Introduction

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The section at Vattenfallet in the southern outskirts of Visby on Gotland (Vattenfallsprofilen 1, Laufeld 1974b) has received particular fame through the discovery of the scorpion *Palaeophonus nuncius* (Thorell & Lindström 1885) in the so-called *Pterygotus* Beds (uppermost 40 cm of the Högklint Limestone). To obtain additional specimens of the scorpion, as well as eurypterids, these beds were literally quarried over a period of several years at the end of the 19th century. The rich collections assembled, including also many other invertebrates, are housed in the Section of Palaeozoology, Swedish Museum of Natural History (Naturhistoriska Riksmuseet), Stockholm.

In connection with mapping the bedrock of Gotland the Geological Survey of Sweden intended to establish several biostratigraphical reference sections through parts of the Silurian sequence. One of the exposures selected for that purpose was the Vattenfallet section, where continuous strata were exposed from the base of the Upper Visby Marl to the top of the Högklint Limestone. The total thickness of the beds exposed was 29 m.

For systematic collecting from Vattenfallet the Geological Survey temporarily employed G. Liljevall, who in the summer of 1908 assembled a large collection of fossils from the section. Collecting was done with great stratigraphical precision, mostly bed by bed. According to his diary, in 1908 Liljevall spent altogether 32 days working on the section, each day from 7 a.m. to 7 p.m. with a two hour rest for lunch. For 21 days he was assisted by Edvin Håkansson, a local quarry-man, who brought with him a great assortment of tools for prizing slabs of limestone from the bed-rock and for crushing the rock. Liljevall's work was very systematic. Normally he spent a whole day collecting and extracting fossils bed by bed from about a single metre of the section, moved next day to the next highest metre, and continued to do so, day by day, up to the top of the section. At suitable intervals limestone and marl samples were also collected. In Stockholm Liljevall himself sorted the material and labelled it with detailed information on the horizons within the section, given in metres above sea-level and based on levelling of the exposure with a theodolite carried out by the Survey a year before. Liljevall's 1908 collections are deposited at the Geological Survey. Subsequently, he also collected some additional material from the section and much of that is deposited at the Riksmuseum.

Georg Gideon Liljevall (1848–1928) was an artist and he worked as such for most of his adult life at the Riksmuseum. He prepared illustrations for most of the papers and

monographs issued from the Department of Palaeozoology between 1885 and 1925, not least for those on Gotland fossils written by Gustav Lindström, head of the Department between 1876 and 1901. Incidentally, one of his very first assignments was to illustrate Thorell & Lindström's (1885) monograph on the scorpion from Vattenfallet. Liljevall was also an outstanding collector of fossils and it was in this capacity that he was employed during the summers by the Geological Survey in the course of their mapping of Gotland (Hedström 1929).

A preliminary report on the Vattenfallet section, based on Liljevall's collections, was published by Hedström (1910). However, an exhaustive description of the section promised by him was never completed. Some of Liljevall's material from Vattenfallet was included in the monographic description of calcareous algae (Rothpletz 1913) and rugose corals (Wedekind 1927) from Gotland, but subsequently most of the collection was stored away and access to it was difficult for many years.

In connection with the examination of cores from Gotland for ostracodes, Sethi assembled and unpacked the Vattenfallet material, and the importance of Liljevall's collections was soon realised. The upper third of Liljevall's section, above 20.5 m, is now covered and the only documentation is in Liljevall's material. Lindström's old scorpion-locality in the "*Pterygotus*" Beds was already built on before 1908. Only traces of it remained and Liljevall succeeded in tieing it into his section 30 m to the northwest. All this material offers a unique opportunity to study the fossil succession in detail through a substantial portion of the lower Wenlockian sequence of Gotland.

Initial plans were to present studies of the fauna of the section in a series of separate papers, and several such studies were started (Sethi on beyrichiacean ostracodes, Klaamann on tabulate corals (see Klaamann 1977a), Brood on bryozoans, and Neuman on rugose corals). At that time Kjellesvig-Waering had also started his study of the eurypterids from the "*Pterygotus*" Beds of Vattenfallet, based on the collections at the Riksmuseum. As a result of discussions in May 1975, between Bassett, Jaanusson, Klaamann, Sethi, and Skoglund, it was found that splitting of the description of the Vattenfallet material between many individual papers, published separately and at irregular intervals, would make it difficult to summarise the results within a reasonable time. Furthermore, without centralised coordination of the project there was a danger that many groups would not be properly covered. It was thus decided that an attempt should be made to cover the whole fauna and flora of the section and to present the results in a single publication. Jaanusson undertook the task of acting as general coordinator of what was now termed "Project Vattenfallet".

The fauna and flora from the section proved to be far more diverse than at first realised. Cooperation of many specialists was needed. Ultimately a team of 32 specialists from eight different countries was assembled, and virtually the

whole fauna and flora from the section could be covered, in the first ever attempt to elucidate the succession of all fossil organisms during an interval of time and to analyse biotic changes based on practically all preserved taxa.

In the lower half of the section the density of Liljevall's rock samples is low. For this reason a series of additional samples was collected by Jaanusson and Skoglund in 1975 throughout the exposed portion of the section, assisted by Bengtson with a theodolite for determining the level of horizons. These samples were used for lithological analyses, for isolating acritarchs, chitinozoans, and foraminifers, and for qualitative and quantitative work on bryozoans based on thin sections and peels. The field party in 1975 also included Franzén, Jeppsson, and Sethi. In 1970 Jeppsson had collected a series of limestone samples from the section, and these were processed for conodonts and scolecodonts, and yielded remains of various other fossils. For the upper part of the section, above 20.5 m above sea-level, Liljevall's samples were used for lithological studies as well as for isolating acid-resistant microfossils. From Högklint *d* ("*Pterygotus*" Beds) a large number of samples were available in the Riksmuseum collections. When it became apparent that in parts of the section the density of Liljevall's marl samples is low, some additional samples were collected by Brood in 1976. These, as well as Liljevall's washed marl samples, were picked for various fossils by some authors themselves and also by Mrs. Meit Lindell at the Department of Palaeobiology, Uppsala University.

In June 1978 Stig Lindbom, who is currently studying the hard-bottom boring endofauna in the Upper Visby Marl, succeeded in obtaining rock samples down to the 0.5 m level at Vattenfallet. Examination of these samples revealed that the section below 1.1 m belongs to the Lower Visby Marl, that the lowermost bed (1.1–1.3 m) accessible to Liljevall was actually the very base of the Upper Visby Marl, and that the lowermost rock sample (1.0 m) collected by Jaanusson and Skoglund was the uppermost bed of the Lower Visby Marl. Despite the shortage of time, various contributors managed to identify the shelly fauna recovered from the Lower Visby samples and the new data have been incorporated in the logs. The only group which has not been covered because of lack of time is the "non-palaeocope" ostracodes.

Sorting of the extensive material presented unexpected problems, not least because of the frequent occurrence of individuals of several groups on a single specimen or slab. The patience of many contributors was sorely tested because of repeated receipt of additional specimens up to the dead-line or even after their manuscript had been submitted.

The main results are presented in the form of logs showing the levels from which a species has been recorded in the section. In Liljevall's collection the precision of data on the level varies from one centimetre to several metres, although cases in which the precision is less than 20 cm are infrequent. For an analysis of faunal changes in general and faunal dynamics in particular it is

important that the entries into the logs are systematic and that differences in the precision of base data are clearly indicated. For the Vattenfallet section the minimum vertical interval entered into the logs was chosen to be 20 cm; that is, irrespective of whether the level was originally given with a precision of one, five or ten centimetres, the occurrence is entered into the logs as an interval of 20 cm. A minimum interval of ten centimetres would have been more satisfactory, but in view of the average precision of the collecting the increase in precision would have been largely illusory. Occurrences recorded with a precision of equal to or greater than 20 cm are marked on the logs as black quadrangles. If the precision is between 20 and 100 centimetres, the corresponding interval is drafted as an open rectangle. With a few exceptions, records with a precision of less than a metre are not used; however, if these data contribute to the vertical range of the species in the section, they are recorded in the annotated faunal or floral list.

Final drafts of all logs were compiled by Jaanusson based on lists of taxa and levels submitted by the contributors or, in a few cases, on the logs prepared by authors themselves. That the entries of all data into the logs should be made centrally proved necessary, since otherwise a uniform presentation would have been difficult to accomplish.

For several groups of organisms in the Wenlockian of Gotland modern monographic descriptions were either available or in an advanced state of preparation. For some additional groups there existed reliable old monographic studies which could be easily updated. The rest of the Wenlockian fauna and flora of Gotland has never been properly described, or even in some cases never recorded. For such groups, as well as in cases where the state of preservation was sufficient for recognising differences between species but insufficient for identifying described species, an extensive use of open nomenclature was necessary. For taxa of species category which could not be named the letters *a, b, c,* etc. are used to designate the species. This is done in order to facilitate the recognition of the species when subsequent monographic studies might provide a formal name. The designation sp. indet. *a, b,* etc. implies that although the specimen is not identifiable at the species level, it cannot possibly be identical with any of the other species recorded in the log. The abbreviation sp. without a letter is normally used if there is some doubt as to whether or not several different species might be involved in the material. Conditional identifications with a confer (cf.) are recorded in the logs with a question mark.

In the logs, an arrow indicates that a species is known above or below the sequence of the section. However, for many species the range is still poorly known and the lack of an arrow does not necessarily imply that a species does not occur in adjacent beds. For supraspecific categories (recorded as sp. or spp.) such information is normally omitted.

For references in this chapter see the list of references at the end of this volume.