Broughton Bank (Hasty Bank)

[NZ 568 035]

Introduction

Broughton Bank (often referred to in the literature as 'Hasty Bank'; (Figure 3.22) and (Figure 3.23)) has yielded an extensive flora of 87 species, and is important for the number of reproductive organs that are associated with the more common shoots and leaves. Cuticles are well preserved here, providing important evidence for linking different plant organs together, which in turn helps in the development of part- or whole-plant reconstructions.

Alum workers first made the exposure at Broughton Bank during the last century, but it was not until the 1920s that Hamshaw Thomas and Maurice Black discovered it to be an important plant fossil locality. It was longer still before Mabel Kendall (1952) published the first record of plant fossils found here, including descriptions of fragments of conifer foliage. Tom Harris was actively collecting from here for some time in the 1940s and 1950s, and some specimens were published by him (Harris, 1950, 1952b, 1953). However, it was not until he published his main series of monographs on the Yorkshire Jurassic floras (Harris, 1961a, 1964, 1969, 1979a; Harris *et al.*, 1974) that he documented any of his finds from here. Hill and van Konijnenburg-van Cittert (1973) and Hill (1974) gave lists of the taxa then known to occur at Broughton Bank. In recent years, van Konijnenburg-van Cittert (1975a,b, 1989, 1996) has carried out research on the flora here, especially on the ferns and their spores. Spicer and Hill (1979) investigated the plant palaeoecology of the site in an attempt to establish what controlled the variations in the composition of the flora across the site.

Description

Stratigraphy

The exposure at Broughton Bank extends over 100 m and is up to 7 m thick. The plant-bearing rocks are at the base of the Saltwick Formation and are, therefore, of early Aalenian age. Here at Broughton Bank the Saltwick Formation was deposited in an eroded depression of the lower Aalenian Dogger Shales.

Harris, in his unpublished notebooks, identified three plant beds here, shown in (Figure 3.24) as A–C. The basal mudstones overlie marine shales containing animal fossils and marine algae, which suggest the region was sometimes flooded by sea water during this period of deposition. Above the mudstones is a siltstone layer that Hill (1974) suggested was the slow part of a river channel. A sandstone-filled erosion channel immediately to the south-east of the siltstone is probably the main river channel. The top dark clay layer is relatively thin and narrow, and lenticular sandstones that form the cliffs at the top of the bank cover the fossiliferous beds.

There is also a leaf coal above the capping sandstone that has yielded abundant plant fragments (mostly cuticles). The flora of this leaf coal includes abundant bennetitaleans, and the conifer *Marskea jurassica* is also present. It is, therefore, rather different from the main Broughton Bank flora below.

Palaeobotany

This locality has a large and important flora of about 90 species (Table 3.1). For seven species, it is the type locality: Osmundopsis hillii (Figure 3.25), Pteroma thomasii, Androstrobus prisma, Hastystrobus muirii, Paracycas cteis, Sphenobaiera gyron and Palissya harrisii.

All the major groups of Yorkshire Jurassic plants, except the lycopsida, have been found here and most are represented by well-preserved specimens yielding good cuticles and/or spores. The most common species are pteridophytes, the *Caytonia* leaf *Sagenopteris colpodes*, cycads and the seed fern *Pachypteris papillosa*. There are only small numbers of bennettites, ginkgos and conifers. Because this is a relatively new locality, very few type species have been described

from it. Harris described his *Cycadites cteis* from here, and van Konijnenburg-van Cittert (1968, 1975a) described both the small cycad cone *Androstrobus major*, and the marattialean fern *Angiopteris blackii*, which has been suggested to be intermediate between older genera and living *Angiopteris*.

Hill (1987) also studied *Angiopteris blackii* from Broughton Bank and showed it to have localized dead areas, most probably caused by a rust fungus. The ferns also showed tilting of sporangia in about one-third of the specimens, which Hill interpreted as being produced by currents acting on the waterlogged, somewhat decayed material, before or during the early stages of burial. Similar post-mortem changes occurred in the related fern *Marattia anglica* (Figure 3.26). Both species are more likely to have been susceptible to post-mortem changes than to have decayed during long-distance transportation.

Van Konijnenburg-van Cittert (1975b, 1989) also used specimens of *Coniopteris murrayana*, *Dicksonia kendalliae* and *Marattia anglica* from here in her studies of in-situ spores of these species.

Muir (1964) studied the palynology of this locality. She identified four ecological groups of palynomorphs, representing species that were living on the lowland swamps, in the lowlands but not in the swampy areas, in the hinterland, and growing both in the hinterland and in the drier lowland areas.

Interpretation

This is a very rich assemblage of nearly 90 species, with many ferns and cycads, which makes it different from that of the Saltwick Formation on the coast. *Equisetum columnare* occurs *in situ* here, in contrast to its obviously drifted nature at most other localities.

The presence of relatively large and well-preserved pieces of *Pachypteris lanceolata*, in association with the male fructification *Pteroma thomasii*, suggests that they were preserved close to their original position of growth. Harris suggested that *Pachypteris* grew in a salt marsh environment at sea level. The consistent association of *Pachypteris*, *Cladophlebis harrisii* and the cycad *Nilssonia kendalliae* with the micro-fossils *Tasmanites* and dinoflagellate cysts strengthens this idea and suggests that all were early colonizers of channel banks close to the sea. In contrast, the fragmentary nature of the conifers *Marskea jurassica* and *Bilsdalea dura* suggests that these species lived some distance inland.

As at Roseberry Topping, the pteridosperm leaf *Pachypteris lanceolata* is closely associated here with the pollen organ *Pteroma thomasii* (for which this is the type locality) and both are now usually attributed to the same parent plant (Harris, 1964). Harris (1983) also used specimens from here in his interpretation of *P. papillosa* as a large shrub with succulent young stems, which formed mangrove-like thickets along tidal rivers.

Broughton Bank has also played an important role in the study of Mesozoic cycads. The male cone *Hastystrobus muirii* is as yet known only from two specimens from this site (van Konijnenburg-van Cittert, 1971). It is a small cone, about 20 mm long and 7 mm across, with spirally arranged microphylls whose entire lower surface was probably covered with sporangia. Its pollen compares closely to the common dispersed pollen genus *Eucommiidites troedonii* Erdtman. Pollen referable to this genus have also been found in the micropyles of the gymnosperm seeds *Spermatites* and *Allicospermum*. Van Konijnenburg-van Cittert suggested that *Hastystrobus* belongs to the cycads because this is the only group that has the whole lower surfaces of its micosporophylls covered with sporangia.

Although not as diverse as in some of the other Yorkshire Jurassic sites, there have been some important bennettite discoveries at Broughton Bank. Most notable has been some finely preserved examples of the female flower *Williamsonia hildae*, which have revealed a number of crucial features of the peduncle and the perianth scales (Harris, 1969).

Conifers are also not particularly rich at this site, but it is the best-known locality for *Brachyphyllum crucis*. Harris (1979a) showed that many of these have undamaged apices where the leaves become progressively shorter, suggesting that the shoots had been shed deciduously. There are also good examples of juvenile shoots of *Geinitzia*, suggesting that the

mature tree produced the occasional juvenile shoot, as happens in some modern conifers, such as *Juniperus sabina*. There are abundant shoots of *Elatides thomasii*, sometimes with attached male or female cones. Fragments of *Marskea jurassica* and *Bilsdalea dura* are also found here.

This is the only site where the Yorkshire Jurassic flora has been the subject of a multivariate statistical analysis. Quantitative data on species abundance were analysed by Spicer and Hill (1979) using 'Correspondence Analysis' and 'Principal Component Analysis'. The main component of the pattern of distribution was apparently controlled by lithology, with two main assemblages being recognized.

- 1. The Siltstone Assemblage characterized by Marattia anglica, Nilssonnia syllis and Nilssoniopteris vittata.
- 2. The Claystone Assemblage characterized by Clathropteris obovata, Cladophlebis harrisii, Nilssonia tenuinervis, Pseudoctenis lanei, Ctenozamites cycadea, Sbhenobaiera gyron, Brachyphyllum crucis, B. mamillare and Hirmeriella sp..

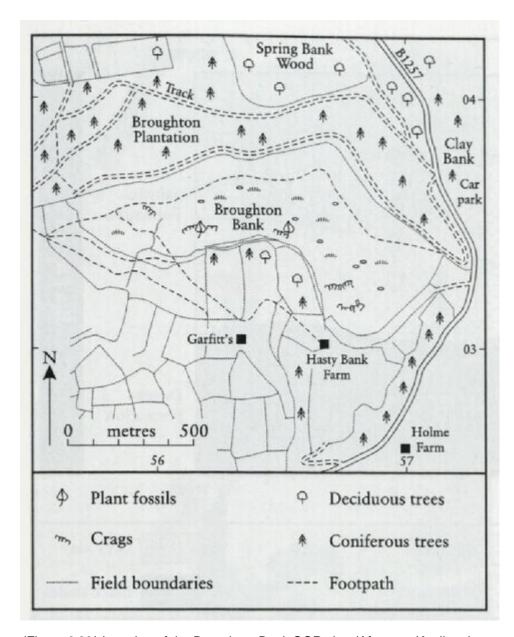
Spicer and Hill also recognized associations between biologically related but physically separated organs. Correspondence Analysis revealed that many of the components of the 'Williamsonia hildae' plant, as reconstructed by Harris (1969), were found close to one another (i.e. the leaf Ptilophyllum pectinoides, the perianth scales Cycadolepis hypene, the male flowers Weltrithia whitbiensis, and the stem Bucklandia pustulosa). Only the female flower (Williamsonia hildae) did not occur in this association, but this flower is always rare as a fossil.

In view of the abundance, diversity and fine preservation of the plant fossils found here, it ks perhaps surprising that there has been so little published work on the flora. There is clearly considerable scope for further investigation of this important flora.

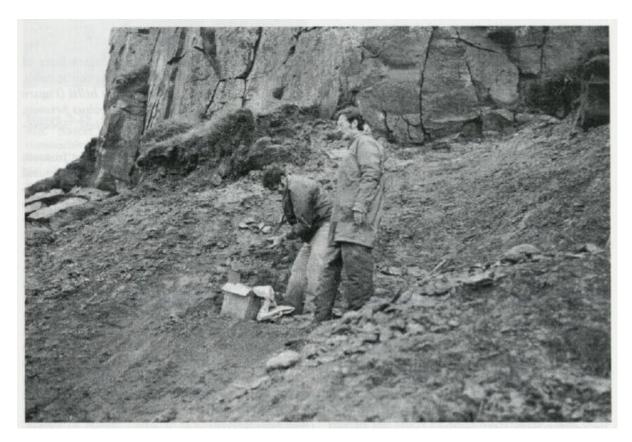
Conclusions

Broughton Bank is an important locality for the Yorkshire Jurassic flora, which has yielded a large number of species of many groups of plant fossils. Cuticles and spores are well preserved, which makes the specimens valuable research material. It has already proved of great importance in the study of fossil cycads and of the extinct group of plants called the corystosperms. It is a site of undoubted potential for helping to improve the understanding of the plant life that was growing in Britain 170 Ma ago.

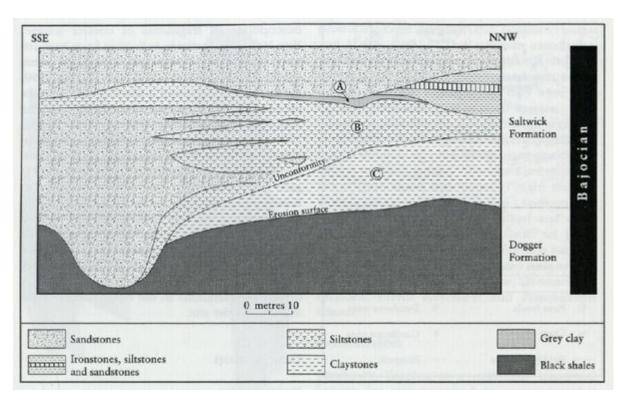
References



(Figure 3.22) Location of the Broughton Bank GCR site. (After van Konijnenburg-van Cittert and Morgans, 1999.)



(Figure 3.23) Collecting from the plant bed at Broughton Bank. (Photo: J.H.A. van Konijnenburg-van Cittert.)



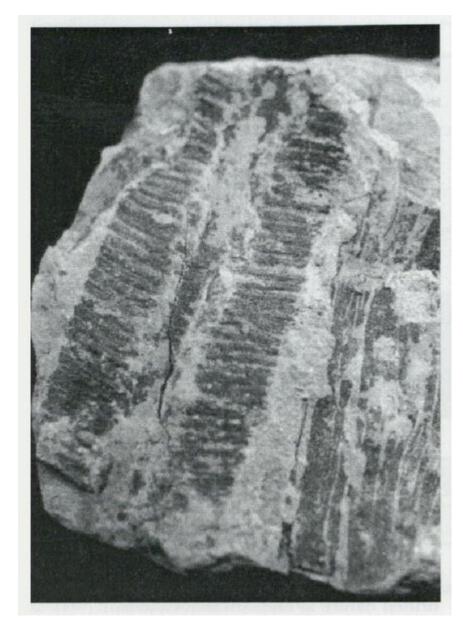
(Figure 3.24) Schematic section of the exposure at Broughton Bank, showing the three main plants beds (A–C). Redrawn from Spicer and Hill (1979).

	the Welseline Jurasia GCE sizes. These records have been				
greated from published accounts, largely	to Name (1964), 1964, 1969, 1979a,b, Santo-et al., 1974), scobarg-ran Giton (1975), Spinor and ISE (1979), van	PERCOPSERS - contd.		CWINDSHIP - contd	
contractions the Chiese (1977), 1975a h.	1078, 1961, 1967, 1989), and non-Kompanishing ran Coton	Packages broduling Storie (I) manipports Witco and Years	X +	A primer Thomas and State	
nd Stregara (1900), Strein profuted Sold	notice to the Natural Wasters Managem (London), and from	21 martigates Wilson and Years	and the same of the same	A prises Thomas and Numb A sant Thomas	The state of the s
nursum suft at anothedro printing	and the National Moseum and Gallery, Cardolf. Seconds	purposityfian regress L and S. Shanaca hitchise (Millips Thomas			
serves to fall remade the boundaries of	the stex have been centred, but these over which there is	Statement of Section 1 Section 1		A squ. 8 of Vitoria. Brownia grandle Corrollora	
ceter stoute have been included.		Allufor-rolls (Millips) Backwala Auditopieris organis (L. and N.) Tomis	4.4.4.4.4	R seamont Thomas and Harris	
White-Salesch	11. Congless Wile	Alumatita anglica (Teoreac) Fluris		A sp. Defraigns outpers Name	
. Reservick Day	SJ. Stuffy News	Algorithe profess (Phoness) Floris Algorithe Profess (Company) Floris Algorithms professor (Compilement) February		A properties from A sector from	
Roscheny Topping		Commendation (editor on A. rose C.		Pl. moles thanks the market market are \$ mark!	
- Broughoos Bank (Harty Starte)	Nor to enabels:	10 of Alexagebona Harris		Principal compact (Philipp) Broom	
Hillionae Nah	* record for the site;	Communiques heller van K. man C. (i) of placosphoral Humb. (ii) annei (Hauberda) Humb. Habelparite (Hauberda) Humb. Plakosphoral (Humb. P. Janobart (Humb.) Schooppert) Humb. P. Janobart (Humb.) Schooppert)			
Haphum Wyler Soston Head	the only record for Yarlahire; spe boulte for the species;	P. Assisted Districts Schools		X of belowler X recolors Starts	* *
Brase Cliff (Bobbs Hood's But)	Of the only record for the species,				
Mary Woler	a in the Solution Red	F woodwards (activities fallowards the texts (Fred, belook		X detailable (Millips) for hongroup	
is Red Cliff (Goldonye Rey Career No.		Spherophera metageresado Floria Stanlagenesi graturas Franced		X desidence femant X shareast floring	
		Starthgeorie gottom: Personal Startine alterioristas (Brongerian) Econor	3 · · · · · · · · · · · · · · · · · · ·	N up. 4 of Harris	
and the second second second		E promope (Prod) Corbon		K sp. Exiliates	
OPENTA		T showard Flattic		Paradyceuses States Paradyceus Acresus States	
hallotte ansonar (f., and ft.) Harris hallomenous Harris		T arithment (hospier) bread		P. Savet Thursday	
Symposylena Plants		GYMNOSPERMORITTA		P. Decisio Harris P. officer Harris	
INFINITS		CAPROPRIAL		Sterogenera manua Humin 3 milinda Humin	
INCIDES minipal depend (folige) there		Amphinisperson puller Facts Consequence order (Thomas) States		E sollista Harris	
		Contrade Name Consciole Name		5 adherent (frogers) form MONOTIFICALIS	
Manhate Broughtest		C sp. Consequence Association Floreign		Assessments advance (Relian Sound)	
Here States Acrosis Fieldige		Capture Anabelli Turre Captures (Terras		A shoreast floore	
salumates (horrorous) (Soliamport) Halls:				Amendments of take Torin A doctor thorn	
athorse Delivere	*	Sagonaprovia colpsular Starta			
properties		Supreport rejeals tions 5 philips: (Incognies) (Section PSIASSOCIES		R pastalosa flurito R sp. R of Huma	* * * * * *
doubles delivered it and fil.		Chronic anothe Higgsto			
		C Baselinear Tributation		ic Audior Huma	
season Market san Clause		C rendit Harts C of Streenhand Harts		C Represe Principal	
glicter van Climen dates (Aumanti Thoris Inglicites alterationale Turnstanina Roberts		C solvicately (Millips) World	7 10	C galendone Flants	
photo altradenso Turunuma funna		C anhibited (Millips) Ward Orenameles (staales (Intges) Arbeid C Indeedys (sorkesty) Nations			1 1
		C manufacture flores		C Myserial Starts C to sex of 100 and	
efforments (f. and ft.) Bringster error van Citory		C regulations Hursi C resoluted Yelepana			
reparts should finds parts belon there				X prints flure X celabe (Mongolet) Flore	1 11
ports tolla forts represe (futnette forest)	The second secon	P pagetter (Texas and Boar) thank		Ottownsky angles formed from	
regress (Nationally) Neward eclinic (News) Chem, Strand Rev.		Pleased Remark State	* * *	Otrupalite anglise (Screen) Harris O Analol (L. and (L.) Brongream	
		CV-shalls			
regional Harts propiete (Brogeles) Brogeles				O promises (Police Tolice O professo (antendo) Square	: ::.: :::.
marker of, and H.; Harris	:: ' : . : : : :	Altergentum op Andreambas Ballest (10) A. Marin State A. Marin State	1	O propleme (antendre) hopers O deplembel (banks O mangitudes haperis	
	1 1 4 4 4 4 7 4 8 10 11 11		1 1 3 1 3 1 7 1 7 1 1 11 11		
NAME AND ADDRESS OF THE PARTY O	The state of the s				
agentifeles Phillips		CERTAIN COMMENT			
savalida Religa	1,,,,,	CERLAGORISCH - sound framanistic abolitomic floris and Miles			
aratioles Publics seem North September Services September Services (Mallian	1.11	Association of African Floring and Affiles Appropriate content Floring Solventing and Philipped Floring			
orafide Relige sees Sorie square Herm makes Extended Relige		Association of African Floring and Affiles Appropriate content Floring Solventing and Philipped Floring			
profite Police one: Serie separat Here marker Earthropy Police separat Here	1.11	Incommunity philippes there and Miller Laprainhar comm Harris Substitut of Miller Harris Substitut mether Dellips Harris Substitut mether Dertical Miller Philips	·		
mathdes Politics seem Harris approved Harris marker Santinetry Politics seemed Harris white for condition that and har		Incommittee under Herite and Miller Approximate concernitions Solventee statemen (Phillips) Herite Splomettee maintain Herite and Miller PENSIS Statementee shielder Carolines			
analistics Politics control States appeared Harms market Eurobenity Politics contact Harms applylithms produces Harms and Harm season Harms control Harms		Insurantus philipeness flores and Willes appropriate passers flores balantus stentenes (Philippi flores philipera matries flores and Milles PASSASS Amenorites philips (anothers through flores matrix famile) if many with plantum and come in the passasses of the passasses in the passasses of the passasses in the passasses of the passasses in the passasses of the passasses the passasses passasses the passasses passasses the passasses passasses the passasses passasses the passasses passasses the pa	· ·		
methods Publish meet Samis meet Samis meet Samis meeter Samish meeter me		Insurantulus philiperasi Flores and Miller Lapriantulus passer Flores Laborato etimente (Philipe Haris philiperasi mathat Haris pol Miller PLNSER Associato philipe Caroline Stationalin philipe Stationalin philipe S	*		
profiles Philips men Stario represed Shares matter Schichel (Millige small Shario shares Sh		femansendus pitolenessi tilanis soli Milles Laptusimises sassem tilanis Laptusimises sassem tilanis Laptusimises sassem tilanis Laptusimises sassem tilanis PENGES Temansensi pitolipe Carolines tilanispitolises ovacio tessado di errora video standardi adale como di errora video standardi a	· ·	-	
medicine Publics ment Terris ment Terris ment Terris menter Excitoris (Publics menter Excitoris) (Publics menter Excitoris) menter Excitoris menter Excitoris publican operation Terris and Ren menter Terris menter		femansendus pitolenessi tilanis soli Milles Laptusimises sassem tilanis Laptusimises sassem tilanis Laptusimises sassem tilanis Laptusimises sassem tilanis PENGES Temansensi pitolipe Carolines tilanispitolises ovacio tessado di errora video standardi adale como di errora video standardi a	· ·		
medicine Publics ment Terris ment Terris ment Terris menter Excitoris (Publics menter Excitoris) (Publics menter Excitoris) menter Excitoris menter Excitoris publican operation Terris and Ren menter Terris menter		Assumenhate philipheness Tierre and Willer Aspanishnica some Tillante and Willer Aspanishnica some Tillante and State and Stat	· ·		
medition finding means them appeared them means them means them means them means them are them pluglishes diseased them and them pluglishes them and them them pluglishes them are of them the		Assumentation philodeness (Torres and Waller Asparaturation and Waller Asparaturation and Waller Asparaturation and Waller Asparaturation of the Waller Asparaturation of the Waller Asparaturation philodeness (Waller Asparaturation philodeness of the Waller Asparaturation of the Waller Asparaturation of the Waller Asparaturation of the Waller Asparaturation of t			
medition findings medition findings meditions meditions meditions meditions findings philiphon considers forms and final meditions meditions meditions meditions meditions meditions findings meditions findings meditions findings findings findings findings meditions m		Amount-whe philoteops (time and Miller Approximate among them (approximate among the philoteops) (philoteops) (philoteops) (philoteops) (philoteops) (philoteops) (philoteops) (philoteops) (philoteops) (philoteops) (philoteops) (philoteops) (philoteops) (philoteops) (philoteops) (philoteops) (philoteops) (philoteops) (philoteops) (philoteops)			
medicine Nitripe mente Timin ingeneral Minimizer (Antilipe mente Timin ingeneral Minimizer) publishen genation filmen and filme mente Henric mente Genetic mente men		Amount-whee philipses have and Miller Amount-whee philipses have planted and an advantage and a second principal have philipses and the ph			
workfole Nichten were Terrin opposet Niere men Terrin opposet Niere men Terrin men Terrin plantine grantine Varma and Rea men Terrin plantine opposition Varma and Rea men Terrin plantine opposition Varma and Rea plantine opposition Varma and Rea plantine opposition Varma plantine opposition Varma men (Philippe Varma plantine Varhame) Varma plantine Varhame) Varma plantine Varhame) Varma plantine Varhame) plantine Varna men (Philippe Varna plantine)		Association of the Control of the Co			
evaluation Milijas maria Carlos (Milijas marias Carlos (Milijas) marias (Amounte-make philoteness (Irons and Maller Amounte-Maller) Marker (Amounte-Maller) Maller (Amounte-Mal			
evaluation Milijas maria Carlos (Milijas marias Carlos (Milijas) marias (Insurantulus enthrouse them and Wille- landers enthrouse Philips Bases (Manufact, enthrouse Philips Bases (Manufact, enthrouse Philips Bases (Manufact, enthrouse Philips Bases (Manufact, enthrouse Philips Philips Philips (Manufact, enthrouse Bases (Manufact, enthrouse Philips Philips Philips Philips (Manufact, enthrouse Philips Philips Philips (Manufact, enthrouse Philips Philips Philips Philips (Manufact, et al., et			
worklook Politique mate Carlon State mater Levinder (Politique materia Carlonder (Politique materia) (Politique materia) (Politique material (Pol		Assumediate printeriors: How are of Willer- toniant printeriors (Printeriors Willer) Assumed a service of Willer Assumed a service of William Assumed a serv			
worklook Nillyin water Statish marker Sandarish Nillyin marker Sandarish marker Sand		Assumed the production of the second of the selection states of the selection states of the second o			
worklook Polity's special laws of the control of th		Assumediate printeriors: How are of Willer- kanderiors centerior (William) faires photomers, method from an William photomers, method from an William and the second of the second of the formation of the second of the formation of the second of the formation of formatio			
workloch Politique was Electric was Electric was Electric was Electric was and Real was all the was al		Assumediate printeriors: How are of Willer- kanderiors centerior (William) faires photomers, method from an William photomers, method from an William and the second of the second of the formation of the second of the formation of the second of the formation of formatio			
worklich Nillige was Teach		Assumed and the control of the control of the colored systems of the			
workloch frühjes were Erech were Erech were Lieber we		Assumed and the second of the			
workloch frühjes were Erech were Erech were Lieber we		Assumed southern the control of the character			
workline Nillya- spectra Harm. The property Harm south from and harm matter of Landau for Harm and harm matter of Landau for Harm and harm matter Harm. The property Harm of Harm and Harm of Market Harm of Harm of Harm of Market Harm of Landau for the Landau for the Landau for the Landau for the Landau for the Landau for Landau for Land		Assumediate printerment linear and effects included and an extra printerment linear and effects and ef			
worklook. Polity's species of the control of the co		Assumediate printerment linear and effects included and an extra printerment linear and effects and ef			
worklook Nillyn special and the second seco		Assumediate printerment (term and Willer- dealertes) entermed ("Miller dealertes) entermed ("Miller dealertes) photometric street ("Miller dealertes) photometric dealertes) photometric dealertes photom			
worklose Nikipe mention Carlose Hilliam manus Hilliam		Assumed between the control of the behavior of			
worklook Nillyin mention Enriched Nilly Interview mention Enriched N		Assumediate plateforms (from an off filter facilities) and the control of the con			
workbox Nidge ment from manuface decidented (Nidge mentione (Nidg		Assumediate printeriors (from an official feature) and the colored printerior (from per filling) faires plants and colored printeriors (from per filling) faires plants (from per filling) faires plants (from per filling) from the colored printerior (from per filling) from the colored			
workhow findings menter for a few menter few menter for a		Assumediate printeriors (time and different industrial printerior). The control of the control o			
workhow. Noticy support the second se		Assumediate printerment linear and Willer- dealertess centerme (Print) and Willer- dealertess centerme (Print) and Willer- sphenous methods (Ferri, and Willer- dealertess (Ferri, and Willer- dealertess (Ferri, and Ferri, and Ferri, Bildeland and Ferri (Ferri, Bildeland and Ferri (Ferri Bildeland and Ferri Bildeland and Ferri Bildeland and Ferri Bildeland and Ferri Bildeland and Bildeland Bildeland and			
worklosh Nillys mater Landinel Millys material Landinel material		Assumediate printeriors (from an effective form) and the charlest printerior (from per filler) from plants (plants) and the charlest printerior (from per filler) and the plants (plants) and the charlest printerior (from per filler) and the per filler (from per filler) and the per filler (from per filler) and the per filler) and the per filler (from per filler) and the per filler) and the per filler (from per filler) and the per filler (from per filler) and the per filler) and the per filler (from per filler) and the per filler) and the per filler (from per filler) and the per filler) and the per filler (from per filler) and the per filler) an			
workbox Ridge misster for the section of the sectio		Assumediate printeriors (from an effective form) and the charlest printerior (from per filler) from plants (plants) and the charlest printerior (from per filler) and the plants (plants) and the charlest printerior (from per filler) and the per filler (from per filler) and the per filler (from per filler) and the per filler) and the per filler (from per filler) and the per filler) and the per filler (from per filler) and the per filler (from per filler) and the per filler) and the per filler (from per filler) and the per filler) and the per filler (from per filler) and the per filler) and the per filler (from per filler) and the per filler) an			
workhole Nidge ment from manuface (action) (Aritige mention (action) (Aritige mention (action) (Aritige mention) (action) (Aritige mention) (action) (action) (action) mention (action) (action) (action) mention (action) (action) (action) mention (action) mention (action) mention (action) mention (action) mention (action) mention mention (action) mention		Assumediate printervent (toler and effect features) and the classification contenting (toleran) and the classification contenting (toleran) and the classification contenting (toleran) and the classification (toleran) and the classi			
workshow findings sent from the control of the cont		Assumed registration of the control			
searchine. Notify: secretary for the control of religion members between the control members between the con		Assumed registration of the control			
workfolier Michiganism Francisco (1994) ministerio de Jacobier (Michiganism Francisco) ministerio francisco) ministerio francisco (Michiganism Francisco) ministerio francisco (Mich		Assumed registration of the control			
searchine. Bridge comments of the comments of		Installational professional from an of William Association processing Political States (Association) processing Political States (Association) processing Political States (Association) processing Political States (Association) professional States (Association) processing Political States (Association) processing Polit			
CONSTITUTED—month provided in Control of Con		Assumed registration of the control			

(Table 3.1) Records of plant fossils from the Yorkshire Jurassic GCR sites. These records have been gleaned from published accounts, largely by Harris (1961a, 1964, 1969, 1979a,b; Harris et al., 1974), Hill et al. (1985), Hill and van Konijnenburg-van Cittert (1973), Spicer and Hill (1979), van Konijnenburg-van Cittert (1971, 1975a,b, 1978, 1981, 1987, 1989), and van Konijnenburg-van Cittert and Morgans (1999), from archived field notes in the Natural History Museum (London), and from examining collections in that museum and the National Museum and Gallery Cardiff. Records known to fall outside the boundaries of the sites have been omitted, but those over which there is some doubt have been included.



(Figure 3.25) Osmundopsis hillii van Konijnenburg-van Cittert. This exceptionally rare fertile osmundalean fern is known only from Broughton Bank. Clusters of sporangia replace the normal sterile segments of the fern, which when found are known as Cladophlebis harrisii van Cittert. Natural History Museum, London, specimen V60955, Saltwick Formation, Broughton Bank, × 7.2. (From van Konijnenburg-van Cittert and Morgans, 1999; photo: J.H.A. van Konijnenburg-van Cittert.)



(Figure 3.26) Marattia anglica (Thomas) Harris. Pinnae and leaf fragments of this Marattiaceae fern are quite common at Broughton Bank, although a complete leaf has yet to be found. Pinnae can reach 300 mm in length and 15–25 mm in width and have entire margins. Veins depart perpendicularly from the midrib at about 10–12 per 10 mm. More than half the specimens found at Broughton Bank are fertile like the one illustrated here. The elongated synangia (fused clusters of sporangia) are about 5–7 mm across. Laboratory of Palaeobotany and Palynology, Utrecht, specimen S.2703, Saltwick Formation, Broughton Bank, × 1.8. (From van Konijnenburg-van Cittert and Morgans, 1999; photo: J.H.A. van Konijnenburg-van Cittert.)