

The type Ludlow Series: Lithostratigraphy

The type Ludlow Series is currently considered to comprise nine formations, corresponding to the nine combined lithological and faunal divisions of Holland *et al.* (1963). These are:

Upper Whitcliffe Formation (top)	c. 30 m
Lower Whitcliffe Formation	c. 25 m
Upper Leintwardine Formation	1.5-5 m
Lower Leintwardine Formation	c. 30 m
Upper Bringewood Formation	12-45 m
Lower Bringewood Formation	50-60 m
Upper Elton Formation	45-75 m
Middle Elton Formation	45-105 m
Lower Elton Formation (base)	30-45 m

Select any formation for more information.

Holland, C.H., Lawson, J.D & Walmsley, V.G. 1963. The Silurian rocks of the Ludlow district, Shropshire. *Bulletin of the British Museum (Natural History)*, Geology, **8**, 95-171, pls 1-7.

[Return to 'The Ludlow Series \(Upper Silurian\) of the type area - introductory page'.](#)

[Author: SGM]

Lower Elton Formation

The stratotype for the base of the Lower Elton Formation is at Pitch Coppice Quarry. An additional basal reference section was listed by Lawson & White (1989, p. 89), at locality A1 in the Goggin Road section. Sutherland (1994), however, considered the strata at locality A1 to be 14.8 m above the base of the formation on chitinozoan and other evidence. Body stratotypes listed by Lawson & White are at locality A6 of the Goggin Road section, and in the stream section of Nunfield Gutter [SO 4366 7266 and SO 4348 7262], about 8 km WSW of Ludlow.

The formation, approximately 30 to 45 m thick, comprises soft, pale olive, bioturbated calcareous silty mudstones or muddy siltstones, irregularly bedded in shaly or flaggy units, with a blocky fracture (Lawson & White 1989).

A diverse fauna, dominated by small brachiopods representing the *Glassia obovata* Association, is scattered through the rocks rather than being concentrated in layers (Lawson & White 1989).

Lawson, J.D. & White, D.E. 1989. The Ludlow Series in the Ludlow area. *In* Holland, C.H. & Bassett, M.G. (eds) *A global standard for the Silurian System*. National Museum of Wales, Geological Series No. 9, Cardiff. 73-90.

Sutherland, S.J.E. 1994. Ludlow chitinozoans from the type area and adjacent regions. *Palaeontographical Society Monograph*, London, 1-104, pls 1-18 (publ. No. 594, part of vol. 148 for 1994).

See: [Glassia obovata Association, Goggin Road, Pitch Coppice Quarry.](#)

[Return to beginning of 'Lithostratigraphy'.](#)

[Return to 'The Ludlow Series \(Upper Silurian\) of the type area - introductory page'.](#)

[Author: SGM]

Middle Elton Formation

The stratotype for the base of the formation is in Nunfield Gutter [SO 4389 7278], about 7.5 km WSW of Ludlow, with body stratotypes in Nunfield Gutter [SO 4352 7264 and SO 4337 7263] and along the Goggin Road (localities A12-A14 and A16-A18) (Lawson & White 1989, p. 89).

The Middle Elton Formation comprises olive-grey, shaly and thinly flaggy, muddy siltstones, commonly 'soapy' with a characteristic smooth conchoidal fracture. Less common are slightly calcareous muddy siltstones with finely divided mica. There are occasional paper shales and calcareous nodules. Bentonites are common and conspicuous. Its well-defined bedding planes, less calcareous nature and colour distinguish the Middle Elton Formation from the Lower Elton Formation. The contact between the two formations is transitional over a few centimetres. The Middle Elton Formation is estimated to be between 45 and 105 m thick (Holland *et al.* 1963; Lawson & White 1989).

A pelagic fauna, consisting of graptolites (*nilssoni* and *scanicus* biozones) and orthocones, is dominant; benthic organisms are rare, although brachiopods are present (Holland *et al.* 1963; Lawson & White 1989).

Holland, C.H., Lawson, J.D & Walmsley, V.G. 1963. The Silurian rocks of the Ludlow district, Shropshire. *Bulletin of the British Museum (Natural History)*, Geology, **8**, 95-171, pls 1-7.

Lawson, J.D. & White, D.E. 1989. The Ludlow Series in the Ludlow area. In Holland, C.H. & Bassett, M.G. (eds) *A global standard for the Silurian System*. National Museum of Wales, Geological Series No. **9**, Cardiff. 73-90.

See: [Goggin Road, *Lobograptus scanicus* Biozone, Lower Elton Formation, *Neodiversograptus nilssoni* Biozone.](#)

[Return to beginning of 'Lithostratigraphy'.](#)

[Return to 'The Ludlow Series \(Upper Silurian\) of the type area - introductory page'.](#)

[Author: SGM]

Upper Elton Formation

The basal boundary stratotype for the Upper Elton Formation is located in a trackside exposure [SO 471 711], about 500 m SSW of the Goggin Road section. The original stratotype of Holland *et al.* (1963, p. 110, fig. 3, locality 76) has now disappeared (Lawson & White 1989, p. 89). Body stratotypes comprise localities A25-A27 of the Goggin Road section, a trackside exposure [SO 4760 7350] west-southwest of Gorsty and about 4 km WSW of Ludlow, and crags above Downton Gorge [SO 4303 7280], about 8.25 km WSW of Ludlow.

The Upper Elton Formation consists of olive-grey, well-bedded, shaly and flaggy sandy and calcareous siltstones, with prominent hard flaggy calcareous bands. The latter distinguish this formation from the underlying beds. The contact with the underlying Middle Elton Formation is transitional. The Upper Elton Formation has an estimated thickness of between 45 and 75 m (Holland *et al.* 1963; Lawson & White 1989).

The fauna, like that of the Middle Elton Formation, is predominantly pelagic, with graptolites (essentially a monospecific fauna of *Pristiograptus tumescens* (Wood), not as diverse as that in the Middle Elton Formation, indicating the *Pristiograptus tumescens*/*Saetograptus incipiens* Biozone) and orthocones, accompanied by rare small brachiopods (Holland *et al.* 1963; Lawson & White 1989).

Holland, C.H., Lawson, J.D & Walmsley, V.G. 1963. The Silurian rocks of the Ludlow district, Shropshire. *Bulletin of the British Museum (Natural History)*, Geology, **8**, 95-171, pls 1-7.

Lawson, J.D. & White, D.E. 1989. The Ludlow Series in the Ludlow area. *In* Holland, C.H. & Bassett, M.G. (eds) *A global standard for the Silurian System*. National Museum of Wales, Geological Series No. **9**, Cardiff. 73-90.

See: [Goggin Road, Middle Elton Formation, *Pristiograptus tumescens*/*Saetograptus incipiens* Biozone.](#)

[Return to beginning of 'Lithostratigraphy'.](#)

[Return to 'The Ludlow Series \(Upper Silurian\) of the type area - introductory page'.](#)

[Author: SGM]

Lower Bringewood Formation

The original basal boundary stratotype in the Mary Knoll Valley (SO 4873 7292; locality 196 of Holland *et al.* 1963, p. 141, fig. 12) has deteriorated (Lawson & White 1989, p. 89). An additional basal reference section is situated in the Goggin Road (locality A28). Body stratotypes include the Deer Park Road section (localities B1-B3), Sunny Dingle Road [SO 4860 7275], 3.5 km SW of Ludlow (locality 31 of Lawson 1973), and two small quarries above the east bank of the River Teme in Downton Gorge (SO 4289 7296; locality 44 of Holland *et al.* 1963, p. 133, fig. 10).

The Lower Bringewood Formation comprises light olive-grey, irregularly bedded and flaggy, calcareous, finely micaceous, medium to coarse siltstones, with frequent bands, lenses and nodules of limestone. The Lower Bringewood Formation is distinguished from the Upper Elton Formation by its more irregular bedding and more homogeneous lithology. The formation is estimated to be between 50 and 60 m thick (Holland *et al.* 1963; Lawson & White 1989).

There is a marked faunal contrast between the Upper Elton and Lower Bringewood formations, with a conspicuous benthic fauna in the Lower Bringewood Formation comprising large brachiopods (including species that are common in the Wenlock), solitary rugose corals and trilobites (the *Mesopholidostrophia laevigata* Association). The faunal change is most marked in the Ludlow area, where the Upper Elton Formation is graptolitic, but is also noticeable where equivalents of the Upper Elton Formation have a more benthic fauna (Holland *et al.* 1963; Lawson & White 1989).

Holland, C.H., Lawson, J.D & Walmsley, V.G. 1963. The Silurian rocks of the Ludlow district, Shropshire. *Bulletin of the British Museum (Natural History)*, Geology, **8**, 95-171, pls 1-7.

Lawson, J.D. 1973. New exposures on forestry roads near Ludlow. *Geological Journal*, **8**, 279-284.

Lawson, J.D. & White, D.E. 1989. The Ludlow Series in the Ludlow area. In Holland, C.H. & Bassett, M.G. (eds) *A global standard for the Silurian System*. National Museum of Wales, Geological Series No. **9**, Cardiff. 73-90.

See: [Deer Park Road, Goggin Road, *Mesopholidostrophia laevigata* Association, Upper Elton Formation](#).

[Return to beginning of 'Lithostratigraphy'.](#)

[Return to 'The Ludlow Series \(Upper Silurian\) of the type area - introductory page'.](#)

[Author: SGM]

Upper Bringewood Formation

The original basal boundary stratotype for the formation is located on Bringewood Chase, in a stream section [SO 4595 7325] south of Deepwood and about 5.5 km WSW of Ludlow, but is now in poor condition (Lawson & White 1989, p. 90). An additional reference section for the base of the formation is situated along the Deer Park Road (locality B7). Strata at locality B7 also constitute a body stratotype, with additional body stratotypes exposed along the River Teme [SO 4306 7313 and SO 4300 7311] near Bow Bridge, about 8.25 km WSW of Ludlow (including locality 45 of Holland *et al.* 1963, p. 133 and fig. 10).

The Upper Bringewood Formation comprises light olive-grey, irregularly bedded, flaggy and nodular silty limestones, frequently crinoidal. An increase in the proportion of harder limestone to calcareous siltstone distinguishes the Upper Bringewood Formation from the Lower Bringewood Formation. The formation is estimated to be between 12 and 45 m thick (Holland *et al.* 1963; Lawson & White 1989).

The benthic fauna includes large brachiopods, tabulate corals and stromatoporoids. Coquinas of the brachiopod *Kirkidium knightii* (J. Sowerby) are characteristic (the *K. knightii* Association), particularly in more western outcrops (Holland *et al.* 1963; Lawson & White 1989; Watkins & Aithie 1980).

Holland, C.H., Lawson, J.D. & Walmsley, V.G. 1963. The Silurian rocks of the Ludlow district, Shropshire. *Bulletin of the British Museum (Natural History)*, Geology, **8**, 95-171, pls 1-7.

Lawson, J.D. & White, D.E. 1989. The Ludlow Series in the Ludlow area. In Holland, C.H. & Bassett, M.G. (eds) *A global standard for the Silurian System*. National Museum of Wales, Geological Series No. **9**, Cardiff. 73-90.

Watkins, R. & Aithie, C.J. 1980. Carbonate shelf environments and faunal communities in the Upper Bringewood Beds of the British Silurian. *Palaeogeography, Palaeoclimatology, Palaeoecology*, **29**, 341-368.

See: [Deer Park Road, *Kirkidium knightii* Association, Lower Bringewood Formation.](#)

[Return to beginning of 'Lithostratigraphy'.](#)

[Return to 'The Ludlow Series \(Upper Silurian\) of the type area - introductory page'.](#)

[Author: SGM]

Lower Leintwardine Formation

The basal stratotype is at Sunnyhill Quarry, with an additional reference section along the Deer Park Road. Body stratotypes are located along the Deer Park Road (localities B21-B37), and in the track section between Sunnyhill and Overton quarries (localities C9-C28) (Lawson & White 1989, p. 90).

The Lower Leintwardine Formation is estimated to be about 30 m thick. Most of the formation consists of light olive-grey, thinly flaggy, calcareous siltstones with shelly limestones and shale bands, but at Sunnyhill Quarry the basal 2.3 m of the formation are lithologically distinct. They comprise nodular, silty, massive and crinoidal limestones with calcareous siltstones, and resemble the Upper Bringewood Formation. The base of the formation at Sunnyhill Quarry is defined on faunal rather than lithological criteria, i.e. above the highest occurrences of *Kirkidium knightii* (J. Sowerby), *Strophonella euglypha* (Hisinger) and tabulate corals, and therefore at the faunal change from the *Mesopholidostrophia laevigata* Association to the *Sphaerirhynchia wilsoni* Association.

The coquinoid occurrence of fossils is typical of the Lower Leintwardine Formation.

Lawson, J.D. & White, D.E. 1989. The Ludlow Series in the Ludlow area. In Holland, C.H. & Bassett, M.G. (eds) *A global standard for the Silurian System*. National Museum of Wales, Geological Series No. 9, Cardiff. 73-90.

See: [Deer Park Road, *Kirkidium knightii* Association, *Mesopholidostrophia laevigata* Association, *Sphaerirhynchia wilsoni* Association \(upper phase\), Sunnyhill Quarry, Upper Bringewood Formation.](#)

[Return to beginning of 'Lithostratigraphy'.](#)

[Return to 'The Ludlow Series \(Upper Silurian\) of the type area - introductory page'.](#)

[Author: SGM]

Upper Leintwardine Formation

The basal stratotype is situated on The Whitcliffe, with additional reference sections along the Deer Park Road (localities B37-B38) and the track section between Sunnyhill and Overton quarries (locality C29). Body stratotypes are located at the same localities, with the addition of a small quarry east of Bow Bridge [SO 4329 7312] in Downton Gorge, about 8 km WSW of Ludlow (Lawson & White 1989)

The Upper Leintwardine Formation is transitional between the Lower Leintwardine Formation and the Lower Whitcliffe Formation. It comprises light olive-grey, flaggy calcareous siltstones similar to those of the Lower Leintwardine Formation near Ludlow, but is more irregularly bedded and less calcareous, like the Lower Whitcliffe Formation, farther west, near Downton. The Upper Leintwardine Formation is estimated to be between 1.5 and 5 m thick (Holland *et al.* 1963; Lawson & White 1989).

As with the Lower Leintwardine Formation, the coquinoid occurrence of shelly fossils is characteristic. Thin shelly layers are characteristic of the western exposures, but such bands are less common in the east, where the Upper Leintwardine Formation may not be distinguished so readily from the Lower Leintwardine Formation. The most diagnostic feature of the formation is its distinctive arthropod fauna (see the *Shaleria ornatella* Association), with the trilobites *Calymene puellaris* Reed and *Encrinurus stubblefieldi* Tripp, and the ostracode *Neobeyrichia lauensis* (Kiesow).

Holland, C.H., Lawson, J.D & Walmsley, V.G. 1963. The Silurian rocks of the Ludlow district, Shropshire. *Bulletin of the British Museum (Natural History)*, Geology, **8**, 95-171, pls 1-7.

Lawson, J.D. & White, D.E. 1989. The Ludlow Series in the Ludlow area. *In* Holland, C.H. & Bassett, M.G. (eds) *A global standard for the Silurian System*. National Museum of Wales, Geological Series No. **9**, Cardiff. 73-90.

See: [Deer Park Road, Lower Leintwardine Formation, Lower Whitcliffe Formation, Ludfordian ostracode faunas, *Neobeyrichia lauensis*, *Shaleria ornatella* Association, Sunnyhill Quarry, The Whitcliffe.](#)

[Return to beginning of 'Lithostratigraphy'.](#)

[Return to 'The Ludlow Series \(Upper Silurian\) of the type area - introductory page'.](#)

[Author: SGM]

Lower Whitcliffe Formation

The basal boundary stratotype section is situated on The Whitcliffe, with additional reference sections along the Deer Park Road (locality B39) and at Overton Quarry [SO 4973 7244]. Body stratotypes occur at the same localities, and above the east bank of the River Teme [SO 4345 7352 and SO 4398 7400] in Downton Gorge, 7.25 to 7.5 km WSW of Ludlow (localities 49 and 51, respectively, of Holland *et al.* 1963, p. 134 and fig. 10; Lawson & White 1989).

The Lower Whitcliffe Formation comprises medium grey to greenish grey, massive or thickly flaggy and irregularly bedded, occasionally micaceous, calcareous, coarse to medium siltstones, with a large-scale conchoidal or crudely blocky fracture. The formation is estimated to about 25 m thick (Holland *et al.* 1963; Lawson & White 1989).

The base of the formation in its stratotype section is located within a succession of calcareous siltstones, and is founded on faunal rather than lithological criteria, coinciding with the base of the *Protochonetes ludloviensis* Association. Holland *et al.* (1963) recorded a distinct faunal depletion across the base of the Lower Whitcliffe Formation at its stratotype, with the brachiopod fauna reduced to *Dayia navicula* (J. de C. Sowerby), *Microsphaeridiorhynchus nucula* (J. de C. Sowerby) and *Protochonetes ludloviensis* Muir-Wood. Flaggy, calcareous siltstones, with a honeycomb weathering characteristic of the Upper Leintwardine Formation, occur about 0.84 m below the base of the Lower Whitcliffe Formation (Bed A of Holland *et al.* 1963). Thickly and irregularly bedded siltstones typical of the Lower Whitcliffe Formation occur about 0.25 m above its base in the stratotype section (Bed I of Holland *et al.* 1963).

Holland, C.H., Lawson, J.D & Walmsley, V.G. 1963. The Silurian rocks of the Ludlow district, Shropshire. *Bulletin of the British Museum (Natural History)*, Geology, **8**, 95-171, pls 1-7.

Lawson, J.D. & White, D.E. 1989. The Ludlow Series in the Ludlow area. *In* Holland, C.H. & Bassett, M.G. (eds) *A global standard for the Silurian System*. National Museum of Wales, Geological Series No. **9**, Cardiff. 73-90.

See: [Deer Park Road, *Protochonetes ludloviensis* Association, Sunnyhill Quarry, Upper Leintwardine Formation, The Whitcliffe.](#)

[Return to beginning of 'Lithostratigraphy'.](#)

[Return to 'The Ludlow Series \(Upper Silurian\) of the type area - introductory page'.](#)

[Author: SGM]

Upper Whitcliffe Formation

The basal boundary stratotype section of the Upper Whitcliffe Formation is on The Whitcliffe, with body stratotypes at the same locality, in Whitcliffe Road and near Downton Castle Bridge [SO 4442 7425], 7 km W of Ludlow (locality 56 of Holland *et al.* 1963, p. 135, fig. 7; Lawson & White 1989).

The Upper Whitcliffe Formation comprises pale olive to light olive-grey, flaggy, sometimes micaceous, clean and well-sorted calcareous siltstones with shelly limestone bands. Typically, strata are more thinly bedded than in the Lower Whitcliffe Formation, but there is a stratigraphical transition between the two formations, and rock types characteristic of each unit may occur in the other, making identification of the lithostratigraphical unit in small exposures difficult. The Upper Whitcliffe Formation is estimated to be about 30 m thick (Holland *et al.* 1963; Lawson & White 1989).

Fossils usually occur in coquinas. They are mainly the same as those in the Lower Whitcliffe Formation (the *Protochonetes ludloviensis* Association), but occur in greater numbers (Holland *et al.* 1963; Lawson & White 1989).

Holland, C.H., Lawson, J.D & Walmsley, V.G. 1963. The Silurian rocks of the Ludlow district, Shropshire. *Bulletin of the British Museum (Natural History)*, Geology, **8**, 95-171, pls 1-7.

Lawson, J.D. & White, D.E. 1989. The Ludlow Series in the Ludlow area. *In* Holland, C.H. & Bassett, M.G. (eds) *A global standard for the Silurian System*. National Museum of Wales, Geological Series No. **9**, Cardiff. 73-90.

See: [Lower Whitcliffe Formation, *Protochonetes ludloviensis* Association, The Whitcliffe, Whitcliffe Road.](#)

[Return to beginning of 'Lithostratigraphy'.](#)

[Return to 'The Ludlow Series \(Upper Silurian\) of the type area - introductory page'.](#)

[Author: SGM]