Revision of the Gault foraminifera from the Hollis and Neaverson Collection (1921)

C. HERRERO & J. R. HAYNES

1 Departamento de Paleontología, Facultad de Ciencias Geológicas, Universidad Complutense de Madrid, Ciudad Universitaria, 28040 Madrid, Spain.
2 Geology Department, Institute of Earth Studies, University of Wales, Aberystwyth, Dyfed SY23 3DB, UK.

ABSTRACT - In 1921, Hollis and Neaverson listed 135 species and varieties of foraminifera from the Gault Phosphatic Nodule Bed at Ford, Buckinghamshire, England. The material has been re-examined, the list is brought up to date and the species are figured. The Collection has yielded a diverse and well preserved foraminiferal fauna of 90 species. Nodosariacea are the dominant group, though Ataxophragmiacea, Hedbergellacea and Miliolacea are abundant. The recorded assemblages allow us to date the Phosphatic Nodule Bed at Ford as belonging to the uppermost Euhopliites laulus Zone to lower part of Mortoniceras inflatum Zone within the Albian standard ammonite zonation. J. Micropalaentol. 16(1): 73–84, May 1997.

INTRODUCTION

Hollis and Neaverson (1921) published a short paper on the Gault foraminifera from the workings for phosphatic nodules at Ford, four miles southwest of Aylesbury, Buckinghamshire (England). They listed 135 species and varieties of foraminifera but neither descriptions nor illustrations were given by the authors. After their paper no other workers have given additional information about the foraminifera of the Gault at Ford. In fact, no references to the paper of Hollis and Neaverson (1921) have been found in the Early Cretaceous literature of Great Britain except for one by Crittenden (1988: p. 19, Unpublished Ph.D. Thesis, Plymouth Polytechnic).

The location of the site in which the Gault was worked at Ford for phosphatic nodules is not known exactly. In their paper, Hollis and Neaverson (1921) commented that the workings from which Hollis had collected his material in 1919 were abandoned and nothing remained but the spoil-heap which was by then (1921) completely grassed over. The available information, about the fields where the workings are said to have been (Fig. 1), was provided by the locals or elderly relatives of the locals to the Buckinghamshire County Museum (pers. comm. Ms K. M. Hawkins, Keeper of Biology and Geology of that Museum).

The only description of the nodules beds is that of Keeping, who saw earlier workings near Ford in 1876. According to Jukes-Brown, who incorporated his observations into his

Fig. 1. Cretaceous outcrops in southern Britain and location of the site of phosphatic nodules ('coprolites') workings, modified from sheet SP 70 NE (by courtesy of Ms K. M. Hawkins, Buckinghamshire County Museum, Aylesbury).
memoir (1900), the nodules were worked on this occasion between the years 1875 and 1884. Keeping's remarks include the following:

The coprolite seam is 3 to 4 inches thick and is constant throughout the pit, though the bed is irregular in position. The irregularity of this kind, the commonest being slips of a few inches (4 to 10), cutting off the seam with a clear face marked by slickensides; in other cases the bed is bent downwards to a similar extent, and this bending is due, I am inclined to think, to subsequent folding and not to irregularity of deposition.

The matrix of the seam is a stiff calcareous clay crowded with phosphatised shells and lumps of 'coprolite' which in my cursory search, I could not prove to have suffered from erosion previous to being embedded in the Gault, while some of them, such as *Hamites* were in such a condition that they could not have sustained much knocking about on a shore.

Above the niche bed comes a hard clay with iron-stained joint planes, which is covered by a true clay, somewhat lighter in colour than ordinary Gault, and containing a second irregular coprolite zone in a series of lenticular patches. Its nodules are smaller than in the regular seam below.

It should be noted that the emphasis on structural relationships in this account may be explained by the fact that Keeping was teaching geology at Aberystwyth at this time and attempting to work out the structure of Plynlimmon!

Jukes-Brown visited the workings in 1885 after they had been abandoned but was able to collect fossils. Collections were also made by a local schoolmaster (Mr Hayter of Monks Risborough) which put together with those of Keeping presented a 'curious assemblage for the Lower Gault', including 'Ammonites' *auritus*, *cristatus* and *lautus*.

Holli and Neaverson in their remarks on the ammonites said,

Judging by specimens of ammonites in the Bucks. County Museum, Aylesbury, the deposit worked belonged to the zones of *Hoplistes auritus* and *H. laetus*. At the typical locality of Folkestone, these zones occupy 17 feet out of a total of 99 feet for the whole of the Gault; but at Ford only three or four feet seem to have been worked. Critical zonal study is, of course, impossible; ...”

We were pleasantly surprised to discover that there were three different sets of slides of the Holli and Neaverson Collection of the Gault at Ford. One set is located in the Buckinghamshire County Museum (Aylesbury, England), the other one in the Natural History Museum (London, England) and the last one in the Micropalaeontological Museum of the University of Wales (Aberystwyth, Wales). The first two sets in the Museum were donated by E. Holli while the third one was eventually deposited at Aberystwyth when acquired by Prof. A. Wood from Neaverson who had been his research supervisor at Liverpool University.

The aim of this work is to bring up to date the list of foraminifera of the Holli and Neaverson paper, document the three scattered collections of slides and their contents and illustrate all the species, which are mostly represented by very well preserved specimens. On this basis we will attempt to relate the fauna to the modern, foraminiferal biostratigraphy of the Gault, foraminiferal ranges now being regarded as somewhat more 'critical' than in the time of Holli and Neaverson who were under the heavy influence of Chapman and the 'English School'.

**MATERIAL**
The state and characteristics of the collections are described below.

**Buckinghamshire County Museum (Aylesbury)**
The set consists of slides made of cedar-wood, originally without cover-glasses (covered in the course of this study). The accession register, number 38, dates from 29 January 1920, and to quote from it, describes the collection as consisting of '108 microscope slides, foraminifera from Gault, Ford, Bucks., collected by Holli 1919'. They are well set out and labelled but the information on them is limited. The labels are arranged in horizontal orientation and comprise on the left side the generic and/or specific identification and the locality and unit (Gault, Ford, Bucks.) and on the right side the specific classification, or nothing. On the back of the slides is written 'E. Holli 1919' and the slide number (see Tables 1 & 2). As it now stands, the collection includes 124 slides (Trays 38:20). Of them, 17 slides contain specimens as yet unidentified (perhaps not originally registered) and 107 slides with identified specimens. Of the 107, four have specimens with only generic classification [Nodosaria (two slides), Pleurostomella (one slide) and Pulvinulina (one slide)], two have specimens left in open nomenclature (Nodosaria sp.) and 101 have specimens with specific identification. Of all the species and varieties that are identified on the slides, 106 are included in Holli and Neaverson's list published in 1921 and 28 are not included. In addition, there are 29 species on the list which were not found in the slides (see Tables 1 & 2).

**Natural History Museum (London)**
As in the Aylesbury collection the slides are made of cedar-wood and without cover-glasses. The labels are arranged in the same way. The only difference is that there are no labels on the back of the slides. The accession register indicates that the material was deposited by E. Holli in 1926 and the register numbers are from P3018 to P3232 (Tray Q94). All the slides have specific identification and of those, 56 are included in the published list of Holli and Neaverson, 10 are not in it and 79 species and varieties of the list were not found in the slides (see Tables 1 & 2).

**Micropalaeontological Museum, University of Wales (Aberystwyth)**
This last set consists of 47 slides, also made of cedar-wood, originally without cover-glasses and now with them, attached in the course of this work. The labels on the slides are arranged in vertical orientation. The label includes at the top the following items: 'Foraminifera, Gault, Ford, Bucks., Aug. 1919, Eng.' The generic and specific identification is written down in ink or in pencil at the bottom of the label. The accession number is JH.389 and now all the slides have been numbered (see Tables 1 & 2). Two of the slides contain specimens as yet unidentified, another two with only generic classification (*Bulimina* and *Nodosaria*) and 43 with specific identification. Of all the species
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| BCM Slide number | NHM Register number | MM (UWA) Slide no. |
|------------------|---------------------|--------------------|
| 1                | 2                   | P23015-23038       |
| 2                | 7                   | P23034-23053       |
| 3                | 10                  | P23025-23034       |
| 4                | 9                   | P23022-23024       |
| 5                | 10                  | P23024-23022       |
| 6                | 11                  | P23207-23209       |
| 7                | 12                  | P23200-23203       |
| 8                | 13                  | P23204-23206       |
| 9                | 15                  | P23199-23192       |
| 10               | 6                   | P23097              |
| 11               | 9                   | P23164-23169       |
| 12               | 3                   | P23173-23176       |
| 13               | 25                  | P23161-23163       |
| 14               | 21                  | P23145-23147       |
| 15               | 29                  | P23148-23149       |
| 16               | 34                  | P23142-23144       |
| 17               | 33                  | P23140-23141       |
| 18               | 45                  | P23116-23118       |
| 19               | 43                  | P23112-23115       |
| 20               | 44                  | P23130-23136       |
| 21               | 49                  | P23122-23123       |
| 22               | 44                  | P23104              |
| 23               | 54                  | P23109-23110       |
| 24               | 56                  | P23137              |
| 25               | 57                  | P23217              |
| 26               | 58                  | P23218              |
| 27               | 59                  | P23219              |
| 28               | 60                  | P23220              |
| 29               | 61                  | P23221              |
| 30               | 62                  | P23222              |
| 31               | 63                  | P23223              |
| 32               | 64                  | P23224              |
| 33               | 65                  | P23225              |
| 34               | 66                  | P23226              |
| 35               | 67                  | P23227              |
| 36               | 68                  | P23228              |

Table 1. Original published list of Hollis & Neaverson (1921) and location of the material in the three museums. BCM: Buckinghamshire County Museum (Aylesbury); NHM: The Natural History Museum (London); MM (UWA): Micropalaeontological Museum, University of Wales (Aberystwyth). 1: empty slide; 2: the specific identification is written in pencil; 3: the specific name is written without the sub-genus (Dentalina) on slide and/or register book; 4: the specific name is written with the sub-genus (Dentalina) in the register book; 5: the variety 'acutangulum' Reuss is written on slide and/or register book; 6: Crinellaria macrorica (Reuss) is written on the slide.
Explanation of Plate I. Hollis and Neaverson Collection of the Gaull of Ford (Buckinghamshire, England). Unless specified, all the specimens are from the Micropalaeontological Museum, University of Wales (Aberystwyth). Scale bars 100 µm. Fig. 1. Thurmmiw sp., AYBCM.1920.38.1.6, Buckinghamshire County Museum (Aylesbury). Fig. 2. Ammodiscus cretaceus (Reuss, 1845), JH.389.7.1. Fig. 3. Halisagromoides moniomoides (Reuss, 1883), JH.389.5.3. Fig. 4. Haploplacinae? sherborni Chapman, 1892, JH.389.6.14. Fig. 5. Spiroplectina annulata (Parker & Jones, 1863), JH.389.14.12. Fig. 6. Dorsaliba turris (d'Orbigny, 1846), JH.389.9.8. Fig. 7. Textularia minus Berthelin, 1880, JH.389.8.6. Fig. 8. Textularia chapmanii Lalicker, 1935, JH.389.8.5. Fig. 9. Bigerina? asperula (Chapman, 1896), JH.389.38.2. Fig. 10. Nodobulimina nodulosa (Chapman, 1891), JH.389.1.16. Fig. 11. Gaudryina disparata Chapman, 1892, JH.389.14.10. Fig. 12. Gauvryina gradúa Berthelin, 1880, JH.389.10.11. Fig. 13. Triassic pyramidalis Reuss, 1863, JH.389.13.13. Fig. 14. Quinqueloculina antiqua (Franke, 1928), JH.389.3.17. Fig. 15. Nubeculina? sp., AYBCM.1920.38.3.1, Buckinghamshire County Museum (Aylesbury). Fig. 16. Eggerellina mariae Ten Dam, 1950, JH.389.9.9. Fig. 17. Arenobulimina chapmanii Cushman, 1936, JH.389.15.7. Fig. 18. Reophax sp., JH.389.4.4. Fig. 19. Spiroloculina gaulina (Ten Dam, 1950), JH.389.2.19. Fig. 20. Spiroloculina cretacea Reuss, 1854, JH.389.2.18. Fig. 21. Nubecularia? depressa Chapman, 1891, AYBCM.1920.38.4.1, Buckinghamshire County Museum (Aylesbury). Fig. 22. Cornaspora cretacea (Reuss, 1845), JH.389.7.15. Fig. 23. Tropcemina concava Chapman, 1892, AYBCM.1920.38.18.1, Buckinghamshire, County Museum (Aylesbury), (a) dorsal view, (b) ventral view, (c) lateral view.
and 32 specific names on the list were not found in the slides (Table 1), unfortunately they could not be included in it has been necessary to change most of the generic names and a

RESULTS

In bringing up-to-date the list of species names used by Hollis and Neaverson for the Foraminifera of the Gault (see Table 1), it has been necessary to change most of the generic names and a number of specific names as well. In part this simply reflects progress in taxonomic discrimination but also the tendency of the members of the 'English School', such as Chapman, to apply Recent names to fossil species. However, in his work on the Gault, Chapman (1891–1898) recognized many new species and accepted many set up by Continental scientists. Interestingly, this preceded the disastrous 'discovery' of the supposed Cambrian foraminifera of the Malverns in 1900 which seemed to confirm all the prejudices of the 'English School'.

In Table 3, the updated names used in this work are in the left column and are arranged following the foraminiferal classification of Haynes (1981). The right column includes the equivalents of the list of Hollis and Neaverson (1921). The species with an asterisk are those that are not included in the published list but were found in the slides. The 'p.p.' for some species is explained at the end of the table.

The agglutinated foraminifera are represented by two species of the Order Astrophyllida and 14 of the Order Lituolida. Of them, two species, Tharammina sp. and Reophax sp., have been left in open nomenclature and another, Bigerina? asperula (Chapman), with doubtful generic identification due to the bad preservation of the initial portion of the test in all the examined specimens. In addition, Sagrinia? calcarata (Berthelin) although on the list could not be identified because it is represented in the slide by two indeterminate fragments of agglutinated foraminifera only. The species Ammodiscus? melittianus Chapman was misidentified by Hollis and Neaverson (1921) as in the slide there are only four fragments of organic carbonates.

The porcelaneous foraminifera, Order Miliolida, are represented by a significant number of specimens belonging to seven species. One of them, Nubecularia? depressa Chapman has been left with doubtful generic identification as it is not possible to see the initial portion of the test in the specimen of the collection. The specimen that Hollis and Neaverson named Nubecularia? tibia (Parker & Jones) has been left in open nomenclature as only the last two free chambers are preserved.

The Order Nodosariida is the best, well-represented group. Sixty species have been identified (50 of the Superfamily Nodosariacea, three of the Superfamily Polymorphinaceae and seven of the genus Ramulina). The specimens of Lingulina? nodosaria Reuss, Nodosaria? (Dentalina?) mucronata (Neugebo- ren) and Nodosaria? prismatica Reuss of the list are completely broken and badly preserved so they have been left as indeterminate fragments of Lingulina, Dentalina and Nodosaria, respectively. Six other species have been left in open nomenclature (Dentalina sp., Fungicola? sp., Marginolina sp., Nodosaria sp., Planularia sp. and Ramulina sp.).

The other groups represented are the Order Buliminida, Superfamily Cassidulinacea, the Order Robertinida, Superfamily Ceratobuliminacea, the Order Rotaliida, Superfamily Discorbacea, and the Order Globigerinida, Superfamily Heddbergellacea. Although only a few species have been identified in all these groups there are a significant number of specimens, especially in the case of the Hedbergellacea [Hedbergella? infractarea (Glaessner)] and Discorbacea [Gavelinella? intermedia (Berthelin)].

The material under the names Clavulin? angularis d'Orbigny, Polymorphin? communis d'Orbigny, Polymorphina? sosoria var. cuspidata Brady and the specimens of Reophax? scoriipus Montfort of the Buckinghamshire County Museum, are here considered as incertae sedis.

A brief and quick analysis of the composition of the assemblages in the Gault at Ford shows that in number of specimens, the dominant species is Hedbergella? infractarea (Glaessner). Gavelinella? intermedia (Berthelin) is also abundant. Among the Nodosariida, Vaginulina? recta Reuss and Lenticulina? gaultina (Berthelin) are the commonest species. Arenobulimina? chapmani Cushman, Spiroplectinata? annectens (Parker & Jones)

Table 2. List of species found in the slides and not included in the published list of Hollis and Neaverson (1921). 1, the specific identification is written in pencil.

| Sl. No. | BCM | NCM | MM |
|--------|-----|-----|----|
| 1      | A. radia (Reuss) | 102 | — | — |
| 2      | C. angularis d'Orbigny | 19 | — | — |
| 3      | C. latifrons Brady | 97 | P23129-23129 | — |
| 4      | C. linearis Reuss | 84 | — | — |
| 5      | C. mamilligera Karrer | 90 | — | — |
| 6      | C. riparia Reuss | 97 | — | — |
| 7      | F. dalmata (Berthelin) | 65 | P23087 | — |
| 8      | F. dalmata Berthelin | — | — | 26 |
| 9      | G. angusta Rey | 99 | — | — |
| 10     | Haplophragmium? nonominae Chapman | 14 | P23111 | — |
| 11     | H. ferox Chapman | 69 | — | — |
| 12     | Nodosaria inflata Reuss | 40 | — | — |
| 13     | N. inflata Reuss | 38 | P23102 | — |
| 14     | N. depressa Chapman | 4 | — | — |
| 15     | N. tibia (Jones & Parker) | 3 | — | — |
| 16     | N. angusta Rey | 79 | — | — |
| 17     | N. communis d'Orbigny | 80 | — | — |
| 18     | N. compressa d'Orbigny | 79 | — | — |
| 19     | N. gibba d'Orbigny | 81 | — | — |
| 20     | N. lactea (Walker) | 81 | — | — |
| 21     | N. soria Reuss | 81 | — | — |
| 22     | N. soria var. cuspidata Brady | 80 | — | — |
| 23     | P. reticulata Reuss | 105 | P23157 | 2 |
| 24     | P. angusta Rey | — | — | — |
| 25     | Textularia? gormen d'Orbigny | 24 | P23170-23172 | — |
| 26     | Thurommella? papillona Brady | 17 | P23193-23197 | — |
| 27     | T. concava Chapman | 18 | P23100 | — |
| 28     | Vaginulina? arguta Reuss | 77 | P23039 | — |
| 29     | V. recta var. tenuis Reuss | 77 | — | — |
| 30     | V. recta var. robusta B. & C. | 73 | P23093-23096 | — |
| Order Astrotrichida | Superfamily Ammudosicae |       |       |
|---------------------|-------------------------|-------|-------|
| Astrorhizida        |                         |       |       |
| Ammodiscus crenatus (Reuss, 1845) | p.p. Ammodiscus incertus (d'Orbigny), 1 |       |       |
| Thamnominus sp.     |                         | p.p. Thamnominus albicans Brady, 2 |       |       |
|                    |                         | Thamnominus papillata Brady* |       |       |
| Order Litidiida     | Superfamily Litidiidae  |       |       |
| Rigenera asperula (Chapman, 1896) | Su.prina asperula Chapman |       |       |
| Haplphysagia nodosomnoides (Reuss, 1863) | Discorhina rugosa (d'Orbigny) |       |       |
| Keophax sp          |                         | p.p. Keophax scophorus Montfort, 3 |       |       |
| Nodosaria (d'Orbigny, 1869) |                         |       |       |
| Textularia chapmani Lalicker, 1935 | p.p. Textularia conica d'Orbigny, 5 |       |       |
| Textularia minuta Berthelin, 1880 | Textularia minuta Berthelin |       |       |

| Superfamily Ataxophysmiaceae |       |       |
|-----------------------------|-------|-------|
| Arenobilina chapmani        | Buliminina affinis d'Orbigny |       |       |
| Chapman, 1936 | Buliminina obtusa d'Orbigny |       |       |
| Pi. 1, fig. 17 | Buliminina orbignyi Reuss |       |       |

| Dorthia terris (d'Orbigny, 1878) | Textularia terris d'Orbigny |       |       |
| Pi. 1, fig. 6 | Textularia terris d'Orbigny |       |       |

| Eggerellina mariae Ten Dam, 1950 | Bulimina brevis d'Orbigny |       |       |
| Pi. 1, fig. 16 | Bulimina brevis d'Orbigny |       |       |

| Gaudryina distans (Chapman, 1892) | not identified |       |       |
| Pi. 1, fig. 11 | not identified |       |       |

| Gaudryina eudala Berthelin, 1880 | Gaudryina eggtalis d'Orbigny |       |       |
| Pi. 1, fig. 12 | Gaudryina eggtalis d'Orbigny |       |       |

| Sproplectina annectens (Parker & Jones, 1863) | Sproplectina annectens (Parker & Jones) |       |       |
| Pi. 1, fig. 10 | Sproplectina annectens (Parker & Jones) |       |       |

| Tritia pyramidalis Reuss, 1863 | Tritia pyramidalis Reuss |       |       |
| Pi. 1, fig. 13 | Tritia pyramidalis Reuss |       |       |

| Trochammina concava Chapman, 1892 | Trochammina concava Chapman* |       |       |
| Pi. 1, fig. 23 | Trochammina concava Chapman* |       |       |

| Order Miolida | Superfamily Nubeculariaceae |       |       |
|---------------|-----------------------------|-------|-------|
| Conuspira cretica Reuss, 1845 | p.p. Ammodiscus incertus (d'Orbigny), 1 |       |       |
| Pi. 1, fig. 22 | p.p. Ammodiscus incertus (d'Orbigny), 1 |       |       |

| Nodobaculida nodosula (Chapman, 1891) | Nubecularia nodosula Chapman |       |       |
| Pi. 1, fig. 10 | Nubecularia nodosula Chapman |       |       |

| Nubecularia depressa Chapman, 1891 | Nubecularia depressa Chapman* |       |       |
| Pi. 1, fig. 21 | Nubecularia depressa Chapman* |       |       |

| Nubaculina* sp | Nubecularia oblonga (Jones & Parker)* |       |       |
| Pi. 1, fig. 15 | Nubecularia oblonga (Jones & Parker)* |       |       |

| Order Miliosida | Superfamily Miliosiaceae |       |       |
|-----------------|--------------------------|-------|-------|
| Quinqueloculina antiqua (Franke, 1928) | Miliosis ferussaci (d'Orbigny) |       |       |
| Pi. 1, fig. 14 | Miliosis tricolorata (d'Orbigny) |       |       |

| Spiroloculina cretica Reuss, 1854 | Spiroloculina asperula Karra* |       |       |
| Pi. 1, fig. 20 | Spiroloculina asperula Karra* |       |       |

| Spiroloculina discoida Reuss, 1854 | Spiroloculina nitida d'Orbigny, 8 |       |       |
| Pi. 1, fig. 20 | Spiroloculina nitida d'Orbigny, 8 |       |       |

| Spiroloculina globula (Ten Dam, 1950) | Spiroloculina nitida d'Orbigny, 8 |       |       |
| Pi. 1, fig. 19 | Spiroloculina nitida d'Orbigny, 8 |       |       |

| Order Nodosariida | Superfamily Nodosariaceae |       |       |
|------------------|---------------------------|-------|-------|
| Astacola tripleura Reuss, 1860 | Cristallaria latifrons Brady* |       |       |
| Pi. 2, fig. 1 | Cristallaria latifrons Brady* |       |       |

| Citrinella didyma (Berthelin, 1880) | Flabellina didyma (Berthelin)* |       |       |
| Pi. 2, fig. 2 | Flabellina didyma (Berthelin)* |       |       |

| Cristallaria trilobata Reuss* | Cristallaria trilobata Reuss* |       |       |
| Pi. 2, fig. 3 | Cristallaria trilobata Reuss* |       |       |

| Cristallaria plicata Berthelin | Cristallaria plicata Berthelin |       |       |
| Pi. 2, fig. 1 | Cristallaria plicata Berthelin |       |       |

Table 3. Left column: updated names used in this work. Right column: list of Hollis and Neaverson. Footnote explanations at end of table.
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Table 3 continued

| Marginulina sp. | Cristellaria exilis Reuss |
|-----------------|--------------------------|
| Nodosaria cf. affinis Reuss, 1845 | p.p. Nodosaria orthopleura Reuss, 14 |
| Nodosaria cf. bimbae Chapman, 1893 | Nodosaria bimbae Chapman |
| Nodosaria fontanensis (Berthelin, 1880) | Nodosaria (D.) fontanensis (Berthelin) Nodosaria infusa Reuss* |
| Nodosaria obcura Reuss, 1845 | Nodosaria (D.) obcura Reuss |
| Nodosaria orthopleura Reuss, 1863 | Nodosaria tetracoma Reuss p.p. Nodosaria orthopleura Reuss, 14 |
| Nodosaria paupercula Reuss, 1845 | Nodosaria (D.) paupercula Reuss |
| Nodosaria sectorem Reuss, 1863 | Nodosaria sectorem Reuss |
| Nodosaria sp. | Nodosaria (D.) tenacissima Reuss |
| Planulatula bradiana (Chapman, 1894) | Cristellaria bradiana Chapman p.p. Cristellaria complanata Reuss, 15 |
| Planulatula cf. priceana (Chapman, 1894) | Vaginula priceana Chapman |
| Planulatula vestita (Berthelin, 1880) | Cristellaria bononiensis Berthelin Cristellaria vestita Berthelin |
| Planulatula sp. | p.p. Cristellaria complanata Reuss, 16 p.p. Cristellaria crepidula (F. & M.), 17 |
| Pseudonodosaria matalibus (Reuss, 1863) | Nodosaria (G.) larvagutii (D'Orbigny)* Nodosaria (G.) matalibus (Reuss) Nodosaria calomphora Reuss Nodosaria radiula (L.) var. jonesii R. Nodosaria (G.) humilis Römer |
| Saracenaria navicula (D'Orbigny, 1840) | Cristellaria italica (Defrance) Cristellaria navicula D'Orbigny |
| Saracenaria triangularis (D'Orbigny, 1840) | Cristellaria triangularis D'Orbigny |
| Tristis excavatus (Reuss, 1863) | Babinognomon excavatum Reuss Babinognomon tricornatum (D'Orbigny) |
| Tristis gouldii Khan, 1950 | not identified |
| Vaginula gouldiana Berthelin, 1880 | Vaginula gouldiana Berthelin |
| Vaginula humilis (Reuss, 1863) | Cristellaria octula Berthelin Vaginula biocellae Berthelin p.p. Cristellaria crepidula (F. & M.), 17 |
| Vaginula mediterranea | Vaginula recta var. territecta Diaphana* Vaginula striatula (Reuss) |
| Ten Dam, 1950 | Pl. 3, fig. 22 |
| Vaginula parallelis (Reuss, 1863) | Cristellaria parallelis (Reuss) Cristellaria trunculata Berthelin |
| Vaginula recta Reuss, 1863 | Vaginula arguta Reuss* Vaginula recta Reuss Vaginula truncata Reuss V. truncata var. robusta B. & C.* |
| Vaginula recta | Cristellaria navicula D'Orbigny |

Superfamily Polymorphinacea

Globalula larva (Reuss, 1845) | Polyphormina gibba D'Orbigny* p.p. Polyphormina fusiformis (Römer). 18 |
| Pyrulaea aff. lucida Berthelin, 1880 | Polyphormina lucida (Walker) |
| Pyrulaea fusiforme (Reuss, 1863) | Polyphormina sp. (Berthelin) |
| Pyrulaea obtusa (Reuss, 1863) | Polyphormina angusta Egg* Polyphormina compressa D'Orbigny* P. Polyphormina fusiformis (Römer). 18 |

Form Genera

Ramulina acauleata (D'Orbigny, 1840) | Nodosaria hispida D'Orbigny p.p. Ramulina globulifera Brady R. acauleata Wright, 19. 20 |
| Ramulina apicinensis Battenstein & Brand, 1951 | p.p. Ramulina globulifera Brady, 19. 21 |
| Ramulina fusiformis Khan, 1950 | p.p. Ramulina globulifera Brady, 19. 22 |

Ramulina aff. globulifera Brady, 19. 21 | p.p. Ramulina globulifera Brady, 19. 21 |
| Ramulina aff. lutescens Jones, 1875 | p.p. Ramulina globulifera Brady, 19. 23 |
| Ramulina maricatina Leebelh. & Tappan, 1949 | p.p. Ramulina acauleata Wright |
| Ramulina sp. | Lagena globosa (Montagu) |

p.p. Thurumminula alliacea Brady, 24 |

Suborder Bollinimina

Superfamily Cassidulinae

Pleurostomella borrelii Berthelin, 1880 | Pleurostomella obtusa Berthelin p.p. Nodosaria (D.) communis (Oth.) 9 |
| Pleurostomella reussii Berthelin, 1880 | p.p. Nodosaria (D.) ferruginea Reuss, 10 |
| Pleurostomella albida Schiweger |

Order Robertinida

Superfamily Ceratobuliminacea

Epistominia aff. ornata (Roemer, 1841) | Polyphormina elegans (D'Orbigny) |
| Epistominia spinulifera (Reuss, 1863) | Polyphormina spinulifera (Reuss) |
| Hoeglundina chapmani (Ten Dam, 1948) | Polyphormina caracalla (Römer) |
| Polyphormina reticulata Reuss* |

Order Rotulida

Superfamily Discorbinae

Gavelinella intermediia (Berthelin, 1880) | Anomalina ammonoides (Reuss) Anomalina radis (Reuss)* Haploglophymnium nonnominoides Reuss* |
| Pl. 4, fig. 16a-c. |

Order Globigerinida

Superfamily Hedbergellacea

Hedbergella infracuta (Glaesener, 1937) | Globigerina equilatratina Brady* Globigerina cretacea (D'Orbigny) |

1 Only p.p. Ammonades incertus (Reuss) of MM (UWA). In the slide there are three species, one of Ammonades incertus (Reuss), and two of Cornuaria crista (Reuss). 2 non Thurumminula alliacea Brady of NHM. 3 non Reuss'ius (Roemer) of MM. 4 Nodosaria (D.) communis (Oth.) non Nodosaria (D.) communis (Oth.) n. 5 non Textularia concinna D'Orbigny of BCM. The specimens of BCM under this name belong to Dendritina species. 6 The specimens of Textularia labyrinthus belong to Textularia chapmani Lalicke and not to Textularia labyrinthus Berthelin as the ones of MM (UWA). 7 Only Textularia concinna D'Orbigny of BCM. 8 p.p. Spiroloculina nitida D'Orbigny in the three collections. 9 This species was only found in MM (UWA). One of the specimens belongs to Dendritina distincta Reuss, and the other two belong to Pleurostomella borrelii Berthelin. 10 Of the three specimens included in the set of MM (UWA) under this name, one belongs to Dendritina distincta Reuss, the other to Dendritina sp. and the last one to Pleurostomella borrelii Berthelin. 11 non Nodosaria (D.) communis (D'Orbigny) of NHM. 12 In the slide of BCM there is one specimen of Lagena sp. and another that is an ostracod, opercula. Also Lagena hospiga Reuss of NHM. 13 non Lagena hospiga Reuss of BCM and NHM. 14 Of the specimens included under this name in the slides of MM (UWA), two belong to Nodosaria cf. affinis Reuss and four to Nodosaria orthopleura Reuss. 15 Only Cristellaria complanata Reuss of BCM. 16 non Cristellaria complanata Reuss of BCM. 17 Two of the specimens under this name of the set of BCM belong to different species, one to Planulatula sp. and the other to Vaginula sp. 18 The slide of Polyphormina fusiformis (Roemer) of MM (UWA) has twelve specimens. Of them, two belong to Globalula larva (Reuss), three to Pyrulaea aff. lucida Berthelin and seven to Pyrulaea obtusa (Roerm). 19 Species belonging to Ramulina have been found in sets of BCM and MM (UWA). In the two sets the species names in the slides are R. acauleata Wright and R. globulifera Brady. The specimens are not properly arranged so it is not possible to know which specimens belong to each species in the view of Hollis and Neaverson. 20 Six specimens of BCM and four specimens of MM (UWA). 21 One specimen of MM (UWA). 22 Two specimens of BCM and five of MM (UWA). 23 Two specimens of BCM and seven of MM (UWA). 24 Only Thurumminula alliacea Brady of NHM. 25 Abnormal specimen. * Not in original list.
and *Tritaxia pyramidata* Reuss are the best represented among the agglutinated foraminifera and *Quinqueloculina antiqua* (Franke) and *Spiroloculina cretacea* Reuss are the commonest species of the porcelaneous group.

**DISCUSSION: AGE OF THE ASSEMBLAGES**

Many of the species recorded in the Phosphatic Nodule Bed of the Gault at Ford are also present in the Chapman Collection of the Gault of Folkstone (England) which has been examined in the Natural History Museum during the course of the present work (see Chapman, 1891–1898). Hollis and Neaverson (1921) pointed out that the relative abundances of the different groups were not the same for these two geographical areas. However, Walters (1958, Unpublished Ph.D. Thesis, U.C.W. Aberystwyth) studying the foraminifera from several outcrops in Southeast England, including Folkstone, shows similar relative abundances to those at Ford. These apparently contradictory results could be due to different approaches in the procedures used to pick and count the specimens.

The recorded assemblages at Ford, which are dominated by the superfamily Nodosariacea, do not seem to be typical of the Middle Albian because in that interval the dominant group is the Superfamily Robertinacea (e.g. Hart & Carter, 1975; Hart et al., 1981, 1989). At the same time they are not quite the same as the typical assemblages of the Upper Albian because in the upper part of the Gault Clay Formation, the fauna totally changes and becomes dominated by agglutinated taxa although nodosarids and gavelinellids are quite numerous (Hart, 1990; Talwar, 1990, Unpublished M.Sc. Thesis, U.C.W. Aberystwyth; Toogood, 1973, Unpublished M.Sc. Thesis, U.C.W. Aberystwyth).

However, looking at the stratigraphical distribution of foraminifera as seen in several key sections of southern and eastern England, Northern Ireland, northwestern Scotland and the North Sea Basin (Carter & Hart, 1977; Hart, 1973, 1990; Hart et al., 1981, 1989, 1990) it is apparent that some of the species recorded in the Gault at Ford, such as *Haplostichia sherborni* Chapman, *Eggerellina mariae* Ten Dam, *Tritaxia pyramidata* Reuss, *Textularia chapmani* Lalicker, *Quinqueloculina antiqua* (Franke), *Frondicularia pinnafomnis* Chapman and *Vaginolina mediocarinata* Ten Dam, are indicative of the Upper Albian.

The presence of *Frondicularia pinnafomnis* Chapman, an important zonal indicator in the Upper Albian (Carter & Hart, 1977), in association with the typical Upper Albian *Arenobulimina chapmani* Cushman, *Nodobulimina nodulosa* (Chapman) and poorly developed specimens of *Epistomina spinulifera* (Reuss), characteristic of the lower Gault Clay (Hart & Carter, 1975; Carter & Hart, 1977; Price, 1977), points to the possibility of the Phosphatic Nodule Bed being in the *Epistomina spinulifera*/Frondicularia pinnafomnis Concurrent Range Zone (Zone 4a) of the benthonic zonal scheme of Carter & Hart (1977). However, the presence of *Eggerellina mariae* Ten Dam could indicate at least the *Frondicularia pinnafomnis* Assemblage Zone (Zone 5) of the same authors.

So, according to the benthonic zonal scheme proposed by Hart (1973) and Carter & Hart (1977) it is most probable that the foraminifera of Ford were recovered from the uppermost lower Gault Clay—lower part of the upper Gault Clay, Zones 4a–5 (from the uppermost Middle Albian to the lower part of the Upper Albian), equivalent to the uppermost *Europolithes lautus* Zone (*cristatum* Subzone) to lower part of *Mortoniceras inflatum* Zone (*orbignyi-varicosum—lowermost auritus* Subzones) of the Albian ammonite zonation (see Fig. 2).

It must be noted that Hart's treatment of the ammonite zones differs slightly from that of Owen (1971, 1973, 1975) in that the *cristatum* Subzone is placed in the *lautus* Zone, i.e. the Middle Albian rather than the Upper Albian. Hart (1973, p. 272) comments, in relation to the Copt Point section at Folkstone, 'The *cristatum* Subzone contains a distinctive bed of rounded nodules ... which represents a non-sequence marking the Lower–Upper Gault boundary (although the top of the *cristatum* Subzone is some 30 cms above this level). The Ford section is therefore quite similar both lithologically and faunally to the Folkstone section.

Although Hart (1973) states that his faunal scheme, 'can, unfortunately, only be described as being of local application,' the type Albian at L'Aube, again shows a similar, major faunal change over the Middle–Upper Albian boundary (lower–upper Gault boundary). Here, as at Folkstone, the passage to the Upper Albian is marked by the appearance of *Arenobulimina chapmani* Cushman and *Frondicularia pinnafomnis* Chapman and their overlap with *Epistomina spinulifera* (Reuss) (see table 3 of Magniez-Jannin, 1975).

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The help of Ms K. M. Hawkins of the Buckinghamshire County Museum (Aylesbury), who arranged the loan of the Hollis and Neaverson's set of specimens from that Museum and also offered helpful information on the site of the phosphatic nodules.
Explanation of Plate 2. Hollis and Neaverson Collection of the Gault of Ford (Buckinghamshire, England). Unless specified, all the specimens are from the Micropalaeontological Museum, University of Wales (Aberystwyth). Scale bars 100 μm. Fig. 1. AsfucoluF tripleura Reuss, 1860, AYBCM. 1920.38.97.4, Buckinghamshire County Museum (Aylesbury). Fig. 2. Citrarinella dalya (Berthelin, 1880), JH.389.26.20. Fig. 3. Dentalina debilis (Berthelin, 1880), JH.389.28.21. Fig. 4. Dentalina distincta Reuss, 1860, JH.389.20.23. Fig. 5. Frondicularia plantifolia Chapman, 1894, JH.389.24.31. Fig. 6. Frondicularia pinasformis Chapman, 1894, JH.389.26.30. Fig. 7. Dentalina pulchella (Chapman, 1893), AYBCM.1920.38.41.2, Buckinghamshire County Museum (Aylesbury). Fig. 8. Dentalina legumen Reuss, 1845), JH.389.19.24. Fig. 9. Frondicularia gautina Reuss, 1860, AYBCM.1920.38.61.4, Buckinghamshire County Museum (Aylesbury). Fig. 10. Dentalina pseudomana Ten Dam, 1950, JH.389.20.25. Fig. 11. Dentalina gracilis (D.Orthogn, 1840), AYBCM.1920.38.50.2, Buckinghamshire County Museum (Aylesbury). Fig. 12. Frondicatoria sp., JH.389.26.32. Fig. 13. Dentalina sp. aff. D. intercellularis (Brady, 1881), JH.389.19.26. Fig. 14. Frondicularia denticulocarinata Chapman, 1894, JH.389.25.28. Fig. 15. Lagena aff. hispida Reuss, 1863, AYBCM.1920.38.33.1, Buckinghamshire County Museum (Aylesbury). Fig. 16. Lagena apiculata (Reuss, 1851), P23140, Natural History Museum (London). Fig. 17. Lenticulina circumcidanea (Berthelin, 1880), JH.389.35.34. Fig. 18. Lenticulina diadema (Berthelin, 1880), JH.389.34.35. Fig. 19. Lenticulina turgida (Reuss, 1863), JH.389.32.38. Fig. 20. Lenticulina gautina (Berthelin, 1880), JH.389.35.37. Fig. 21. Dentalina sp., JH.389.19.27. Fig. 22. Lenticulina toryi Berthelin, 1880, JH.389.24.29. Fig. 23. Lenticulina semiornata Reuss, 1863, JH.389.23.39. Fig. 24. Marginulina inaequalis Reuss, 1860, JH.389.28.40.
Explanation of Plate 3. Hollis and Neaverson Collection of the Gault of Ford (Buckinghamshire, England). Unless specified, all the specimens are from the Micropalaeontological Museum, University of Wales (Aberystwyth). Scale bars 100 μm. Fig. 1. Marginulina jonesi (Reuss, 1863), JH.389.28.41. Fig. 2. Marginulina linearis (Reuss, 1863), AYBCM.1920.38.38.84.1, Buckinghamshire County Museum (Aylesbury). Fig. 3. Marginulina striatocostata (Reuss, 1863), JH.389.28.42. Fig. 4. Marginulina sp., JH.389.31.43. Fig. 5. Nodosaria cf. affinis Reuss, 1845, JH.389.21.44. Fig. 6. Nodosaria fontannesi (Berthelin, 1880), JH.389.21.46. Fig. 7. Nodosaria orthoplicata Reuss, 1863, JH.389.21.48. Fig. 8. Nodosaria cf. bambusus Chapman, 1893, JH.389.21.45. Fig. 9. Nodosaria sp., AYBCM.1920.38.35.3, Buckinghamshire County Museum (Aylesbury). Fig. 10. Nodosaria obesura Reuss, 1845, JH.389.22.47. Fig. 11. Planularia bradyana (Chapman, 1894), JH.389.32.51. Fig. 12. Planularia mutabilis (Reuss, 1863), P23/02, Natural History Museum (London). Fig. 13. Planularia paupercula Reuss, 1845, JH.389.22.49. Fig. 14. Planularia cf. pricena (Chapman, 1894), JH.389.30.52. Fig. 15. Planularia vestita (Berthelin, 1880), JH.389.33.53. Fig. 16. Planularia sp., JH.389.32.54. Fig. 17. Saracenaria navicula (d’Orbigny, 1840), JH.389.31.56. Fig. 18. Saracenaria triangularis (d’Orbigny, 1840), JH.389.31.57. Fig. 19. Nodosaria sceptrum Reuss, 1863, JH.389.22.50. Fig. 20. Vaginulina recta Reuss, 1863, JH.389.29.64. Fig. 21. Vaginulina gaulfina Berthelin, 1880, JH.389.30.60. Fig. 22. Vaginulina mediocrurata Ten Dam, 1950, JH.389.30.62. Fig. 23. Vaginulina humilis (Reuss, 1863), JH.389.32.61. Fig. 24. Tristix excavatum (Reuss, 1863), JH.389.27.58. Fig. 25. Vaginulina parvula (Reuss, 1863), JH.389.32.63. Fig. 26. Tristix gaulfina Khan, 1950, JH.389.28.59.
Explanation of Plate 4. Hollis and Neaverson Collection of the Gault of Ford (Buckinghamshire, England). Unless specified, all the specimens are from the Micropalaeontological Museum, University of Wales (Aberystwyth). Scale bars 100 μm.

Fig. 1. Globulina furcata (Reuss, 1847), fusiform form, JH.389.37.65. Fig. 2. Ramulina apicatai Berendsen & Brand, 1951, JH.389.39.69.

Fig. 3. Pyrumina sp. fusiformis Berthelot, 1880, fusiform form, JH.389.37.66. Fig. 4. Pyrumina obtusa (Reuss, 1863), JH.389.37.67. Fig. 5. Ramulina fusiformis Khan, 1950, JH.389.39.70.

Fig. 6. Piaaustomella barroisi Berthelot, 1880, JH.389.16.75. Fig. 7. Ramulina aff. globo-tubulosa Cushman, 1938, JH.389.39.71.

Fig. 8. Ramulina sp., P23189, Natural History Museum (London).

Fig. 9. Ramulina aculeata (d'Orbigny, 1840), JH.389.21.68. Fig. 10. Ramulina aff. laevigata Jones, 1875, JH.389.39.72.

Fig. 11. Ramulina muciculata Loeblich & Tepper, 1949, JH.389.39.73. Fig. 12. Piaaustomella reussi Berthelot, 1880, JH.389.16.76. Fig. 13. Hoeglandina clavipuncta (Ten Donk, 1948), JH.389.42.79, (a) dorsal view, (b) ventral view, (c) lateral view.

Fig. 14. Epistomina spinulifera (Reuss, 1863), JH.389.43.78, (a) dorsal view, (b) ventral view, (c) lateral view.

Fig. 15. Epistomina aff. ornata (Roemer, 1841), JH.389.42.77, (a) dorsal view, (b) ventral view, (c) lateral view.

Fig. 16. Gosseolina intermedia (Berthelot, 1880), JH.389.41.80, (a) dorsal view, (b) ventral view, (c) lateral view.

Fig. 17. Hedbergella infractaeta (Glaessner, 1937), JH.389.40.81, (a) dorsal view, (b) ventral view, (c) lateral view.
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NB. Unfortunately, although it is clear that Neaverson was Science Master in Aylesbury Grammar School in the early 1920s and went on to become Lecturer and Senior Lecturer at Liverpool, the dates when he entered and left these institutions are as yet unknown.

Please note that the Aberystwyth Theses mentioned in the text can be obtained on loan from Hugh Owen Library (University of Wales, Aberystwyth). Also photocopies from the National Library of Wales (Aberystwyth).

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