LOCALITY DESIGNATIONS IN OLD COLLECTIONS FROM THE SILURIAN OF GOTLAND

By

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The Silurian bedrock is exposed on Gotland in hundreds or even thousands of localities, ranging from high and extensive cliffs to shallow temporary ditches and patches of bare rock on the surface. The smaller and ephemeral exposures are important in areas where outcrops are few. The problem has been to define and name localities in a consistent manner, to enable the same designation to be used for a particular locality by every scientist who collected fossils or samples.

On Gotland, collecting of fossils for scientific purposes goes back to Bromell (1738) and Linnaeus (1745), but for many years "Gotland" was deemed satisfactory as information for the source of the material. This is true for most collections made on Gotland during the first half of the nineteenth century, for example the extensive macrofossil material brought home by Gabriel Marklin (1777-1857) which is now housed in the museum of the Department of Palaeontology, Uppsala University. Nils Petter Angelin (1805-1876), Head of the Department of Palaeontology at Riksmuseum between 1864-1876, was also careless with regard to locality information in his collections from Gotland. The situation improved when Gustaf Lindström (1829-1901) entered the scene. Lindström, a native of Gotland, was not only an outstanding collector of fossils since his early youth, but he obviously acted as a coordinator for much of the field work on Gotland, at least until the Geological Survey of Sweden started mapping the island in 1892. He was a resident of Gotland until his appointment as Head of the Department of Palaeozoology at Riksmuseum in 1876, and he became while still young the leading specialist on the Silurian fauna of Gotland. Several people assisted Lindström in collecting, especially Anton Florin and Georg Liljevall.

At that time fossils from Gotland were collected mainly for palaeontological purposes. For this reason the localities preferred were those that yielded abundant, well-preserved material. In 1857, Friedrich Schmidt (1832-1908), then 25 years old, accompanied his three years older friend G. Lindström and E. Walmstedt on a collecting tour of Gotland, and his report of the trip (Schmidt 1859) gives a fairly good concept of the collecting strategy. Only selected, richly fossiliferous localities were visited, but each major exposure was investigated for a considerable time, mostly three days. Schmidt, who had almost completed the manuscript of his important paper on the Ordovician and Silurian stratigraphy of Estonia (Schmidt 1858), and whose primary interest on this trip was stratigraphical, was dissatisfied with the lack of opportunity to examine palaeontologically less attractive but stratigraphically important outcrop areas.

Notes in G. Lindström's preserved pages of his field diary reveal that his coverage of exposures which existed at that time on Gotland was extensive and fairly detailed. However, the main collecting strategy which prevailed for a long time appears to have been similar to that recorded by Schmidt. As a result, G. Lindström and his associates assembled an immense quantity of macrofossils, but the collections are characterised by emphasis on key localities, such as Norderstrand, Kyrkberget (Visby), Lansa, Alnäse, Stormyr kanal, Lergravsberget, Klints klint, Bara backe, Tjelders, Västergarn, Djupvik (Eksta parish), Mallgårds klint, Stenbroå, Linde klint, Petesvik, Bursvik, Gannviken, Stockvikens kanal, and Klev. Each locality was exploited for macrofossils over many years. The main localities near Lindström's home in Fardhem parish, such as Visne myr kanal and Sandarve kulle, are represented by especially voluminous material. The localities mentioned above are purposely ones whose names differ from current usage or which are not listed in the index of Gotland localities (Laufeld 1974). In addition, there are many old key localities whose designation is still familiar, such as Gnisvärd, Hallshuk, Västös, Lutterhorn, Samsugns, Storugns, Bogeklint, Lerberget on Stora Karlsö, Gandarve (Dalhem parish), Fjäle, Gothemshammar, Lau backar (earlier also termed Lauberg), and Klinteberg. Such localities are not considered further in this paper.

It is seldom realised that some exposures which have been popular for collecting fossils are from a comparatively late date. This is especially the case with outcrops in drainage ditches. The localities recorded by Lindström (1885) for Gotland trilobites include only three drainage ditches: Vestös kanal, Stormyr kanal (Rute parish) and Visne myr kanal; almost all other major ditch exposures are later. Lau kanal (Gannor 1-3) came into being by the deepening of Närså brook for drainage of Sumpträsk in around 1890. Lindström, for example, never had the opportunity to visit this outcrop (Munthe 1902:229). Hörsne kanal, immediately south of Hörsne church (Hörsne 1-6), was blasted into bedrock still later, probably around 1905. Mästermyr kanal is also fairly late because old geological field maps do not indicate any exposures along that part of Snoderå.

In his important paper on the Silurian stratigraphy of Gotland, Hede (1921) was critical of the use of old collections for stratigraphical purposes, and decided to rely only on his own material. Old collections are in fact seldom suitable for detailed stratigraphical or ecological studies because the material was normally not collected for these purposes. The main importance of old collections is to provide an indispensable base material for taxonomic and morphological studies, not least because these collections include material from outcrops which no longer exist or where the rock is now poorly accessible for collecting macrofossils. Owing to the large sample size from many old key localities, the material also includes rare species. The collections also enable the information published in earlier papers to be updated and brought into accord with the current level of taxonomic precision. In explanations to various geological map-sheets of Gotland Hede published lists of fossils from a great number of localities. However, in the collections at SGU and elsewhere there appears to be surprisingly little material to document his identifications. Without documentation the value of Hede's lists of fossils is limited, because the modern taxonomic precision differs greatly from that of Hede's time.

Research into the Silurian sequence of Gotland intensified greatly from around 1955 and soon indicated the need for a system of

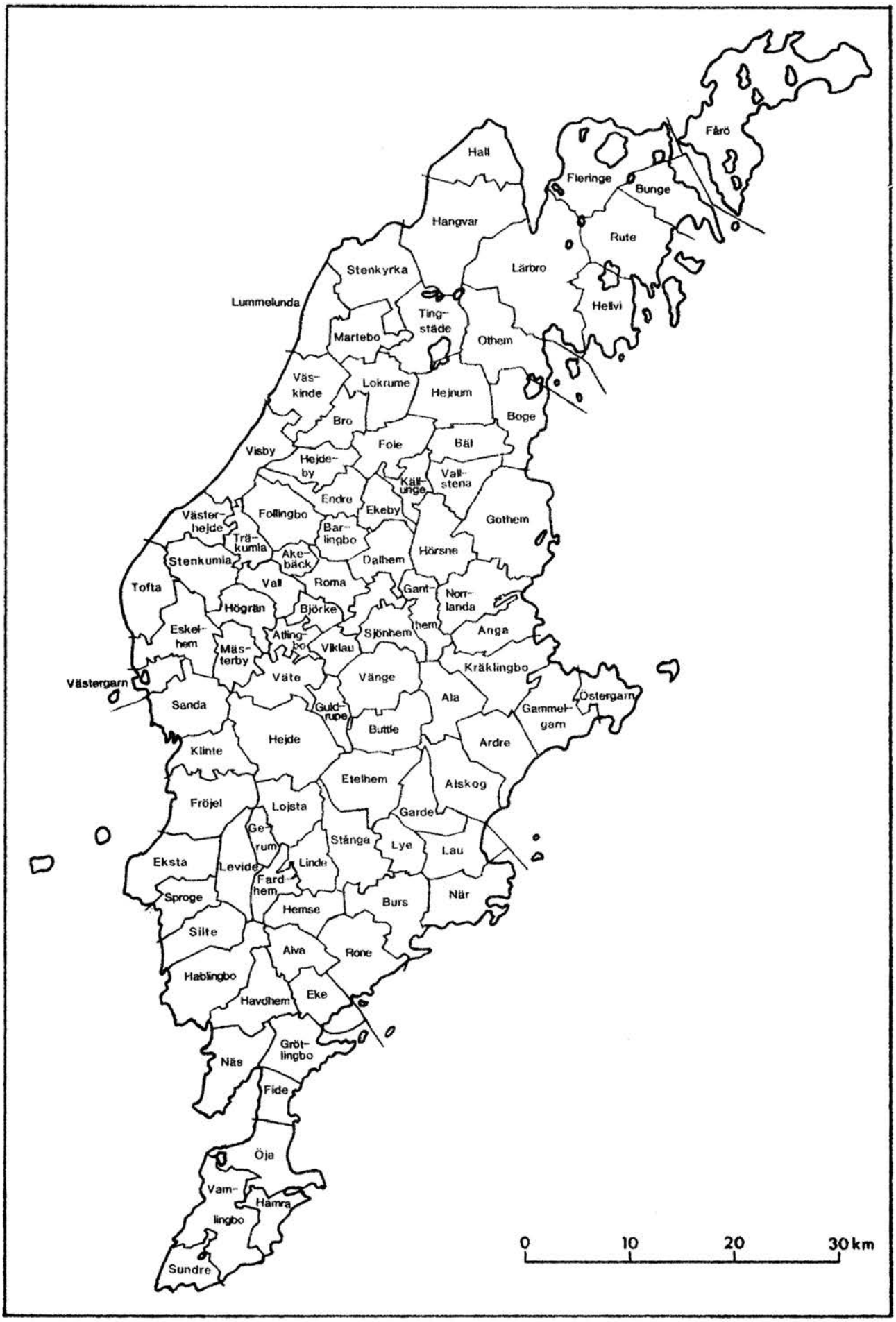

Fig.1. Parishes on Gotland.

unambiguous code names for localities. The first attempt in this direction was made by Martinsson (1962). A comprehensive list of code names for localities was presented by Laufeld (1974), subsequently complemented by Larsson (1979) and others. The advantage of code names is not only that each exposure is given an "official" designation, but also that it requires definition of the localities in terms of SNG and UTM grid references.

The introduction of code names caused some complications. In several cases the new designations differ from those which had been in long and accustomed usage and which designate the locality for thousands of specimens in museum collections. Some of the discrepancies, such as Sandarve instead of Sandarve kulle, Linde instead of Linde klint and Hörsne instead of Hörsne kanal, appear quite unnecessary because the latter, accustomed names define the location more precisely than the new code names. Moreover, experience shows that, in order to avoid misunderstanding, names of parishes, such as Linde, Hörsne or Vallstena, should be used very restrictively for locality designations unless further specified.

In earlier collections from Gotland, both at Riksmuseum and SGU, the locality name is accompanied by the name of the parish within which the locality is situated. Parishes (Fig.1), as used for collections, are historical administrative units with fixed boundaries which are marked on geological and topographical maps, and an advantage of adding their name is to supply immediate information as to roughly where on Gotland the locality is situated. In the list of reference localities (Laufeld 1974 and others) the distance of the locality from a church is normally given for purposes of orientation, but occasionally the church referred to is from a neighbouring parish. This has already caused misunderstandings. It would be advantageous if the practice of adding the name of the parish to that of the locality be continued.

The purpose of this paper is to explain a number of locality designations which appear on labels in old collections. Emphasis is put on exposures which have yielded appreciable collections of macrofossils. Many of the old locality names were used in a broader sense than modern code names, where even roughly continuous exposures are commonly subdivided into several separate localities (e.g., Alby 1-6, Hörsne 1-6 and Juves 1-4). Moreover, 100-150 years ago the extent of an exposure may have differed from that at the present time. For this reason, an exact comparison of many old localities with those defined in the lists of code names is difficult or even impossible. Additional problems arise in cases where the old designation was consistently used in the sense of composite locality, for example for a group of quarries (such as Bursvik or Gannviken) or for long stretches of shore outcrops (such as Lansa, Djupvik or Petesvik). However, stratigraphical resolution is more important than topographical, and in many such cases the former can be defined with acceptable precision. Problems arise particularly with localities on the main north-eastern cliff of Gotland, where lack of stratigraphical information decreases the value of the material although the location of the exposure may be defined with high precision.

The sites of the key collecting localities on Gotland in last century, as well as their customary designations, were apparently well known to contemporary collectors of fossils, but this knowledge disappeared successively through the first half of the twentieth century. The location of some important old localities, such as Lansa, Alnäse,

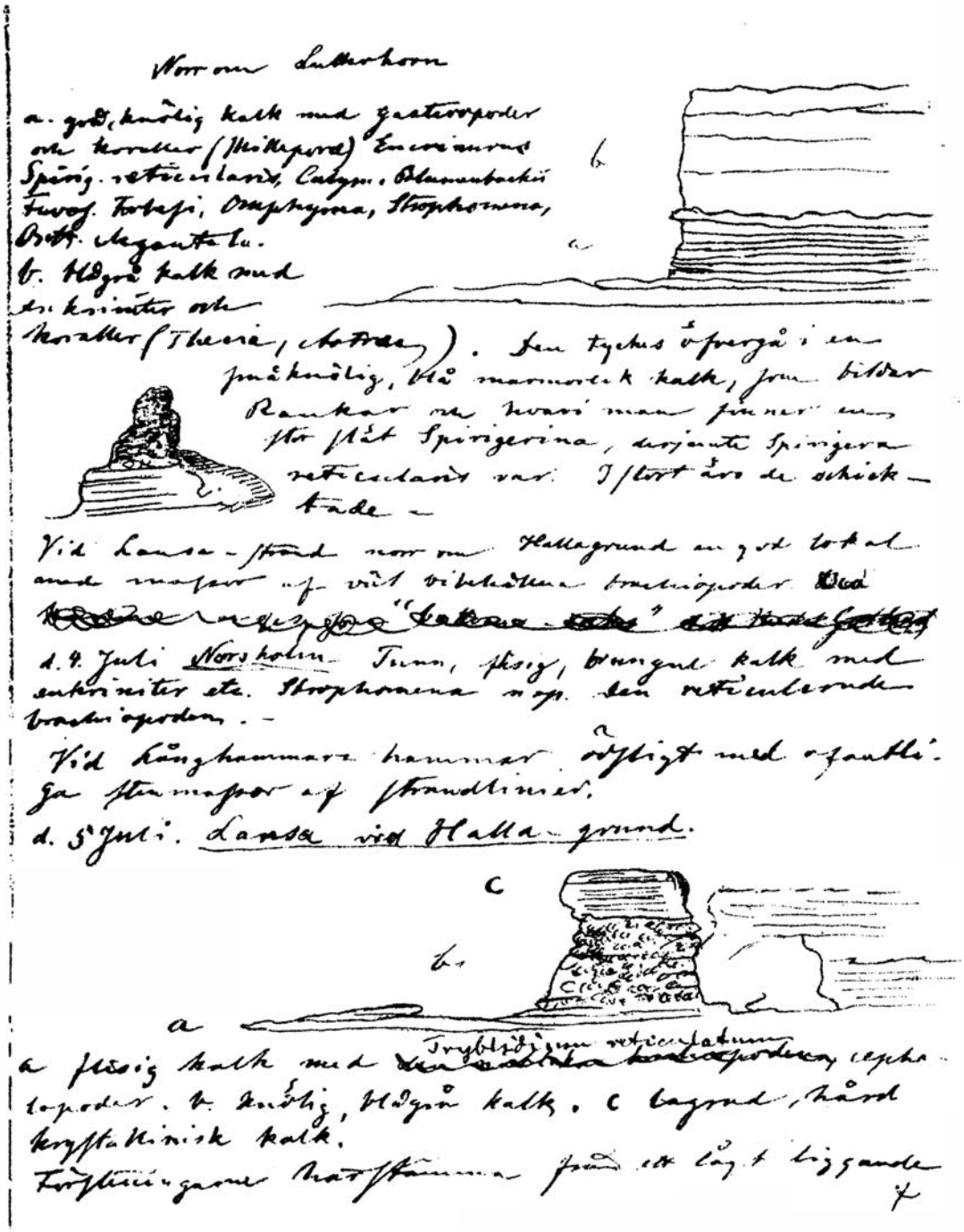

Fig.2. A page from G. Lindström's field diary of 1860.

Tjelders and Västergarn, was no longer known, and information on several other localities was vague. The main task for this paper was to find information which would enable the location of the old localities to be defined with some precision, preferably in terms of grid systems. Search for pertinent information in published sources disclosed some data. G. Lindström's field diary and manuscript notes proved useful for understanding the concept of some old localities. The diary includes references to a field map but this could not be located. Unfortunately, G. Lindström preserved only selected pages of his diary; those dated are from 1852 and 1856-1860. G. Holm's field diary of 1898 also proved useful, and a few pertinent references were found in field diaries of other geologists employed by SGU. G. Holm's field diaries of 1901-1905 should contain interesting information but these could not be located. Holm's field maps were an important source for the exact location of a number of localities.

Because of difficulties in translating the information on old localities into modern terms, I suggest that these two sets of locality designations should not be integrated, except in cases where the two are probably the same. This implies that a locality number should normally not be added to the old locality designations. Instead, it would be useful to add the letter "G" (from Swedish gammal, meaning old) after the name of the old locality in order to avoid possible confusion between the old names and code names.

In the following list of old localities, modern Swedish spelling is used (e.g., Gannarve instead of Gannarfve and Västergarn instead of Westergarn) whereas Swedish texts are cited as they were written. The following abbreviations are used: CN, code name; CNL, locality with a code name; SNG, Swedish National Grid System; UTM, Universal Transverse Mercator Grid System.

LIST OF LOCALITIES

LOWER VISBY MARL

NORDERSTRAND, Visby. No CN. The location of this shore exposure is shown by Hedström (1912, Pl.1; the outcrop at the shore 600-1000 m north-east of the northern town wall of Visby), and is, in fact, also recorded on the geological map-sheet Aa 183 (Visby and Lummelunda). Grid reference: from SNG 639454 164902 (UTM CJ 3902 9326) to 639494 164923 (CJ 3928 9366). Hedström (1910:1464) described the general appearance of the outcrop. The locality has been covered and inaccessible for many years. Previously Norderstrand was the most prolific locality for collecting fossils in the Lower Visby Marl. In places, at low water level, bedrock is still accessible on the sea-floor just west of the former exposures (C. Franzen-Bengtson, pers. comm.), but rational collecting is hardly possible.

TALLUDDEN, Visby. Includes CNL Gustavsvik 1. For the former extent of this exposure see Hedström (1912, Pl.1).

VISBY A. In 1861 Lindström distinguished three subdivisions in his Visby Group - in ascending order a, b and c. Those agree fairly closely with Hede's (1921) topostratigraphical units Lower Visby Marl (=Visby a), Upper Visby Marl (=Visby b) and Högklint Limestone (=Visby c) (Hede 1958). The units are accessible in countless places along the

main north-western cliff of Gotland, and the two lower units are fairly uniform, both lithologically and faunally, along the whole outcrop belt. In old collections at Riksmuseum the material from each of the three stratigraphical units is occasionally lumped together without a locality name. "Visby a" denotes consistently the Lower Visby Marl.

UPPER VISBY MARL

S. OM KOPPARSVIK or, more exactly, S. OM KOPPARSVIK, NEDRE BRANTEN; Visby town and Västerhejde parish. The cliff along the shore from the southern end of Kopparsvik to Kneippbyn. The southern part of the cliff is the popular locality for Upper Visby Marl that is currently called N. om Kneippbyn, nedre branten, or simply Kneippbyn (no CN; includes locality 9 Kneippbyn, Mori 1969). On previous editions of the topographical map-sheets the name Kneippbyn was not given, which is probably why the location of the cliff was recorded with reference to Kopparsvik.

VISBY B. "Visby b" is Lindström's (1861) denomination for a stratigraphical unit which corresponds fairly closely to Upper Visby Marl (see also Visby a). However, the material in Riksmuseum labelled Visby b occasionally includes species which are known to appear in the Högklint Limestone, and thus "Visby b" is not quite unambiguous stratigraphically. Even for modern collectors it is not always easy to distinguish between the uppermost Upper Visby Marl and the lowermost beds that yield a Högklint fauna.

HÖGKLINT LIMESTONE

KYRKBERGET, Visby. No CN. Cliff immediately behind (east of) Visby Cathedral. Grid reference: SNG 639350 164890 (UTM CJ 3884 9223).

KRIST KLINT, Hall parish. No CN. According to an undated manuscript note by G. Lindström, Kristeklint is defined as "den låga väggen litet söder om Westöös Kanal".

LUMMELUNDA KANAL, Lummelunda parish. No CN. Stridsberg (1985:62, Kanalen) suggested that this designation may have referred to the farm Kanalen and not the drainage ditch. In 1898, G. Holm visited the locality with A. Florin, and from notes in Holm's field diary it is quite clear that the denomination "Lummelunda kanal" referred to this particular ditch. The contemporary extent of exposures in the ditch is shown on Holm's field map. From Holm's notes it is evident that exposures used for collecting were in Högklint Limestone, from the point where the main coast road crosses the ditch (SNG 165524 640480; UTM CK 4600 6344) to c. 500 m south-east. After a gap of about 300 m, bedrock in Tofta Limestone was exposed in the ditch eastwards as far as the road leading to the farm Kanalen. No exposures were recorded east of the farm. Subsequently the ditch was deepened, and exposures in the Tofta Limestone referred to by Hede (1940:35; CNL Kambs 1-3) are comparatively modern.

KULLSHAGE KANAL and HANGVAR KANAL, Hangvar parish. No CN. At the turn of the century there were substantial exposures of Högklint Limestone in three main drainage ditches between Hangvar church and Kullshage village. The location of the exposures is shown on Holm's field map. In 1896, A. Florin made substantial collections for Riksmuseum from

that area. At that time, the exposures in at least two of the ditches must have been fairly recent, because the topographical map-sheet issued in 1890 shows only the easternmost ditch ("Kullshage kanal"). In 1898 G. Holm visited, together with A. Florin, the two eastern ditch exposures, and in 1902 he revisited the area.

The easternmost ditch exposure appears consistently to have been termed Kullshage kanal. The exposure 0.2 km farther south-west was referred to by G. Holm as Kanal SV om Kullshage, and in his diary he noted that "lokalen är af Florin betecknad i Riksmuseum Hangvar kanal". The locality is notable for the abundance, in some beds, of Celticystis gotlandicus (Angelin) (Bockelie 1979), a fact recorded also in Holm's diary (although he believed the echinoderm to represent an echinoid). The western exposure, 0.6 km south-east of Lunds farm, was referred to by G. Holm as Hangvar kanal nedan Lunds, and its western part as Hangvar kanal V om Lunds bro. A. Florin's locality Hangvar kanal Cassle represents the same ditch exposure. Lunds farm belongs to Kassle village, and it is interesting to note that on some labels G. Holm had originally written "Hangvar kanal nedan Kassle" but then crossed over "Kassle" and written "Lunds". In and near Kassle village there were no other drainage ditches at that time. All three localities are marked on the geological map-sheet Aa 171 (Kappelshamn). Thus, there were three main exposures in that part of Hangvar parish:

(1) Kullshage kanal A. The ditch exposures extended about 50 m south and some 100 m north of the intersection of the ditch and the road from Kullshage to the south (SNG 167399 641640; UTM CK 6560 1315).
(2) Kullshage kanal B (Holm's Kanal SV om Kullshagé; Florin's Hangvar kanal). The exposures in the ditch extended about 50 m east and 100 m west of the intersection of the ditch and the road southwards from Kullshage (SNG 167390 641619; UTM CK 6548 1294).
(3) Hangvar kanal (Holm's Hangvar kanal nedan Lunds; Florin's Hangvar kanal Cassle). From the point where the road from Kassle southwards crosses the ditch (SNG 167306 641615; UTM CK 6465 1297), the ditch exposure extended some 200 m north-east and 150 m south-west.

SLITE BEDS

LANSA, Fårö. Includes CNL Stutsviken 1. In his field diary (July 5, 1860), G. Lindström described the locality "Lansa vid Hallagrund" in some detail. The locality begins in the north-west as a low cliff, 1-2 m high, at the shore (SNG 169225 642690), illustrated in section in the diary (Fig.2). "Försteningarna härstamma från ett lågt liggande tunnbandadt lager blå kalk. Söderut emellan fiskläget och Hallagrund ligger en hvitgrå hård kalk" (SNG 642679 169246) "med fragmenter af koraller, samt Tryblidium. Äfven den släta Spirigerina, sannolikt yngre än Lansa strandens brachiopodrika kalk. Straxt bredvid finnes en flisig kalk fylld med försteningar Cephalopoder, Lamellibranchier (5 arter), Calym. Blumenbachii, Lichas, Bumastus, Proetus, Leperditia, Crinoideer". The locality designated as Lansa thus comprised "limestone and shale beds along the shore" (Lindström 1884:10) which extend NW-SE from the cliff 250 m south-east of the tip of Hallagrund almost to Lansa Fiskläge. It included CNL Stutsviken 1. The full name of the locality was probably "Lansa fiskläge" or "Lansa sjöbodar", for convenience shortened to "Lansa". Hedström (1923) referred to the locality consistently as "Lansa sea-shore sheds", that is, fishing huts of Lansa village at the shore.

Last century, the locality Lansa was one of the favoured exposures for collecting macrofossils on Gotland. It is the type locality for several trilobite and brachiopod species. The sequence belongs to the Slite Beds (member c), except in places where the underlying topmost Högklint Beds are exposed close to sea-level. The possibility that collections from Lansa may include some material from Högklint Limestone should therefore be kept in mind.

G. Lindström (undated ms) recorded that "I skogen, ofvan stranden stenbrott med fingrynig kalksten, stromatoporaknölar, eljest inga synnerliga försteningar". Specimens from these closely spaced quarries (including CNL Lansa 1) were also labelled as coming from Lansa, but the lithology of the rock (Slite Beds, member e) is so different that this material can be distinguished easily from that collected along the shore.

ALNÄSE, Fårö. No CN. The composition and preservation of the material in Riksmuseum from "Alnäse" indicates that this old locality designation referred to a specific locality in the Rhipidium tenuistriatum beds and not to some poorly defined area adjacent to Alnäse träsk. In the field diary of July 5, 1860, G. Lindström recorded that "norr om Frigårds i grannskapet af Alnäse träsk i en myrlik äng ej långt från landsvägen anträffas Pentamerus Verneuili i lösa jorden, jemte åtskilliga koraller Cyathophyllum, etc. samt Spirif. cyrtaena". P. verneuili was subsequently (Lindström 1861: 365) referred to as "P. tenuistriatus Walmstedt in Mss.", with Alnäse as the only locality recorded from Fårö. The direction "norr om Frigårds" must be incorrect because it is incompatible with the location "ej långt från landsvägen". Also in some other places in his diary G. Lindström demonstrably confused north and east on Fårö. For example, the location of Lansa shore exposures was given as north of Hallagrund, but that direction points to the sea (it should have been east or, more exactly, south-east of Hallagrund).

In his field diary of August 20, 1882, N.O. Holst listed, based on information from Ludvig Fegraeus, "botten af en liten myr norr om St. Hoborg" as an important locality for collecting fossils on Gotland. This must be the same place reported by G. Lindström, and again the direction "norr om" is questionable. It should be noted that all other places listed by Holst are well-known key localities.

A more detailed description of this somewhat unusual locality is found in A. Hjalmar Olsson's field diary of 1914. On July 31, A.H. Olsson visited, together with G. Liljevall, "Pentamerus-förekomsten O om S:a ändan af Alnäs träsk", and made the following observations: "0.7 km Ö om Båta. Odlad myr med 0.2-0.6 m nytorf. I södra kanten af myren förekomma rikligt med stora och små Pentamerus. Hällen närmast myren på S:a sidan består af en fragmentkalkartad kalk, med pall i myrkonturen på c:a 0.25 m. Det är i undre delen däraf Pent. förekommer". The small bog referred to is marked on the geological map-sheet Aa 180 (Fårö); its southern end is at SNG 642860 170035 (UTM CK 9275 2330). As recorded by Lindström, the locality is situated "not far from the main road".

The old locality Alnäse has yielded hundreds of articulated specimens of Rhipidium tenuistriatum and many other fossils to various museums. Specimens in Riksmuseum collected by G. Liljevall from the same locality are labelled as coming from "Liten myr OSO om Båta".

LERGRAVSBERGET, Rute parish. Includes CNL Puttarsjaus 1-2 and the locality 41-Lergravsviken of Mori (1969).

STORMYR KANAL or KANALEN FRÅN STORMYR, Rute parish. CNL Alby 1-6.

KLINTS or KLINTS KLINT, Othem parish. CNL Spillings 1-2. It should be observed that this is a quite different locality from CNL Klintsklint 1 in Gammelgarn parish.

KANAL N OM TJELDERS, Boge parish. CNL Vike 1.

TJELDERS, Boge parish. No CN. Schmidt (1859:434) described the exposure as follows: "In der Nähe des Hofes Tjelder, links am Wege" (as he approached the locality from the south, this means west of the road) "auf etwa 30 Schritt Ausdehnung /steht/ eine 10 Fuss hohe Entblössung aus festem, grauem Kalk, mit untergeordneten Mergelschichten an". It is evident that Schmidt was describing the inland cliff at Norrgårda, somewhat north of Tjälder (SNG 639383 167652; UTM CJ 6638 9046). The locality Tjelders in van Hoepen (1910:79) refers to the same place. The exposure was described by Hede (1928:30) who also gave a short list of fossils. Hede called the hill Spinnbjersbacke, but on the modern topographical map-sheet this name refers to another hill, 2 km west of Tjälder.

The amount of material in Riksmuseum indicates that "Tjelders" was formerly among the most popular localities for collecting macrofossils. The collections include a few specimens of Pentamerus gotlandicus. The name Tjeldersholm is not on earlier editions of the topographical map-sheet (even Hede 1928 does not use the name), and this caused problems in naming the shore exposure (CNL Tjeldersholm 1). It is probable that Lindström's locality "stranden i Boge" or "the shore of Boge" refers to Tjeldersholm.

HEJNUM KALKBROTT or BJERS I HEJNUM, Hejnum parish. No CN. In his field diary of 1898, G. Holm described the locality in some detail. "I skogen på backsluttningen Ö om Bjers här och der små gamla stenbrott grupperade omkring en gammal kalkugn. Hård hvitbrun tätare eller kristallinisk kalk. c). De högsta lagren bildar inåt stora hällflak. Hård, tät. b.) De mellersta lagren straxt nedom kalkugnen innehålla fossil Cephalop., Trimerella, Megalomus, Gasteropoder. Kalken något rödaktig, stundom kristallinisk. Den påminner om Cephalopodkalken vid Skrubba. I Riksmuseum mycket från detta lager sändt af Florin under lokal "Hejnum kalkbrott". a) Medelkornig brunhvit kalk brytes, nu inga andra fossil än Stromatopora sågos i öfversta lagret". The group of quarries mentioned by Holm is not marked on the geological map-sheet Aa 169 (Slite). The position of Holm's reference number (101) for the locality on his field map indicates a place 600-700 m directly east of the main road from Tingstäde to Bäl, opposite the name of the village "Bjers" on the geological map-sheet. This is obviously the locality "Bjers i Hejnum" recorded by Lindström (1890:5) as one of the localities particularly rich in cephalopods.

VALLSTENA KANAL, Vallstena parish. CNL Vallstena 1-2.

BARA BACKE, Hörsne parish. No CN. This well-known locality (Lindström 1861:353; Hede 1928:33, with a list of fossils) is a prominent hill (Munthe et al. 1928, fig.5) formed by Slite reef limestone (SNG 638790 166752; UTM CJ 5696 8522). The quarry CNL Bara 1, type locality of the Bara Oolite, presumed to form the base of the Halla beds, is at the foot of the hill to the south.

MYRSJÖ KANAL, Stenkumla parish. Includes CNL Myrse 1. According to G. Holm's field map the exposure in the drainage ditch extended 150 m north and 50 m south of the road.

ROMA KANAL, Roma parish. No CN. The ditch for drainage of Stormyr was blasted into the bedrock about 1 km south of the ruins of Roma monastery (SNG 637885 165926; UTM CJ 3266 6285), exposing beds with Pentamerus gotlandicus. Hede (1927a:29) referred to the locality as "kanalen 375 m ONO om Roma järnvägsstation". The location of the exposure is shown on the geological map-sheet Aa 160 (Klintehamn).

ATLINGBO KANAL, Atlingbo parish. No CN. Previously the drainage ditch 1.5 km south-west of Atlingbo church was one of the best exposures of beds with Pentamerus gotlandicus. From the point where the small road running northwestwards at Lilla Atlings crosses the ditch (SNG 637506 165354; UTM CJ 4802 7684), the exposure extended about 150 m to both north-east and south-west. There were also some smaller exposures farther south-west in the ditch. Hede (1927a:29) referred to the locality as "kanalen resp. 900 m SSV, 600 m SSV och 525 m SSO om L.-Atlings (norra) i Atlingbo". The extent of the exposures in the ditch is shown on geological map-sheet Aa 160 (Klintehamn).

VÄSTERGARN, Sanda parish. CNL Valbytte 4. It was known that G. Lindström and his contemporaries must have used the designation "Westergarn" not for the parish but, unless followed by further specifications, as a designation for a specific exposure, or possibly several adjacent exposures, situated at the shore. Lindström (1884:9) described the locality as "low shale beds uncovered along the shore line, rich in fossils". In his manuscript notes he also consistently referred to "Westergarn" as a shore exposure. However, Lindström did not give any hint of the location, probably because this was regarded generally known. The material collected from the soft Slite marl at "Westergarn" is voluminous, indicating that the outcrop must have been substantial. Lindström (1882) discussed the composition of the fauna and provided a list of species; the material upon which the list is based is in Riksmuseum collections. The problem was that in Västergarn parish no shore exposure is known. Moreover, experience with other shore exposures on Gotland indicates that such an exposure could hardly have disappeared without trace.

In 1898, G. Holm examined the coast between Djupvik and Gnisvärd in some detail and did not record any shore exposure on the mainland of Västergarn parish. However, he reported that "Något S. om Valbytte Fiskläge (vid södra ändan af Vestergarns by) strandhällar af mergelskiffer med tunna kalkskikt. Mergeln blågrön, fin. Som det nu var högvatten kunde endast något enda tunnt kalkskikt ses i vattenbrynet men vid lägre vatten lära större hällar vara blottade". It should be noted that the position of the locality makes reference to Västergarn village, and this explains the concept of Lindström's "Westergarn". Västergarn village extended southwards along the main road to Klintehamn across the boundary between Västergarn and Sanda parishes, and continued 750 m into the latter. The shore exposure described by Holm began opposite the southern end of the village and continued, according to Holm's field map, 600 m southwards. The locality was named after Västergarn village but is in Sanda parish. The shore exposure is still there and may not differ much from Lindström's time. It was recorded as CNL Valbytte 4 (Ramsköld 1983:177). The marl is best exposed, mostly at the strand-line, along about 200 m, some 300 m from the northern end of the outcrop as marked

on Holm's map southwards.

VÄSTERGARNS UTHOLME, Västergarn parish. Utholmen is a small island 3 km west of Västergarn church. Lindström's collection in Riksmuseum includes specimens with this locality designation, derived from a soft Slite marl similar to that from his locality Västergarn. There are also some specimens with labels written by N.P. Angelin. In his field diary of 1915 (Aug. 15), Henrik Munthe provided a short description of the bedrock of the island. "Holmen, hvars "kärna" tydligtvis utgöres af märglig kalksten - denna anstår med all sannolikhet strax utanför stranden å öns W:a, SW:a, S:a och SÖ:a delar, ty där strandgruset bestående öfvervägande af denna bergart". Thus the fossils were probably collected from shingle on the beach derived from seafloor exposures of the marl. It is possible that at extreme low water levels the marl became exposed at the strand-line along the southern and south-western shore of the island.

KANALEN SO OM KLINTEHAMN, Klinte parish. No CN. Around the turn of the century, the brook which runs through Robbjäns kvarn (also called Klinte kvarn) was deepened, and between the mill (or CNL Robbjäns kvarn 1) and the main road from Klintehamn to Klinte church in places cut down into Slite marl. The locality comprised the ditch from the point where it makes a sharp turn towards south-east (SNG 164442 636429; UTM CJ 3214 6344) to a point about 300 m farther south-east. The ditch exposure is marked on Holm's field map in Riksmuseum (locality 1020) and on the geological map-sheet Aa 180 (Klintehamn). The locality has yielded Pentamerus gotlandicus, and Hede (1927a:29) referred to it as "kanalen 700 m SSO om Klintehamns järnvägsstation". The exposures in the ditch are overgrown, and practically no rock is now accessible for collecting.

DJUPVIK NEDANFÖR STENSTUGU, Fröjel and Klinte parishes. No CN. Lindström (1861:343) reported that "vid Djupviken nedanför Stenstugu i Fröjel anträffas fossilier i större mängd... I öfvervägande mängd förefinnas här Spirig. compressa? hvilken jemte Cyathaxonia siluriensis ger lokalen sin karakter". In an undated manuscript G. Lindström noted that "Allra innerst i Fröjels Djupvik ligger spårstenslagret med graptolitskiffer (Monograptus Ludensis). Mergelskifferns och spårsandstenens karakterer äro blandade nära nog i samma stuffer". On his field map, G. Holm marked a shore exposure from the north-western shore of Juvik (=Djupvik) to a point c. 600 m north in Klinte parish. The rock was characterised as "tunna skikt af merglig knölig kalk". The exact location of Lindström's locality "nedanför Stenstugu" is difficult to determine, but it may have comprised the southern part of the shore exposure in Slite marl recorded by Holm. The composition of the fauna indicates beds comparable to those exposed immediately below the Slite siltstone at CNL Svarvare 1, where Glassia is also common.

GANNARVESKÄR, Klinte parish. No previous CN. Lindström (1861:343) described the locality as follows: "Vid vikens" (=Gannarveviken) "södra strand uppträder på en utskjutande landtunga, kallad Skäret, en sandhaltig kalkskiffer med flera egendomliga försteningar". In the description of fossils the locality is called "Skäret nedanför Gannarfve i Fröjel". The small peninsula is shown on Lindström's (1861: Pl.14) map. On labels the locality is almost invariably written as Gannarfveskär (misspelt as "Gannarfleskar" by Bassett & Cocks 1974:28). Although commonly referred to as belonging to Fröjel parish, the peninsula is in fact situated within an enclave of the Klinte parish. Gannarveskär is the type locality of Plagiorhyncha cordata

(Lindström, 1861) and Streptochonetes cingulatus (Lindström, 1861). Recent examination of the area by L. Ramsköld revealed that the locality still exists, and it is defined by him here as CL Gannarveskär 1.

GANNARVESKÄR 1 (new CN), Klinte parish. SNG 636100 164235 (UTM CJ 2982 6034). Low cliff section along the western shore of Skäret. The locality includes the exposure of Slite siltstone from the north-western tip of the peninsula to a point 100 m SSW.

VÄRSÄNDE, Klinte parish (Lindström's collection). CNL Mulde 1. In his manuscript notes (undated) G. Lindström gave the following information. "Vid Värsände strandvägens utmynning i stora landsvägen till Klintehamn ligger flisig kalksten med försteningar af samma slag som vid Skäret i Fröjel: Atrypa cordata i betydande massor, men klämd och tryckt, Chonetes cingulata. Lagren stundom sandstensartade. På somliga ytor långa, smala spåraftryck". The location of the exposure is the same as CNL Mulde 1.

MULDE MARL

GANNARVESKÄR 2 (new CN), Klinte parish. SNG 635980 164265 (UTM CJ 2980 6013). Small exposure of argillaceous limestone at the strand-line of the small bight which faces south-west on the western side of Skäret, 100 m south of Gannarveskär 1. The limestone appears to belong to basal beds of the sequence overlying Slite siltstone, but its topostratigraphical classification requires further study.

The exposure is interesting for a particular reason. In the old collections at Riksmuseum there are numerous specimens of a distinctive, large sphaeriorhynchiid brachiopod. Most of the material has no locality information other than Gotland, but some is labelled as coming from Gannarfveudde. The labels were written by N.P. Angelin, and the specimens were apparently, in part at least, collected by him. Lindström (1861) did not record the species, and his collections lack this brachiopod. The provenance of this unusual form was something of a mystery until, in 1985, L. Ramsköld rediscovered the exposure and found it to contain the species. It is possible that formerly the exposure was more extensive, at least temporarily.

DJUPVIK, Eksta parish. Includes CNL Blåhäll 1 and Djupvik 1-2. According to Lindström (1884:9) "there is a long stretch of the coast comprised under this denomination from the northern shore of Skäret in Fröjel to the shore south of Djupvik, being of almost the same soft, blue shale with a large number of fossils of all orders. It is interrupted by the peculiar "calcareous shale" (kalkstensskiffer HISINGER) which, intermingled with sandy slates occupies the shore around Skäret and contains a great number of curious tracks, besides fossils of a fauna distinct from that of the neighbouring shores". According to this description the "locality" Djupvik is defined very broadly, comprising not only Djupvik in the accustomed sense but also the bay which on earlier editions of topographical maps was spelled Juvik or Jauvik (these names are different spellings of the same name which means "deep bay"; Juvik was spelled Djupvik on Lindströms map of 1861, Pl.14). The distinction between the two "Djupviks" was made by reference to the parish. The northern Djupvik ("Juvik") is situated in Fröjel parish (see the locality "Djupviken nedanför Stenstugu"). In the collections, the distinction between this Djupvik and "Djupviken i Eksta" does not present any difficulties.

The famous locality which was customarily termed Djupvik is situated in Eksta parish and was described by Lindström (1861:344) as follows: "På ömse sidor om Djupviken i Eksta sträcka sig låga klippväggar mot norr in i Fröjel och mot söder ner till Wafle fiskläge. Hafvet, som alltjemt undergräfver dem, utsköljer de inneslutna försteningarna och gör derigenom denna strand till en af de rikaste fyndorterna på Gotland" (see also Schmidt 1859:430-431). Thus the old locality Djupvik in Eksta, the type locality of many species, comprised exposures at the shore which extended for at least two kilometres and included CNL Blåhäll 1 and Djupvik 1-2. The whole sequence is within Mulde Marl.

KLINTEBERG LIMESTONE

MALLGÅRDS KLINT, Levide parish. No CN. Lindström (1861:348) reported that "i den norra skogsbevuxna delen av Lefvede framstryker en låg kalkvägg, kallad Mallgårds klint, i nordlig och sydlig riktning. Dess kalk liknar fullkomligt Klintebergets, och man har här samma försteningar med tillägg af en obestämd, slät Spirigerina." Lindström's collections from Mallgårds klint include several specimens of this smooth atrypacean.

DIKE MELLAN STJERNARVE OCH LEVIDE or ÖSTER OM STJERNARVE EKSTA VID LANDSVÄGEN, Eksta parish (Lindström's collection). No CN. In an undated manuscript note, G. Lindström reports that "Vid Stjernarve i Eksta i ett dike öster om gården vid stora landsvägen åt Levede. Gråaktig kalksten". The locality has yielded Conchidium biloculare and other fossils. The exact location of the ditch exposure is difficult to determine because it is not known to which farm Lindström refers, nor the distance of the ditch from the farm. However, its location is within a fairly limited area.

HEMSE BEDS

HAMMARUDD, Kräklingbo parish. CNL Garnudden 1. Schmidt (1859:48) reported that "an der Spitze Hammarudd selbst sahen wir einen Stromatoporen und Syringoporenkalk mit Zwischenschichten eines dunkelgrauen Mergels... überfüllt von Rhynchonella diodonta". See also Lindström (1861:355).

DJUPVIK VID HAMMARS, DJUPVIK Ö. OM L. HAMMARS or occasionally simply DJUPVIK, Kräklingbo parish. CNL Djaupviksudden 1. The locality where Balteurypterus (B. n.sp. according to the late Erik N. Kjellesvig-Waering, personal communication) was discovered on Gotland. Schmidt (1859:48) reported that "kurz vor der Spitze von Hammarudd werden die Platten weisslich und ärmer an Petrefacten... Hier entdeckte ich... den Eurypterus remipes".

BOTES KULLE, Etelhem parish. No CN. A small hill c. 100 m west of Botes' farm (SNG 635943 166093; UTM CJ 4820 5737), exposing Etelhem Limestone. The locality, which is about 1250 m ESE of Etelhem church, was referred to by Hede (1927b:27).

LINDE KLINT, Linde parish. Includes CNL Linde 1 and 2. The hill is called Lindeberget on the modern topographical map-sheet.

STENBROÅ, Silte parish. Proposed CN Kvännakershamn 1. SNG 634592

164205 (UTM CJ 2836 4536), c. 4850 m west of Silte church. Stream section just west of the bridge across Snoder å, including exposures immediately west of the dam, c. 50 m west of the bridge (L. Ramsköld, personal communication).

Lindström (1861:344-345) described the locality as follows: "Det är icke förr än vid Stenbro-åens utlopp som nya lager framträda... Stenbroåens södra arm inneslutes af vid pass 12 fot mägtiga kalkvallar, bestående af småknölig, tunnskivig kalk, af blågrå färg och stundom mergelartad. Den är i allmänhet fattig på försteningar...". The outcrop is marked on the geological map-sheet Aa 164 (Hemse) along the southern branch of the river close to the outlet. The river was formerly called Stenbroå (see Lindström 1861, Pl.14) but is now Snoderå.

MÄSTERMYR KANAL, Silte and Sproge parishes. Includes CNL Snoder 1-3 and, possibly, Eske 1. Along much of its course the ditch runs along the boundary between Sproge and Silte parishes, but it is mostly within Silte parish. On museum labels the reference to Sproge parish may not always be correct. The term "Sproge kanal" was occasionally used as a synonym of Mästermyr kanal. Hede (1927b) referred to the ditch as Mästarmyr-kanal.

OCKSARVE, Hemse parish. Includes CNL Likmide 1. Outcrops in this brook existed already in Lindström's time. He reported (1861:346) that "i en genomskärning vid Oxarfve å, norr om landsvägen, ser man en tunnflisig, knölig kalk... Under denna kalk ligger en djupt blå, fin, tunnskivig lera med svarta, alglika aftryck, fullkomligt liknande en dylik bildning vid Petesviken". Even in fairly recent collections the locality is consistently termed Ocksarve.

VISNE MYR KANAL, Fardhem parish. Includes CNL Gerete 1. "In the same parish of Fardhem there is an extensive canal cut through a moorland, Wisne myr, lying open a fine section of the shale for nearly half a Swedish mile" (Lindström 1884:10). The distance is exaggerated, because according to the geological map-sheet Aa 164 (Hemse) where the extent of exposure along the ditch is shown, it could hardly have exceeded 2 km. Visne myr kanal was one of Lindström's favourite localities, and he obviously collected there over many years.

SANDARVE KULLE, Fardhem parish. CNL Sandarve 1-3.

PETESVIK, Hablingbo parish. No CN. The earliest description of the locality is by Schmidt (1859:437): "Zunähst haben wir... ein Mittelglied... in den blaugrauen Mergeln, die sich einige Werste weit an der Petesvik, im Kirchspiel Hablingbo, hinziehen. Das anstehende Gestein erhebt sich kaum 1-2 Fuss über das Meeresniveau; ist aber vorzüglich zum Petrefaktensammeln geeignet, indem, durch die häufige Einwirkung des überschwemmenden Meerwassers, die Petrefakten aus dem umgebenden Gestein sich lösten und nur aufgesammelt zu werden brauchen." Lindström (1861:345) provided additional information: "Vid (Petesvik)... har man en liknande kalk, hvars skiktytor ligga blottade öfver stora sträckor af den flacka stranden... Anmärkningsvärdt är det inskränkta område, inom hvilket åtskilliga arter här förekommer. Spirif. plic. var. interlineata träffas endast på en viss punkt på vikens södra sida och Spirif. exporrecta på den norra". On Sept. 6, 1898, G. Holm visited the locality and described the exposure briefly in his field diary. "Hela stranden från Ljusskär (?)" (= Laxskär) "till utgångspunkten af Skinds långref mycket låg långgrund och lång samt uppstigande mergelskiffer med tunna kalkplattor. Detta

är den fordom så rika fossilfyndorten af ursköljda saker på stranden, som är betäckt af smått kantigt lerigt grus af den underliggande hällen". Van Hoepen (1910:41-42) reported that "aan de Petesvik komt overal vast gesteente aan de oppervlakte, doch alleen in het zeeniveau... Het zuidelijk gedeelte van de baai si betrekkelijk fossiel-arm, het middengedeelte is zeer rijk aan vesteeningen, terwijl het noordlijke stuk weer armer is". Hede (1921:61) provided a list of species from "den klassiska lokalen vid Petesvik i Hablingbo". Subsequently the locality began successively to fall into oblivion. In the description of Hemse map-sheet (Hede 1927b) the shore exposure at Petesvik is not mentioned. Over the past few decades, opinion became widespread that the locality no longer existed, or that "the classical Petesvik locality" corresponds to the ditch exposure CNL Lilla Hallvards 1 (Larsson 1979:180). Examination of the area by L. Ramsköld in 1986 revealed that the shore exposure is still there and that it in the main conforms to earlier descriptions. The exposed rock at the shore can be followed from a point c. 100 m south of the fishing huts (SNG 644273 164261; UTM CJ 2867 4213) through c. 800 m northwards, and it is possible that exposures continue intermittently farther to the north.

Exposures along the shore of Petesvik formerly formed one of the most famous localities for collecting fossils on Gotland. Lindström (1882) provided a detailed list of species; the material upon which the list is based is in the collections of Riksmuseum. According to Lindström's (1861) description, the sequence exposed at Petesvik is not quite uniform faunally but embraces several different faunal assemblages, although the total thickness of the exposed Hemse marl hardly exceeds 3-4 m. CNL Lilla Hallvards 4 has a faunal assemblage similar to one assemblage from Petesvik.

BURGSVIK SANDSTONE and BASAL HAMRA LIMESTONE

GANNVIKEN (Gansviken) or, more fully, STENBROTT VID GANNVIKEN, Grötlingbo parish. Includes CNL Lunde 1 and Rovalds 1-3. Schmidt (1859:442) reported that "... am letztgenannten Orte" (=Grötlingbo) "treten, im Liegenden eines ausgedehnten Steinbruchs nahe am Meere, noch Sandsteinschichten hervor". Lindström (1861:357) referred to "Stenbrotten vid Gannviken i Grötlingbo". The old locality designation Gannviken certainly referred to the closely spaced quarries, most of them now overgrown, along the road from Grötlingboudd to Grötlingbo church; CNL Lunde 1 and Rovalds 1-3 are some of these quarries. The amount of fossils labelled Gannviken indicates intensive collecting from these quarries over many years. The sequence exposed in the quarries comprises Burgsvik Sandstone and basal Hamra Beds; the material from these two units is easily distinguished lithologically.

BURSVIK (Burgsvik), Öja parish. This old locality term was evidently used for a belt of quarries along the eastern and southern coast of Burgsviken, most of them now completely overgrown. Hisinger (1828:224-225) reported that "sandsten uppbrytes på flera ställen vid Bursviken, der äfven en lång sträcka af gamla övergifna brott finnas vid Botarfve." Thus already at that time there were numerous abandoned quarries. The fact that the locality designation Bursvik was used for a large group of quarries does not reduce the value of the extensive collections labelled "Bursvik", because in this area Burgsvik Sandstone and basal Hamra Beds appear to be spatially fairly uniform in both fauna and lithology.

HAMRA LIMESTONE

STOCKVIKENS KANAL, Öja parish. No CN. Drainage ditch for Rörviksträsk. One of G. Lindström's favourite localities in Hamra Beds. Field maps from the end of the last century show that the only place where the ditch was cut into bedrock was north of the road at Ollajvs, c. 150 m north-west along the ditch from the intersection between the ditch and the road (SNG 632215 165295; CJ 2085 3742) to about 400 m farther north-west and west. The exposure along the ditch is marked on geological map-sheet Aa 152 (Burgsvik). The ditch exposure CNL Ollajvs 1, south of the road and c. 200 m south-east from the eastern end of the old locality, does not appear to have existed at that time.

KLEV, Sundre parish. CNL Juves 1-4.

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