Runswick Bay

[NZ 809 170]

Introduction

Three-dimensionally preserved plant fossils have been known from the Yorkshire Jurassic succession since Young and Bird (1822) described them from the ironstone seams (sideritic sandstone beds) in the cliff at Runswick Bay (Figure 3.15). Others were later labelled as coming from 'Saltwick' and 'Hawsker'. Interestingly, Chapman (1973) suggested that these plant fossils were found on stones collected from the beach for the Tyne Iron Company. This parallels the much earlier discovery and collecting of the Tertiary pyritized fruits and seeds on the beach at Sheppey (see Chapter 5). Other specimens were collected by Yates (1855), Williamson (1870) and Halle in 1910 (Hill *et al.*, 1985). Thomas (1915) described some of Yates's specimens in the Paris Museum as male flowers of *Williamsonia gigas*, later transferred by Harris (1969) to his new species *Weltrichia sol*. In this work Harris also stated that the beds from which the ironstone casts were collected are no longer known. The discovery in 1980 of an in-situ sideritic sandstone bed at Runswick Bay yielding three-dimensionally preserved plants was followed up by extensive collecting and subsequent publication of the flora by Hill *et al.* (1985) and Hill (1990).

There are over 30 species described from the site, of which about five are new, and many show previously unknown anatomical details. The most important of these are a new species of the cycad male cone *Androstrobus (A. balmez*), the bennetite 'flower' *Williamsonia gigas* and the male cone of the conifer *Elatides thomasii*.

Description

Stratigraphy

The stratigraphy at this site is summarized in (Figure 3.16). The main plant bed (the Wrack Hills plant bed) is within the Saltwick Formation (Aalenian). Hill *et al.* (1985) based their dating on the occurrence of abundant, relatively unfragmented, plant remains and fossils of the freshwater mussel *Unio*. They showed that the Saltwick Formation here overlies the Dogger Formation, which itself rests upon Lower Jurassic Alum Shale. Their excavations also led them to deduce that the fossil-bearing undercliff region had slipped from the main cliff some distance behind it.

Palaeobotany

There are two kinds of preservation of plant fossils at the Runswick locality. The more commonly found compressions are present in the basal claystones, but of far more importance are the three-dimensionally preserved organs in the sideritic sandstone. The uncompressed state of the plants must be due to early diagenetic carbonate precipitation.

Hill *et al.* (1985) described 31 species of plant fossils, representing what they thought to be 23 whole plant species in the sideritic sandstone (a more complete list of the 34 species that have been found at this site is given in (Table 3.1); see also (Figure 3.17) and (Figure 3.18). Cycad remains include leaves that have been tentatively referred to *Nilssonia tenuinervis*, male cones to *Androstrobus* and a fragment of the female cone *Beania*. The reproductive organs retain not only their original form, but also considerable amounts of structural and microscopic detail. Hill (1990) subsequently described the ultra-structure of in-situ pollen that he had extracted from his new species of male cycad cone *Androstrobus balmei*.

Hill *et al.* collected about 30 specimens of *Williamsonia gigas* (Figure 3.18) out of the 200 they saw. They appear to represent a developmental sequence from relatively small, immature specimens to larger, presumably more mature, specimens in which the gynoecium reaches up to 8 cm long and the base of the corona is up to 26 mm wide. This collection prompted a new restoration of a relatively mature 'flower' or 'fruit' in which the surface of the corona and mamilla is composed of modified interseminal scales that lie adpressed to the surface.

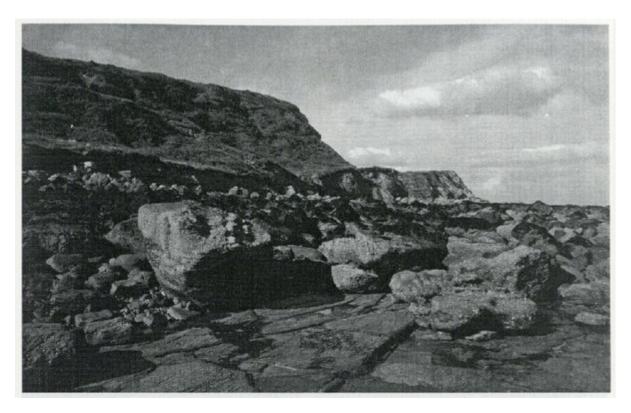
Interpretation

The species diversity at Runswick Bay is much less than at many of the other Yorkshire Jurassic sites, such as Broughton Bank and in the Gristhorpe Bed at Cayton Bay. Nevertheless, the three-dimensional preservation gives the specimens unique value for the Yorkshire Jurassic fossil material. This new locality does not fit with the site location described by Yates, nor is it certain whether it is the ironstone bed from where Williamson (1870) described *Williamsonia* and *Zamites gigas*. It may be that there is more than one ironstone band or that such plant fossil lenses were distributed throughout the area. In time, other localities might well be discovered, but for now the potential value of this site is immense.

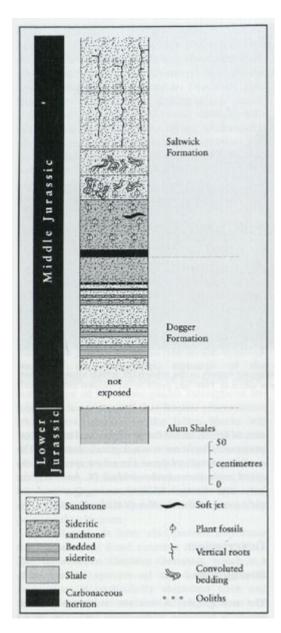
Conclusion

Runswick Bay is the most important Middle Jurassic site in Britain for three-dimensionally preserved plant fossils. These give much needed morphological information about the plants growing in this country about 170 Ma ago. Of especial interest is the evidence provided of the detailed structure of fructifications of the bennettitaleans, one of the most important plant groups of that time.

References



(Figure 3.15) Cliffs at Runswick Bay. The fossiliferous ironstone occurs in the undercliff, which appears to have slipped from the main cliff behind it. The photograph was taken in 1980 just prior to the excavations that were made there. (Photo: C.J. Cleal.)



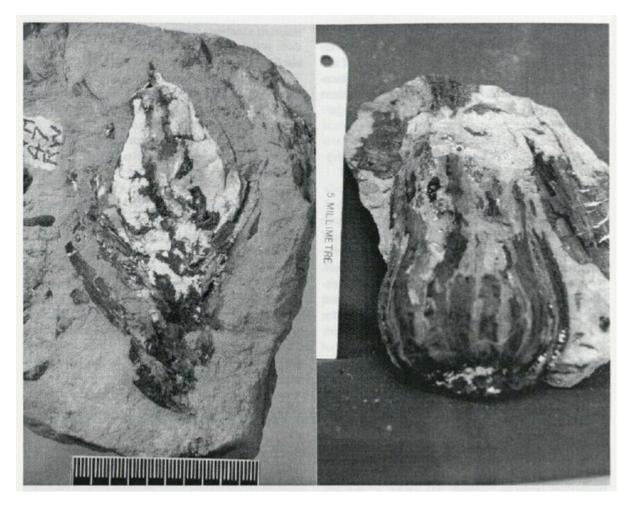
(Figure 3.16) The succession through the Dogger and Saltwick Formations at Runswick Bay, showing the position of the main plant beds. (After Hill et al., 1985.)

	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 3.17) Stem of the horsetail Equisetum beanii (Sunbury) Harris from Runswick Bay. The ruler is 130 mm long. (Photo: R. Williams.)



(Figure 3.18) The female Williamsonia flower (left, scale graduated in mm) and male Weltrichia flower (right, scale graduated in 5 mm intervals) of the Williamsonia gigas plants from Runswick Bay. The female flower is preserved in longitudinal section, the male flower shows the outer surface. (Photos: R. Williams.)