

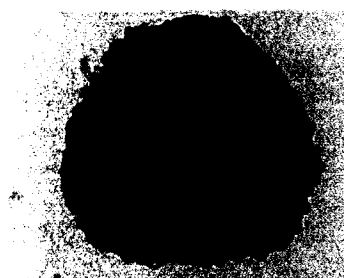


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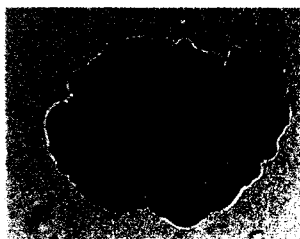
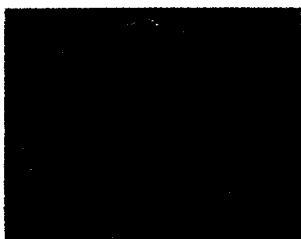
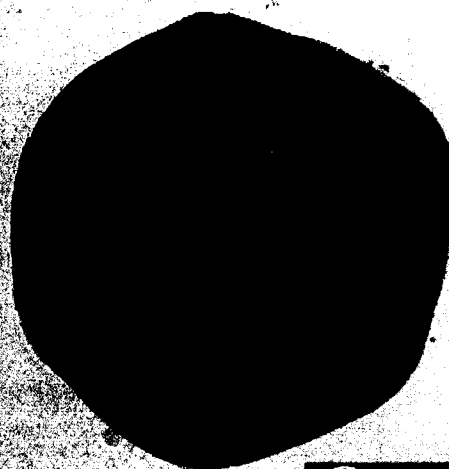
The 'Bernard Owens Collection': preliminary online database for the first phase

Internal Report IR/02/57



The 'Bernard Owens Collection' Late Palaeozoic spores and pollen

Gallery
Taxa
Search
Exit





BRITISH GEOLOGICAL SURVEY

INTERNAL REPORT IR/02/57

The 'Bernard Owens Collection': preliminary online database for the first phase

M H Stephenson

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Key words

Palynology Database Diagnostic
Key.

Bibliographical reference

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preliminary online database for
the first phase. *British
Geological Survey Internal
Report*, IR/02/57. 14pp.



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1 Introduction

This report outlines the contents and functionality of a computer database of photomicrographs and taxonomic information on taxa in the 'Bernard Owens Collection', produced as part of a capability study to develop online taxonomic information for professional palaeontologists. The work was completed under codes ESB 64900013 (Taxonomy Online) and ESB 91900082 (CRP Collections). The intention of the study is to demonstrate how an in-house computing system can be developed to provide the functions required by a professional user, and can be placed on the internet for outside users.

This report details the three primary functions of the database:

- ◆ to illustrate taxa;
- ◆ to make access to cross referenced textual and curatorial information easy;
- ◆ diagnostic function.

A copy of the database is included in the CD at the back of this report, this includes 7 taxa; the first phase of the project is to complete 30 taxa, listed in Appendix 1. Prints of the main elements of the database are shown in Appendix 2.

2 The 'Bernard Owens Collection'

The collection of single grain mounts which are illustrated is one of the most important collections of Carboniferous palynomorphs in the world, with over 145 taxa represented by many specimens (up to 25 specimens per taxon), showing a wide range of preservation and natural variation. The specimens were collected from localities world-wide, but are most closely associated with the UK and NW Europe. Many of the taxa illustrated and described are integral to the biozonation of the Carboniferous of NW Europe published by Clayton et al. (1977) and to earlier regional biozonations of smaller stratigraphical intervals within the UK (Owens et al., 1977; Smith & Butterworth, 1967; Neves et al., 1972; Owens & Burgess, 1965; Owens et al. 1977).

David Owens

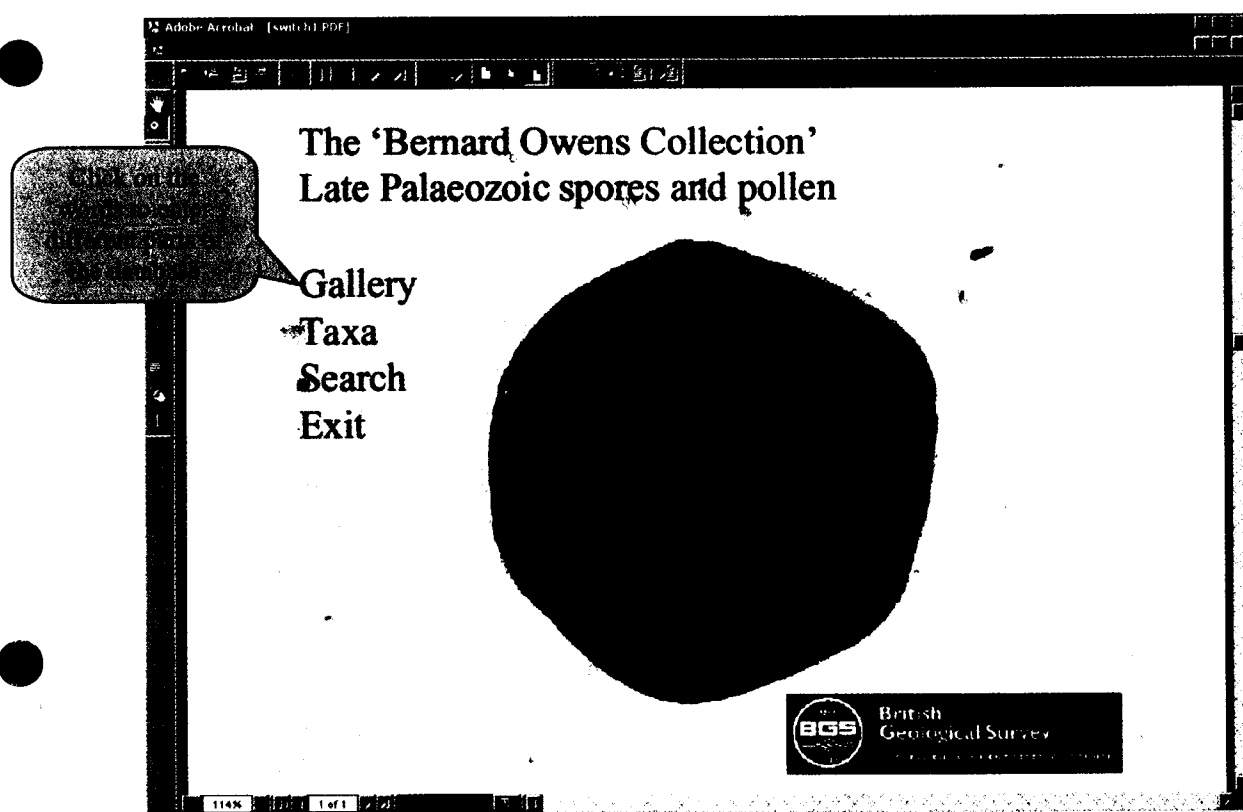
3 Guide to Use

After clicking on the 'Switch 1' icon,



the introductory window appears. Functions of the database can be accessed by clicking in the introductory window.

Fig. 1 Introductory window



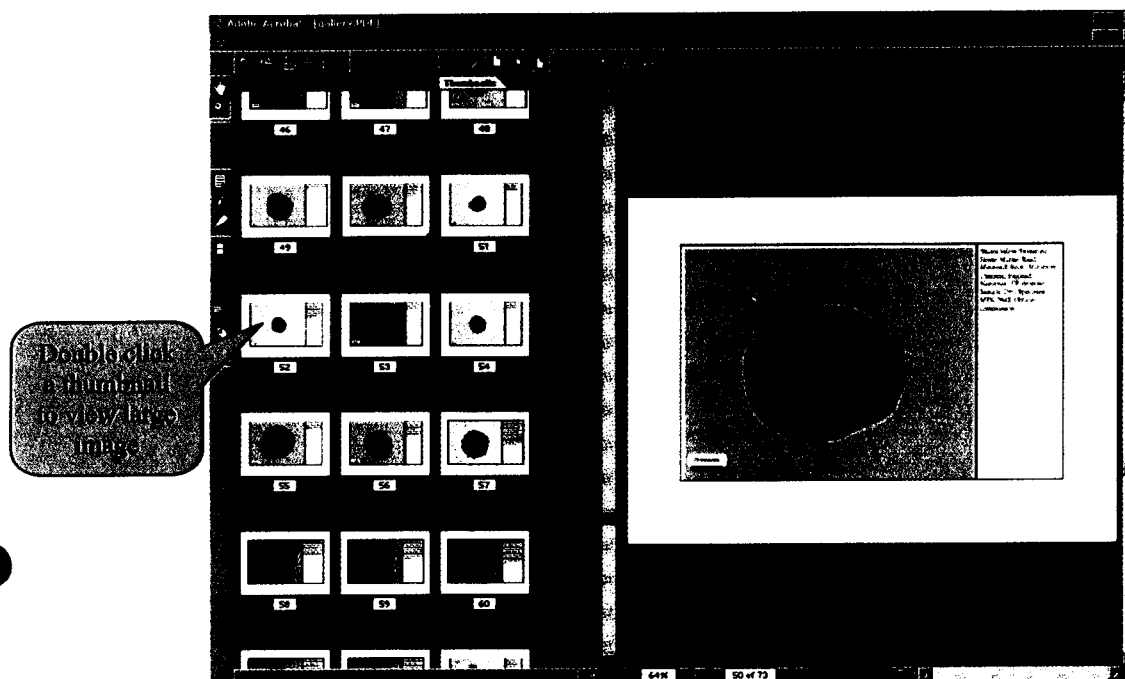
The three functions of the database are:

1. to display light microscope images in the form of a 'gallery';
2. to describe the illustrated taxa;
3. to allow searching for taxa by entering technical details.

3.1 LIGHT MICROSCOPE GALLERY

This window displays specimens in high resolution images. The user can scroll through the thumbnails, and by double clicking on a thumbnail, view a large image. At present the gallery contains 73 images of the 7 taxa so far completed, but will, at the end of the first phase, contain approximately 280 images.

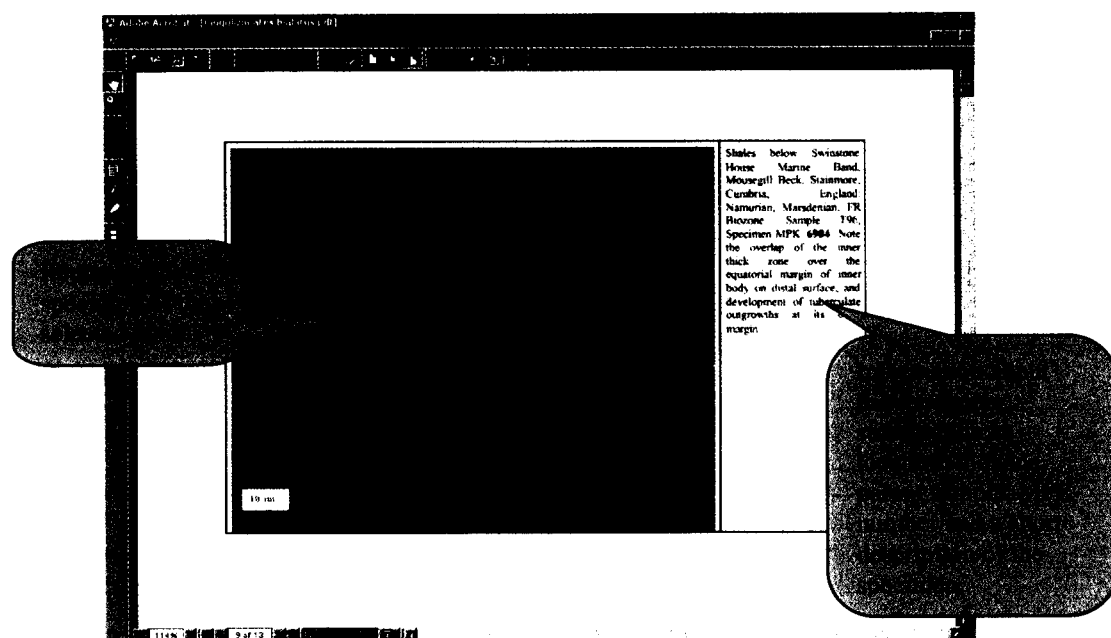
Figs. 2 Gallery window



3.1.1 Information displayed in the gallery

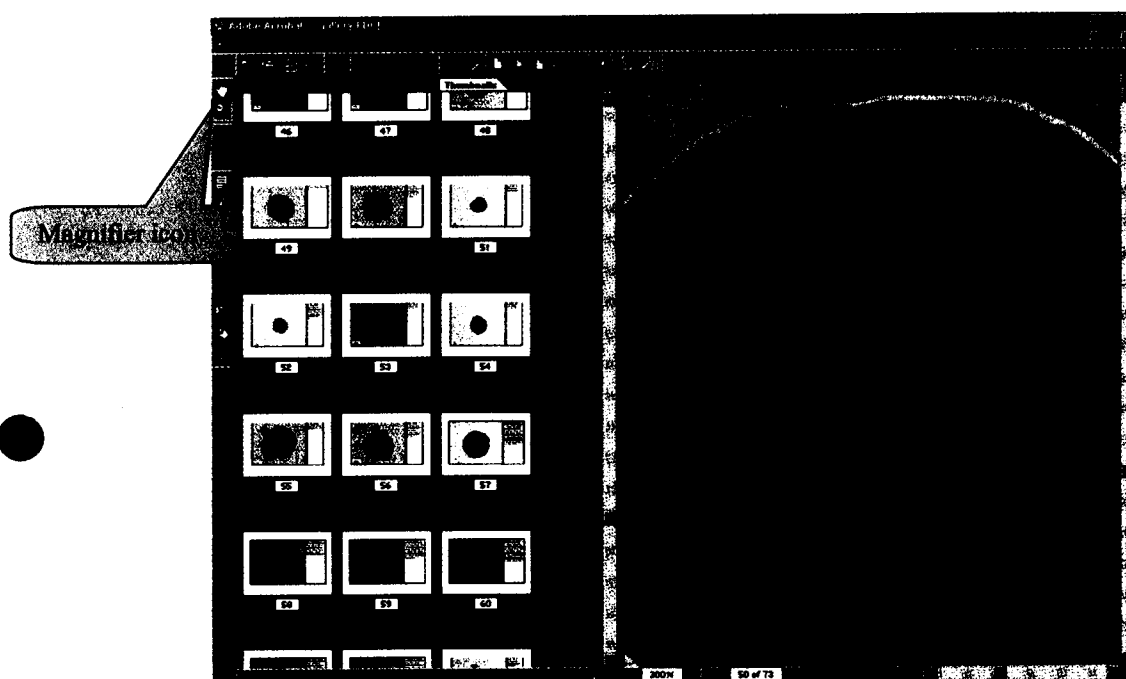
Each image shows a specimen of the taxon selected. There may be as many as twenty representative specimens of a particular taxon. Where marked the illustrated specimen is a holotype, lectotype or topotype. To the right of the image is an account of the specimen: its stratigraphical horizon, the biozone to which this horizon is assigned, the sample from which the palynomorph was recovered and the BGS Collections code number it has been allocated (the MPK number). Where necessary, a short description of the specimen is included which may indicate how it differs from the holotype or may comment on the specimen's preservation or compression orientation.

Fig. 3 Information shown in the gallery



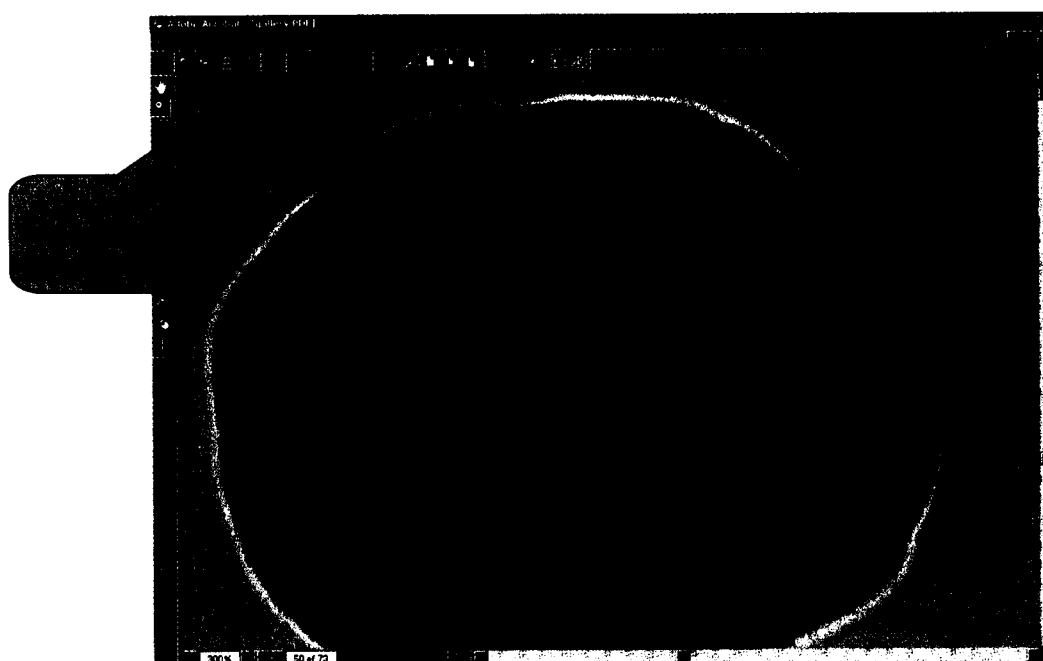
By clicking on the magnifier icon, the user can magnify the main image.

Fig. 4 Magnifying the image



By clicking the thumbnail icon you can remove the thumbnail images.

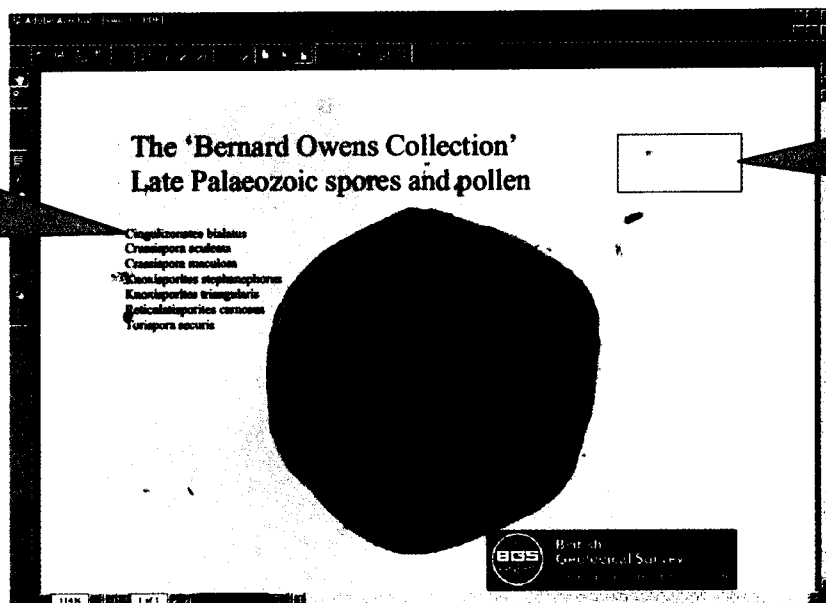
Fig. 5 Removing thumbnails



3.2 THE 'TAXA' WINDOWS

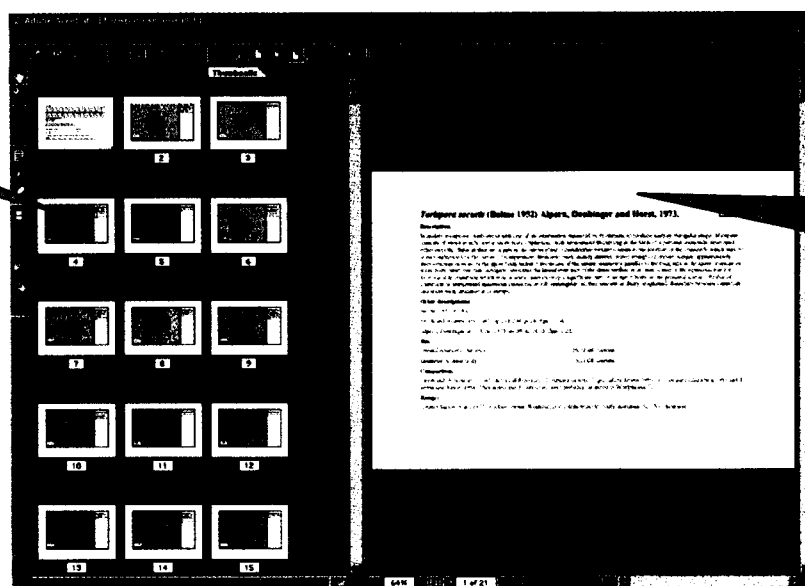
It is intended that in the first phase of databasing, 30 taxa will be illustrated. At present 7 are complete, though all photomicrographs have been taken and most of the taxonomic information for the remaining 23 taxa is complete.

Fig. 6 The introductory 'Taxa Window'



Information displayed in the taxon windows includes a description taken from relevant sources, an alternative description (usually the original description or diagnosis of the taxon), details of size, comparisons with other taxa and basic details of the taxon's range. Photomicrographs of a representative group of specimens are displayed to the left of taxonomic information. As in the gallery, information about each specimen (stratigraphy, location, biozone, parent sample, MPK number) and often a short description of the specimen is given to the right of each image.

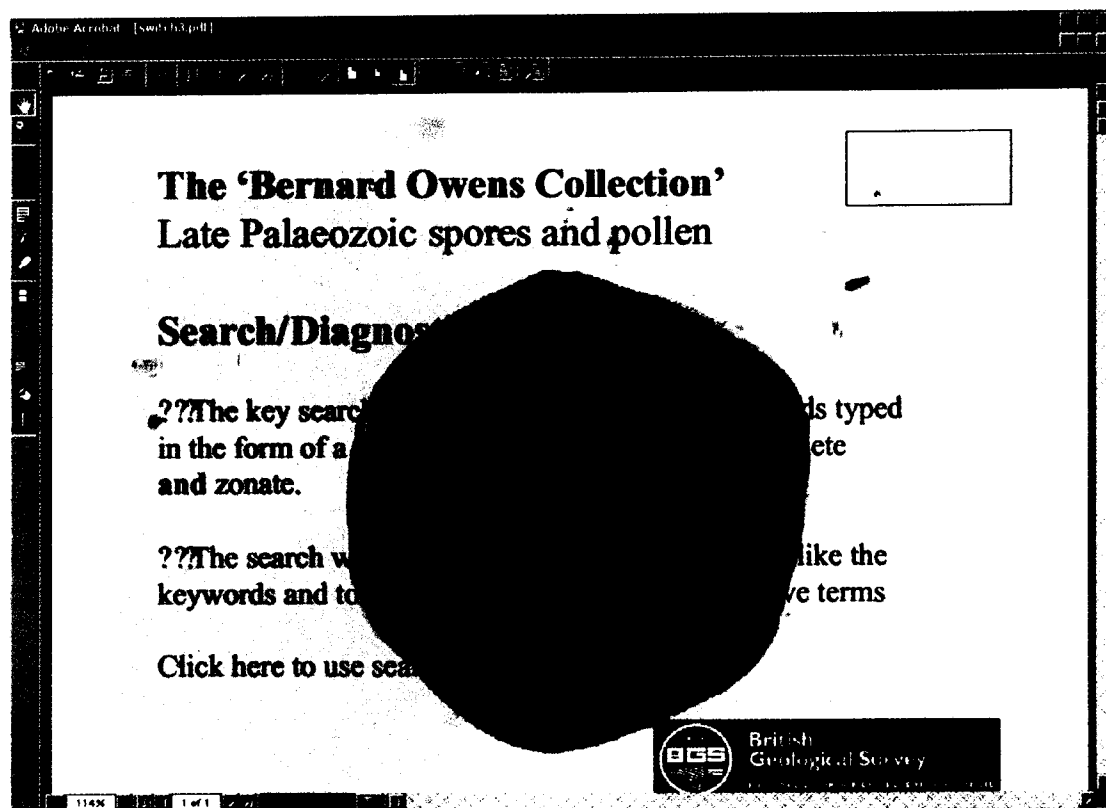
Fig. 7 Descriptions and other taxonomic information



3.3 DIAGNOSTIC FUNCTION

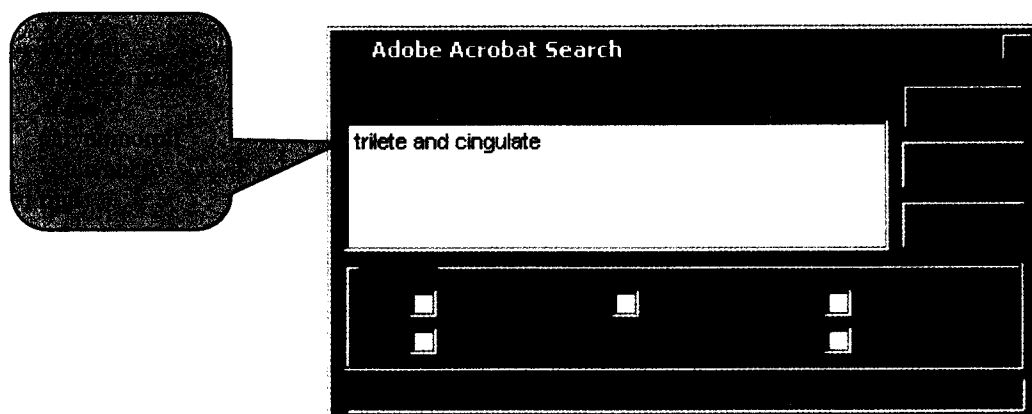
The 'Diagnostic Key' window is shown below.

Fig. 8 The 'Diagnostic Key' window



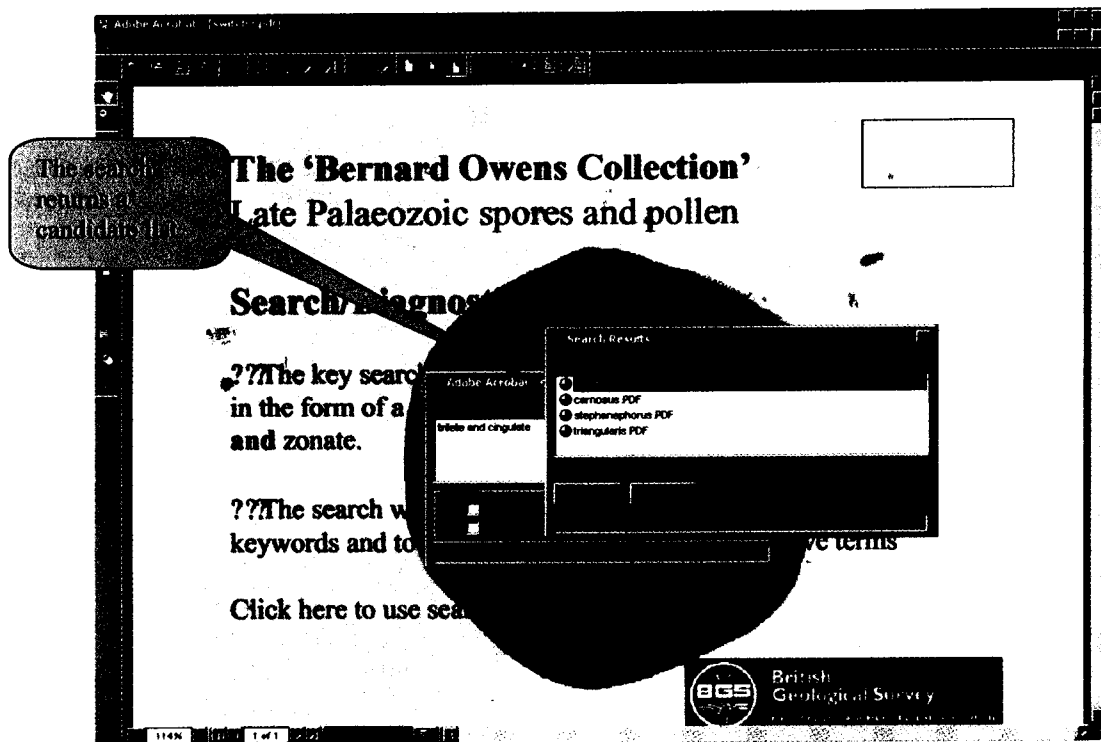
This function can be used to find taxa conforming to a combination of characteristics that can be typed in the 'search' box.

Fig. 9 The 'Search Box'

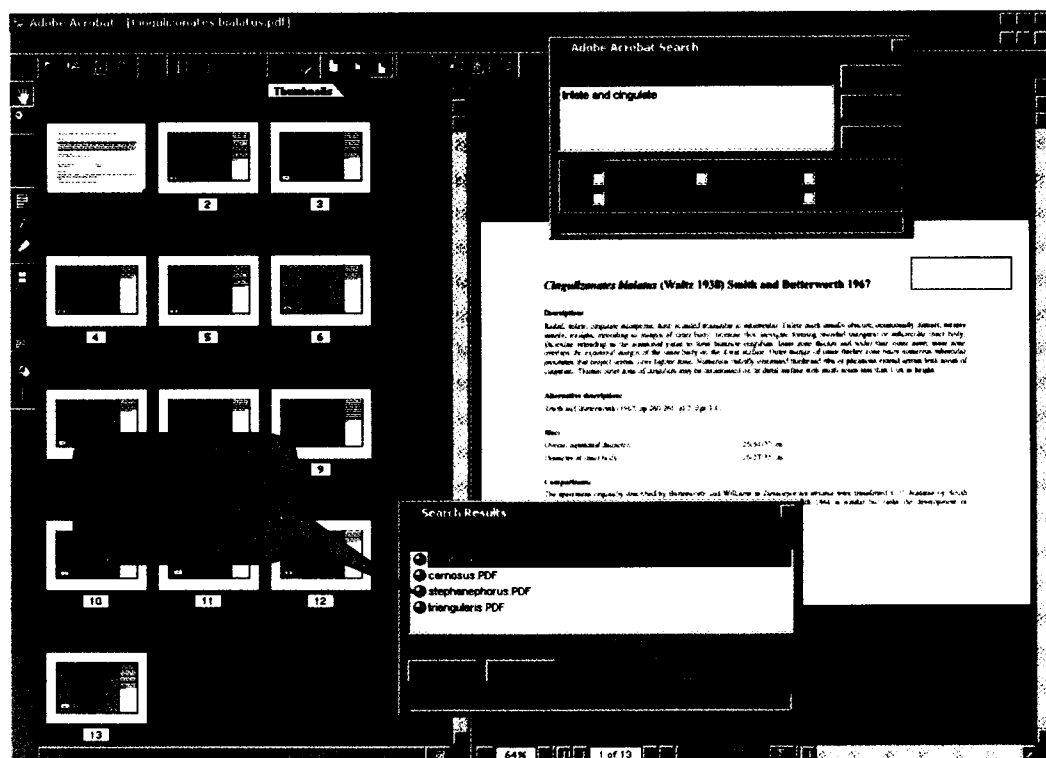


The key searches the database for taxa fitting words typed in the form of a boolean string, e.g. 'verrucate and trilete and zonate'. The search will also respond to words that sound like the keywords and to established synonyms of descriptive terms.

The search returns a candidate list of taxa which conform to the typed characteristics.
 Fig. 10 Returned 'candidate taxa'



The user can double click on the taxa listed to see details.
 Fig. 11 The 'Taxon Window'



References

CLAYTON, G, COQUEL, R, DOUBINGER, J, GUEINN, K J, LOBOZIAK, S, OWENS, B. and STREEL, M. 1977. Carboniferous miospores of Western Europe: illustration and zonation. *Mededelingen Rijks Geologische Dienst*, Vol. 29, 1-71.

NEVES, R, GUEINN, K J, CLAYTON, G, IOANNIDES, N and NEVILLE, R. S. W. 1972. A scheme of miospore zones for the British Dinantian. *C. R. 7th Congr. Adv. Étud. Stratigr. Géol. Carbonifère*, Krefeld, 1979, Vol. 1, 347-353.

OWENS, B and BURGESS, I C. 1965. The Stratigraphy and palynology of the Upper Carboniferous outlier of Stainmore, Westmorland. *Bulletin of the Geological Survey of Great Britain* No. 23, 17-44.

OWENS, B, NEVES, R, GUEINN, K J, MISHELL, D R F, SABRY, H S M Z and WILLIAMS, J E 1977. Palynological division of the Namurian of northern England and Scotland. *Proc. Yorks. Geol. Soc.*, 41, 381-398.

SMITH, A. H. V. & BUTTERWORTH, M. A. 1967. Miospores in the coal seams of the Carboniferous of Great Britain. *Spec. Pap. Palaeont. Ass.*, 1-324.

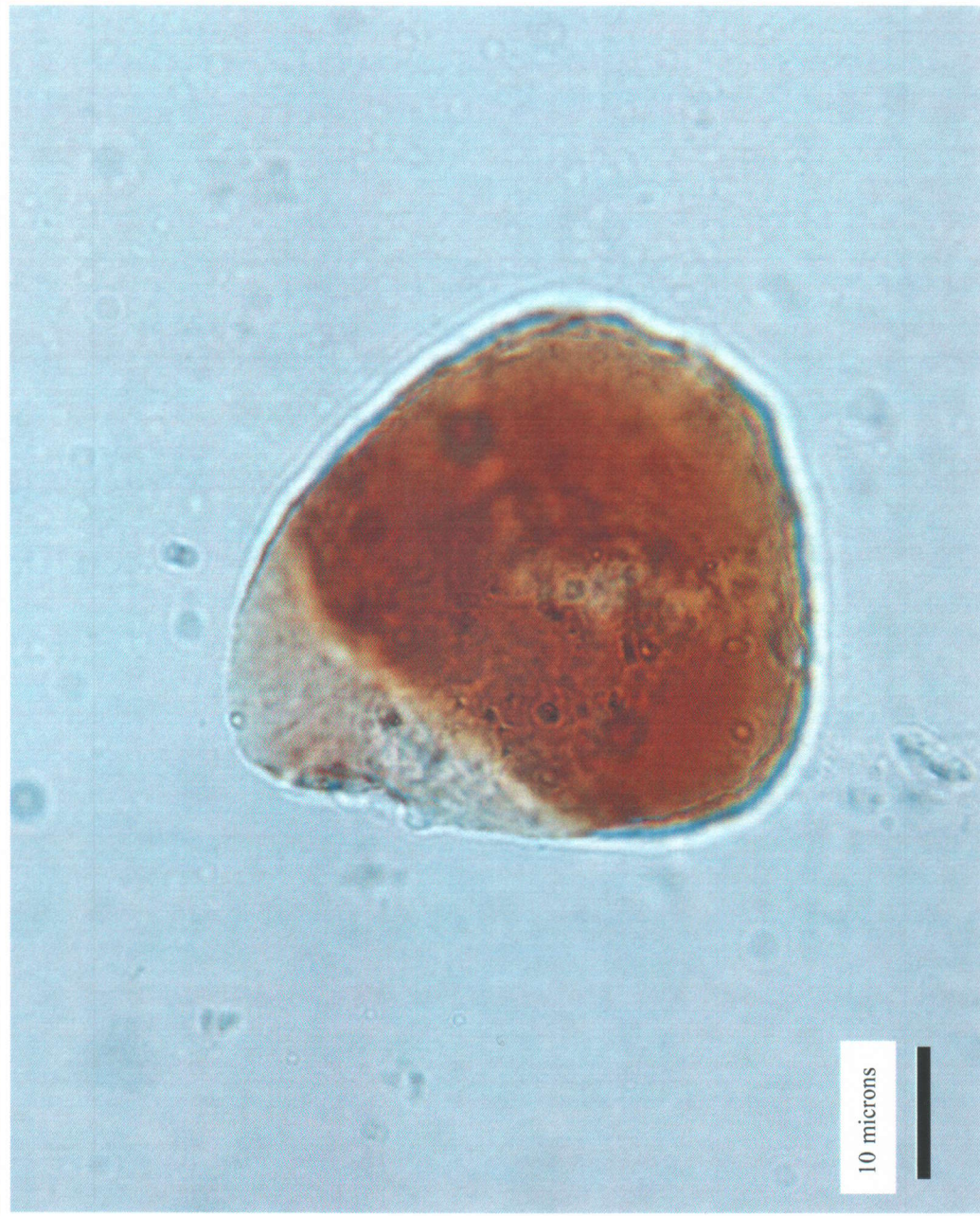
4 Appendix 1 List of taxa for 1st phase of the BO Collection

Bernard Owens Collection	MPK Numbers
<i>Cingulizonates capistratus</i>	6958-6976
<i>Cingulizonates bialatus</i>	6977-6988
<i>Radiizonates aligerens</i>	6989-7000
<i>Crassispora kosankei</i>	7001-7011
<i>Crassispora trychera</i>	7012
<i>Crassispora aculeata</i>	7013-7018
<i>Reticulatisporites carnosus</i>	7019-7030
<i>Knoxisporites literatus</i> var. <i>triangularis</i>	7031-7036
<i>Knoxisporites stephanephorus</i>	7037-7048
<i>Angulisporites splendidus</i>	7049-7055
<i>Kraeuselisporites echinatus</i>	7056-7061
<i>Vallatisporites hystricosus</i>	7062-7073
<i>Crassispora maculosa</i>	7074-7079
<i>Vallatisporites ciliaris</i>	7080-7091
<i>Torispora securis</i>	7092-7111
<i>Spelaeotriletes balteatus</i>	7112-7123
<i>Retispora lepidophyta</i>	7124-7129
<i>Grandispora spinosa</i>	7130-7135
<i>Schulzospora campyloptera</i>	7136-7146
<i>Spelaeotriletes arenaceus</i>	7147-7158
<i>Spelaeotriletes triangulus</i>	7159-7164
<i>Murospora parthenopia</i>	7165-7179
<i>Schulzospora ocellata</i>	7180-7191
<i>Convolutispora major</i>	7192-7202
<i>Triquitrites sculptilis</i>	7215-7229
<i>Murospora moniloformis</i>	7230-7244
<i>Spelaeotriletes owensi</i>	7245-7252
<i>Spelaeotriletes giganteus</i>	7253-7256
<i>Labiadensites fimbriatus</i>	7257-7266
<i>Hystricosporites multifurcata</i>	7267-7268

5 Appendix 2 Print of information in the database

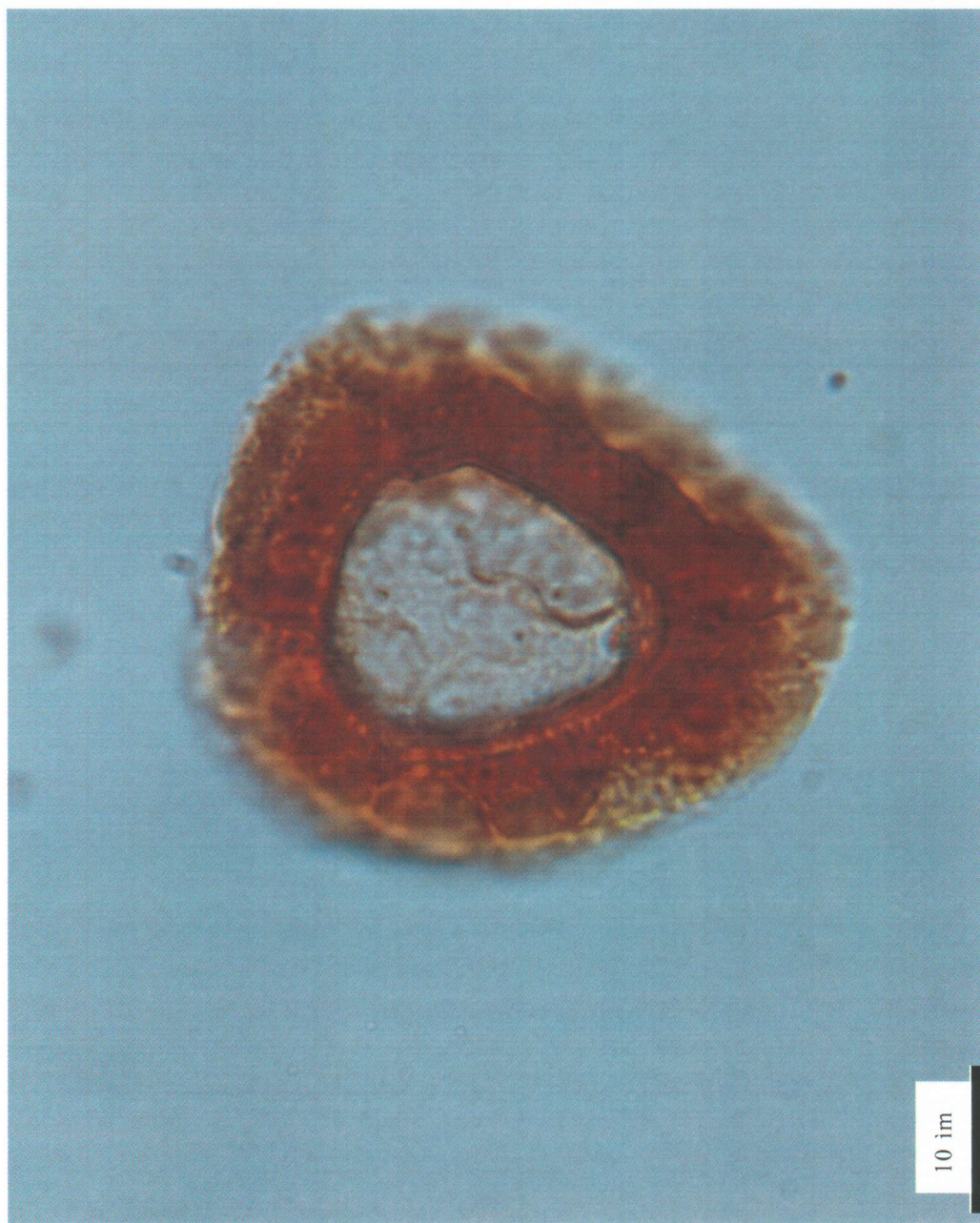
Print of database contents

Sample C, Specimen MPK
7092. Distal focus showing
body protruding from
patinate structure. Radwood
Borehole, 3008 ft., West
Midlands, England:
Westphalian C, SL Biozone.

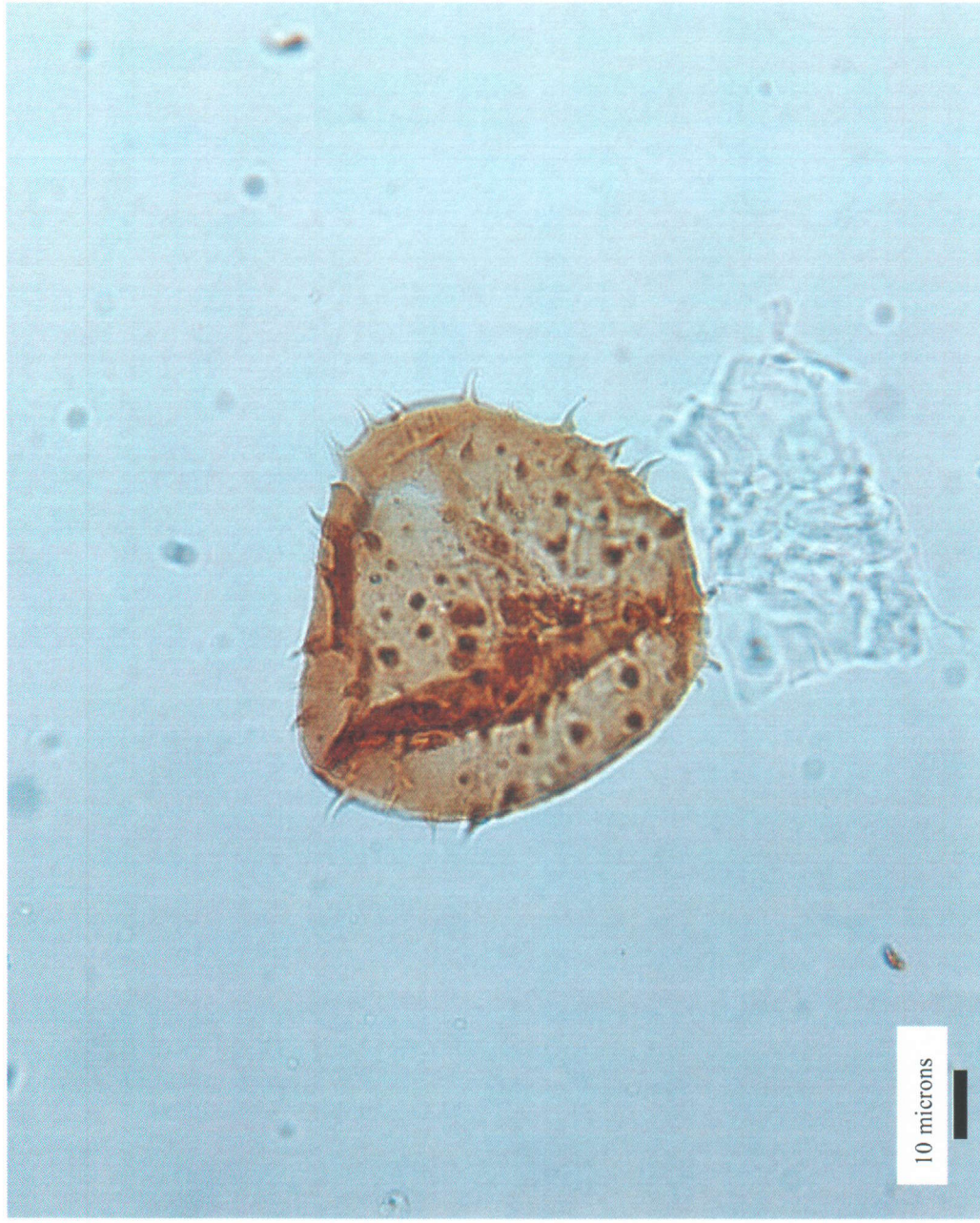


10 microns

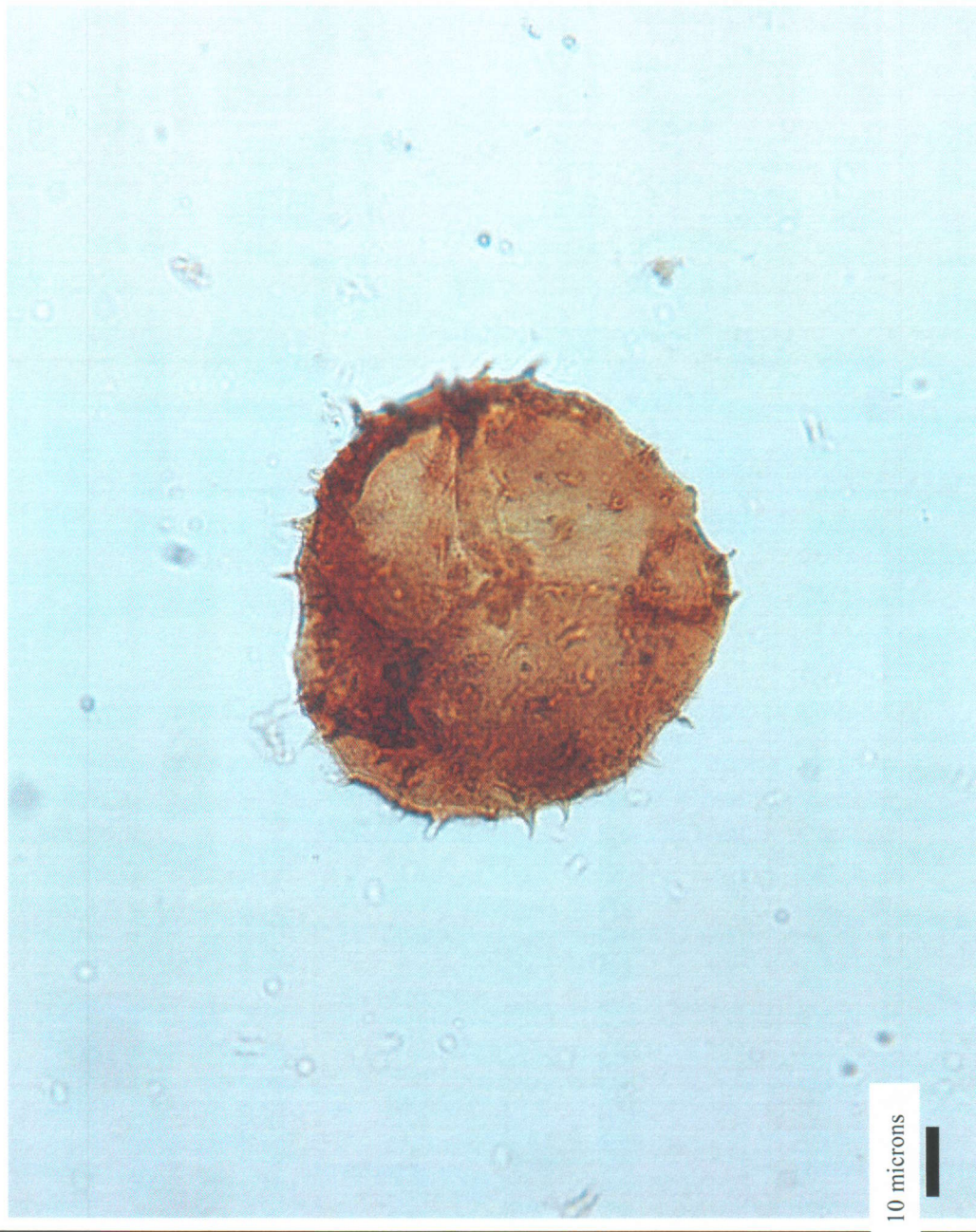
Shales below Swinestone
House Marine Band,
Mousegill Beck, Stainmore,
Cumbria, England:
Namurian, Marsdenian, FR
Biozone. Sample T96.
Specimen MPK 6977.
Proximal focus. Trilete
mark simple; sutures
extending to equator of
subcircular inner body.
Cingulum bizonate, darker
thicker inner zone wider
than thinner outer zone.
Outer zone also appears to
bear scattered ornament of
small con.



Sample MPA 9158,
Specimen MPK 7013.
Subcircular trilete miospore
with ill-defined equatorial
crassitude, trilete mark
distinct, rays extend at least
three-quarters of spore
radius, accompanied by
elevated flexuous folds that
decrease in height towards
equator. Ends of trilete
sutures may merge into
invaginated extension from
ill-defined inner margin of
equatorial crassitude. Well-
developed spinose ornament
developed over entire distal
surface and more equatorial
portion of proximal surface.
Elements sharply pointed
surmounting bulbous base.
Shales below Hurlet
Limestone, Hurlet Borehole,
130.68 m, Scotland; Viséan,
VF Biozone.

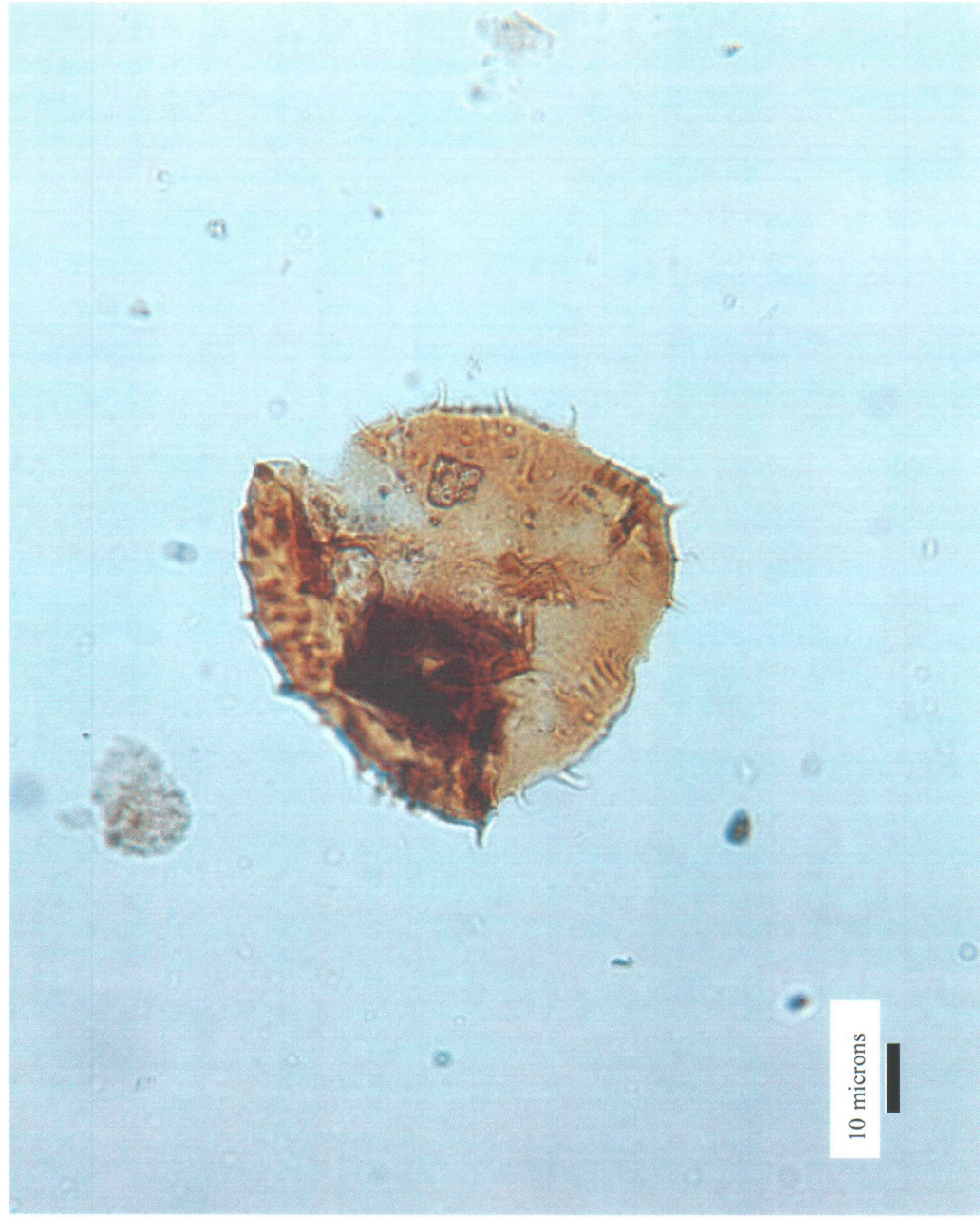


Sample MPA 9158,
Specimen MPK **7014**. Note
elevated folds
accompanying trilete mark,
decreasing towards equator.
Shales below Hurler
Limestone, Hurler Borehole,
130.68 m, Scotland; Viséan,
VF Biozone.

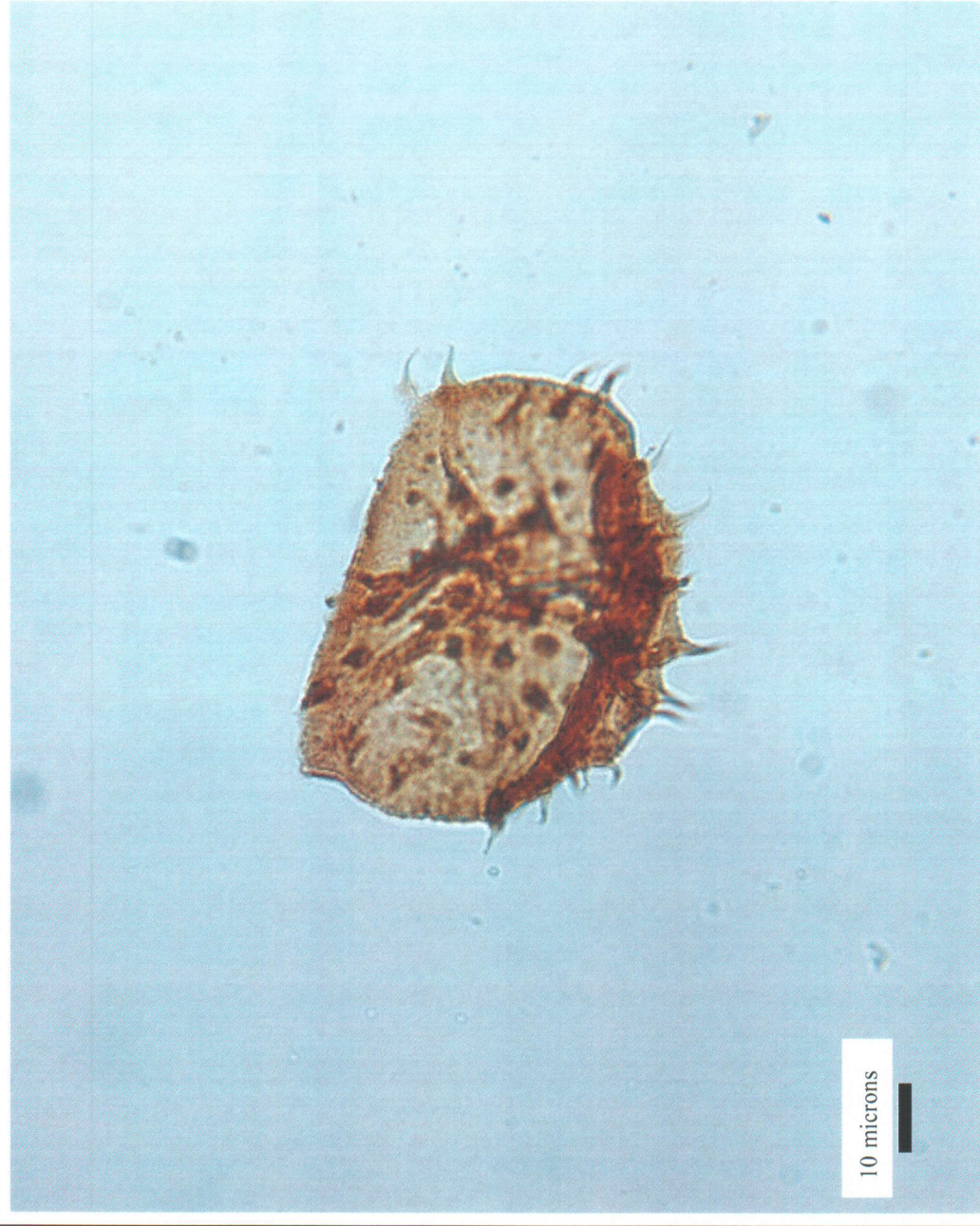


10 microns

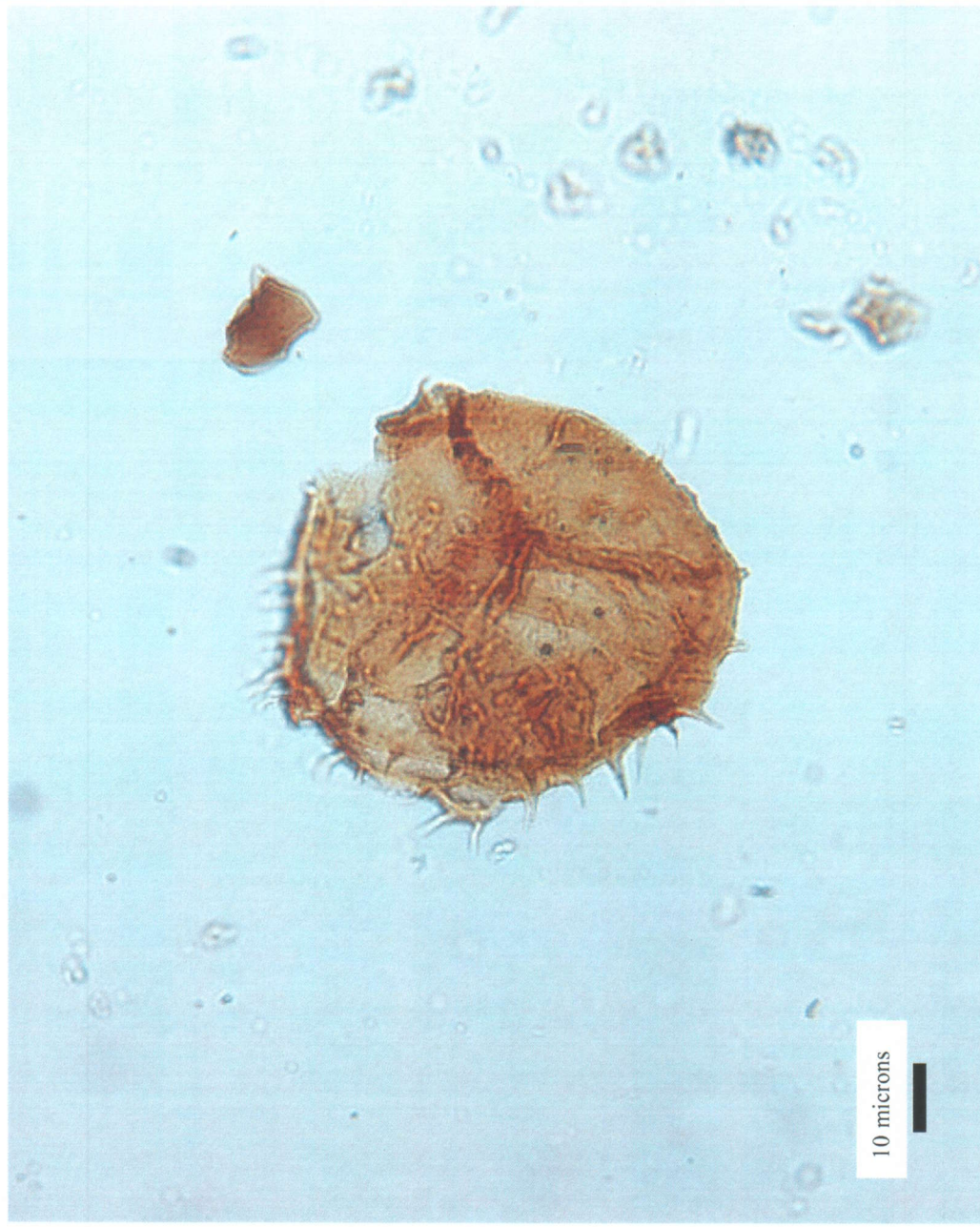
Sample MPA 9158,
Specimen MPK 7015.
Shales below Hurllet
Limestone, Hurllet Borehole,
130.68 m, Scotland; Viséan,
VF Biozone.



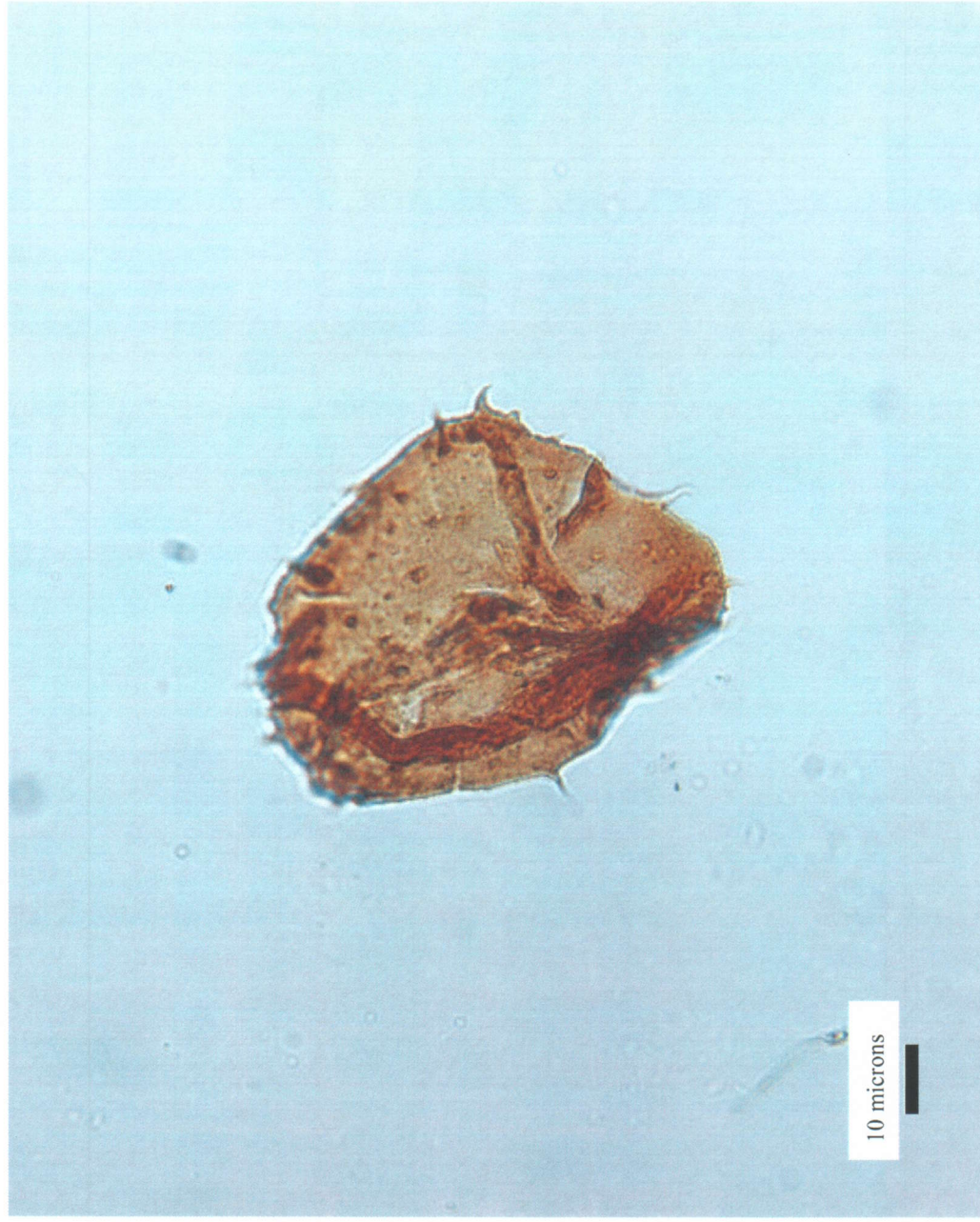
Sample MPA 9158,
Specimen MPK **7016**. Note
character of spinose
ornament with long sharply
pointed spines surmounting
bulbous base. Shales below
Hurlet Limestone, Hurlet
Borehole, 130.68 m,
Scotland; Viséan, VF
Biozone.



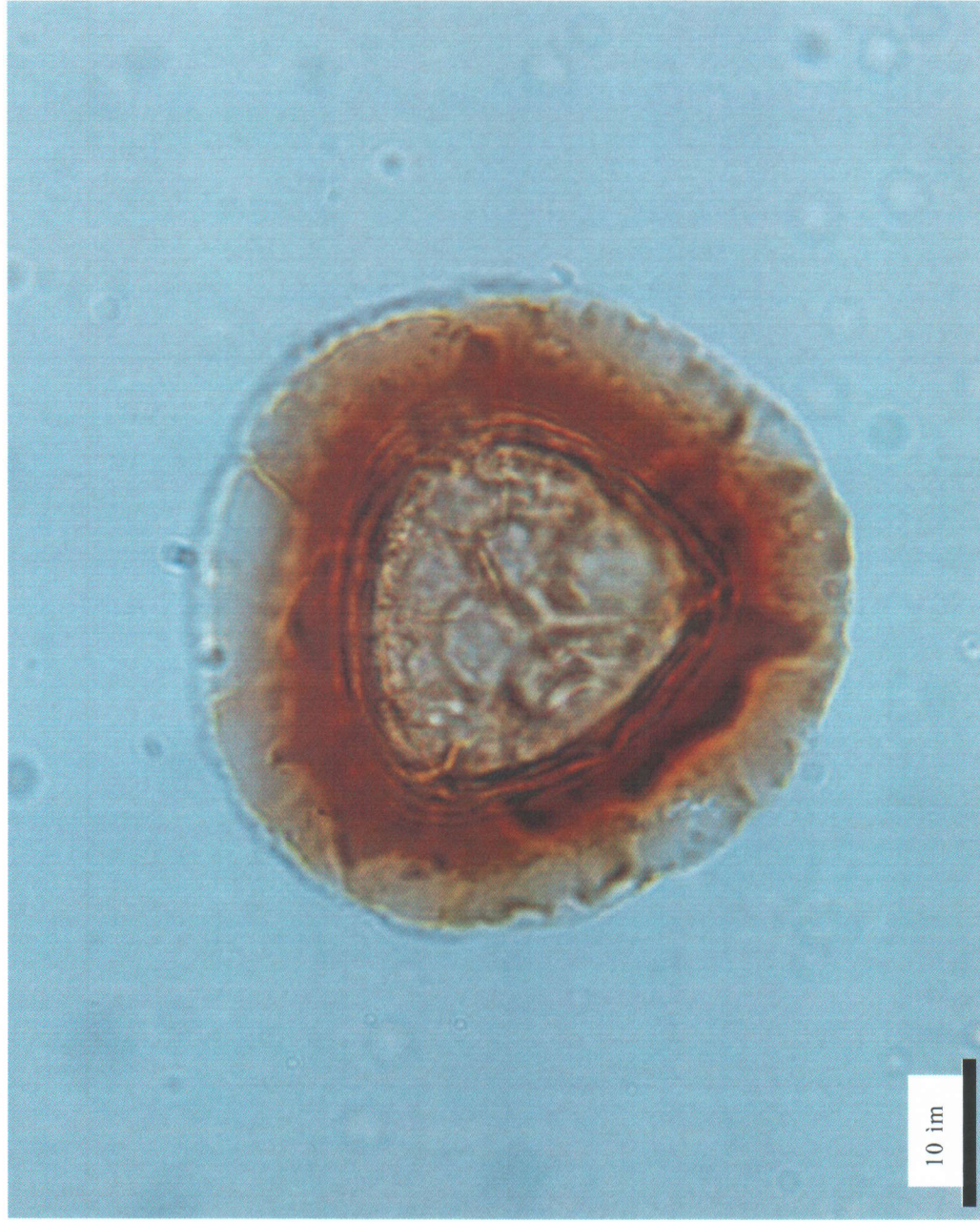
Sample MPA 9158,
Specimen MPK 7017. Note
indication of separation of
exoexine from the intexine
in the equatorial region.
Well-developed elevated
folds accompany trilete
sutures, decreasing in height
towards equator. Shales
below Hurler Limestone,
Hurler Borehole, 130.68 m,
Scotland; Viséan, VF
Biozone.



Sample MPA 9158,
Specimen MPK **7018**. Note
spinose elements in distal
polar region appear smaller
than those in equatorial
region. Shales below Hurlet
Limestone, Hurlet Borehole,
130.68 m, Scotland; Viséan,
VF Biozone.



Shales below Swinestone
House Marine Band,
Mousegill Beck, Stainmore,
Cumbria, England:
Namurian, Marsdenian, FR
Biozone. Sample T96.
Specimen MPK 6978. Distal
focus showing that the dark
inner zone of the cingulum
overlaps the equatorial
margin of the inner body on
the distal surface. Note
tubercular outgrowths on the
equatorial border of the
inner thicker zone of
cingulum.



Shales below Swinestone
House Marine Band,
Mousegill Beck, Stainmore,
Cumbria, England:
Namurian, Marsdenian, FR
Biozone, Sample T96,
Specimen MPK 6979.

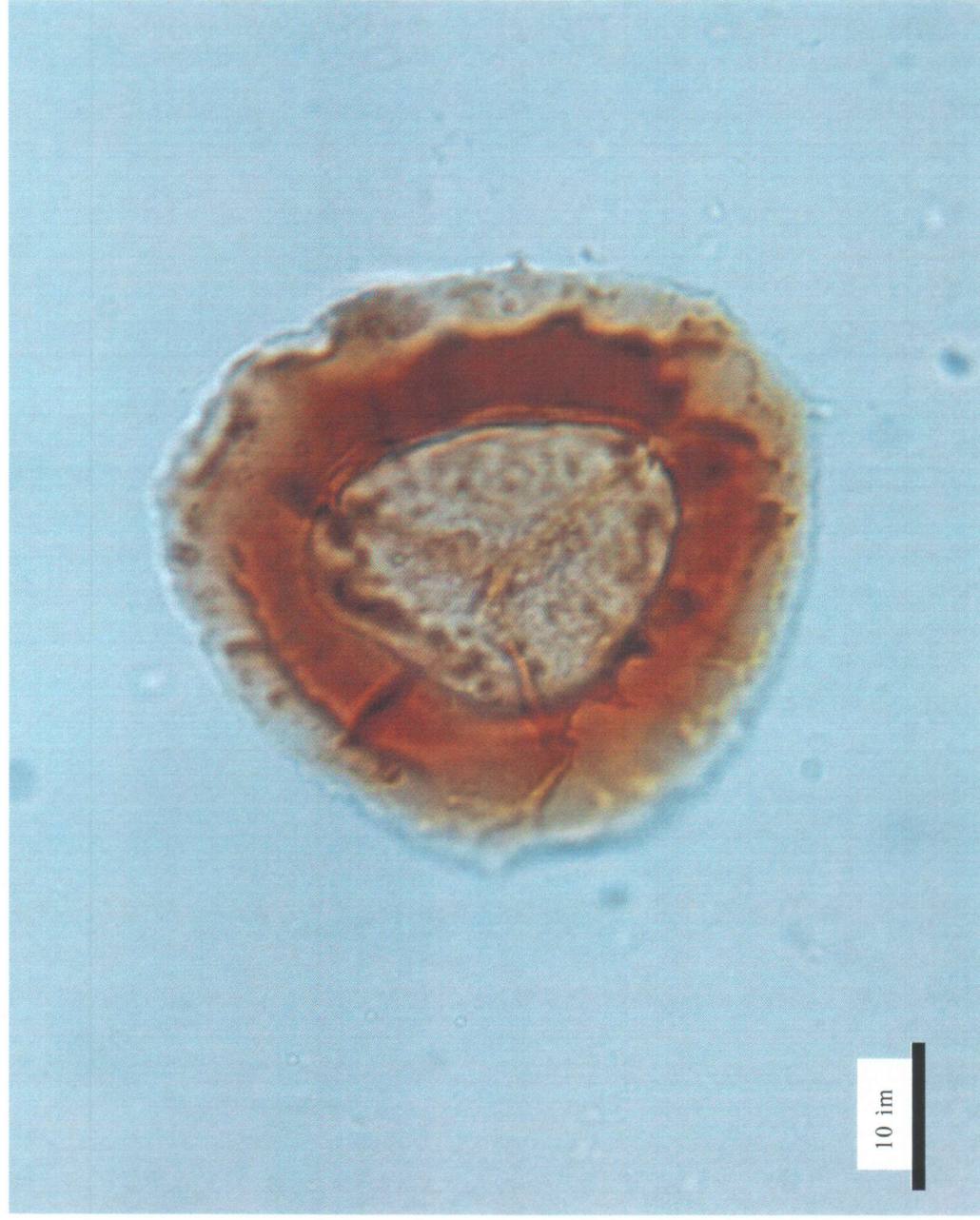


Shales above Mousegill
Marine Band, Crag House
Gill. Stainmore, Cumbria.
England. Namurian, KV
Biozone. Sample CHG 1,
Specimen MPK **6980**.
Specimen with bizonate
cingulum showing
development of striations on
inner thicker zone of
cingulum. May indicate
transitional form with
Radiizonates striatus.

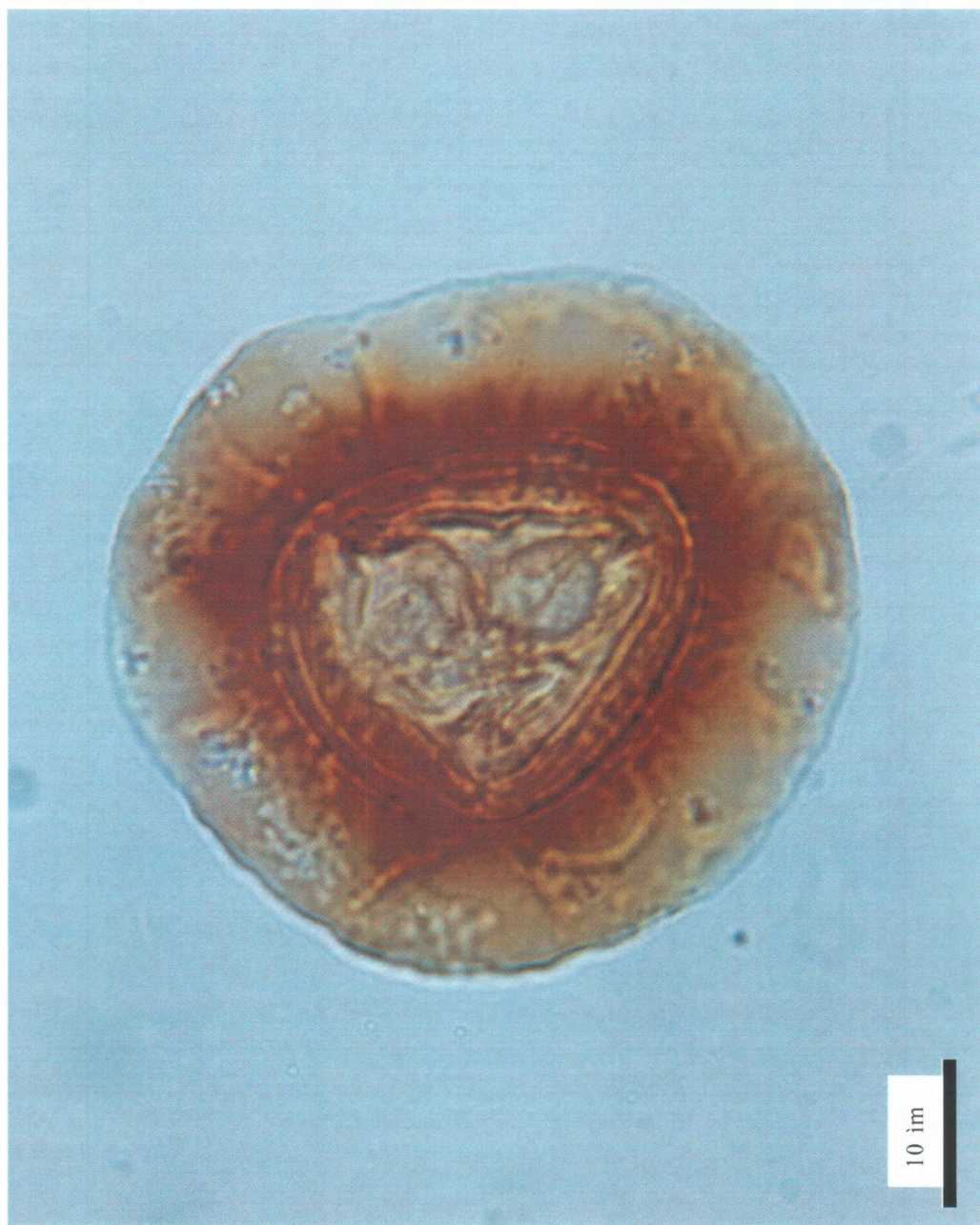


10 μ m

Hurlet Borehole, 160.70 m,
Scotland: Viséan, VF
Biozone. Sample MPA
9162, Specimen MPK **6981**.
Note development of
tuberculate structures at
outer margin of dark inner
thick zone of cingulum.



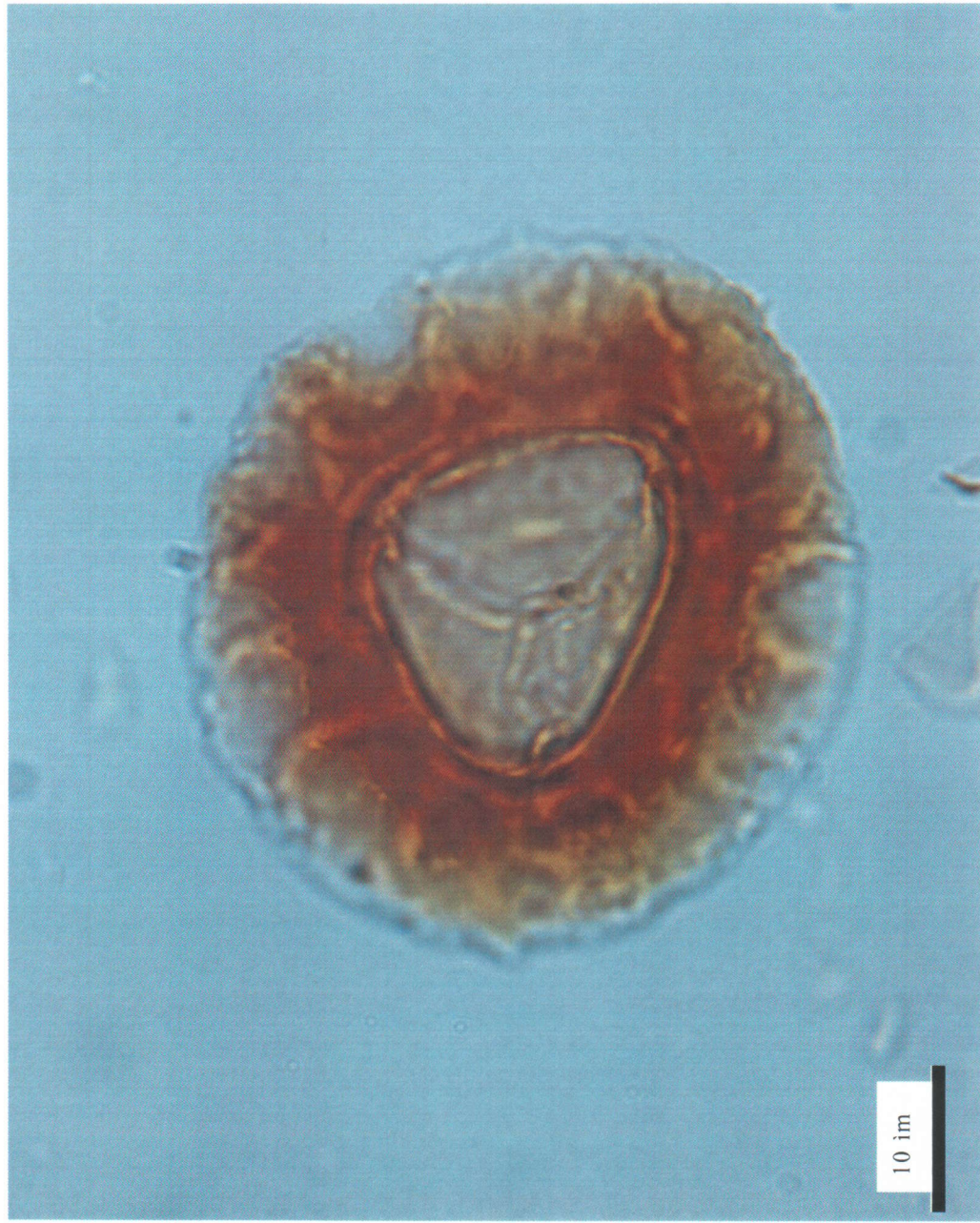
Shales below Swinestone
House Marine Band,
Mousegill Beck, Stainmore,
Cumbria, England:
Namurian, Marsdenian, FR
Biozone. Sample T96.
Specimen MPK 6982.



Shales below Swinstone
House Marine Band,
Mousegill Beck, Stainmore,
Cumbria, England:
Namurian, Marsdenian, FR
Biozone, Sample T96.
Specimen MPK 6983.



Shales below Swinestone
House Marine Band,
Mousegill Beck, Stainmore,
Cumbria, England:
Namurian, Marsdenian, FR
Biozone. Sample T96,
Specimen MPK 6984. Note
the overlap of the inner
thick zone over the
equatorial margin of inner
body on distal surface, and
development of tuberculate
outgrowths at its outer
margin.



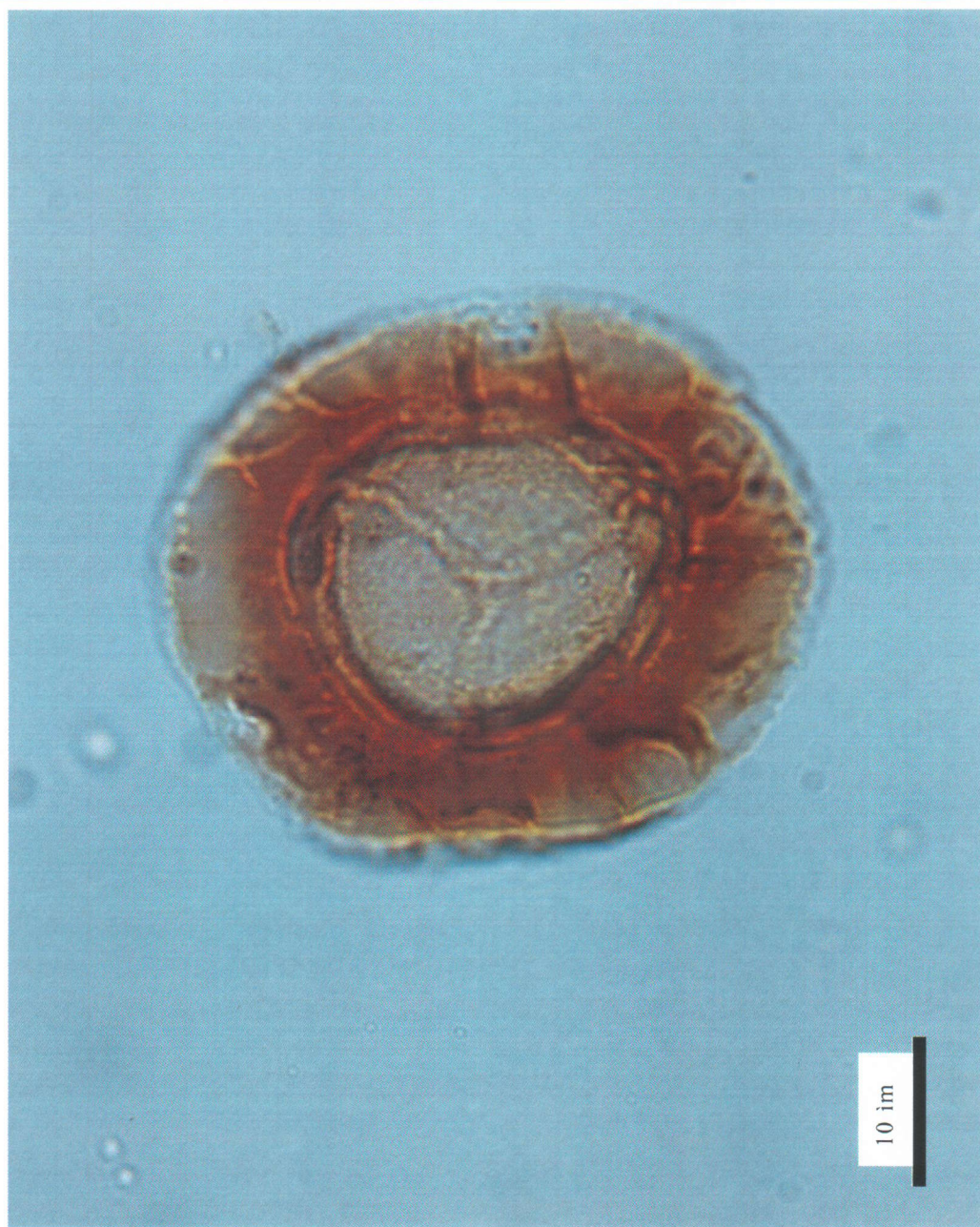
Shales below Swinstone
House Marine Band,
Mousegill Beck, Stainmore,
Cumbria, England:
Namurian, Marsdenian, FR
Biozone, Sample T96,
Specimen MPK 6985.



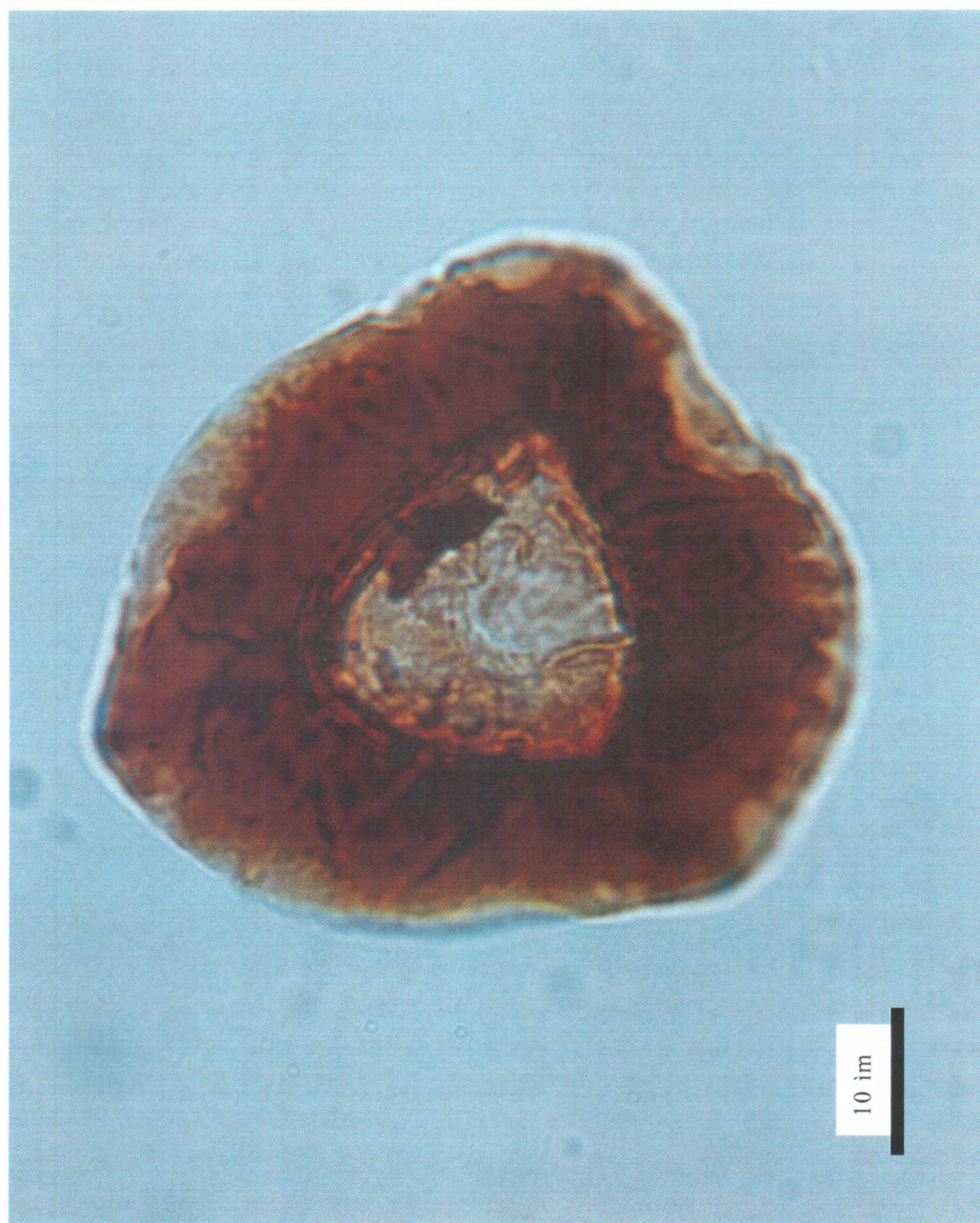
Shales below Swinestone
House Marine Band,
Mousegill Beck, Stainmore,
Cumbria, England:
Namurian, Marsdenian, FR
Biozone, Sample T96.
Specimen MPK 6986. Distal
focus showing overlap, on
distal surface, of the inner
thicker zone of cingulum
across spore body margin
and development of
tubercles that protrude
from its outer margin onto
the thinner outer zone.



Shales below Swinestone
House Marine Band,
Mousegill Beck, Stainmore,
Cumbria, England:
Namurian, Marsdenian, FR
Biozone, Sample T96,
Specimen MPK 6987.



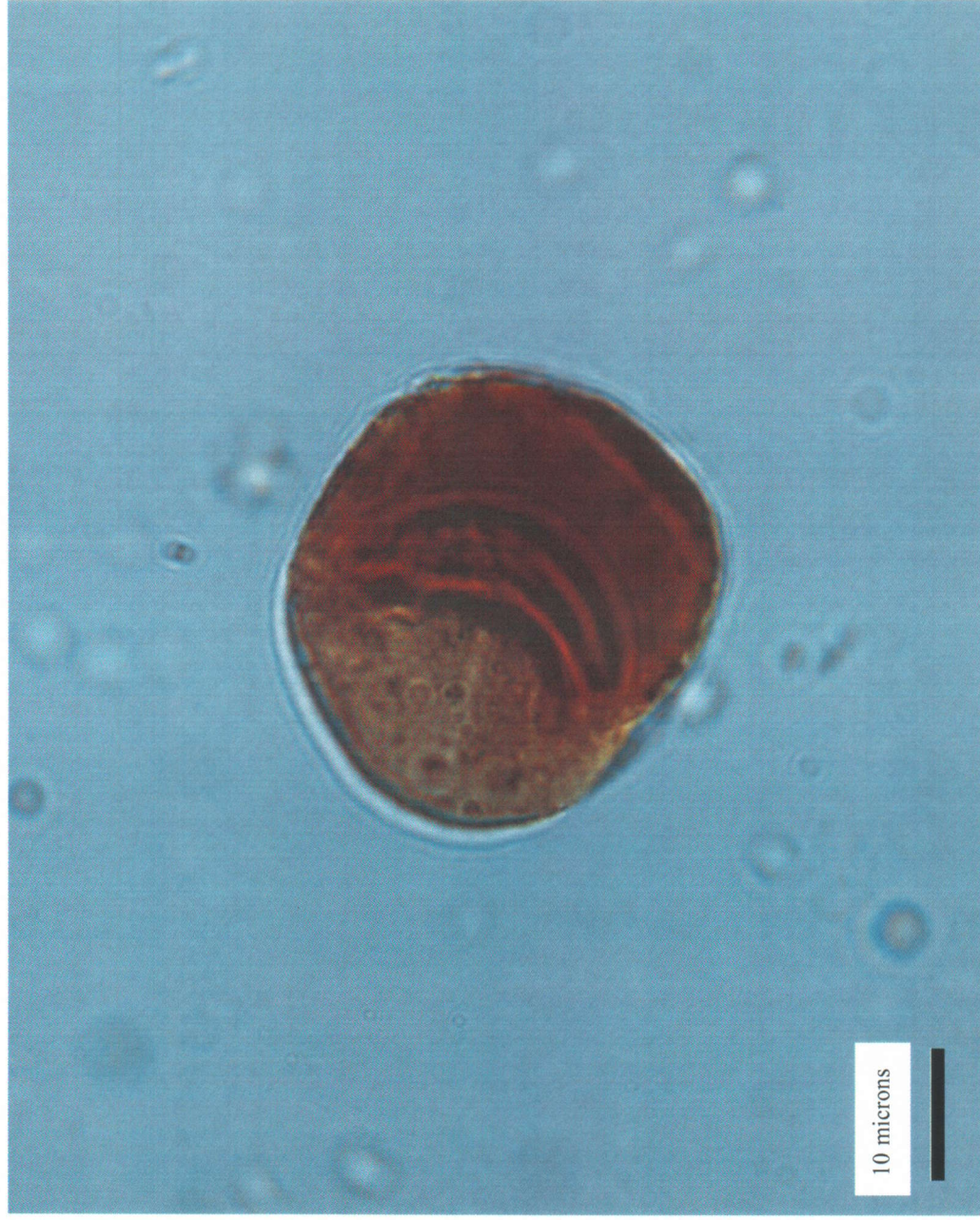
Mattson Formation, south
face of Twisted Mountain,
northwest of South Nahanni,
N.W.T., Canada: Viséan
MA Biozone. Sample
MATT, Specimen MPK
6988. Specimen showing
well defined trilete mark
with rays extending to inner
body margin. Darker inner
thick zone of cingulum
shows extensive
development of tubercles
which protrude onto thin
outer zone.



Sample C, Specimen MPK
7093. Radwood Borehole,
3008 ft., West Midlands,
England: Westphalian C, SL
Biozone.



Sample C, Specimen MPK
7094. Note body with short
simple monolete mark
enclosed within sharply
defined patina. Exine of
body and patina laevigate.
Radwood Borehole, 3008
ft., West Midlands,
England: Westphalian C, SL
Biozone.



Sample C, Specimen MPK
7095. Radwood Borehole,
3008 ft., West Midlands,
England: Westphalian C, SL
Biozone.



Sample C, Specimen MPK
7096. Possible oblique
compression. Monolete
mark, short, simple. Patina
sharply defined, surface
laevigate. Radwood
Borehole, 3008 ft., West
Midlands, England:
Westphalian C, SL Biozone.



Sample C, Specimen MPK
7097. Patina developed in
lateral direction, apparently
attached to body on only a
small part of its surface.
Radwood Borehole, 3008
ft., West Midlands,
England: Westphalian C, SL
Biozone.



Sample C, Specimen MPK
7098. Quadrate patina
developed in lateral plane.
Radwood Borehole, 3008
ft., West Midlands,
England: Westphalian C, SL
Biozone.



Sample C, Specimen MPK
7099. Quadrate patina,
probably polar in location,
on laterally compressed
specimen. Monoletic mark
simple. Radwood Borehole,
3008 ft., West Midlands,
England: Westphalian C, SL
Biozone.

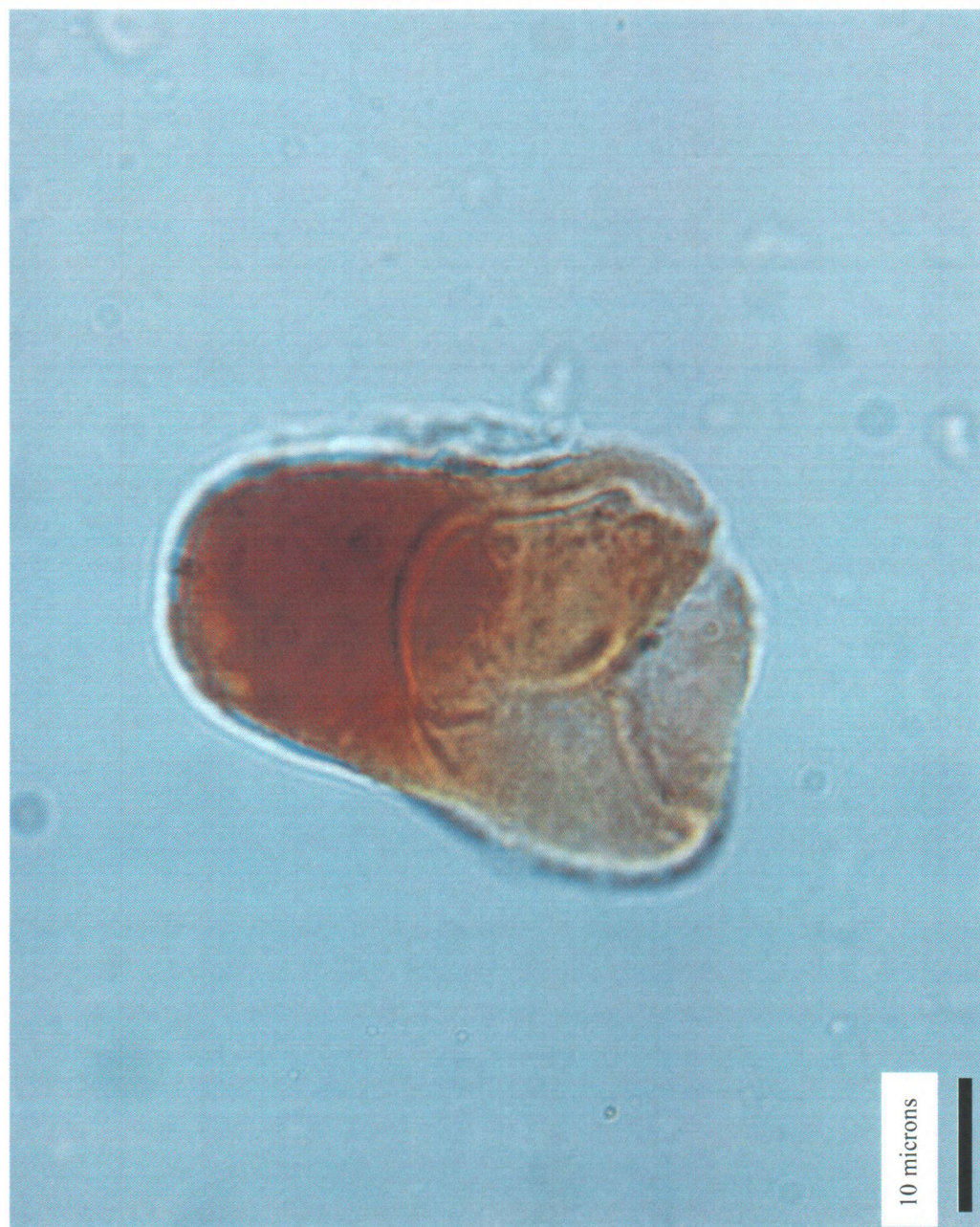


10 microns

Sample C, Specimen MPK
7100. Proximal focus. Note
monolet mark almost equal
to body diameter. Radwood
Borehole, 3008 ft., West
Midlands, England:
Westphalian C, SL Biozone.



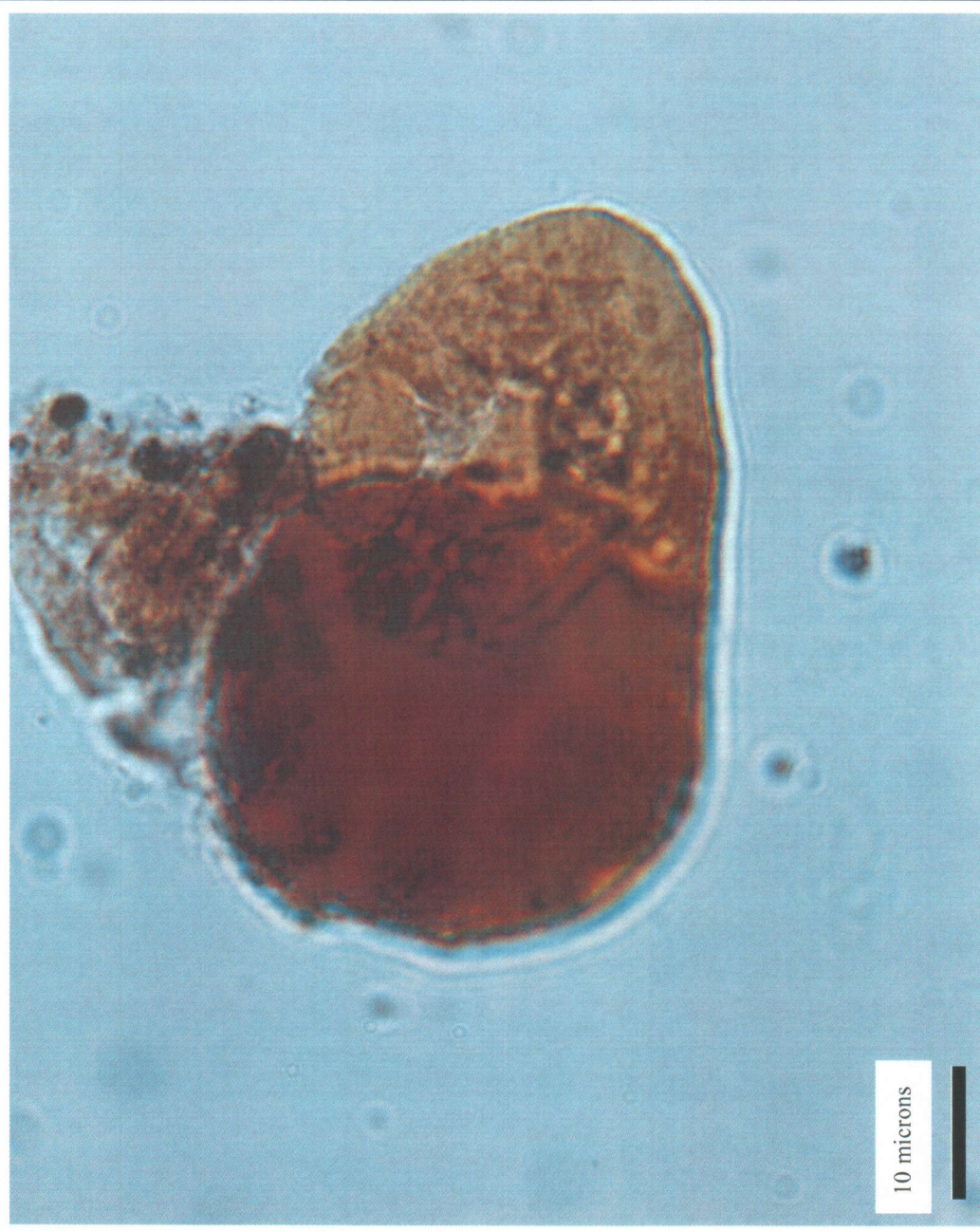
Sample C, Specimen MPK
7101. Radwood Borehole,
3008 ft., West Midlands,
England: Westphalian C, SL
Biozone.



Sample C, Specimen MPK
7102. Radwood Borehole,
3008 ft., West Midlands,
England: Westphalian C, SL
Biozone.



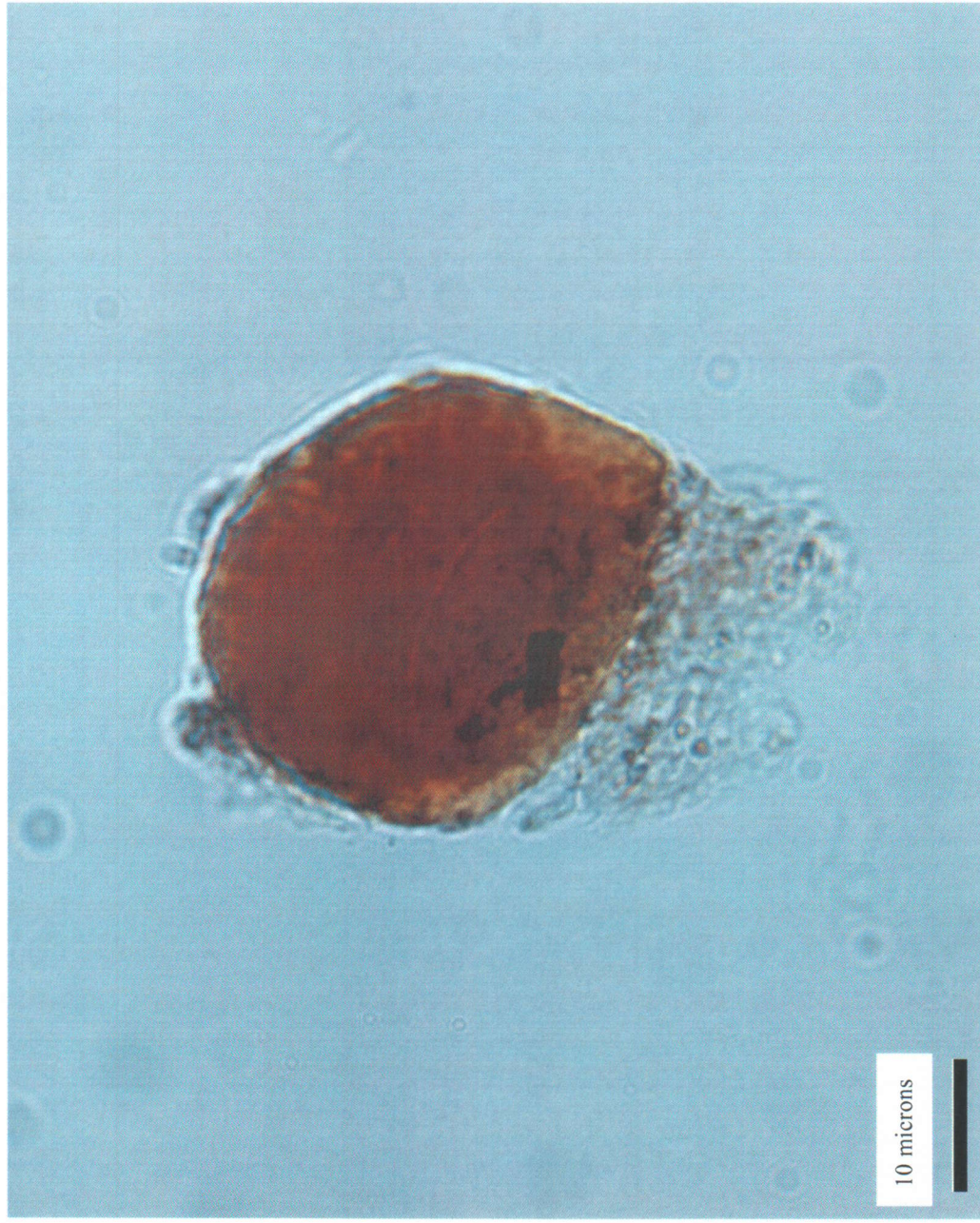
Sample C, Specimen MPK
7103. Torn specimen.
Radwood Borehole, 3008
ft., West Midlands,
England: Westphalian C, SL
Biozone.



Sample C, Specimen MPK
7104. Note proximal
extension of patina which
engulfs body. Monolete
mark short and simple.
Radwood Borehole, 3008
ft., West Midlands,
England: Westphalian C, SL
Biozone.



Sample C, Specimen MPK
7105. Radwood Borehole,
3008 ft., West Midlands,
England: Westphalian C, SL
Biozone.



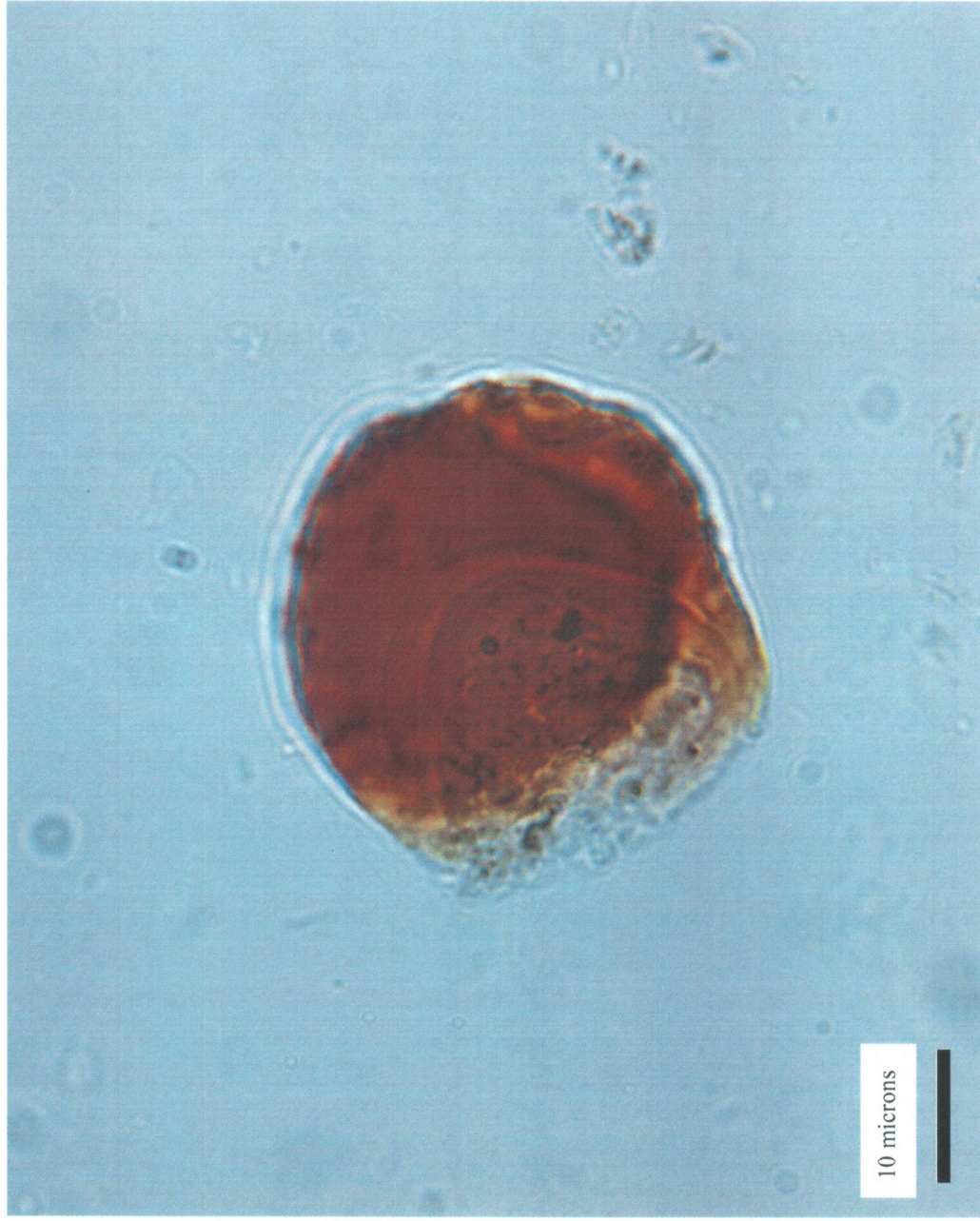
Sample C, Specimen MPK
7106. Radwood Borehole,
3008 ft., West Midlands,
England: Westphalian C, SL
Biozone.



Sample C, Specimen MPK
7107. Patinate development
mainly in lateral plane.
Monolete mark short and
simple. Radwood Borehole,
3008 ft., West Midlands,
England: Westphalian C, SL
Biozone.



Sample C, Specimen MPK
7108. Radwood Borehole,
3008 ft., West Midlands,
England: Westphalian C, SL
Biozone.



Sample C, Specimen MPK
7109. Radwood Borehole,
3008 ft., West Midlands,
England: Westphalian C, SL
Biozone.



Sample C, Specimen MPK
7110. Note curved monolet
mark. Radwood Borehole,
3008 ft., West Midlands,
England: Westphalian C, SL
Biozone.



Sample C, Specimen MPK
7111. Radwood Borehole,
3008 ft., West Midlands,
England: Westphalian C, SL
Biozone.



Shales below Faraday
House Sill, Argill Beck,
Stainmore, Cumbria,
England: Namurian,
Pendleian, NC Biozone.
Sample NC, Specimen MPK
7074. Oblique compression.
Note thick nature of exine
and narrow equatorial
crassitude. Trilete mark
distinct, sutures
accompanied by elevated
folds or ridges which extend
to the crassitude. Distal
surface of exine ornamented
with relatively coarse conate
ornament.

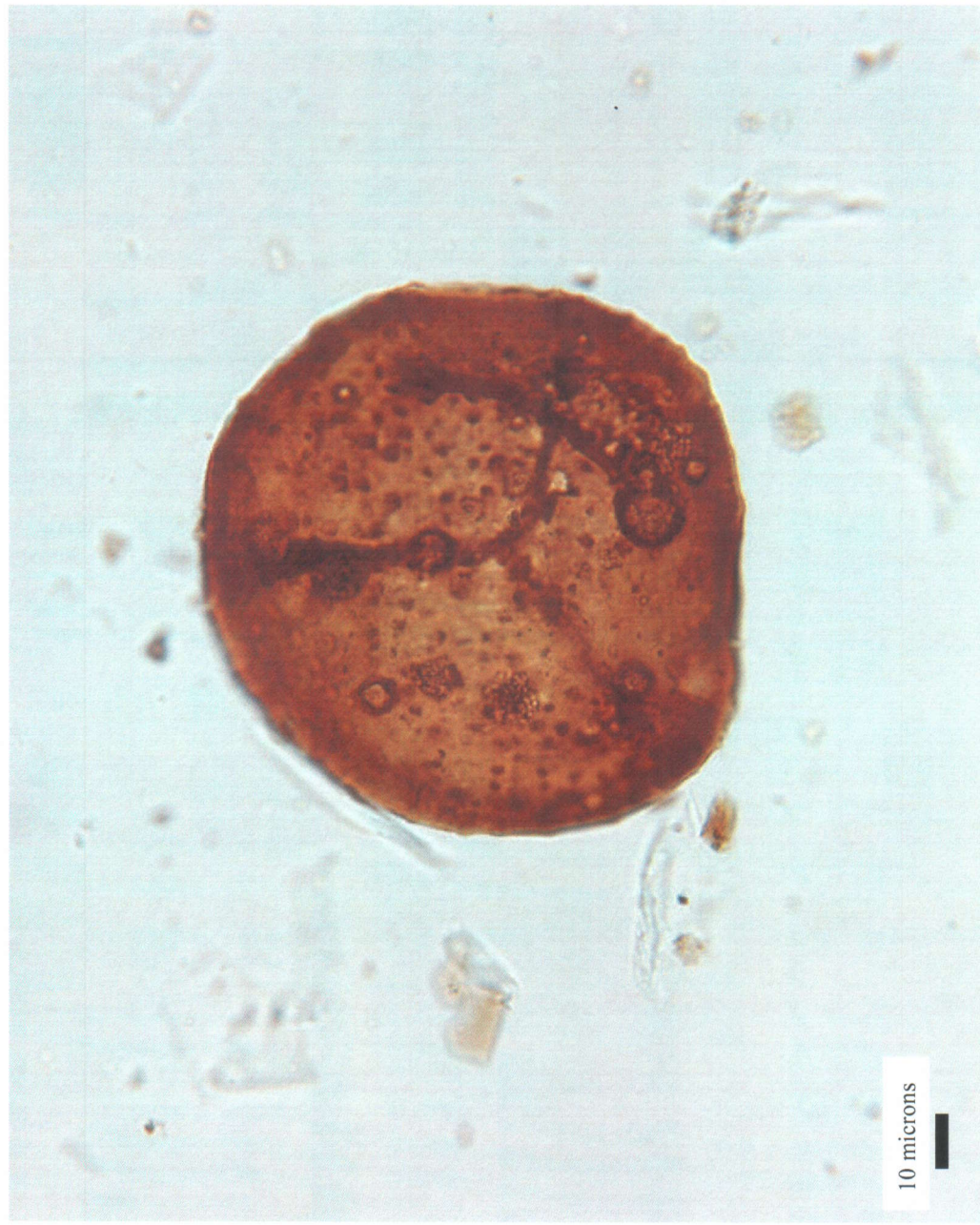


Shales below Hurler
Limestone, Hurler Borehole
160.70 m, Scotland: Viséan,
VF Biozone. Sample MPA
9162, Specimen MPK 7075.

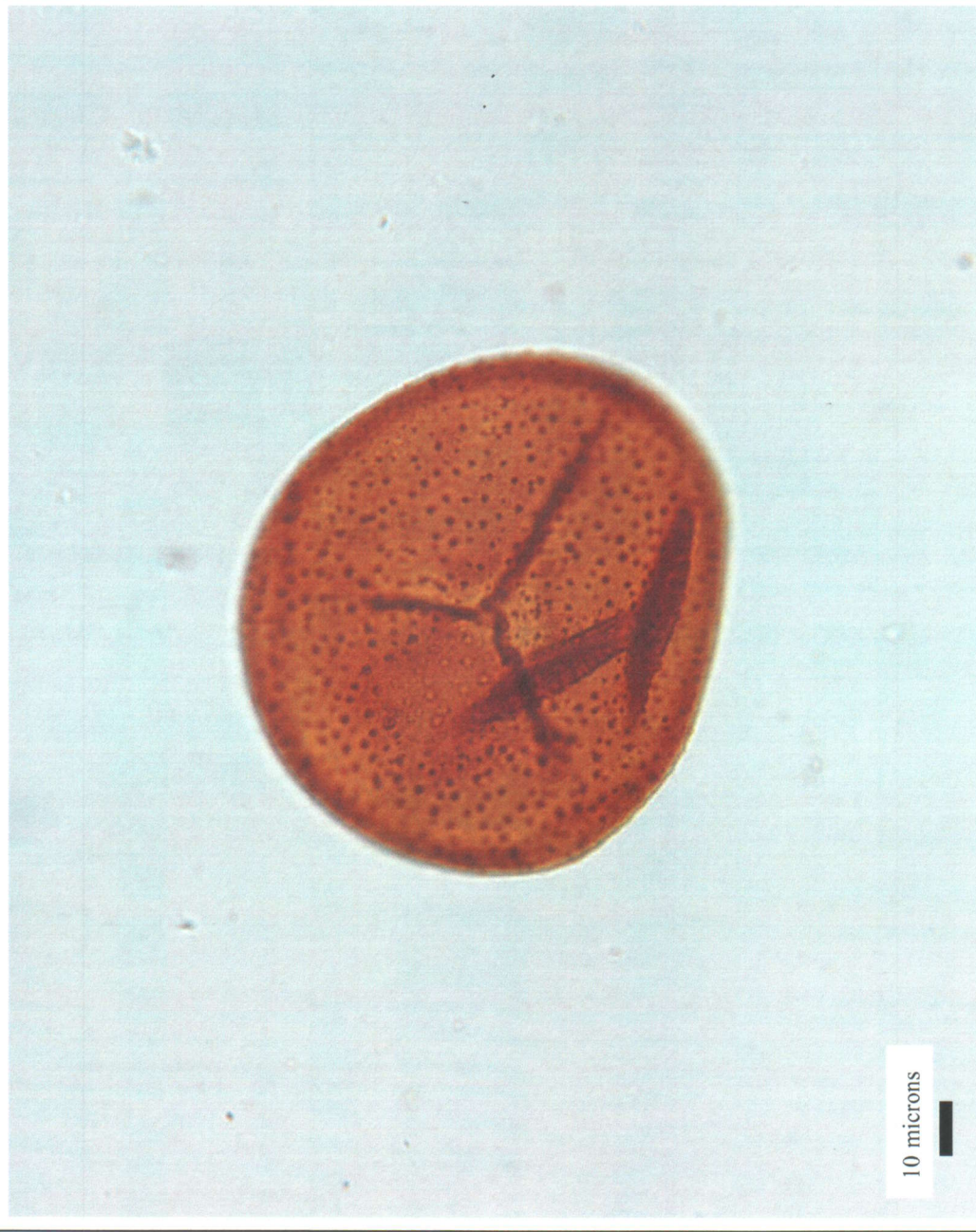
Proximal focus of slightly
obliquely compressed
specimen. Trilete mark
distinct, sutures
approximately three quarters
of spore radius,
accompanied by elevated
thickened ridges. Equatorial
crassitude, narrow, poorly
defined. Exine relatively
thick. Proximal surface
smooth, distal surface bears
fine granular or conate
ornament that protrudes at
equator. Minor compression
fold present.



Shales below Faraday
House Sill, as in Fig. 1,
Sample NC, Specimen MPK
7076. Equatorial crassitude
narrow, poorly defined.



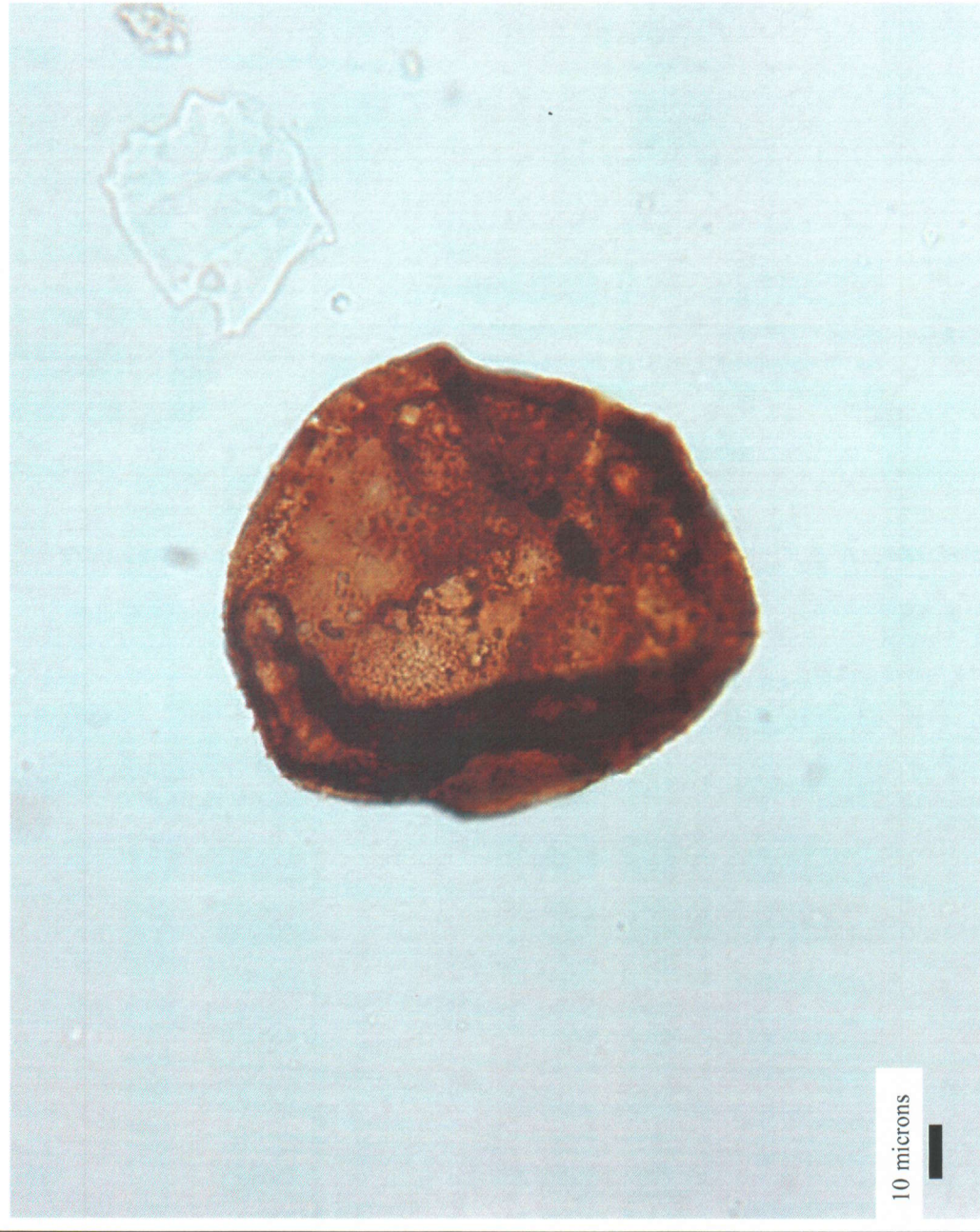
Shales below Hurler
Limestone, as in Fig. 2,
Sample MPA 9162,
Specimen MPK 7077. Note
narrow equatorial crassitude
and fine, relatively dense
conate ornament on distal
surface.



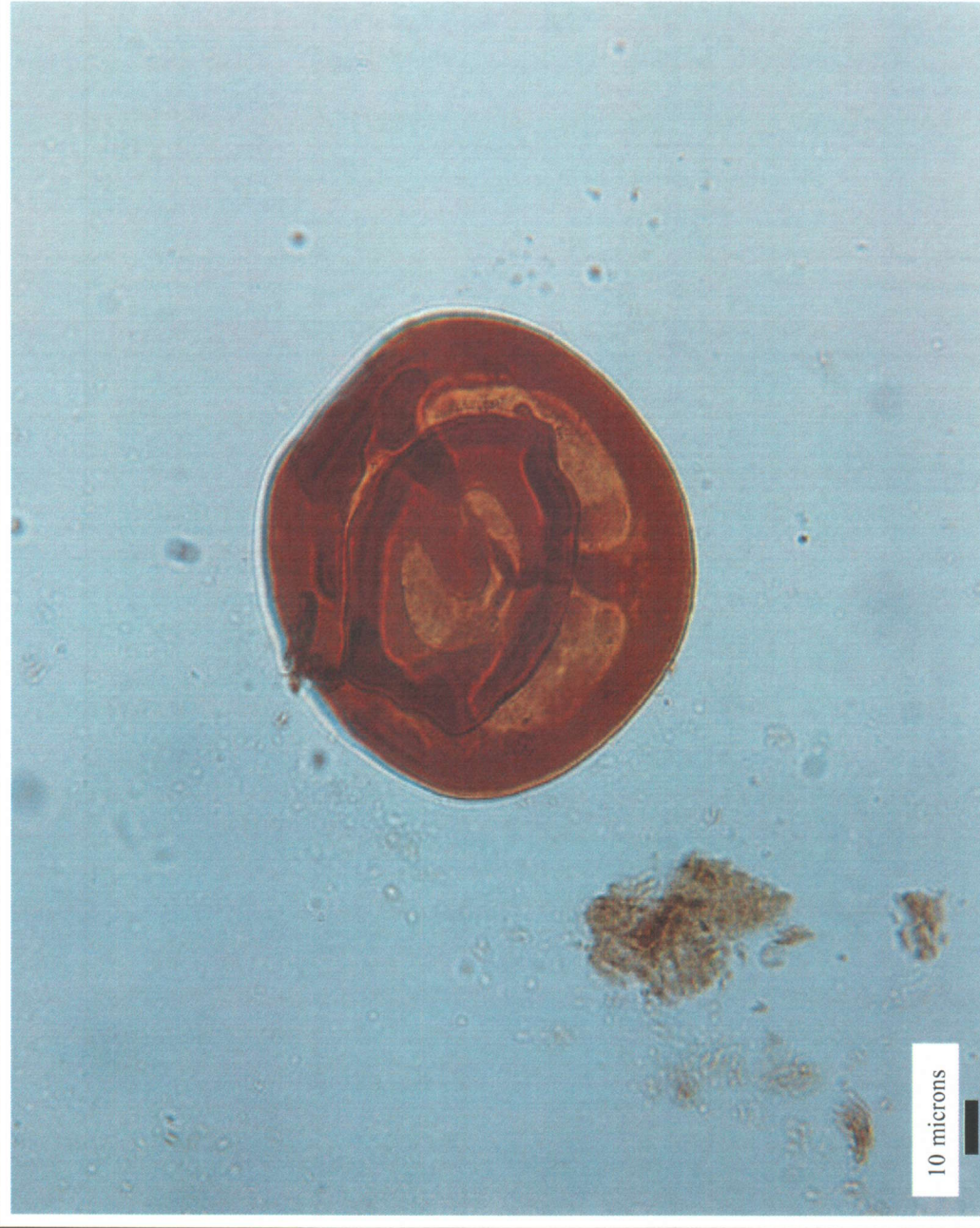
Shales below Faraday
House Sill, as in Fig. 1,
Sample NC, Specimen MPK
7078.



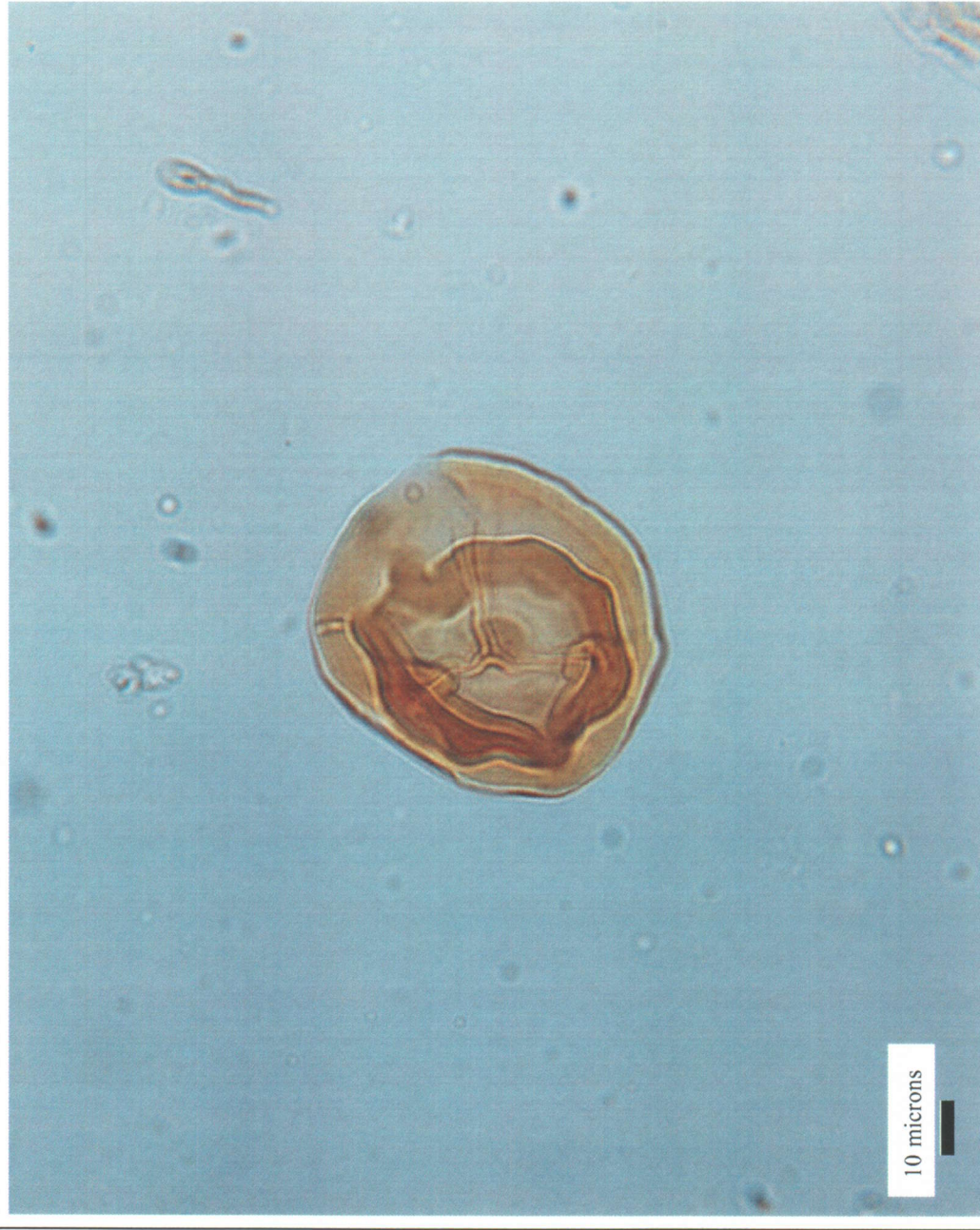
Shales below Faraday
House Sill, as in Fig. 1,
Sample NC, Specimen MPK
7079.



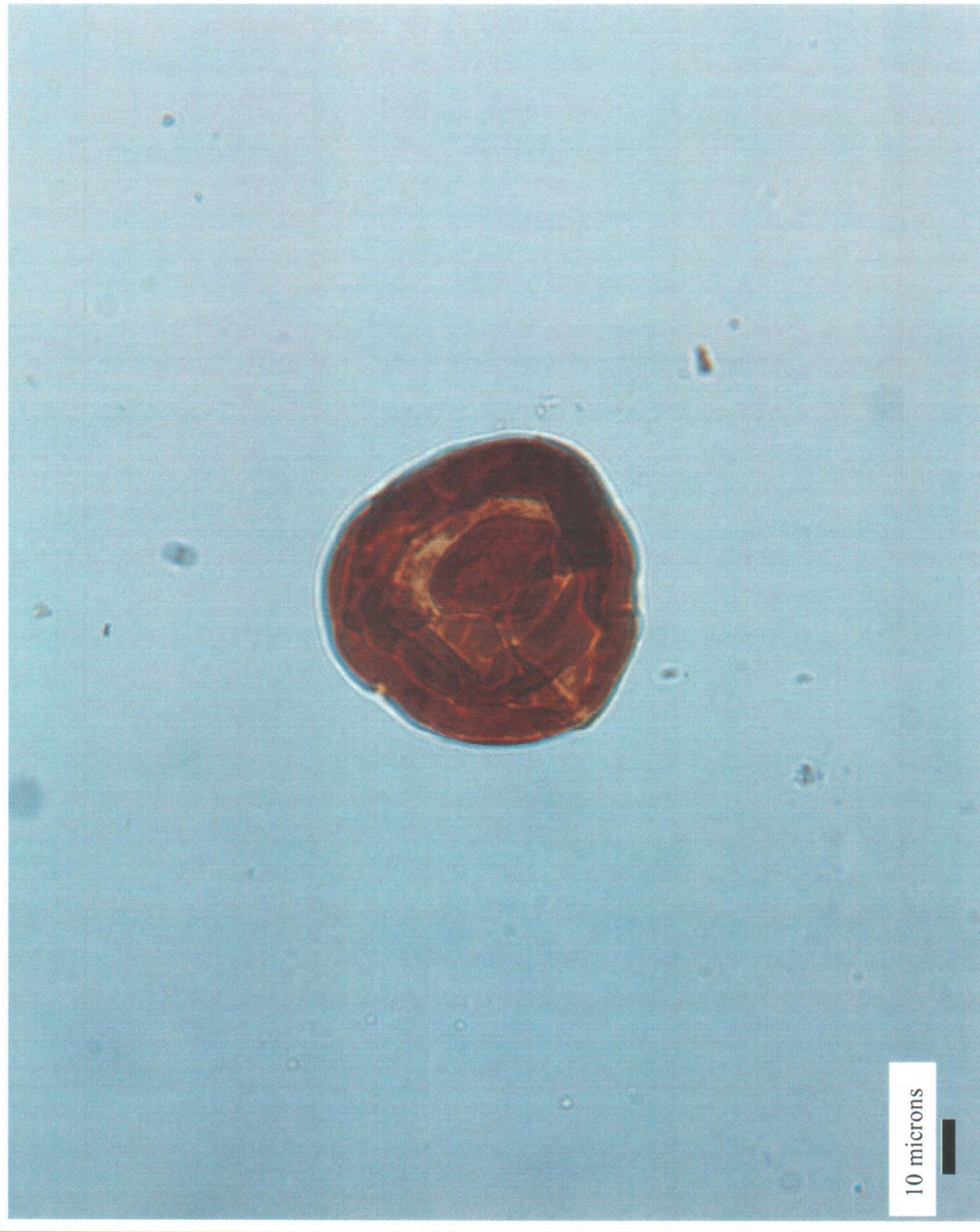
Shales below Hurllet Limestone, Hurllet Borehole, 160.70 m, Scotland; Viséan, VF Biozone. Sample MPA 9162, Specimen MPK 7037. Characteristic development of uniform equatorial cingulum, circular ring of thickening half way to distal pole and distal polar thickening. Trilete mark extends almost to equator of body where it fuses with invaginated extension from inner surface of cingulum.



Coal above Lower Stonesdale
Limestone, Coldkeld Beck, Stainmore,
Cumbria, England; Namurian,
Pendleian, NC Biozone. Sample CB2
1, Specimen MPK **7038**. Trilete
sutures accompanied by thickened lips
which become expanded towards
equator and fuse with cingulum that is
invaginated in that position.



Waters Farm Borehole, 14.50 m,
Lancashire, England; Namurian,
Yeadonian, FR Biozone. Sample MPA
18197, Specimen MPK 7039. Note
development of prominent thickening
in distal polar region.

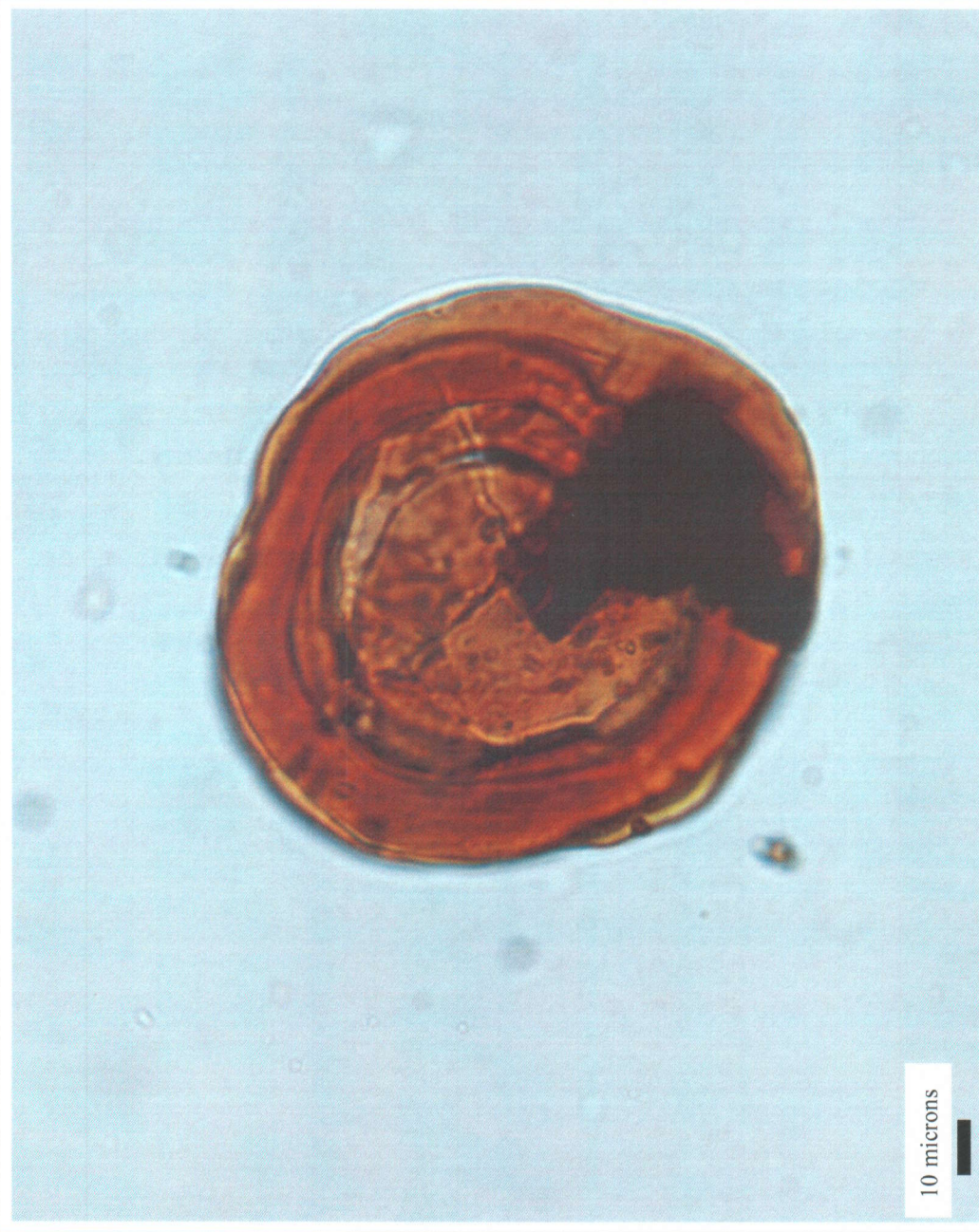


10 microns

Shales below Faraday House Sill,
Argill Beck, Stainmore, Cumbria,
England; Namurian, Pendleian, NC
Biozone. Sample MPA 31161,
Specimen MPK 7040.



Shales below Faraday House Sill, as in
Fig. 4, Sample 31165, Specimen MPK
7041.



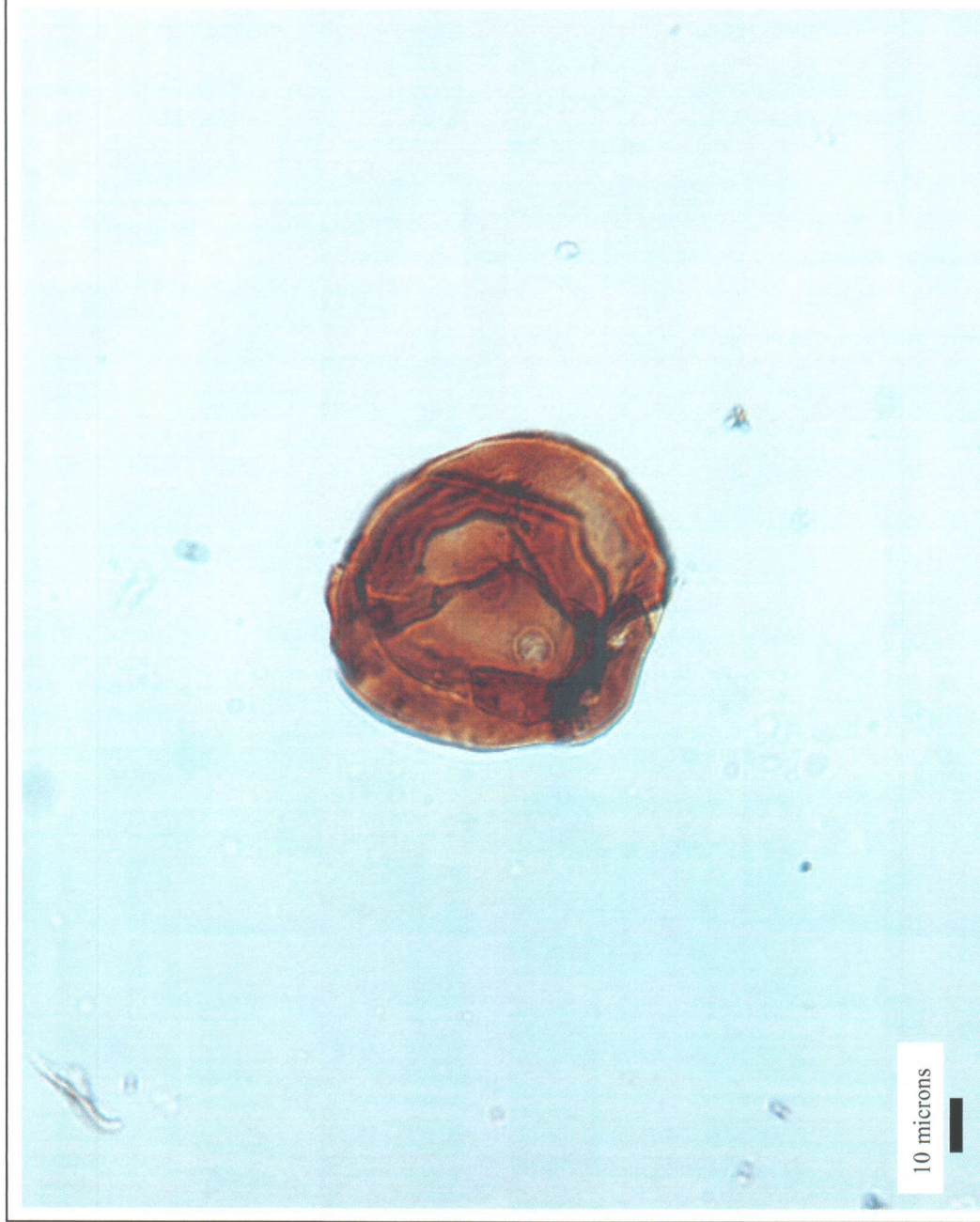
Shales below Swinstone
House Marine Band,
Mousegill Beck, Stainmore,
Cumbria, England;
Namurian, FR Biozone.
Sample T96, Specimen
MPK 7042. Oblique
compression.



Waters Farm Borehole,
14.50 m, as in Fig. 3,
Sample MPA 18197,
Specimen MPK **7043**.
Oblique compression.



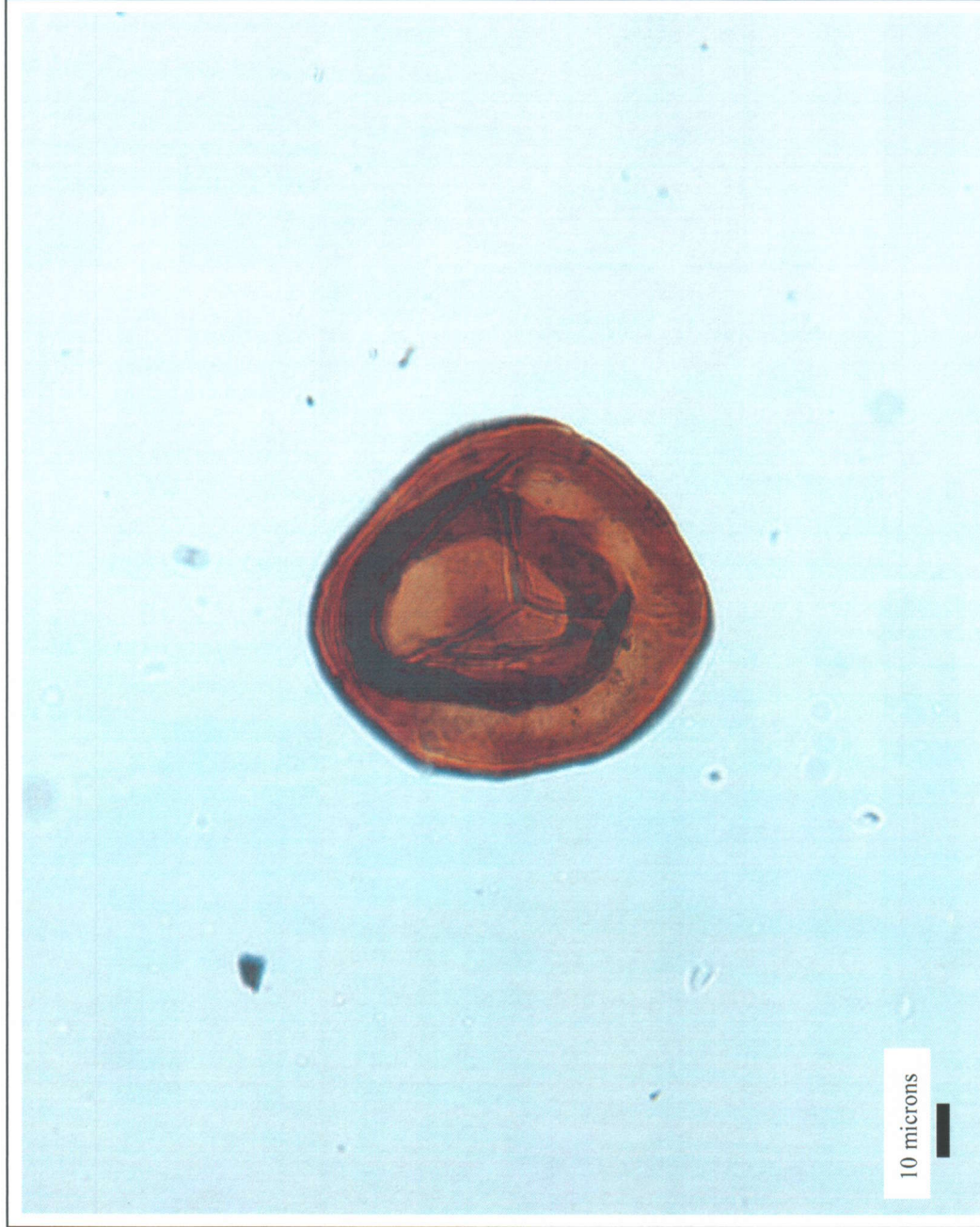
Waters Farm Borehole,
14.50 m, as in Fig. 3,
Sample MPA 18197,
Specimen MPK 7044. Note
development of relatively
small thickening at distal
pole and thickenings at end
of trilete sutures which
appear to fuse with
cingulum.



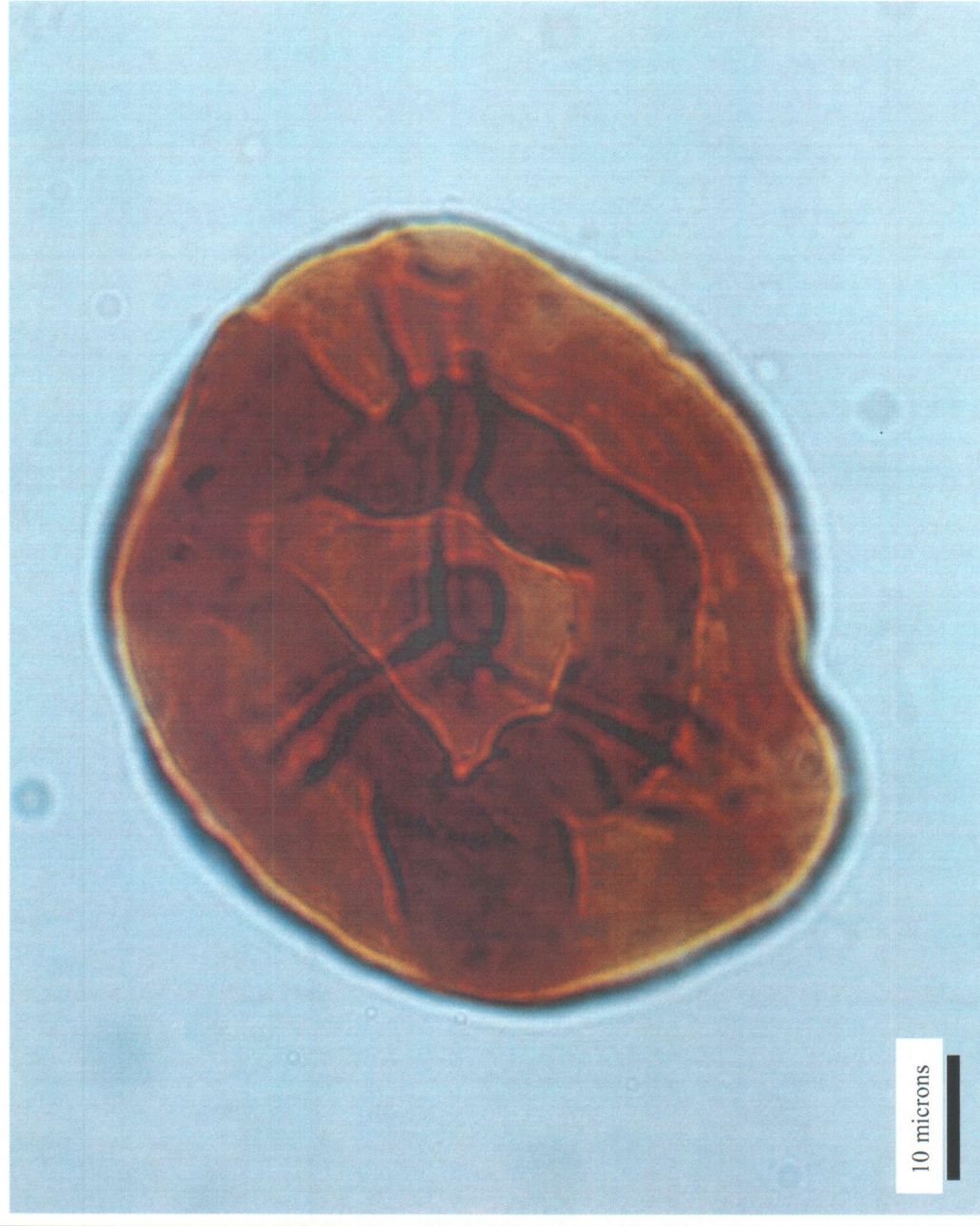
Shales below Faraday
House Sill, as in Fig. 4,
Sample MPA 31165,
Specimen MPK 7045.



Waters Farm Borehole,
14.50 m, as in Fig. 3,
Sample MPA 18197,
Specimen MPK 7046.



Diddup Borehole, 7.20 m,
Scotland; Westphalian A,
SS Biozone, Sample MPA
4578, Specimen MPK 7047.
Distal focus.

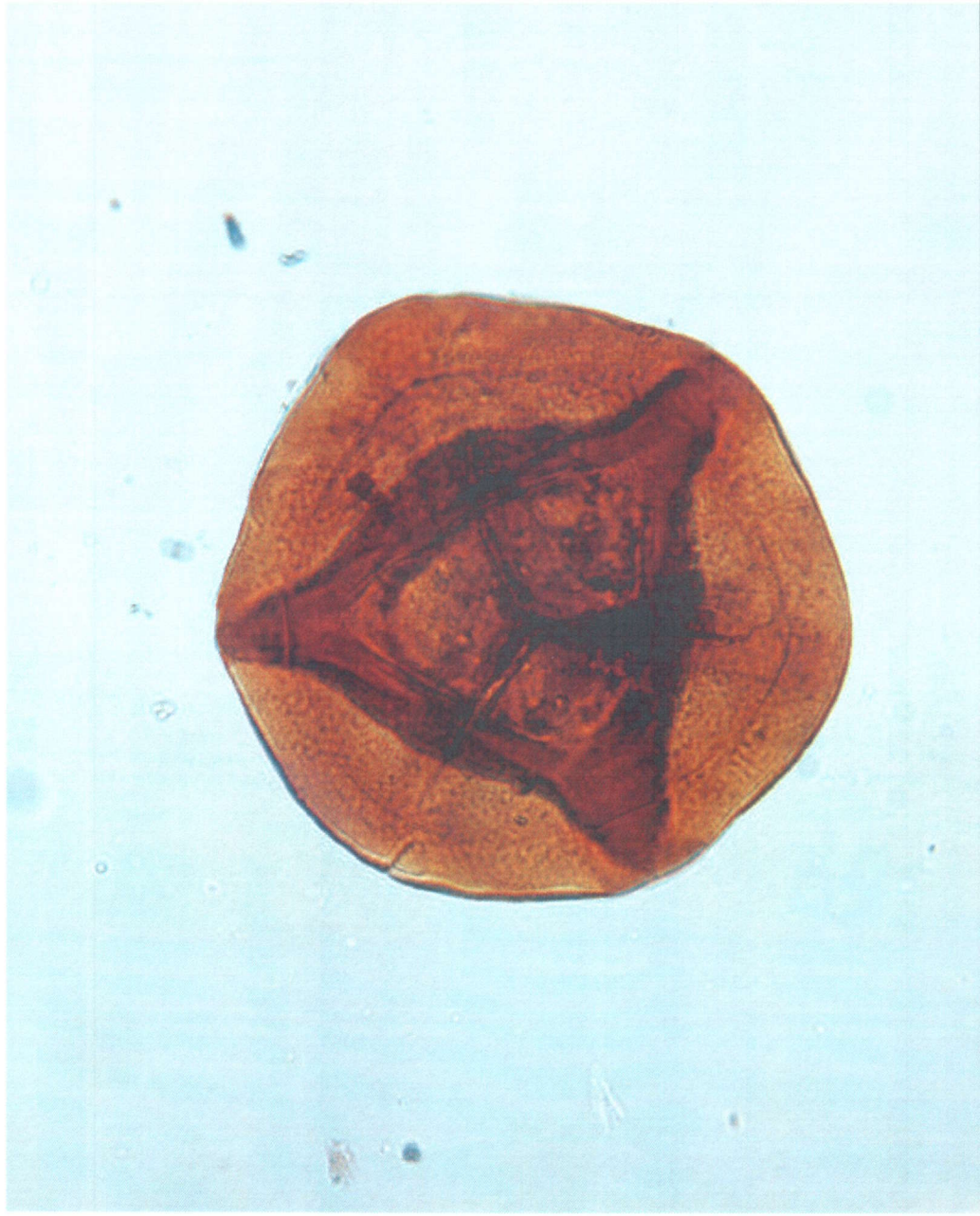


Halesowen Beds, Callow
Brook, Staffordshire,
England; Westphalian D,
UP Biozone, Sample MPA
12628, Specimen MPK
7048. Proximal focus
showing development of
thickenings at end of trilete
sutures which fuse onto
cingulum.

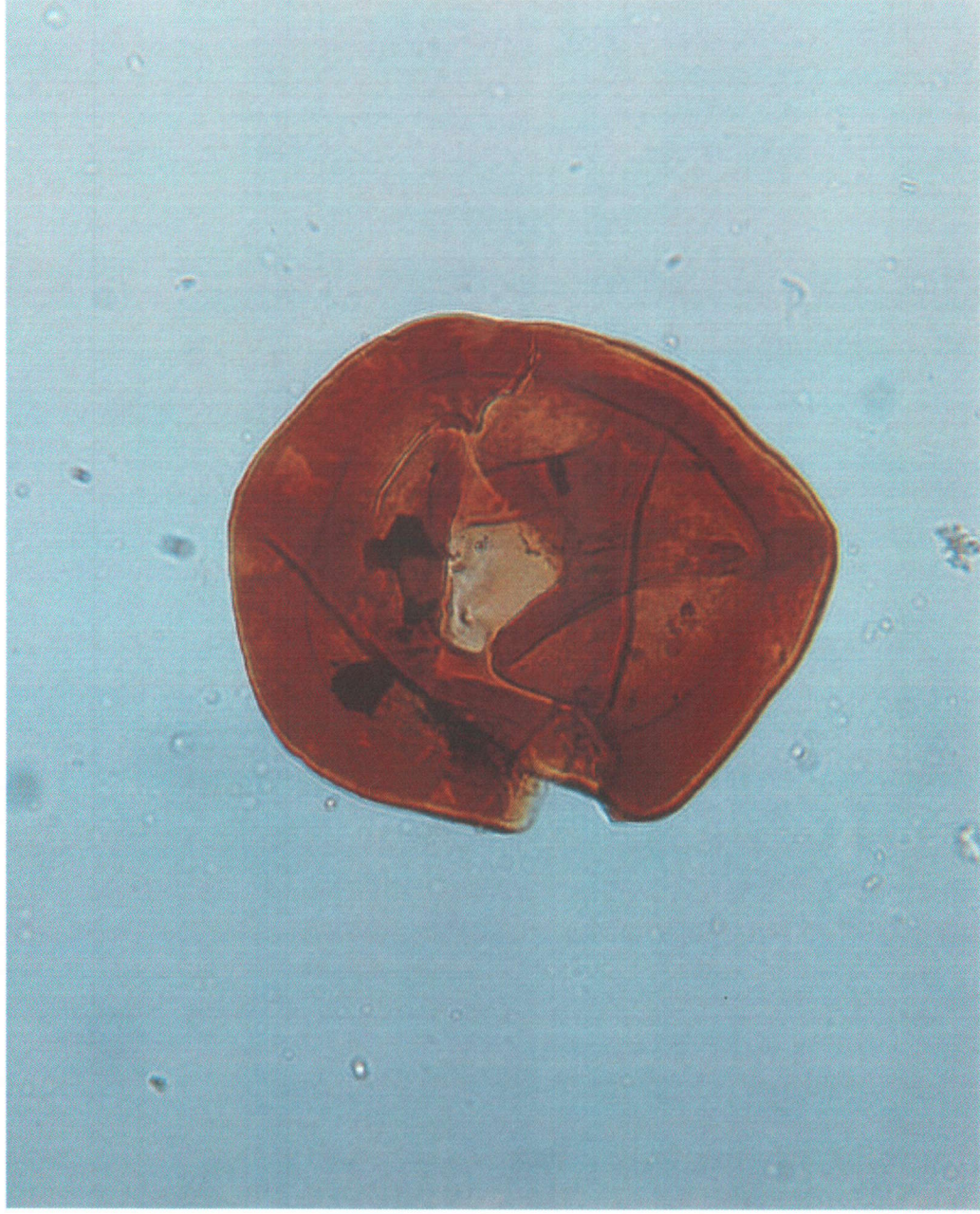


10 microns

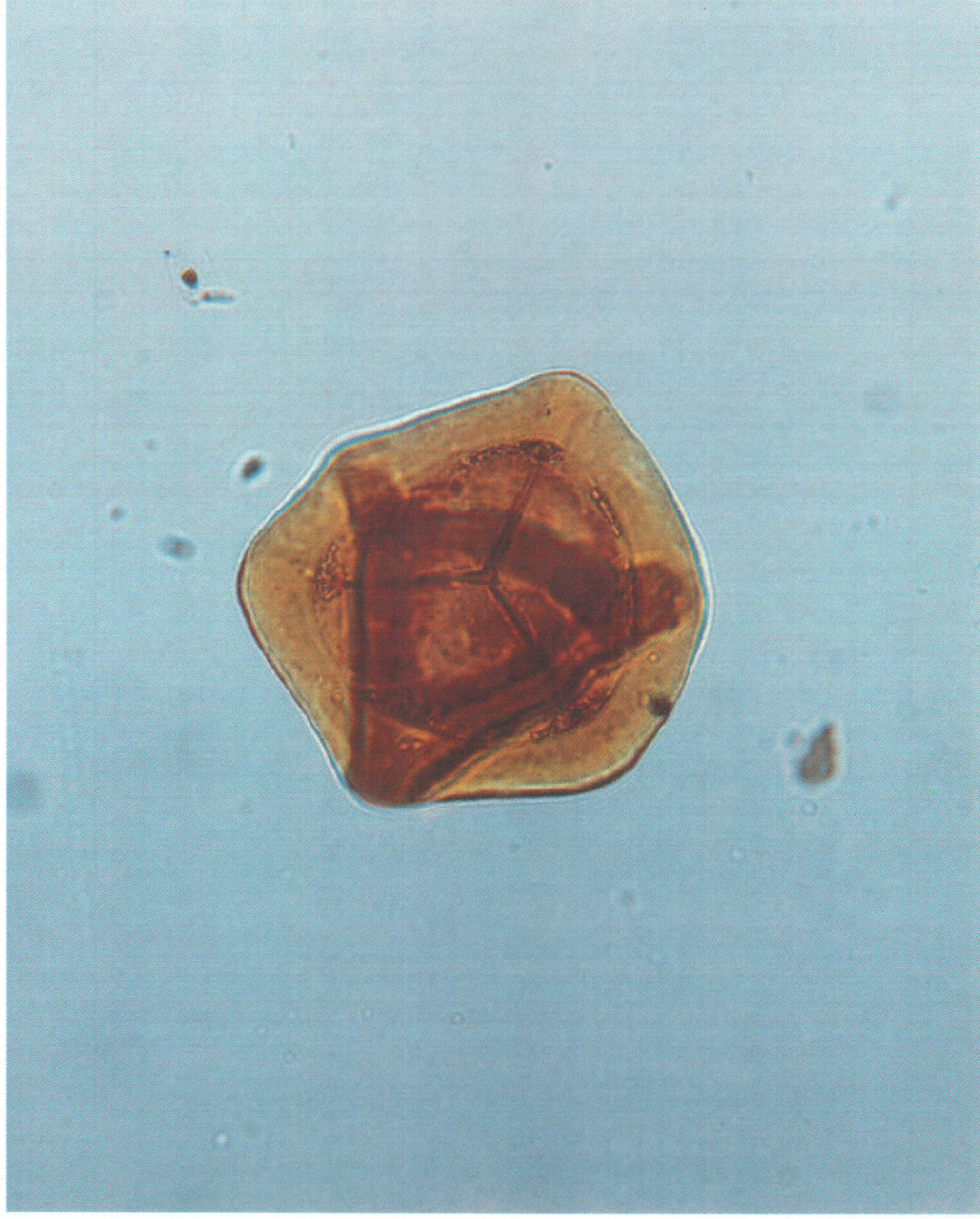
Pinskey Gill Beds, Wygarth Gill
Borehole, Ravenstonedale, Cumbria,
England: Tournaisian, CM Biozone,
Sample MPA 292, Specimen **7031**.
Subcircular-pentagonal cingulate
miospore. Trilete mark distinct,
sutures accompanied by low, broad
labra extend almost to equatorial
margin of spore body. Cingulum thick,
uniform. Distal surface of spores bears
three straight to slightly bent thickened
ridges that form distinctive triangular
structure. Apices of triangle fused to
distal surface of cingulum in the inter-
radial position. Exine surface laevigate
or very finely roughened.



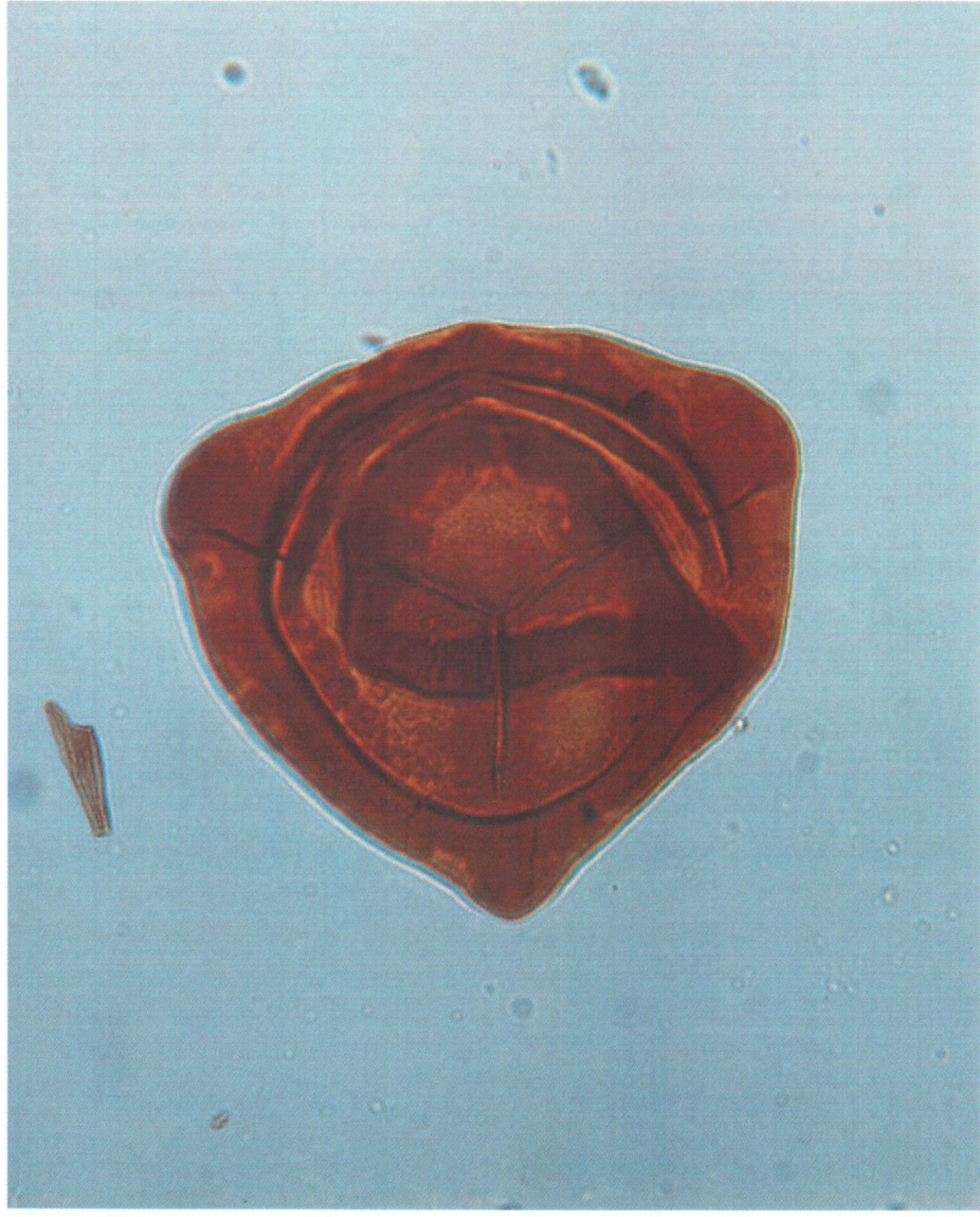
Pinskey Gill Beds, Wygarth Gill
Borehole, Ravenstonedale, Cumbria,
England, as in Fig. 1, Sample MPA
292, Specimen MPK **7032**. Torn
specimen, proximal focus. Trilete
mark distinct, open; sutures
accompanied by low broad thickened
labra which extend almost to
equatorial margin of body. Triangular
distal structure distorted by a tear.



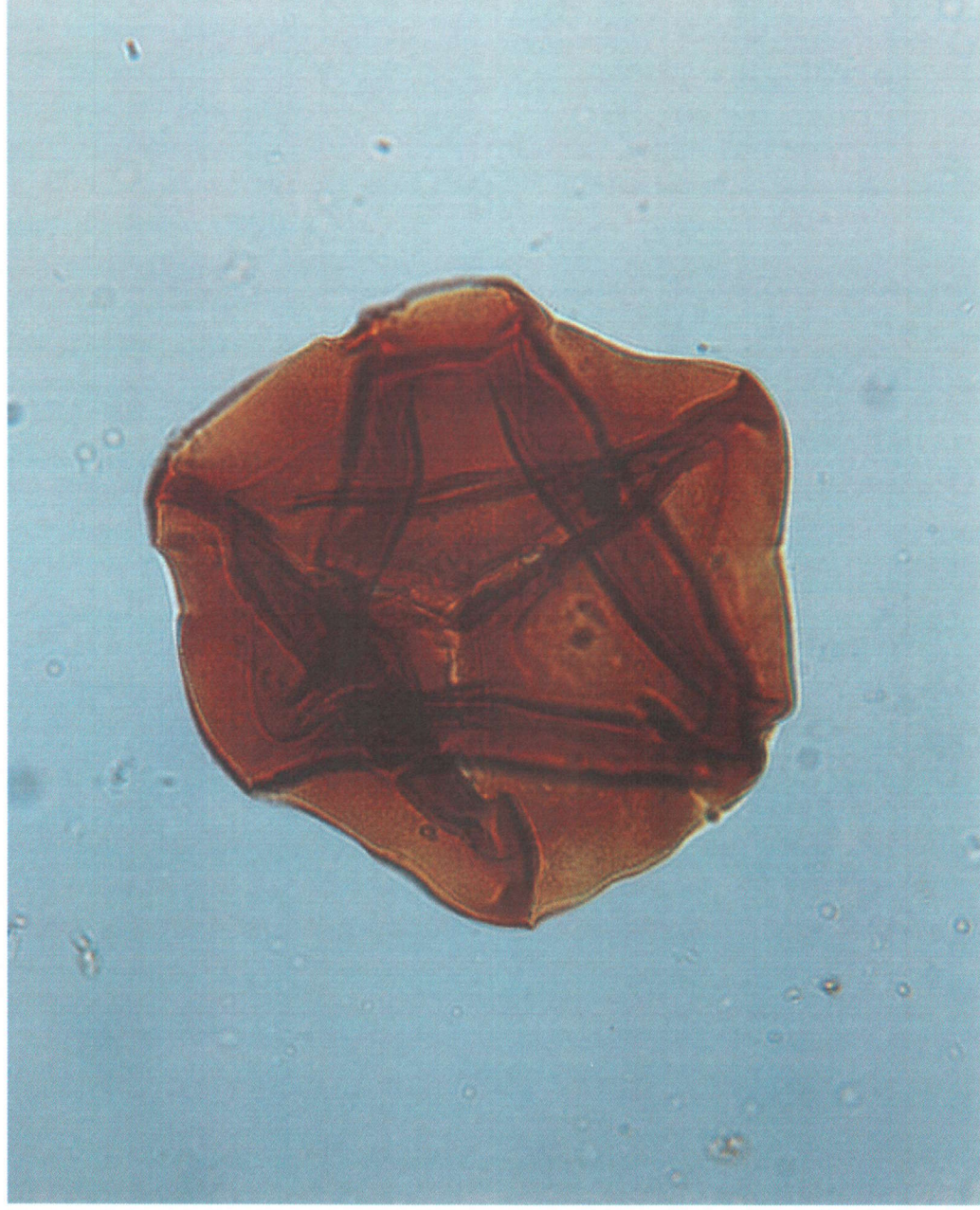
Cementstone Group, Bracken Bay,
Heads of Ayr, Ayrshire, Scotland;
Tourmaisian, CM Biozone. Sample
MPA 29832, Specimen MPK **7033**.
Rounded triangular miospore with
uniform, thick, cingulum. Trilete mark
distinct, sutures apparently without
thickened labra extend to equator of
spore body. Characteristic triangular
shaped thickening on the distal surface
appears to show minor expansion at
the apices where it fuses with
cingulum surface.



Cementstone Group, Bracken Bay,
Heads of Ayr, Ayrshire, Scotland, as
in Fig. 3, Sample MPA 29832,
Specimen MPK **7034**. Rounded
triangular specimen with subcircular
inner body surrounded by cingulum
showing slight expansion in width at
the radial margins. Trilete mark
distinct, sutures extend to equatorial
margin of body and accompanied by
low, broad, thickened labra that extend
beyond ends of trilete rays onto
proximal surface of cingulum. Distal
thickening ill formed being attached to
cingulum only in one inter-radial
position.

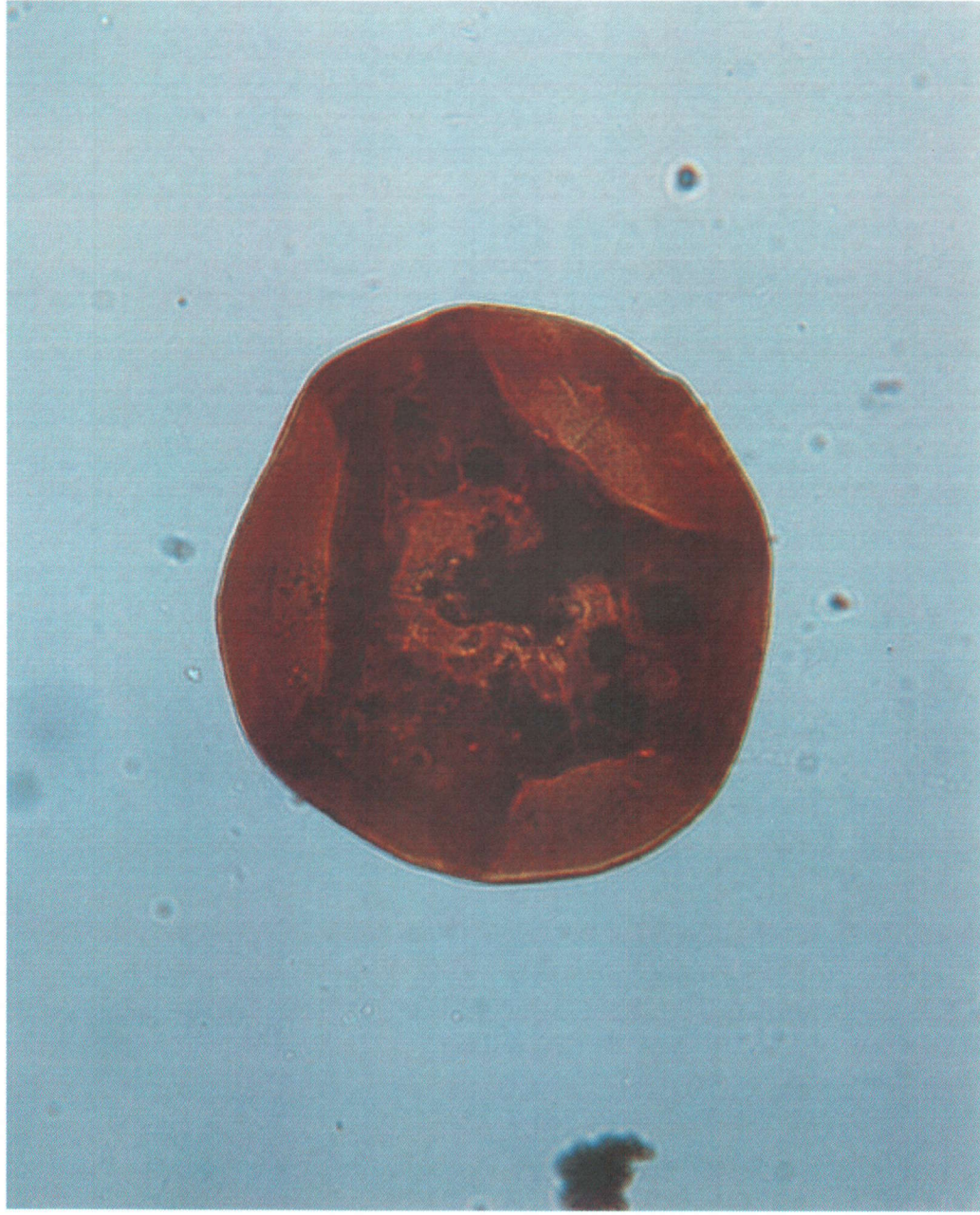


Pinskey Gill Beds, Wygarth Gill
Borehole, Ravenstonedale, Cumbria,
England, as in fig. 1, Sample MPA
298, Specimen MPK **7035**.
Hexagonal, slightly folded specimen
with characteristic triangular
thickening on the distal surface. Trilete
mark distinct, sutures extending to the
body margin accompanied by broad,
low, thickened lips that extend beyond
the end of the trilete rays, across the
cingulum to the equatorial margin.

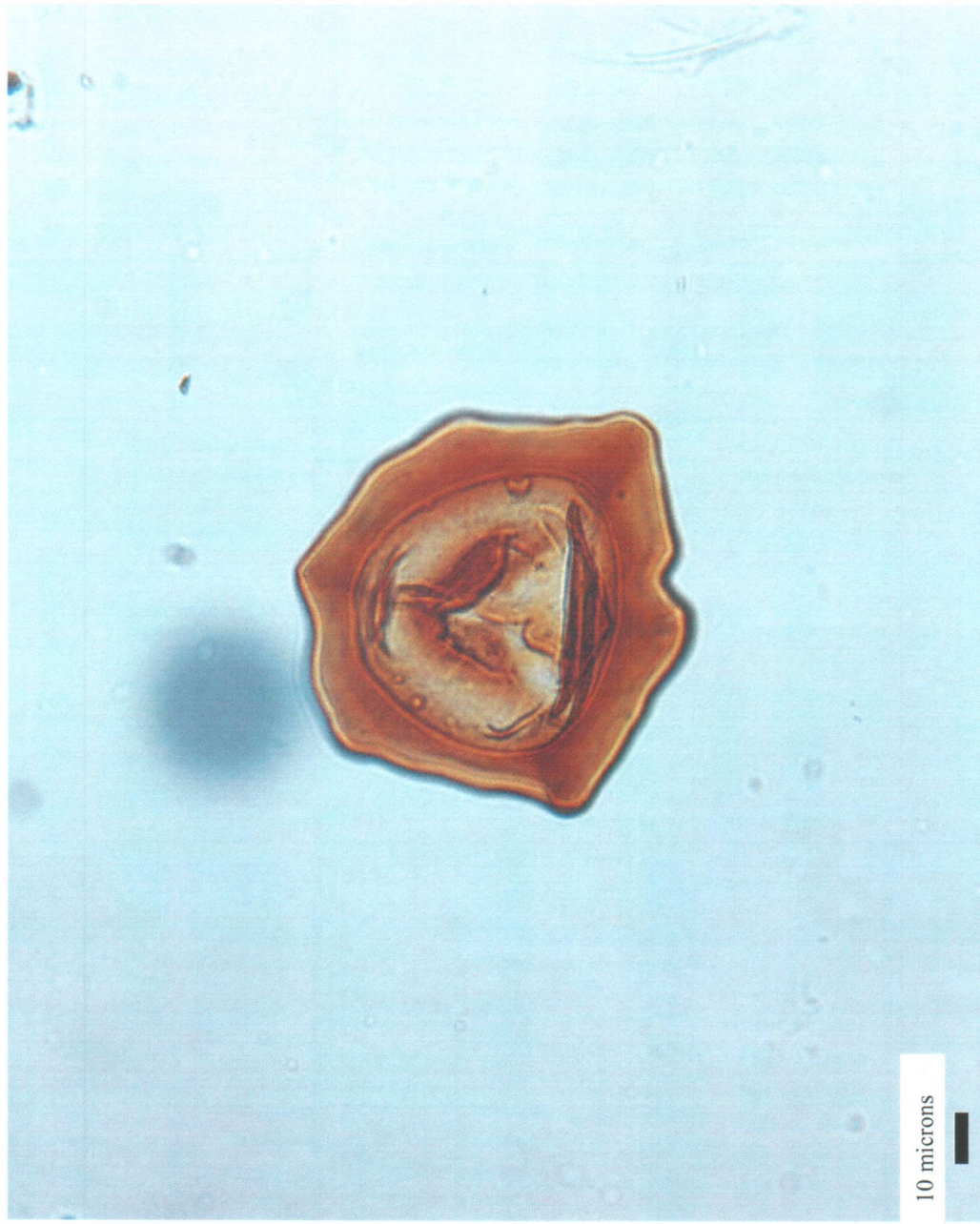


Pinskey Gill Beds, Wygarth Gill
Borehole, Ravenstonedale, Cumbria,
England, as in Fig. 1, Sample MPA
292, Specimen MPK 7036.

Morphological variant where sides of
distinctive triangular structure on
distal surface do not fuse together onto
the cingulum but form a 'kyrtome like'
structure.



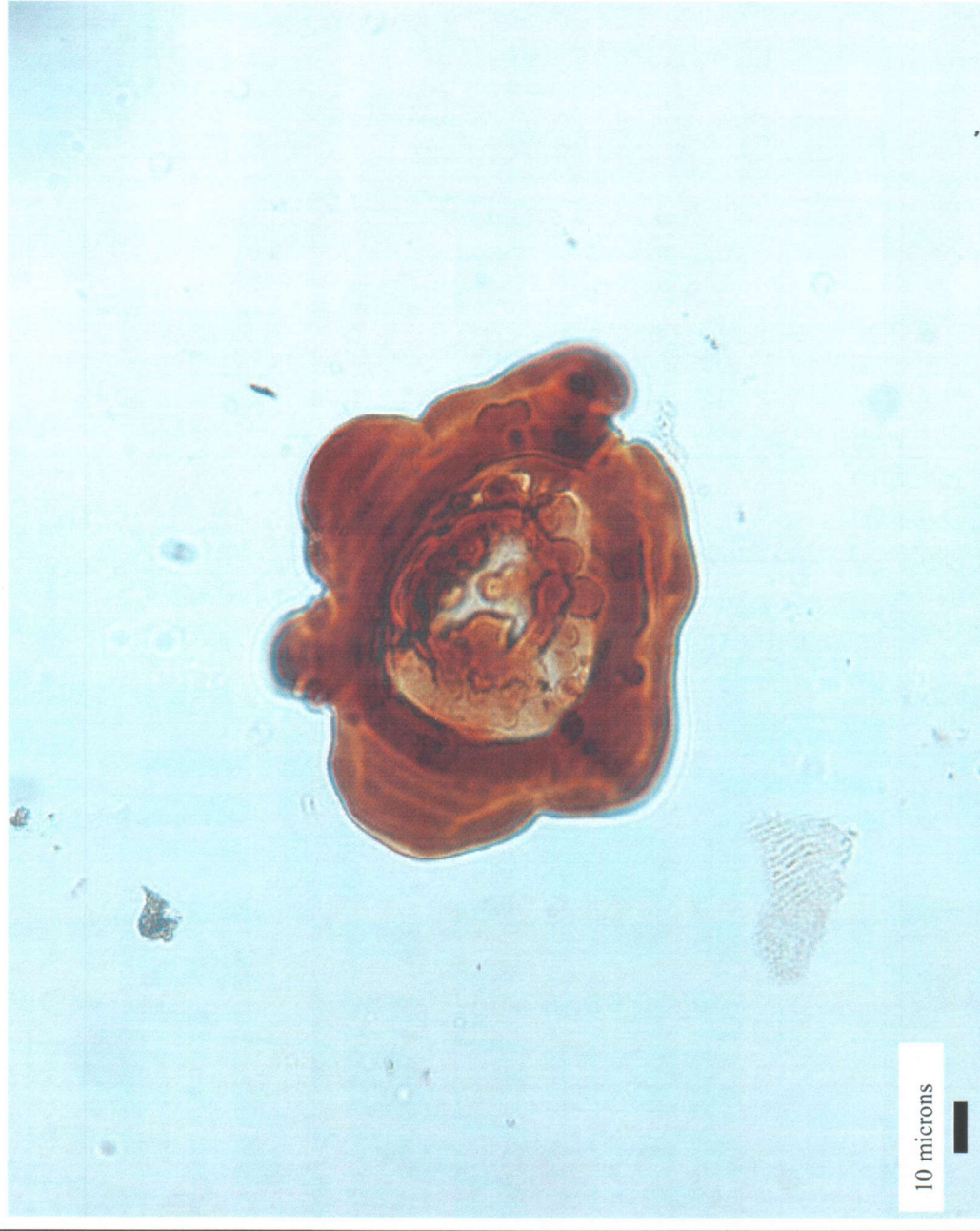
Sample MPA 4597,
Specimen MPK 7019.
Equatorial focus of
specimen with polygonal
equatorial outline but
rounded triangular-
subcircular inner body.
Trilete mark distinct, open,
sutures extend to outer
margin of inner body.
Cingulum thick and weakly
trizonate. Minor thickenings
developed on proximal
surface of cingulum
extending from equatorial
margin to ends of trilete
rays. Diddup Borehole, 7.20
m, Scotland; early
Westphalian A, SS Biozone.



Sample MPA 4579,
Specimen MPK 7020.
Characteristic development
of differentially thickened
cingulum with three zones,
inner relatively narrow
thickened zone, wide
thinner median zone and
relatively narrow
incomplete outer zone.
Equatorial margin undulate.
Inner body rounded
triangular, showing minor
separation in the equatorial
plane from the cingulum.
Trilete mark distinct, simple
open, extending to body
margin. Diddup Borehole,
7.20 m, Scotland; early
Westphalian A, SS Biozone.

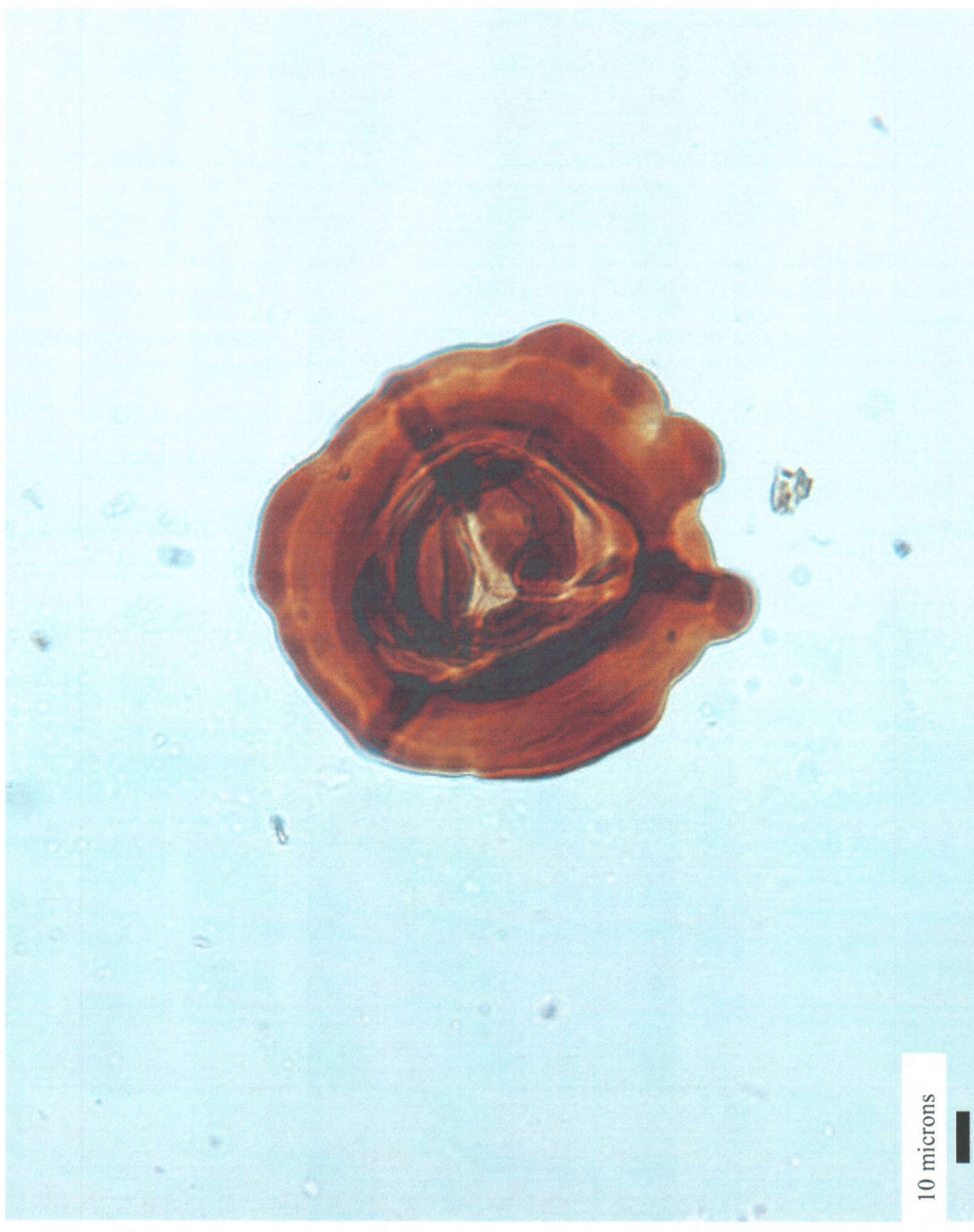


Sample MPA 4579,
Specimen MPK 7021.
Folded specimen showing
three fold subdivision of
cingulum. Equatorial margin
irregular. Diddup Borehole,
7.20 m, Scotland; early
Westphalian A, SS Biozone.



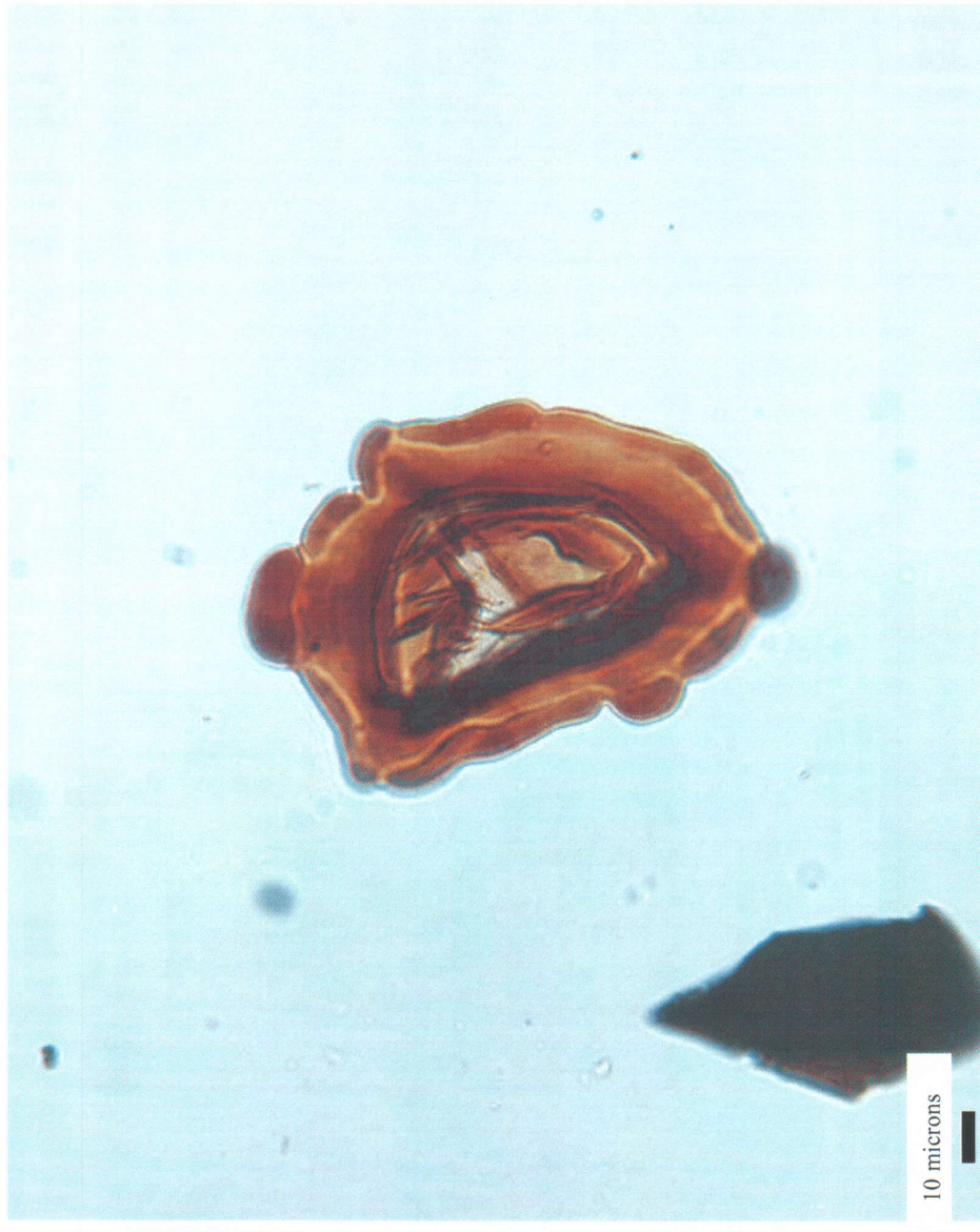
10 microns

Sample MPA 4579,
Specimen MPK 7022. Note
thickened outer zone of
cingulum incomplete.
Radial thickenings
developed on proximal
surface extending from
equatorial margin to join up
with ends of trilete sutures.
Limited development of
irregular distal thickening
underneath inner body.
Diddup Borehole, 7.20 m,
Scotland; early Westphalian
A, SS Biozone.



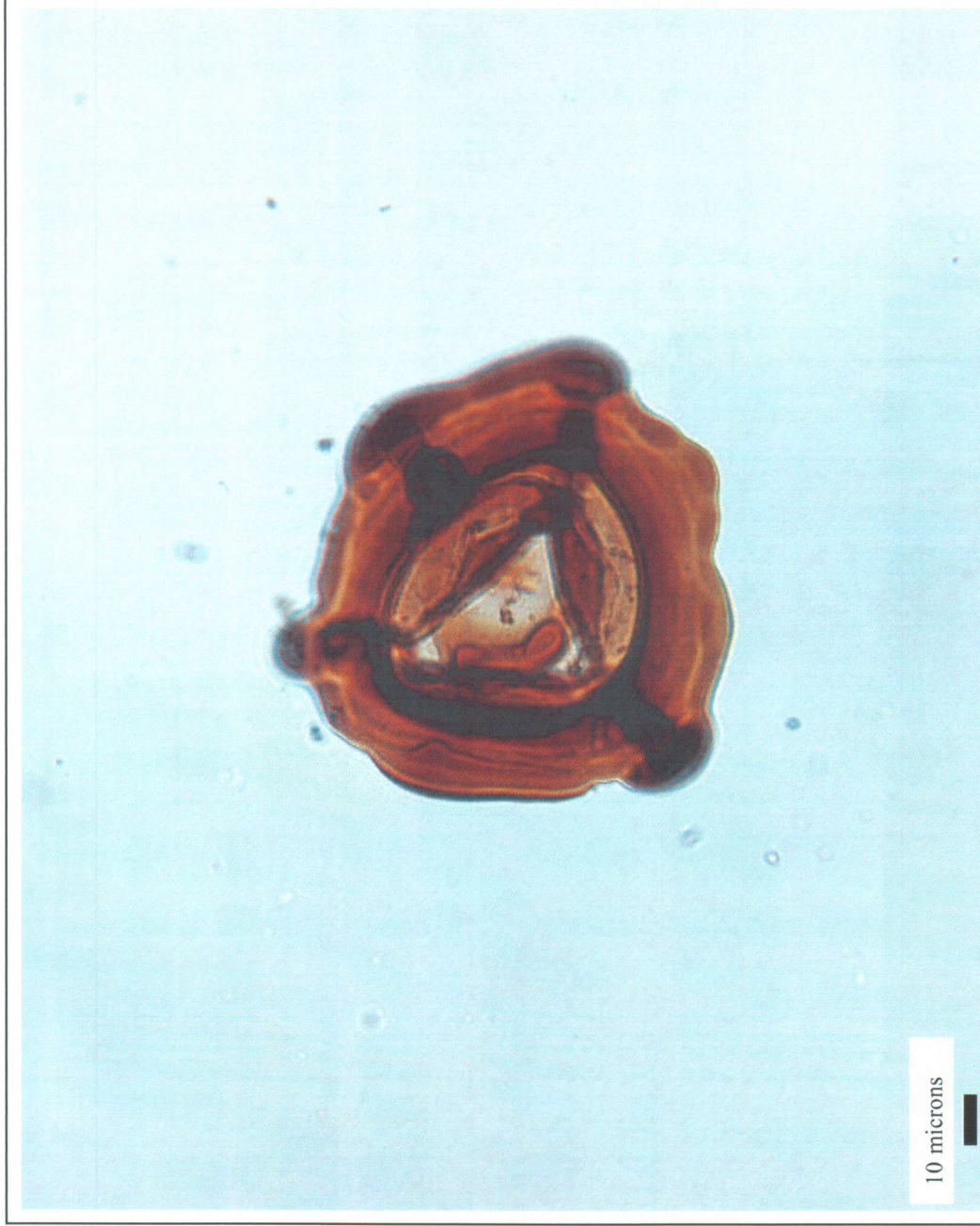
10 microns

Sample MPA 4579,
Specimen MPK 7023.
Specimen showing marked
irregularities in
development of outer
thickened zone of cingulum.
Note evidence of minor
separation of inner body
from cingulum in the
equatorial plane. Trilete
mark partly obscured, open
and with indication of
narrow thickened lips.
Diddup Borehole, 7.20 m,
Scotland; early Westphalian
A, SS Biozone.



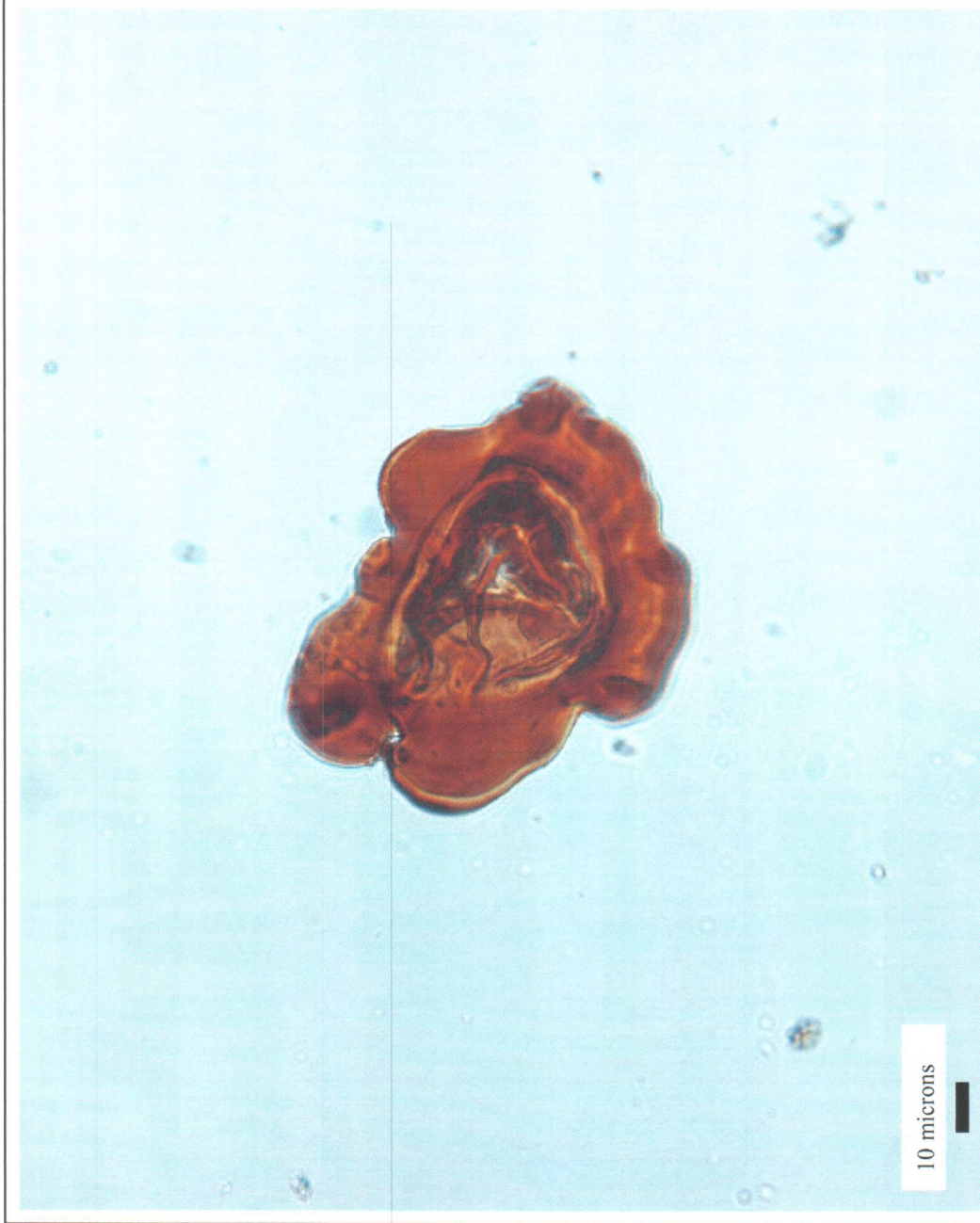
10 microns

Sample MPA 4579,
Specimen MPK 7024.
Trilete mark open but with
sutures which appear to
extend to equatorial margin
of body. Well-developed
differentially thickened
cingulum with relatively
wide thickened inner zone,
narrow thinner median zone
and erratically developed
thicker outer zone. Radial
thickenings well developed
on proximal surface,
extending from equatorial
margin to join up with ends
of trilete rays. Diddup
Borehole, 7.20 m, Scotland;
early Westphalian A, SS
Biozone.

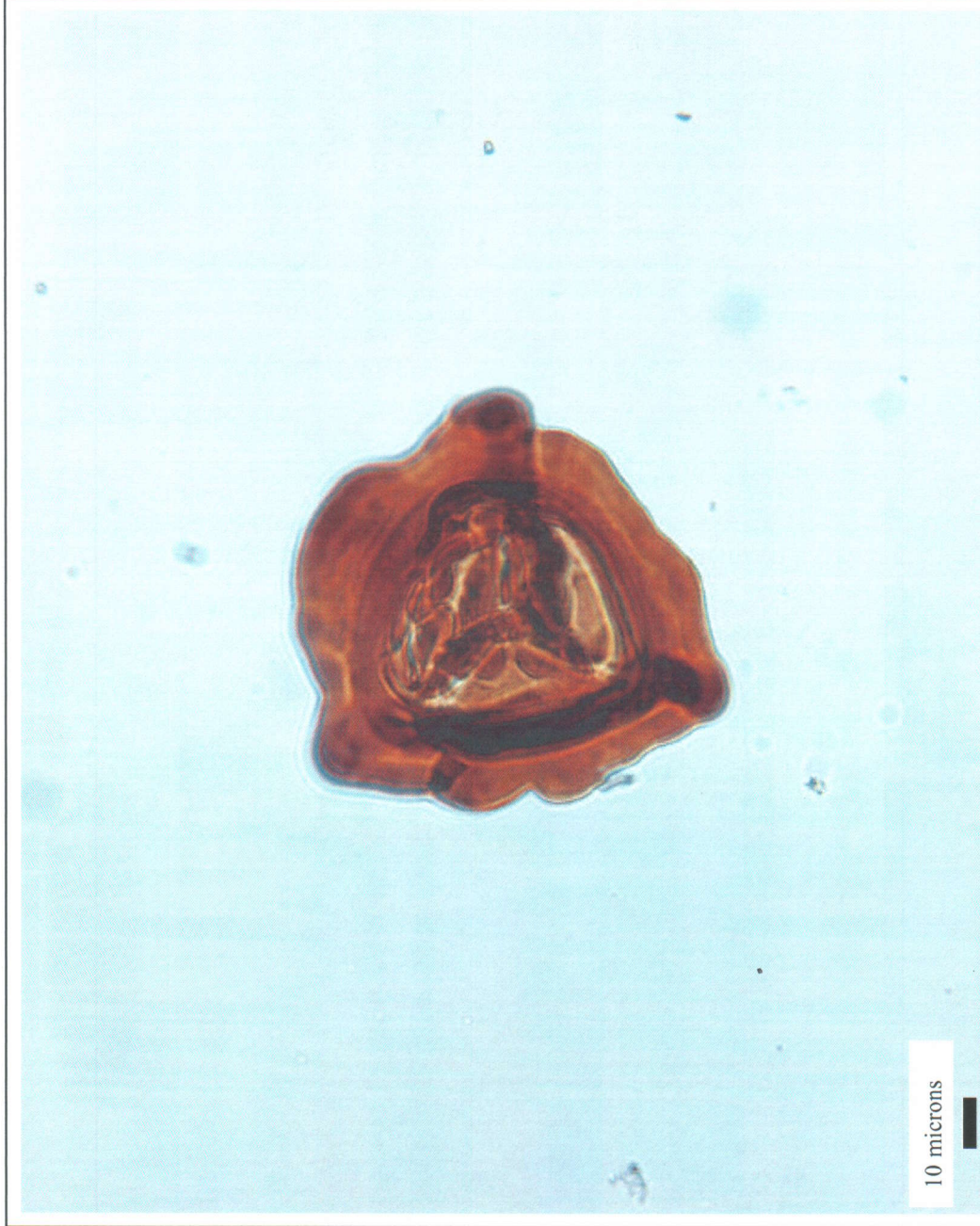


10 microns

Sample MPA 4579,
Specimen MPK 7025.
Diddup Borehole, 7.20 m,
Scotland; early Westphalian
A, SS Biozone.

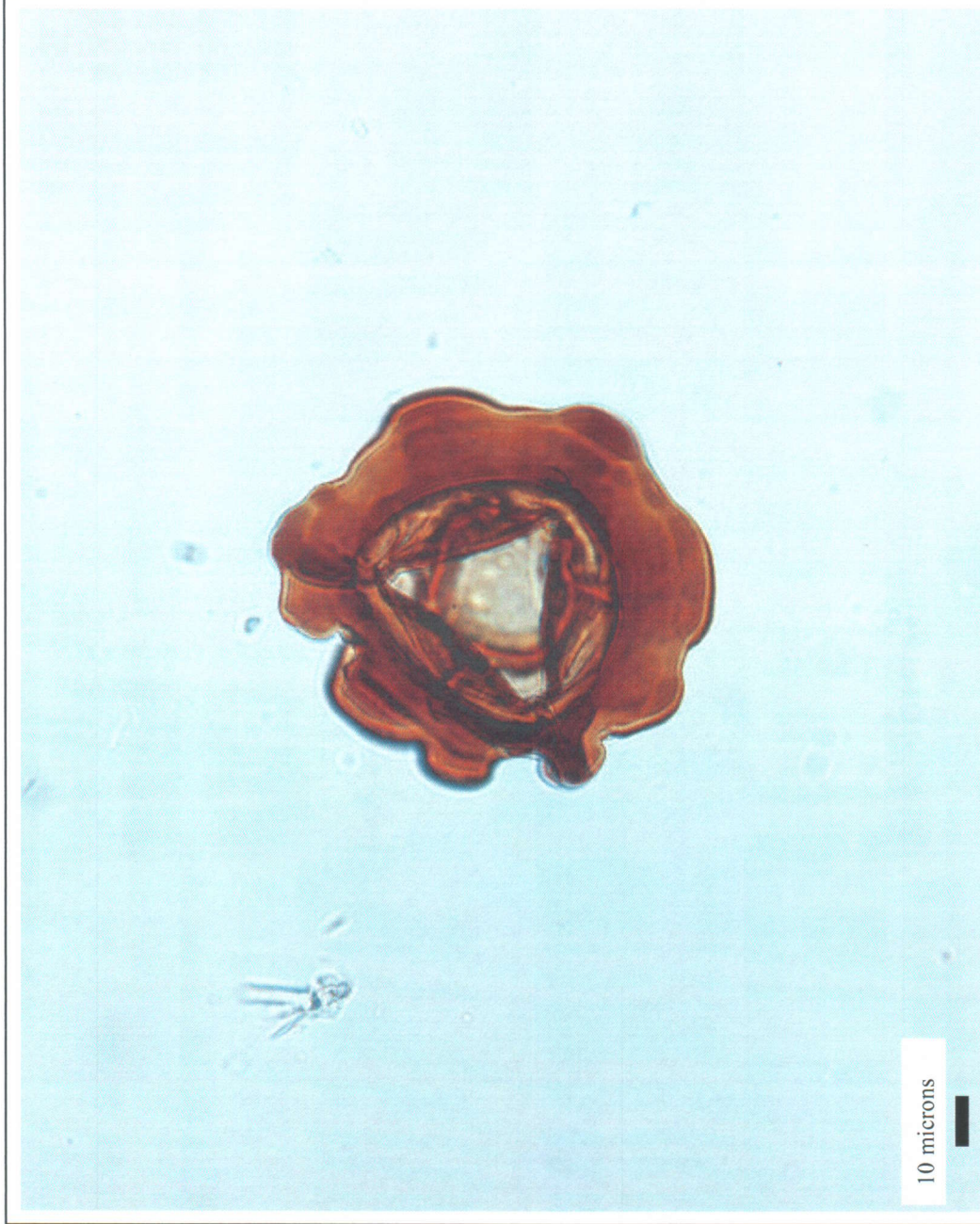


Sample MPA 4579,
Specimen MPK 7027.
Diddup Borehole, 7.20 m,
Scotland; early Westphalian
A, SS Biozone.



10 microns

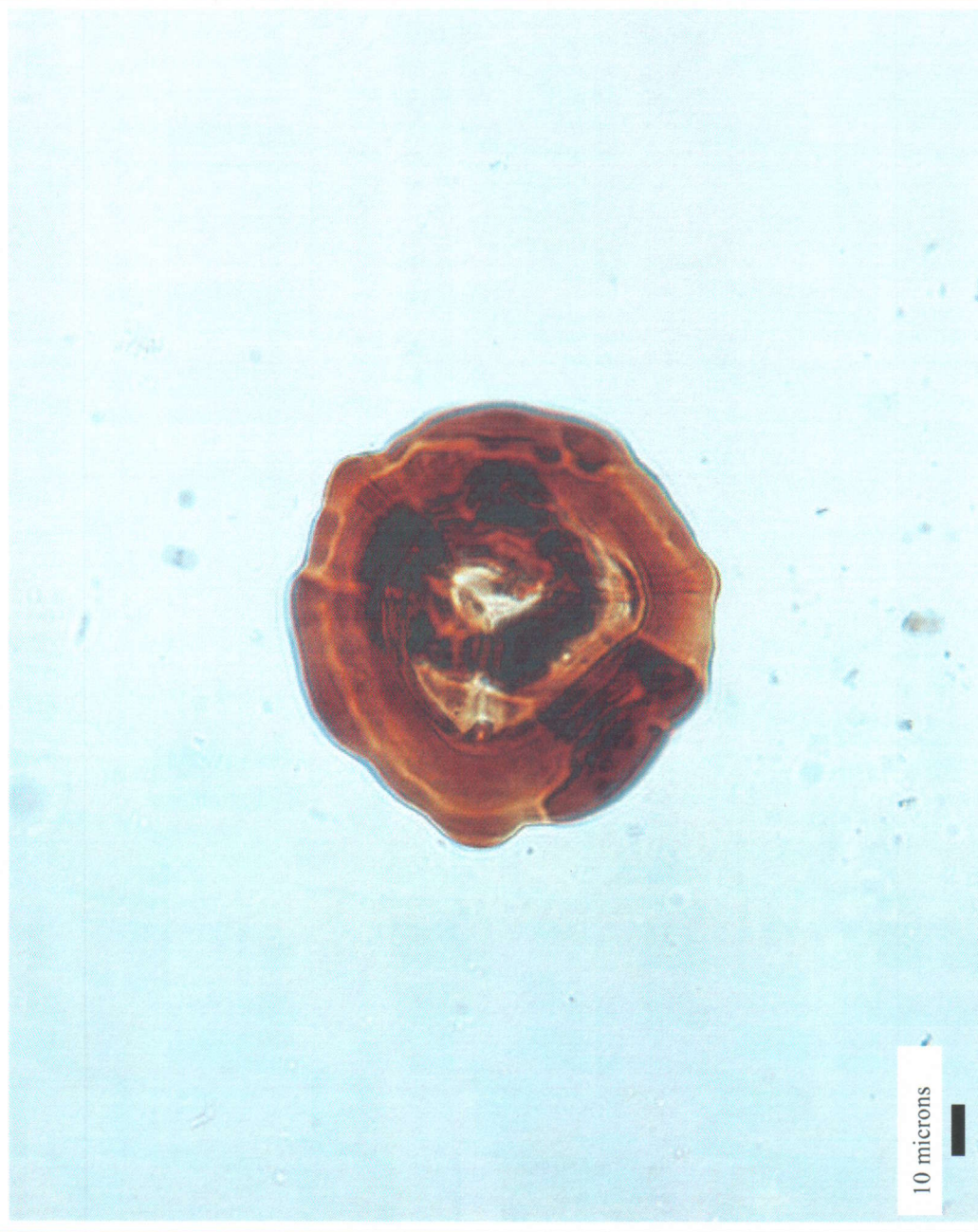
Sample MPA 4579,
Specimen MPK 7028.
Proximal focus. Trilete
mark open, sutures reaching
almost to the equatorial
margin of the inner body.
Note irregular development
of the outer thickened zone
of the cingulum creating
irregular margin to spore.
Diddup Borehole, 7.20 m,
Scotland; early Westphalian
A, SS Biozone.



Sample MPA 4579,
specimen MPK 7029.
Proximal focus. Diddup
Borehole, 7.20 m, Scotland;
early Westphalian A, SS
Biozone.



Sample MPA 4579,
Specimen MPK 7030.
Diddup Borehole, 7.20 m,
Scotland; early Westphalian
A, SS Biozone.



10 microns

Cingulizonates bialatus (Waltz 1938) Smith and Butterworth 1967

Description:

Radial, trilete, cingulate miospores. Amb rounded triangular to subcircular. Trilete mark usually obscure, occasionally distinct, sutures simple, straight, extending to margin of inner body. Intexine thin. laevigate forming rounded triangular or subcircular inner body, Exoexine extending in the equatorial plane to form bizonate cingulum. Inner zone thicker and wider than outer zone; inner zone overlaps the equatorial margin of the inner body on the distal surface. Outer margin of inner thicker zone bears numerous tubercular processes that project across outer lighter zone. Numerous radially orientated thickened ribs or plications extend across both zones of cingulum. Thinner outer zone of cingulum may be ornamented on its distal surface with small cones less than 1 μ m in height.

Alternative description:

Smith and Butterworth (1967, pp.260-261. pl.2. figs 3 4)

Size:

Overall equatorial diameter:

25(54)77 μ m

Diameter of inner body

20(27)35 μ m

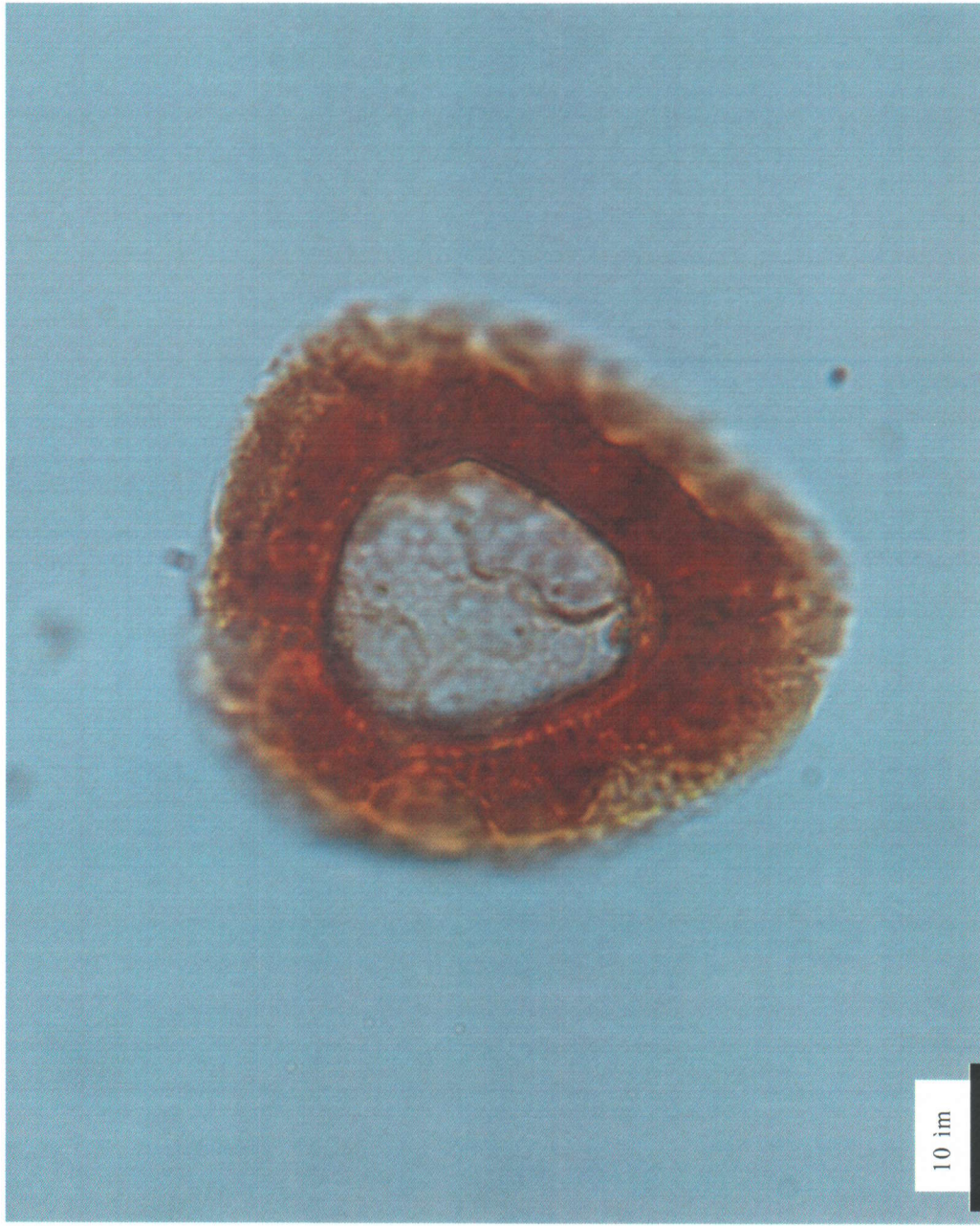
Comparisons:

The specimens originally described by Butterworth and Williams as *Densosporites striatus* were transferred to *C. bialatus* by Smith and Butterworth (1967). *Cingulizonates loricatus* (Loose) Butterworth and Smith 1964 is similar but lacks the development of tubercles on the outer margin of the inner thick zone of the cingulum.

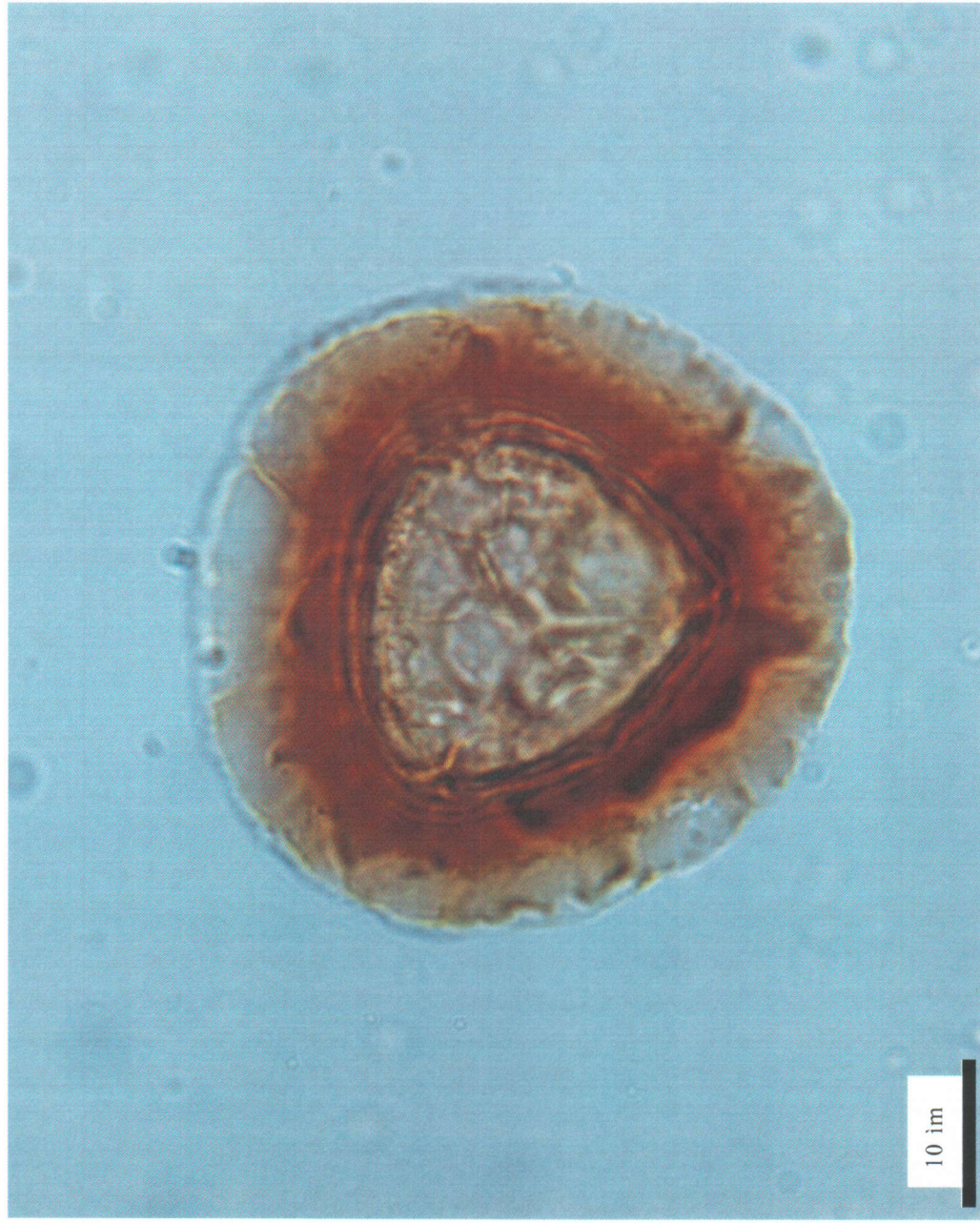
Range:

(From Smith & Butterworth 1967) Carboniferous; Viséan to Namurian

Shales below Swinstone
House Marine Band,
Mousegill Beck, Stainmore,
Cumbria, England:
Namurian, Marsdenian, FR
Biozone. Sample T96.
Specimen MPK 6977.
Proximal focus. Trilete
mark simple; sutures
extending to equator of
subcircular inner body.
Cingulum bizonate, darker
thicker inner zone wider
than thinner outer zone.
Outer zone also appears to
bear scattered ornament of
small con.



Shales below Swinestone
House Marine Band,
Mousegill Beck, Stainmore,
Cumbria, England:
Namurian, Marsdenian, FR
Biozone. Sample T96.
Specimen MPK 6978. Distal
focus showing that the dark
inner zone of the cingulum
overlaps the equatorial
margin of the inner body on
the distal surface. Note
tubercular outgrowths on the
equatorial border of the
inner thicker zone of
cingulum.



Shales below Swinestone
House Marine Band,
Mousegill Beck, Stainmore,
Cumbria, England:
Namurian, Marsdenian, FR
Biozone, Sample T96,
Specimen MPK 6979.

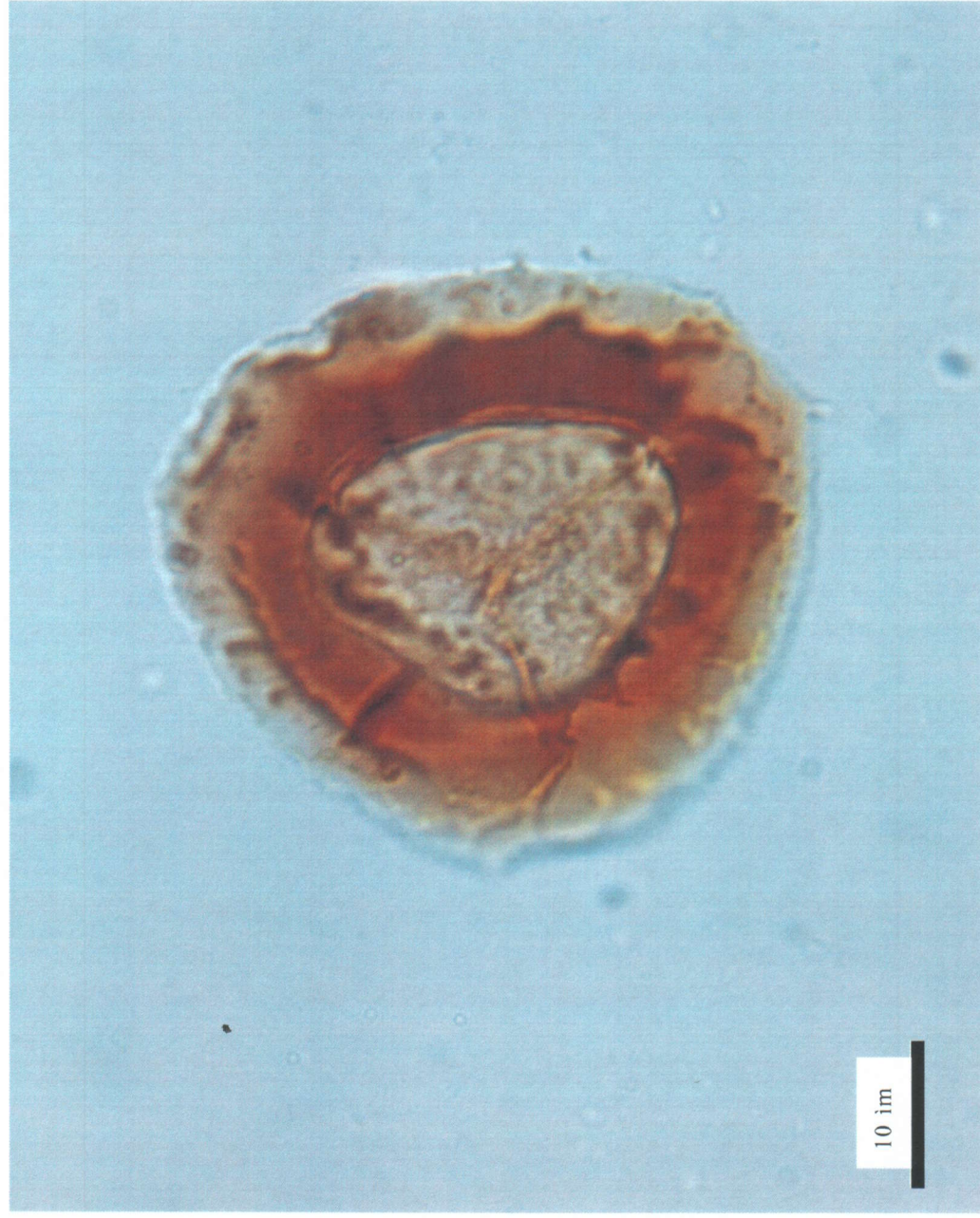


Shales above Mousegill
Marine Band, Crag House
Gill. Stainmore, Cumbria.
England. Namurian, KV
Biozone. Sample CHG 1,
Specimen MPK **6980**.
Specimen with bizonate
cingulum showing
development of striations on
inner thicker zone of
cingulum. May indicate
transitional form with
Radiizonates striatus.

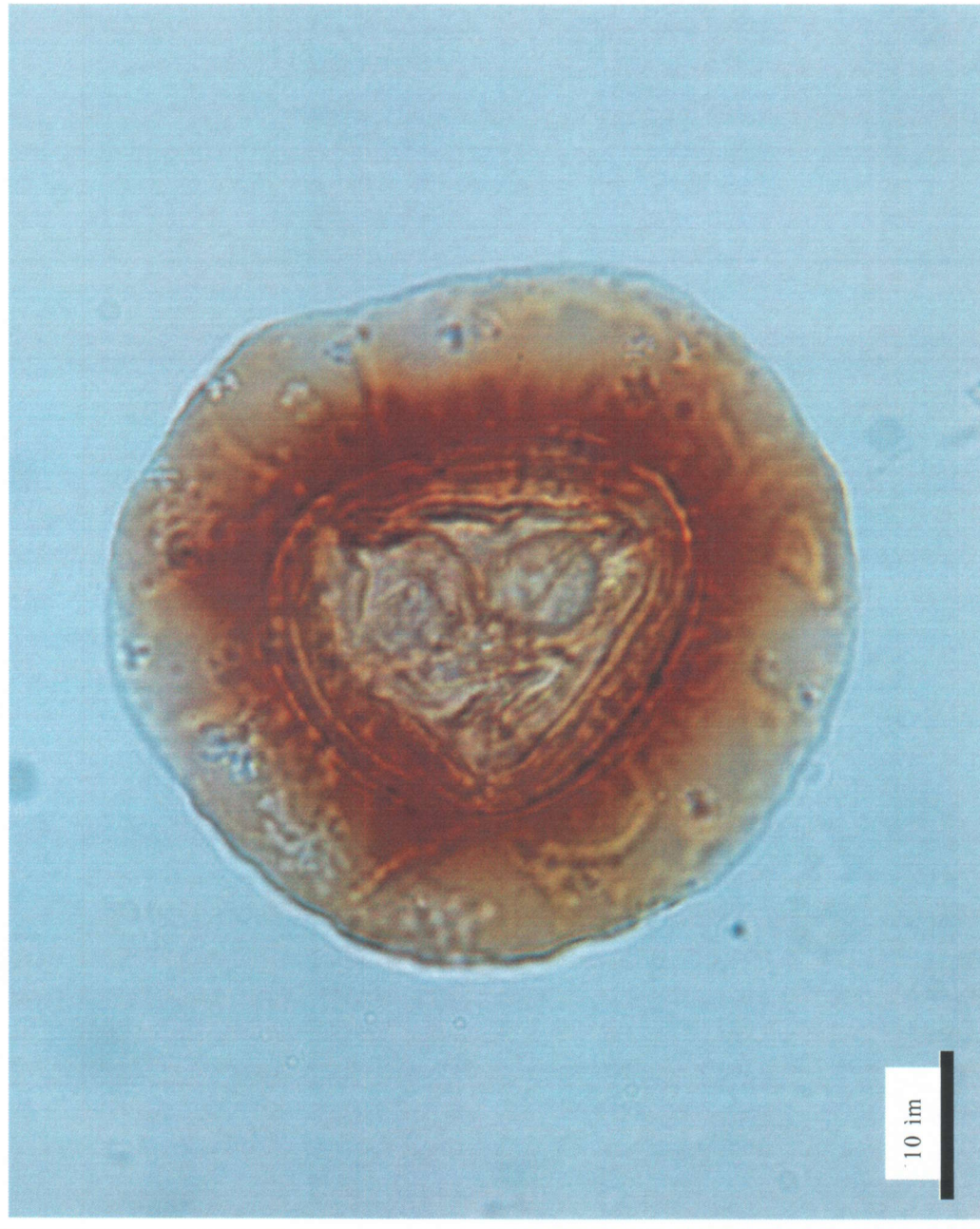


10 μ m

Hurler Borehole, 160.70 m,
Scotland: Viséan, VF
Biozone. Sample MPA
9162, Specimen MPK **6981**.
Note development of
tuberculate structures at
outer margin of dark inner
thick zone of cingulum.



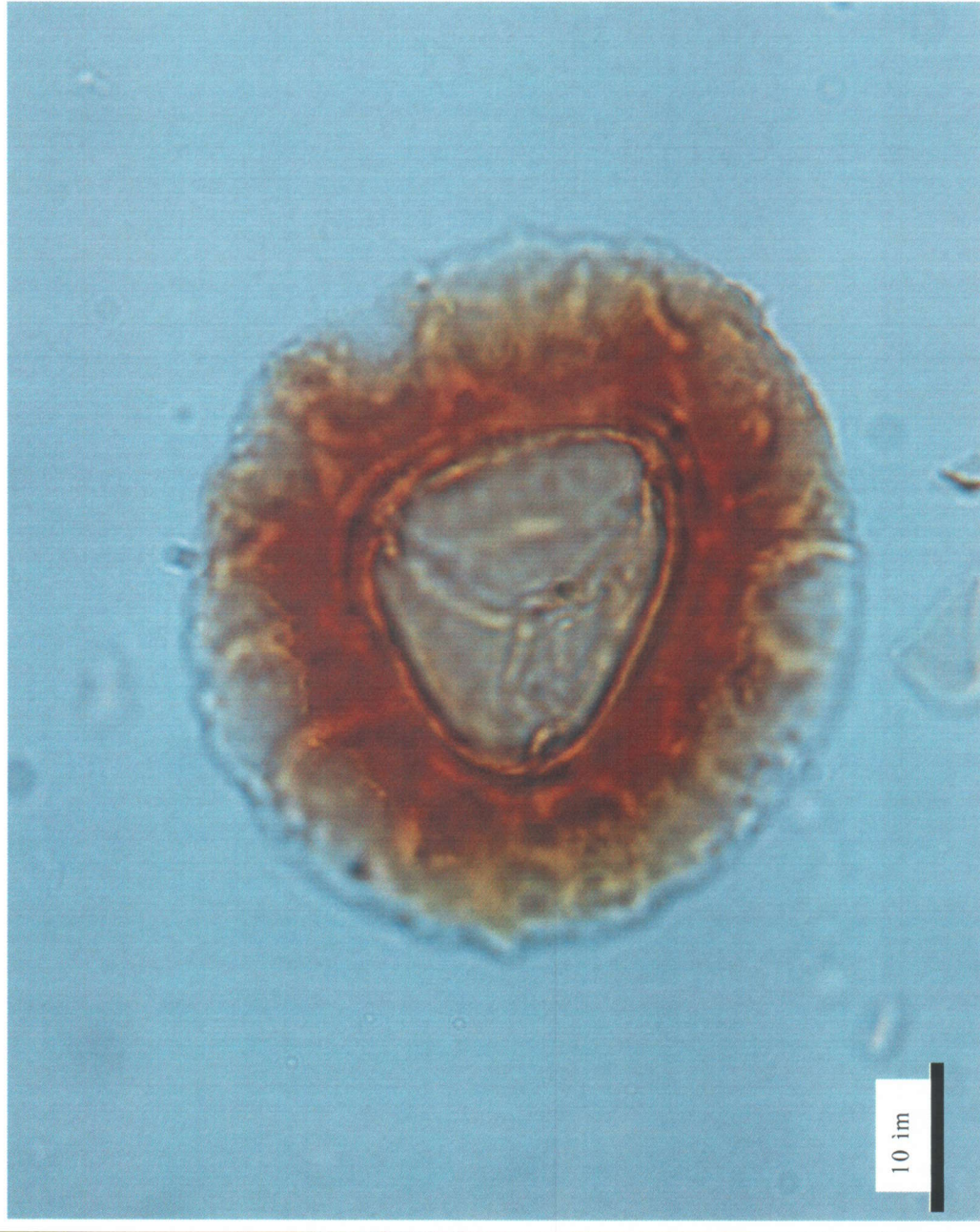
Shales below Swinstone
House Marine Band,
Mousegill Beck, Stainmore,
Cumbria, England:
Namurian, Marsdenian, FR
Biozone. Sample T96.
Specimen MPK 6982.



Shales below Swinestone
House Marine Band,
Mousegill Beck, Stainmore,
Cumbria, England:
Namurian, Marsdenian, FR
Biozone, Sample T96.
Specimen MPK 6983.



Shales below Swinestone
House Marine Band,
Mousegill Beck, Stainmore,
Cumbria, England:
Namurian, Marsdenian, FR
Biozone. Sample T96,
Specimen MPK **6984**. Note
the overlap of the inner
thick zone over the
equatorial margin of inner
body on distal surface, and
development of tuberculate
outgrowths at its outer
margin.



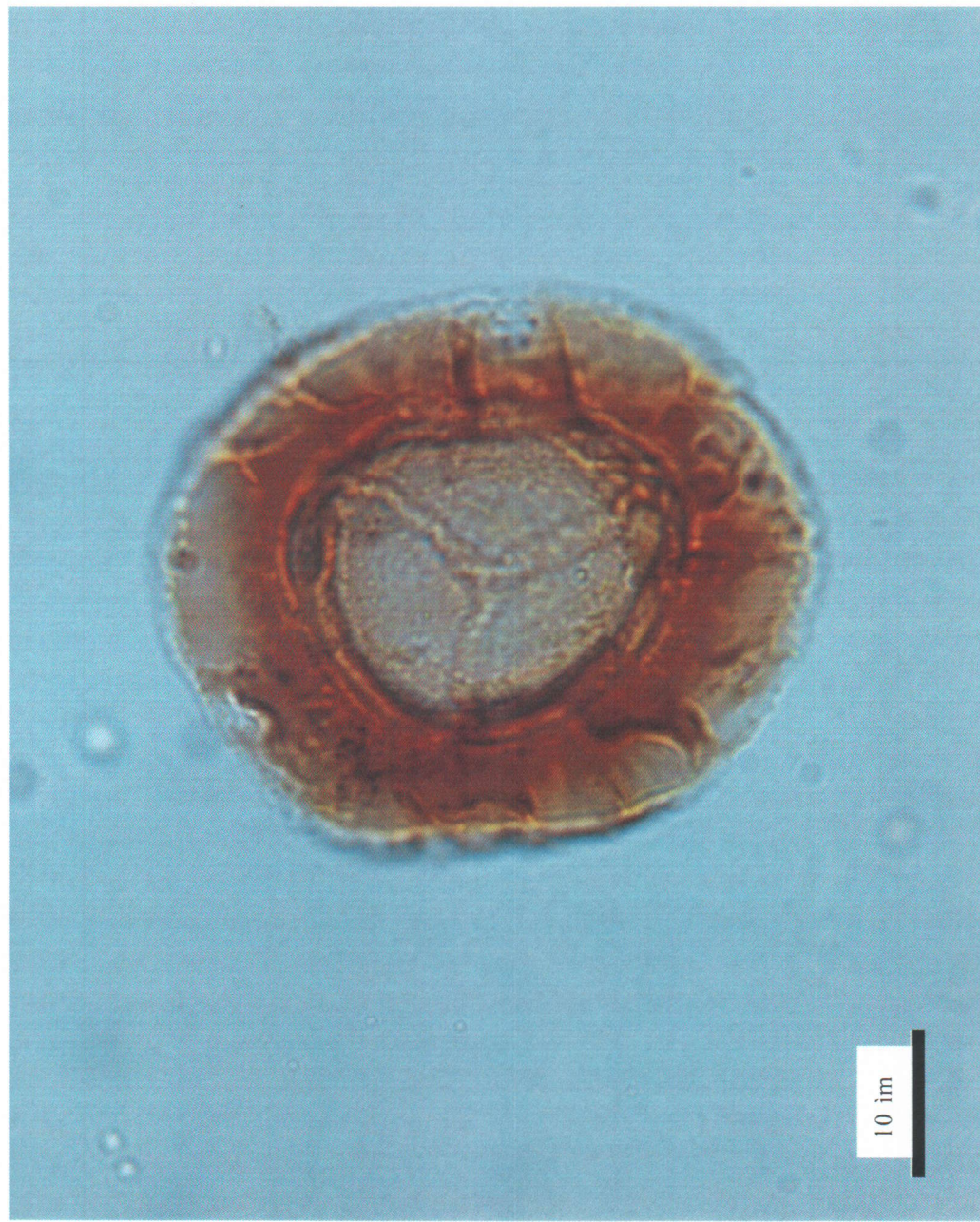
Shales below Swinestone
House Marine Band,
Mousegill Beck, Stainmore,
Cumbria, England:
Namurian, Marsdenian, FR
Biozone, Sample T96,
Specimen MPK 6985.



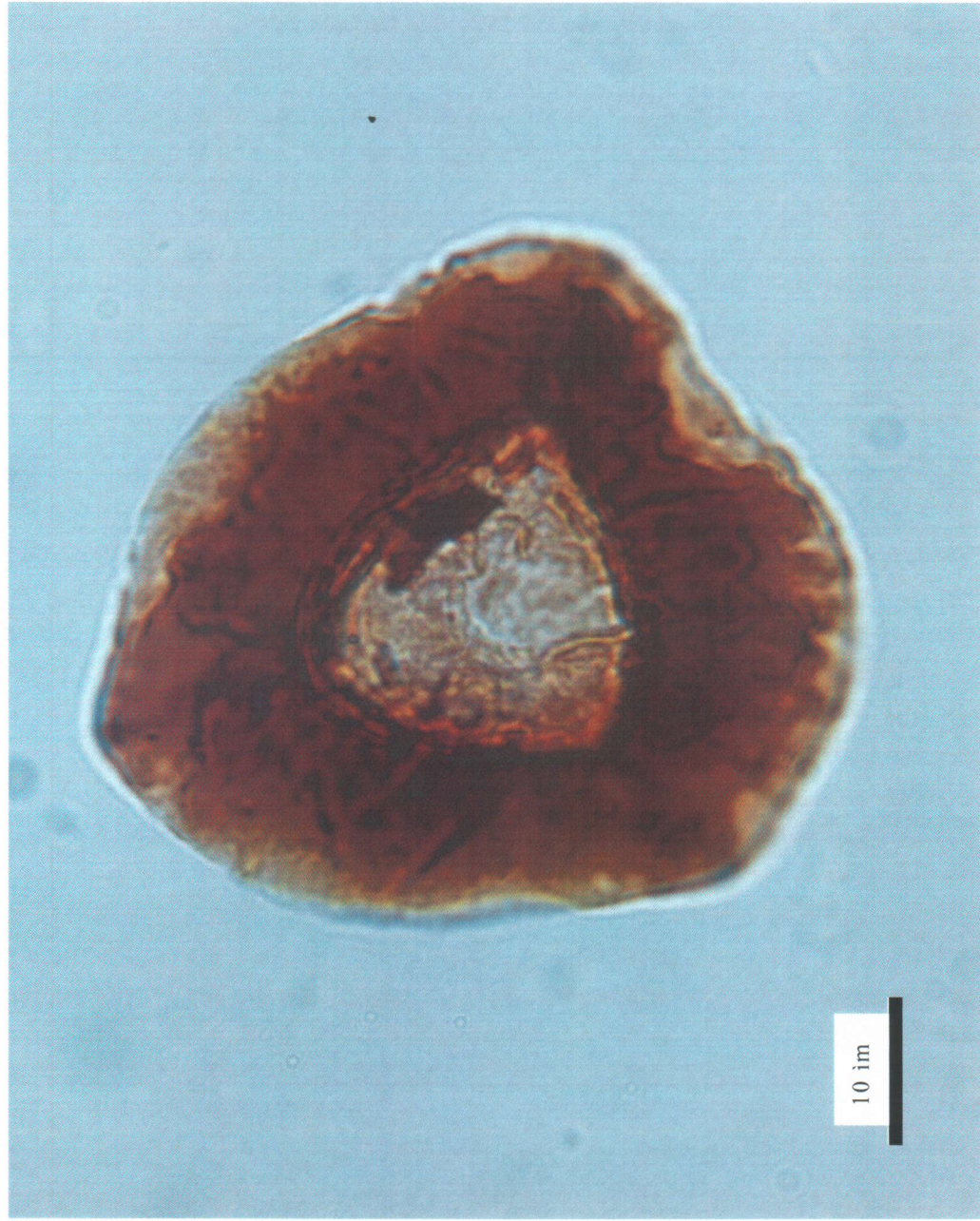
Shales below Swinstone
House Marine Band,
Mousegill Beck, Stainmore,
Cumbria, England:
Namurian, Marsdenian, FR
Biozone, Sample T96.
Specimen MPK 6986. Distal
focus showing overlap, on
distal surface, of the inner
thicker zone of cingulum
across spore body margin
and development of
tubercles that protrude
from its outer margin onto
the thinner outer zone.



Shales below Swinstone
House Marine Band,
Mousegill Beck, Stainmore,
Cumbria, England:
Namurian, Marsdenian, FR
Biozone, Sample T96,
Specimen MPK 6987.



Mattson Formation, south
face of Twisted Mountain,
northwest of South Nahanni,
N.W.T., Canada: Viséan
MA Biozone. Sample
MATT, Specimen MPK
6988. Specimen showing
well defined trilete mark
with rays extending to inner
body margin. Darker inner
thick zone of cingulum
shows extensive
development of tubercles
which protrude onto thin
outer zone.



Crassispora aculeata Neville 1968

Description:

Radial, trilete miospores. Amb subcircular to rounded triangular. Trilete mark distinct, sutures straight, extending to or nearly to the spore margin, accompanied by elevated flexuous folds that extend, decreasing in height, to the inner margin of the equatorial crassitude with which they fuse laterally. Apical papillae common in the intertectal areas. Exine laevigate or infrapunctate, thickened in the equatorial region to form ill-defined crassitude with weak inner margin. Crassitude invaginated in the radial positions where it fuses with folds accompanying trilete sutures to form clearly defined curvaturae which run just on the proximal side of the equatorial margin. Distal surface of exine and equatorial margin ornamented with spines and rare cones, elements 1.5-15 μ m height, and 1-5.5 μ m in basal diameter. Approximately 20 elements project at the equatorial margin, elements normally discrete and more or less constant in size on any individual specimens.

Alternative description

Neville (1968, pp. 443-446, pl.2, figs 5-6)

Size :

Overall equatorial diameter

56(74)96 microns

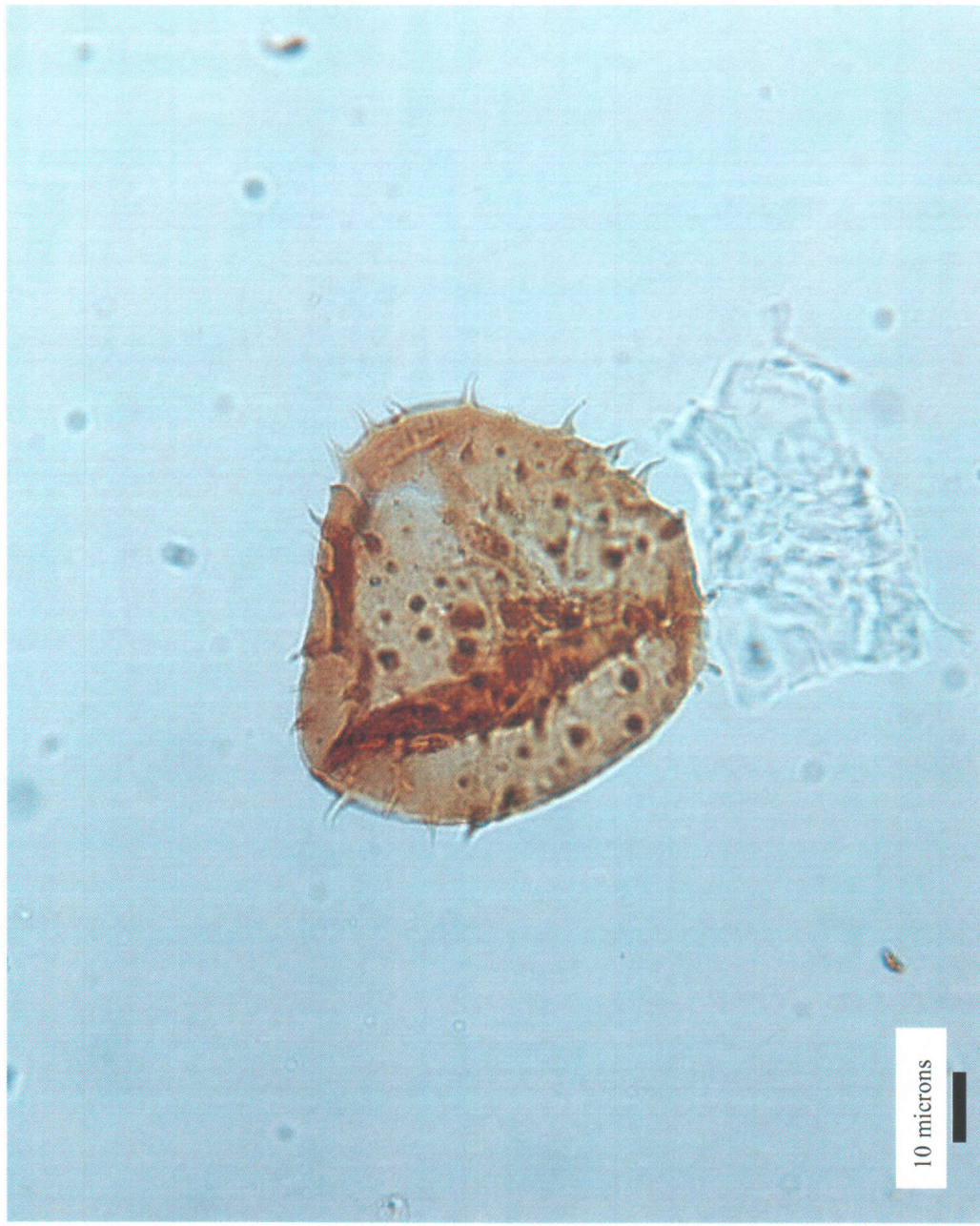
Comparisons :

Crassispora maculosa (Knox) Sullivan 1964 is similar in size but is distinguished by possessing an ornament of more densely distributed smaller cones.

Range:

(From Clayton et al. 1977) Carboniferous; Viséan to Namurian, TC-NC Biozones

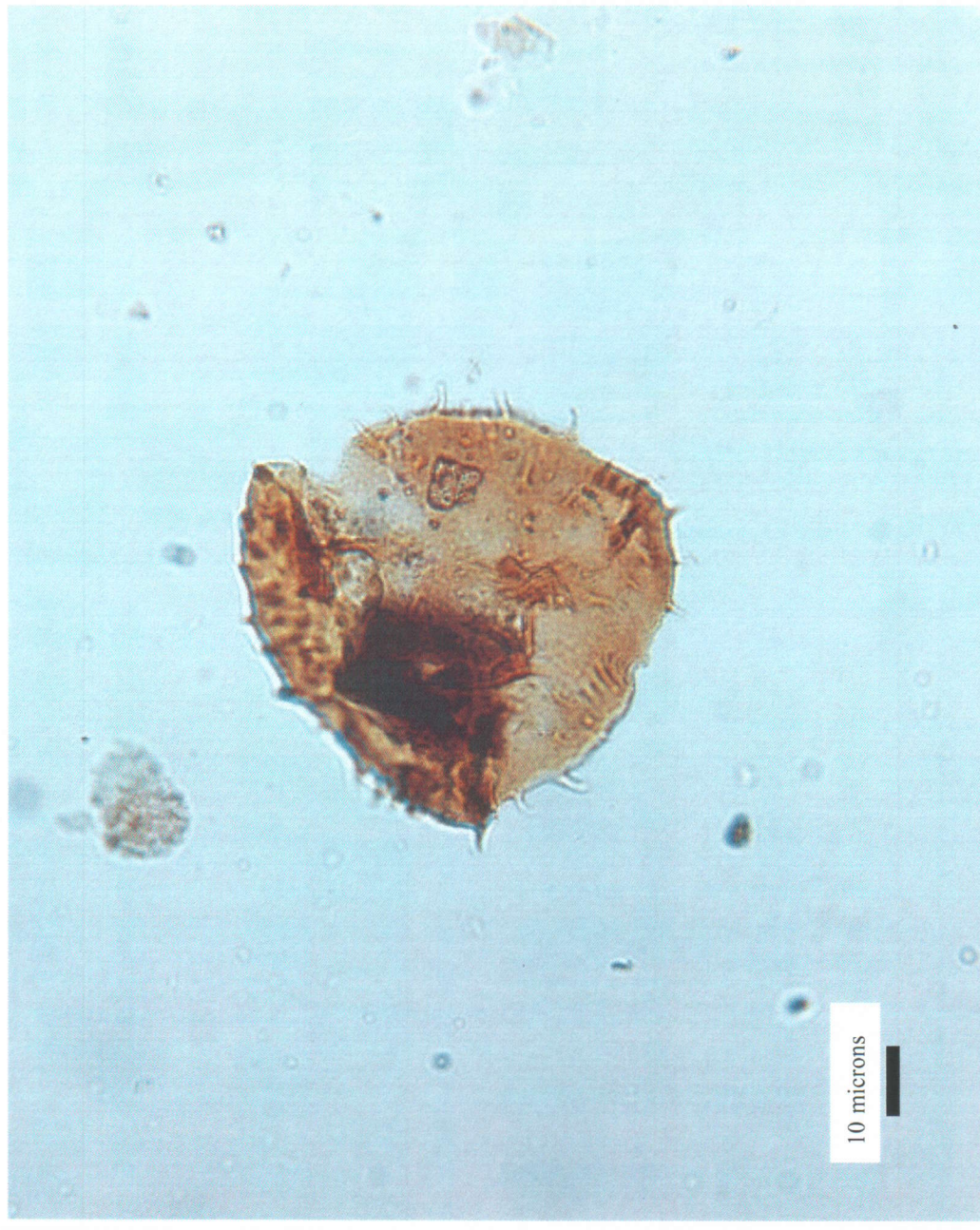
Sample MPA 9158,
Specimen MPK 7013.
Subcircular trilete miospore
with ill-defined equatorial
crassitude, trilete mark
distinct, rays extend at least
three-quarters of spore
radius, accompanied by
elevated flexuous folds that
decrease in height towards
equator. Ends of trilete
sutures may merge into
invaginated extension from
ill-defined inner margin of
equatorial crassitude. Well-
developed spinose ornament
developed over entire distal
surface and more equatorial
portion of proximal surface.
Elements sharply pointed
surmounting bulbous base.
Shales below Hurlet
Limestone, Hurlet Borehole,
130.68 m, Scotland; Viséan,
VF Biozone.



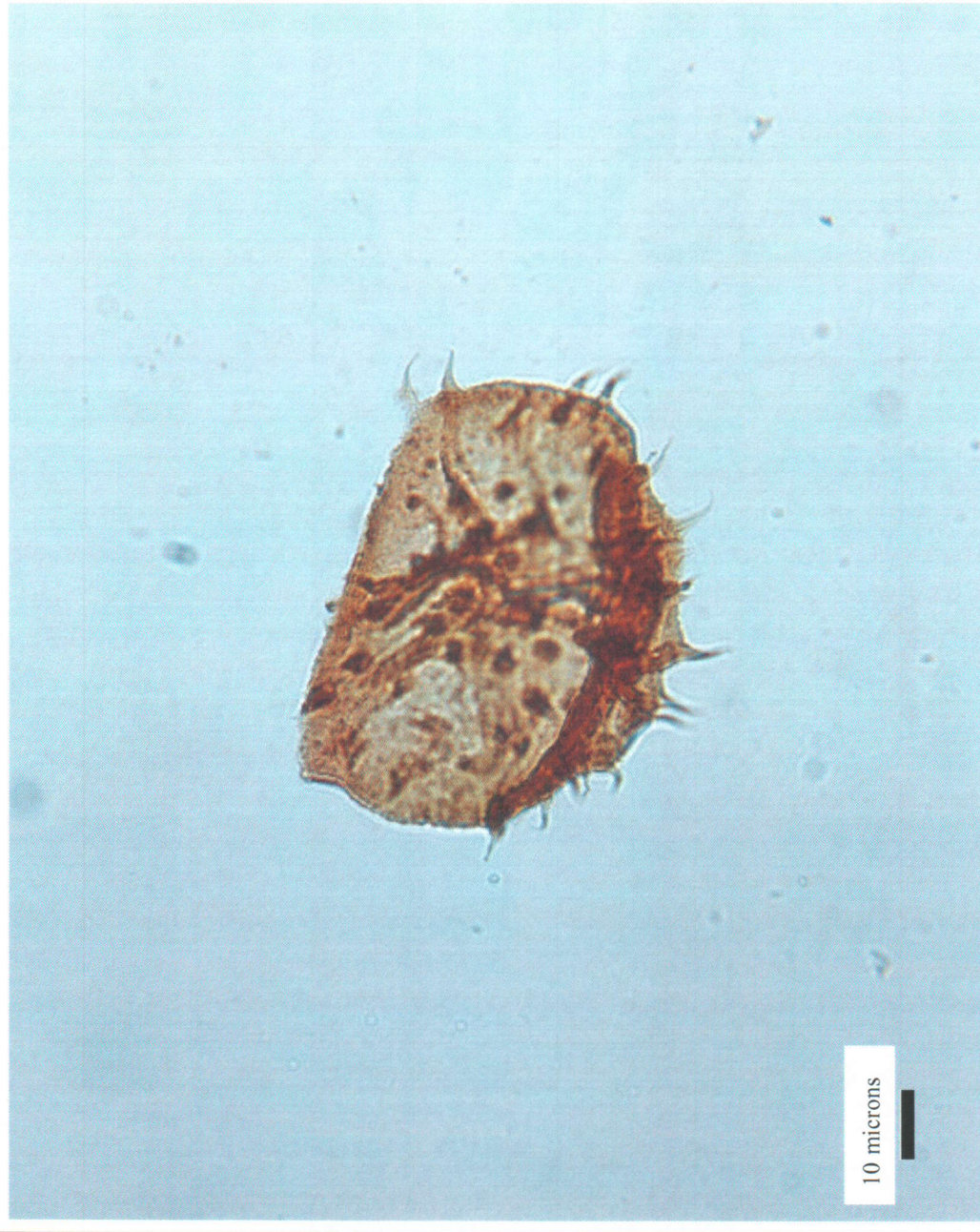
Sample MPA 9158,
Specimen MPK **7014**. Note
elevated folds
accompanying trilete mark,
decreasing towards equator.
Shales below Hurler
Limestone, Hurler Borehole,
130.68 m, Scotland; Viséan,
VF Biozone.



Sample MPA 9158,
Specimen MPK 7015.
Shales below Hurler
Limestone, Hurler Borehole,
130.68 m, Scotland; Viséan,
VF Biozone.



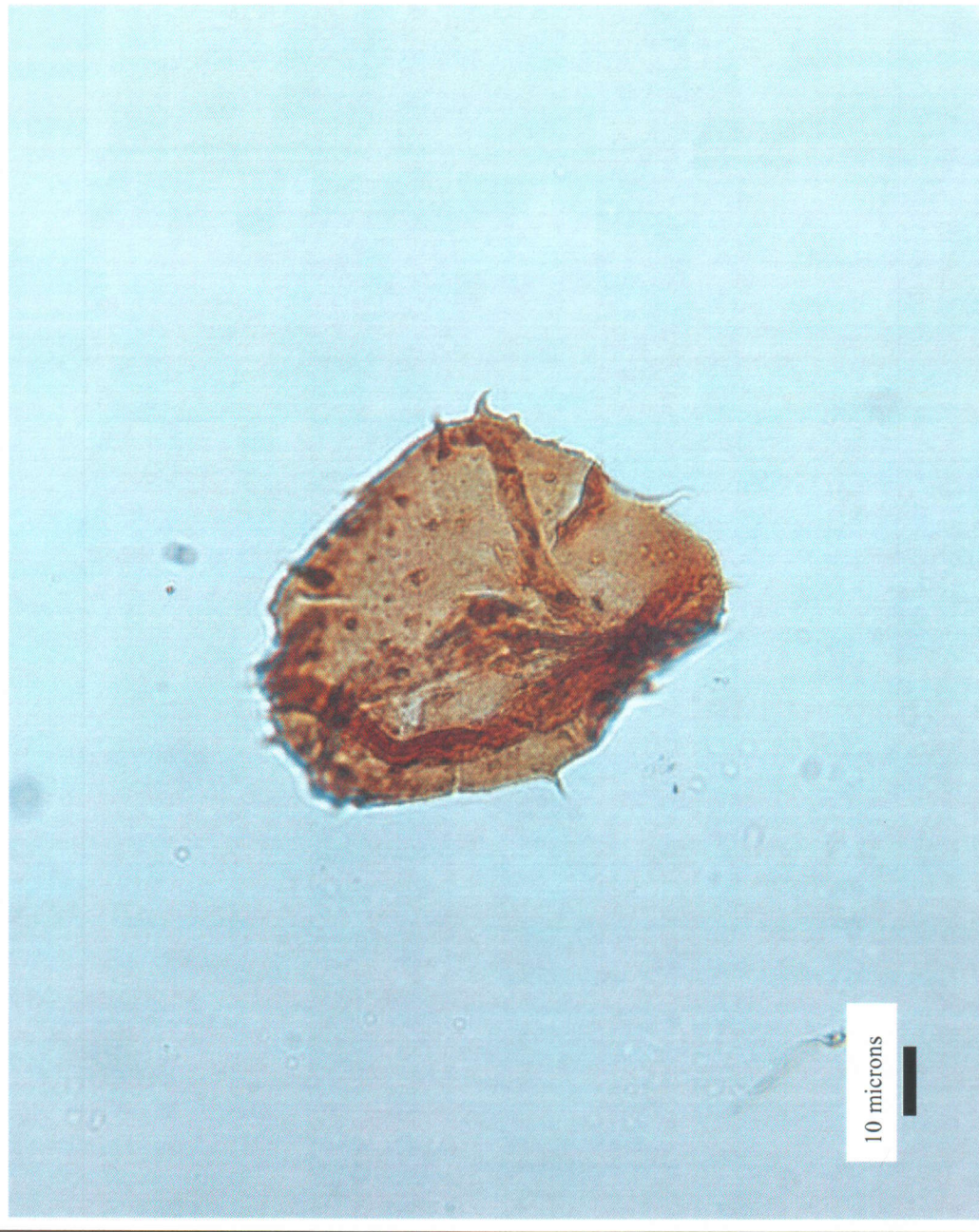
Sample MPA 9158,
Specimen MPK **7016**. Note
character of spinose
ornament with long sharply
pointed spines surmounting
bulbous base. Shales below
Hurler Limestone, Hurler
Borehole, 130.68 m,
Scotland; Viséan, VF
Biozone.



Sample MPA 9158,
Specimen MPK 7017. Note
indication of separation of
exoexine from the intexine
in the equatorial region.
Well-developed elevated
folds accompany trilete
sutures, decreasing in height
towards equator. Shales
below Hurler Limestone,
Hurler Borehole, 130.68 m,
Scotland; Viséan, VF
Biozone.



Sample MPA 9158,
Specimen MPK 7018. Note
spinose elements in distal
polar region appear smaller
than those in equatorial
region. Shales below Hurllet
Limestone, Hurllet Borehole,
130.68 m, Scotland; Viséan,
VF Biozone.



Crassispora maculosa (Knox 1950) Sullivan 1964

Description:

Radial, trilete, camerate miospores. Amb circular to subcircular. Trilete mark distinct, sutures straight, extending half to three-quarters of spore radius, accompanied by low relatively narrow, thickened labra, individually up to 4 im wide, which fuse equatorially into the variably defined equatorial crassitude which is frequently slightly invaginated in the radial positions. Crassitude narrow, weakly developed with ill-defined inner margin. When seen in off-polar compressions the crassitude simulates clearly defined curvaturae but these are often obscured by folding. Exine up to 3 im thick, with dense granulate infrastructure. Distal surface of exine ornamented with scattered broad based coni up to 2-3 im in height, projecting at equatorial margin. Proximal surface laevigate.

Other descriptions:

Knox, 1950, p.318.

Sullivan, 1964, p.376.

Smith and Butterworth, 1967, pp.235-236, pl.18, figs 7-8; pl.19, fig. 1.

Size:

Overall equatorial diameter

76(94)120 im

Comparisons:

Crassispora kosankei (Potonié and Kremp) Bharadwaj 1957 is smaller, has a wider equatorial crassitude and a more densely distributed conate ornament.

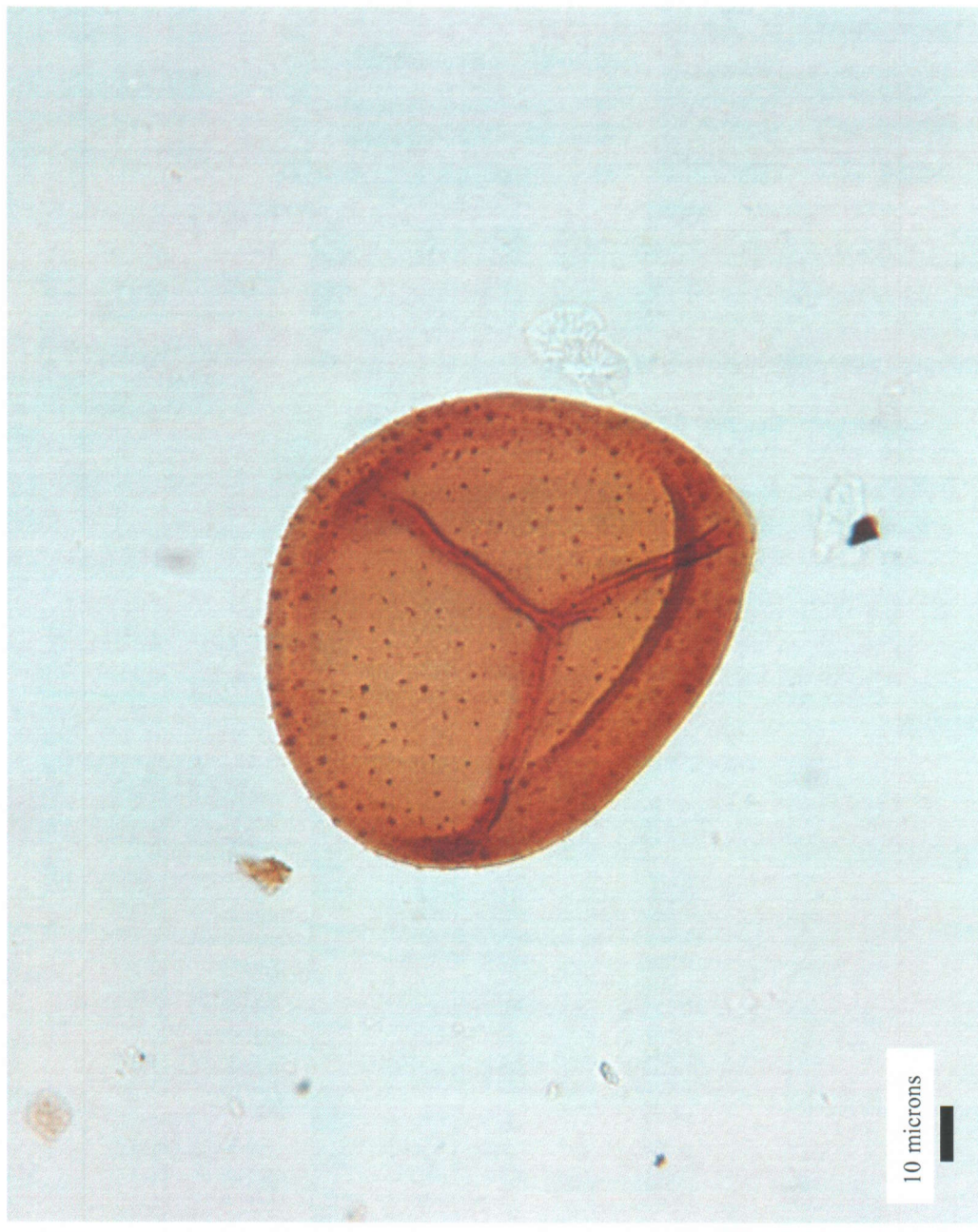
Range:

(from Smith & Butterworth (1967) and unpublished information) Carboniferous; Viséan to Namurian.

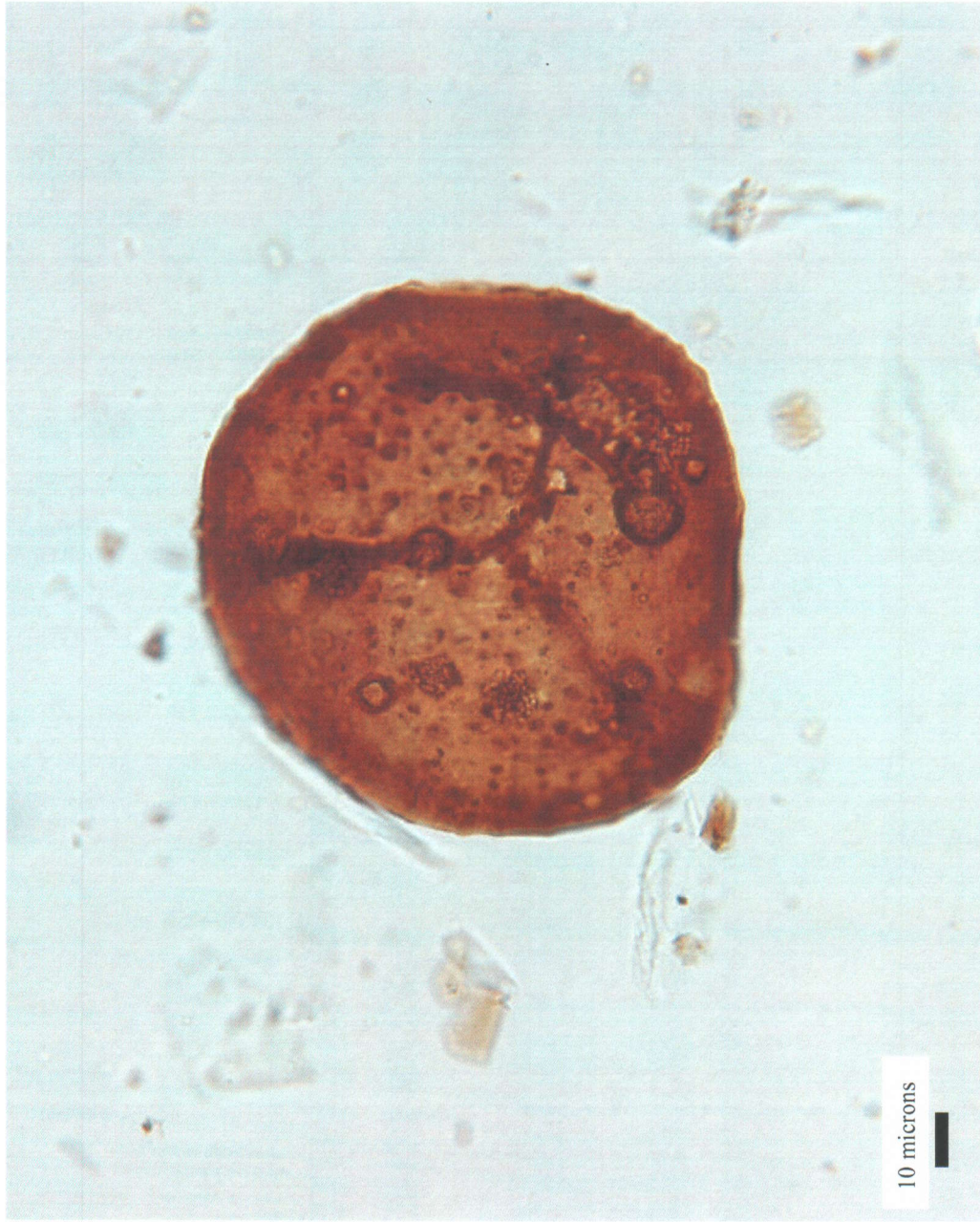
Shales below Faraday
House Sill, Argill Beck,
Stainmore, Cumbria,
England: Namurian,
Pendleian, NC Biozone.
Sample NC, Specimen MPK
7074. Oblique compression.
Note thick nature of exine
and narrow equatorial
crassitude. Trilete mark
distinct, sutures
accompanied by elevated
folds or ridges which extend
to the crassitude. Distal
surface of exine ornamented
with relatively coarse conate
ornament.



Shales below Hurllet
Limestone, Hurllet Borehole
160.70 m, Scotland: Viséan,
VF Biozone. Sample MPA
9162, Specimen MPK **7075**.
Proximal focus of slightly
obliquely compressed
specimen. Trilete mark
distinct, sutures
approximately three quarters
of spore radius,
accompanied by elevated
thickened ridges. Equatorial
crassitude, narrow, poorly
defined. Exine relatively
thick. Proximal surface
smooth, distal surface bears
fine granular or conate
ornament that protrudes at
equator. Minor compression
fold present.

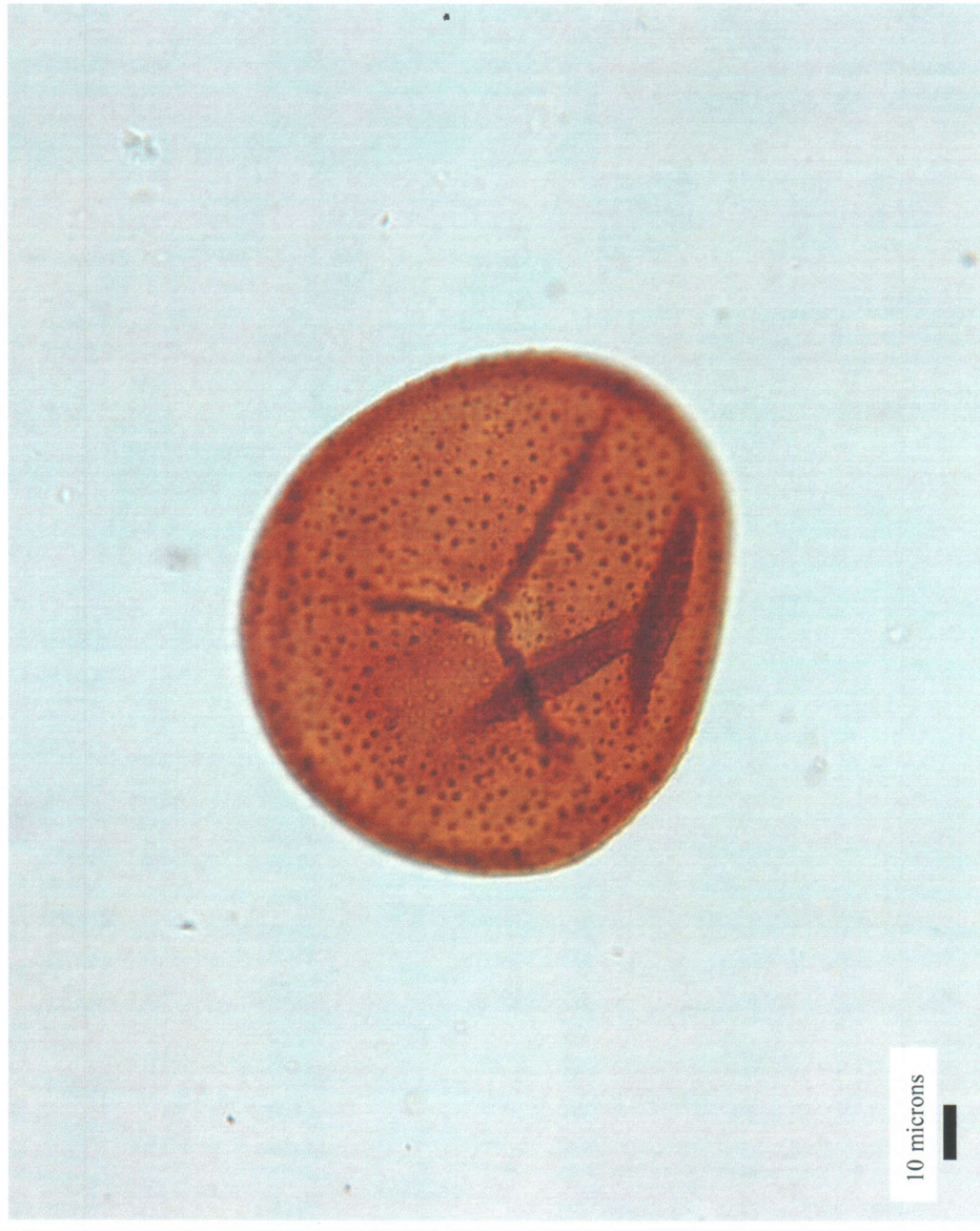


Shales below Faraday
House Sill, as in Fig. 1,
Sample NC, Specimen MPK
7076. Equatorial crassitude
narrow, poorly defined.

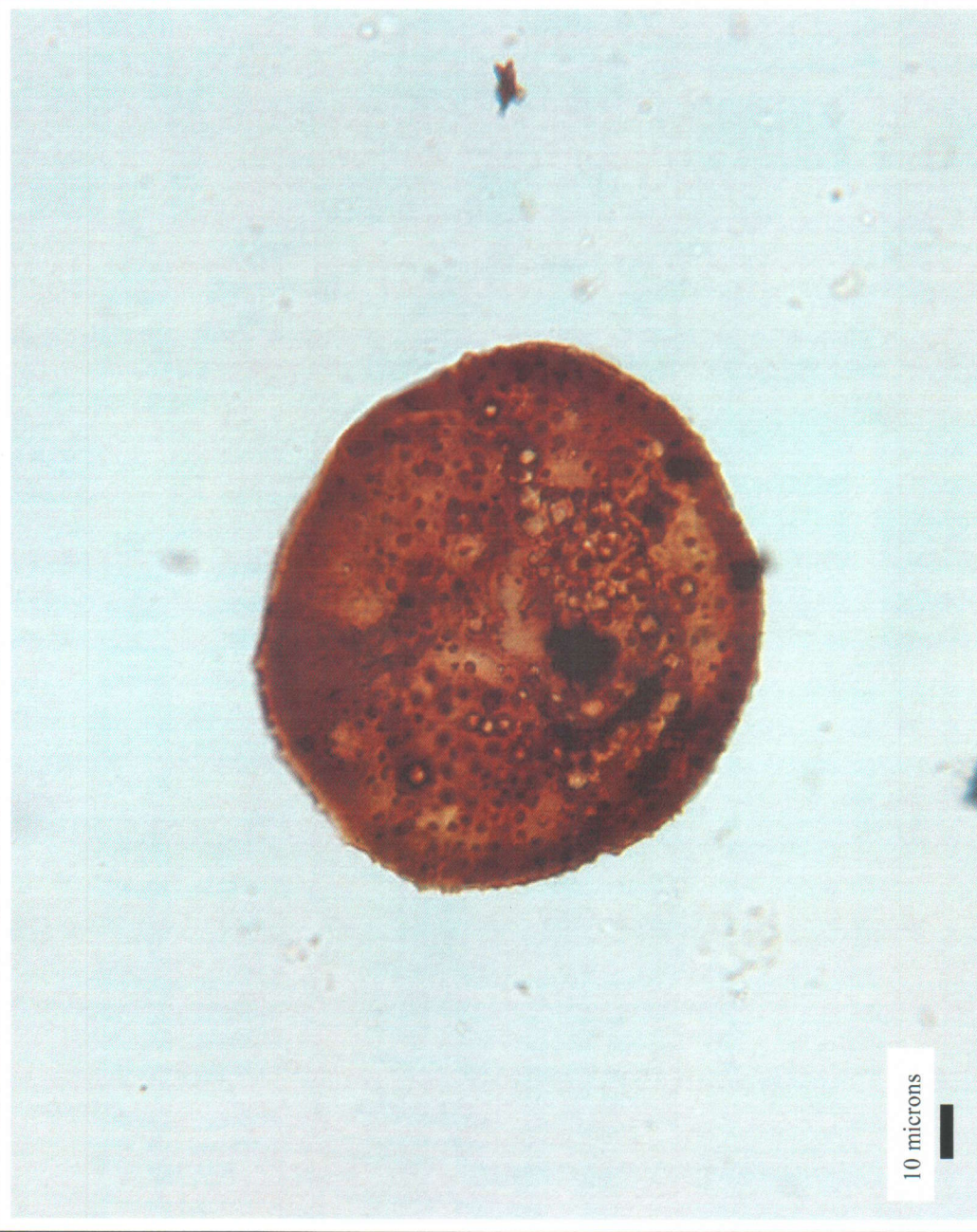


10 microns

Shales below Hurler
Limestone, as in Fig. 2,
Sample MPA 9162,
Specimen MPK 7077. Note
narrow equatorial crassitude
and fine, relatively dense
conate ornament on distal
surface.



Shales below Faraday
House Sill, as in Fig. 1,
Sample NC, Specimen MPK
7078.



Shales below Faraday
House Sill, as in Fig. 1,
Sample NC, Specimen MPK
7079.



Knoxisporites stephanephorus Love 1960

Description:

Radial, trilete, cingulate miospores. Amb circular, subcircular to rounded triangular. Trilete mark distinct, sutures straight, extending to margin of spore body, simple or accompanied by low narrow thickened labra which typically become expanded equatorially to form triangular thickened areas that fuse to the proximal surface of the cingulum. Exine laevigate. Intexine forming spore body rarely discernible. Exoexine closely adpressed to intexine but extended in the equatorial plane to form thickened undifferentiated cingulum, 5-15 μm wide. Exoexine developed into second ring of thickening mid-way between the equator and the distal pole with irregular radially orientated thickened ribs in the inter-radial positions sometimes connecting it to the cingulum. An area of distal polar thickening is also developed on the exoexine, 5-10 μm in diameter.

Alternative description:

Love (1960, pp. 118-119, p12, fig. 1)

Size :

Overall equatorial diameter

40-90 microns

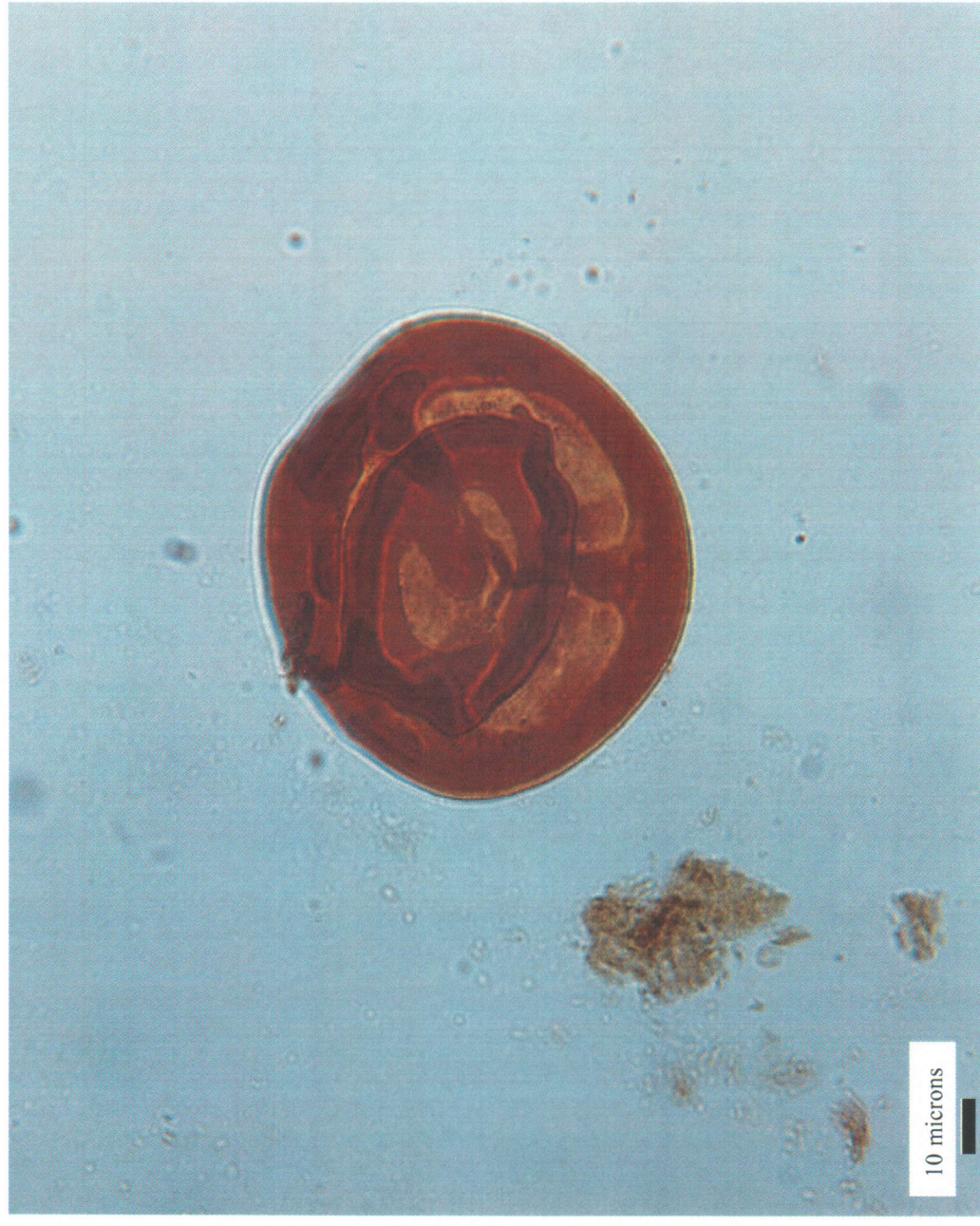
Comparison:

Knoxisporites rotatus Hoffmeister, Staplin and Malloy 1955 is similar but distinguished by the absence of the distal polar thickening and by the presence of more prominent radially orientated ribs connecting the cingulum to the distal circular ring of thickening.

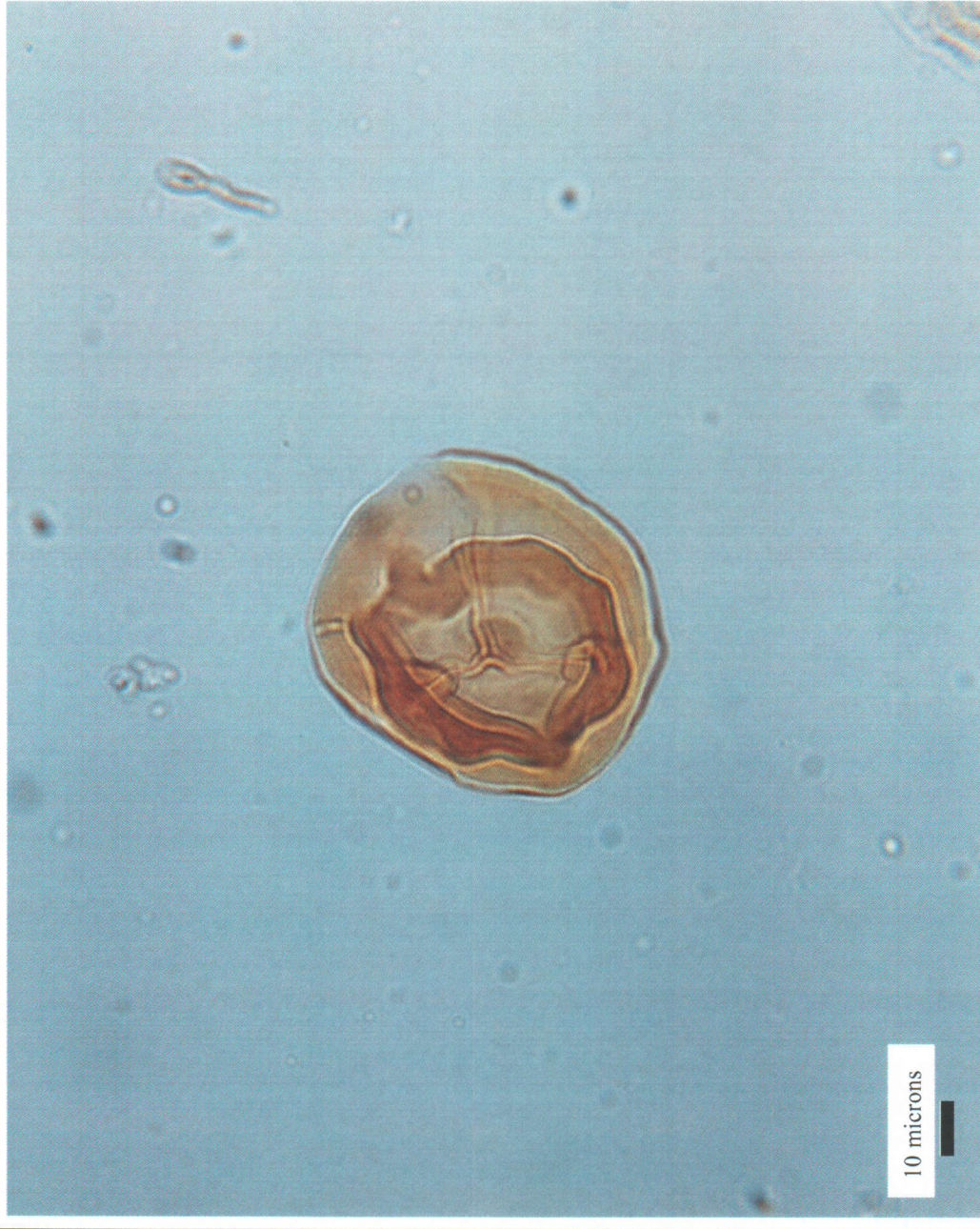
Range:

(from Clayton (1985) and unpublished information) Carboniferous; (Viséan) Late Arundian to ?Westphalian D, TS to OT Biozones.

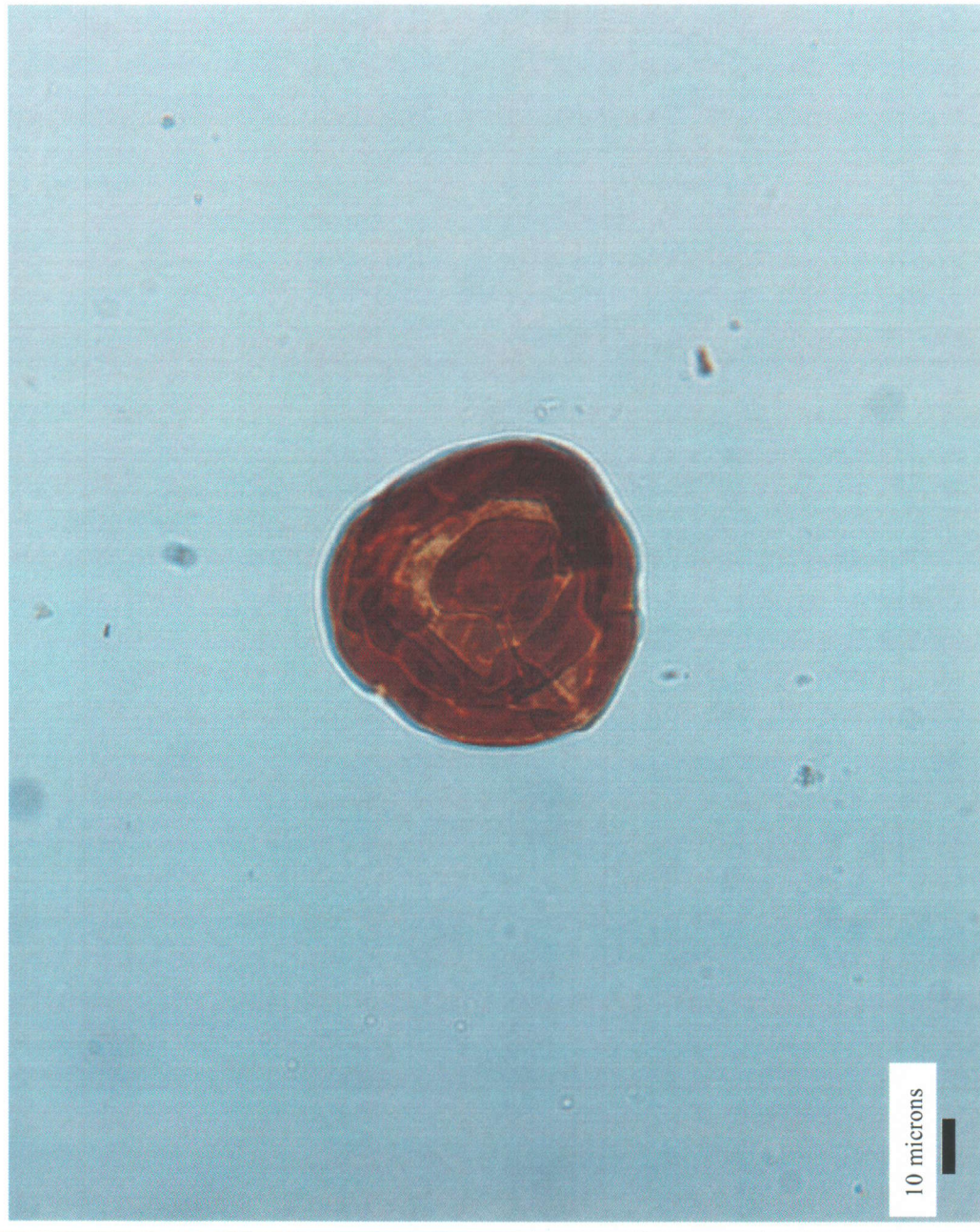
Shales below Hurllet Limestone, Hurllet Borehole, 160.70 m, Scotland; Viséan, VF Biozone. Sample MPA 9162, Specimen MPK 7037. Characteristic development of uniform equatorial cingulum, circular ring of thickening half way to distal pole and distal polar thickening. Trilete mark extends almost to equator of body where it fuses with invaginated extension from inner surface of cingulum.



Coal above Lower Stonesdale
Limestone, Coldkeld Beck, Stainmore,
Cumbria, England; Namurian,
Pendleian, NC Biozone. Sample CB2
1, Specimen MPK **7038**. Trilete
sutures accompanied by thickened lips
which become expanded towards
equator and fuse with cingulum that is
invaginated in that position.



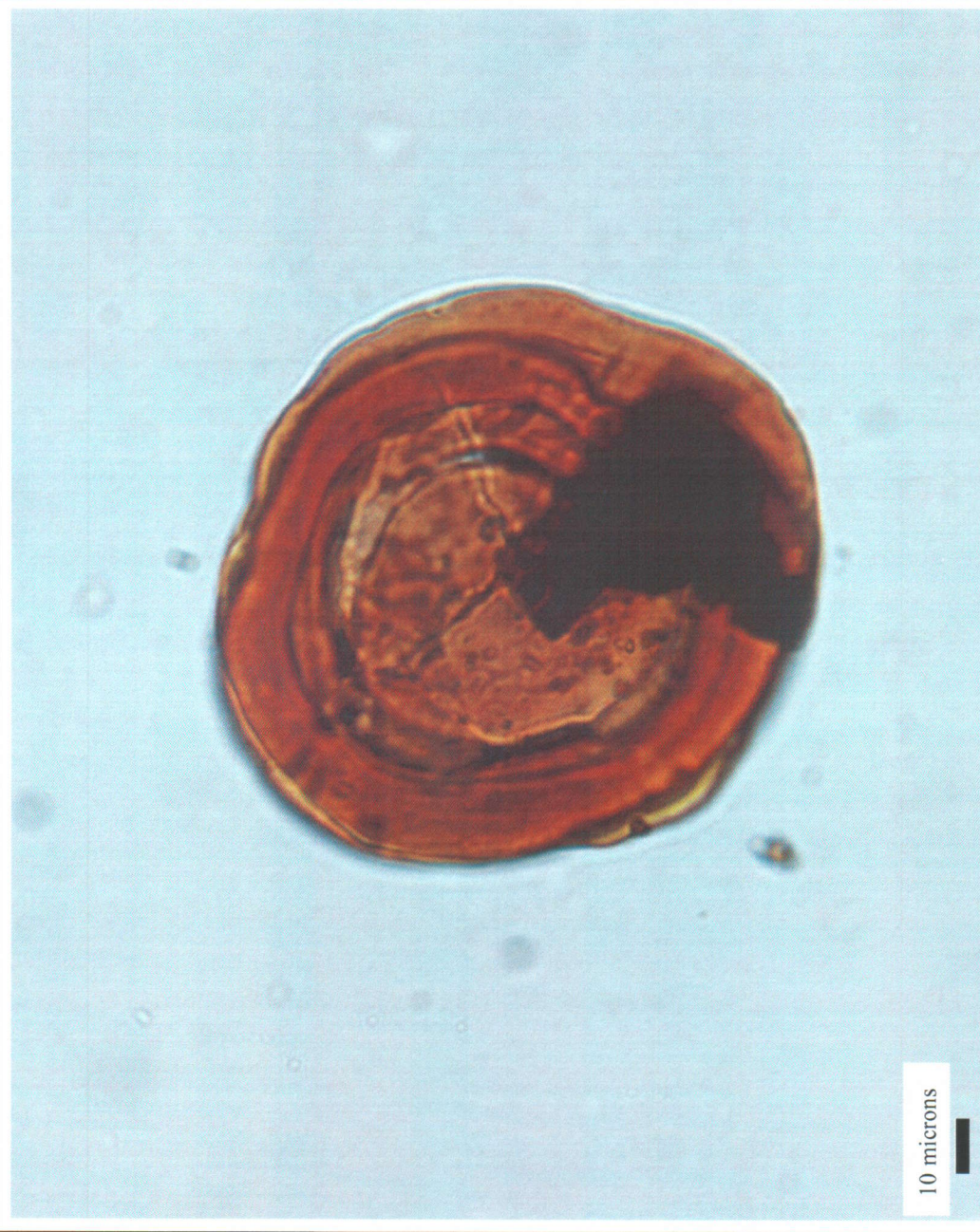
Waters Farm Borehole, 14.50 m,
Lancashire, England; Namurian,
Yeadonian, FR Biozone. Sample MPA
18197, Specimen MPK 7039. Note
development of prominent thickening
in distal polar region.



Shales below Faraday House Sill,
Argill Beck, Stainmore, Cumbria,
England; Namurian, Pendleian, NC
Biozone. Sample MPA 31161,
Specimen MPK 7040.



Shales below Faraday House Sill, as in
Fig. 4, Sample 31165, Specimen MPK
7041.



Shales below Swinstone
House Marine Band,
Mousegill Beck, Stainmore,
Cumbria, England;
Namurian, FR Biozone.
Sample T96, Specimen
MPK **7042**. Oblique
compression.



Waters Farm Borehole,
14.50 m, as in Fig. 3,
Sample MPA 18197,
Specimen MPK 7043.
Oblique compression.



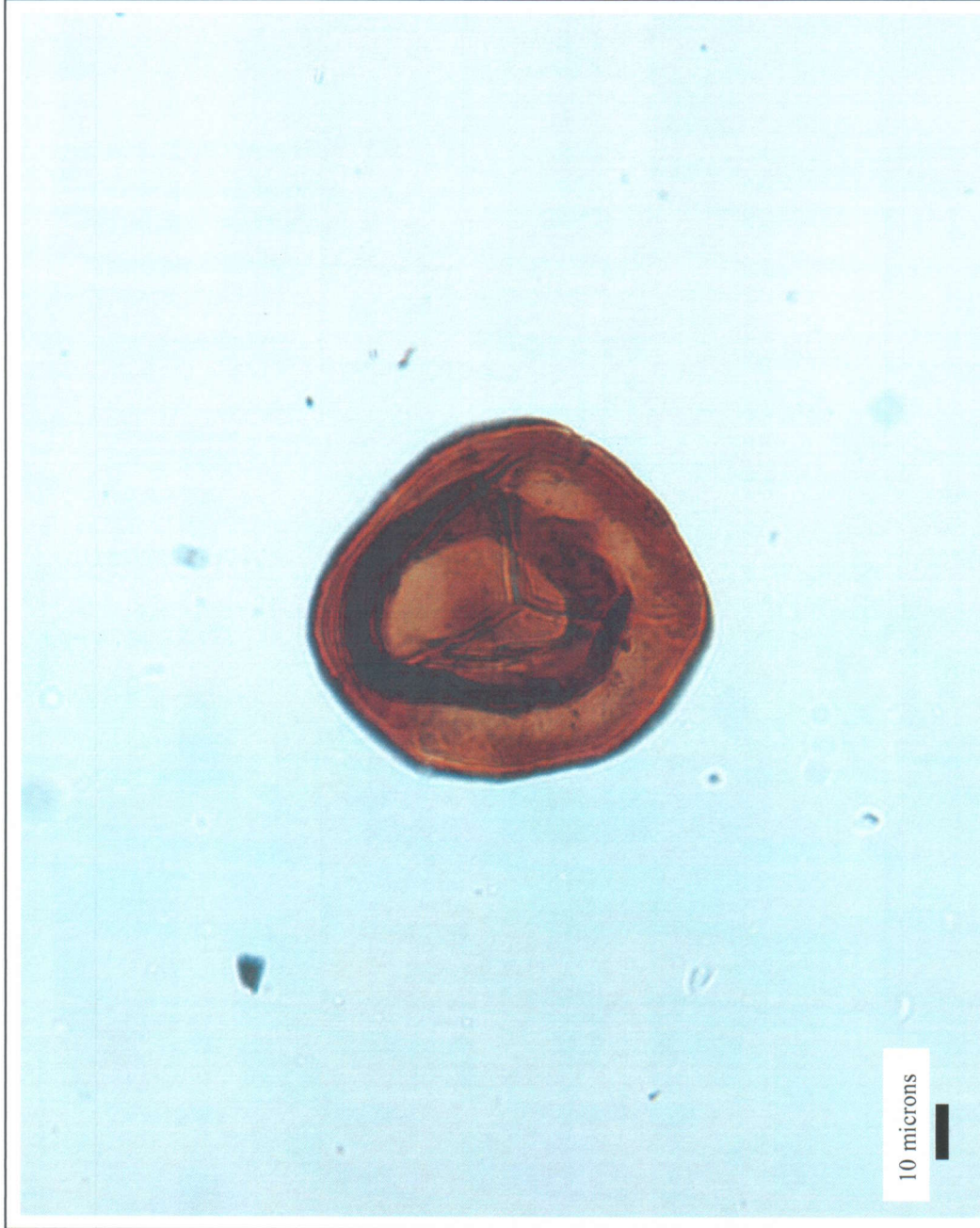
Waters Farm Borehole,
14.50 m, as in Fig. 3,
Sample MPA 18197,
Specimen MPK 7044. Note
development of relatively
small thickening at distal
pole and thickenings at end
of trilete sutures which
appear to fuse with
cingulum.



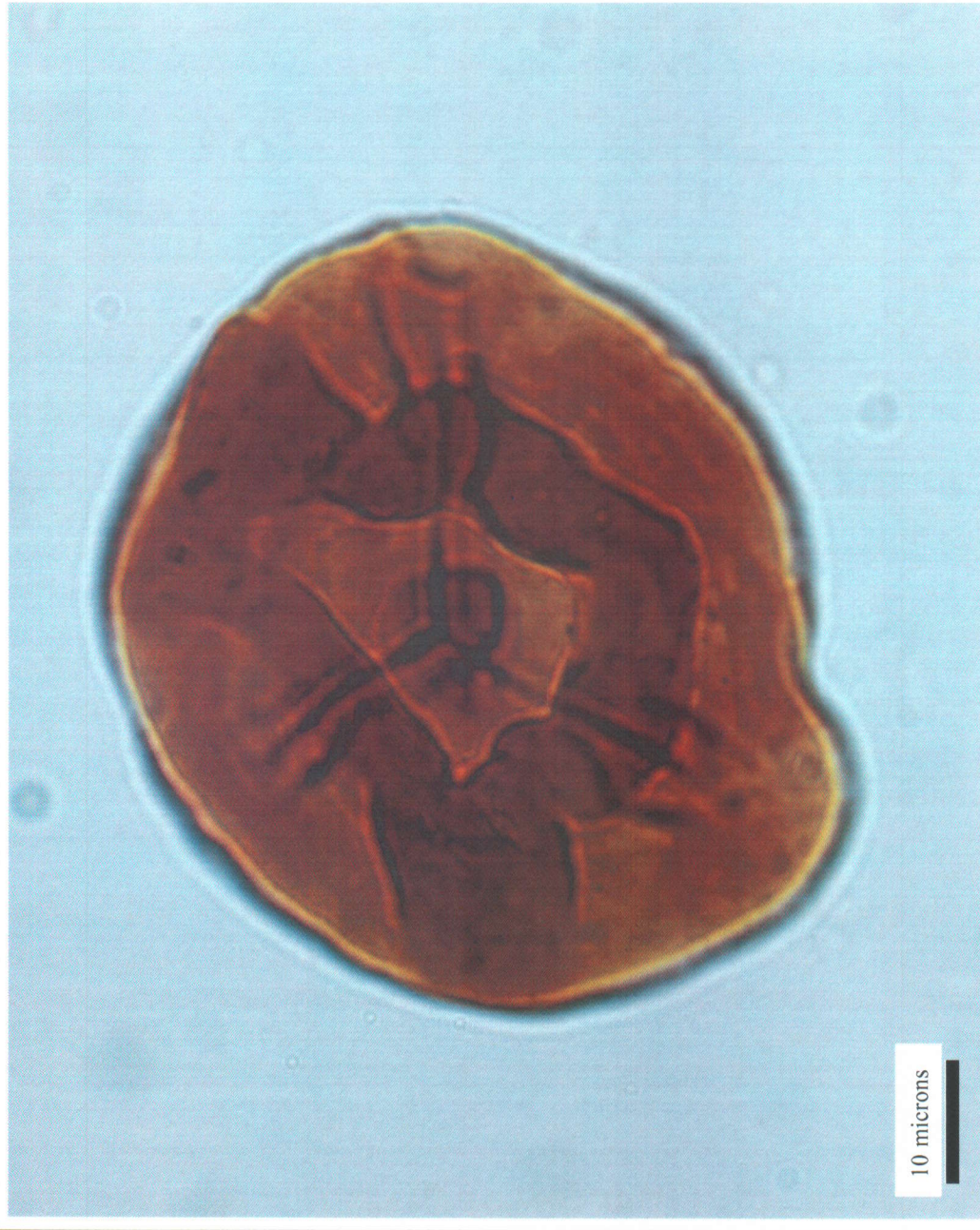
Shales below Faraday
House Sill, as in Fig. 4,
Sample MPA 31165,
Specimen MPK 7045.



Waters Farm Borehole,
14.50 m, as in Fig. 3,
Sample MPA 18197,
Specimen MPK 7046.

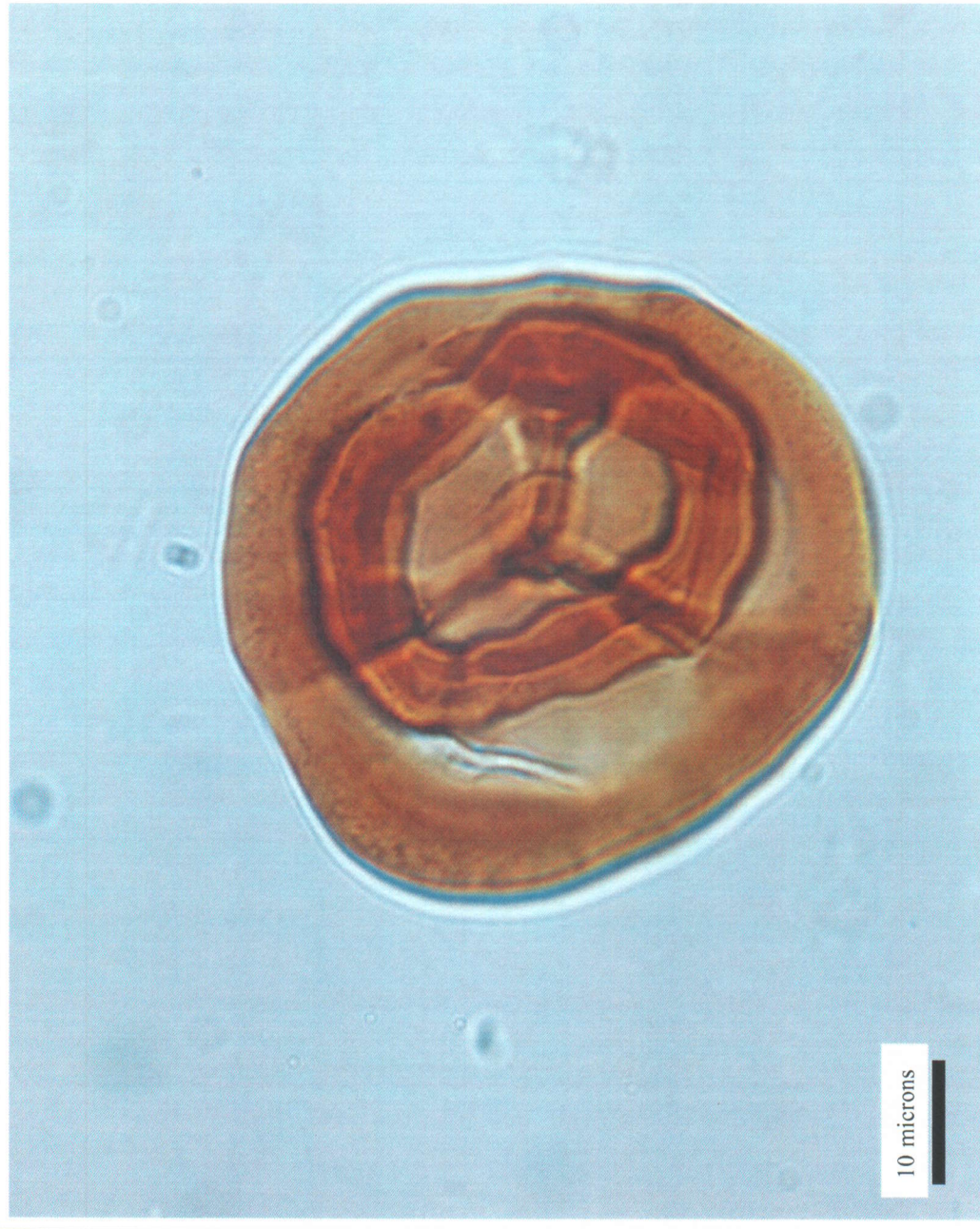


Diddup Borehole, 7.20 m,
Scotland; Westphalian A,
SS Biozone, Sample MPA
4578, Specimen MPK 7047.
Distal focus.



10 microns

Halesowen Beds, Callow
Brook, Staffordshire,
England; Westphalian D,
UP Biozone, Sample MPA
12628, Specimen MPK
7048. Proximal focus
showing development of
thickenings at end of trilete
sutures which fuse onto
cingulum.



10 microns

***Knoxisporites triangularis* Higgs, Clayton and Keegan, 1988.**

Description:

Radial, trilete, cingulate miospores. Amb subcircular to convexly triangular. Trilete mark distinct, sutures straight, sometimes open, extending to the inner margin of the cingulum, accompanied by broad prominent labra up to 20 im in overall width. Intexine relatively thin forms rounded triangular to subcircular inner body. Exoexine extended in equatorial plane to form undifferentiated cingulum, up to 14 im wide. Proximal surface laevigate. Distal surface ornamented with three muri arranged to form a triangular pattern with the apices of the triangle joining the cingulum in the inter-radial positions. Muri vary between 8-12 im in width and often slightly expanded where they fuse with the cingulum. Remainder of exine laevigate to scabrate.

Alternative description:

Higgs, Clayton and Keegan (1988, p.66, pl.8, figs 3,6)

Size:

Overall equatorial diameter

79(91)121 microns

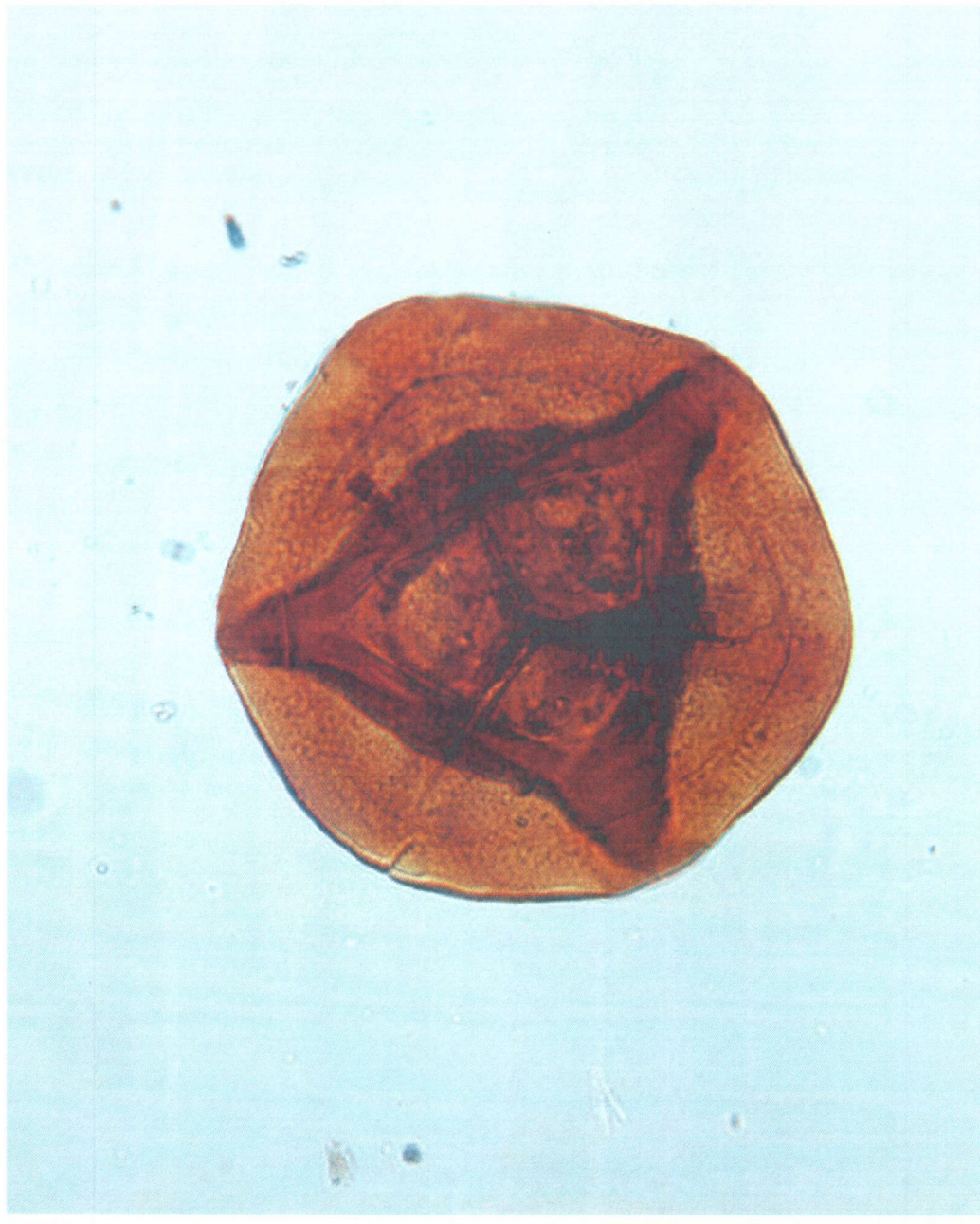
Comparisons:

The distinctive triangular structure created from three muri on the distal surface distinguish this species from others assigned to the genus *Knoxisporites*. Higgs, Clayton and Keegan 1988 elevated this form to specific status considering that it was sufficiently distinct from *Knoxisporites literatus* (Waltz) Playford 1963 within which it had previously been allocated varietal status.

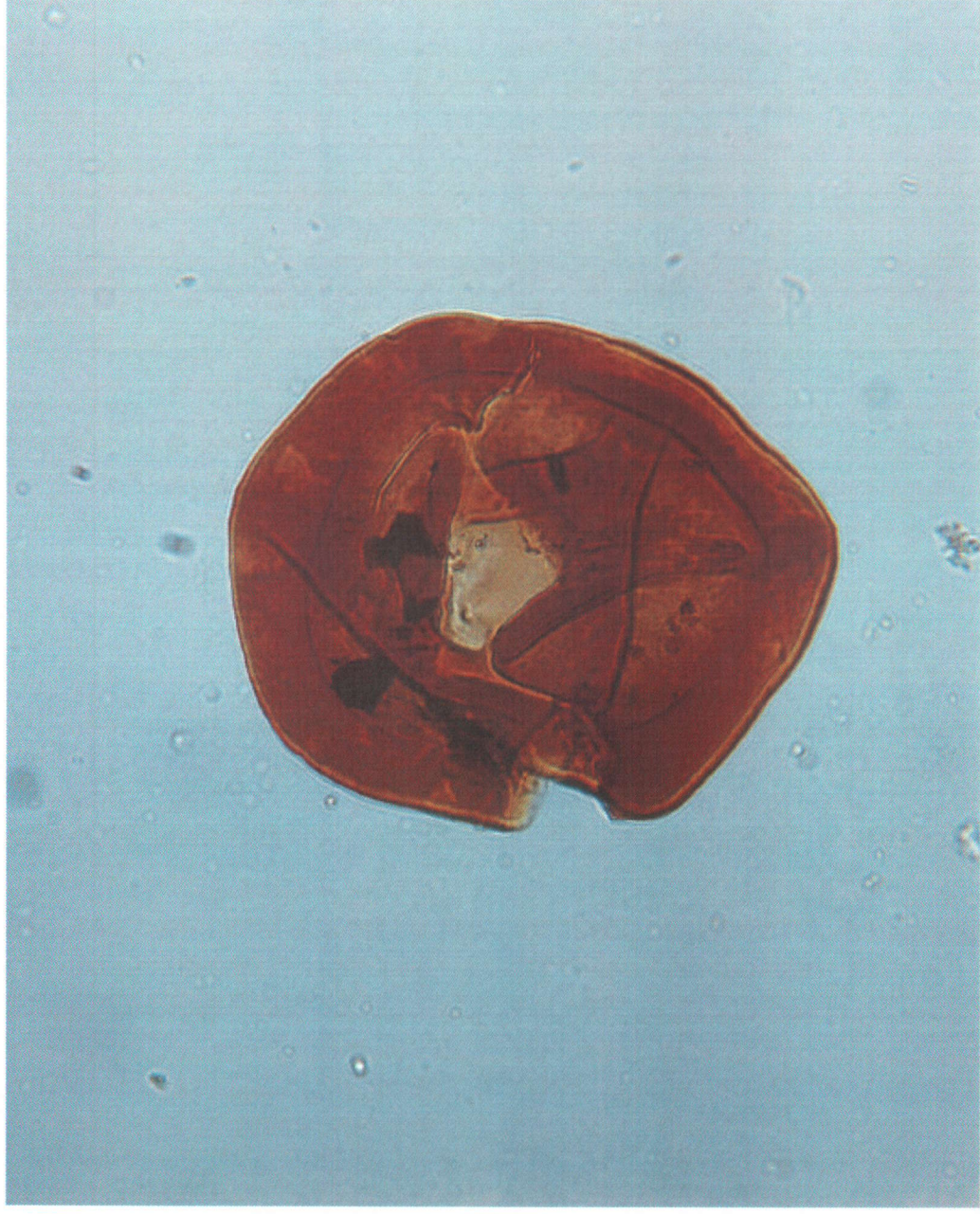
Range:

(From Higgs et al. (1988)) Tournaisian Tn1b to Tn3c, VI- CM Biozones.

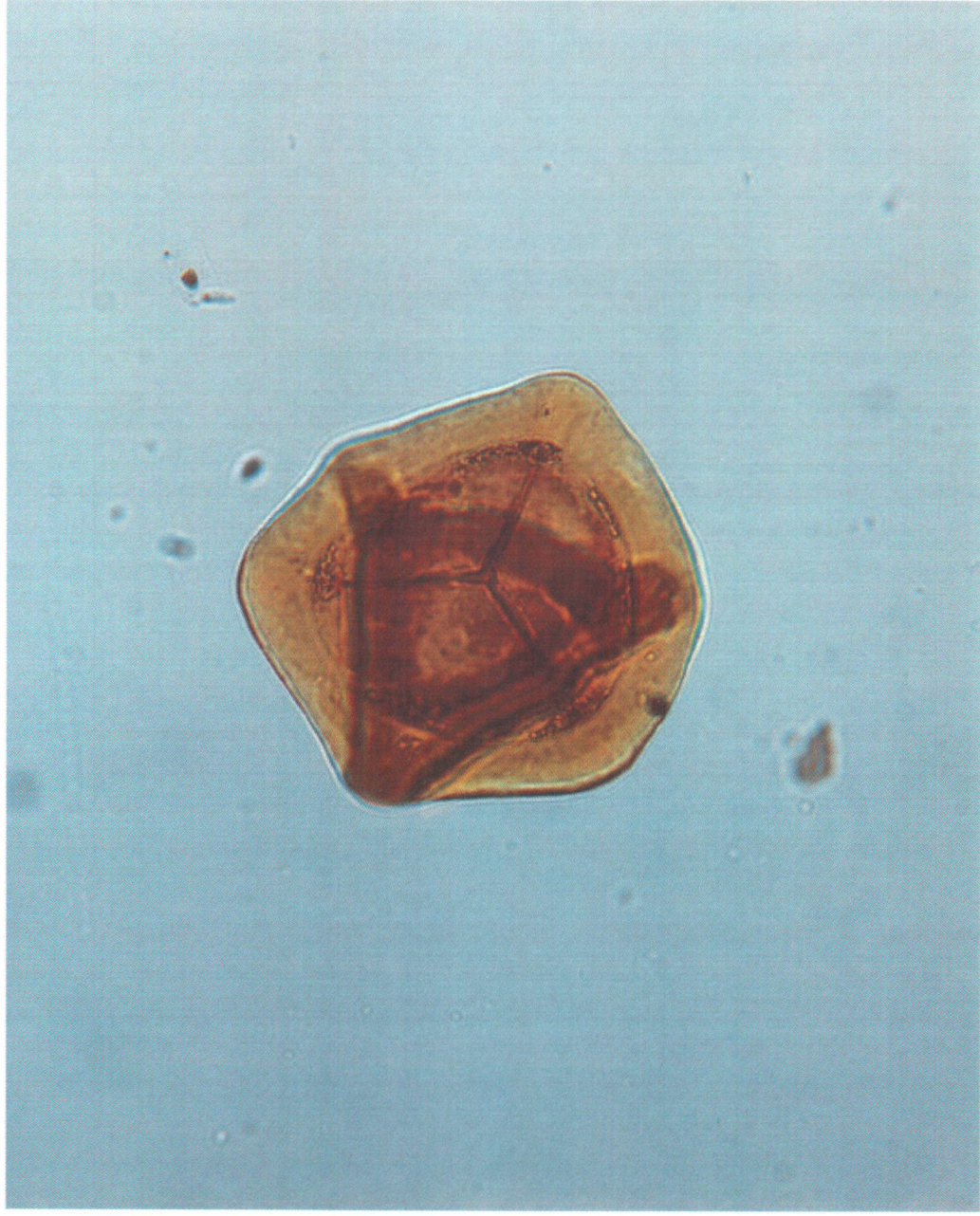
Pinskey Gill Beds, Wygarth Gill
Borehole, Ravenstonedale, Cumbria,
England: Tournaisian, CM Biozone,
Sample MPA 292, Specimen **7031**.
Subcircular-pentagonal cingulate
miospore. Trilete mark distinct,
sutures accompanied by low, broad
labra extend almost to equatorial
margin of spore body. Cingulum thick,
uniform. Distal surface of spores bears
three straight to slightly bent thickened
ridges that form distinctive triangular
structure. Apices of triangle fused to
distal surface of cingulum in the inter-
radial position. Exine surface laevigate
or very finely roughened.



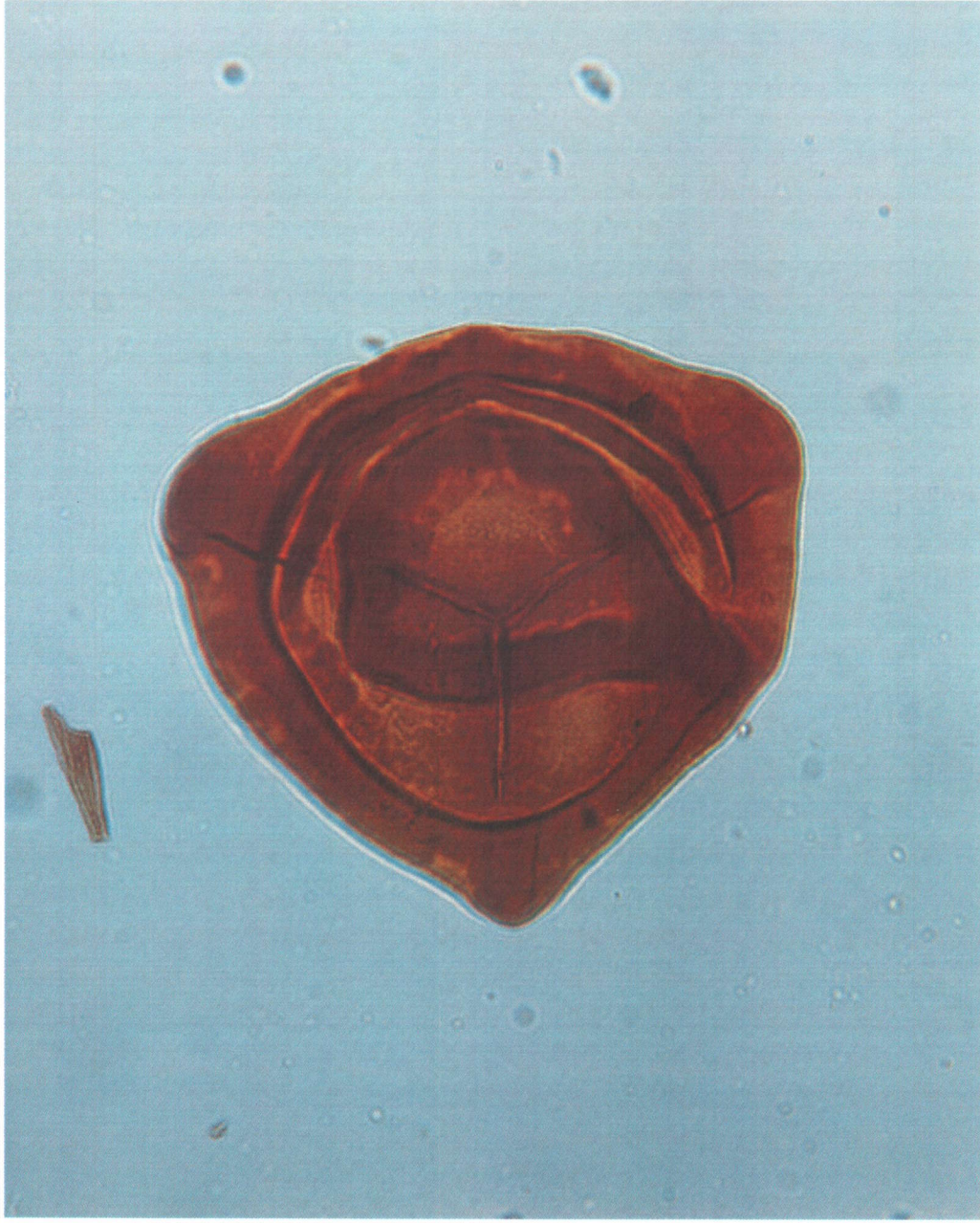
Pinskey Gill Beds, Wygarth Gill
Borehole, Ravenstonedale, Cumbria,
England, as in Fig. 1, Sample MPA
292, Specimen MPK **7032**. Torn
specimen, proximal focus. Trilete
mark distinct, open; sutures
accompanied by low broad thickened
labra which extend almost to
equatorial margin of body. Triangular
distal structure distorted by a tear.



Cementstone Group, Bracken Bay,
Heads of Ayr, Ayrshire, Scotland;
Tournaisian, CM Biozone. Sample
MPA 29832, Specimen MPK **7033**.
Rounded triangular miospore with
uniform, thick, cingulum. Trilete mark
distinct, sutures apparently without
thickened labra extend to equator of
spore body. Characteristic triangular
shaped thickening on the distal surface
appears to show minor expansion at
the apices where it fuses with
cingulum surface.

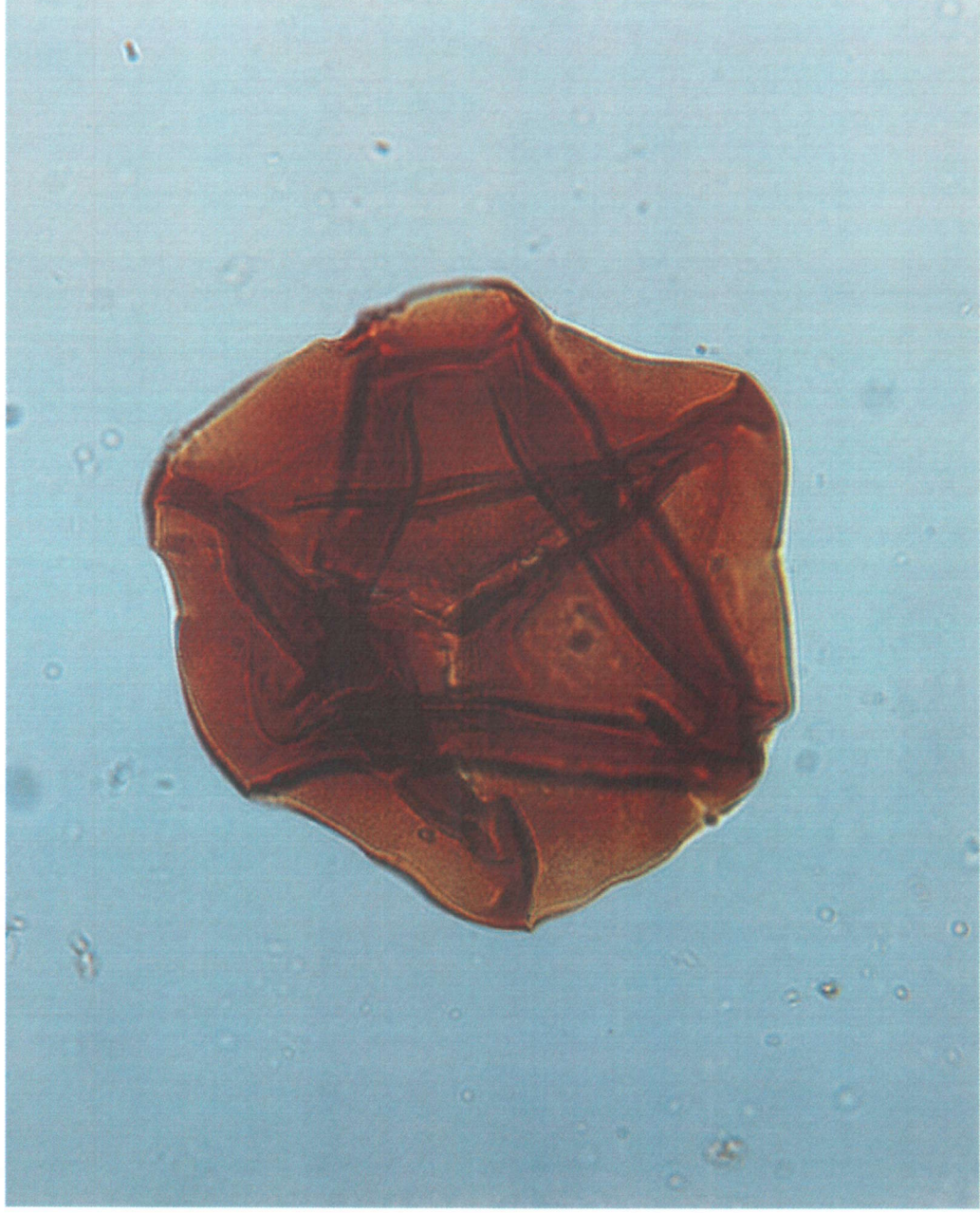


Cementstone Group, Bracken Bay,
Heads of Ayr, Ayrshire, Scotland, as
in Fig. 3, Sample MPA 29832,
Specimen MPK 7034. Rounded
triangular specimen with subcircular
inner body surrounded by cingulum
showing slight expansion in width at
the radial margins. Trilete mark
distinct, sutures extend to equatorial
margin of body and accompanied by
low, broad, thickened labra that extend
beyond ends of trilete rays onto
proximal surface of cingulum. Distal
thickening ill formed being attached to
cingulum only in one inter-radial
position.



Pinskey Gill Beds, Wygarth Gill
Borehole, Ravenstonedale, Cumbria,
England, as in fig. 1, Sample MPA
298, Specimen MPK **7035**.

Hexagonal, slightly folded specimen
with characteristic triangular
thickening on the distal surface. Trilete
mark distinct, sutures extending to the
body margin accompanied by broad,
low, thickened lips that extend beyond
the end of the trilete rays, across the
cingulum to the equatorial margin.

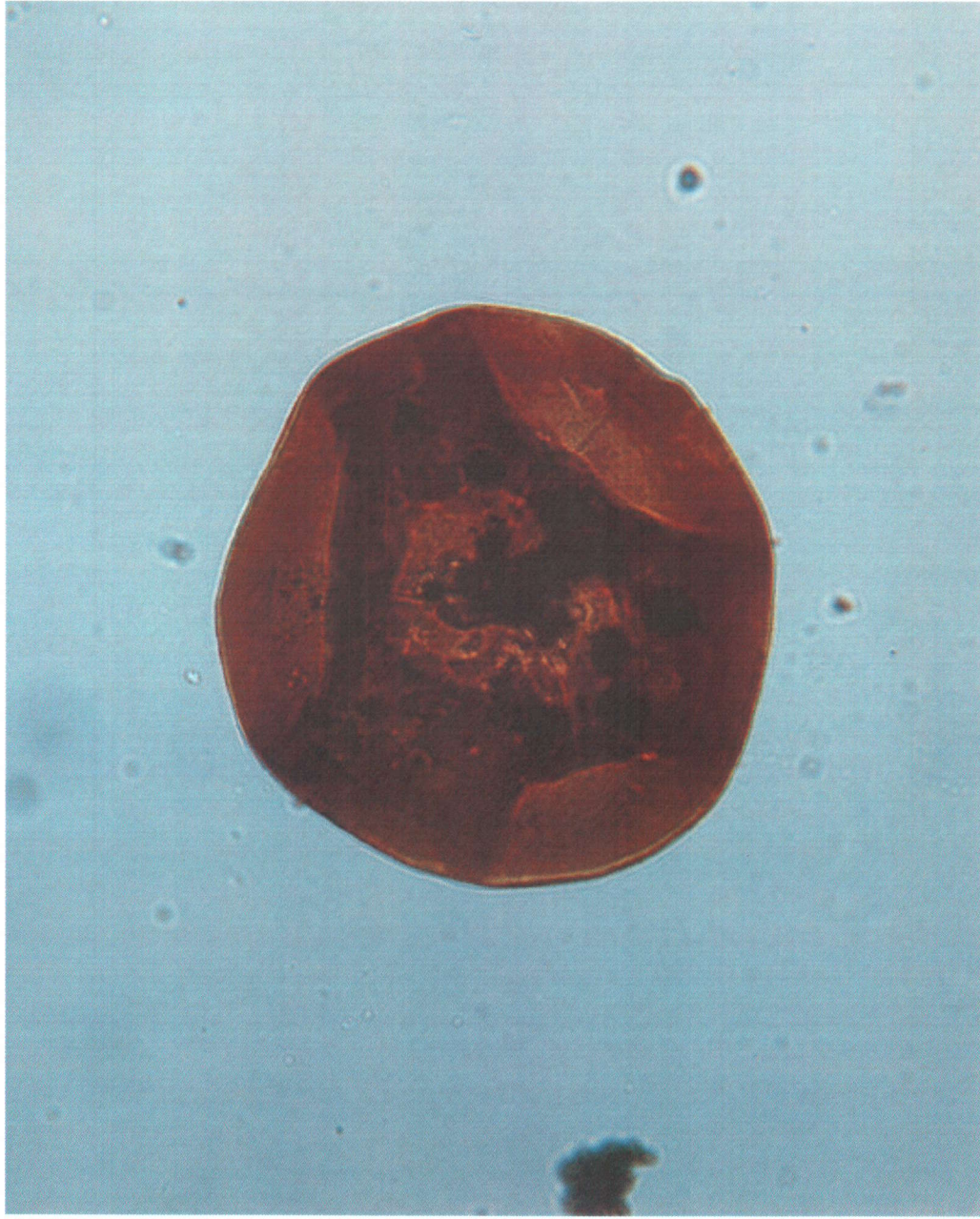


Pinskey Gill Beds, Wygarth Gill

Borehole, Ravenstonedale, Cumbria,
England, as in Fig. 1, Sample MPA

292, Specimen MPK 7036.

Morphological variant where sides of
distinctive triangular structure on
distal surface do not fuse together onto
the cingulum but form a 'kyrtome like'
structure.



Reticulatisporites carnosus (Knox 1950) Neves 1964

Description:

Radial, trilete, cingulate miospores. Amb broadly rounded triangular to subcircular, margin usually smooth, occasionally undulate to uneven or highly involute. Trilete mark distinct, sutures straight, simple or with low narrow labra, extending to inner margin of the cingulum. Intexine relatively thin forming subcircular to rounded triangular inner body. Exoexine extended equatorially to form differentially thickened cingulum consisting of these zones with individual zones varying from 5-17 μ m in width. The inner thickened zone is broader and more prominent than the outer marginal thickened zone. The thinner median zone may be reduced to a mere line but in other specimens may be of significant width. Radially orientated thickenings may be present on the distal surface and take the form of a Y-shaped structure attached to the cingulum in the inter-radial positions. Faint proximal thickenings may arise from the radial positions but they scarcely extend poleward beyond the inner thickened zone of the cingulum.

Other descriptions

Knox (1950, p.329, pl. 19, fig. 290)

Neves (1964, p.1667)

Smith & Butterworth (1967, pp.220-221, pl.14, figs 11-12)

Size:

Overall equatorial diameter

67(84)90 microns

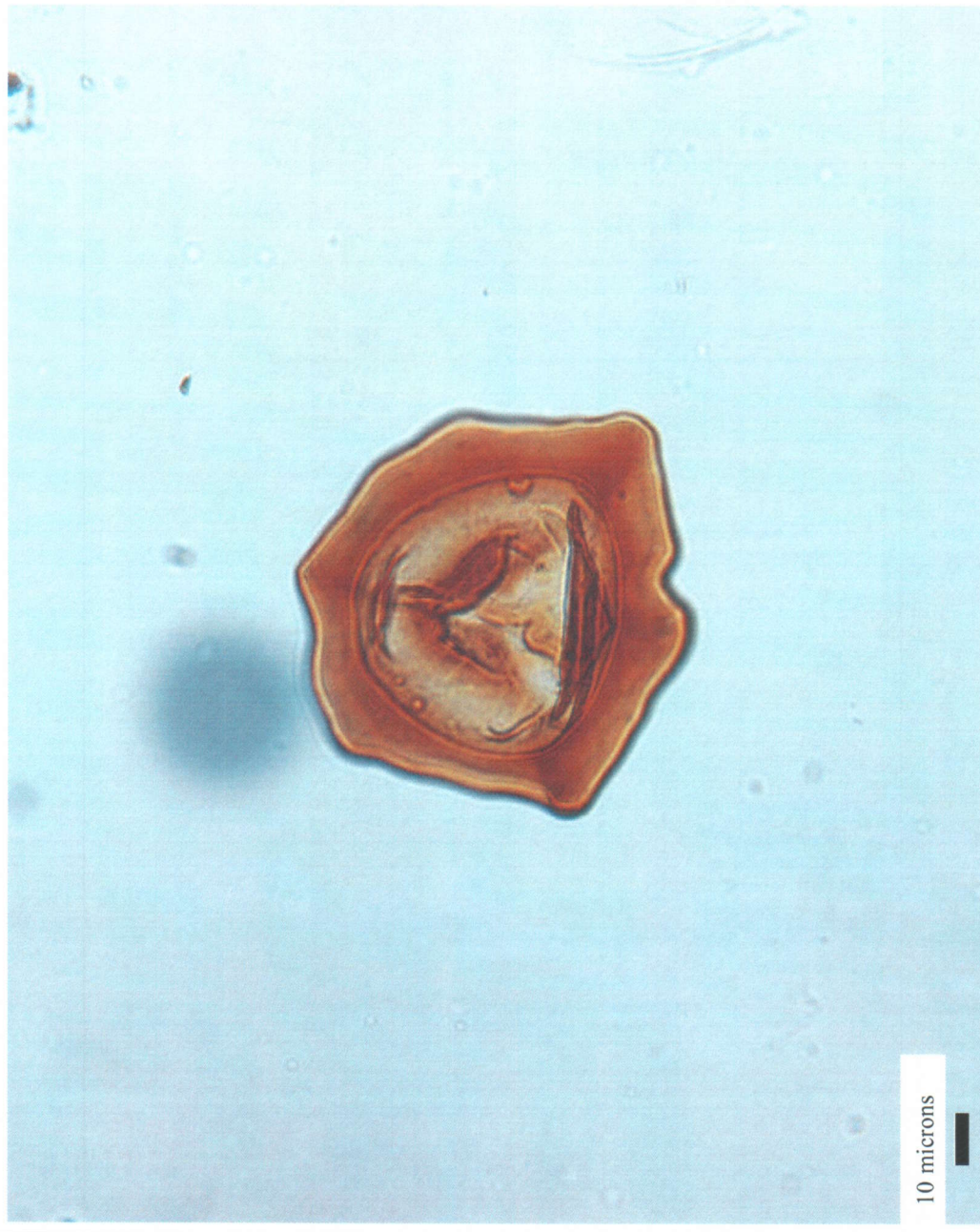
Comparisons:

Distinguished from other species assigned to the genus by the absence of any elaborate pattern of distal thickenings. In some specimens assigned to this species a distal pattern of thickenings comparable to those in *Reticulatisporites polygonalis* (Ibrahim) Neves 1964 may occur.

Range:

(from Clayton et al. (1977) and Smith & Butterworth (1967)) Carboniferous; late Viséan to ?early Westphalian A, NC to ?SS Biozones.

Sample MPA 4597,
Specimen MPK 7019.
Equatorial focus of
specimen with polygonal
equatorial outline but
rounded triangular-
subcircular inner body.
Trilete mark distinct, open,
sutures extend to outer
margin of inner body.
Cingulum thick and weakly
trizonate. Minor thickenings
developed on proximal
surface of cingulum
extending from equatorial
margin to ends of trilete
rays. Diddup Borehole, 7.20
m, Scotland; early
Westphalian A, SS Biozone.

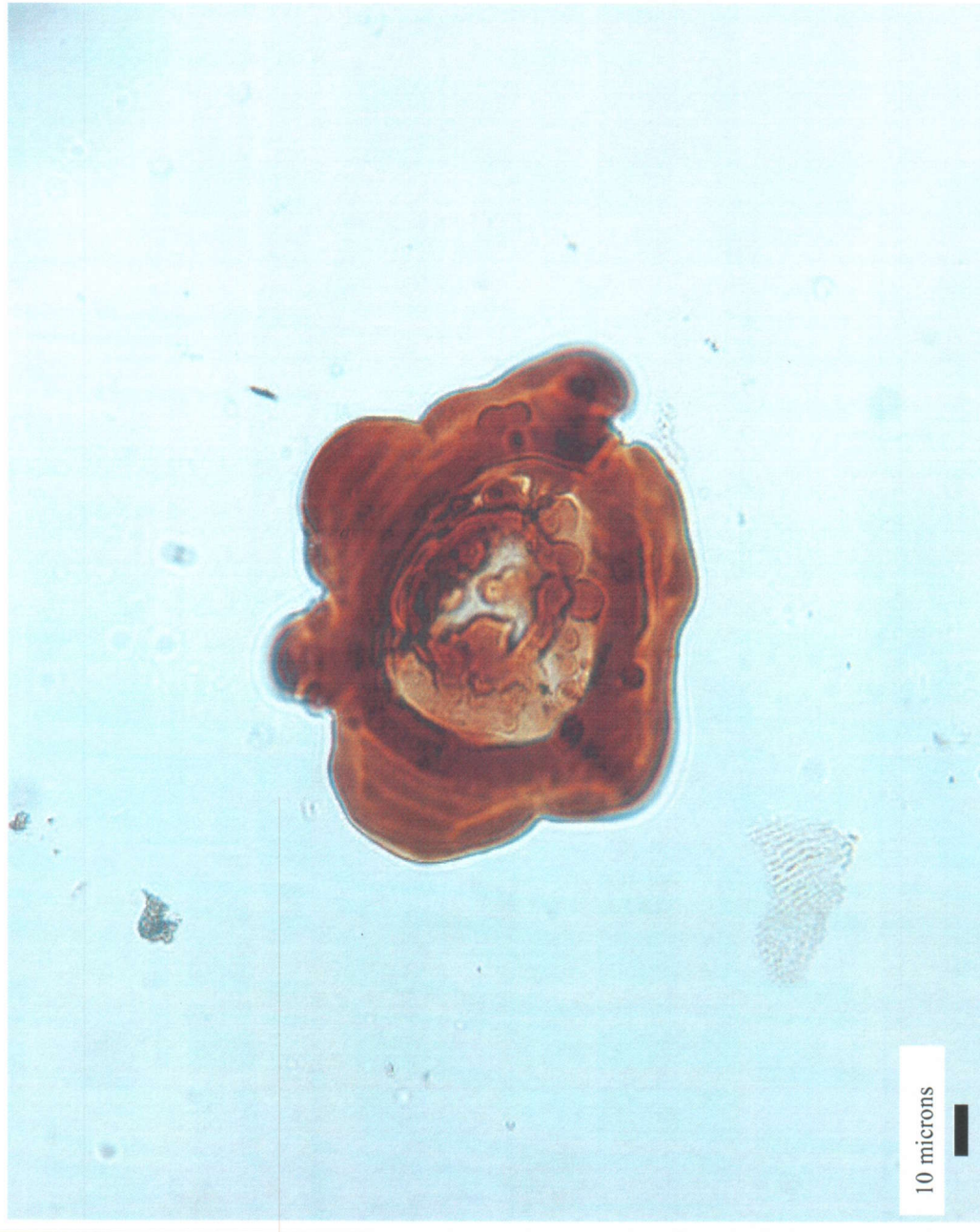


10 microns

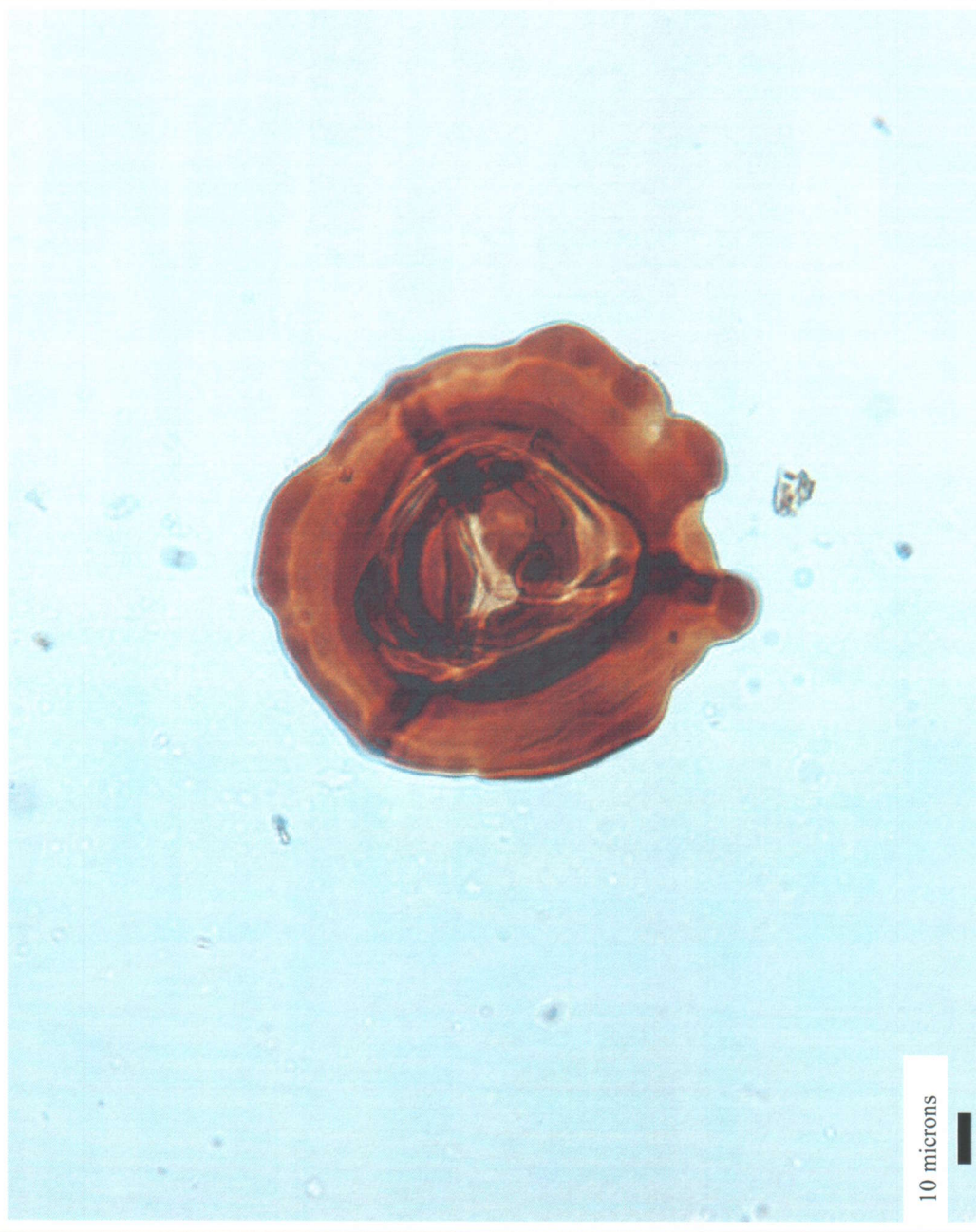
Sample MPA 4579,
Specimen MPK 7020.
Characteristic development
of differentially thickened
cingulum with three zones,
inner relatively narrow
thickened zone, wide
thinner median zone and
relatively narrow
incomplete outer zone.
Equatorial margin undulate.
Inner body rounded
triangular, showing minor
separation in the equatorial
plane from the cingulum.
Trilete mark distinct, simple
open, extending to body
margin. Diddup Borehole,
7.20 m, Scotland; early
Westphalian A, SS Biozone.



Sample MPA 4579,
Specimen MPK 7021.
Folded specimen showing
three fold subdivision of
cingulum. Equatorial margin
irregular. Diddup Borehole,
7.20 m, Scotland; early
Westphalian A, SS Biozone.

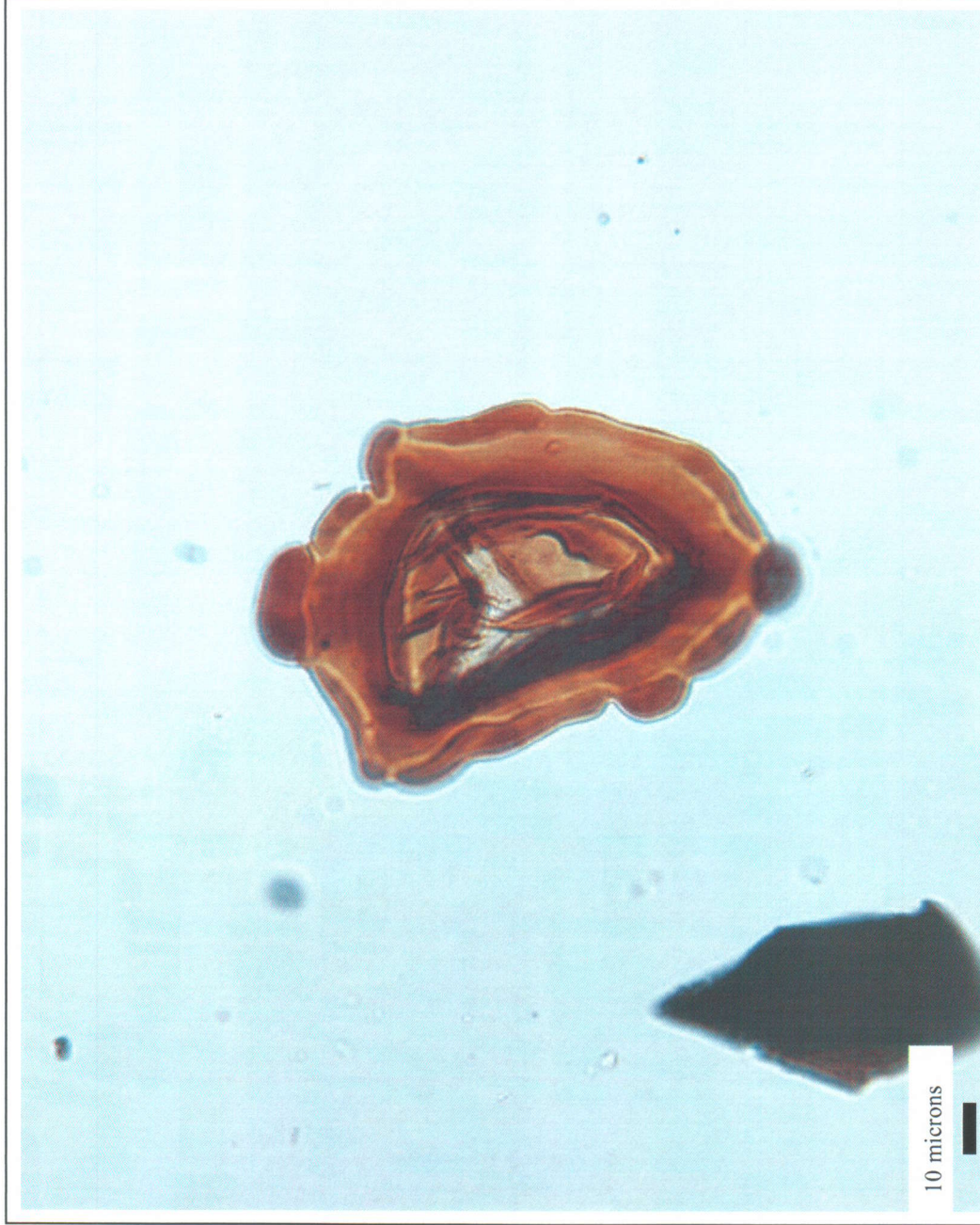


Sample MPA 4579,
Specimen MPK 7022. Note
thickened outer zone of
cingulum incomplete.
Radial thickenings
developed on proximal
surface extending from
equatorial margin to join up
with ends of trilete sutures.
Limited development of
irregular distal thickening
underneath inner body.
Diddup Borehole, 7.20 m,
Scotland; early Westphalian
A, SS Biozone.



10 microns

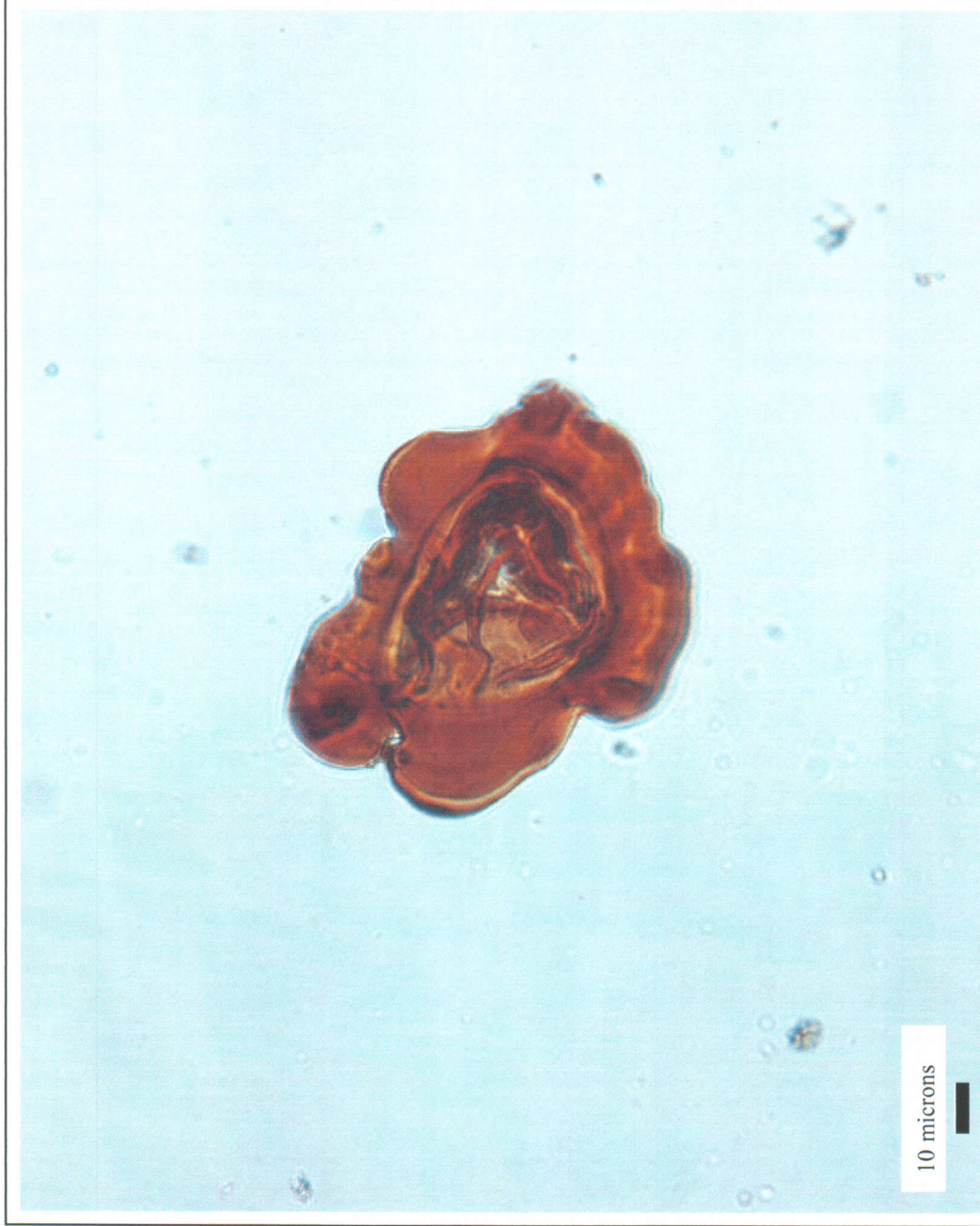
Sample MPA 4579,
Specimen MPK 7023.
Specimen showing marked
irregularities in
development of outer
thickened zone of cingulum.
Note evidence of minor
separation of inner body
from cingulum in the
equatorial plane. Trilete
mark partly obscured, open
and with indication of
narrow thickened lips.
Diddup Borehole, 7.20 m,
Scotland; early Westphalian
A, SS Biozone.



Sample MPA 4579,
Specimen MPK 7024.
Trilete mark open but with
sutures which appear to
extend to equatorial margin
of body. Well-developed
differentially thickened
cingulum with relatively
wide thickened inner zone,
narrow thinner median zone
and erratically developed
thicker outer zone. Radial
thickenings well developed
on proximal surface,
extending from equatorial
margin to join up with ends
of trilete rays. Diddup
Borehole, 7.20 m, Scotland;
early Westphalian A, SS
Biozone.

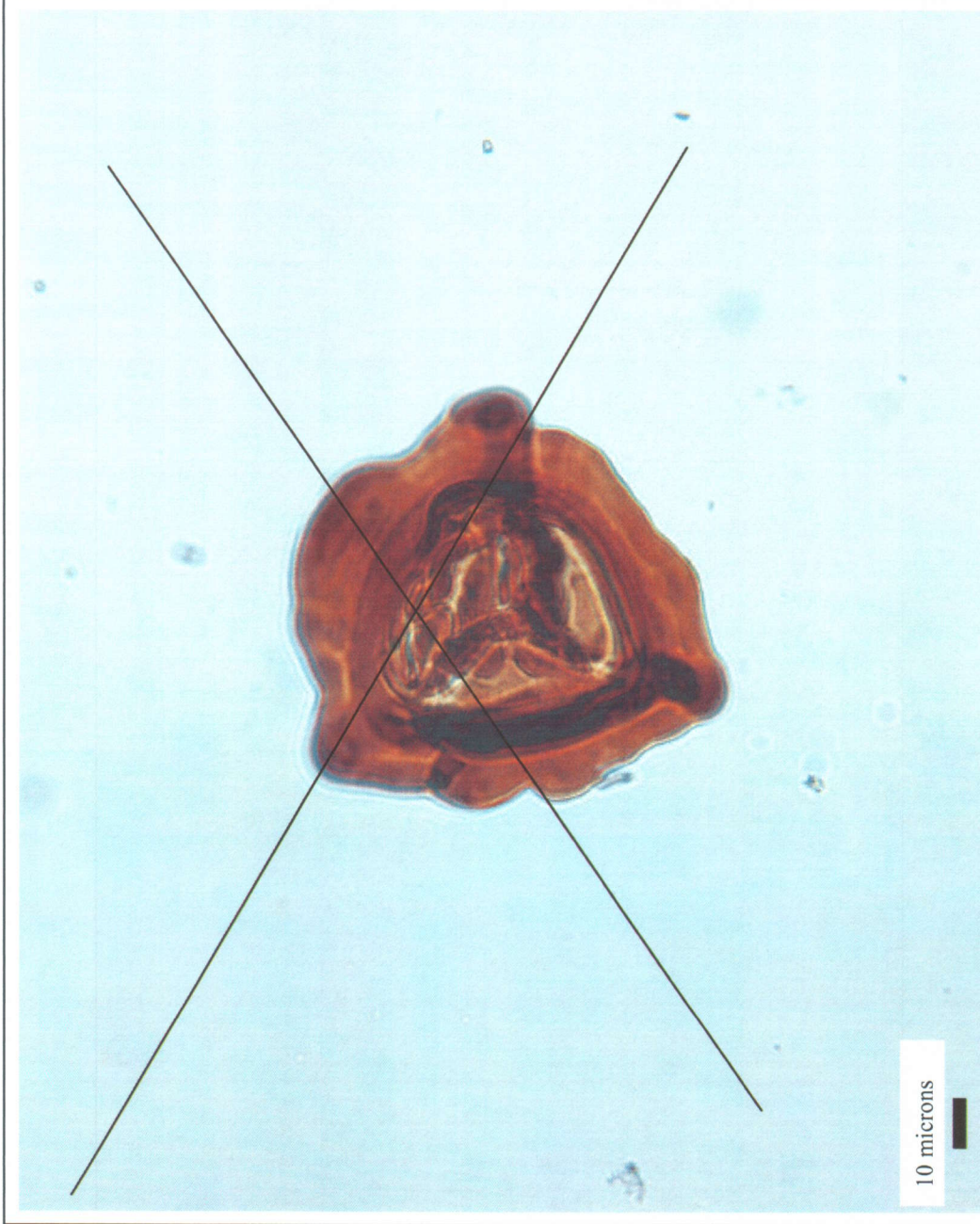


Sample MPA 4579,
Specimen MPK 7025.
Diddup Borehole, 7.20 m,
Scotland; early Westphalian
A, SS Biozone.



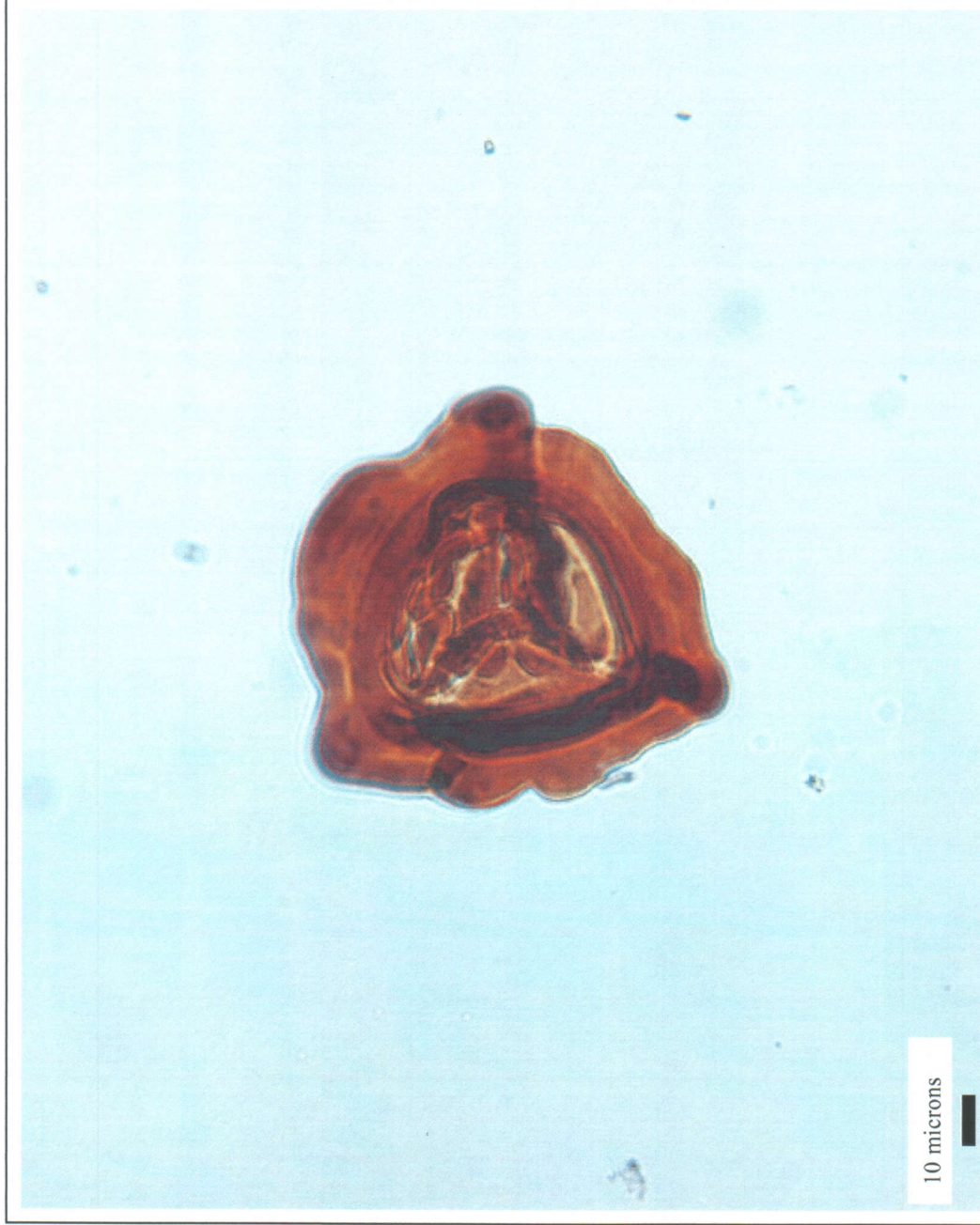
Sample MPA 4579,
Specimen MPK 7026.
Specimen with undulose
margin caused by variable
development of the thinner
median and thick outer
zones of the trizonate
cingulum. Radial
thickenings developed on
the proximal surface
connecting the equatorial
margin and the ends of the
trilete rays. Distal polar
region bears small irregular
circular ring of thickening
and a number of globular
verruca-like elements.
Diddup Borehole, 7.20 m,
Scotland; early Westphalian
A, SS Biozone.

Actually no picture for 7026

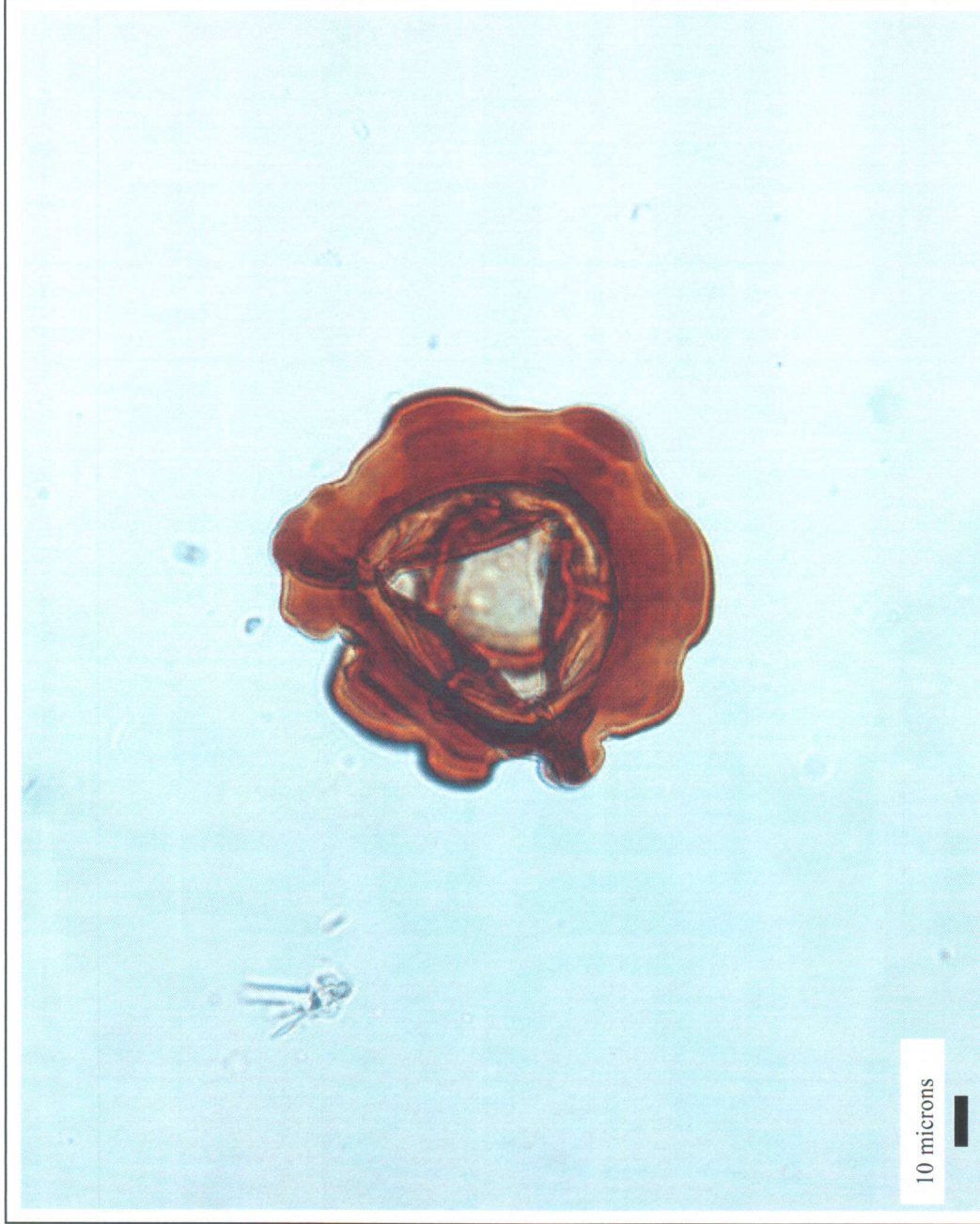


10 microns

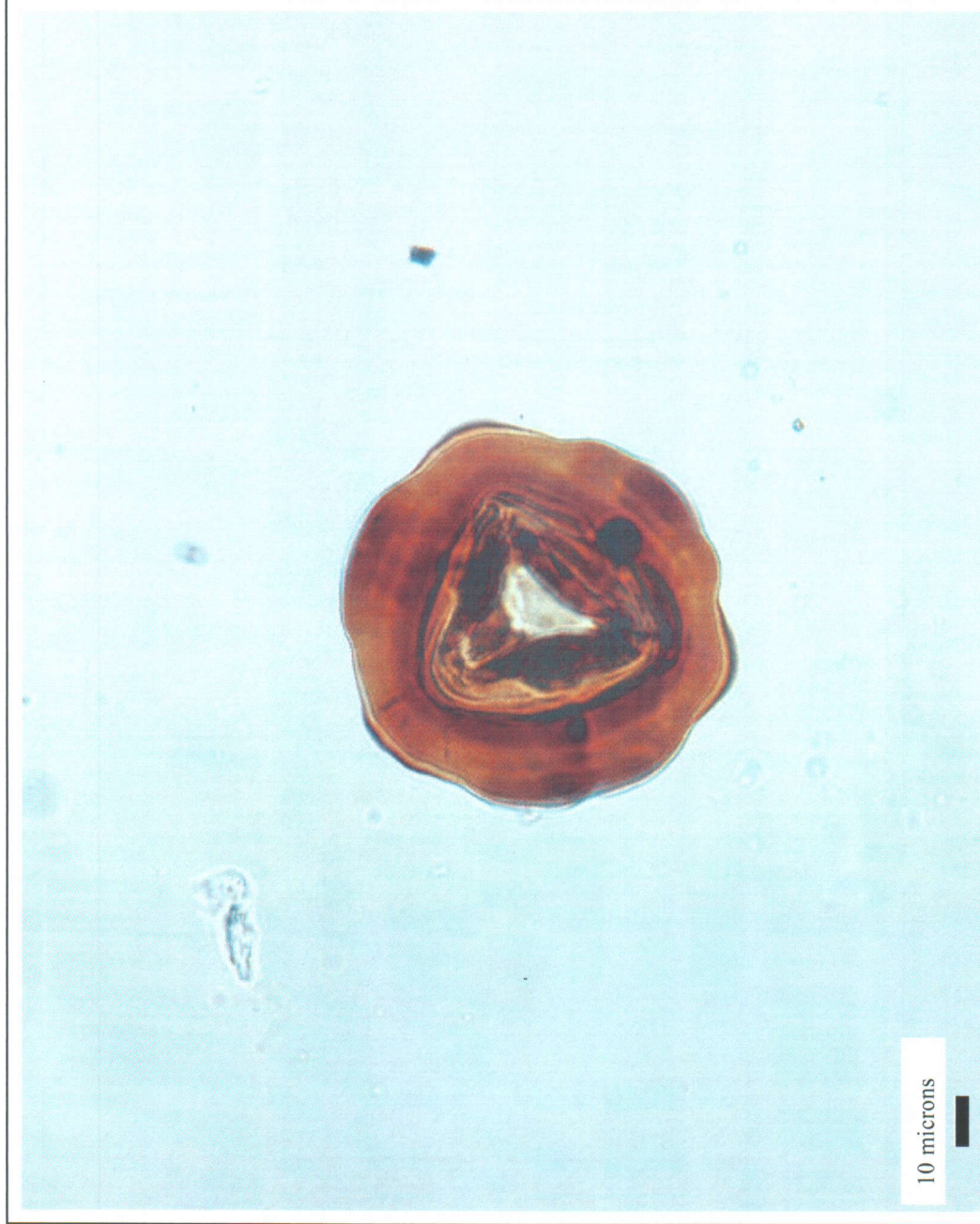
Sample MPA 4579,
Specimen MPK 7027.
Diddup Borehole, 7.20 m,
Scotland; early Westphalian
A, SS Biozone.



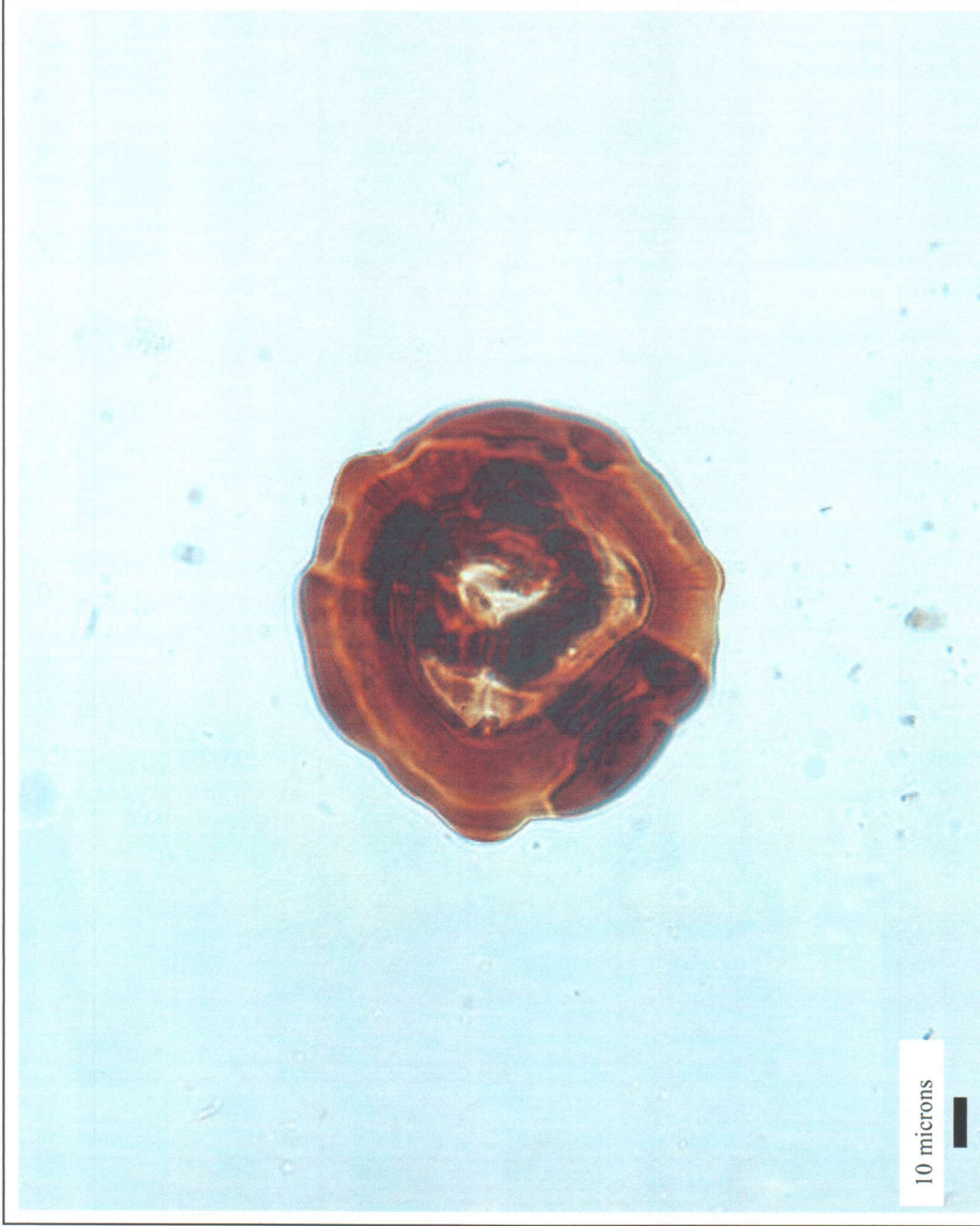
Sample MPA 4579,
Specimen MPK 7028.
Proximal focus. Trilete
mark open, sutures reaching
almost to the equatorial
margin of the inner body.
Note irregular development
of the outer thickened zone
of the cingulum creating
irregular margin to spore.
Diddup Borehole, 7.20 m,
Scotland; early Westphalian
A, SS Biozone.



Sample MPA 4579,
specimen MPK 7029.
Proximal focus. Diddup
Borehole, 7.20 m, Scotland;
early Westphalian A, SS
Biozone.



Sample MPA 4579,
Specimen MPK 7030.
Diddup Borehole, 7.20 m,
Scotland; early Westphalian
A, SS Biozone.



Torispora securis (Balme 1952) Alpern, Doubinger and Horst, 1973.

Description:

Monolete miospores. Amb ovoid with one of the extremities expanded by thickening to produce slightly triangular shape. Miospore consists of ovoid to subcircular spore body (?spherical) with pronounced thickening in the form of a patinate crassitude developed either over the distal surface or in part in the lateral plane. Considerable variation exists in the location of the crassitude which may be in part influenced by the nature of compression. Monolete mark usually distinct, suture straight or curved, simple, approximately three-quarters or more of the spore body radius. Orientation of the suture commonly parallel to the long axis of the spore. Intexine of spore body relatively thin, laevigate. Exoexine thickened over part of the distal surface or at least in part in the equatorial plane to form variable crassitude which may in some cases overlap a significant part of the spore body on the proximal surface. Profile of crassitude in compressed specimens crescentic or sub-rectangular, surface smooth or finely roughened. Boundary between crassitude and spore body gradational or abrupt.

Other descriptions:

Balme, 1952, p.183.

Smith and Butterworth, 1967, pp.293-294, pl.24, figs 31-34.

Alpern, Doubinger and Horst, 1973, pp.59-62, pl.15, figs. 1-22.

Size:

Overall equatorial diameter

26(34)44 microns

Diameter of inner body

15(21)28 microns

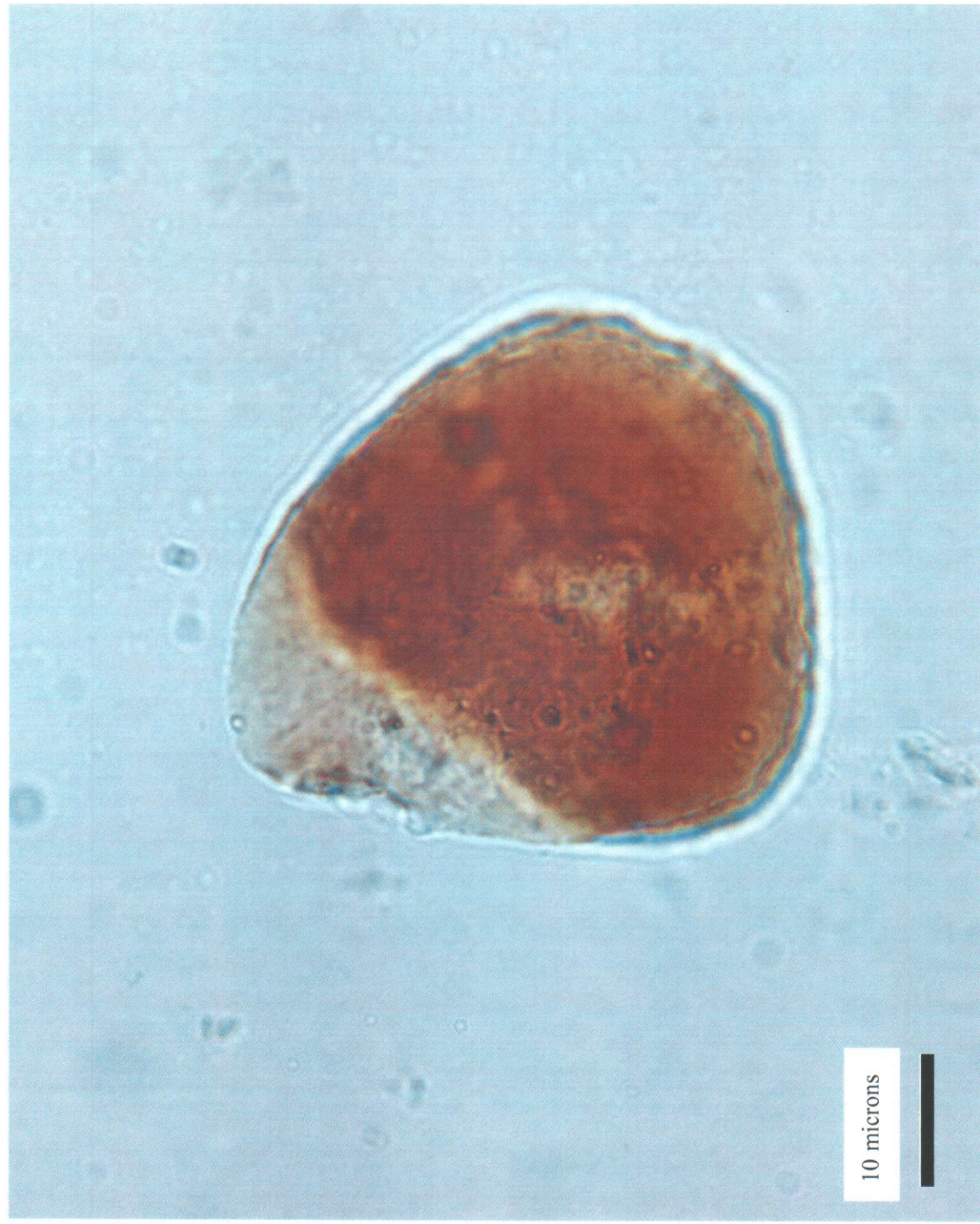
Comparison:

Smith and Butterworth (1967) did not differentiate *Torispora securis*, *T. granulata* Alpern 1959, *T. laevigata* Bharadwaj 1957 and *T. verrucosa* Alpern 1958. They noted that *T. verrucosa* were probably restricted to Westphalian D.

Range:

(From Clayton et al. (1977)) Carboniferous; Westphalian C (Bolsovian) to ?early Autunian, SL-?VC Biozones

Sample C, Specimen MPK
7092. Distal focus showing
body protruding from
patinate structure. Radwood
Borehole, 3008 ft., West
Midlands, England:
Westphalian C, SL Biozone.

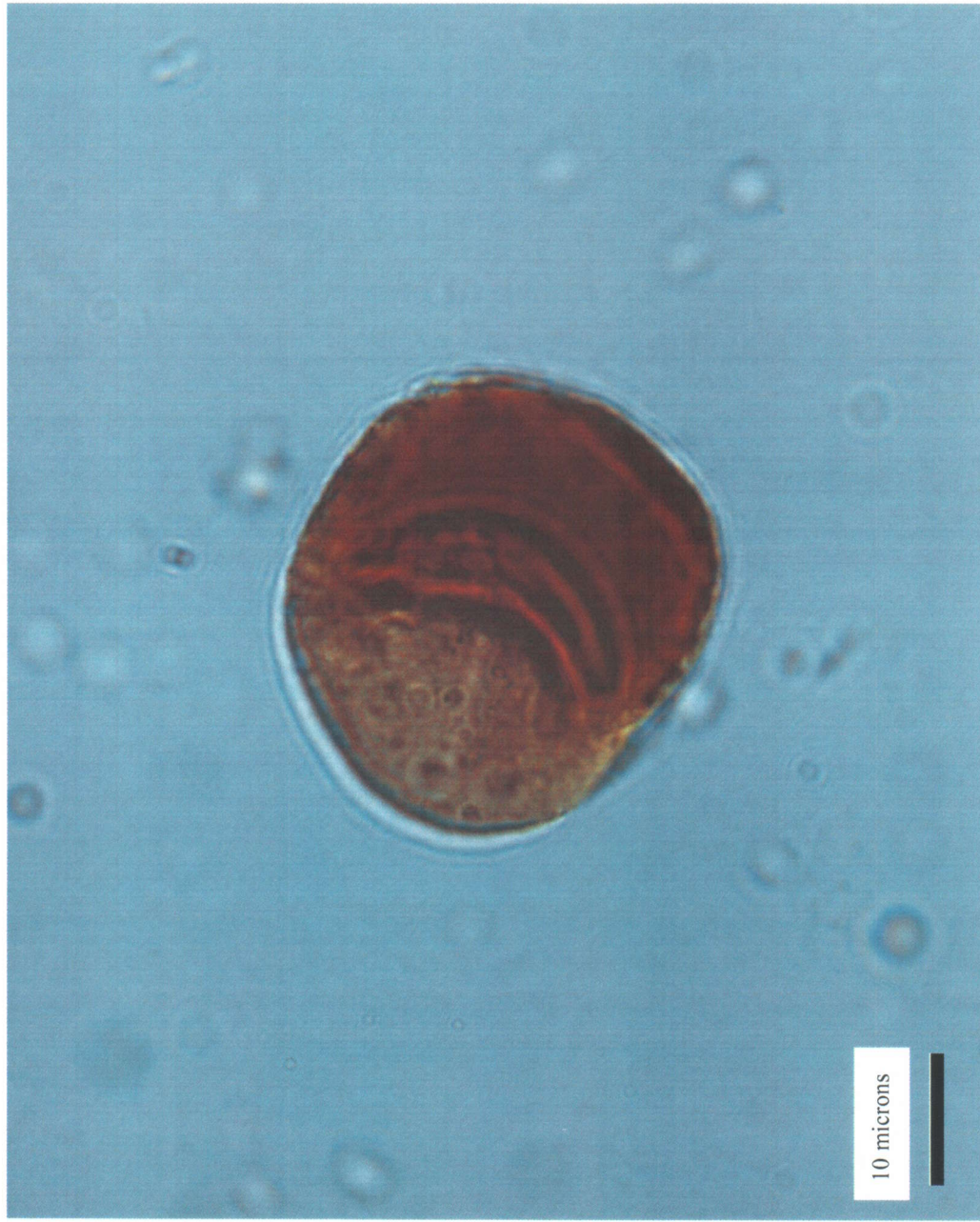


10 microns

Sample C, Specimen MPK
7093. Radwood Borehole,
3008 ft., West Midlands,
England: Westphalian C, SL
Biozone.

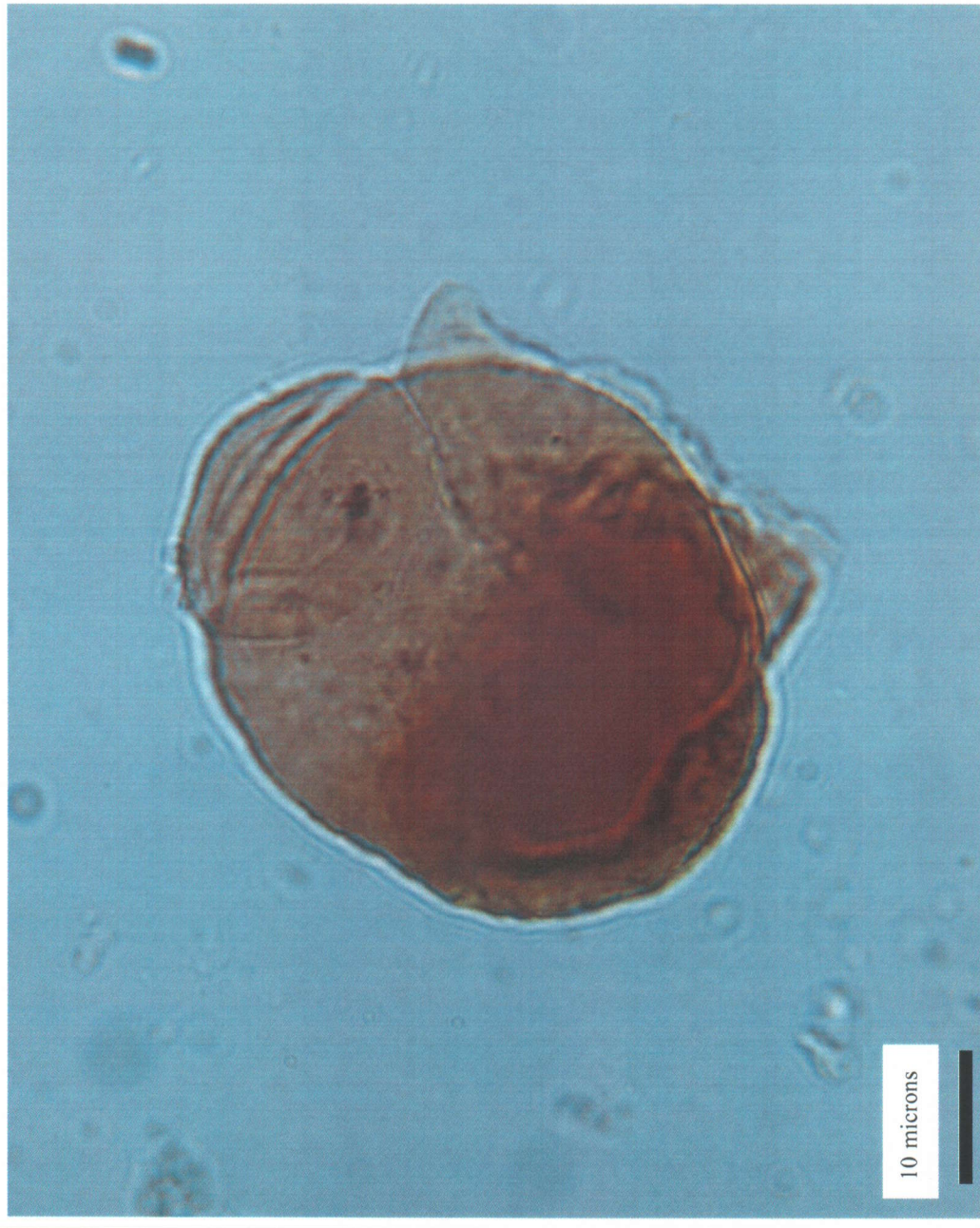


Sample C, Specimen MPK
7094. Note body with short
simple monolete mark
enclosed within sharply
defined patina. Exine of
body and patina laevigate.
Radwood Borehole, 3008
ft., West Midlands,
England: Westphalian C, SL
Biozone.



10 microns

Sample C, Specimen MPK
7095. Radwood Borehole,
3008 ft., West Midlands,
England: Westphalian C, SL
Biozone.



Sample C, Specimen MPK
7096. Possible oblique
compression. Monolete
mark, short, simple. Patina
sharply defined, surface
laevigate. Radwood
Borehole, 3008 ft., West
Midlands, England:
Westphalian C, SL Biozone.



Sample C, Specimen MPK
7097. Patina developed in
lateral direction, apparently
attached to body on only a
small part of its surface.
Radwood Borehole, 3008
ft., West Midlands,
England: Westphalian C, SL
Biozone.



Sample C, Specimen MPK
7098. Quadrate patina
developed in lateral plane.
Radwood Borehole, 3008
ft., West Midlands,
England: Westphalian C, SL
Biozone.



10 microns

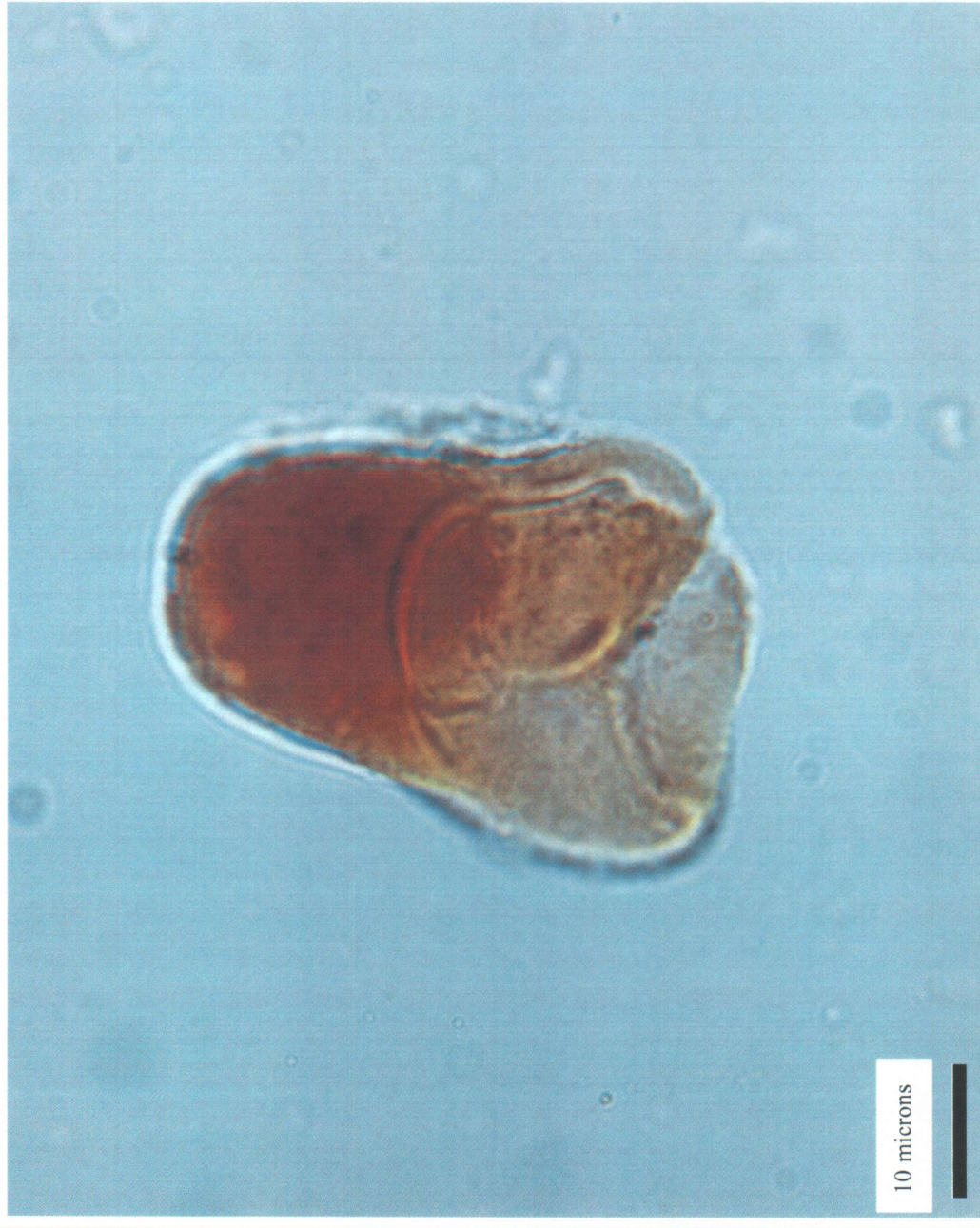
Sample C, Specimen MPK
7099. Quadrate patina,
probably polar in location,
on laterally compressed
specimen. Monolete mark
simple. Radwood Borehole,
3008 ft., West Midlands,
England: Westphalian C, SL
Biozone.



Sample C, Specimen MPK
7100. Proximal focus. Note
monolet mark almost equal
to body diameter. Radwood
Borehole, 3008 ft., West
Midlands, England:
Westphalian C, SL Biozone.



Sample C, Specimen MPK
7101. Radwood Borehole,
3008 ft., West Midlands,
England: Westphalian C, SL
Biozone.



Sample C, Specimen MPK
7102. Radwood Borehole,
3008 ft., West Midlands,
England: Westphalian C, SL
Biozone.



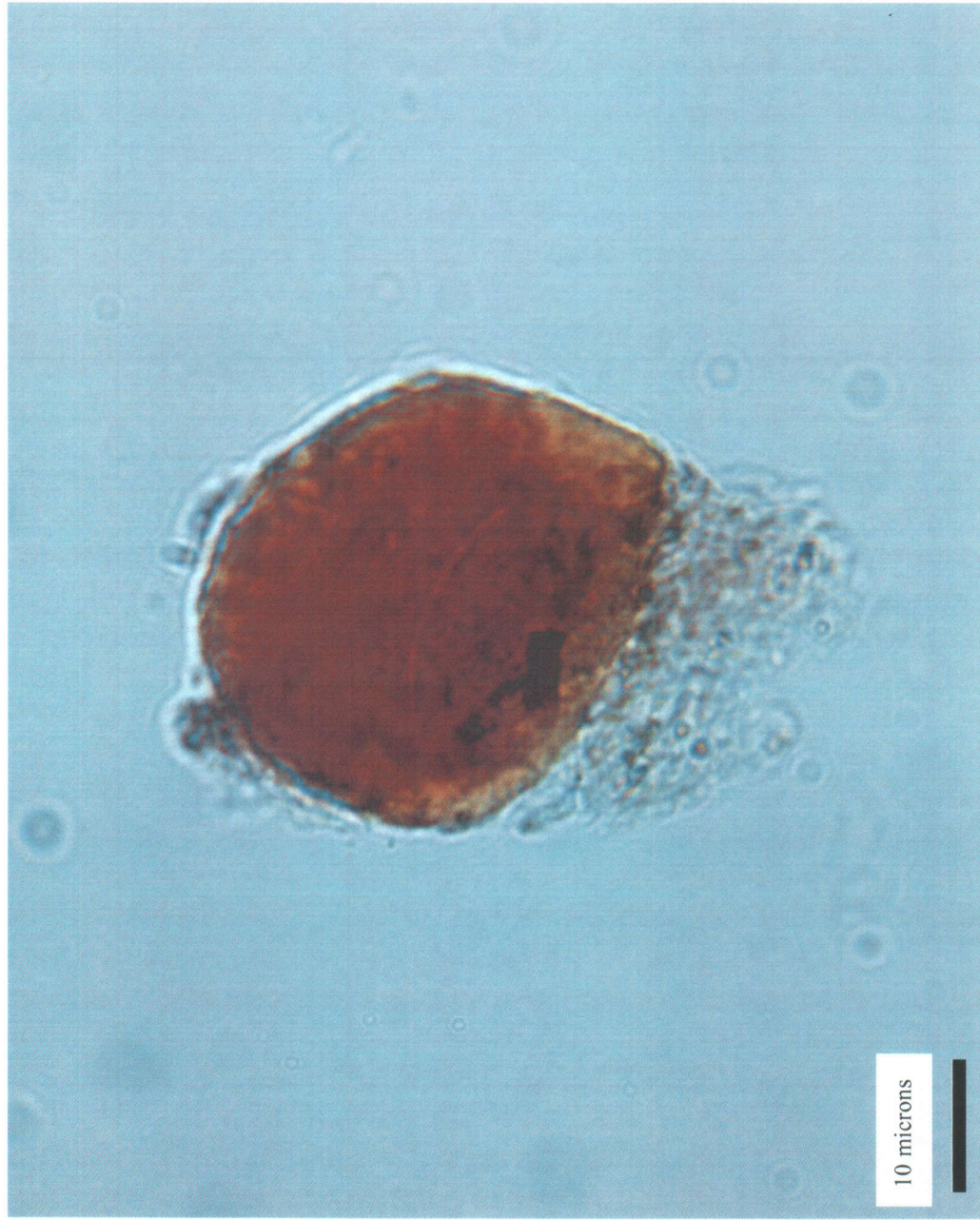
Sample C, Specimen MPK
7103. Torn specimen.
Radwood Borehole, 3008
ft., West Midlands,
England: Westphalian C, SL
Biozone.



Sample C, Specimen MPK
7104. Note proximal
extension of patina which
engulfs body. Monolete
mark short and simple.
Radwood Borehole, 3008
ft., West Midlands,
England: Westphalian C, SL
Biozone.



Sample C, Specimen MPK
7105. Radwood Borehole,
3008 ft., West Midlands,
England: Westphalian C, SL
Biozone.



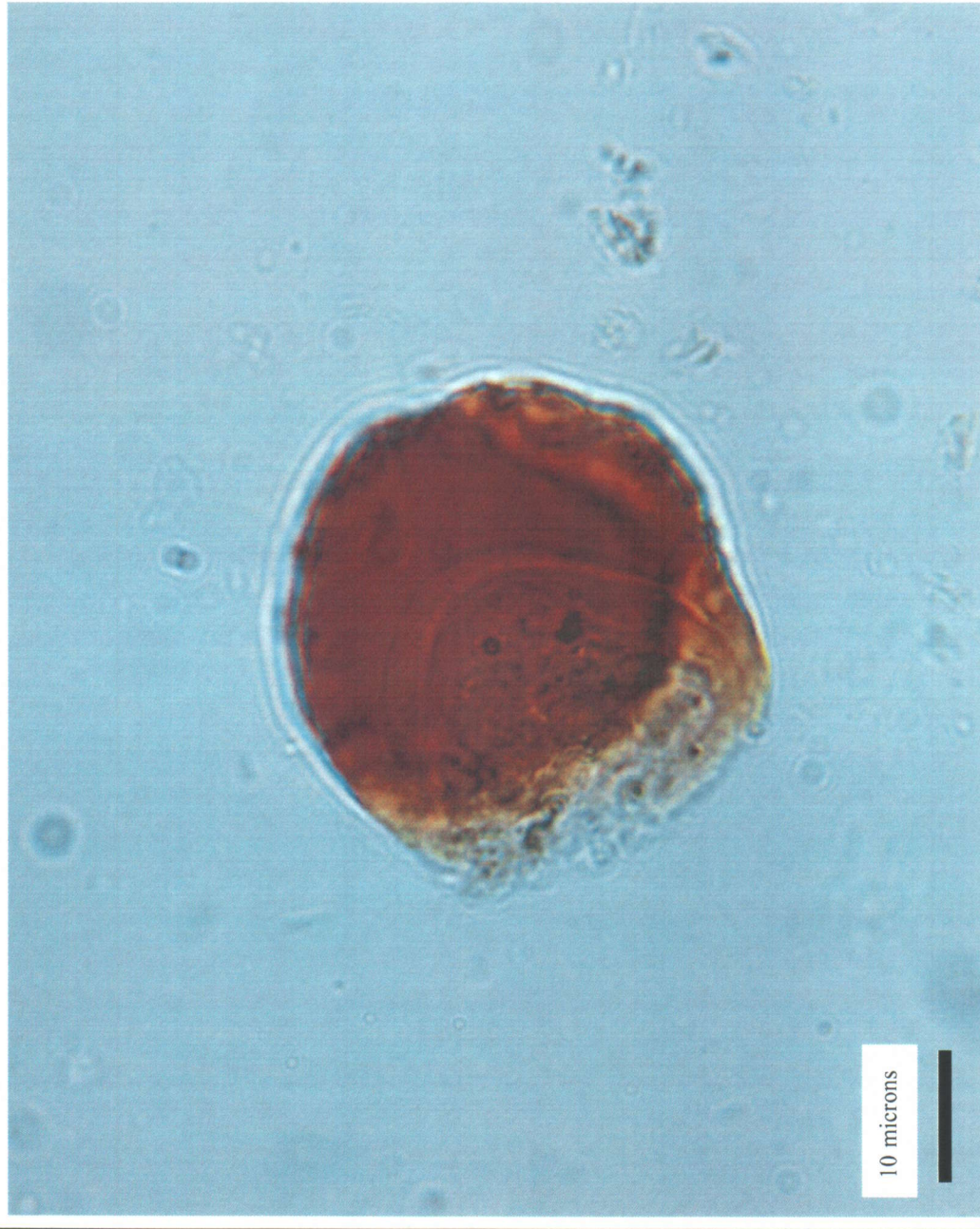
Sample C, Specimen MPK
7106. Radwood Borehole,
3008 ft., West Midlands,
England: Westphalian C, SL
Biozone.



Sample C, Specimen MPK
7107. Patinate development
mainly in lateral plane.
Monolete mark short and
simple. Radwood Borehole,
3008 ft., West Midlands,
England: Westphalian C, SL
Biozone.



Sample C, Specimen MPK
7108. Radwood Borehole,
3008 ft., West Midlands,
England: Westphalian C, SL
Biozone.



Sample C, Specimen MPK
7109. Radwood Borehole,
3008 ft., West Midlands,
England: Westphalian C, SL
Biozone.



Sample C, Specimen MPK
7110. Note curved monolet
mark. Radwood Borehole,
3008 ft., West Midlands,
England: Westphalian C, SL
Biozone.



Sample C, Specimen MPK
7111. Radwood Borehole,
3008 ft., West Midlands,
England: Westphalian C, SL
Biozone.

