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Who Was the First Person Known to Have Discovered Fossils of the Precambrian (Ediacaran) Organism *Aspidella terranovica*?

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Article abstract

This article briefly examines the possible confusion pertaining to the discoveries of Precambrian (Ediacaran) fossils made in the self-governing British colony of Newfoundland in 1868 by the amateur naturalist, the Reverend Moses Harvey, and the subsequent description and naming of the fossil organism *Aspidella terranovica* in 1872 by Elkanah Billings, the father of Canadian paleontology. Both events could be misinterpreted as one transaction that began with the former event and ended with the latter event. Accounts published by Alexander Murray, the director of the Geological Survey of Newfoundland at the time, arguably may have inadvertently exacerbated the possibility for confusion. The determination of who first discovered fossils of *A. terranovica* and whose fossil material Billings primarily relied upon when he first described and named the taxon could be placed into doubt as a consequence. Although the confusion does not affect the undisputed priority that Billings holds in having described and named *A. terranovica*, the opportunity to remedy the confusion serves to benefit the historical record. The incomplete or ambiguous ascertaining and documenting of contextual information whenever an historically significant fossil discovery is made arguably may precipitate subsequent misinterpretations, distortions or omissions in the resulting historical narrative as it develops and becomes entrenched or mythologized in its retelling.

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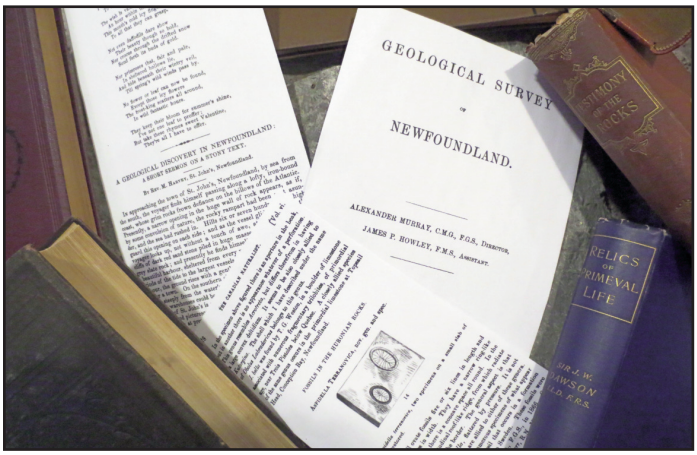

Who Was the First Person Known to Have Discovered Fossils of the Precambrian (Ediacaran) Organism *Aspidella terranovica*?

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SUMMARY

This article briefly examines the possible confusion pertaining to the discoveries of Precambrian (Ediacaran) fossils made in the self-governing British colony of Newfoundland in 1868 by the amateur naturalist, the Reverend Moses Harvey, and the subsequent description and naming of the fossil organism *Aspidella terranovica* in 1872 by Elkanah Billings, the father of Canadian paleontology. Both events could be misinterpreted as one transaction that began with the former event and ended with the latter event. Accounts published by Alexander Murray, the director of the Geological Survey of Newfoundland at the time, arguably may have inadvertently exacerbated the possibility for confusion. The determination of who first discovered fossils of *A. terranovica* and whose fossil material Billings primarily relied upon when he first described and named the taxon could be placed into doubt as a consequence. Although the confusion does not affect the undisputed priority that Billings holds in having described and named *A. terranovica*, the opportunity to remedy the confusion serves to benefit the historical record. The incomplete or ambiguous ascertaining and documenting of contextual information whenever an historically significant fossil discovery is made arguably may precipitate subsequent misinterpretations, distortions or omissions in the resulting historical narrative as it develops and becomes entrenched or mythologized in its retelling.

RÉSUMÉ

Cet article examine brièvement la confusion possible concernant les découvertes de fossiles Précambriens (Ediacaran) fabriqués dans la colonie Britannique autonome de Terre-Neuve en 1868 par le naturaliste amateur, le Révérend Moses Harvey, et la description et l'appellation suivantes de l'organisme fossile *Aspidella terranovica* en 1872 par Elkanah Billings, le père de la paléontologie Canadienne. Les deux événements pourraient être mal interprétés comme une transaction qui a commencé avec l'événement précédent et s'est terminée avec le dernier événement. Les comptes publiés par Alexander Murray, le directeur de la Commission Géologique de Terre-Neuve à l'époque, ont sans doute peut-être exacerbé par mégarde la possibilité de confusion. La détermination de qui a découvert les fossiles d'abord de *A. terranovica* et dont Billings s'appuyait principalement sur le matériel fossile dont il a d'abord décrit et nommé le taxon pourrait être mis en doute en conséquence. Bien que la confusion ne porte pas atteinte à la priorité incontestée que Billings détient en ayant décrit et nommé *A. terranovica*, la possibilité de remédier à la confusion sert à bénéficier du dossier historique. La constatation et la documentation incomplètes ou ambiguës de l'information contextuelle chaque fois qu'une découverte fossilifère historiquement significative peut être faite peut précipiter des interprétations, des distorsions ou des omissions subséquentes dans le récit historique résultant au fur et à mesure qu'il se développe et devient ancré ou mythologisé dans son récit.

NEWFOUNDLAND AND THE FIRST KNOWN EDIACARAN BODY FOSSIL

Newfoundland has been recognized for its complex and fascinating early history (see, for example, Bannister 2003). It began as an English colony founded in 1610, administered by the fishing admirals, with customary law comprising an important aspect of its legal system. It evolved into a British colony with representative government in 1832 and responsible govern-

ment in 1855. It became a British dominion in 1907 (resolved at the Imperial Conference of that year and by Royal Proclamation) and finally entered into confederation with Canada as its 10th province in 1949 (United Kingdom 1949). The geological history of the province has proven to be no less varied and intriguing. In particular, the Avalon Peninsula of southeastern Newfoundland contains several spectacular Precambrian fossil deposits, including one of the richest in the world known as the Mistaken Point Konservat–Lagerstätten (Fig. 1). This United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Site, inscribed in 2016, was discovered in 1967 by Shiva Balak Misra, then a graduate student at Memorial University of Newfoundland, with Professor Michael Marchmont Anderson as his academic supervisor (Anderson and Misra 1968; Misra 1969, 1971; Fedonkin et al. 2007). Canada's first professional paleontologist, the Ontario lawyer Elkanah Billings, described and named the Precambrian fossil organism *Aspidella terranovica* (Fig. 2) in 1872 from material that had been discovered in Precambrian (Ediacaran) rocks of the Fermeuse Formation (St. John's Group) from Newfoundland (Billings 1872). Paleontologists have since credited Billings with having described and named the first known Ediacaran body fossil (Gehling et al. 2000).

THE REVEREND MOSES HARVEY AND HIS 1868 DISCOVERY OF FOSSILS

The Reverend Moses Harvey, an amateur naturalist and a dedicated researcher on the history of Newfoundland, reported in 1869 on some unknown, primordial fossils from Newfoundland that he had apparently discovered in 1868. He suggested that the most prominent of these might be referable to *Oldhamia radiata*, a taxon initially postulated to have been a body fossil (Kinahan 1856) but which is presently classified as an Early Cambrian ichnotaxon (trace fossil) (Herbosch and Verniers 2011). Harvey stated that he had sent photographs of the putative *O. radiata* material to the prominent geologist Alexander Murray, director of the Geological Survey of Newfoundland, and to Sir J. William Dawson of McGill University. Dawson referred the matter to Billings for study. Harvey also reported finding other fossils, which he described as "markings much resembling the whorls of shell fish" and "shell-markings, or traces of mollusca." He also found what he characterized as "*two other forms* in the same slate rock." It does not appear that he had arranged for anyone to examine any of this additional material. He concluded his 1869 report with a note that –

> *"It must be borne in mind that the fossils referred to have yet to be examined by a* professional *Palaeontologist, only photographs of them having yet been sent. I have, however, given the evidence which seems strongly to point to the conclusion that they are Cambrian forms identical with* Oldhamia*, or at all events closely allied thereto. Mr. Billings reserves his final verdict till he has examined the fossils themselves"* (Harvey 1869).

Murray made reference to Harvey's discovery in a report on the activities of the Geological Survey of Newfoundland for 1868 (Murray and Howley 1881).

ELKANAH BILLINGS AND HIS 1872 DESCRIPTION OF *ASPIDELLA TERRANOVICA*

The published literature indicates that the fossils that Billings had discussed in his 1872 publication on *A. terranovica* and those that Harvey had reported in 1869 had been discovered only two years apart near St. John's on the Avalon Peninsula and both discoveries had involved the participation of Murray and Billings. An assumption could be made that either Harvey's mollusc-like fossils or the "*two other forms*" were *A. terranovica*. It had been argued in the late 19th century that *A. terranovica* represented "problematical forms…which may be Crustaceans or Mollusks allied to the limpets" from strata "underlying the Lower Cambrian" (Dawson 1897). As exemplified by statements made in Walcott (1891), and in Fensome et al. (2014), a possibility has consequently existed that the events of both discoveries could be misinterpreted as one transaction that began with Harvey's fossil discovery in 1868 and ended with Billings' description of *A. terranovica* in 1872. Walcott (1891) stated: "…It was in this series of slates that the Rev. Moses Harvey discovered the fossil which Mr. Billings described as *Aspidella terranovica*." Fensome et al. (2014) stated: –

> *"The first inkling that Newfoundland's Avalon Peninsula had something special to contribute to our knowledge of the history of life came in the late nineteenth century. In a report published in 1881, the first Director of the Geological Survey of Newfoundland, Alexander Murray, remarked on a discovery in rocks previously thought to be barren of fossils. Murray noted, 'I have long had some obscure forms in my possession, collected [by the Rev. Mr. Harvey] in the neighbourhood of St. John's, which were suspected to be organisms of a low type, but which I could not venture to pronounce to be such without palaeontological reference.'*
>
> *That 'palaeontological reference' was Elkanah Billings, a lawyer whose passion was fossils…It was natural, then, that Murray would send Reverend Harvey's finds to Billings, Canada's first professional paleontologist.*
>
> *Billings examined the dime-sized discs and, in an 1872 publication, named them* Aspidella terranovica *(Newfoundland's little shield)…"*

Fensome et al. (2014) inserted the above parenthetical reference to Harvey within Murray's quote.

Billings' 1872 description of *A. terranovica* and Harvey's 1869 report on the purported *O. radiata* fossils, mollusc-like fossils, and "*two other forms*", do not necessarily lead to the conclusions that Harvey's work had contributed to, or formed the basis of, Billings' 1872 description of *A. terranovica* or that both publications had, in fact, concerned identical fossil material comprising *A. terranovica*. Billings made no references to Harvey's 1868 discovery or 1869 report. Billings stated that the *A. terranovica* "fossils were first discovered by A. Murray, Esq., F.G.S. in 1866. Other specimens were collected by Capt. Kerr, R.N., Mr. Howley, and Mr. Robertson" (Billings 1872). He repeated this statement in 1874 in the second volume of his renowned publication *Palaeozoic Fossils* (Billings 1874). Murray repeated the statement in his report on the activities of the Geological Survey of Newfoundland for 1872 (Murray and

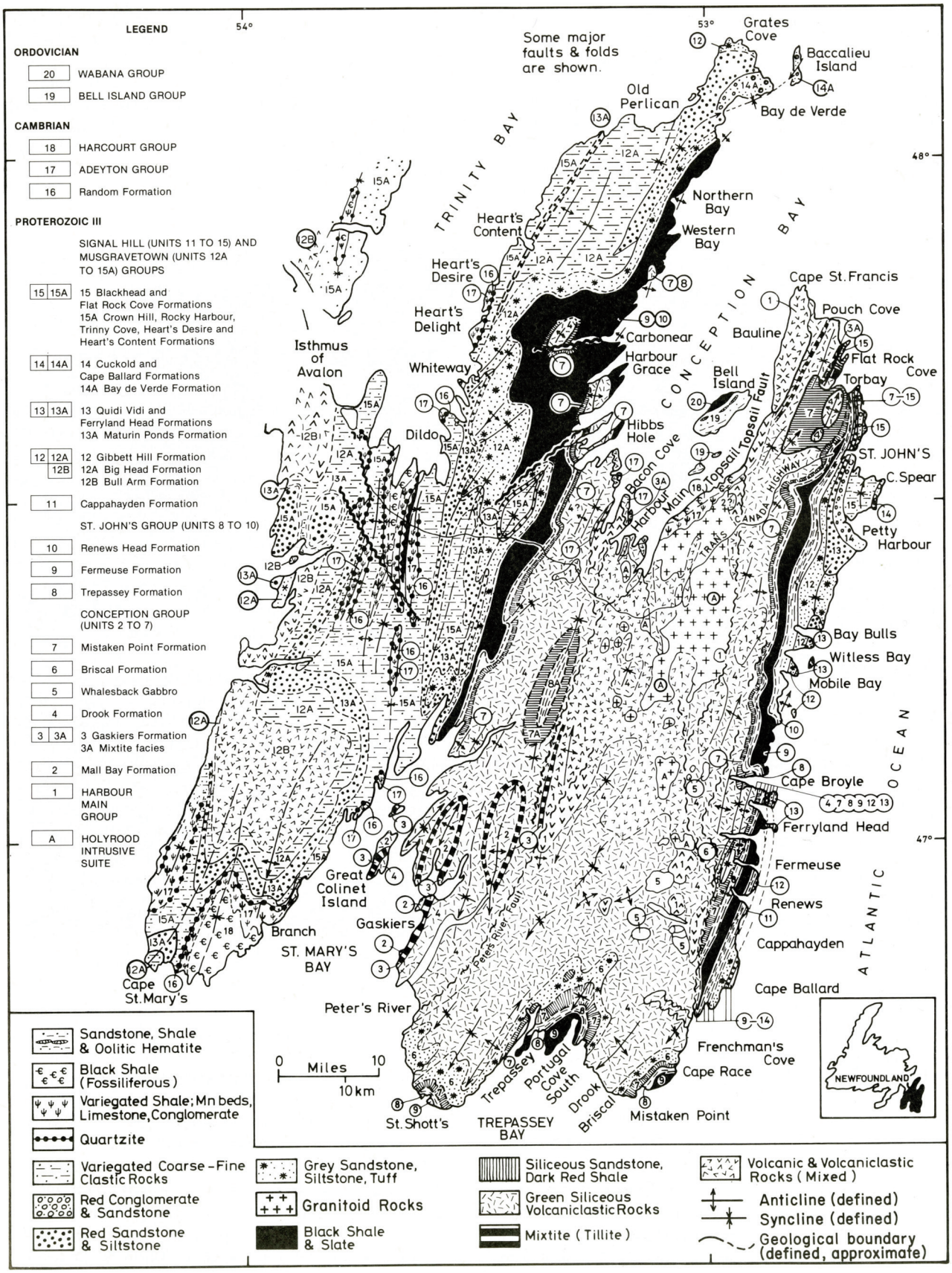

Figure 1. Geological map of the Avalon Peninsula, Newfoundland from King 1990, figure 3.

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Figure 2. Remains of two individuals of *Aspidella terranovica* from Ferryland, Newfoundland. 5 cm scale bar shown. Photograph courtesy of Marc Laflamme.

Howley 1881). Billings' 1872 and 1874 discussions on *A. terranovica* both indicate that he did not knowingly examine, rely upon or make reference to any fossils that Harvey had collected in 1868 (or subsequently) and reported on in 1869.

ALEXANDER MURRAY AS A POTENTIAL SOURCE FOR CONFUSION

The potential for confusion concerning which primordial fossils from Newfoundland had first been found, when they had been found, and who had found them arguably appears to have originated with Murray, who reported in 1868: –

> *"The Rev. Mr. Harvey of this place had the good fortune to find the first well-defined specimen of these organic forms; and they, with others subsequently obtained, will doubtless be of inestimable service in finally settling the question of horizon. I have long had some obscure forms in my possession, collected in the neighbourhood of St. John's, which were suspected to be organisms of a low type, but which I could not venture to pronounce to be such without palaeontological reference. Since Mr. Harvey's discovery, I have obtained many more, all apparently of the same low order of existence; some of them so much resembling forms described by Sir Roderick Murchison, Jukes, Salter, and others, as peculiarly Cambrian, that there seems but little reason to doubt that the rocks of Avalon are the representatives of that system"* (Murray and Howley 1881).

Murray's 1868 statement that he "long had" primordial Newfoundland fossils appears to suggest that Murray had made a discovery of fossils that had predated Harvey's and agrees with Billings' assertion that Murray had been the first person known to have discovered *A. terranovica* fossils in 1866. Murray's statement "Since Mr. Harvey's discovery, I have obtained many more" appears to suggest that the additional quantities of fossils that Murray had obtained had not been discovered by Harvey. Murray did not state that anyone other than himself had collected the fossils that he had "long had" or those that he had obtained "Since Mr. Harvey's discovery". Murray also specifically stated that Harvey had discovered "the first well-defined specimen of these organic forms" (Murray and Howley 1881). Murray did not state that Harvey had been the first person known to have discovered "these organic forms." Murray arguably did not adequately distinguish to which "forms" he was referring. Was he referring to the *O. radiata* fossils, the mollusc-like fossils, the "*two other forms*" or a combination of some or all of these? Harvey reported in 1869 that he had not yet submitted the purported molluscan fossils or the "*two other forms*" to any researcher for analysis. He stated they "are yet unread…it remains for a palaeontologist to determine what they are" (Harvey 1869).

In the absence of a detailed study of the primordial Newfoundland fossils known to Harvey and Murray at the time that Murray had made his Geological Survey of Newfoundland report for 1868, Murray briefly summarized the available fossils by tentatively commenting on the collected material in a limited, generalized context. However, in a footnote added when all of the Geological Survey of Newfoundland reports were compiled, revised, and republished in England as one volume in 1881 (see the Preface in Murray and Howley 1881 for the reasons behind the compilation), Murray distinguished the Newfoundland "forms" that purportedly resembled *O. radiata* from the fossils that Billings described as *A. terranovica* in 1872. No specific reference was made in the footnote to Harvey's "*two other forms*" or mollusc-like fossils: –

> *"The forms in question were supposed to resemble the* Oldhamii *of Bray Head, but were pronounced upon examination by the late E. Billings to be undeterminable. He doubted their organic origin altogether. At a later date, however, fossils of a very low type were found, which Mr. Billings describes and names* Aspidella terranovica *and* arenicolites" (Murray and Howley 1881).

The mention of the taxon "*arenicolites*" in Murray and Howley (1881) was a reference to *Arenicolites spiralis*, an ichnotaxon that Billings briefly described in his 1872 publication on *A. terranovica* (Billings 1872). Murray's 1881 statement that *A. terranovica* fossils were found "At a later date" appears to contradict his 1868 statement that he had "long had" such fossils and Billing's 1872 statement that the first *A. terranovica* "fossils were first discovered by A. Murray, Esq., F.G.S. in 1866." The 1881 footnote did not mention or distinguish the date when the *A. terranovica* fossils had first been discovered (1866) from the date when they had first been described (1872). Perhaps Murray's footnote was referring specifically to the *A. terranovica* fossils on the slab that Billings had figured in his 1872 description (Billings 1872, figure 14). These specific fossils may have been discovered "At a later date" either by Murray or by one of the other persons ("Capt. Kerr, R.N., Mr. Howley, and Mr. Robertson") whom Billings had credited with having discovered *A. terranovica* fossils.

OTHER STUDIES OF THE FOSSILS AT ISSUE

Whitney and Wadsworth (1884) reviewed Murray's Geological Survey of Newfoundland reports and they appeared to have readily understood the differences between the discoveries of the *O. radiata* and *A. terranovica* fossil material. Weston (1896) distinguished the *A. terranovica* fossils that Billings described from the –

"…other forms found in Huronian argillite by the Rev. Mr. Harvey. At the time of the discovery of these fossil-like markings they were considered to be most important, and were supposed to belong to the genus Oldhamia*, and specimens were sent to Sir W. E. Logan. Billings would not decide one way or the other as to their organic affinity and they were handed to me. I said at once they were concretionary, and, what had not been observed by others, that these markings lay transverse to the bedding of the slate in which they were."*

With respect to *A. terranovica*, Weston expressed his doubts that the taxon represented a fossil: "I am afraid they will ultimately be classed with the concretionary forms already spoken of, collected by the Rev. Mr. Harvey" (Weston 1896). No matter what the status of *A. terranovica* may have been perceived to have been, Weston's writing arguably does not communicate an understanding that Harvey had in any way contributed to either the collection or the description of *A. terranovica* fossils. The applicable primary sources convey an overall impression that the only fossils that Harvey had ever been explicitly or implicitly recognized for having unearthed had been those interchangeably referred to in the literature as *Oldhamia radiata*, *Oldhamia* or "*Oldhamii*". In a comprehensive review of known Precambrian fossils from Canada, Hofmann (1971) discussed Murray's references to *Oldhamia* and Billings' 1872 description of *A. terranovica* under the headings macro-pseudofossils and macro-problematica. Concerning *A. terranovica*, Hofmann stated that "these structures were first collected in 1866 and reported by A. Murray (1868, pp. 11, 12) in the St. John's Formation" (Hofmann 1971).

Whitney and Wadsworth drew attention to an interesting discrepancy concerning the appearance of some particular *A. terranovica* fossils that they had examined: –

"Specimens of Aspidella *sent us by Mr. Murray, however, do not resemble in any respect the fossil figured by Mr. Billings. There are several indistinct impressions on the fragment of rock, neither of them like that fossil, and none of them necessarily of organic origin, at least so far as we are able to discover. They look more like spray markings than anything else with which we are able to compare them"* (Whitney and Wadsworth 1884).

It may be fairly stated that undoubted *O. radiata* fossils do not generally resemble fossils of *A. terranovica*, which is not even an ichnotaxon. Gehling et al. (2000) identified three predominant preservational morphs of *A. terranovica*, none of which resemble *O. radiata* fossils. *O. radiata* typically consists of radially branching structures, while *A. terranovica* remains are typically preserved as discoidal structures representing the holdfast of a sessile, frond-like organism (Gehling et al. 2000; Carbone et al. 2015). Menon et al. (2013, 2014) controversially argued that *A. terranovica* fossils may suggest evidence of vertical and horizontal movement consistent with the behaviour of cnidarians, however Retallack (2014) disputed this argument. Liu et al. (2015) argued the possibility "that *Aspidella* reflects several very different original entities, including holdfast discs, microbial colonies (cf. Grazhdankin and Gerdes, 2007), and discrete organisms (cf. MacGabhann, 2007)".

The literature arguably does not appear to offer any applicable data that could reasonably be construed to indicate that

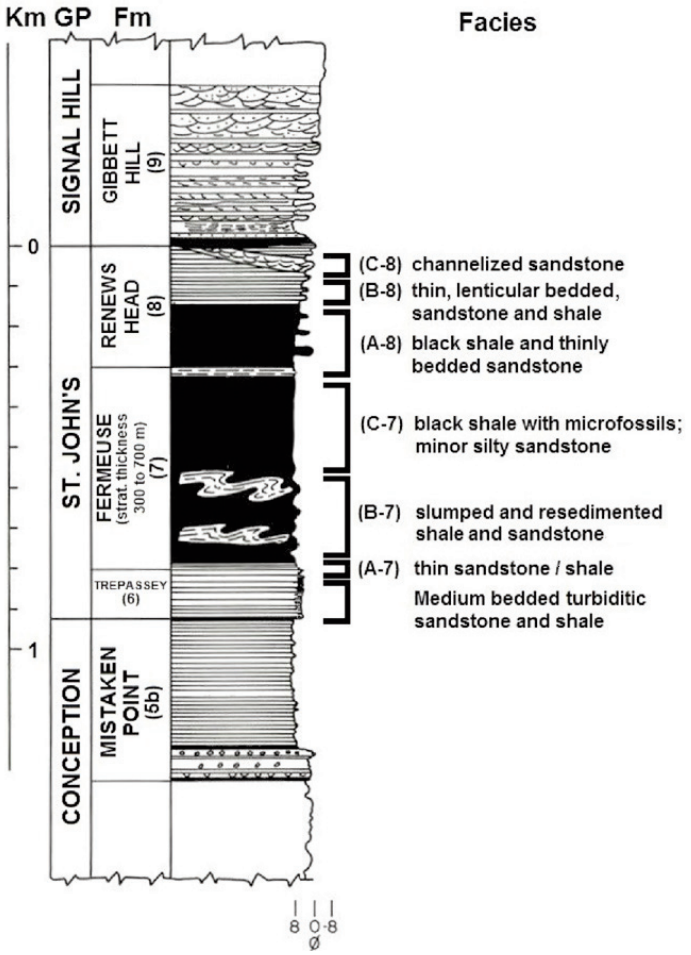

Figure 3. Composite stratigraphic section of the St. John's Group from King 1990, figure 14.

fossils of *Aspidella* and *Oldhamia* are taphonomically the same or represent the same organism. A statement was nonetheless published in Fedonkin et al. (2007) that "Some other workers suggest that *Oldhamia* may even be a body fossil, some allying it with *Aspidella* (Runnegar, 1992)". Tacker et al. (2010) cited Fedonkin et al. (2007) stating that "*Oldhamia* was originally questioned as an Ediacaran trace fossil by Runnegar (1992), who affiliated it with the body fossil *Aspidella*."

The Fermeuse Formation is one of several geologic formations on the Avalon Peninsula (Fig. 3) containing fossils of *A. terranovica*. Fossils of the Ediacaran genus *Hiemalora*, which, like *A. terranovica*, are known to occur in the Fermeuse Formation, combine what arguably could be described as a superficially *A. terranovica*-like discoidal structure with superficially *O. radiata*-like radially branching structures (see, for example, Fedonkin et al. 2007). But because neither *A. terranovica* nor *O. radiata* each exhibit a combination of such structures, it would be difficult or even implausible to argue that the purported *O. radiata* fossils that Harvey had reported in 1869 were, in fact, fossils of *Hiemalora*. Some researchers have suggested that the Ediacaran bush-like body fossil *Parviscopa bonavistensis*, which occurs along with *Hiemalora* and *A. terranovica* on the Bonavista Peninsula, Newfoundland, may display 'similarities' to the Cambrian trace

fossil *Oldhamia flabellata* (Hofmann et al. 2008; Liu et al. 2015). However, there is no evidence that Harvey's presumed *Oldhamia* fossils could have been referable to *P. bonavistensis*. Harvey had not even made his discovery of fossils on the Bonavista Peninsula.

It would be useful to contrast, compare, and conclusively identify all of the Newfoundland fossils that Harvey, Murray, and Billings had each independently studied and precisely place each of the fossils in their proper stratigraphic context. Complete stratigraphic information would be extremely important in view of the arguments presented by Herbosch and Verniers (2011). Inter alia, they argued that the ichnogenus *Oldhamia* is not definitively known from the Precambrian. The organisms responsible for creating *Oldhamia* traces were argued to have lived "probably between the earliest Cambrian and the middle Cambrian mostly in deep oceanic environments and more rarely in shallow ones." Tacker et al. (2010) argued that *O. recta* known from the Precambrian of North Carolina, U.S.A. potentially represents the body fossil of a rod-like organism and not a trace fossil falling within the scope of the ichnogenus *Oldhamia*.

Not all of the fossils at issue appear to be presently accounted for in institutional collections. The fossils that Billings had consulted in his 1872 description of *A. terranovica* were placed in the repository of the National Type Collection of Invertebrates and Plants, Geological Survey of Canada (GSC) in Ottawa, Ontario, Canada. Gehling et al. (2000, figure 4) examined the metal plastotype (GSC 221c) of the slab that Billings had figured in 1872 (Billings 1872, figure 14). It would appear that the original material on which the metal plastotype had been based was lost. Gehling et al. presumed that a small cross marked on the slab above the largest specimen of *A. terranovica* was intended to indicate the holotype, although Billings did not formally designate it as such in the literature (Gehling et al. 2000). Boyce (pers. comm. 2016) was of the opinion that the putative holotype of *A. terranovica* was transferred to the Canadian Museum of Nature in Ottawa along with a substantial amount of other material that had been held in the collections of the Geological Survey of Canada (Stewart 2015). Additional fossils that Boyce and Reynolds (2008) documented are in the Provincial Museum of Newfoundland and Labrador in the Rooms in St. John's.

CONCLUSIONS

It arguably appears, in the absence of clear and convincing evidence to the contrary, that the credit for having been the first person known to have discovered fossils of *A. terranovica* belongs with Murray, not Harvey, and that the discovery of the fossils occurred in 1866. Furthermore, even if it were proven that Harvey discovered fossils of *A. terranovica* prior to Murray, it nonetheless appears evident that such a discovery had not been recognized, and it was Murray's discovery of *A. terranovica* fossils that had influenced Billings' 1872 description of what constituted the first known Ediacaran body fossil. The priority that Billings holds in having described and named *A. terranovica* is not at issue and, of course, remains undisputed.

From whom did Billings obtain the information that Murray first discovered fossils of *A. terranovica* in 1866 and that "Capt. Kerr, R.N., Mr. Howley, and Mr. Robertson" subsequently discovered additional quantities of *A. terranovica* fossils? If Billings obtained the information from any or all of these persons, could Billings have either misunderstood any of them or could any of them have been faulty in their recollections at the time during which Billings had prepared his description of *A. terranovica* for publication in 1872? The available evidence does not appear to support these possibilities. It is sincerely hoped that further information may elucidate the matter.

The incomplete or ambiguous ascertaining and documenting of contextual information whenever an historically significant fossil discovery is made arguably may precipitate subsequent misinterpretations, distortions or omissions in the resulting historical narrative as it develops and becomes entrenched or mythologized in its retelling.

AN UNEXPECTED NEXUS BETWEEN RESEARCHERS

Billings and Harvey shared an ironic and unexpected connection with one another in their respective studies on primordial Newfoundland fossils and in the fact that they each independently had dealings with the American researcher Addison Emery Verrill, the first professor of zoology at Yale University and one of the first curators of the Yale Peabody Museum. Teuthologists remember Verrill as a prominent investigator of occurrences of the giant squid *Architeuthis dux* off the coast of Newfoundland. Harvey became a kind of local folk hero and a legendary figure in *Architeuthis* lore for his work on the cephalopod (especially in 1873) and for his concomitant collaboration with Verrill (Ellis 1998; Frank 2015; Conniff 2016). In 1866, Billings challenged Verrill's misinterpretation of Billings' research on the fossil organism *Pasceolus halli* (Minicucci 2016). For an excellent photograph of Billings, see City of Ottawa Archives (2015); for Murray, see The Rooms (2016); and for Harvey, see Heritage Newfoundland and Labrador (2001).

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