

INTRODUCTION AND BIBLIOGRAPHY

by R. B. RICKARDS *and* D. E. JACKSON

IN 1973 we conceived the notion of a collection of papers to honour Professor Bulman's profound contribution to our knowledge of the Graptolithina. Tentative feelers put out to graptolite workers around the world revealed considerable enthusiasm for the idea, and indicated also that much research was at the point of fruition. The moment really did seem opportune, and we hope that we have captured in this volume some of the best aspects of current research. As befits the fact that he was interested in graptolites of all ages the contributions span a considerable range of time, from Middle Cambrian to Devonian, and for purely practical reasons we have arranged the papers approximately stratigraphically with the works of a more general nature separating the major time divisions.

Professor Bulman was born in 1902 and whilst at Battersea Grammar School, his interest in geology led him in 1918 to attend A. J. Maslen's classes on Friday evenings and Saturday mornings at Chelsea Polytechnic (now Chelsea College). Also attending those evening classes was C. J. Stubblefield with whom Bulman was to have a long and close association. In 1920 he became a day-student at Chelsea and in 1921 entered the Imperial College of Science to study for an honours degree in geology with zoology as the subsidiary subject. As Bulman had already acquired a London University Geology Scholarship, Professor W. W. Watts was able to gain him exemption from the first- and second-year courses, provided that he having not previously taken any zoology course, could by October 1921 satisfy the college's Zoology Department of his competence to enter final-year zoology; this he achieved by attending a short course organized for him in the summer vacation by Lancelot T. Hogben, then a lecturer in Professor E. W. MacBride's department. In 1922, having taken the Zoology honours course at the Imperial College under MacBride and Hogben and having passed the B.Sc. subsidiary in zoology, he went to University College once a week for a course in vertebrate palaeontology given by Professor D. M. S. Watson, where amongst other things he learnt much concerning palaeontological techniques. His instruction in invertebrate palaeontology was helped considerably by the excellent collections at the Imperial College which Professor A. Morley Davies had arranged. Bulman graduated with first-class honours in geology in 1923 and was awarded a Beit Scientific Research Fellowship which he held until 1925. During that period he and Stubblefield, who had graduated at the same time, were, at Watts's suggestion, studying the Shineton Shales of Shropshire which subject was accepted by the authorities of the University of London as a joint Ph.D. (external) project on the basis that the mapping and structural interpretation was shared but the palaeontological work was separated. Bulman concentrated on the extensive *Dictyonema*, brachiopod, hyolithid, and agnostid trilobite collections, whilst Stubblefield took over the other trilobites, the clonograptids, and 'bryograptids'. Both Bulman and

Stubblefield isolated their graptolithine material by using hydrofluoric acid as advocated earlier by Carl Wiman, but Bulman also made serial sections of the *Dictyonema* by methods previously indicated by W. J. Sollas (for *Palaeospondylus*) and he described the techniques and the results in his first (1925) paper.

Later in 1925, having been awarded the London Ph.D. degree, Bulman became an 1851 Senior Student and he spent a further year (1925–1926) at Imperial and University colleges. He contributed a paper on *Branchiosaurus* in 1926, in co-authorship with W. F. Whittard, who incidentally accompanied Bulman to Sidney Sussex College, Cambridge in that autumn; this paper, along with a second paper on *Branchiosaurus*, and two further papers, respectively dealing with *Lasanius* and *Palaeospondylus* were Bulman's only published vertebrate works, though in later years he gave a splendid course on vertebrate palaeontology. The last two years of his tenure of the 1851 Studentship he spent at the Sedgwick Museum working on dendroid graptolites supervised by Miss Gertrude L. Elles. During this period the first two parts of his Monograph of the British Dendroid Graptolites were published as were several other papers on dendroid graptolites and these earned him his Cambridge Ph.D.

In 1928 Bulman was awarded the Huxley Memorial Medal and Prize by Imperial College to which he returned to serve for one year as a demonstrator in the Zoology Department and for two subsequent years in the department of Geology. In 1929 he attended the Tagung of the Deutsche Paläontologische Gesellschaft at Stuttgart, Tübingen, and Ulm; amongst the other non-German members of the party was Professor E. A. Stensiö. Stensiö was so favourably impressed with Bulman's *Dictyonema* work that he invited him to take over from the Stockholm Riksmuseum the unfinished descriptive work on South American and Scandinavian graptolites commenced by Professor Gerhard Holm.

In 1931 Bulman returned to Cambridge as a Demonstrator in Geology, a post he held until 1934 when he became a University Lecturer and subsequently Reader in Palaeozoology from 1945–1955. Upon the retirement of W. B. R. King, Bulman was elected to the Woodwardian Professorship of Geology and remained in this office until 1966 when he resigned a year earlier than the Statutes required so that he could continue his research without the encumbrances of administrative chores. As many of his colleagues will remember, this early retirement meant that he reverted to the title 'Dr. Bulman' until his appointment as Professor Emeritus a year later. Perusal of the Bibliography below will show that after retirement he did indeed complete many aspects of research started years earlier, and that he employed many skills such as the preparation of isolated graptolites and production of serial microtome sections.

Bulman's first paper was on graptolites (1925) and dealt with the detailed structure of *Dictyonema flabelliforme*. Apart from the skilful technique of serially sectioning specimens in the rock and the conclusions reached therefrom, the paper is instructive in several other respects. In the first place the method of shading employed on the drawings was that used by D. M. S. Watson, and which is still used by vertebrate palaeontologists, and betrays one of Bulman's other interests of the day: he continued shading drawings in this way for a number of years, but eventually changed either to more schematic shading as in the 1955 'Treatise', or to actual portrayal of the growth lines.

The paper also shows his considerable artistic ability which was perhaps to reach a peak in his wash drawings for graptolites prepared by Holm (1932–1936) and the Laggan Burn monograph (1944–1947): the original illustrations for the latter are now housed in the archives of the I.G.S. and will give pleasure to many palaeontologists. His artistic ability and clarity of both illustrations and writing facilitated the general receptiveness of palaeontologists to his ideas on growth of the rhabdosomes, evolution, and mode of life.

His interest in *Dictyonema* and other dendroids, engendered by his work on the Shineton Shales, led him to revise the British dendroid graptolites in his first major work (1927–1967) following the account (1927) with Stubblefield of the Shineton Shales of the Wrekin district. He rounded off the dendroid revision in 1967 but referred to it as belonging to the Lapworth era of graptolite taxonomy and clearly felt that modern descriptions of dendroids required more or less isolated and either cleared or sectionable material to be of value. One of the main features of his early work on graptolites was his attempted elucidation of the relationship of hydrothecae and bithecae in the dendroids, and the clearer definition of such genera as *Dictyonema* and *Callograptus* (1928, 1929, 1930): a result was the recognition of new morphological features and, occasionally, important new genera as in the case of *Koremagraptus*.

In the 1930s his work extended to the graptoloids, notably reflected in his descriptions of the graptolites prepared by Holm (1932–1936). During the same period he began to produce more general interpretations of graptolite relationships (1932) and in particular published his paper on programme-evolution (1933).

However, in 1938 came an event in the world of graptolite research that was to have an effect lasting until the present day. Bulman had been corresponding for some years with Professor Roman Kozłowski of Warsaw and in 1938 Bulman persuaded him to give a preliminary account of his now famous exciting discoveries on isolated Tremadoc graptolites: the full account did not appear for more than a decade but was suitably given an essay review in *Geological Magazine* by Bulman himself (1949). The preliminary account, taken in conjunction with Bulman's detailed discussions with Kozłowski, meant that radical rethinking was necessary on the understanding of, particularly, dendroid graptolites. Bulman himself immediately began a reappraisal of earlier work and published (1942) a paper on the structure of dendroid graptolites in which, using *Koremagraptus*, he described the relationships between stolothecae, autothecae, bithecae, and stolons.

It is intriguing that with Bulman's considerable early work on dendroids, and with the contribution of Kozłowski, much work was still necessary even on such a well-known genus as *Dictyonema*. Bulman published several accounts of this genus (1949, 1950, 1966, 1967, 1971, 1972, 1973) and it receives further detailed analysis in Legrand's contribution to this volume.

Bulman also continued his work on other graptolites and his notes on thecal variation in *Monograptus* (1951) are valuable to workers in this field. However, whilst most of his research on dendroids was published, large sections of work on other graptolites remained, and remain, in notes or manuscript form: in this latter category it is now clear that many of the detailed monograptid structures elucidated by Adam Urbanek in later years had already been studied by Bulman. This explains to the

present writers Bulman's elation at Urbanek's work, for Bulman himself had considerable difficulty in relating the monograptid structures he had found to an over-all evolutionary pattern and presumably for this reason refrained from publication, except for the account of *M. scanicus* (1953).

He continued his general appraisals of graptolite evolution and classification notably, for example, in the Palaeontological Association address (1958) on the sequence of graptolite faunas, and in the Geological Society of London papers on the evolution and classification of the graptoloidea (1963) and on Lower Palaeozoic Plankton (1964). But in this sense the highlight of his work was his account of the graptolites and other hemichordates in the 1955 and 1970 first and second editions of the *Treatise on Invertebrate Paleontology*. His clarity of illustration and brevity of pen combined to make these relatively thin but concentrated publications milestones in graptolite works of reference.

Bulman's work on graptolites was recognized by the Royal Society who elected him a Fellow in 1940 at the age of 37. Subsequently he became a Fellow of Sidney Sussex College (1945), a Fellow of Imperial College (1961), and an honorary Dr. Phil. of the University of Oslo (1965). His work for various societies was unstinting and he became Vice-President and President of the Geological Society of London (respectively 1953–1957, 1967–1968; 1962–1964), President of the Palaeontological Association (1960–1962), President of Section C of the British Association (1959), President of the Palaeontographical Society (1971 to his death), and was an Editor of the *Geological Magazine* from 1934 to 1972.

R. B. RICKARDS

Department of Geology
Sedgwick Museum
Downing Street
Cambridge CB2 3EQ
England

D. E. JACKSON

Department of Earth Sciences
The Open University
Milton Keynes
England

- BULMAN, O. M. B. 1925. Notes on the structure of an early *Dictyonema*. *Geol. Mag.* **62**, 50–67.
- and STUBBLEFIELD, C. J. 1925. The Shineton Shales (title page) or Notes on the Shineton Shales. In *The Geology of South Shropshire* by WATTS, W. W. WELLS, A. K. (ed.), Geologists' Association, London, 54–56, also *Proc. Geol. Ass.* **36**, 374–376.
- and WHITTARD, W. F. 1926. On *Branchiosaurus* and allied genera (Amphibia). *Proc. zool. Soc. Lond.* **36**, 533–579.
- 1927. Some structural characters of the genus *Dictyonema* and the technique employed in their determination. [Abstract] *Biol. Rev.* **2**, 395.
- STUBBLEFIELD, C. J. and BULMAN, O. M. B. 1927. The Shineton Shales of the Wrekin district: with notes on their development in other parts of Shropshire and Herefordshire. *Q. Jl geol. Soc. Lond.* **83**, 96–146.
- BULMAN, O. M. B. 1927. *Koremagraptus*, a new dendroid graptolite. *Ann. Mag. nat. Hist. ser. 9*, **19**, 344–347.
- 1927. Über *Koremagraptus fibratus* sp. nov. (Grapt., Dendr.). *Senckenbergiana*, **9**, 38–40.
- 1927–1967. A Monograph of British Dendroid Graptolites. *Palaeontogr. Soc. [Monogr.]*, pt. 1, 1927, 1–28; pt. 2, 1928, i–xxxii, 29–64; pt. 3, 1934, xxxiii–lx, 65–92; pt. 4, 1967, lxi–lxiv, 93–97.
- 1928. Additional notes on some *Branchiosaurus* from Odernheim. *Ann. Mag. nat. Hist. ser. 10*, **1**, 250–255.
- 1928. *Odontocaulis* Lapworth, a synonym of *Callograptus* Hall. *Geol. Mag.* **65**, 337–343.
- 1929. Remarks on the attachment of *Dictyonema flabelliforme* (Eichw.). *Ibid.* **66**, 492–495.
- 1929. The genotypes of the genera of graptolites. *Ann. Mag. nat. Hist. ser. 10*, **4**, 169–185.

- BULMAN, O. M. B. 1930. On the general morphology of the Anaspid, *Lasanius*, Traquair. *Ibid.* **6**, 354–362.
- 1930. Studies in the dendroid graptolites: a revision of the genus *Dictyonema* Hall, in Britain. *Abstr. Diss. Univ. Camb.* 1928–1929, 28–29.
- 1931. Some petrological and paleontological relations in subsurface stratigraphy. *J. sedim. Petrol.* **1**, 37–42.
- 1931. Note on *Palaeospondylus gunni* Traquair. *Ann. Mag. nat. Hist.* ser. 10, **8**, 179–190.
- 1931. South American graptolites with special reference to the Nordenskiöld Collection. *Ark. Zool.* **22A**, 1–111.
- and WILLIAMS, H. 1931. The geology of the Dolwyddelan syncline (North Wales). *Q. Jl geol. Soc. Lond.* **87**, 425–458.
- 1932–1936. On the graptolites prepared by Holm, 1–7. *Ark. Zool.* **24A**, no. 8, 1932, pt. 1, 1–46, quarto pls. 1–9; no. 9, 1932, pts. 2–5, 1–29, quarto pls. 1–9; **26A**, no. 5, 1933, pt. 6, 1–52, quarto pls. 1–9; **28A**, no. 17, pt. 7, 1–107, quarto pls. 1–4.
- 1933 [dated 1932]. Notes on the evolution and morphology of certain Graptoloidea. *Ibid.* **24A**, no. 13, 1–37.
- 1933. Programme-evolution in the graptolites. *Biol. Rev.* **8**, 311–334.
- 1933. Graptolites from the Quitari Area. In DOUGLAS, J. A., *Q. Jl geol. Soc. Lond.* **89**, 348–356.
- 1936. *Rhaphidograptus*, a new graptolite genus. *Geol. Mag.* **73**, 19–26.
- 1936. The structure of *Oncograptus* T. S. Hall. *Ibid.* 271–278.
- 1937. The structure of *Acanthograptus suecicus* and the affinities of *Acanthograptus*. *Geol. För. Stockh. Förh.* **59**, 182–188.
- 1937. Carl Wiman's work on the structure of the Graptoloidea. *Bull. geol. Instn Upsala*, **27**, 10–18.
- 1937. Report on a collection of graptolites from the Charchaq Series of Chinese Turkestan. In TROEDSSON, G. T. On the Cambro-Ordovician faunas of western Quruq tagh, eastern Tien-Shan. *Palaeont. sin.* **106**, 1–6. Also issued as *Repts Sci. Expn to N.W. Provinces China: The Sino-Swedish Expn Publ.* **4**, 2–7.
- 1938. The proximal end of *Cryptograptus*. *Geol. Mag.* **75**, 539–43.
- 1938. *Graptolithina*. In SCHINDEWOLF, O. H. *Handbuch der Paläozoologie*, Berlin 2D, **2**, 1–92.
- 1939. Muscle systems of some inarticulate brachiopods. *Geol. Mag.* **76**, 434–444.
- 1939. Animals of the Past. In COX, I. (ed.). *The Wildlife around us and the story of the rocks*. Allen and Unwin.
- 1941. Some dichograptids of the Tremadocian and Lower Ordovician. *Ann. Mag. nat. Hist.* ser. 11, **7**, 100–121.
- 1942. The structure of the dendroid graptolites. *Geol. Mag.* **79**, 284–290.
- 1944. The floor of the ocean: a review of Daly, R. A. 1942. Univ. N. Carolina Press. *Discovery Lond.* Jan. 1944, **5**, 19–22.
- 1944. Review of JOHNSON, D. 1942. 'The Origin of the Carolina Bays', Columbia Geomorphic Studies no. 4, xiii, 341 pp. *Discovery Lond.* Sept. 1944, **5**, 285.
- FEARNSIDES, W. G. and BULMAN, O. M. B. 1944. *Geology in the Service of Man*. Pelican Books. 217 pp.
- BULMAN, O. M. B. 1945–1947. A monograph of the Caradoc (Balclatchie) graptolites from limestones in Laggan Burn, Ayrshire. *Palaeontogr. Soc. [Monogr.]*, 1, 1945, 1–42; 2, 1946, 43–58; 3, 1947, i–xi, 59–78.
- 1946. Britain's geological history. *Endeavour*, **5**, 43–53.
- 1946. Proposed suppression of the name *Graptolithus* Linnaeus, 1768 (Class Graptolithina, Order Graptoloidea). *Bull. zool. Nom.* **2**, 163–164.
- 1946. Proposed suspension of the règles for *Monograptus* Geinitz, 1852 (Class Graptolithina, Order Graptolithoidea). *Ibid.* 164–166.
- 1946. Proposed suspension of the règles for *Retiolites* Barrande, 1850 (Class Graptolithina, Order Graptolithoidea). *Ibid.* 166.
- 1948. Some Shropshire Ordovician Graptolites. *Geol. Mag.* **85**, 222–228.
- 1949. The Anatomy and Classification of the Graptolites. *Rep. 13th Int. Congr. Zool. Paris 1948 Sect. 9*, 529–535 (published 1950, pers. comm. O. M. B. Bulman to C. J. Stubblefield).
- 1949. Review of KOZŁOWSKI, R. 1949. *Les Graptolithes et quelques nouveaux groupes d'animaux du Tremadoc de la Pologne*. *Geol. Mag.* **86**, 329–332.
- 1949. A re-interpretation of the structure of *Dictyonema flabelliforme* Eichwald. *Geol. För. Stockh. Förh.* **71**, 33–40.

- BULMAN, O. M. B. 1950. On some Ordovician graptolite assemblages of Belgium. *Bull. Inst. r. Sci. nat. Belg.* **26**, 1-8.
- 1950. Some didymograptids and associated forms from the *Phyllograptus* Shales of Tossåsen, Jemtland. *Geol. För. Stockh. Förh.* **72**, 389-396.
- 1950. Graptolites from the *Dictyonema* Shales of Quebec. *Q. Jl geol. Soc. Lond.* **106**, 63-99.
- 1950. Rejuvenation in a rhabdosome of *Dictyonema flabelliforme*. *Geol. Mag.* **87**, 351-352.
- 1950. The structure and relations of *Cyclograptus* Spencer. *J. Paleont.* **24**, 566-570.
- 1950. Obituary of Robert Heron Rastall (1871-1950). *Geol. Mag.* **87**, 73-76. Also *Q. Jl geol. Soc. Lond.* **105**, lxxvi-lxxvii.
- 1951. Notes on thecal variation in *Monograptus*. *Geol. Mag.* **88**, 316-328.
- 1953. Some graptolites from the *Ogygiocaris* Series (4a α) of the Oslo district. *Ark. Miner. Geol.* **1**, 509-518.
- 1953. On the thecae of *Monograptus scanicus* Tullberg. *Geol. Mag.* **90**, 131-136.
- 1953. Obituary of Henry Woods 1868-1952. *Obituary Notices of Fellows of the Royal Society*, **8**, 645-654.
- 1954. The Graptolite fauna of the *Dictyonema* Shales of the Oslo region. *Norsk geol. Tidsskr.* **33**, 1-40.
- 1954. Status of Invertebrate Paleontology, 1953: 7. Graptolithina. *Bull. Mus. comp. Zool. Harv.* **112**, 201-215.
- 1955. Graptolithina with sections on Enteropneusta and Pterobranchia. In MOORE, R. C. (ed.). *Treatise on Invertebrate Paleontology, Part V*. Geological Society of America and University of Kansas Press, i-xvii, 1-101.
- 1957. Graptolites. In LADD, H. S. (ed.). *Treatise on marine ecology and paleoecology: 2, paleoecology*. *Mem. geol. Soc. Am.* **67**, 987-991.
- 1957. Proposed use of the plenary powers to designate for three taxa belonging to the Class Graptolithina lectotypes which will secure the continued use of the names concerned in their accustomed sense. *Bull. zool. Nom.* **13**, 313-317.
- 1958. The sequence of graptolite faunas. *Palaeontology*, **1**, 159-173.
- 1958. Patterns of colonial development in graptolites. *J. Linn. Soc. Lond. (Zool.)* **44**, Bot. **56**, 24-32.
- 1959. Recent developments and trends in palaeontology. *Advmt. Sci. Lond.* **62**, 33-42.
- 1960. Obituary notice of Gertrude L. Elles, M.B.E. *Nature, Lond.* **188**, 1152.
- 1960. Some morphologically intermediate genera in graptolite phylogeny. *21st Int. geol. Congr. Norden, sect.* **22**, 65-70.
- 1961. Graptolite generic names: proposed use of the plenary powers to validate certain emendations. *Bull. zool. Nom.* **18**, 149-154.
- 1961. Obituary: Gertrude Lillian Elles. *Proc. geol. Soc.* **1592**, 143-145.
- and COWIE, C. M. 1962. On the occurrence of *Kinnegraptus* Skoglund in Norway. *Norsk geol. Tidsskr.* **42**, 253-260.
- 1962. On the genus *Amplexograptus* Lapworth, Elles & Wood. *Geol. Mag.* **99**, 459-467.
- 1963. On *Glyptograptus dentatus* (Brongniart) and some allied species. *Palaeontology*, **6**, 665-689.
- 1963. The evolution and classification of the graptoloidea. *Q. Jl geol. Soc. Lond.* **119**, 401-418.
- 1964. Lower Palaeozoic plankton. *Ibid.* **120**, 455-476.
- RICKARDS, R. B. and BULMAN, O. M. B. 1965. The development of *Lasiograptus harknessi* (Nicholson 1867). *Palaeontology*, **8**, 272-280.
- BULMAN, O. M. B. 1965. Demonstration: Giant rhabdosomes of *Monograptus* cf. *flemingii* (Salter). *Proc. geol. Soc.* **1624**, 99-102.
- 1966. *Dictyonema* from the Tremadocian of Estonia and Norway. *Geol. Mag.* **103**, 407-413.
- 1966. On the type material of *Dictyonema norvegicum* Kjerulf. *Norsk geol. Tidsskr.* **46**, 289-298.
- 1966. Walter Frederick Whittard 1902-1966. *Biographical Memoirs of Fellows of the Royal Society*, **12**, 531-542.
- 1966. Graptolites. In LAW, M. D. and DIXON, M. V. (eds.). *Chambers's Encyclopaedia. New Revised Edition, Volume VI*, p. 481. Oxford.
- and RICKARDS, R. B. 1967. A revision of Wiman's dendroid and tuboid graptolites. *Bull. Instn geol. Univ. Upsala*, **43** (for 1966), 1-72.
- 1967. Obituary: Walter Frederick Whittard. *Proc. geol. Soc.* **1636**, 214-215.

- BULMAN, O. M. B. 1967. *Dictyonema flabelliforme* (Eichwald, 1840) (Graptolithina) application for conservation under the plenary powers by designation of a neotype. *Bull. zool. Nom.* **24**, 49–51.
- and RICKARDS, R. B. 1968. Some new diplograptids from the Llandovery of Britain and Scandinavia. *Palaeontology*, **11**, 1–15.
- 1968. The mode of development of *Isograptus manubriatus* (T. S. Hall). *Geol. Mag.* **105**, 211–215.
- and COOPER, R. A. 1969. On the supposed occurrence of *Triograptus* in New Zealand. *Trans. R. Soc. N.Z. (geol.)* **6**, 213–218.
- 1969. William George Fearnside, 1879–1968. *Biographical Memoirs of Fellows of the Royal Society*, **15**, 83–89.
- 1969. ‘Prothecal Folds’ and the origin of *Dicellograptus*. In CAMPBELL, K. S. W. (ed.). *Stratigraphy and Palaeontology: essays in honour of Dorothy Hill*. Canberra. 3–16.
- 1969. Discussion of Kirk, N. H. ‘Some thoughts on the mode of life of graptolites’. *Proc. geol. Soc.* **1659**, 280–281.
- 1970. Graptolithina with sections on Enteropneusta and Pterobranchia. In TEICHERT, C. (ed.). *Treatise on Invertebrate Paleontology, Part V (2nd edition)*. Geological Society of America and University of Kansas Press. i–xxxii + 1–149, 158–163.
- and RICKARDS, R. B. 1970. Classification of the Graptolite family Monograptidae Lapworth, 1873. In TEICHERT, C. (ed.). *Ibid.* 149–157.
- JACKSON, D. E. and BULMAN, O. M. B. 1970. On the generic name *Trigonograptus* Nicholson, 1869. *Proc. geol. Soc.* **1663**, 107–109.
- BULMAN, O. M. B. and STØRMER, L. 1971. Buoyancy structures in rhabdosomes of *Dictyonema flabelliforme* (Eichwald). *Norsk geol. Tidsskr.* **51**, 25–31.
- 1971. Graptolite faunal distribution. In MIDDLEMISS, F. A., RAWSON, P. F., NEWALL, G. (eds.). *Faunal Provinces in Space and Time. Geol. JI special issue*, **4**, 47–60.
- 1971. Some species of *Bryograptus* and *Pseudobryograptus* from Northwest Europe. *Geol. Mag.* **108**, 361–371.
- BLACK, W. W., BULMAN, O. M. B., HEY, R. W. and HUGHES, C. P. 1972. Ordovician stratigraphy of Aberiddy Bay, Pembrokeshire. *Ibid.* 546–548.
- BULMAN, O. M. B. 1972. A new *Dictyonema* fauna from the Salmien of the Stavelot Massif. *Bull. soc. belge Géol. Paléont. Hydrol.* **79** (for 1970), 213–224.
- 1973. Graptolite Periderm Structure and Budding Patterns: a Resumé. In LARWOOD, G. P. (ed.). *Living and Fossil Bryozoa, recent advances in research*. Academic Press, London and New York, 11–20.
- and RUSHTON, A. W. A. 1973. Tremadoc faunas from boreholes in Central England. *Bull. geol. Surv. Gt Br.* **43**, 1–40.

