-11 m in thickness.

***HAWKSMOOR FORMATION.** **Trias, Sherwood Sandstone Group.**

Type-locality: Hawksmoor Wood, 2.5 km. ENE of Cheadle, Staffordshire, SK 035443. Also between Alton Village (SK 0720 4243) and the River Churnet; Ordley Brook, Stanton (SK 1395 4589-1387 4510); stream gully north of Upper Mayfield (SK 1509 4655-1514 4665).

Charsley T.J., 1982, pp.2, 5. Middle formation of the Sherwood Sandstone Group, above the Huntley Formation and below the Hollington Formation. Includes the Freehay Member near the base and the Lodgedale Member near the top. Renamed Bunter Pebble Beds of Hull 1869. Red brown, yellow or yellow mottled very fine to coarse grained sandstone commonly cross-bedded, micaceous in places, silty or argillaceous. Pebbles—quartzites, well rounded in places. Conglomerate units up to 56 m as separate Members. Weakly cemented and friable. 0-156 m thick.

Aitkenhead N. Chisholm J.I. and Stevenson I.P. 1985, pp.99-101, extends the formation to the Leek outlier. Soft red sandstones, trough current-bedding and parallel lamination.

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

Type-locality: Quarries around Newark and Cropwell Bishop, Nottinghamshire. Also in boreholes ar Fauld Mine and East Leake.

Taylor S.R., 1983, p.13, fig.3. Top beds of the Trent Formation, above the Fauld Member. Nodular sulphate seams (0.3 to 1.5 m thick) separated by sulphate poor reddish-brown dolomitic mudstones lithologically similar to those of the Fauld Member. Contains laterally persistent grey-green siltstones and sandy siltstone horizons which exhibit cross-bedding, graded-bedding, planar structures, ripple marks, salt pseudomorphs and desiccation cracks. [Synonym of Newark and Cropwell Gypsum of other authers?. Cropwell Bishop Quarry now infilled.]

HAYMAN'S FARM BEDS. **?Trias, Sherwood Sandstone Group.**

Type-locality: ?Hayman's Farm Borehole, Alderley Edge, Cheshire.

Thompson D.B. 1966; Warrington G. and Thompson D.B. 1971, pp.69 and 70. Base of the "Keuper Sandstone" above the Upper Mottled Sandstone and below the Beacon Lodge Sandstones. Lateral equivalent of the Engine Vein Conglomerates.

***HAYTON ANHYDRITE.** **Permian, Zechstein.**

Type-locality: Hayton borehole, SE 826 445, 8 miles NW of Market Weighton, Yorkshire, 855.9-963.5 m depth. East Yorkshire and West Sole Gas Field (southern North Sea) areas.

Smith D.B., et al. 1974, table 3, cols.17, 18, p.39. EZ1 Don Group, above the Lower Magnesian limestone and below the Kirkham Abbey Formation. Correlated with the Hartlepool Anhydrite; col. 20, Leman Gas Field, listed as Werra Anhydrite. Thick dolomitic anhydrite sequence, up to 120 m (east Yorkshire).

Smith D.B., Harwood G.M., Pattison J. and Pettigrew T., 1986, p.11, listed as Hayton (Anhydrite) Formation, EZ1A.

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

(Heavitree and Alphington Breccia, Heavitree Conglomerate.)

Type-locality: Heavitree, south Devon.

Sedgwick A., 1829. p.122 and footnote. [Implies that this formation is of Rothe-todt-liegende age but Sedgwick prefers a younger age for most of the Devonshire Conglomerates.] Refers to Heavitree Conglomerate containing fragments of trap and porphyry.

De la Beche, H.T. 1839 refers to the conglomerate at Heavitree.

Murchison R.I., 1867, p.57, as Conglomerates of Heavitree.

Ormerod G.W., 1875 as Murchisonite Beds.

Ussher W.A.E., 1902, p.20, description of Heavitree Breccia, includes fragments of K-feldspar.

Laming D.J.C., 1968, pp.23-25, fig.1, local base of the New Red Sandstone.

Smith D.B. et al. 1974, table 6, col.29, as Heavitree and Alphington Breccias, Exeter, 260 m including the Rougemont Lavas, Permian, base, Clyst Sands above; resting on Culm Measures.

Bristow C.R. et al. 1984b, p.14; 1985, pp.35-41, t.2, The base is taken at the first influx of murchisonite feldspar; up to 300 m in thickness. Feldspar used to correlate other Breccias (e.g. Alphington) at about the same horizon.

HEAZILLE LAVAS. **Permian, ?Rotliegende.**

Culm Valley, Exeter, see: Exeter Volcanics.

***HELSBY SANDSTONE FORMATION.** **Trias, Sherwood Sandstone Group.**

Type-locality: Helsby Hill, Cheshire, SJ 495755. Also found in Cheshire and north Shropshire generally.

Warrington G., et al. 1980, table 4, cols. 9, 10, pp.31, 58. Top of the Sherwood Sandstone Group, above the Wilmslow Sandtone or Buckley Hill Sandstone Formation and below the Tarporley Silstone Formation (Mercia Mudstone Group). Includes the Frodsham, Delamere and Thurstaston Members (Thompson 1970). Renamed Keuper Sandstone excluding the Waterstones, of the Cheshire Basin. Miospores suggest early Triassic age. 100-200 m in central and north Cheshire, Clwyd, south Merseyside, south of the Manchester area; ?20-200 m, south Cheshire and north Shropshire where the Formation is not subdivided.

Thompson D.B., 1970c, pp.151-181, for description of constituent members.

***HEWETT SANDSTONE.** **?Trias, Bacton Group.**

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

Rhys G.H., 1974, fig.4. Bunter, base, part of the Bacton Group or New Red Shale Formation, passing laterally into the Brockelscheifer. [No real evidence for the age.] Sandstone fine to medium, red-brown with laminations of shale/siltstone, chocolate brown becoming medium to coarse, red-brown and locally grey, with angular to subangular pebbles of siltstone grey to green grey, conglomeratic in parts, grey, with pebbles mainly siltstone, green-grey.

HIGH HABBERLEY BRECCIA. **?Permian, New Red Sandstone.**

(Habberley Breccia.)

Type-locality: High Habberley, Kidderminster, Worcestershire; also at Bewdley, Kinver and Wollaston.

Wills L.J., 1948, pp.71, 72, fig.16. Part of the Clent Group occurring above the Dune-Bedded Sandstone and below the Pebble Beds. ?base of the latter. Post-dates the Clent Breccias. Up to 9.1 m thick.

Wills L.J., 1976, pp.27, 66, ?Protobunter, probably the same horizon as the Quartzite Breccia, Bellington Breccia, overlies part of the Shingle Beds.

!HIGHEST LIMESTONE. **Permian, Zechstein.**

See: Hartlepool and Roker Dolomites.

!HILTON PLANT BEDS. **Permian, Zechstein.**

(Hilton Beds, Hilton Series, Hilton Shales, Sandstones and Limestones, Plant Beds.)

Type-locality: Hilton (or Helton) Beck and River Belah, Vale of Eden.

Goodchild J.G., 1893, pp.1-24. (as Plant Beds.) Above the Penrith Sandstone and below predominantly red mudstones. Green-grey and thin red mudstones with plants.

Murchison R.I. and Harkness R., 1864, p.154, in part as Hilton Shales, Sandstones and Limestones; Hilton Beds, between Penrith Sandstone and St. Bees Sandstone, Hilton Beck, Bela (sic) Water, Westmorland.

Smith B., 1924, pp.289-308. Below and merging with the St. Bees Shales.

Burgess I.C., 1965, pp.91-101, as Hilton Series, River Eden.

Meyer H.O.A., 1965, p.72, fig.2, Restricts term to Hilton Beck and River Belah and from above the Brockram to below the Magnesian Limestone.

Smith D.B. et al. 1974, table 4, cols. 10, 11, as grey plant bearing clastics, lower part of the Eden or St. Bees Shales.

Arthurton R.S. and Wadge A.J., 1981. Penrith Mem. G.S.G.B., p.68 explains the inconsistency in the use of the term.

!HOCKLEY MOULDING SANDS. **?Trias, Sherwood Sandstone Group.**

Type-locality: Hockley, Birmingham.

Wills L.J., 1970, p.228. Palaeotrias, English Bunter Series, Wildmoor Regional Stage (top), above the City Road Beds and below the Keuper Sandstone. Renamed Upper Mottled Sandstone of Hull 1869; also as Upper Wildmoor Beds, Bromsgrove Moulding Sands. Miocyclothem BSIV, mainly drought sequence, may commence with pebbly or coarse sandstone, fine-grained red, soft mottled sandstone with marl bands less than 0.5 inches in thickness.

***HOLLINGTON FORMATION.** **Trias, Sherwood Sandstone Group.**

Type-locality: ollington, east Staffordshire, SK 059 388, to Alton SK 072 422; quarries between the two localities.

Charsley T.J., 1982, pp.2, 7. Top formation of the Sherwood Sandstone Group of this area, renamed lower part of the Lower Keuper Sandstone (below Waterstones) Hull 1869, and Keuper Building Stones. Vertebrate fossils not particularly diagnostic of age. Cross-bedded sandstones commonly arranged in a number of fining upward units. Pebbly base, through coarse-medium grained sandstone with mudstone and siltstone at the top. Prominent mudstone band (cf. Denstone Formation) may occur close to the top of the formation, 11.37 m thick. Sandstones well cemented (?secondary) generally giving topographical features and used as a building stone. Fossils: *Cyclotosaurus leptognathus*(Owen) (ex. *C. stantonensis* (Woodward)) from Stanton Quarry, footprints from Townhead Quarry Alton and from Hollington. Plant impressions and plant remains (Greatgate Quarry); 35-50 m thick.

***HOLLYGATE SKERRY.** **Trias, Mercia Mudstone Group.**

Type-locality: Hollygate Lane, Cotgrave, south Nottinghamshire.

Elliott, R.E., 1961, pp.200, 220. Keuper Series, top of the Edwalton Formation. Greenish-grey dolomitic siltstone or fine-grained sandstone; argillaceous, with interbedded red-brown mudstone. [?absence of diagnostic sedimentary structures compared with other named skerries in Elliott's paper.]

Geiger M.E. and Hopping C.A., 1968, pp.1-36, equivalent of the Schilfsandstein of Lower Saxony.

Balchin D.A. and Ridd M.F., 1970, pp.91-101, fig.3, pl.14, part of their Nottingham Group.

Warrington G. et al. 1980, p.52, most widespread of the skerries in the Mercia Mudstone Group, ?local equivalent of the Arden and Dane Hills Sandstone Members.

HOLMEAD LAVAS. **Permian, ?Rotliegende.**

Tiverton Valley, Devon, see: Exeter Volcanics.

***HOPEMAN SANDSTONE FORMATION.** **Late Permian-early Trias.**

(Hopeman and Cummingstone Sandstone; Hopeman and Cuttie's Hillock Sandstone.) See also: Cummingtone Beds.

Type-locality: Quarries at Quarry Wood Ridge, west of Elgin and coastal section north-east of Hopeman, Morayshire, NJ 167705.

Warrington G. et al. 1980, table 4, col.1, p.22, 58. Scythian, = *Lystrosaurus* Zone. ?Above the Old Red Sandstone and below the Burghead Sandstone Formation. Previously referred to as Hopeman and Cummingstone Sandstone or as Cummingstone Sandstone. Aeolian sandstone including reptile remains-*Gordonia, Geikia, Elginia*. Slump bedding. 0-60 m thick.

Huxley T., 1859, as Sandstones of Cummingstone.

Hickling G., 1909; Watson D.M.S., 1909, pp.103-107, as Cummingstone Sandstone, or Hopeman and Cummingstone Sandstone.

Craig G.Y., 1965, as Hopeman and Cutties Hillock Sandstone.

Peacock J.D., Berridge N.G., Harris N.L. and May F., 1968, pp.57-63, as Sandstones of Cuttie's Hillock and Hopeman; p.59, sandstones with large aeolian bedding with well rounded grains of quartz and feldspar and little mica.

Walker A.D., 1973, pp.177-183, reviews reptile evidence for Scythian age.

Glennie K.W. and Buller A.T. 1983, pp.43-81, record thickness of up to 600 m offshore. Propose early Permian age for the sandstones on the evidence of partial deformation of the aeolian sandstones said to be due to the transgression of the Zechstein Sea.

Lovell J.P.B., 1983, p.328, 334, as Hopeman Sandstone.

Benton M.J. and Walker A.D. 1985, pp.208, 213, 216, 227-8, prefer to restrict this term to the coastal exposures between Cummingstown(sic.), and Coresea and Halliman Skerries retaining Cuttie's Hillock Sandstone Formation for the inland exposures. Fossils now composed only of poor footprint tracks (Dicynodonts, Middle to Upper Permian) from Masmohaugh Quarry, Cummingstown. Dreikanter pebbles at the base as for the Cutties Hillock Sandstone Formation. Thickness given as 60 m.

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

Type-locality: Hopwas, Lichfield, Staffordshire and Sutton Coalfield, Warwicks.

Gilbert C.J., 1890, 1910, p.232. Refers to breccias at Sutton Park and at Hopwas.

Barrow G., Gibson W., Cantrill T.C., Dixon E.E.L. and Cunnington C.H., 1919, 302pp. ?Upper Carboniferous, ?Permian, above the Clent Breccias and below the Pebble Beds; local base of the Bunter ?, compare with Barr Beacon Beds. Marked unconformity on Enville Beds, erosion surface only ? Red sandstone and breccias containing mainly Carboniferous Limestone pebbles and quartzites; 0-30.5 m thick.

Wills L.J., 1948, pp.67-70, part of the Clent Group.

Smith D.B. et al. 1974, table 3, col.24, between Clent or Nechells Breccias and the Kidderminster Pebble Beds, possibly stratigraphically equivalent to the Barr Beacon Beds, 30+ m in thickness.

Wills L.J., 1976, pp.27, 29, ?Protobunter in part, different facies of Quartzite Breccia, cf. Moira Breccia, Stockport Conglomerate.

Charsley T.J., 1982, p.4, compare with the Huntley Formation of Staffordshire and Derbyshire.

HORSWELL HOUSE LAVA. **Permian, ?Rotliegende.**

South of Exeter, see: Exeter Volcanics.

HOUGHTON LIMESTONE. **Permian, Zechstein.**

See: Lower Magnesian Limestone.

***HUNTLEY FORMATION.** **?Trias, Sherwood Sandstone Formation.**

Type-locality: Huntley, Staffordshire, SK 003412 and the railway cutting to the north SK 0037 4156-0024417, and at SK 0016 4193).

Charsley T.J., 1982, pp.2-4. Sherwood Sandstone Group, base, Hawksmoor Formation above; previous Bunter Sandstone of this area; Cheadle Breccias, Wills L.J. 1956. Pebble Beds base compare with Clent, Moira and Hopwas Breccias. [Triassic age based on Mitchell and Stubblefield, no fossils.] Poorly sorted matrix supported conglomerate or very coarse pebbly sandstone containing locally derived sub-rounded to angular clasts of granule to pebble size up to 38 cm long. Medium red brown-yellow sand. Commonly calcite or dolomitic cement. Mudstones and siltstones in some layers. 4-15 m thick.

Barrow G., 1903, 62pp., two beds of conglomerate, subangular, calcareous matrix each 7.6 m thick and separated by thin marl, railway tunnel 2 km south-west of Cheadle.

Mitchell G.H. and Stubblefield C.J., 1941. 41pp., lithological reasons for Triassic age.

Aitkenhead N, Chisholm J.I. and Stevenson I.P. 1985, p.99, formation extended to Longsdon Wood, Leek outlier.

INFERIOR SANDSTONE. **Lower New Red Sandstone.**

See: Lower Red Sandstone or Penrith Sandstone.

KENILWORTH BRECCIA GROUP. **?Carboniferous, ?Permian, New Red Sandstone.**

(Kenilworth Breccia, Kenilworth Sandstone Formation, Kenilworth Sandstone, Kenilworth Sandstone and Breccia.)

Type-locality: Kenilworth, Warwickshire.

Vernon R.D., 1912, pp.606-607, as Kenilworth Sandstone. ?Permian, above the Corley Conglomerate and below the Trias. Calcareous red sandstone and marl, current bedding, shallow water origin. [No breccias recorded.]

Newell-Arber E.A., 1916, pp.46, 47, as Kenilworth Sandstone, includes *Dasyceps bucklandi* Lloyd 1850, *Walchia imbricata, Oxyodon britannicus* Huene, thus lower part of the Enville Series (sic.). [Ashow Group of Shotton.]

Richardson L. and Fleet W.F. 1926, pp.292, 296, 298. Above the Tile Hill Marls and below the Trias, excludes the Whitemoor Sandstones and Marls. Red Sandstone with breccia bands, ?24.4 m; heavy mineral analysis given.

Shotton F.W., 1929, pp.177-179. Above the Gibbet Hill Group and below the Ashow Group; the possible equivalent of the Clent, Nechells, Enville etc. Breccias. Sandstones with two bands of breccias [conglomerates?), 60.7 m in thickness. [?Includes the Whitemoor Sandstones and Marls of Richardson and Fleet 1926.]

Romer A.S., 1947, pp.168-172, *Oxyodon* is stated to be Permian in age.

Smith D.B. et al. 1974, table 5, col.25, 60 m thick, above the Gibbet Hill Group and below the Ashow Group.

Old R.P., Sumbler M.G. and Ambrose K., 1987, pp.13, 16, as Kenilworth Sandstone Formation to include the Kenilworth Breccia as the top part and the Gibbet Hill Group of Shotton (1929) at the base. The breccia bands are impersistent whereas the base of the Gibbet Hill 'Group' is readily recognised at outcrop and in sections. Red, massive, commonly soft sandstones with lenses of mudstone. The Gibbet Hill Conglomerate occurs close to the base and there are thin lenses of breccia towards the top.

Lexicon 3aVIII, pp.193-194.

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

Type-locality: Haldon Hills to Exeter, Devon.

Laming D.J.C., 1968, pp.23-25, fig. 1. Lower New Red Sandstone, ?Permian, =Clyst Sands between Heavitree and Langstone Breccias. [= Exminster Breccias ?, no description]

Smith D.B. et al., 1974, t.4, ?lateral equivalent of the Heavitree Breccia.

Rundle C.C. 1981, K-Ar radiometric age of biotite is about 281 my.

Bristow C.R. et al., 1985, p.36, includes murchisonite feldspar as part of the description of this unit which thus may be the lateral equivalent of the Heavitree Breccias.

KETTLEHOLM BRECCIA FORMATION. **?Permian, New Red Sandstone.**

Type-locality: Kettleholm, Water of Milk, Lochmaben, NY 143768.

Brookfield M.E., 1978, p.127. Part of the Lochmaben Basin sequence, isolated from other red bed exposures of the area. Massive and poorly bedded coarse to medium-grained breccias with relatively well rounded clasts Silurian micaceous greywacke and argillite uo to 20 cm in diameter. 20 m exposed at the type-locality.

Lovell J.P.B., 1983, p.322, gives a thickness of 50 m.

!KEUPER. **Trias.**

Buch L. von, 1822. Upper part of the Trias, above the Muschelkalk, below the Rhaetic. Red mudstones and evaporites.

Sedgwick A., 1829, p.121, first reference for the British Isles; red marls above the Muschelkalk or red marls above the Bunter in Great Britain. [including what eventually became known as the Keuper Sandstone.]

Hull E., 1869, p.10 et seq., above the Bunter, below the Rhaetic, includes Building Stones, Waterstones and New Red Marls, with their detailed description.

Warrington G. et al. 1980, pp.8-15, term rejected, not necessarily compatible with the Upper Trias of Germany as Lower and Middle Trias miospores have been found from some British localities of so-called 'Keuper' lithologies; term ?retained for the southern North Sea. [see table 4, col.28; See also Bunter, Muschelkalk and Rhaetic. Term not to be used on its own or as a prefix.]

!KEUPER ANHYDRITIC MEMBER. **Trias, Haisborough Group.**

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

Rhys G.H., 1974, table 3, fig. 5, pp.4-5. Part of the Triton Anhydritic Formation, forming the greater part of that formation. Mudstone, red, red-brown and grey-green, interbedded with anhydrite, white, light grey and transparent, and, at top, dolomite, buff, lavender and green-white; some beds of siltstone. 112 m thick.

Warrington G. et al. 1980, table 4, col.28. [term accepted ?]

!KEUPER BASEMENT BEDS. **Trias, ?Sherwood Sandstone Group.**

See: Basement Beds.

!KEUPER BUILDING STONES, KEUPER BUILDING STONES GROUP.

See: Building Stones.

!KEUPER CONGLOMERATE. **Trias, ?Mercia Mudstone Group.**

Type-locality: south Nottinghamshire and Derbyshire.

Lamplugh G.W., Gibson W., Sherlock R.L. and Wright W.B., 1908, p.36. Base of the Keuper Series, probably equivalent of the Basement Beds [of the Nottinghamshire Keuper]. Small pebbles in clay matrix or pebbles in sandy matrix.

Warrington G., 1970, p.186, as Basal Keuper Conglomerate or Keuper Conglomerate or Conglomerate Formation, referred to as the Engine Vein Beds Upper Scythian (miospores), Alderley Edge, Cheshire. [Conglomerates occur at other 'Keuper' horizons.]

!KEUPER HALITE MEMBER. **Trias, Mercia Mudstone Group.**

(Keuper halite, Keuper Halite.)

Type-locality: Eskdale Boreholes, north-east Yorkshire Moors.

Raymond L.R., 1953, pp.296. Near to the base of the Keuper. Coarse granular halite, colourless or tinged with orange, with inclusions of angular grey or red marly anhydrite/dolomitic rock, from 29.6-49.4 m.

Warrington G., 1974a, pp.149, 155, near the base of the Keuper; possibly the equivalent of the North Sea Rotsalinar, Upper Bunter, ?Scythian.

Rhys G.H., 1974, table 3, fig. 5, pp.4-5, as Rot Halite Member, first record for the southern North Sea, euivalent of the Keuper Halite Member.

Warrington G. et al. 1980, table 4, col. 28, as Keuper Halite Member, 155 m thick, southern North Sea.

Riddler G.P. 1981, pp.341-346, on geophysical evidence considers this unit is the equivalent of the Rotsalinar or Rot Halite Member.

!KEUPER MARL GROUP. **Trias, Mercia Mudstone Group.**

(Keuper Marl, Keuper Marls, Keuper Marl Series. English Keuper Marl, English Keuper Marl Series.) See also: New Red Marl or Red Marl.

Type-locality: central Midlands, but England and Wales generally.

Sedgwick A., 1829, pp.37-124, correlates the Upper Red Marls and Gypsum with the German Keuper.

Murchison R.I. and Strickland H.E., 1837, pp.331-348, refer Red Marls to the Keuper.

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

Lamplugh G.W., Gibson W., Sherlock R.L. and Wright W.B., 1908, as Keuper Marls.

Butler A.J. and Lee J., 1943, as Keuper Marl Series.

Wills L.J., 1948, Upper part of the Keuper Series, above the Keuper Sandstone Group below the Rhaetic or Penarth Group. Red marls or siltstones, dolomitic siltstones or fine-grained sandstones, gypsum and rock salt. Audley-Charles M.G., 1970, pp.31 as Division 5, including Lower, Middle and Upper Keuper Mudstones and Lower and Upper Saliferous Bands.

Wills L.J., 1970, pp.225-285, as Droitwich (Regional) Stage; new name for Keuper Marl Series.

Warrington G., 1970, p.211, including the Waterstones, Radcliffe, Carlton, Harlequin, Edwalton, Trent and Parva Formations of Elliott 1961, with their extension into the central Midlands. The base on miospore evidence is Scythian in places.

Wills L.J., 1976, p.164, as an alternative to the Droitwich Stage.

Warrington G. et al. 1980, the base assigned to the Scythian (Lower Trias), on miospores; a new name is required and hence in part assigned to the Mercia Mudstone Group.

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

Ramsay A.C., 1864, p.xliv. Keuper, above the Lower Keuper Sandstone, and below Westbury beds, (Rhaetic) Bone-bed and *Avicula contorta* Beds. [No description, informal use ?]

!KEUPER SANDSTONE. **Trias, Sherwood Sandstone Group.**

(Keuper Sandstone Formation, Keuper Sandstone Group, Keuper Sandstone Series. Lower Keuper Sandstone, English Keuper Sandstone.) See also: Bromsgrove Group.

Type-locality: Midland Counties of England including Stourport, Pattingham, Hawkstone, Great Ness-Shropshire; Bromsgrove-Worcestershire; Peckforton, Delamere and Frodsham- Cheshire; Alton-Staffordshire.

Hull E., 1869, p.10, 66-98, as Lower Keuper Sandstone or Keuper Sandstone. Lower part of the Keuper, above the Basement Beds and below the Waterstones; alternative term for the Building Stones. Basement Beds may be included also. Massive sandstones.

Murchison R.I. and Strickland H.E., 1837, pp.331-348. Name applied to sandstones 60.7 m below the Lias and above the Saliferous Marls, later referred to as the Upper Keuper Sandstone or Arden Sandstone Group. [Although this is the original reference subsequent authors follow Hull 1869.]

Swinnerton H.H., 1948, pp.57-58 applied the term to the Waterstone facies of the East Midlands.

Wills L.J., 1948, as Keuper Sandstone Group or Bromsgrove Sandstone Group.

Wills L.J., 1970, pp.227-229, 247, 249, as Bromsgrove Regional Stage or Keuper Sandstone Series, KS1-14, or English Keuper Sandstone, Mesotrias, lower part of the English Keuper Series, Bromsgrove Regional Stage. Includes the Basement Beds Group, Birmingham Keuper Sandstone, Building Stones Group, Keuper Sandstone, Keuper Sandstone Series, Stratford Keuper Sandstone, Stratford-Warwick Keuper Sandstone, Warwick Keuper Sandstones and lower part of the Waterstones.

Thompson D.B., 1970, p.151, refers to Murchison's original use, p.169, as Keuper Sandstone Formation. Defined as the lowest occurrence of red pebbly sandstone below the base of the Waterstones but above a hundred m or so of soft sandstone lithofacies, the Bunter Upper Mottled Sandstone or below the Frodsham Member if the Upper Mottled Sandstone is not recognised or if no red pebbly sandstone is present for example between Ruyton and Marchamley. The Keuper Sandstone includes the Thurstaston Soft Sandstone Member or Alderley Conglomerate Member at the base; Delamere Red Pebbly Sandstone Member in the centre and the Frodsham Soft Sandstone Member or Nether Alderley Soft Sandstone Member at the top.

Warrington G., 1970, p.211, as Keuper Sandstone Group including Conglomerate and Building Stones Formations but excluding the Waterstones; p.198, miospores of Scythian and Anisian age.

Wills L.J., 1976, pp.107-163, as Keuper Sandstone including the Bromsgrove Regional Stage, Bromsgrove Stage, Birmingham Keuper Sandstone, Stratford Keuper Sandstone, Bromsgrove Keuper Sandstone, Warwick Keuper Sandstone, Stratford and Warwick Keuper Sandstone.

Warrington G. et al 1980, table 4, cols. 12-15, as Bromsgrove Formation, col.9 as Helsby Sandstone Formation.

!KEUPER SANDSTONE PASSAGE BEDS. **Trias, Sherwood Sandstone Group.**

Type-locality: Cheshire.

Poole E.G. and Whiteman A.J., 1966, pp.14, 17, 29-34. Keuper, above the Upper Mottled Sandstone and below the Keuper Sandstone. Hard brown sandstones, flaggy brown sandstones and red and green mudstones, interbedded with 21.3 m red millet seed sandstones; ?33.5 m in thickness.

Warrington G. et al. 1980, table 4, col. 9, as Bulkeley Hill Sandstone Formation, passage beds between the Wilmslow and Helsby (top) Sandstone Formations.

!KEUPER SANDY LIMESTONES. **Trias, New Red Sandstone.**

Type-locality: Vale of Porlock, North Devon.

Thomas A.N., 1940, p.19. Calcareous part of the Keuper Sandstone.

Laming D.J.C., 1968, pp.23-25, fig.1, Vale of Portlock between the Luccombe Breccia and Keuper Marls (top), Upper New Red Sandstone. [Considered by Thomas 1940 to be a local variable lithological development, given stratigraphical significance by Laming.]

KEUPER SERIES. **Trias, Sherwood Sandstone and Mercia Mudstone Groups.**

(English Keuper Series.)

Type-locality: Cheshire ?; Midlands generally.

Wedd C.B., King W.B.R. and Wray D.A., 1929, pp.149 et seq.. Basement Beds, Building Stones, Waterstones, Ruyton Sandstone and New Red Marls.

Elliott R.E., 1961, pp.197-234, Keuper Series of south Nottinghamshire, subdivided into Woodthorpe, Waterstones, Radcliffe, Carlton, Harlequin, Edwalton, Trent and Parva (top) Formations.

Balchin D.A. and Ridd M.F. 1970, renamed the East Midland part of this unit as the Nottingham Group.

Wills L.J., 1970, pp.225-285, includes the formations included in his English Keuper Sandstone and English Keuper Marl.

Warrington G. et al 1980, table 4, cols.11, 23, 24, reject the main term but keep most of Elliott's formations.

[Suffix 'Series' possibly added to 'Keuper' of other authors, to indicate stratigraphical usage.]

!KEUPER WATERSTONES.

See: Waterstones.

KIDDERMINSTER FORMATION. **?Trias, Sherwood Sandstone Group.**

(Kidderminster Conglomerate, Kidderminster Conglomerate Formation.)

Type-locality: Kidderminster and its vicinity, Worcestershire. Also throughout Worcestershire, Hereford, south Staffordshire and west Warwickshire.

Warrington G. et al. 1980, table 4, cols. 12, 13, pp.38, 58. Above the Bridgnorth Sandstone Formation or ?Permian breccias and below the Wildmoor Sandstone Formation (above the last pebbles). Renamed Bunter Pebble Beds or Kidderminster Conglomerates of the area] Medium to coarse red sandstones with rounded quartzite pebbles in layers, patches or singly; thin red marl beds not uncommon. 0-200 m in thickness.

Smith D B. et al. 1974, table 3, cols. 21-25, term listed, but no description.

KILLERTON PARK LAVAS. **Permian, base.**

Type-locality: Killerton Park, Exeter, Devon.

Ussher W.A.E., 1892, pp.247-250; 1902, pp.64-66. Part of the Exeter Volcanics, within the lowest beds of the New Red Sandstone. Andesites.

Tidmarsh W.G., 1932, pp.724-725. Mineralogical and petrological description.

Miller J.A., Shibata K. and Munro M., 1962, pp.394-396, K-Ar radiometric age given as 279 + 6 my.

Knill D.C., 1969, p.115, revised petrological description.

Smith D.B. et al. 1974, table 6, col.30. Above the Culm Measures and below the Silverton Formation; K-Ar radiometric age at approximately 280 my, similar to the Dunchideock Lavas; part of the Exeter Volcanics.

***KINNERTON SANDSTONE FORMATION.** **?Trias, Sherwood Sandstone Group.**

Type-locality: Kinnerton Green, Clwyd, SJ 340610, North Wales. Cheshire Basin generally, including north Shropshire and south Lancashire.

Warrington G., et al. 1980, table 4, cols. 9, 10, pp.31, 58-59. Generally above Coal Measures and below the Chester Pebble Beds Formation, in part lateral equivalent of the Collyhurst Sandstone and Manchester Marls; renamed Lower Mottled Sandstone of the Cheshire Basin. Red fine-grained sandstones with green and yellow layers and patches. Up to 380 m in the northern part of the area; up to 300 m in the south.

***KIRKHAM ABBEY FORMATION.** **Permian, Zechstein.**

Type-locality: Whitwell-on-the-Hill borehole, Yorkshire, SJ 728687, 1025 m- 1149 m depth.

Smith D.B., et al. 1974, table 3, cols. 17, 18, p.39. EZ2 base, base of Aislaby Group, above the Hayton Anhydrite, below the Fordon Evaporites. Carbonate formation, 15-150 m thick.

Smith D.B., 1974, pp.116, 132, centre part of the Permian Middle Marls, the equivalent of the Concretionary Limestone with the Hartlepool and Roker Dolomite of Durham.

Smith D.B., Harwood G.M., Pattison J. and Pettigrew T.H., 1986, p.11, listed as Kirkham Abbey Formation, EZ2Ca.

***KIRKHAM MUDSTONE FORMATION.** **Trias, Mercia Mudstone Group.**

(Kirkham Mudstones.)

Type-locality: Boreholes north of Blackpool, Lancashire, eg. Coatwalls Farm, Staynall. Generally throughout north Lancashire and south Cumberland.

Evans W.B. and Wilson A.A., 1975, as Kirkham Mudstones. ?Anisian-Ladinian, above the Singleton Mudstones, below the Breckells Mudstones, includes the Preesall Salt. [Halite.] Red-brown, alternating with grey-green well bedded mudstones. Thin (1 cm) intercalations of siltstone and dolomitic siltstone. Thick solution breccia marks the position of the Preesall Halite. Miospores indicate age; in addition there are a few *Euestheria*, trails, and borings. The formation is 230 m thick excluding the Preesall Salt.

Rose W.C.C. and Dunham K.C., 1977, 170pp., top part of the Mercia Mudstone Group, including the Preesall Halite .

Warrington G. et al. 1980, table 4, col.8, as Kirkham Mudstone Formation, 150-200 m thick. Preesall Halite is excluded, referred to as the Preesall Halite Formation.

***KIRKLINTON SANDSTONE FORMATION.** **Trias, Sherwood Sandstone Group.**

(Kirklinton Sandstones.)

Type-locality: Kirklinton, Westmorland and at Cummersdale, Rockcliff, and Netherby in the same area.

Holmes T.V., 1881, pp.286-297. Base of the Trias, above the Gypseous Marls, and below the Stanwix Marls. Soft bright red (scarlet) sandstone and marl with an occasional hard bed, 51.8 m thick plus.

Arthurton R.S., Burgess I.C. and Holliday D.W., 1978, p.202, part of the Sherwood Sandstone Group (top), strongly cross-bedded. Interdigitates with the top of the St. Bees Sandstone or thin marls separate them, 100 m thick.

Warrington G. et al. 1980, table 4 col.7, as Kirklinton Sandstone Formation, up to 100 m thick, west Cumbria, east Dumfries, Galloway.

KIRKSANTON BEDS. **Permian, Zechstein.**

Type-locality: south Cumberland and Furness.

Dunham K.C. and Rose W.C., 1949, pp.11-41. (p.12, fig.1, p.18,20.) Located above the Penrith Sandstone and below the St. Bees Shales, compares with the Magnesian Limestone and Hilton Plant Beds of the Vale of Eden sequence. Anhydrite and gypsum, 12.2 m above dark grey shales, calcareous or dolomitic, with obscure plant remains.

Rose W.C.C. and Dunham K.C., 1977, for the latest revised redescription.

KNOWLE LAVAS. **Permian, ?Rotliegende.**

South-west of Exeter, see: Exeter Volcanics.

KNOWLE HILL LAVAS. **Permian, ?Rotliegende.**

Crediton Valley, Devon, see: Exeter Volcanics.

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

Type-locality: Bow and Crediton areas, Devon.

Edmonds E.A., et al. 1968, pp.146, 149, 157-8. Carboniferous-Permian, equivalent to the top part of the Bow Beds of Hutchins 1958. Above the Bow Conglomerate and below the Crediton Conglomerate. Fine to coarse sandstone with tourmaline, rutile, staurolite, topaz, andalusite and optically dispersed biotite and garnet. Some volcanic beds included.

Hutchins P.F., 1963, pp.107-128, the upper part of Hutchins' Bow Group.

Laming D.J.C., 1968, pp.23-25, fig.1, part of the Creedy Group, possibly the lateral equivalent of the Oddicombe Breccias.

Smith D.B. et al. 1974, table 6, col.31, between Bow and Crediton Breccias, 150 m, Crediton Valley, Devon.

KUPFERSCHIEFER. **Permian, Zechstein.**

(Copper Shale.)

D'Omalius D'Halloy, 1808, 1834. Elemente de Geologie. [First reference with details from West Germany.

Sedgwick A., 1829, pp.37-124, equates the Kupferschiefer of Germany (Mansfeld) with the Marl Slate of north-east England.

Smith D.B. et al. 1974, table 3, col.20, as Copper Shale, Leman Gas Field, southern North Sea.

Rhys G.H., 1974, table 3, Shell/Esso well 49/26-4, south North Sea, Z1 base, compared with the Marl Slate of Yorkshire, 1 m in thickness.

***LAG A'BHEITH FORMATION.** **Trias, Mercia Mudstone Group.**

(Lag a'Bheith Marls and Cornstones.)

Type-locality: Headwaters of the Lag a'Bheith, Brodick; Loch na Larg Plateau, Isle of Arran, Scotland. NS 007328.

Tyrell G.W., 1928, pp.77, 96-103, as Lag a'Bheith Marls and Cornstones. ?Bunter, ?Part of the Upper Division or Upper Series of Gregory, above the Glen Dubh Sandstone and below the Auchenhew Sandstones and Shales. Shales and marls with nodules and layers of cornstone; green and red calcareous micaceous sandstones.

Gregory J.W., 1915, pp.174-187, as Bennan Shales.

Craig G.W., 1965, renamed as part of the Auchenhew Beds.

Warrington G. et al. 1980, table 4, col. 3, p.59, renamed as Lag a'Bheith Formation, base of the Mercia Mudstone Group, above the Glen Dubh Sandstone Formation and below the Auchenhew Mudstone Formation, ?thin; p.26, the formation contains early to middle Trias miospores.

Lovell J.P.B., 1983, term is listed, fig.11.3, p.328.

***LAMLASH SANDSTONE FORMATION.** **?Trias, Sherwood Sandstone Group.**

(Lamlash Beds, Lamlash Sandstone, Lamlash and Machrie Sandstones.)

Type-locality: Redesignated by Tyrell 1928, Warrington et al. 1980: Lower part of the Lag a'Bheith, Lamlash, Machrie Water and Machrie Burn, Isle of Arran, Scotland, NS 020350 to NS 030320.

Gregory J.W., 1915, p.187, as Lamlash Sandstone from Corrygills, Arran. Above the Brodick Breccia, below the Ballymichael Sandstones. Massive, fine-grained red sandstone on softer more argillaceous sandstone; often conglomeratic.

Tyrell G.W., 1928, pp.77, 85-94, as Lamlash and Machrie Sandstones. ?Permian, Lower New Red Sandstone, Lower Division or Lower Series, above the Brodick Breccia and below the Glen Dubh Sandstone. Coarse red sandstone slightly false-bedded, regular thin beds at Machrie, occasional lenticles of conglomerate.

Craig G.W., 1965, pp.387-388 as Lamlash Beds, includes Tyrell's Glen Dubh Sandstones. Additional to Tyrell's description-occasional massive white and brown speckled sandstones.

Smith D.B. et al. 1974, table 4, col.1, p.22, age uncertain, no useful fossils.

McLean A.C. and Deegan C.E., 1978, p.102, Red and white sandstones with some mica, 400 m; the formation is extended into the Firth of Clyde.

Warrington G. et al. 1980, table 4, col.3, p.59, name reformed, part of the Sherwood Sandstone Group, above the Brodick Breccias and below the Glen Dubh Sandstone Formations; synonym of Lamlash and Machrie Sandstones of Tyrell, lateral passage between underlying and overlying formations possible.

Lovell J.P.B., 1983, p.328, prefers Craig's Lamlash Beds, to include both the Glen Dubh and Machrie Sandstones with a thickness of about 400 m.

!LANCASTRIAN PERMIAN. **?Permian, ?Rotliegende.**

Type-locality: Collyhurst, and elsewhere in south Lancashire and north Cheshire.

Hull E., 1869, pp.11, 26. ?Rotliegende, local base, unconformable above Coal Measures and overlain by red marls with thin dolomitic seams. [Later-Manchester Marls.] Contemporary with the Salopian Permian. Brown-red soft sandstones with thin (5 mm) marl seams, moulding sands, 457.2 m.

Tonks L.H., et al. 1931, pp.159, 160 as Collyhurst Sandstone.

Smith D.B. et al. 1974, table 3, cols. 12 and 13, as Collyhurst Sandstone.

Warrington G. et al. 1980, table 4, col.9, as Collyhurst Sandstone.

***LANGPORT MEMBER.** **Trias, Penarth Group.**

(Langport Beds.)

Type-locality: Charlton Mackrell railway cutting, between Langport and Castle Cary, Somerset. Extends from the south Devon and Dorset coasts to Leicestershire.

Richardson L., 1911, pp.8, 40-41), as Langport Beds. Rhaetic, upper, renamed White Lias of Smith 1815, above Cotham Beds with disconformity and below the Watchet Beds or Lias. Similar lithology to the Cotham Beds including massive limestones, the Sizes; well bedded limestones with corals; regularly bedded limestones; rubbly beds; and at the top the Sun- or Block-Beds; subordinate grey or cream marl partings. Fossils include *Dimyodon intus-striatus, Volsella minima, Ostrea liassica, Plagiostoma valoniensis, Cardinia, Protocardinia*; total thickness up to 7.6 m.

Warrington G., 1974a, p.158, top of Lincolnshire Cotham Beds, nodular limestone with bivalves. ?Langport Beds.

Warrington G. et al. 1980, pp.41, 59, 60 as Langport Member, part of the Lilstock Formation, Penarth Group, renamed Langport Beds, White Lias, Pre- *planorbis* Beds, Watchet Beds; all beds above the Cotham Member to the base of the Lias.

LANGPORTENSIS ZONE. **Trias, ?Penarth Group.**

Type-locality: [None given.]

Tutcher G.W., 1918, pp.279, 281. Considered as the lowest zone of the Hettangian Stage, below the *Planorbis*, *Ostrea* and *Tatei* Zones. Characterised by *Volsella (Modiola) langportensis*, named and figured in Richardson L. and Tutcher J.W., 1916, p.54, pl.9, fig.11.

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

Type-locality: Haldon Hills to Exe Estuary, Devon.

Laming D.J.C., 1968, pp.23-25, fig.1. Lower New Red Sandstone, above the Dawlish Sands and below the Exmouth Sandstones. [No description]

Smith D.B. et al. 1974, table 6, cols.27, 28, local Permian base, Haldon Hills; 50-85 m thick.

***LANGWATHBY ANHYDRITE.** **Permian, Zechstein.**

(Langwathby Bed.)

Type-locality: Langwathby borehole, Vale of Eden.

Arthurton R.S., 1971, p.13. Part of the Eden Shales above the C-Bed and below the Belah Dolomite. Dark grey or brownish grey algal mat gypsum-anhydrite, 1.07 m.

Smith D.B. et al. 1974, table 3, col.10, as Langwathby Anhydrite, 1-2 m, part of the Eden Shales, Vale of Eden.

Arthurton R.S. and Wadge A.J., 1981, see pp.74, 80-81, for latest description.

LAZONBY STONE. **?Permian, New Red Sandstone.**

Type-locality: Lazonby Fell, Westmorland.

Harkness R., 1862, p.207, refers to the superior sandstone at Lazonby Fell, part of the Lower Sandstone [Penrith Sandstone.]

Murchison R.I. and Harkness R., 1864, p.149, referred to as the sandstone at Lazonby. Upper silicified part of the Penrith Sandstone.

Holmes T.V., 1881, refers, p.291, to an erroneous record of the Lazonby Stone close to the surface at Garlands borehole, 84.4 m of red stone with white bands.

Arthurton R.S., Burgess R.C. and Holliday D.W., 1978, p.191, the silicified upper part of the Penrith Sandstone, used as a building stone.

LEINE HALITE. **Permian, Zechstein.**

Rhys G.H., 1974, table 2, fig. 3. Shell/Esso well 49/26-4, southern North Sea. Z3 top, equated with the Boulby Halite of east Yorkshire. 93 m thick, potash salts at the top. [First reference for the British Isles area.]

Smith D.B. et al. 1974, table 7, col.35, Z3 top, part of the Leine Series of north-west Germany.

***LEMAN SANDSTONE FORMATION.** **Permian ?Rotliegende.**

Type-locality: Shell/Esso well 49/26-4, southern North Sea.

Rhys G.H., 1974, table 2, fig. 2. Below Z1, above Carboniferous shales, similar stratigraphical position to the Yellow Sands or Basal Breccia of the Yorkshire sequence; interdigitates with the Silver Pit Formation. Sandstone red-brown and grey, very fine to medium and coarse, partly laminated, slightly anhydritic, dolomitic, calcitic and argillaceous; a few thin bands of siltstone/mudstone, red-brown, 276 m thick.

Smith D.B. et al. 1974, table 3, col.20, possibly listed as un-named grey- white sandstone, about 210 m in thickness; white grey and red brown sandstone with beds of red-brown mudstone, about 50 m thick; and variegated pebbly sandstone, about 9 m in thickness at the base.

***LENTON SANDSTONE FORMATION.** **?Trias, Sherwood Sandstone Group.**

Type-locality: North-west side of the Queen's Medical Centre, University Hospital, Lenton, Nottingham, SK 547388.

Warrington G. et al. 1980, table 4, cols. 23-25, 27, p.50. Permo-Trias, basal formation of the Sherwood Sandstone Group, overlies ?Permian Red Marls or Upper Carboniferous, below the Nottingham Castle Formation. Renamed Lower Mottled Sandstone, possibly the lateral equivalent of the Permian Middle Marls and/or Upper Magnesian Limestone and/or Permian Upper Marls. [Upper Mottled Sandstone not recorded in the Nottingham area.] Includes red fine-medium grained mottled sandstone, moulding sands and argillaceous layers. ?thin. [This lithology is similar to the former Upper Mottled Sandstone of the West Midlands!.]

Taylor F.M., 1965, p.188, records 30 m of 'Mottled Sandstone' close to the type locality.

***LEVENCORROCH MUDSTONE FORMATION.** **Trias, Mercia Mudstone Group.**

(Levencorroch Marls, Levencorroch Marls and Mudstones.)

Type-locality: Torr nan Uain, Levencorroch; Derenenach; Isle of Arran, Scotland, NR 970205-NS 005210; redesignated by Tyrell 1928 and Warrington et al. 1980.

Gregory J.W., 1915, p.186; as Levencorroch marls (sic). Upper part of the New Red Marl (Keuper) Series, Upper Division or Series. Above the Auchenhew Shales and below the Red shales with green layers and thin sandstones. Marls with thin calcareous sandstones, shales with layers of nodular and earthy limestone, 61 m thick.

Tyrell G.W., 1928, pp.76, 96-103. Above the Auchenhew Sandstones and Shales, below Rhaetic black shales and limestones. Three units are represented: 1. Red marls and shales with layers of nodular and earthy limestone and calcareous sandstone, 61 m ; 2. Red shale with green layers and thin sandstones, 18.3 m; 3. greenish grey marls (top).

Warrington G. et al. 1980, table 4, col.3, p.59, renamed as Levencorroch Mudstone Formation, (Units 1 and 2 above) and Derenenach Formation (unit 3, above, of Tyrell.) Part of the Mercia Mudstone Group, above the Auchenhew Mudstone Formation and below the Derenenach Mudstone Formation; 8O m in thickness.

Lovell J.P.B., 1983, fig.11.3, p.328, as Warrington et al. 1980.

***LILSTOCK FORMATION.** **Trias, Penarth Group.**

Type-locality: North of Lavernock Point, south Glamorgan, ST 187682 or ST 177454, west Somerset. Generally in British Isles.

Warrington G. et al. 1980, table 4, cols. 1-4, 10-14, p.60. Top of the Penarth Group and the Trias, above the Mercia Mudstone Group, includes the Cotham and Langport Members, ex. Cotham Beds, White Lias, Langport Beds, Watchet Beds, Crazy Cotham or Landscape Marble, Sun Bed, Pre-*planorbis* Beds. Situated above the Westbury Formation and below the Paper Shales (with *Psiloceras planorbis*, (Lias) see Whittaker, A., 1978, pp.63-67.) Up to 10 m thick; for lithological description see details of the Members or Richardson L., 1911.

LINKSFIELD SHALES. **Trias, New Red Sandstone.**

(Linksfield Beds.)

Type-locality: Linksfield, Elgin, Scotland.

Duff P., 1842, Purbeck or Wealden in age, on ostracod fauna.

Moore C., 1860, pp.445-6, on the basis of ostracods and fish age is Rhaetic presumably occurring above the Cherty Rock of Stotsfield and Elgin Sandstones ?. Clay and 'stone', 8 m thick with *Cypris, Modiola, Euestheria, Lepidotus* and *Hybodus*.

Judd J.W., 1873, pp.145-149, lists opinions on the age, description of fossils and correlates the beds with the Hoganas Series of Sweden.

Benton M.R. and Walker A.D., 1985, p.213, refer to a glacial erratic at Linksfield which has yielded ostracods, fish and reptiles, Rhaetian in age.

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

(Littlebeck Formation.)

Type-locality: Littlebeck (F3) Borehole, Littlebeck, north Yorkshire, 1197.4 to 1198.3 m.

Smith D.B., Harwood G.M., Pattison J. and Pettigrew T., 1986, pp.16. Renamed Top Anhydrite of north Yorkshire coast, located above the Sleights Siltstone and below the Roxby Formation; EZ5A. Anhydrite, fine-grained with closely-spaced faintly pink hematite partings; 0.8 to 1.5 m thick.

***LITTLEHAM MUDSTONE FORMATION.** **?Permian, New Red Sandstone.**

(Littleham Beds, Littleham Formation.)

Type-locality: South Devon Coast, Straight Point and eastwards, SY 0395 7947. Also the Haldon Hills to Colaton Raleigh, Devon.

Henson M.R., 1970, p.174, as Littleham Beds. ?Trias, above the Exmouth Sandstone Formation and below the Budleigh Salterton Pebble Beds Formation. [Age based on sedimentary characteristics.] Fluviatile red-brown mudstones with thin green beds and fine-grained siltstones, 88 m in thickness.

Laming D.J.C., 1968, pp.23-25, fig. 1, as Littleham Beds, Lower New Red Sandstone, Permian, above the Exmouth Sandstones and below the Budleigh Salterton Pebble Beds. [No description.]

Henson M.R., 1972, pp.447-457, as Littleham Mudstone Formation.

Smith D.B. et al. 1974, table 33, col.28, top part of the Aylesbeare Group, 240 m, ?Permian.

Warrington G. et al. 1980, table 4, col.18, ?Trias, up to 275 m.

Selwood E.B. et al. 1984, pp.91, 92, 95, 106. ?Upper Permian, above the Exmouth Sandstone and Mudstone and below the Budleigh Salterton Pebble Beds. Upper division of Ussher's Lower Marl. Reddish brown mudstone with occasional thin sandstone; up to 275 m thick.

Bristow C.R. et al., 1985, t.2, top of the Aylesbeare Mudstone Formation, now considered as a Member.

LITTLEWORTH BEDS. **?Permian, New Red Sandstone.**

Type-locality: Littleworth, Warwickshire.

Boulton W.S., 1933, pp.53-83. (pp.69-71). Basal Bunter, similar to the Barr Beacon Beds, overlain conformably by Pebble Beds. Massive thick bedded, well jointed, buff and yellow sandrock, absence of large quartzite fragments, 12.2 m thick.

Barrow G., Gibson W., Cantrill T.C., Dixon E.E.L. and Cunnington C.H., 1919, pp.128, 133-5, first description but not named.

Wills L.J., 1948, pp.70-72. Base of the Pebble Beds above the Clent Breccia Group.

Wills L.J., 1976, pp.29-33, Protobunter, similar in age to the Quartzite Breccia, or Barr Beacon Beds, slightly different facies.

LIVERMEAD BEDS. **?Carboniferous, ?Permian, New Red Sandstone.**

Type-locality: Livermead Cliff, Torquay, SX 904627, south Devon.

Laming D.J.C., 1966, table 2. Lower New Red Sandstone, above Vicarage Hill Breccias and below Paignton Breccias. Soft fluviatile sandstones, siltstones, rare breccias, 76.2 m.

Laming D.J.C., 1968, pp.23-25, fig.1, part of the Maldon Group between Tor Bay Breccias and Paignton Breccias (top), ?lateral equivalent of the Chelston Breccias.

LOCHARBRIGGS SANDSTONE FORMATION. **?Permian, New Red Sandstone.**

Type-locality: North Quarry, Locharbriggs, 6 km north-east of Dumfries, NX 810990.

Brookfield M.E., 1978, pp.116-118. Above Carboniferous or older strata and below the Doweel Breccia Formation. [?Renamed part of the Dumfries Sandstone of Harkness.] Fine-medium-grained red quartz sandstone showing aeolian cross-bedding. Footprints are recorded. 25 m known from the type-locality; Dumfries basin up to 1000 m deep. (Bott M.P.H. and Masson-Smith D. 1960).

Lovell J.P.B., 1983, p.332, as Brookfield 1978.

LOCHEBEN BRECCIA FORMATION. **?Permian, New Red Sanstone.**

Type-locality: Locheben, Garrel Water, Thornhill, NY 960967.

Brookfield M.E., 1978, p.134. High beds interdigitate with the Thornhill Sandstone Formation. ?Base not seen. Well-sorted sandy breccia sandstone. Clasts of grewacke and argillite within a matrix of sub-angular to rounded grains. 10 m measurered at the type-locality.

Lovell J.P.B., 1983, p.331, below the Thornhill Formation; 50 m ?including the Durisdeer Formation.

***LOCH RYAN BRECCIA.** **?Permian, New Red Sandstone.**

Type-locality: Western shore of Loch Ryan, Stranraer, Scotland.

Geikie A. and Irvine D.R., 1873, p.21. Unconformable above Carboniferous sandstones, similar in lithology to other [?] Permian breccias of south Ayreshire and Dumfriesshire. Dark red breccia, fragments up to 0.3 m in length of Silurian grits, greywackes and shales; at least 45.7 m in thickness.

Smith D.B. et al. 1974, table 4, col.6, p.24, overlies rocks from Ordovican to ?Namurian in age and underlies ?sandstones also of ?Permian age and Quaternary deposits, ?1350+ m thick on geophysical evidence. (Mansfield J. and Kennett P., 1963.)

Brookfield M.E., 1978, p.142, redesignates type-locality as the shore and cliff sections between Clachan Heugh and Corsewall Farm, NX036695-035704. and east to the village of Kirkholm. Fine to medium-grained moderately to well sorted red breccia without aeolian sand. 50 m recorded at the type- locality.

Lovell J.P.B., 1983, p.332, unconformable on Ordovician to Carboniferous rocks. Basin, 1,500 m thick on structural evidence, Keling and Welsh 1970.).

LOCKERBIE BRECCIA FORMATION. **?Permian, New Red Sandstone.**

Type-locality: road-cutting, north of Lockerbie, NY 131828.

Brookfield M.E., 1978, pp.127-128. Above Carboniferous or older strata. Isolated from other Lochmaben formations, but compares with the Doweel Breccia Formation of Dumfries. Possibly extends below the Corncockle Sandstone Formation. Coarse to medium-grained red sandy breccias with mostly grewacke clasts but also argillite, siltstone and white Carboniferous limestone set in a sandy matrix. 4 m seen at the type-locality, ?thin, edge of the basin.

Lovell J.P.B., 1983, p.331, rest directly on Silurian rocks, below Corncockle Sandstone.

***LODGEDALE MEMBER.** **?Trias, Sherwood Sandstone Group.**

Type-locality: Lodgedale Farm, SK 0467 3957, 1.6km north-north-west of Hollington, Winnothdale and Greatgate, Staffordshire. Also at Intake Quarry, SK 045403.

Charsley T.J., 1982, pp.2, 6. Top Member of the Hawksmoor Formation, renamed Bunter Conglomerate. Sequence of pebbly sandstones and conglomerates in which conglomeratic beds, though locally thick are believed to be impersistent over the area as a whole; 13-32 m thick.

LONGBRIDGE SANDSTONE. **?Permian, ?Trias, New Red Sandstone.**

Type-locality: Grants Sand Pit, Longbridge, and to Rubery, Birmingham.

Wills L.J., 1970, pp.225-285; p.228, fig.1; 1976, pp.28-33. Permian, above the Northfield or Nechells Breccias and below the Queslett Shingle Bed. Similar in age to the Tessall Lane Breccia (with lateral passage) Southall's Sandrock; Protobunter, lowest part of sandstones previously mapped as Bunter Sandstones. Sandstone with occasional large fragments of quartzite.

***LOSSIEMOUTH SANDSTONE FORMATION.** **Trias, New Red Sandstone.**

(Lossiemouth Beds.)

Type-locality: Old sea-cliff and quarries in the vicinity of Lossiemouth, Morayshire, NJ 2267 7072-NJ 232 704. Also at Spynie and Findrassie.

Warrington G. et al. 1980, table 4, col.1, pp.22, 60, as Lossiemouth Sandstone Formation; renamed Elgin Sandstone in part. Unconformably on Old Red Sandstone or above and interdigitating with the Burghead Sandstone Formation; below the Cherty Rock. Sandstones partly aeolian, partly fluviatile, with reptilian fauna, 0-30 mthick.

Symonds W.S., 1860; Harkness R. 1864; Judd W.J., 1873, 1886; Boulenger G.A. 1903; as part of their Reptiliferous Sandstones.

Huxley T.H., 1859; Murchison R.I., 1859, Newton E.T. 1893 as part of their Elgin Sandstones.

Boulenger G.A. 1904; Huene F., 1910a; as *Stagonolepis* Beds.

Huene F., 1910b, as *Stagonolepis* Sandstones.

Westoll T.S., 1951, as Sandstones of Lossiemouth, Spynie and Findrassie.

Peacock J.D., Berridge N.G., Harris A.L. and May F., 1968, pp. 67-70, as sandstones of Spynie, Lossiemouth and Findrassie, above Burghead Beds and below the Cherty Rock. Previous history of the term recorded.

Walker A.D., 1973, pp.177-183, *Stagonolepis* fauna redescribed.

Lovell J.P.B., 1983, p.328, 334, as Lossiemouth Sandstone; top 5 m renamed Sago Pudding Sandstone after Williams 1973.

Benton M.J. and Walker A.D., 1985, pp.209-213, 216, 218, describes the formation as white, buff, yellow and pink sandstones with feldspar, chert and quartzite grains. Large scale current bedding and a general absence of pebbles and mica; thickness from 7-30 m. The extensive reptile fauna includes *Stagonolepsis, Leptopleuron, Hyperodapedon, Ornithosuchus, Erpetosuchus, Scleromochlus, Saltopus* and *Brachyrhinodon*. Age above the Burghead Sandstone, Carnian to Norian.

!LOWER BROCKRAM. **?Permian, New Red Sandstone.**

See: Brockrams.

!LOWER BUNTER. **?Permian, ?Trias, New Red Sandstone.**

Type-locality: Midlands, England.

Audley-Charles M.G., 1970, p.24. Lowest division of the Bunter comparable with the Lower Mottled Sandstones of Hull 1869; also ?St. Bees Shales. [This subdivision is attributed to Richardson L., 1929 by Audley-Charles but only the sense of the unit is described in the paper, not actually named as such; Hull E., 1869 similarly, table p.10, uses C1, C2 and C3, C1 being the 'Lower Bunter', i.e. Lower Mottled and Red Sandstone. The term could include Bunter Shale of Rhys G.H., 1974, southern North Sea.]

Hull E., 1869, p.10, lowest subdivision of the Bunter.

Richardson L., 1929, p.199, as the lowest subdivision of the Bunter.

!LOWER DIVISION. **?Permian, New Red Sandstone.**

(Lower Series 2.—term already defined by Hull 1869, Lower Series 1, see below.)

Type-locality: Isle of Arran, Scotland.

Gregory J.W., 1915, pp.186-7. Lower Series used as a synonym of Lower Division. Permian part of the New Red Sandstone, also referred to as Lower New Red Sandstone. Includes the Brodick Freestones, Brodick Breccia, Lamlash Sandstones and Ballymichael Sandstones.

Tyrell G.W., 1928, p.76, referred to as the Lower New Red Sandstone.

!LOWER EVAPORITE ZONE. **Trias, Mercia Mudstone Group.**

(Lower Evaporite Group 2.) [Lower Evaporite Group already used in Yorkshire—see below.]

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

Wills L.J., 1970, pp.273, 276, 277. English Keuper Series, Neotrias, Droitwich Regional Stage. Between the Lower and Middle Keuper Marls Groups. To include the Lower Keuper Saliferous Beds, Saliferous Beds of Stafford, and Lower Anhydrite (Lower Evaporite Zone) of the Stowell Park Borehole. Red marls with rock salt and minimum gypsum, KMVIII-V miocyclothems.

Wills L.J., 1976, pp.28, 101, 164 et seq. as Lower Evaporite Zone, part of the first Keuper Macrocyclothem.

Warrington G. et al. 1980 renamed as Stafford or Droitwich Halite Formations.

!LOWER EVAPORITES. **Permian, Zechstein.**

(Lower Evaporite Bed, Lower Evaporite Group 1.)

Type-locality: Eskdale no.2 borehole, east Yorkshire.

Stewart F.H., 1949, pp.621-675. Between Lower and Upper Magnesian Limestone.

Raymond L.R., 1953, pp.5-23, as Lower Evaporite Group.

Stewart F.H., 1963, p.3, table 1, Fordon no.1 borehole Yorkshire, 325.8 m thick. [Term with initial capitals for the first time.]

Smith D.B. et al. 1974, table 3, col.17, renamed as Fordon Evaporites.

LOWER KEUPER. **Trias, ?Sherwood Sandstone Group.**

Type-locality: England, generally.

Audley-Charles M.G., 1970, pp.19-48; p.24, 26. Arenaceous base of the Keuper includes Basement Beds, Building Stones, Waterstones, Keuper Sandstone, Lower Keuper Sandstone, Kirklinton Sandstone. Attributes the term to Richardson L., 1929, p.200 who states that the Keuper Series can be divided into two parts: a Lower in which sandstone predominates and an Upper in which marl predominates. [Term Lower Keuper not actually printed in this paper. Term commonly used to prefix lithology, eg. Lower Keuper Sandstone. Term also implied by Hull 1869, p.10, see Lower Bunter.]

!LOWER KEUPER MARL FORMATION. **Trias, Mercia Mudstone Group.**

(Lower Keuper Marl, Lower Keuper Marls, Lower Keuper Marl Group, Lower Keuper Marls Group, Lower Keuper Mudstones.)

Type-locality: Warwickshire.

Matley C.A., 1912, pp.264-5. Keuper, above the Lower Keuper Sandstone and below the Arden Sandstone Group. Synonym of Lower Marls of Brodie 1870. Red, grey, green and mottled marls, softer than the Upper Marls. Gypsum present but no rock salt; pseudomorphs after halite, known.

Pugh W., 1960, pp.278-279, Wilkesley Borehole, above the Upper Keuper Sandstone and below the Lower Keuper Saliferous Beds.

Garrett P.A., 1960, pp.868-869, points out inconsistency in use of terms by Pugh 1960. Lower Keuper Saliferous Beds and Lower Keuper Marl all part of the Upper Keuper.

Poole E.G. and Whiteman A.J., 1966, p.19 attempt to correct Pugh 1960 but term still not used as Matley 1912.

Audley-Charles M.G., 1970, pp.19-48, unit referred to as Lower Keuper Mudstones.

Wills L.J., 1970, pp.272, 273, 276, as Lower Keuper Marls Group, Saleway Bore- hole, 3 miles south-east of Droitwich, SO 928601 (I.C.I.Ltd.). English Keuper Series, Neotrias, Droitwich Regional Stage, above the Waterstones and below the Arden Sandstone or above the Keuper Passage Beds and below the Lower Evaporite Group. KMIV-I miocyclothems, red marls with thin halite and gypsum veins. [Combined usage of Matley and Poole and Whiteman.]

Wills L.J., 1976, pp.28, 101, 164 et seq. as Sub-Arden Keuper Marls in part.

Warrington G. et al. 1980 as Tarporley Siltstone Formation and/or undifferentiated Mercia Mudstone Group.

!LOWER KEUPER SALIFEROUS BEDS. **Trias, Mercia Mudstone Group.**

(Lower Keuper Saliferous Band, Lower Keuper Saliferous Marls, Lower Saliferous Formation.)

Type-locality: Wilkesley Borehole, Cheshire.

Pugh W., 1960, pp.278-9. Lower of two thick rock salt and marl sequences within the Keuper Marl.

Poole E.G. and Whiteman A.J., 1966, for full description within the Cheshire Basin, 190.5 m at Wilkesley, (143.3 m of rock salt) and 304.8 m at Middlewich.

Audley-Charles M.G., 1970, pp.19-48, as Lower Keuper Saliferous Band.

Wills L.J., 1970, pp.273, 276, 277, as Lower Evaporite Group 2.

Warrington G., 1970, p.200 as Lower Saliferous Formation, between Lower and Middle Keuper Marl Formations, miospores suggest Anisian age, (ICI Ltd. borehole Holford, Cheshire).

Wills L.J., 1976, as Lower Evaporite Zone.

Warrington G. et al. 1980, renamed unit as Northwich Halite Formation.

!LOWER KEUPER SANDSTONE. **Trias, Sherwood Sandstone Group.**

(Lower Keuper Sandstone Series, see also: Keuper Sandstone.)

Type-locality: Midland Counties of England; also at Stourport, Bromsgrove, Kidderminster, Bridgnorth, Eccleshall, Whitemoor, Hawkstone Hills west Cheshire, Peckforton Hills, Delamere Forest, Wirral, Liverpool, Ormskirk, east Warwickshire, Ashby, Alton, north Staffordshire, Nottingham.

Hull E., 1860,p p.27-29; 1869, pp.10, 65, 98, as Lower Keuper Sandstone or Waterstones. Base of the Keuper, above the Upper Mottled and Red Sandstone and below the New Red Marl. Includes Basement Beds, Building Stones and Waterstones. Thinly laminated micaceous red sandstones and marls passing downwards into white brown or reddish sandstone with a base of calcareous conglomerate or breccia. [As Hull did not use the term Upper Keuper Sandstone it is possible that to Hull 'Upper Keuper' referred to the New Red (Keuper) Marls.]

Wills L.J., 1948, in Warwickshire it rests unconformably on Precambrian and Palaeozoic rocks.

Thompson D.B., 1970, refers to Hull's Lower Keuper Sandstone as Keuper Sandstone.

Wills L.J., 1970, p.247, as Bromsgrove Regional Stage, Mesotrias.

Warrington G. et al. 1980, in part as top of the Sherwood Sandstone Group (Basement Beds and Building Stones) and base of the Mercia Mudstone Group (Waterstones). Includes the Helsby Sandstone, Bromsgrove Sandstone, Nynehead and Otter Sandstone, and Colwick Formations.

!LOWER LIAS MARLS. **?Trias, ?Penarth Group.**

Type-locality: Said to outcrop in Saltford Railway Cutting and at Aust, Gloucestershire.

Bourne J.C., 1846, p.75. Basal Member of the Lias, above the White Lias, below *Psiloceras (Ammonites) planorbis*. [?Synonym of Lower Marls, Conybeare W.D. and Phillips W., 1822.]

***LOWER MAGNESIAN LIMESTONE.** **Permian, Zechstein.**

(Lower Limestone, Houghton Limestone.)

Type-locality: Yorkshire and Durham.

Wilson E., 1881, pp.121-124, 187-191. Lower part of the Magnesian Limestone, above the Quicksands (Yellow Sands), Marl Slate and/or Basal Breccia and below the Middle Marls. Compact grey or yellow limestone or dolomite.

Kirkby J.W., 1861, pp.287-323, as Lower Limestone [of the Magnesian Limestone].

Woolacott D., 1912, in addition as 'The Lower regularly bedded Limestone', and pp.261-2 as Lower Limestone, Houghton Limestone. Localities-Houghton Quarry, High Down Quarry, Frenchman's Bay, Boldon Hills, Cullercoats Bay.

Smith D.B. et al. 1974, table 3, cols. 14-18. Usually above the Marl Slate or Lower Marls or Yellow Sands or Basal Breccia. May be subdivided into a Lower and an Upper Sub-Division separated by the Hampole Beds. Below the Permian Middle Marl or Middle Magnesian Limestone or Hayton Anhydrite, may include the Middle Magnesian Limestone. Up to 76 m thick. Part of the Don Group.

Magraw D., 1975, pp.397-414, between the Marl Slate and Velvet Beds Limestone and Breccias of south-east Northumberland and Durham.

Smith D.B., Harwood M.G., Pattison J. and Pettigrew T. 1986, pp.10-14, Lower Magnesian Limestone renamed Cadeby Formation in Nottinghamshire, Derbyshire, Yorkshire, and Humberside; and the Raisby Formation in Durham.

!LOWER MARLS. **?Permian, ?Trias, New Red Marl.**

(Lower Marl, Lower Marles)

Type-locality: Borehole near Bath and north-east Somerset and south Gloucestershire.

Conybeare W.D. and Phillips W., 1822, pp.261-3, as Lower marles (sic.) Separating the lias (Upper marles, Stoney or true lias) from the new red sandstone formation (sic.). [Sections pp.262-3, begin below the White lias rock, and include Black marle and Light blue marle, presumably including the Tea Green Marls, Westbury Beds and Cotham Beds.]

De La Beche W.T. 1826, as Lower Marl.

Wright T. 1860, pp.376-8 renames the unit, Zone of *Avicula contorta* or *Avicula contorta* Beds. [See also: Black Shales.]

Brodie P.B., 1870, pp.10-34, Trias, Keuper Marls below the Upper Keuper Sandstone. [Clearly Brodie's term differs from Conybeare and Phillips 1822.]

Ussher W.A.E., 1875. pp.163-168, south coast of Devon, ?Trias, above red sandstones and below conglomerates of Budleigh Salterton; red variegated marls slightly calcareous, loamy in the lower part and containing impersistent beds of sandstone near the base. [clearly not the same horizon as Conybeare and Phillips or Brodie.]

Henson M.R., 1970, pp.172-177, renames Ussher's unit Littleham Formation, ?Trias.

Smith D.B. et al. 1974, table 3, col. 14, as Lower Marl, referred to p.18 as Permian Lower Marl, distinct lithology and younger than the Marl Slate, 0-50 m thick. [4th interpretation]. table 6, col.28, as Littleham Mudstones.

!LOWER MEMBER. **Permian, Zechstein.**

See: Aller Halite.

!LOWER MOTTLED SANDSTONE. **?Permian, ?Trias, New Red Sandstone.**

(Lower Red and Mottled Sandstones.)

Type-locality: Bridgnorth, Shropshire; but also throughout the West Midlands and in the Severn and Dee Estuaries, Welsh Borders and ?East Midlands.

Hull E., 1860, pp.23-24; 1869, pp.10, 32, [Both terms used, the second appearing first in the text but little used subsequently.] Lowest unit of Hull's Trias Series, considered to be the lower part of the German Buntsandstein. Above red marls with thin bedded fossiliferous limestones (Permian) or above Upper Carboniferous red beds and below Pebble Beds. Soft red and variegated sandstone without pebbles, cross-bedding well developed; up to 198.1 m thick at Bridgnorth.

Lamplugh G.W., Gibson W., Sherlock R.L. and Wright W.B., 1908, p.9, Nottingham area between Upper Permian and Pebble Beds. Medium to fine-grained red sandstones with thin red marls. [Facies unlike that of Bridgnorth being moulding sands.]

Wills L.J., 1948, as Bridgnorth Sandstone Group or Dune Sandstone.

Taylor F.M., 1965, p.188, as Mottled Sandstone.

Smith D.B. et al. 1974, table 4, col.14, above the Permian Upper Marls and the Nottingham Castle Formation. [No col. for Shropshire!]

Warrington G. et al. 1980, table 4, col. 12 renamed as Bridgnorth Sandstone; cols. 9 and 10, as Kinnerton Formation; cols.23-25, as Lenton Sandstone Formation.

!LOWER NEW RED SANDSTONE. **?Carboniferous, ?Permian.**

Type-locality: West Midlands.

Murchison R.I., 1839. Lowest subdivision of the New Red Sandstone, ?Permian in age. Red Beds below the ?Triassic sandstones.

Binney E.W. 1839, pp.37, 47-48; 1844, p.244; 1846 p.12, describes the Lower New Red Sandstone of the Manchester area, see Collyhurst Sandstone.

Hull E., 1869, pp.10, 12, rocks of Worcestershire, Shropshire and Staffordshire above the Coal Measures; similar to the Salopian Permian, Rotliegende.

Tyrell G.W., 1928, p.77, term used for the Permian rocks of Arran.

Laming D.J.C., 1966, pp.940-959, term used for the lower part of the New Red Sandstone of Devon, ?Permian age, possibly Carboniferous, often breccias. [Useful term to separate breccias and aeolian deposits from higher fluviatile deposits both of doubtful age.]

!LOWER NEW RED SERIES OF ROTH-TODT-LIEGENDE. **?Permian, New Red Sandstone.**

(Lower New Red Series.)

Type-locality: North-west England.

Goodchild J.G., 1893, pp.1-24. Rotliegende. Includes the Lower Brockram, Penrith Sandstone, Upper Brockram and Copper Red Sandstone (St. Bees Sandstone.)

LOWER *PECTEN* LIMESTONE.

See: *Pecten* Limestone.

LOWER PERMIAN.

See: Rotliegende.

!LOWER PERMIAN LANCASTRIAN TYPE.

See: Lancastrian Permian.

!LOWER PERMIAN LIMESTONE. **Permian, Zechstein.**

Type-locality: Market Weighton borehole, Yorkshire.

Sherlock R.L., 1921, p.108, table. Equivalent of the Lower Magnesian Limestone; ?Lower Limestone. 179.5 m thick, including anhydrite.

LOWER PERMIAN MARL.

See: Permian Lower Marl.

!LOWER PERMIAN SALOPIAN TYPE.

See: Salopian Permian.

!LOWER RED MARL AND GYPSUM. **?Permian, ?Zechstein.**

Type-locality: Ferrybridge-Doncaster.

Sedgwick A., 1829, pp.64, 101-103. New Red Sandstone, lower part of the Magnesian Limestone unit. [Later referred to as the Permian Lower Marls?.]

Kirkby J.W., 1861, pp.287-323, redefines the beds below the Upper Limestone or Brotherton Beds, and above the Lower Limestone in the south Yorkshire area. [Thus now the equivalent of the Permian Middle Marls.]

!LOWER RED AND MOTTLED SANDSTONES. **?Permian, ?Trias.**

See: Lower Mottled Sandstone.

!LOWER RED SANDSTONE. **?Permian, ?Rotliegende.**

Type-locality: Nottingham to Durham.

Sedgwick A., 1829, pp.64, 68, 121. New Red Sandstone Series, Rothe-todte-liegende, including the Pontefract Rock of Smith W. 1815. Rocks between the Coal Measures and the Yellow Magnesian Limestone. To include the yellow sands, coarse siliceous sandstones, red conglomerates, micaceous sandstones, and marls, a variable complex.

Sedgwick A., 1832, pp.383-407, term used for the lower part of the New Red Sandstone at St. Bees Head, Cumberland.

Murchison R.I. and Harkness R., 1864, pp.144-165, refer Kirkby Stephen unit to the Penrith Sandstone. [Reference here to 'Lower Red Sandstone' of Murchison's Silurian System.

Gunn W., 1903, 200pp. uses this term for the lower part of the New Red Sandstone of Arran and suggests a Bunter age for the rocks. Same group referred to by Gregory 1915 as Lower Division of ?Permian age.

Woolacott D., 1912 as Yellow Sands, considered that Sedgwick included undoubted reddened Coal Measures in his term.

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

(Lower Sandstone.)

Type-locality: Lavernock Point, Glamorgan or West Somerset Coast.

Richardson L., 1911, pp.1-74; to include the Black Shales or *Avicula contorta* Beds of previous authors.

Tucker M.E., 1977, pp.169-188; term represented by the Lower Sandstone.

!LOWER SALIFEROUS BANDS. **Trias, Mercia Mudstone Group.**

See: Lower Keuper Saliferous Marls.

!LOWER SANDSTONE.

See: Penrith Sandstone, Lower Rhaetic, Lower Sandstones and Breccias.

LOWER SANDSTONES AND BRECCIAS. **?Permian, New Red Sandstone.**

Type-locality: Burlescombe-Williton, south Devon, also near Torquay, Teignmouth, Heavitree, Sampford Peverell, Dawlish and Exmouth.

Ussher W.A.E., 1875, pp.165, 166.; 1876, p.385, as Lower Sandstones or Lower Division. Trias age is implied in the title of the paper. Red sandstones and beds of rock sand locally brecciated. Breccia of angular fragments of grit and quartz in sand rock, pebbles, mudstones.

Laming D.J.C., 1966, pp.940-959, unit split into local geographical units. Tor Bay Breccias, Vicarage Hill Breccias, Livermead Beds, Paignton Breccias, Chelston Breccias, Watcombe Beds, Oddicombe Breccia, Ness Beds, Teignmouth Breccias, Dawlish Sands and Exmouth Beds.

Henson M.R., 1970, pp.172-177, refers part of the unit to Teignmouth and Crediton Breccias, and Exmouth Formation.

!LOWER SERIES 1. **?Permian, New Red Sandstone.**

(Lower Series of Permian Beds.) See also: Lower Division (Lower Series 2.)

Type-locality: Enville, Shropshire, quarries 2 miles south of Bridgnorth and at Uplands, Ashfield Hill and Claverley.

Hull E., 1869, pp.12-13. [Term partly implied.] Permian, Rotliegende. Purple sandstones becoming red, brown, white; calcareous, mottled.

LOWER STOCKPORT MARL. **Permian, Zechstein.**

Type-locality: Stockport, Cheshire.

Taylor B.J., Price R.H. and Trotter F.M., 1963, p.51 and plate IV. Term attributed to P.F. Kendall [m.s. record only]. Close to the top of the Collyhurst Sandstone. Band of red marl varying in thickness.

Smith D.B. et al. 1974, table 3, col.13, 0-15m, top part of the Collyhurst Sandstone. ?Permian, ?Lower.

!LOWER SUBDIVISION. **Permian, Zechstein.**

Type-locality: Hampole quarries, Doncaster, Yorkshire.

Mitchell G.H., Stephens J.V., Bromehead C.E.N. and Wray D.A., 1947, p.114. Lower part of the Lower Magnesian Limestone composed of thick, usually well- bedded oolites and compact limestones and associated reef limestones; base may sandy. Also referred to as Lower Beds, fig.27, p.113. [Thickness not given; ?about 25 m at Hampole.]

Smith D.B., 1968, pp.463-477. (p.465). Unit now redefined with reference to the top; lower part of the Lower Magnesian Limestone, below the Hampole Beds. Regularly bedded dolomite. [Smith's definition may not be the same as Mitchell et al. 1947.]

Smith D.B. et al. 1974, table 3, col.14, north Nottinghamshire and south Yorkshire.

Smith D.B., Harwood G.M., Pattison J. and Pettigrew T., 1986, pp.10, Lower Subdivision of Smith 1968, renamed Wetherby Member which includes the lower bed of the Hampole Beds and is part of the Cadeby Formation.

LOWER WERRAANHYDRIT. **Permian, Zechstein.**

Rhys G.H., 1974, table 2, fig.3, Shell/Esso well 49/26-4, southern North Sea. Z1, the equivalent of the Hayton Anhydrite of Yorkshire; and the Werra Dolomit of Germany; includes dolomite, anhydrite at the top, 83 m thick. [First reference for the southern North Sea.]

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, Miocyclothems BSIIA, BSIIB, 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 *Bakevellia, 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, Bakevellia, 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 epicontinetal 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, Ayreshire.

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 ?] Porpyritic 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, Ayreshire, 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 prefering 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, Kirklinton, 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, Miocyclothems 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 Nottinghashire, 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 Woolacoott'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 Nynehead 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 Netherton Formation, may pass laterally into the top of the Oddicombe Breccias.

NETHER ALDERLEY RED SANDSONE 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.**

(Netherton 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, prefering 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, macrocyclothems BSIIA BSIIB, 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 (Brockrams) and Cherty Rock. [Lazonby Stone.]

Smith D.B. et al. 1974, table 3, col.10, local base above Brockram ?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 Brockram; 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, Tletsk, all Orenbourg Goverment Department, provence 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.

Swinnerton 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 Upgang 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, Upgang 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 (Richardson1911). 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: O.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 Sandsone.

!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 Levencorroch 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.).

Swinnerton 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 Swinnerton'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, Dumfrieshire.

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 ooliths 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, Liebea 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, hasselgebirge 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 Hardegsen 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 unmistakeable 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, Rotliegend.)

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.1O, 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., 198l, 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 Salzton 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 annhydrite 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 a anhydrite phase.) Shelly dolomite, algal mat dolomite, birds eye dolomite, 2 m thick including *Bakevellia* 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 *Bakevellia 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 *Bakevellia* 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 Cummingstone.)

Type-locality: Quarry Wood, Cutties Hillock, west of Elgin. Also at Knock of Alves, Carden Hill; Cummingstown (Cumminstone) 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-Cummingstone.

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 Burghead 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 *Bakevellia 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 l 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 fluviatile 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 Macrocyclothem 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; Macrocyclothem 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: Ogmore-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, Upgang 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 Kirklinton 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 Kirklinton 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; Storetveldt 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 microcyclothems. 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 Macrocyclothem, miocyclothems 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: Ogmore-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 Anhydrte, 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 idential to the sandstones of [Mauchline] Ayreshire.

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; ?aeolion.

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 Cnglomerate 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, (Worssom 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 Britian] 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 Rhaetian. 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 Nottingamshire, 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, Auchenhew Sandstones and Shales, Levencorroch 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; miocyclothems 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 Macrocyclothem.

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 Kirklinton 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, Warickshire 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 siltsones 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. Miocyclothem 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, Kirklinton 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 sqamosa*(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, superceded 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 Marldon 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 Conglomerte 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 Kirklinton. 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 Marldon 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 miocyclothems, composed of varied, multicoloured series of thin sandstones, siltstones, shales, mudstones, each with massive brown sandstones at the base. Miocyclothems 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/Esso 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/Esso 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 *Bakevellia 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 Nynehead 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. Miocyclothems BSI, BSIIA, BSIIB, 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 Warchet and Blue Anchor. Thin intraformational conglomerate at the base; well bioturbated throughout. Bivalves include *Gervillia, Protocardium, Eottrapezium, 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, Dumfrieshire. 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. Surburban Railway.

Elliott R.E., 1961, p.211. Keuper Series, basal formation, above the Bunter Pebble Beds and below the Waterstones Formation; possible disconformities above and below the unit. Rhythmic alternation of buff and yellow-green sandstones and red mudstones. The lowest sandtones 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 litte 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 Kupferscheifer, 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 Kupferscheifer and Werradolomit, Z1.

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CONTENTS

Mercian Geologist, Vol. 11,
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pp. 1–143, one plate