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Lithostratigraphy of the Late Cretaceous to ?Paleocene succession in the western part of the Central Inlier of Jamaica

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Abstract – The lithostratigraphy of the Late Cretaceous to ?Paleocene rocks in the central and western parts of the Central Inlier (Jamaica) is formally described based on detailed geological mapping of the inlier. Seven formations are recognised: Slippery Rock Formation; Thomas River Formation (new formation); Guinea Corn Formation; Green River Formation (new formation); Peckham Formation (new formation); Mahoe River Formation (new formation); and Waterworks Formation (new formation). The latter four formations comprise the Summerfield Group. Type sections for each formation are described.

INTRODUCTION

THE CENTRAL Inlier represents the second largest inlier of Cretaceous rocks in Jamaica (Fig. 1). It contains a succession of igneous lava flows and minor intrusives, extensive volcaniclastic sediments and subordinate carbonates. The Cretaceous succession can be divided into an older succession represented by sedimentary rocks (Peters Hill Formation) and baked or metasomatised sedimentary and igneous rocks (variously called the Bull Head Formation, Main Ridge volcanics, Arthurs Seat Formation and Eastern Volcanic Complex), and a younger succession of conglomerates, sandstones and limestones (Slippery Rock, Guinea Corn and Summerfield formations). It is this younger succession of Cretaceous rocks which is considered in this paper.

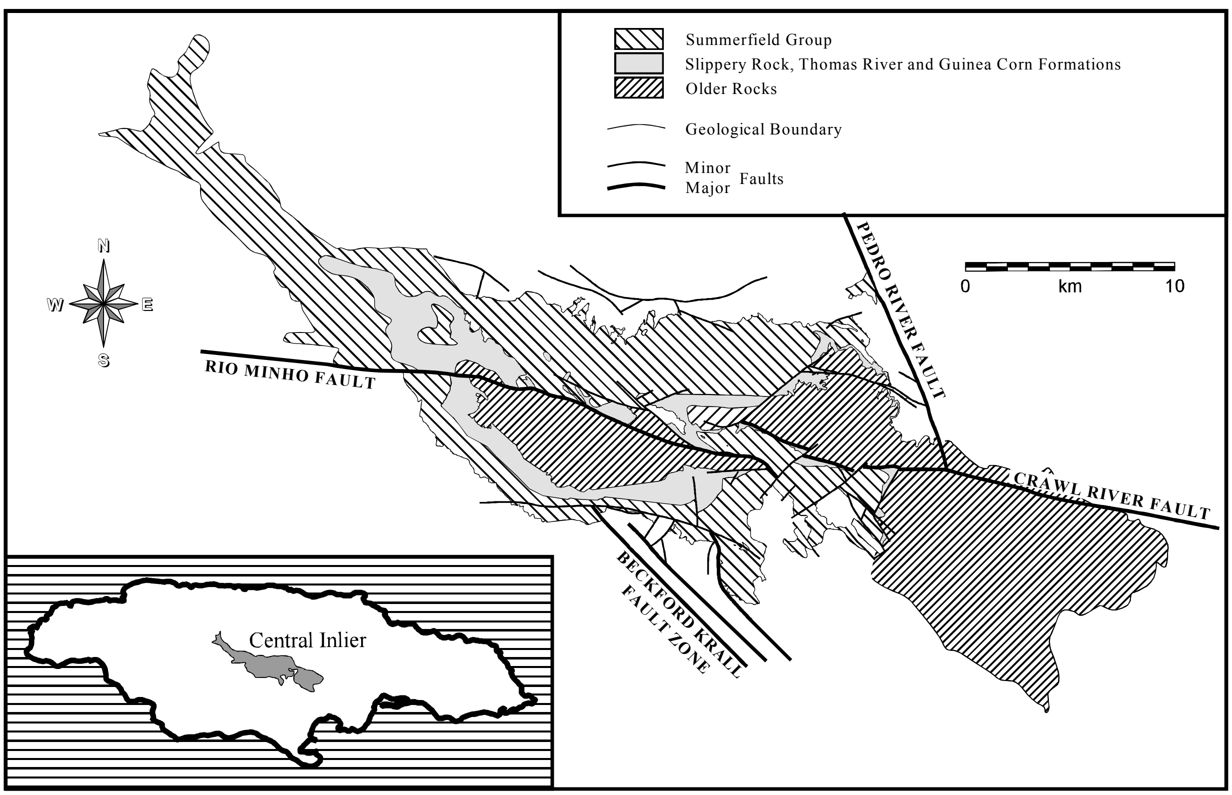

Figure 1. Simplified geological map for the Central Inlier showing the major faults. Inset, location of the Central Inlier in Jamaica.

Table 1. Comparison of lithostratigraphic schemes for the Central Inlier.

Williams, 1959a	Williams, 1959b	Chubb, *in* Zans *et al.*, 1963	Coates, 1965, 1968 (South)	Coates, 1965, 1968 (North)	Robinson *et al.*, 1972	Jiang & Robinson, 1987	Scheme used here
Yellow Lmst.	Yellow Lmst.	Yellow Lmst.	Yellow Lmst.	Yellow Lmst.	Yellow Lmst.	Yellow Lmst.	Yellow Limestone Gp.
Upper Tuffaceous Series	Upper Tuffaceous Series	Upper Tuffaceous Series	Sumerfield Formation	Bullhead Formation	Sumerfield Formation	Sumerfield Formation	Summerfield Group: Waterworks Fm.; Mahoe River Fm.; Peckham Fm.; Green River Fm.
Rudist Limestone	Rudist Limestone	*Titano ser.*: Guinea Corn Lst.; Logie Green Lst.; Praebarrettia Lst.	Guinea Corn Fm.		Guinea Corn Formation	Guinea Corn Formation	Guinea Corn Fm.
	Lower Tuffaceous Series	Lower Tuffaceous Series	Bullhead Formation		Slippery Rock Formation	Slippery Rock Formation	Thomas River Fm.
Lower Tuffaceous Series							Slippery Rock Fm.
					Main Ridge Fm.	Main Ridge Fm.	'Main Ridge Fm.'

HISTORY OF RESEARCH

De la Beche (1827) produced the first geological map of eastern Jamaica. He mapped the central and eastern portions of the Central Inlier as 'porphyritic conglomerates and trap rocks' and referred to them as the 'St. John's trap' (De la Beche, 1827, p. 168). Sawkins (1869) mapped two units in the Central Inlier, the Trappean and Metamorphic Series, and Hill (1899) recognised a distinctive succession of rudist-bearing limestones at Logie Green (northern Clarendon), which he called the Logie Green Beds. Trechmann (1924) provided a measured section through these beds at Logie Green, and recorded the presence in them of *Praebarrettia sparcilirata* (Whitfield). He also introduced the generic name *Titanosarcolites* for Whitfield's (1897) species *Caprinula gigantea* which was also common at Logie Green.

The Geological Survey of Jamaica was established in 1949 with V. A. Zans as director. During the first ten years of the Geological Survey, extensive mapping was undertaken throughout much of central Jamaica (Dixon, 1957). Hose (1950) called the limestones exposed at Logie Green, and those elsewhere in Jamaica that yielded *Titanosarcolites*, the Titanosarcolites Series. Williams (1959a, b) summarised the results of the Jamaican Geological Survey's mapping in the Central Inlier during the fifties. He recognised a threefold classification for the Cretaceous rocks of the western part of the Central Inlier (Table 1). These were, in ascending order: the "Lower Tuffaceous Series"; the "Upper Rudist Limestone and Shales"; and the "Upper Tuffaceous Series". The provisional 1:250,000 geological map was produced in 1958 and showed the distribution of these rocks; the accompanying memoir was published in 1963 (Zans *et al.*, 1963, although the cover has a 1962 imprint). Chubb (*in* Zans *et al.*, 1963, p. 7) suggested a threefold division of the Upper Rudist Limestone in his correlation table for the Central Inlier (Table 1). In ascending order this was: "Praebarrettia Lst."; "Logie Green limestones and intervening shales"; and "Guinea Corn Lst.". In the text, Chubb (*in* Zans *et al.*, 1963, p. 14) was of the opinion that the limestones were separate, stating "these limestones have not been separated on the [provisional geological] map".

Coates (1964, 1965, 1968) reported the results of his geological mapping in the Central Inlier (Table 1). He recognised an important fault system, the Crawle River Fault Zone, which he beleived separated a younger Cretaceous succession (Guinea Corn and Summerfield formations) to the south from an older succession (Arthurs Seat, Peters Hill and Bull Head formations) to the north. He produced a map in 1968 and formally described the formations (Arthurs Seat, Peters Hill, Bull Head, Guinea Corn, and Summerfield) present.

Robinson and Lewis (*in* Robinson *et al*., 1972, p. 13) produced a revised map of part of the Central Inlier around Frankfield (which was reproduced in Jiang and Robinson, 1987). They proposed the name Slippery Rock Formation for the reddish conglomerates, sandstones and siltstones that represented the upper part of the Lower Tuffaceous Series of Williams (1959a) and the middle of Coates' (1968) Bull Head Formation (Table 1).

The 1:50,000 geological sheets covering the mid Central Inlier were published in the mid nineteen-seventies (Porter and Bateson, 1974; Bateson, 1974; Porter, Bateson and McFarlane, 1974). These were based on the previous mapping by the Geological Survey, which was revised to take account of the introduction of the Slippery Rock Formation by Robinson and Lewis (*in* Robinson *et al*., 1972).

Roobol (1976) gave a measured section through the upper part of the Guinea Corn Formation (at Cabbage Hill) and the Summerfield Formation (between Cabbage Hill and John's Hall). In 1977, the most recent 1:250,000 scale map of Jamaica was produced (McFarlane, 1977), and contained further updates from the 1:50,000 series maps. Mitchell (1999) studied the Guinea Corn Formation in detail and divided it into 7 units lettered A to G. Mitchell and Blissett (1999) produced a map of the Cretaceous rocks around Johns Hall, and demonstrated that there was only a single ignimbrite unit in the Summerfield Formation.

LITHOSTRATIGRAPHY

The lithostratigraphy of the late Cretaceous rocks of the Central Inlier developed gradually during the period from 1965 to 1972. Unfortunately, there has been little systematic revision of the scheme. Mapping by us from 1997 to date of the Central Inlier has shown that a complex lithostratigraphic succession is present. Structurally the inlier contains two major East-West faults, the Rio Minho Fault and the Crawle River Fault (Fig. 1). Left lateral movement along this fault zone has juxtapositioned rocks with somewhat different lithostratigraphic successions against one-another. In this paper we describe the lithostratigraphic scheme for the succession in the western and southern portions of the Central Inlier (Fig. 1). Seven formations and one group are recognised (Table 1); they are described in detail below. The location of sections mentioned in the text is shown in Figure 2.

SLIPPERY ROCK FORMATION (Robinson and Lewis *in* Robinson *et al.*, 1972, emended herein)

Introduction. The Slippery Rock Formation is used for the lowest conglomerate unit in the Late Cretaceous succession of the Central Inlier. It rests unconformably on the older Cretaceous rocks.

History of unit. Robinson and Lewis (*in* Robinson *et al*., 1972) introduced the Slippery Rock Formation for 'a series of reddish conglomerates, sandstones and siltstones overlying the Bullhead {sic} Formation and the Main Ridge volcanics'. The formation has subsequently been shown on the 1:50,000 and 1:250,000 geological sheets.

Interpretation. We restrict the Slippery Rock Formation to the conglomerates in the lower part of the unit proposed by Robinson and Lewis (*in* Robinson *et al*., 1972). These conglomerates are the predominant rock-type exposed at the type section, and are therefore clearly the best lithology to take as the formation, particularly as the additional unit separated here had already been recognised previously (Williams, 1959a, 1959b).

Previous names: Middle part of the Lower Tuffaceous Series (Chubb *in* Zans *et al*., 1963, p. 14); upper part of the Lower Tuffaceous Series (Williams, 1959a, p. 254); conglomerate series of the Lower Tuffaceous Series (Williams, 1959b, p. 11); middle part of the Bull Head Formation (Coates 1968); Crooked River Formation (Robinson and Lewis *in* Robinson *et al*., 1972, p. 18) – a mistake for Slippery Rock Formation; lower part of the Slippery Rock Formation (Jiang and Robinson, 1987, p. 36).

Description. Red, brown or grey conglomerates and sandstones in relatively thick, poorly defined beds. Beds range in thickness from a few tens of centimetres up to several metres. The conglomerates are predominantly poorly to moderately sorted, and contain rounded granules and pebbles. The matrix is sandy. Tabular and trough-cross bedding may be present. The conglomerate beds are generally sharp and erosively based. Clast types are predominantly andesitic and basic volcanic rocks, however small

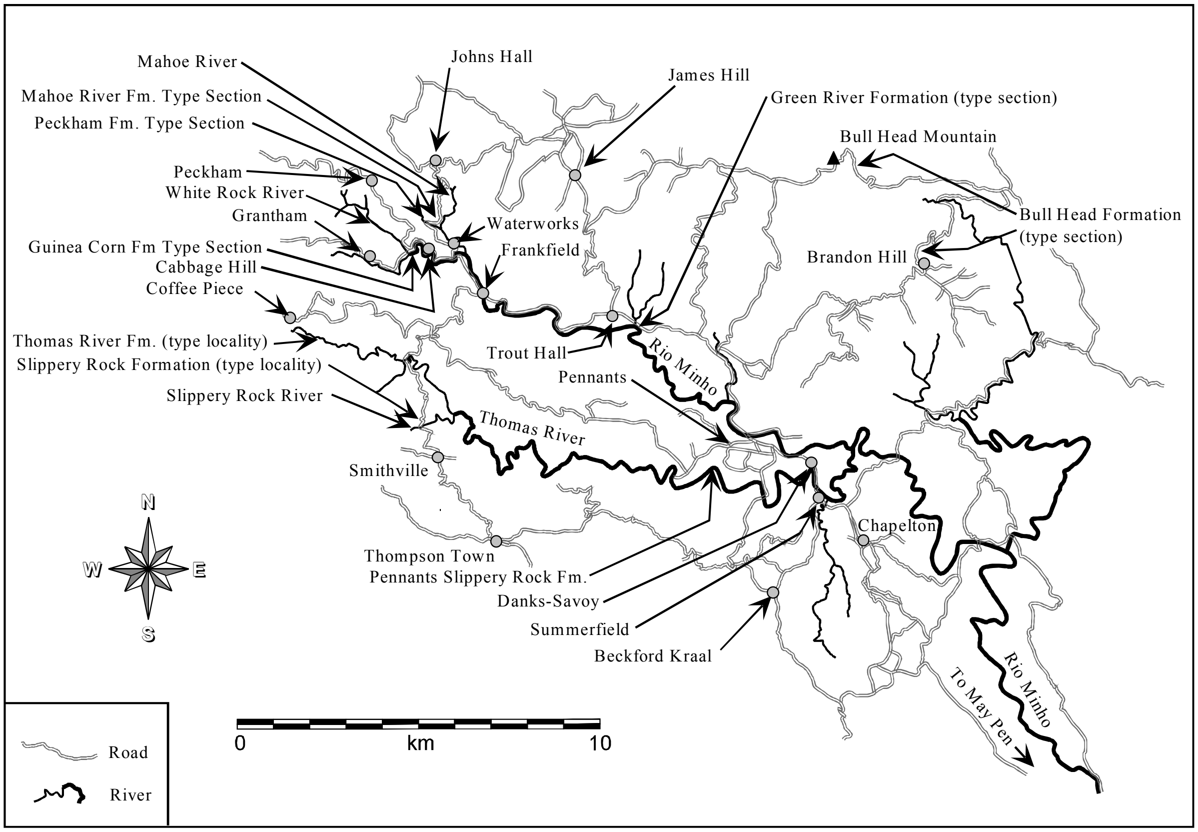

Figure 2. Map showing locations of sections mentioned in the text.

proportions of sandstones, siltstones and limestones and even a little agate may be present. Quartz is generally very rare. The conglomerates pass upwards into sandstones and pebbly sandstones, sometimes with carbonate concretions. The concretions are interpreted as calcretes. Subordinate red sandstones and siltstones may be present.

Type Locality. The type locality of this formation is 'along the road from Smithville to Frankfield, immediately north of the bridge over Slippery Rock River' (Robinson and Lewis *in* Robinson *et al*., 1972; Fig. 2). Although the formation is well-exposed at its type locality, the beds have a low amount of dip and the exposures are of limited lateral extent. Consequently, it has not prooved possible to log a suitable long section at this locality.

Other Localities. The formation is extensively exposed around the Central Inlier. Good exposures are to be seen in the Rio Minho at Grantham and Trout Hall, and in the Thomas River at Pennants (Robinson and Mitchell, 1999; Fig. 3).

Thickness. The thickness of the formation determined from cross-sections is about 175 m in the vicinity of Slippery Rock River.

Relationships with other units. The base of the Slippery Rock Formation is taken at the unconformity with the underlying 'Main Ridge Formation'. This is usually poorly exposed, marking the change form monolithic conglomerates/breccias with subordinate andesites to the overlying polylithic conglomerates of the Slippery Rock Formation. The base of the formation can be easily mapped because it gives rise to soils containing rounded pebbles of variable lithology; the underlying 'Main Ridge volcanics' give rise to clayey soils with or without angular shards of andesite and baked conglomerate.

The top of the formation is marked by the change from conglomerates to siltstones. It may be locally represented by a thin succession of sandstones with marine fossils (oysters) or trace fossils (*Taenidium* isp. and ?*Arenicolites* isp.), which indicate a marine incursion. Where developed, these sediments consist of sandstones and thin conglomerates and are therefore attributed to the Slippery Rock Formation.

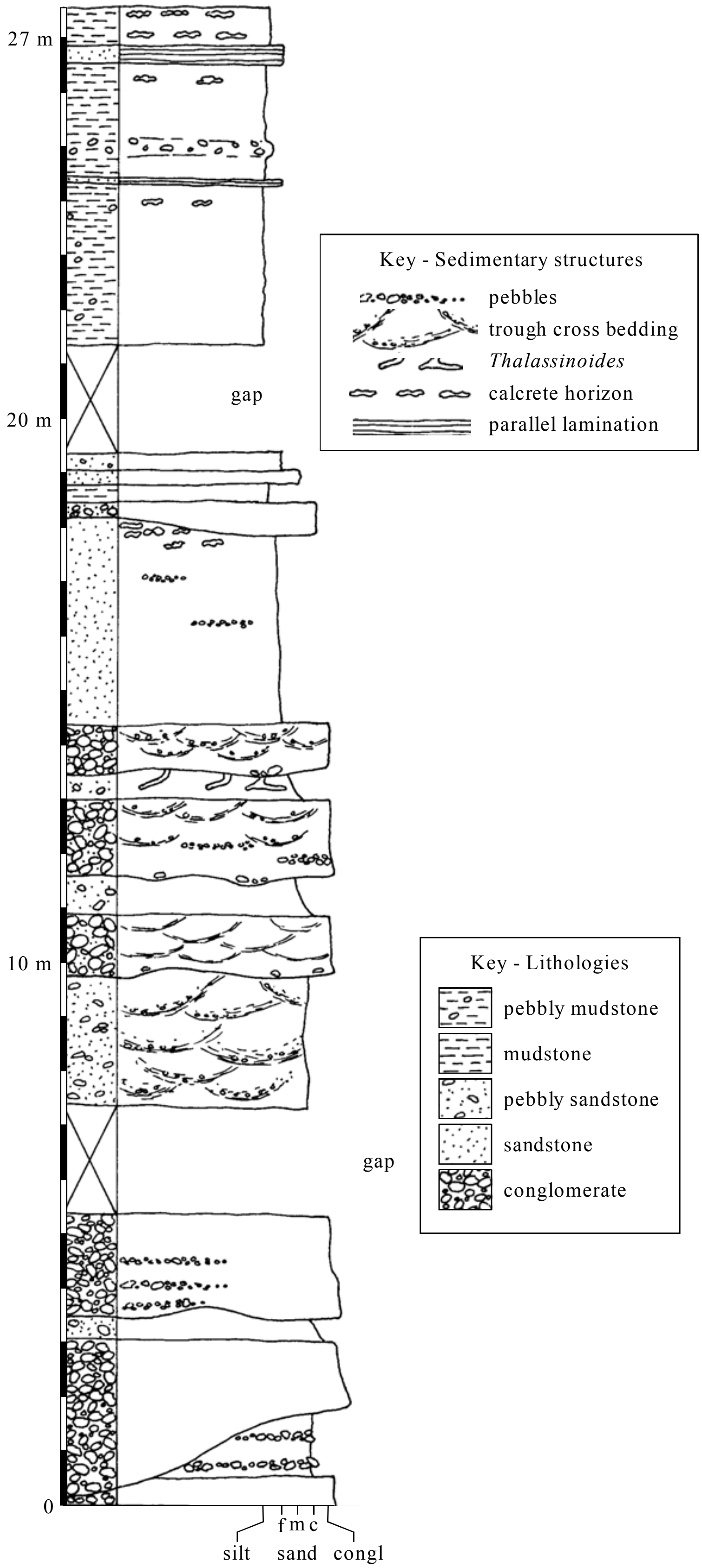

Figure 3. Graphic log through the Slippery Rock Formation in the Thomas River at Pennants.

THOMAS RIVER FORMATION (new name)

Introduction. The Thomas River Formation is introduced here for the distinctive unit of mudstones and thin sandstones, that have previously been included in either the upper part of the Slippery Rock Formation or the lower part of the Guinea Corn Formation.

History. Williams (1959a, p. 256) recognised that the conglomerates of his Lower Tuffaceous Series were succeeded by 'a shale horizon about 500 ft in thickness' which Williams assigned to the base of the Rudist Limestone. Hence Williams considered the shales to be part of the Rudist Limestone. Williams (1959a, p. 256) description was 'unfossiliferous red-weathering clay-shale overlain by fine laminated clay shales which contain a fauna of small molluscs together with plant remains, and show traces of ripple marking'. The unit has not been formally separated subsequently.

Previous names. "500 ft of shales at the base of Rudist Limestone" (Williams, 1959a, p. 256); "500 ft of shales of the Lower Tuffaceous Series" (Williams, 1959b, p. 12); 'grey shale crowded with small molluscs' in the upper part of the Lower Tuffaceous Series (Chubb *in* Zans *et al*., 1963, p. 14); upper part of the Slippery Rock Formation and lower part of the Guinea Corn Formation of Robinson and Lewis (*in* Robinson *et al*., 1972, p. 13); upper part of the Slippery Rock Formation (Jiang and Robinson, 1987, p. 36).

Description. Unfossiliferous red mudstones, and grey laminated mudstones with ripple cross-laminated heterolithics and thin limestones and calcareous sandstones. Fossils common at many levels in the grey mudstones, calcareous sandstones and limestones. The base of the formation is defined by

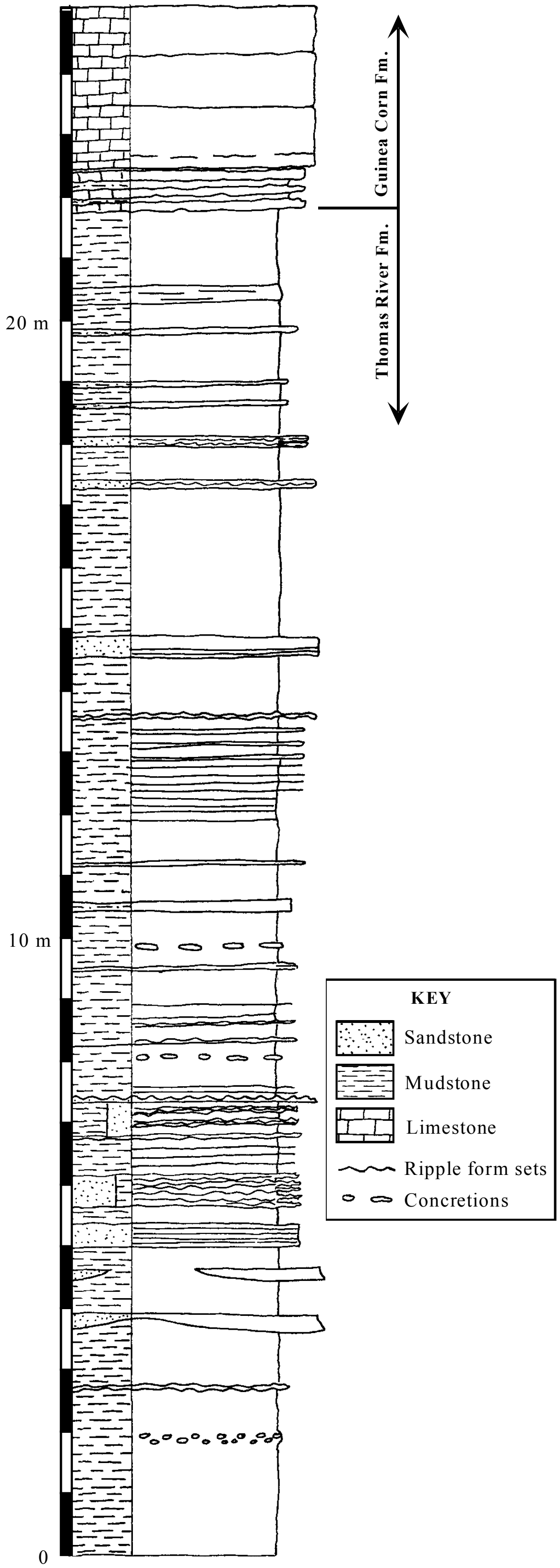

Figure 4. Graphic log of the type locality of the Thomas River Formation in the Thomas River at Coffee Piece.

the change from the conglomerates and sandstones of the Slippery Rock Formation to the red and grey mudstones of the Thomas River Formation.

Type Locality. In the Thomas River below Coffee Piece (Fig. 2). A graphic log of the type section is shown in Figure 4.

Other Localities. The formation is only developed at the western end of the Central Inlier. Good sections are available in the Slippery Rock River between the new foot-bridge and the overlying interbedded limestones and mudstones of the Guinea Corn Formation; Rio Minho up stream of confluence with White Rock River.

Thickness. The formation has an estimated thickness (from cross-sections) of about 175 m in the vicinity of Slippery Rock River.

Relationship with other units. The formation has a relatively abrupt contact with both the underlying Slippery Rock Formation and the overlying Guinea Corn Formation. The formation thins to the east and is absent in the eastern regions of the inlier.

Discussion. Williams (1959a) considered that the grey shales of our Thomas River Formation were part of the Rudist Limestone (=Guinea Corn Formation), while in another paper, Williams (1959b) considered that they were part of the Lower Tuffaceous Series, but above the conglomerate series. Clearly, Williams although associating these units with different ‘series’ considered that the shales were a distinct unit. Robinson and Lewis (*in* Robinson *et al.*, 1972) and Robinson (1988) drew the boundary between the Slippery Rock Formation and the Guinea Corn Formation at the colour change from red to grey (and a corresponding increase in carbonate content): this is within the middle of Williams’ 500 ft of shales. Conversely, Jiang and Robinson (1987) suggested that the Slippery Rock Formation consisted of ‘variegated, mainly red conglomerates with limestone in the lower part, passing upwards into red, followed by green or grey siltstones’. Thus in this publication the boundary was placed at a stratigraphically higher level than by Robinson and Lewis (*in* Robinson *et al.*, 1972).

Williams (1959a, b) and Chubb (*in* Zans *et al.*, 1963) considered that it was the upper part of our Thomas River Formation that yielded molluscs and plant fragments. The charophyte gyrogonite assemblages previously described from the Slippery Rock Formation (Kumar and Oliver,

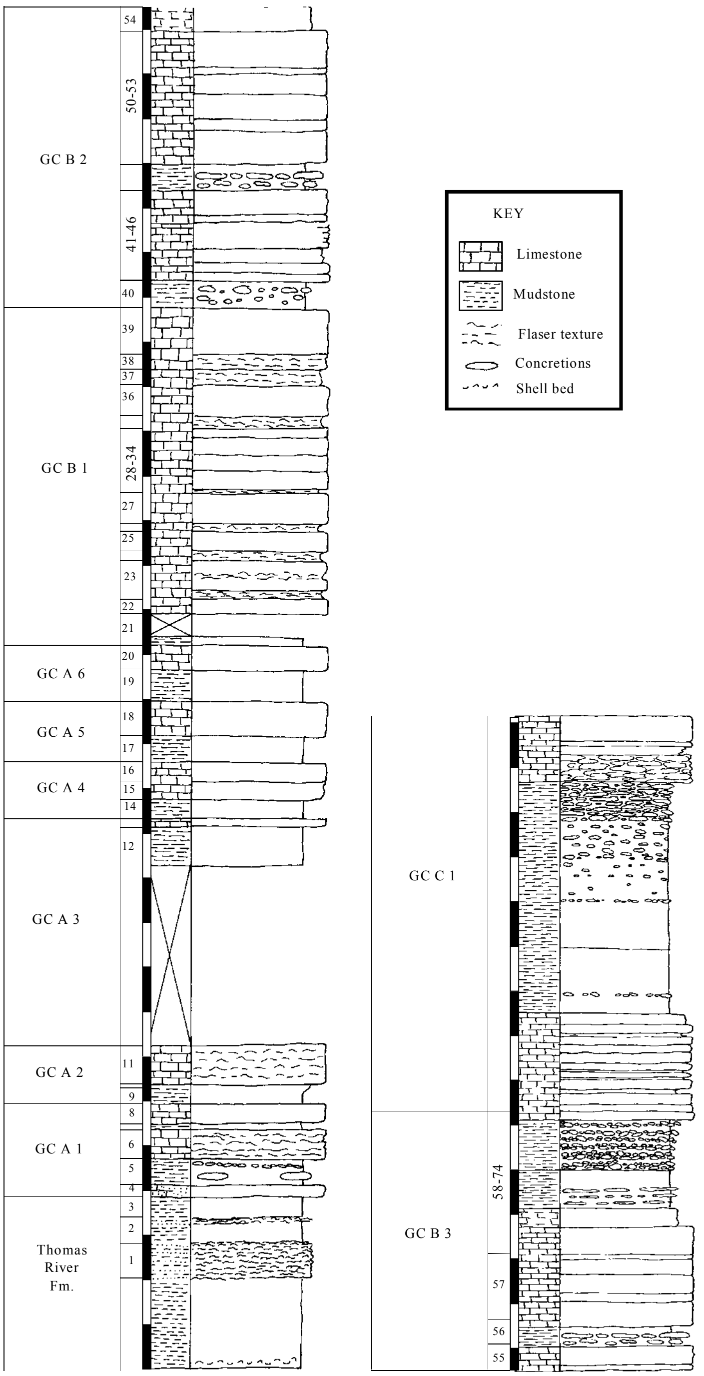

Figure 5. Graphic log through the type section of the Guinea Corn Formation at Grantham. Scale bar in metre intervals. Bed numbers are shown together with the units recognised by Mitchell (1999).

1984; Kumar and Grambast-Fessard, 1984) occur in samples we have collected from the uppermost part of the Thomas River Formation at Grantham (i.e., the lower part of the Guinea Corn Formation *sensu* Robinson and Lewis *in* Robinson *et al*., 1972, and Robinson, 1988; but the upper part of the Slippery Rock Formation of Jiang and Robinson, 1987, p. 36).

GUINEA CORN FORMATION (Coates, 1965, attributed to Chubb *in* Zans *et al*., 1963 [Coates, 1968, p. 313]) (Fig. 5)

Introduction. The Guinea Corn Formation is the main rudist-bearing limestone in the Late Cretaceous and is used in the sence of Coates (1965) and Mitchell (1999) herein.

History. The rudist limestone in the Central Inlier was referred to as the Cretaceous Limestone (Sawkins, 1869), the 'rudist limestone' (Williams 1959a, b) or the 'Titanosarociltes Series' (Chubb, 1956). Chubb (*in* Zans *et al*., 1963, Table 2) introduced the name 'Guinea Corn Lst.' for the uppermost limestone of the Titanosarcolites Series in the Central Inlier, although the name Titanosarcolites Series was not used in his table. Subsequently, Coates (1965, 1968) used the term Guinea Corn Formation for the rudist-bearing limestone that was exposed in the Crawle River to the north of Chapelton. He defined the type section of the Guinea Corn Formation near to the village of Guinea Corn to the west of Frankfield. The name has subsequently been used without exception for the whole of the 'Titanosarcolites Series' in the Central Inlier (e.g., Robinson and Lewis *in* Robinson *et al*., 1972; Kauffman and Sohl, 1974; Jiang and Robinson, 1987; Robinson, 1988; Mitchell, 1999).

Previous names. 'Titanosarcolites Limestone' (Hose, 1950, p. 22; Coates, 1964, p. 9); 'Rudist Limestone Series' (Williams, 1959a, p. 254; 1959b, p. 12); 'rudist limestone' and 'Titanosarcolites Series' (Chubb *in* Zans *et al*., 1963, p. 14), which were divided in ascending order into 'Praebarrettia Lst.', 'Logie Green limestones and intervening shales' and 'Guinea Corn Lst.' (Chubb *in* Zans *et al*., 1963, table 2).

Description. Rudist-bearing limestones varying from massive to thinly bedded to nodular. Rudist bivalves abundant throughout. Locally thin clastic units are present; they are predominantly mudrocks in the lower part and interbedded mudstones and graded sandstones in the upper part (Robinson and Lewis *in* Robinson *et al*., 1972; Roobol, 1976; Mitchell, 1999). The clastic units thicken towards the east (Coates, 1965; Mitchell, 1999). The base of the formation is taken at the significant lithological change from mudstones with ripple cross-laminated and parallel laminated heterolithics with thin limestone or calcareous sandstone layers, to limestones and calcareous sandstones with subordinate massive, featureless mudrocks. The boundary is exposed in the Rio Minho immediately above its confluence with the White Rock River, in the Slippery Rock River 150 m upstream of the new (foot) bridge to the north of Smithville, and in the Thomas River near Coffee Piece.

Type Section. Coates (1965) stated that the type section for the formation was near Guinea Corn to the west of Frankfield (following Chubb *in* Zans *et al*., 1963). Mitchell (1999) accepted this section as the type section and presented the detailed lithological succession at this locality. The type section shows the junction with the underlying Slippery Rock Formation and a graphic log of this section is shown in Figure 5.

Other sections. Numerous sections through the Guinea Corn Formation have been described (e.g., Coates, 1965; Kauffman and Sohl, 1974; Mitchell, 1999; Robinson and Mitchell, 1999).

Thickness. The unit ranges in thickness from 180 m to 210 m (Mitchell, 1999). To the north-east, the unit thins dramatically and to the north of Brandon Hill it is absent with the Summerfield Group resting conformably on the Slippery Rock Formation.

SUMMERFIELD GROUP (formally introduced by Coates, 1968, as a formation; raised to group status here)

The name Summerfield volcanics was used on a map by Coates (1965, p. 29) for the Trappean Series of Sawkins (1869) and the Upper Tuffaceous Series of Williams (1959a, b), but without formal definition. In 1968, Coates formally defined the Summerfield Formation with a type locality 'along the road from Savoy through Summerfield to Beckford Kraal'. Coates considered that the Summerfield Formation embraced the whole succession exposed between the top of the Guinea Corn Formation and the base of the Yellow Limestone Group. Coates (1968) was able to map two separate horizons within the Summerfield Formation, a 'lower part, approximately 500 feet thick, consists dominantly of regularly bedded 6″ to 2′ units of volcanic grits and sandstones' and an upper part of 'bedded volcanic conglomerates alternating with grits and sandstones'.

Robinson and Lewis (*in* Robinson *et al*., 1972) recognised an additional 'member' in the Summerfield Formation. This was described as a 'massive hornblende pumice tuff' with 'flattened devitrified pumice lenticles and lineated hornblende needles', and was well-exposed below James Hill, on the road from Johns Hall to Frankfield.

Roobol (1976) published the succession through the Summerfield Formation exposed along the road from Guinea Corn to Johns Hall. He recognised a lower interval of bedded marine sandstones and an upper unit of interbedded conglomerates and sandstones with two ignimbrite horizons (the hornblende pumice tuff of Robinson and Lewis *in* Robinson *et al*., 1972). The uppermost conglomerate was succeeded by the Guys Hill 'Member' of the Yellow Limestone. Mitchell and Blissett (1999) recognised that Roobol's succession was incorrect due to the structural complexity of the rocks along this road and that only one ignimbrite horizon was present. Furthermore, the uppermost unit in the area is the ignimbrite, and the succeeding Yellow Limestone Group has a basal development of the Stettin Formation followed by the Guys Hill Formation.

While the Summerfield Formation represents a well-defined lithostratigraphic unit, it is capable of subdivision into regionally mappable lithostratigraphic units to which formational status is applied here. These units are invaluable in determining the structure of the Central Inlier and have proved mappable on both the northern and southern flanks of the 'anticlinal' structure representing the Central Inlier. We therefore raise the rank of the Summerfield Formation to that of Group and define four formations (Green River, Peckham, Mahoe River and Waterworks formations) within the Summerfield Group.

GREEN RIVER FORMATION (new name)

Introduction. The lowest bedded sandstone unit in the Summerfield Group consists of thinly bedded sandstones and is called the Green River Formation here.

History. Coates (1968) recognised that the lower part of the Summerfield Formation was characterised by thinly bedded, graded sandstone units. He mapped this in the eastern part of the inlier. We have consistently been able to map this unit across the Central Inlier and give the unit formational status here.

Former names. Lower horizon of the Summerfield Formation (Coates, 1968); unit S1 of Mitchell and Blissett (1999); unit S1 of Mitchell (2000).

Description. Thinly bedded coarse-, medium- and fine-grained sandstones interbedded with mudrocks. The sandstones range in thickness from a few cm to 40 cm, rarely thicker sandstones may be present, but this is unusual. The sandstones may show a variety of sedimentary structures: most show well-developed normal grading, while their upper parts may show parallel lamination, sole marks are largely absent, bioturbation is very rare or absent. The base of the formation is taken at the top of the last limestone bed of the Guinea Corn Formation. Consequently, the base of the unit may be represented by either a sandstone bed or a mudstone bed.

Type Locality. The type locality is in the cliffs adjacent to the road and in the bed of the Rio Minho immediately adjacent to the confluence between the Green River and the Rio Minho, to the east of Frankfield. A graphic log showing the succession in the type section is shown in Figure 6.

Other Sections. The formation is also well-exposed at several points along the Rio Minho between Guinea Corn and Cabbage Hill, and immediately south of the Rio Minho on the road NW of Danks-Savoy.

Thickness. The formation is about 60 m thick in the vicinity of Guinea Corn (Mitchell and Blissett, 1999).

Relationship with other units. The unit rests with a sharp abrupt contact on the Guinea Corn Formation.

PECKHAM FORMATION (new name)

Introduction. The name Peckham Formation is introduced for thickly bedded massive sandstones that occur between the thinly bedded sandstones of the Green River Formation and the conglomerates of the Mahoe River Formation.

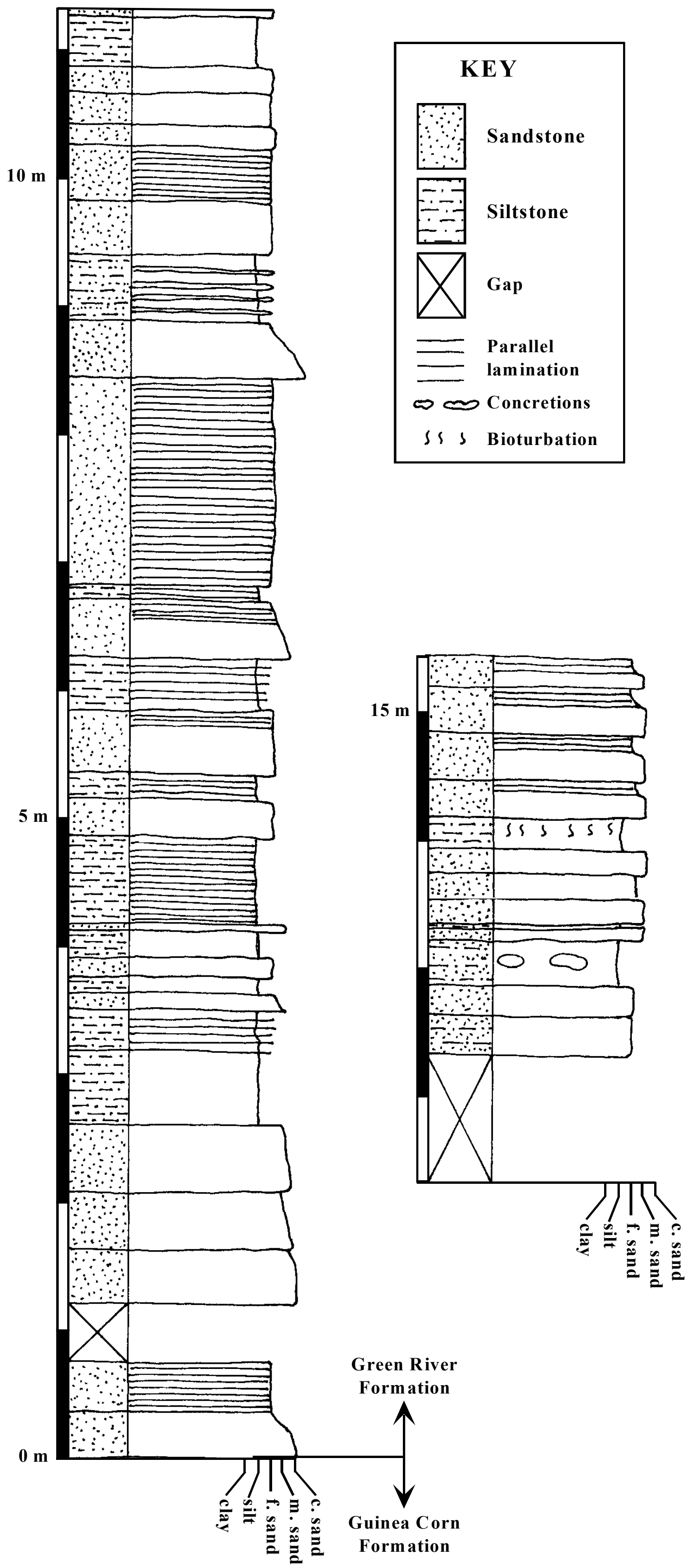

Figure 6. Graphic log through the type locality of the Green River Formation in the Rio Minho just upstream of its confluence with the Green River.

Former names. Unit S2 of Mitchell and Blissett (1999) and Mitchell (2000).

Description. Thick, predominantly massive coarse- and medium-grained sandstones interbedded with mudstones. The sandstones are typically between 1 m and 3 m thick with thin mudstone laminae, many of which have been disrupted by soft sediment deformation. The base of the formation is taken at the change from thinly bedded to thickly bedded sandstones. This change is remarkably dramatic in all sections showing the boundary, and suggests a significant environmental change. This significant lithological change makes the Green River and Peckham formations easily distinguishable, even in very small exposures.

Type Locality. In the small river that runs under the bridge at Peckham on the road between Guinea Corn and Johns Hall. The parastratotype is in the Rio Minho in the bend at Cabbage Hill. Both sections show well-developed thick sandstones with intervening mudrocks. Sedimentary structures are clearly visible in the Rio Minho sections (Figure 7).

Other Sections. Other sections showing this formation are on the road from Summerfield to Danks-Savoy where the sandstones contain horizontal trace fossils assignable to the ichnotaxon *Gigantoplanolites* isp. (R. K. Pickerill, person. commun., 1999).

Thickness. The formation is about 150 m thick in the vicinity of Guinea Corn (Mitchell and Blissett, 1999).

Relationship with other units. The Peckham Formation rests with a sharp contact on the Green River Formation. To the east the formation thins out, and it was not recognised by Coates (1964, 1965, 1968) in the area around Crawle River.

MAHOE RIVER FORMATION (new name)

Introduction. The Mahoe River Formation is introduced for the conglomerates and interbedded conglomerates and sandstones which comprise the upper part of the Summerfield Group throughout the Central Inlier.

Former names. Upper horizon of the Summerfield Formation (Coates, 1968); unit S3 of Mitchell and Blissett (1999); unit S3 of Mitchell (2000).

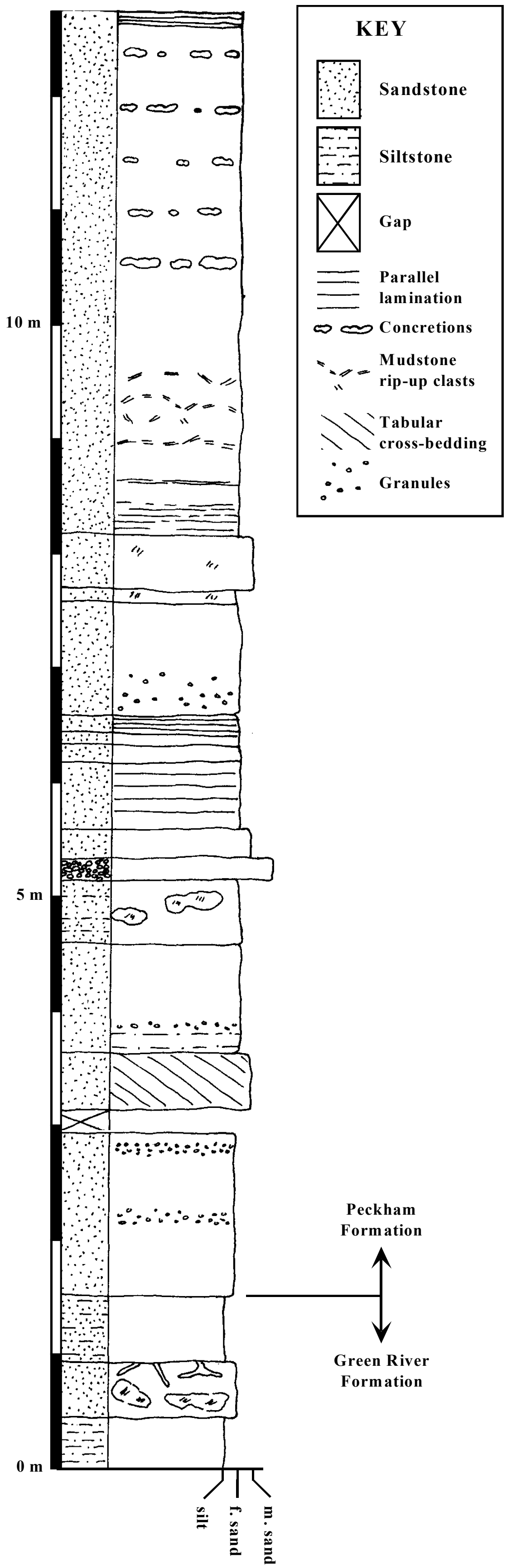

Figure 7. Graphic log of the parastratotype of the Peckham Formation in the Rio Minho at Cabbage Hill.

Description. Interbedded matrix and clast supported conglomerates alternating with massive sandstone beds. Mudstones are largely absent. Clasts rounded, and composed almost exclusively of andesite, very rarely other clasts are encountered, but are extremely rare. The base of the formation is taken at the lowest well-defined band of conglomerate. Isolated large clasts (up to boulder grain size) are present in the Peckham Formation, however they are always rare. The Mahoe River Formation is easily distinguished by the abundance of conglomerates and rarity of mudrocks.

Type Locality. Exposures along the road from Guinea Corn to Johns Hall above the bridge at Peckham (Fig. 2). The type locality shows extensive exposures of conglomerates. A graphic log is shown in Figure 8.

Other localities. The formation is extensively exposed on roads and in rivers across the Central Inlier (Coates, 1968; Robinson and Lewis *in* Robinson *et al*., 1972; Mitchell, 2000).

Thickness. The formation is about 210 m thick in the vicinity of Guinea Corn (Mitchell and Blissett, 1999).

Relationship with other units. The base of the formation is taken at the first band of conglomerate. The lower part of the formation is composed of interbedded sandstones and conglomerates, and the base has proved easy to map across the inlier.

WATERWORKS (TUFF) FORMATION (new name)

Introduction. The Waterworks Formation is introduced for the ignimbrite at the top of the Summerfield Formation.

Former names. Pumiceous tuff of Robinson and Lewis (*in* Robinson *et al*., 1972), Roobol (1976); unit S4 of Mitchell and Blissett (1999).

Description. Hornblende pumice ignimbrites with fragments of red or brown mudrocks. Base represented by a variably thick ?basal surge deposit. The base of the formation is taken at the base of the surge deposits (no ash-fall deposits have been recognised to date).

Type Locality. In the bank of the main Guinea Corn to Johns Hall road and on the small track to Waterworks, to the north of Guinea Corn (Fig. 2).

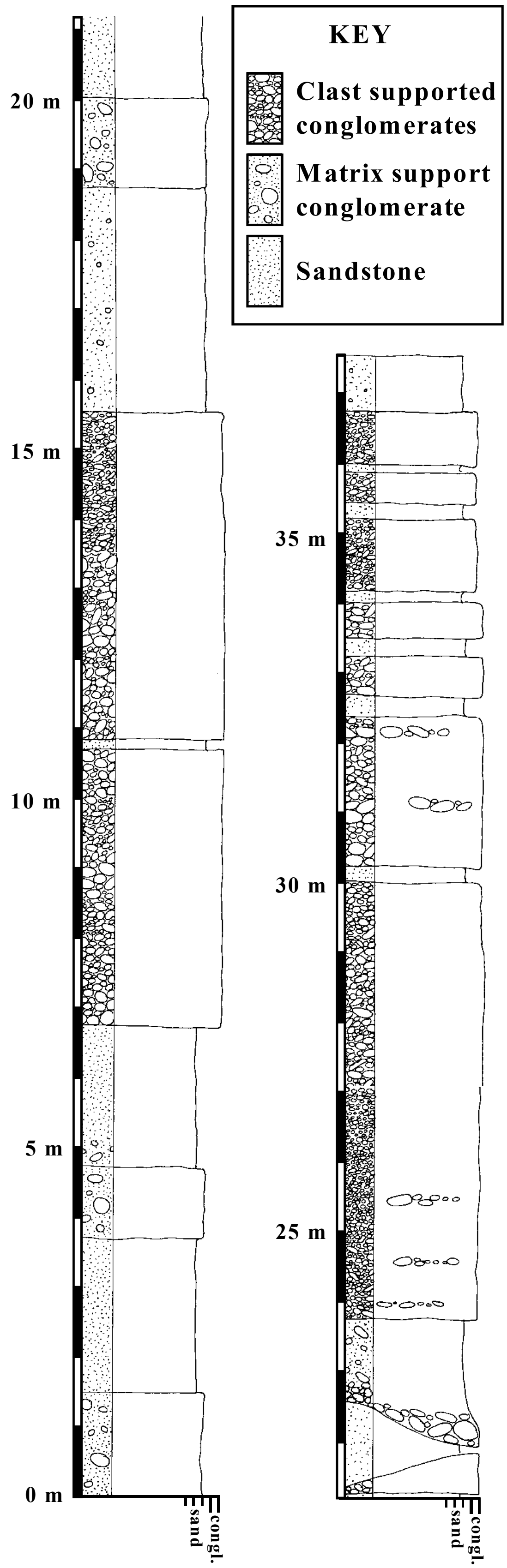

Figure 8. Graphic log of the type locality of the Mahoe River Formation on the road between Guiena Corn and Johns Hall (above the gorge of the Mahoe River).

Other localities. The Waterworks Formation is extensively exposed around the town of Johns Hall (Mitchell and Blissett, 1999), and can also be seen on the southern side of the Central Inlier to the west of Thompson Town (Robinson and Lewis *in* Robinson *et al*., 1972).

Thickness. Mitchell and Blissett (1999) estimated a minimum thickness of about 75 m for the formation in the vicinity of Johns Hall.

Relationship with other units. The Waterworks Formation rests sharply on the top of the Mahoe River Formation. The top of the formation is truncated by the angular unconformity at the base of the Yellow Limestone Group.

Discussion. Ahmad *et al*. (1988) obtained a fission track date of 55.3 ± 2.8 Ma from apatites separated from the ignimbrite (i.e., Waterworks Formation) at Johns Hall. This indicates the Thanetian Stage of the Late Paleocene (Breggren *et al*., 1995). However, more dates are required to confirm this, particularly since Summerfield-like sandstones occur interbedded with Late Cretaceous limestones in the upper part of the Guinea Corn Formation (Roobol, 1976; Mitchell, 1999).

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