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N:r 7

ON THE HÖGANÄS SERIES OF SWEDEN
(RHAETO-LIAS)

BY

GUSTAF TROEDSSON

WITH 24 PLATES

PRINTED WITH CONTRIBUTION FROM THE
SWEDISH NATURAL SCIENCE RESEARCH COUNCIL

LUND
C. W. K. GLEERUP

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Read before the Royal Physiographic Society, Febr. 14, 1951.

L U N D
HÅKAN OHLSSONS BOKTRYCKERI
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Contents

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Preface

The first part of this volume is a summary of the studies of the Lower Mesozoic of N.W. Scania made by the author from 1929 onwards. Several investigations have been published independently, chiefly in "Geologiska Föreningens i Stockholm Förhandlingar", and are therefore only summarily reviewed here. They deal with the Kågeröd formation (TROEDSSON 1942) the Rhaeto-Liassic boundary (1943), the Rhaetic fossils (1948), and the Höör (1940), Vallåkra (1943), Stabbarp (1947) and Helsingborg regions (1947). Preliminary results have been made public at different times, as for instance, in a report to the town council of Helsingborg on the water resources of the Rhaeto-Liassic bedrock (1935), in a short summary of the stratigraphy (1938), and in a paper on the rhythmic sedimentation of the Rhaeto-Liassic beds of Sweden, read at the XVIIIth International Geological Congress in London in 1948.

Our knowledge of the Höganäs Series is based upon data received from natural exposures, and from shafts, mining, and bore-holes, and is therefore most complete as far as the colliery districts are concerned, but somewhat deficient in other respects. E. ERDMANN has published results of a great many sections from drillings and still more are preserved in the records of the Geological Survey of Sweden. The Höganäs-Billesholm Co. has complete records of more than 500 borings. These do not include the series of drilling cores Nos. 201—299, most of which have been recorded in the Eastern coalfields during the past 25 years. And finally, during the past 15 years, borings have frequently been made for water. Consequently, the author has had a multitude of data at his disposal, though of varying quality. Thus the records of the water-borings are rather summary as to the sequence of strata and often of no value, while those of the coal-borings are rich in data, which, however, as a rule, are not always reliable. The shaft-sections studied and already published by ERDMANN, as well as the drilling-cores, are in a class by themselves. These latter have made it possible to classify the rocks in detail, since they are scattered over the whole region, and allow a correlation with the old, more crowded borings, especially in the colliery districts. Of course, it would be impossible to publish the whole of this material. Therefore, the following report is based to a great extent on the drilling-cores, whose distribution is seen in the map, Fig. 1.

The second part, dealing with the fossils, was actualized by the uncovering of the Katslösa section in 1945. In order to get as adequate correlations as possible with strata already known it became necessary to study anew the old collections,

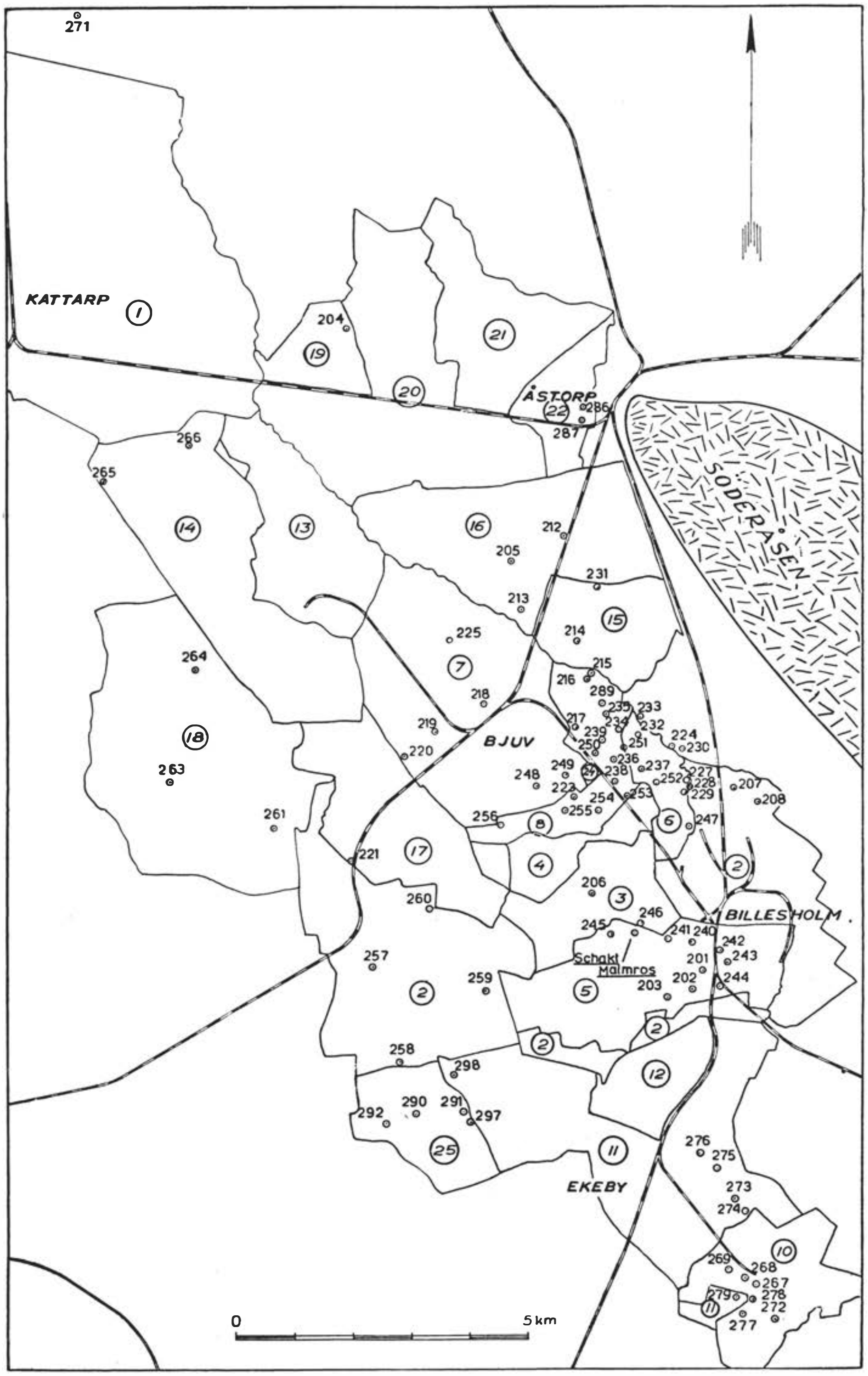

KATTARP
ÅSTORP
SÖDERÅSEN
BJUV
BILLESHOLM
Schakt Malmros
EKEBY
0
5 km

Fig. 1.

above all the types described by Lundgren and Moberg. These were loaned to the writer by the courtesy of Dr T. Thorslund, Curator of the Museum of the Geological Survey of Sweden, and by Dr J. E. Hede, Curator of the Museum of the Paleontological Institute, Lund.

The author is indebted to the Director of the Geological Survey of Sweden, Professor P. A. Geijer, who has taken much interest in this publication, *e. g.* by enabling him to increase his collections at the new locality of Katslösa, which was measured by Drs. Brotzen and Mohrén and the undertaking financed by the Geological Survey.

Most of the first fossils collected in the field were sent to the Paleozoological Department of the Natural History Museum, Stockholm. But the investigation of the collections was carried out at Stockholms Högskola, where the author had the privilege of full access to the resources of the Geological Institute, thanks to the courtesy of Professor L. von Post.

Statens Naturvetenskapliga Forskningsråd (Swedish Natural Science Research Council) defrayed the costs of the preparation of the fossils, photography, retouching, and other laboratory work, and granted the funds for the publication of this work.

Mrs. I. G. Mars, Miss A. Brasch, Miss R. Sandegren, and Miss V. Troedsson assisted in preparing the fossils. Most of the photographs were taken by Mrs. Mars and retouched by Mrs. S. Samson.

The drawings were made by Mr. B. Kallerdahl and Mrs. G. Sarnäs.

To these and other, more occasional, collaborators, the writer wishes to express his most sincere thanks.

Finally he wishes to thank Mrs. Florianne Dalberg for revision of the English.

Lund, Paleontological Institute, August 1950.

Fig. 1. Map showing the position of the core-drillings of the eastern coalfields.

The encircled figures denote the concessions: 1. The chartered Höganäs district of the year 1737. 2. Billesholm coalfield. 3. Charlottenburg-Mörshög concession. 4. Mörshög-Olstorp concession. 5. Boserup conc. 6. Ljungsgård coalfield. 7. Bjuv coalfield. 8. Selleberga-Mörshög conc. 10—12. Skromberga conc. 13. Hyllinge conc. 14. Rosendal conc. 15. N. Vram conc. 16. Broby conc. 17. Mörarp conc. 18. Fleninge conc. 19. Strövelstorp conc. 20. Nygård conc. 21. Ausås conc. 22. Åstorp conc. 23. Björnekulla conc. 24. Bjuv conc. 25. Hesslunda conc.

Part I

GEOLOGY

1. Introduction

Distribution and Characteristic Features of the Höganäs Series

The Höganäs Series, i. e. the coal-bearing formation of Sweden, generally called the Rhaeto-Lias, is built up of grey and white sandstones, grey and dark, often laminated clays, contains thin coal beds, and is sometimes calcareous or ferruginous in thin horizons (siderite). The lower part is rich in plant fossils of the Rhaetic and Liassic ages. As to the fauna lamellibranchs dominate the lower part of the column, but the top beds also contain gastropods, ammonites, belemnites, crinoids, brachiopods, ostracods, and foraminifers.

The Höganäs Series is entirely restricted to Scania, the southernmost province of Sweden, where it occupies 1) about 700 sq. kilometres in the north-west-corner, 2) the Höör district in the centre, 3) the small Stabbarp outlier, south-west of Höör, the latter continued south-eastwards till 4) the narrow strip of vertically raised Liassic beds along the Fyle Valley (Fyledalen) of S.E. Scania (Fig. 2).

The most complete succession is developed in N.W. Scania. It is partly non-marine, partly marine, and the strata have been deposited under humid conditions.

The underlying beds, the Kågeröd formation, are badly stratified, consisting of red or green, coarse arkoses, sandstones, and conglomerates (made up of half-weathered detritus from Archaean rocks) with chocolate-brown clays at the top. The colour indicates ferric oxide. The Kågeröd is quite devoid of fossils, having been laid down during arid or semi-arid climatic conditions. It rests upon Silurian or Ordovician beds and Archaean rocks, and belongs to the Permo-Triassic desert facies.

Historical Remarks

Scania has produced coal since the 18th century, but the geological age of the coal-bearing beds was only decided much later. The first to recognize and describe fossil plants and Liassic shells from these beds was the Swedish naturalist, Sven Nilsson (1819, 1820, 1824, 1832). The name "*Höganäs formation*" was introduced by N. P. Angelin in his geological map of Scania (1859), and in his description (printed posthumously 1877) he assigned this formation to the Infra-Lias, which then embraced the Rhaetic and the Hettangian. In the seventies and eighties Nathorst described the fossil floras in a series of monographs (1876, 1878, 1879, 1886, &c.), and Lundgren made a study of the fossil fauna (1878, 1881). From these studies the following stratigraphical table was established (Lundgren 1881. Nathorst 1880, 1894):

Lias	14.	Ammonite Bank
	13.	*Avicula* Bank
	12.	*Ostrea* Bank
	11.	Zone of *Cyclas nathorsti*
	10.	*Cardinia* Bank
	9.	*Mytilus* Bank
Rhaetic	8.	Zone of *Nilssonia polymorpha* (The Pålsjö flora)
	7.	" " *Dictyophyllum acutilobum* (The Helsingborg flora)
	6.	*Pullastra* Bank
	5.	Zone of *Thaumatopteris Schenki*
	4.	" " *Equisetites gracilis*
	3.	" " *Lepidopteris Ottonis*
	2.	" " *Camptopteris spiralis*
	1.	" " *Dictyophyllum exile*

These zones were gathered from different sections: Nos. 1—4 from the eastern collieries, especially Skromberga and Bjuv; Nos. 2, 4 and 5 from the Stabbarp coalfield, No. 6 from Ramlösa, south of Helsingborg; No. 7 from some unknown locality within the Helsingborg radius; Nos. 8—11 from the shore sections at Pålsjö, Gravarna, and Sofiero, immediately northwest of Helsingborg; Nos. 12—13 from the shore sections at Kulla Gunnarstorp, 3 km further to the north-west; and No. 14 from marl pits at Dompäng, Döshult, and other localities 4 or 5 km. north or north-east of Kulla Gunnarstorp.

Owing to the scattered position of the fossiliferous beds in a region well covered by Quaternary deposits much uncertainty of course remained as to the true succession of the strata, and several marks of interrogation were inserted in their stratigraphical table by Lundgren and Nathorst. In spite of this the schedule was considered valid and appeared for more than 50 years in text-books and other publications.

In 1913 the present writer questioned the given position of the *Pullastra* Bank and in 1922 Johansson denied the existence of a zone with *Dictyophyllum exile*. In 1931 in connection with his studies of the Mesozoic floras of E. Greenland Harris pointed out the marked difference between the world-wide Rhaetic and the Liassic floras, only a few long-ranging species being common to both. The Rhaetic flora was characterized by *Lepidopteris Ottonis*, the Liassic by *Thaumatopteris Schenki*. The Rhaeto-Liassic boundary should accordingly be situated below the zone of *Th. Schenki*.

In his studies of the Höganäs formation the present writer found a well-marked disconformity in all the sections just above the zone of *Lepidopteris Ottonis* (Troedsson 1934, 1943 a), which is, most probably, the boundary between the

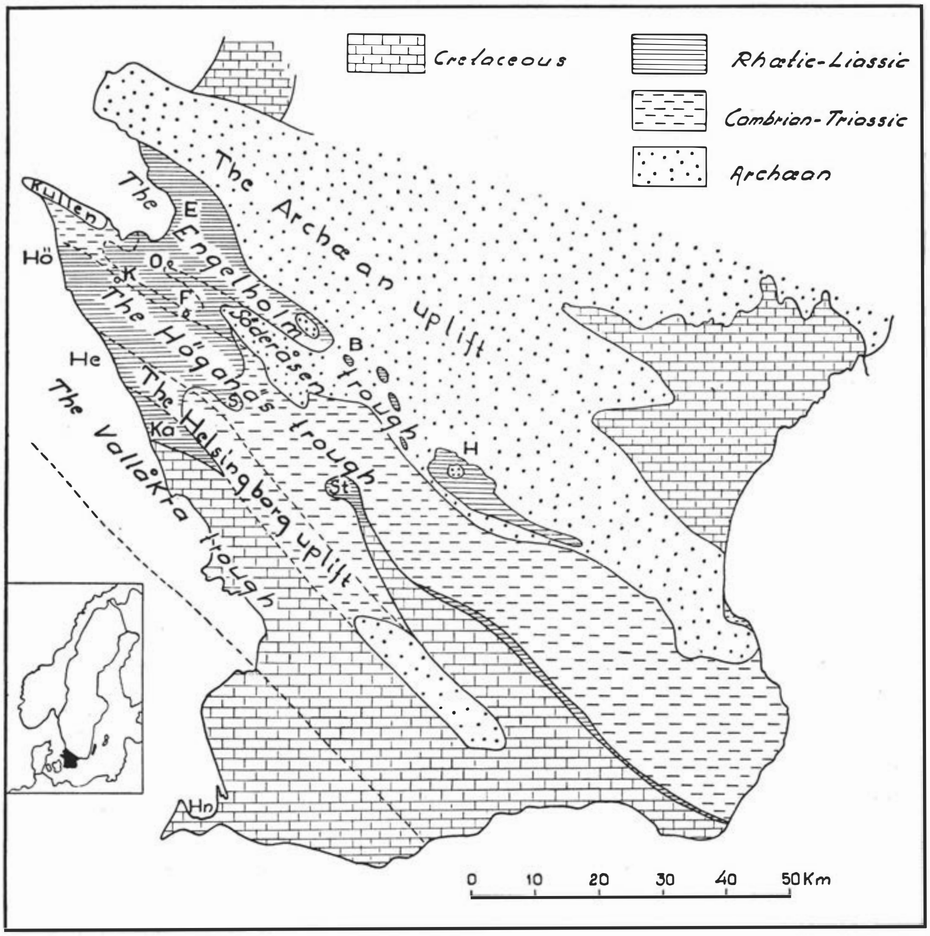


Fig. 2. Geological map of Scania, showing the present distribution of the Höganäs Series and the faulting of the Liassic basin.
B, Brandsberga. E, Engelholm. F, Fleninge. H, Höör. He, Helsingborg. Hn, Höllviken. Hö, Höganäs. K, Klappe. Ka, Katslösa. O, Oregården. S, Skromberga. St, Stabbarp.

Rhaetic and the Lias. The *Pullastra* Bank is Liassic in age, not Rhaetic (TROEDSSON 1948), and has its place above the zone of *Cyclas nathorsti* (TROEDSSON 1934). Finally the zone of *Dictyophyllum acutilobum* (the Helsingborg flora) and the zone of *Thaum. Schenki* are equivalent, or even identical.

Stratigraphical Account

In the revised time-table the Liassic beds below the *Avicula* Bank constitute the Helsingborg Stage. The *Avicula* and the Ammonite Banks belong to the Döshult Stage, and still younger strata, recently discovered south of Helsingborg, are divided into the topmost Döshult and the Katslösa Stages.

Thus, the Höganäs Series embraces:

1. The Rhaetic, predominatingly non-marine, comprising the main coal beds, and characterized by the *Lepidopteris* flora and the *contorta* fauna,
2. The Helsingborg Stage (= the Hettangian or the Lias α_1 and α_2), composed of alternating non-marine and marine beds, characterized by the *Thaumatopteris* flora and lamellibranchs, such as *Liostrea hisingeri* NILSSON, *Modiola hillana* SOWERBY, *Gervillia angelini* LUNDGREN, *Cardinia* spp., *Eotrapezium* spp., &c., all belonging to the *planorbis* or the *angulatum* zones of the Lower Lias.
3. The Döshult Stage (= the Lower Sinemurian or the Arieten-Lias, α_3), composed of sandstone and marls with *Oxytoma sinemuriensis*, *Cardinia kullensis* n. sp., *Coroniceras bucklandi*, &c., and
4. The Katslösa Stage, corresponding in its middle and upper parts to the Lower Pliensbachian (Lias γ) and consisting mainly of clays and ferruginous sandstones or iron-oolites with ammonites, belemnites, brachiopods, echinoderms, foraminifers, and, above all, lamellibranchs.

In the following a more detailed stratigraphy has been attempted with the aid of a rhythmic sedimentation, sometimes well-marked, especially in the lower parts of the series, which is rather poor in marine fossils. The rhythm consists of a repeated succession of the series sandstone — clay with coal and plants — ferruginous or calcareous beds with marine fossils. Certain members may be slightly developed or entirely absent. But in spite of this the rhythmus is well discernable as a pulsation within the whole region, from Höganäs in the north-west to Stabbarp in the south-east.

As mentioned above the term "Höganäs formation" was introduced by ANGELIN. But when true Rhaetic and Liassic beds were recognized by LUNDGREN and NATHORST, the stratigraphical term Rhaetic-Lias became the ruling one. However, the Liassic record is rather incomplete, only the Lower Lias having been recorded hitherto in Sweden. For this reason the present writer has found it more appropriate to revive the more adequate name of "Höganäs", which embraces all the Rhaetic and Liassic beds of Scania.

Though the lithologic character of the Rhaetic and the Liassic parts of the column are quite similar in Sweden, the Rhaetic was formerly placed in the Trias, in accordance with the Alpine facies and the old English and German interpretations. This, of course, would constitute quite an unnatural breaking up of the uniform Höganäs Series. Furthermore, the lower limit of the Rhaetic is exceedingly well-marked, the arid, continental, non-fossiliferous Kågeröd formation being succeded by the humid, partly marine Höganäs Series. *The Rhaetic is therefore here considered as the lowest part of the Jurassic System of Sweden, in accordance with the French conception, which is now the ruling one also in England* (ARKELL, etc.).

Sedimentary Conditions

The Rhaeto-Liassic sediments of N.W. Scania were deposited in a basin, open towards the northwest or the west, and now filled up with the Kågeröd, Rhaetic and Lower Liassic beds.

Figs. 2 and 3 show the present tectonic structure of this basin, dominated by the breaking up and faulting of the sediments. The horst Söderåsen, now quite devoid of sediments, has cut through a region in which the Rhaetic and the basal Liassic strata gradually become finer towards the south-west. However, at least one fault is older than the Mesozoic, the rocks on either side being covered by remnants of the Kågeröd. This is the Variscan displacement, which runs along the south-west side of Kullen and Söderåsen and farther towards the south-east, separating the Lower Paleozoic from the Archaean (Fig. 38).

This fault line played an important rôle during Kågeröd and Rhaeto-Liassic sedimentation. In reality it was a condition for the considerable accumulation of the Kågeröd beds, which were transported south-westwards and deposited upon the eroded Silurian surface. The Rhaetic and, probably, also the Basal Liassic (the Boserup) sediments were deposited — as far as we can judge now — in an undivided basin extending on either side of the Variscan fault. The following stages indicate the transportation of sediments in various other directions. However, the present "grabens", of Engelholm, Höganäs, and Vallåkra, show such differences regarding Liassic sedimentation, that we may ascribe their original outlining to the earliest Lias.

Accordingly, the whole region may be divided into minor elements, basins or troughs (Fig. 3), which have been loaded with sediments, and ridges or horsts with a tendency to rise and perhaps able to supply the troughs with sediments. These elements are: The Engelholm trough, extended south-eastwards via Höör and Hörby; the Höganäs trough, or the central basin, extending from Höganäs and Viken via Skromberga to Stabbarp, then continuing into the Vomb syncline, towards the island of Bornholm; and finally the Vallåkra trough from Ramlösa via Katslösa and Vallåkra to Kävlinge and Lund along the S.W. side of the Archaean horst, Romeleåsen. The ridges between are: 1) Söderåsen and Kullen with the offsets Rögle and Danhult in close contact, and 2) Romeleåsen-Helsingborg with a probable offset farther to the north-west. Important sources for the local sediments were the Archaean to the east of the Engelholm trough and a supposed ridge west of the Vallåkra trough.

The greater part of the sediments was probably derived from regions far outside Scania and transported by rivers from the south-east with tributaries from the east and north-east (the Baltic region). The thickest sediments were deposited in those places where the tributaries had their outlet. Among such are the main coal basin of N.W. Scania, the Upper Helsingborg Stage of the Stabbarp coalfield, the iron-ore deposits of S.E. Scania, and the Lias of Bornholm.

The Engelholm trough extends from the Skelder Vik towards the south-

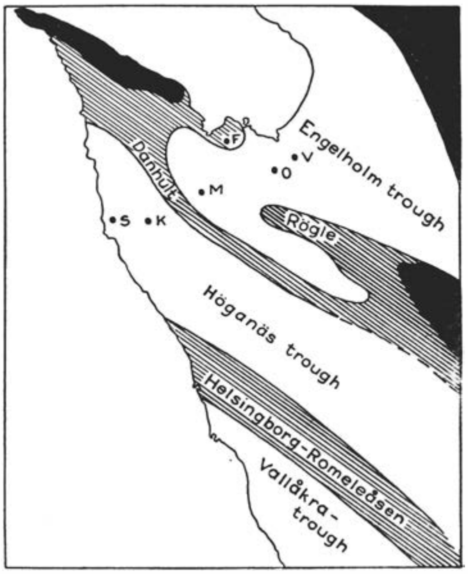


Fig. 3. The present tectonic elements of N.W. Scania. Synclines, blank; anticlines, black (Archaean) or grey (sediments). F, Farhult 270; K, Klappe diamond drilling; M, Mjöhult; O, Oregården 271; S, Svanebäck 209; V, Vilhelmsfält diamond drilling.

east, its utmost point being the Rhaetic outlier at Önneköp (SE of Hörby), and is occupied by Lake Ringsjön and its outlet Rönneå. In all this trough the Rhaetic beds repose directly upon the Archaean or are only separated from the latter by thin arkoses of Kågeröd facies. In the vicinity of Engelholm the Archaean bottom has been struck at a depth of 410 metres and the filling consists mainly of Rhaetic-Liassic rocks. Towards the north-east the trough is bounded by the Archaean, which also forms the elevated ridges Kullen and Söderåsen along the S.W. border of the basin. At a first glance the Engelholm basin seems to be confluent with the Höganäs basin in the plains between Kullen and Söderåsen, but the two parallel ridges, the Rögle and Danhult upheavals which in reality connect these horsts, seem already to have been active in the Lias. Anyhow, they indicate a westerly extension of the Engelholm basin as far as Mjöhult, as is also seen from the detailed coincidence between the two bore-hole sections at Oregården (320 m) and Mjöhult (231 m). To the same basin belong the drillings at Farhult (131 metres) and Vilhelmsfält (426 metres). The narrow strip between the Rögle and Danhult upheavals opens towards the south-west and belongs to the Ormastorp and Gunnarstorp mines of the Höganäs basin. These coal mines are situated on the southern slope of Söderåsen. The Farhult boring, on the other side, is placed on the south-eastern slope of Kullen, facing the Engelholm basin. These localities, situated on the very borders of the troughs, are characterized by rather thin beds, viz. coarse sediments — mostly arkoses — in the basal parts of the column, and, predominatingly, clays in the upper parts. Thus, for instance, at Ormastorp the two coal beds, A and B, are less than one metre apart and are accordingly worked together, while at Höganäs the same beds are separated by 25 metres of country rock, and at Oregården by 13.5 metres.

The Höganäs trough is the site of all Scanian coalfields of any importance: Höganäs, Ormastorp, Gunnarstorp, Hyllinge, Bjuv, Billesholm, Bosarp, Skromberga, all of which are situated in the Höganäs basin, and Stabbarp — in the small Stabbarp outlier. Here, also, most of the drillings have been closed down, especially the deep ones, for instance at Klappe (517 metres), Svanebäck (267 metres), Fleninge No. 266 (180 m), Rosendal No. 264 (96 m), Vikens Ryd (238 m), Flundrarp (163 m), L. Tornhult (199 m), Hjelmshult (150 m), Höganäs No. 85 (181 m), the Höganäs borings Nos. 22—26 (160—208 m), and Bjuv (235 m). A leading horizon of this basin is the coarse Döshult sandstone, which is present in all those parts of the trough which are deep enough to preserve it, i. e. mainly in the north-western part of the basin, though recently it has also been discovered in the deep graben just S.E. of the Stabbarp field. A third feature brought to light by the borings is the frequent marine transgressions, in rhythmic alternation with non-marine sediments. — The boundary towards the south-west is less known than the N.E.-border, which is due to the one-sided distribution of the coal.

Within the Höganäs basin the Kågeröd deposits increase in thickness from almost nothing in the east to several hundred metres in the west. They rest upon Lower Palaeozoic, mainly Silurian beds.

The Archaean ridge Romeleåsen is continued towards the north-west by a well-marked upheaval which has exposed Silurian beds at Sireköpinge and the Kågeröd beds at Ottarp. Its Liassic continuation towards the coast region at Kulla Gunnarstorp is not known, owing to a rather thick cover of Quaternary deposits. The few exposures have given no fossils, and the borings are old and un-recorded. However, this ridge seems to be effaced in the vicinity of Helsingborg and replaced by another, more westerly, which forms an anticline within the central part of the town, where the Liassic base is exposed. This anticline is cut obliquely by the shore-line which shows repeated exposures of the Lower Helsingborg beds (Troedsson 1947 b).

The Vallåkra trough is accessible only along its north-eastern border which, however, slopes towards the south-west, descending to a great depth beneath the Cretaceous. The Liassic deposits are thicker and more complete than in the Höganäs trough and are rather coarse-grained in their upper stages. The Kågeröd probably attains its greatest thickness here, the Vallåkra is mostly argillaceous, and both may contain salt water. Borings in the southern part of Helsingborg have given over-saturated solutions of gypsum. The Rhaetic has led to coal-mining in one single place, viz. at Vallåkra. Here the lower coal bed was worked, the distance between the coal beds being 20—25 metres. The Helsingborg Stage is of the same thickness — at least — as in the Höganäs trough, or about 200 metres, and contains — as at Stabbarp — thin coal beds in its lower part which have been worked occasionally. Here, too, occur coarse Döshult sandstones and the youngest beds of all the region, viz. the marine fossiliferous, partly coarse-grained and ferruginous beds at Katslösa. These are without any counterpart in the true Höganäs basin though well developed in its south-eastern continuation in S.E. Scania, and presumably also as pelitic top sediments in the Engelholm basin.

The coarse and thick sediments of the Vallåkra trough are most readily explained by the presence of a raised basin border to the west or south-west which delivered part of the Liassic sediments but is now hidden beneath the Cretaceous deposits of Denmark.

The Sediments

The predominating rocks of the Höganäs Series are sandstones and clays with all the intermediate. True conglomerates are practically absent. Arkoses occur in the basal parts. Furthermore, there are calcareous and ferruginous beds and concretions, as well as bituminous clay and coal beds. White, grey or black colours predominate. The light sandstones are sometimes pale green, and the dark clays at the base of the formation may incline to brown.

Arkoses are met with at the very base of the Rhaetic (Vallåkra member) and the Lias (Boserup member). They are coarse-grained and rich in weathered feldspar. In the Boserup they are intercalated with irregular beds of kaolin.

Coarse sandstones, mostly cross-bedded and loose, with rounded quartz grains, 1—2 mm., and well-worn pebbles of quartz, 10—20 mm. in diameter, occur regularly in the Döshult beds, and are met with in the Döshult region and at Gantofta. They are light greenish in fresh rock, yellow or brown after weathering.

The majority of the sandstones are mostly white and fine-grained (the average grain size being 0.05—0.1 mm.), and consist of angular quartz with rare grains of weathered feldspar and are sometimes micaceous. Ripple marks and cross-bedding (Fig. 4) are common. Pure beds of sandstone may attain thicknesses of tens of metres and grade often into argillaceous beds. Most sandstones are loose or only slightly indurated, and only in a few instances have they been quarried for building purposes or for grindstone. One sandstone below the Upper Coal Bed at Hyllinge contained 99.46 % SiO_2 (analyst Paijkull). The grind sandstones are less pure, the content of silica being 91.3 % at Brandstorp (Ingelsson), and 79.3 at Hittarp (Palmqvist). The *Mytilus* sandstone at Gravarna contains 94.62 % SiO_2 (Palmqvist) and the *Pullastra* sandstone at Ramlösa 95.16 % (Palmqvist). The sandstones have been studied in detail by Hadding (1929) as to their mechanical and chemical compositions and their sedimentary conditions.

Towards the clay beds the sand often becomes still more fine-grained and more or less laminated with clay. According to the frequency of the clay laminae the rock is a laminated sandstone ("sandstensskiffer") or laminated clay ("skifferlera"), with transitional types, difficult to classify.

The clays are in colours varying from white to black, sometimes mixed with

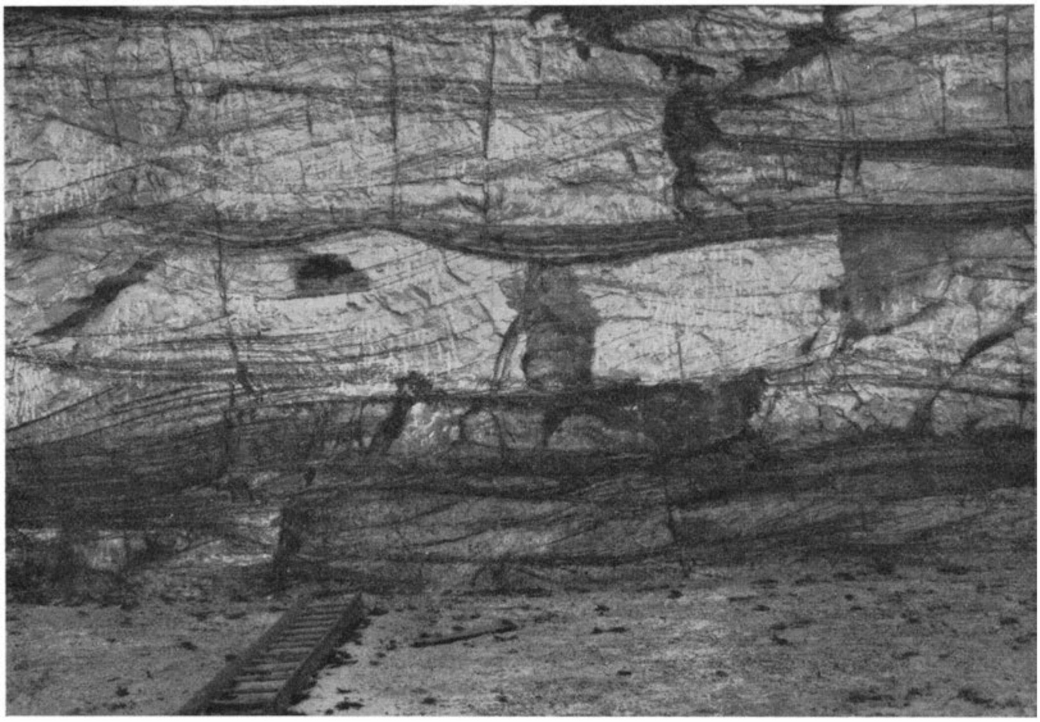


Fig. 4. Cross-bedded Fleninge sandstone, cut N.W.—S.E., at right angles to the transport direction which was from the north-east. S. Storgatan, Helsingborg, 1929.

fine quartz sand, as just mentioned, and sometimes rather pure. The clay minerals are kaolin (Boserup beds) or montmorillonites. The latter are especially common in the Vallåkra clay, but occur at different horizons, even rather high up in the Liassic succession. Clays poor in alkalies and iron are exploited as fire-clays, mainly in connection with the coal-mining.

The coal beds are rather thin, and usually connected with more or less bituminous fire clay. In the Rhaetic there are two coal measures, the upper one, in contact with the Basal Lias or the Boserup beds, is known as A, and the lower and usually the best one, as B. Each measure contains coal of varying quality classified as I, II, and III, and bituminous clay, of which the thickness never exceeds one metre. The varying intervals between the coal measures is treated on page 127. Occasionally coal has been dug up from the lowest part of the Lias, viz. in the Lower Helsingborg beds at Helsingborg and Stabbarp. The main collieries are Höganäs, Hyllinge (closed down), Ormastorp, Gunnarstorp, Bjuv, Billesholm, Bosarp (closed down), and Skromberga. The quality of the coal varies between bituminous coal and lignite.

Calcareous beds are rare. The lime occurs as thin cone-in-cone beds or as a matrix in thin beds of sandstone, and — not rarely — mixed with siderite in clay ironstone.

Ferruginous sandstones and clays are met with in several horizons. Nodules of clay ironstone or iron-sandstone are common and sometimes form continuous beds. In the Katslösa Stage we meet with oolitic iron ores of the same kind as in the contemporaneous beds of S.E. Scania (HADDING, PALMQVIST), though much thinner.

Of special interest are the clay beds, crowded with spherical grains of siderite (spherosiderite), in the Vallåkra member, because they are never missing in this horizon and never occur elsewhere.

2. The Engelholm Trough

In the Engelholm district the rock is never accessible in outcrops on account of the thickness of the Quaternary deposits. The latter are probably not less than 20 metres but in some bore-holes they are claimed to be more than 100 metres thick. Their lower boundary is not easy to determine, because the underlying Liassic beds are mostly unconsolidated clays or argillaceous marls. The majority of the bore-holes are cable-tool drillings with incomplete sampling, and accordingly of little stratigraphical value. One of the deepest and most carefully controlled of these borings was made in the years 1887—1888 at Kelliehouse north of Engelholm, at a depth of 178 metres, of which 110 metres were composed of Quaternary deposits. The corresponding figures of some other borings are as follows: Åvarp, parish of Höja, 207 and 92 metres, Petersgård (Sandåkra), south of Engelholm, 170 and 70 (or 120) metres; and S. Varalöv 120 metres (only Quaternary). In a second boring near Åvarp, to a depth of 223 m., the Quaternary was stated to be only 20 metres.

Several of these old borings have given gas, which seems to escape from the Quaternary part of the column. These are (ERDMANN 1915):

Spannarp, S.E. of Engelholm, No. 8 of the Ausås concession at 44—52 metres, the Quaternary being 22 metres. The gas was ignited and burned with a flame 10 metres high.

Ibid., Ausås conc. No. 9, at 43 metres (Quaternary > 60 m.).

At Rönne river, N.E. of Höja, at 46 metres ("from strongly coal-mixed formation").

Nya (New) Vilhelmsfält, S. of Engelholm, at 55 metres (Quaternary > 60 m.).

Gamla (Old) ", ibid. at 69 metres (only Quaternary beds).

Count Taube's borehole No. 16, at Skörpinge, S. of Engelholm, at 55 metres (Quaternary 65 m.).

The Sugar Works, Engelholm, at 33 and 75 metres (only Quaternary beds).

From more recent borings I only know of two with gas, both executed in the year 1934 by Mr. H. Gustafsson at Åkersholm, N. of Engelholm, to a depth of 24.93 and 21.80 metres, respectively. In the first one — 4 $^1/_2$ inches wide — clay was pierced to 22.42 metres, then followed gravel, dislosing a gas which, according to the analysis, was methane. The eruption was so rapid that sand and small stones were thrown up and water lifted to a height of 5 or 6 metres above the surface. According to Gustafsson "the amount of gas was almost as great as that at

Spannarp". In order to evade the gas the hole was tightened, and the second boring, only half as wide, made close by. Here the gravel began at 18.45 metres, and at this level gas escaped together with the water.

However the quantities of gas were relatively small and only in one case, viz. at Vilhelmsfält, have they been exploited, and then only for local use.

A great many cable-tool drillings in this district, have disclosed a thick formation of fine-grained sediments, mostly clays, but have not given any clear idea of the stratigraphy. Far more adequate information has been obtained by drilling cores. Three such bore-holes have been made during this century, viz. at Nya Vilhelmsfält, Farhult and Oregården. These will be treated more closely below, together with a cable-tool drilling at Mjöhult.

Farhult. Bore-hole No. 270, 1 km. E. of the church, made in 1937 by Höganäs-Billesholm Co. Depth 131.54 m.

Geological Succession	Thickness (metres)		Total depth (metres)
Quaternary	32.20		32.20
Lias, upper part	38.71		
Boserup beds	13.58	52.29	84.49
Rhaetic. Coal Bed A	0.44		
A—B	8.17		
Coal Bed B	0.57		
B—V(allåkra)	4.33		
Vallåkra	25.93	39.44	123.93
Kågeröd	7.61 +		131.54

The Lias succession consists of clays and argillaceous sandstones with a couple of thin coal seams and ferruginous clay. At 41.23—41.35 there is an unconsolidated, cross-bedded sandstone containing pieces of ferruginous clay, fibrous coal, and white clay, the latter similar to that in the Boserup beds.

47.09—48.06 m. fine unconsolidated sand with badly preserved specimens of *Eotrapezium pullastra* Troedsson.

48—49 m. Grey clay with plant remnants, mostly stem-fragments.

49.09 m. *Modiola* sp. (fragments).

52.66—53.36 m. Sandstone with a beautiful stem of *Equisetites* sp., 17 cm. in length and 2.5 cm. in diameter and with 6 complete and 2 incomplete internodes. The bed immediately below is a sandstone with vertical pipes — from plants *in situ* — filled with sand.

63.30—63.58. Sandstone with an indeterminable lamellibranch (cf. Lundgren, "bivalv", 1881, p. 48, Pl. 1, Fig. 16; Pl. 4, Fig. 4).

70.26—70.91. Sandstone, fine, greyish white, somewhat argillaceous.

70.91—84.49. The Boserup beds, well defined both at the top and at the base. The uppermost bed consists of a bluish kaolin, partly browned by ferric hydroxide.

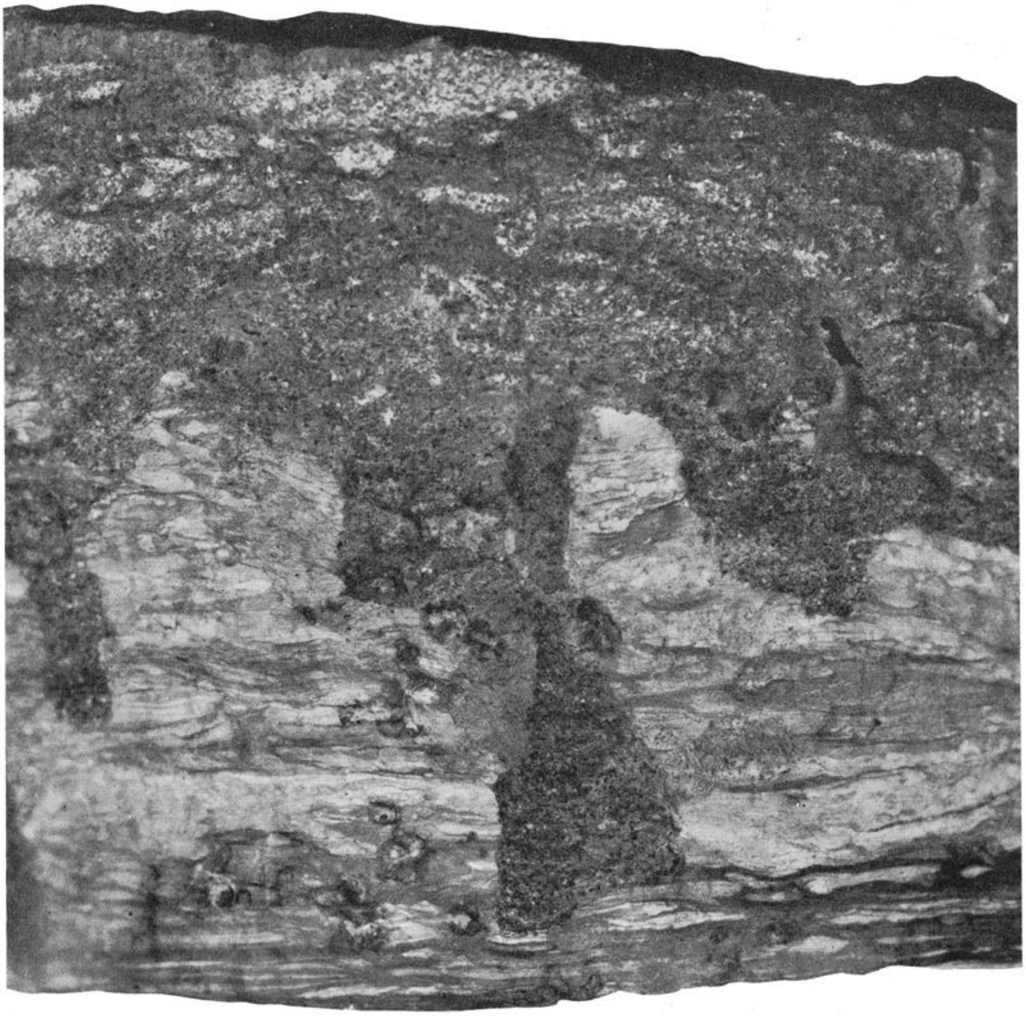


Fig. 5. A part of the core, Farhult 270, showing the corroded upper surface of the Vallåkra, succeeded by the coarse sandy basement of the B-Cycle. Nat. size.
Paleontological Institute, Lund.

It is underlain by a series of impure sandstones, mostly coarse-grained and badly stratified, but rich in weathered feldspar and kaolin and, at certain horizons, nodules of iron-sandstone, mostly brown. The sandstone is sometimes fine-grained and cross-bedded and the quartz grains are well rounded, which is not the case in the more typical localities close to Söderåsen. A lens of brown iron-clay in the sandstone contains large, rounded quartz-grains and pieces of white kaolin. At their contact with the surrounding sandstone, the kaolin pieces are crowded with quartz grains derived from the adjacent rock. One part of the lens with a low percentage of iron is compressed and flattened; the lens was accordingly embedded in the sand as a soft body of clay, able to stick at quartz-grains but only partly consolidated by siderite. Below the sandstone lies the basal bed of the Boserup, of white kaolin clay, at its lower contact rich in indeterminable plant remains. Here, too, are intermittent impregnations of siderite.

The Rhaetic. The Upper Coal Bed (at 84.49) was underlain by a fine-grained sandstone, laminated downwards with coal and clay, 8.17 m. The Lower Coal Bed, 0.57 m., was rich in clay and underlaid by well stratified sandstones with lamina of coal and clay, the latter grey or black and slicken-sided. The lower contact of the coal-bearing sequence is well-marked. The basal bed contains brecciated pieces of a laminated, arenaceous dark clay, embedded in reworked Vallåkra sand. It rests upon a corroded surface of the same laminated clay, the top bed of the Vallåkra (Fig. 5).

The Vallåkra member in this boring is for the rest almost entirely made up of sandstones. The few and thin clay beds are hard and non-stratified, with plant-fragments, and easily break up into cubes. The Vallåkra has much in common with the Boserup beds. This is especially the case with the sandstones, which can hardly be kept separate. As regards this bore-hole, however, the Boserup sandstones differ in having well-rounded quartz-grains, while the Vallåkra sandstones are unusually angular and probably poorer in feldspar. In addition the sandstones are coarse, loose, and grey, and (down to 110.60 m.) rich in plant remains. The quartz grains are white from kaolin and look badly washed.

Further down the grain-size increases, as well as the percentage of kaolin and feldspar. At 113 m. there appears a spherosiderite — a typical Vallåkra mineral. Then comes a kaolin-sandstone of various colours, mostly white. An especially coarse-grained sandstone, with a grain size of 4 mm., and rich in feldspar, was struck at 116.20—117.11 m. At this depth green colours appeared. At 119.10—119.48 the rock is red or brownish. Several sandstones are quite unconsolidated. At 122.73—122.92 the sandstone is cemented by calcite. At 123.22—123.93 there appears a conglomerate with pebble of greyish brown, non-stratified and arenaceous clay in a coarse greenish sand, rich in feldspar (Fig. 6). Fissures in the clay are filled with sand. This is the basal conglomerate of the Vallåkra member. The lower limit lies at 123.93 m.

The Kågeröd formation was pierced to a depth of 131.54 m. The topmost bed consists of red-spotted arenaceous clay and red sandstone. At 130.21 there is an arkose, only slightly consolidated, with feldspar pieces more than one centimetre in diameter. At the bottom of the bore-hole came a less coarse-grained light arkose, sprinkled over with dots of kaolin.

The conglomeratic beds at the base and the top of the Vallåkra only contain local material, embedded in situ or without any considerable transportation. The pebbles are all angular. They are derived from a clay bed, broken into pieces. In spite of this the conglomerates indicate disconformities, probably minor ones caused by emergences. They form the boundaries between cycles of sedimentation,

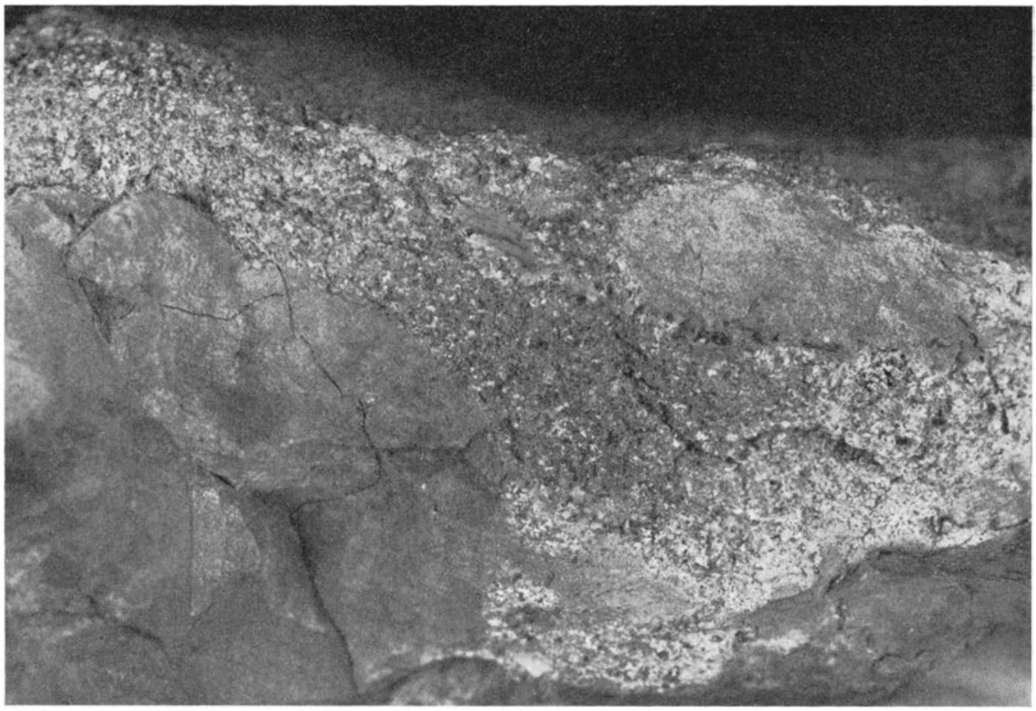


Fig. 6. Farhult core-drilling 270. A part of the core, showing the boundary between the brownish red Kågeröd clay and the greenish, coarse-grained Vallåkra base. In the latter is an ovate pebble of Kågeröd clay. Nat. size. Paleontological Institute, Lund.

each new cycle beginning with a basal sediment, sandy or conglomeratic. The upper boundary, at 98.00 m. introduces the Lower Coal Bed cycle, or the B-cycle. The lower one, at 123.93 m. inaugurates the Vallåkra cycle.

Oregården, core-boring No. 271, situated 4.5 km. S.E. of the Farhult boring. Carried out in 1937--1938 by Höganäs-Billesholm Co. Depth 320.24 m.

Geological Succession	Thickness in metres	Total depth in metres
Quaternary	38.50	38.50
Lias. Döshult Stage	72.38	110.88
Helsingborg Stage	185.30	296.18
Rhaetic. Mine beds	18.44	314.62
Vallåkra beds	5.62	320.24

The Döshult Stage. The upper part is rich in clay and fossiliferous, especially to a depth of 64 m.

At 52.70—53.79 m. a black shale, crowded with *Coroniceras sauzeanum*, is disclosed.

Ten metres below, at 62.88—63.48, there is a marly shell breccia, consisting of arenaceous clay with grey layers of rather coarse sand and black layers of clay, all crowded with well preserved shells: ostracods, lamellibranchs, gastropods, ammonites, echinoderms, and foraminifers. In some parts *Liogryphaea arcuata* or *Oxytoma sinemuriensis* make up most of the rock. There are pieces of coal in the clay, and quartz pebbles up to 5 mm. in the sand. Fairly large pebbles of brown sideritic clay are included in the rock. One such piece, measuring $12 \times 5 \times 3.2$ cm., is well rounded, and attached to it are specimens of *Oxytoma sinemuriensis*, *Gryphaea arcuata*, *Astarte* sp., etc., which occur also in the surrounding rock.

These horizons correspond to the Ammonite Bank of Lundgren.

Samples of this boring were assigned as early as the year 1938 to Dr. Fritz Brotzen for investigation of the foraminifers. As he has kindly informed me the foraminifers are met with down to 68 m., the remaining part of the Liassic sequence (228 m.) being quite devoid of these fossils. The beds carrying foraminifers accordingly amount to only 30 m. at Oregården. In this column he has recognized two faunal zones, an upper one from 38 to 53 m. and a lower one from 53 to 68 m., the latter corresponding largely to the Ammonite Bank. According to Brotzen (verbal information) both horizons belong to the Arietenschichten, though the upper one comes close to, but not within, the Lias β.[1]

The lower part of the Döshult is sandy and unfossiliferous. Between 71.90 and 79.81 m. there is a coarse, unconsolidated quartz sand, with rare grains of feldspar. It is well washed with spherical grains, mostly 0.08—0.38 mm. in diameter, though there are grains that come up to 4 mm. This is a typical Döshult sand, though finer than in the type region farther to the west and accordingly representing a more offshore facies.

At 95.41—95.83 there is a fine loose sandstone with *Tancredia arenacea* and *T. erdmanni*, probably equivalent to the *Avicula* Bank at Kulla Gunnarstorp.

The series from 95.41 to 110.88 is of the same general type as the Boserup member. The uppermost five metres are rich in white clay, at 97.91—99.22 m. are plant remains, and at 107.69—108.03 there is an arenaceous gray clay with red clay galles. As regards the remainder, the series consists of cross-bedded ferruginous sandstone, non-stratified, fine-grained arkose, and non-stratified brown clay ironstone, dotted with kaolin. These beds differ mainly from the Boserup in that they are more fine-grained. They have certainly originated similarly from weathered Archaean rocks. They are likely to correspond to a part of the coarse sandstones of the Döshult basin and at Hittarp.

The Helsingborg beds are argillaceous in the upper part, the grain diameter rarely exceeding 0.2 mm. Only a few remarks will be made here.

110.88—111.14 m. Hard, fine-grained calcareous sandstone with micaceous bedding planes and casts of *Modiola hoffmanni* (= *M. hillana* Sow.), *Liostrea hisingeri*, and *Gervillia hagenowi*.

[1] A still younger foraminifer fauna — though probably not yet the Lias β — was identified in a drift pebble found by the writer at Sofiero, just north of Helsingborg.

119.30—119.79. Bituminous clay with a coal seam.

At 148 m. is cone-in-cone marl, at 165 m. calcareous sandstone.

171.92—178.29. A second "Boserup facies".

180.65—180.91 m. Black clay with fish scales; a few metres below is cone-in-cone marl.

190—195 m. Two horizons with *Cardinia ingelensis*.

206.01—206.54. Black clay, crowded with squeezed lamellibranchs, identified as *Eotrapezium pullastra* and *Modiola hillana*. This is the lowest horizon with invertebrate fossils, though calcareous beds occur still deeper, for instance at 248 and 271 m.

280.46—296.18. The Boserup beds, 15.72 m., at the base of the Lias, consist mainly of sandstone, and are typically developed with loose, coarse and cross-bedded sandstones, rich in kaolin; nodules of clay ironstone; grey clay at the top, and white or light grey kaolin clay at the base in irregular contact with the Upper Coal Bed (Fig. 34).

At 261 m. a brecciated zone, 40 cm. thick, and dipping 48°, was found. It was made up of angular pieces of sandstone, shale, and clay ironstone from the surrounding rock. From the surface down to 192 m. the strata were horizontal. From there they began to dip, first slightly, then more and more; at the breccia as much as 29°, decreasing again downwards to 11° at 274 m. Another maximum, 30°, was measured at the Rhaetic-Liassic boundary (at 296.18).

The Rhaetic. The Upper Coal Bed (A) is replaced by a bituminous clay, 7 cm. thick; then follow a sequence of sandstones, mostly pure and fine-grained, with 3 additional bituminous beds but no coal. The lowest of these black horizons, at 309.40—310.30, very likely corresponds to the Lower Coal Bed (B).

Below 314.62 the succession is built up of non-stratified grey or greyish brown clays and green sandstones, pertaining to the Vallåkra. At 319 m. a spherosiderite bank was met with.

Mjöhult No. 10, a cable-tool drilling, 1 1/2 km. E. of Mjöhult railway station and 6 km. W.S.W. of Oregården. Höganäs-Billesholm Co. 1902—1903. Depth 231 m. The succession shows a detailed coincidence with that of Oregården. The differences are due to the thickness and the more or less argillaceous or arenaceous character of the beds. Thus, thin clay beds at Mjöhult are duplicated at Oregården. The sandstones dominate at Mjöhult, the clays at Oregården. A thick sandstone at Mjöhult at 114.05—139.65 m., corresponding to a similar bed, 28 m. thick, at Fleninge (the Fleninge beds, see Page 57), is practically absent at Oregården. This is the most striking dissimilarity between these two borings.

Geological Succession	Thickness in metres	Total depth in metres
Quaternary deposits	13.80	13.80
Lias: Helsingborg Stage	196.38	210.18
Rhaetic	20.82	231.00

Nya (New) Vilhelmsfelt. Diamond drilling, subsidized by the Swedish Government. Carried out in 1917 under the scientific control of the late Professor K. A. Grönwall. Depth 426.24 m. A detailed hand-written record of the strata was made by G. Ekström, and a short notice was published by A. GAVELIN in 1919. The core is preserved in the Geological institute of Lund, but no closer investigation has been made. During a visit to Lund in 1937 the present writer had the opportunity of studying the lowest part of the sedimentary column and found that it showed a striking similarity to the Jurassic bottom beds in adjacent regions. Furthermore, this drilling corroborated earlier data obtained by cable-tool borings, as to the predominating argillaceous character of the Lias of the Engelholm basin.

Geological Succession	Thickness in metres	Total depth in metres
Quaternary deposits	65	65
Stratified rock above the Rhaetic	322.45	387.45
Rhaetic (incl. the Vallåkra)	20.05	407.50
Red and mottled beds (Kågeröd facies)	4.60	412.10
Archaean, weathered	14.14	426.24

Of the greatest interest is the stratified succession between the Rhaetic and the Quaternary. It should contain a rather complete Lower Liassic succession, probably even more. According to the record, the first fossils (plants) were met with at 135 m., molluscs from 157 to 314 m., and plants from 285 to 392 m. There are ammonites at 180 and 240, "*Avicula*" at 168, 170 and 180, and a belemnite at 193 m. It is the intention of the present writer to work through this core material.

As mentioned above, the Lias of the central part of the Engelholm basin consists mainly of clays and only thin and rare sandstone beds. However, in the region around Engelholm sandstones are usually met with immediately below the Quaternary deposits. They are sometimes rather heavy and are underlain by clays, but their stratigraphical position is not clear. Since they are entirely absent at Nya Vilhelmsfelt they may be totally younger than the Liassic column there, or they might be equivalent to a part of it (Fig. 7). If the first interpretation be right the thickness of the sedimentary beds should increase rapidly towards the Archaean boundary to the north-east, which would mean a rather important displacement at this line. This supposition, however, is not supported by geophysical evidence.

On the other hand, if we imagine a gradual transition from sand in the north to clay at Vilhelmsfelt, we get a picture of a fan-shaped deltaic deposit extending at least 2 km. from the Archaean boundary towards the south. This gives rise to the idea of a lateral tributary unloading its sediments into the main trough, probably a general feature of the Rhaetic-Liassic sedimentation in Scania and Bornholm.

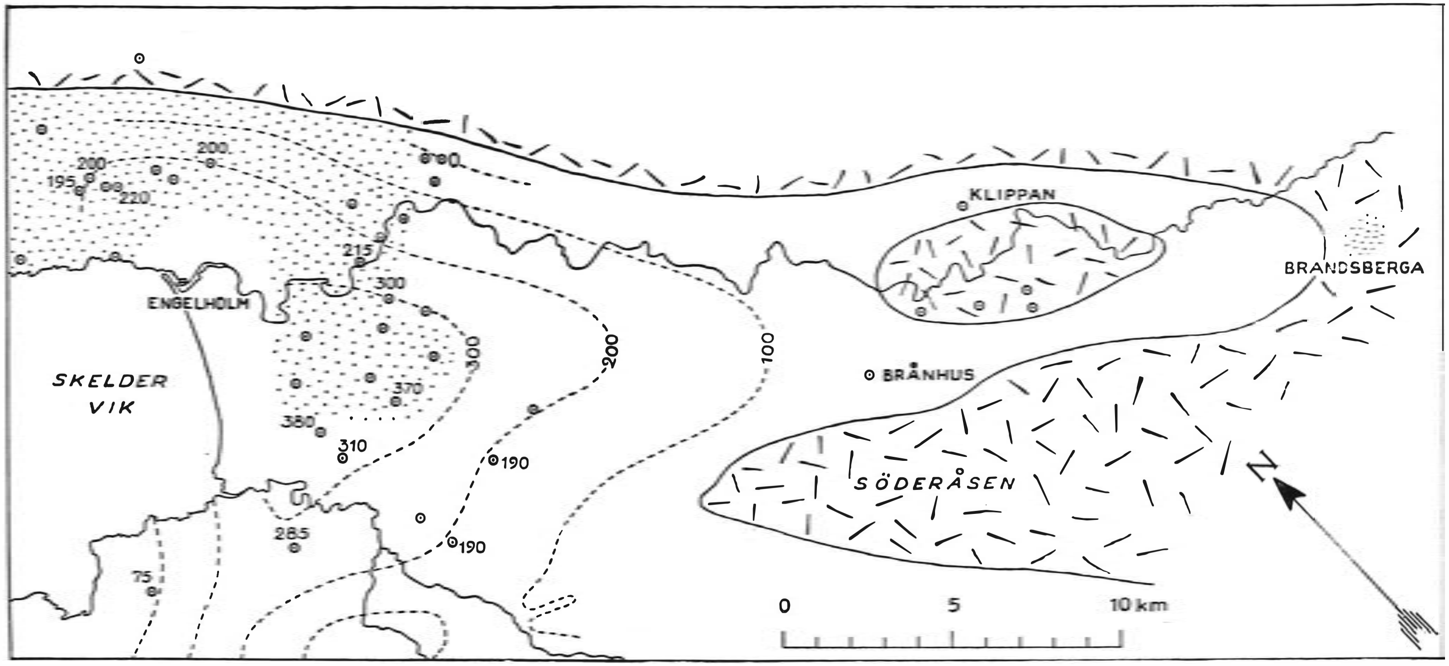


Fig. 7. The Engelholm district, drained by the Rönne river and the small Vege river into the Skelder Vik. The map shows the position of the Rhaetic-Liassic boundary, the sandy facies around Engelholm, and the south-eastward outthinning of the sediments on the Archaean. The figures indicate the depth in metres of the Rhaetic-Liassic boundary, below the sea-level: 380 metres at Nya Vilhelmsfelt, 285 m. at Oregården and 75 m. at Farhult. Sandstone, stippled. Archaean, oblique dashes.

The Engelholm basin becomes shallower towards the S.E. At Klippan Rhaetic basal beds, and at Brånhus 110 m. Rhaetic and Liassic beds have been pierced (TROEDSSON 1940, p. 264). But between these places the Archaean has been found in 4 bore-holes directly beneath the Quaternary, and outcrops of the same rock form rapids in the Rönne river close to Klippan. This indicates an Archaean inlier surrounded more or less completely by thin Jurassic deposits; perhaps a horst, but more probably a monadnock, suggesting a rather uneven pre-Rhaetic land surface.

Farther towards the south-east we pass into the Archaean of Central Scania. Just outside the south-eastern end of the Engelholm basin at Brandsberga and Kolleberga, there is a small area covered with erratics of sandstone crowded with lamellibranchs of Liassic age. The fauna was described by LUNDGREN (1881), and consists of:

Rhynchonella spp.
Liostrea nathorsti LUNDGREN
Plicatula suecica LUNDGREN, a large species (Cf. P. 223)
Plagiostoma succincta v. SCHLOTH.
Chlamys tullbergi LUNDGREN
Oxytoma inaequivalvis SOW.
" *scanica* LUNDGREN, common
Pseudomonotis gregarea LUNDGREN, very common
Isognomon sublamellosa (LUNDGREN)
Pleuromya ? jönssoni LUNDGREN
"*Myacites*" *odini* LUNDGREN
Trigonia sp. (cf. *T. primaeva*), *Cardium*? sp. and other lamellibranchs
Nerita ? scanica LUNDGREN, *Pleurotomaria*? sp.
Ammonites sp., *Belemnites* sp.

Plagiostoma succincta, *Chlamys tullbergi*, and *Oxytoma inaequivalvis* have also been met with in the ferruginous beds at Katslösa, and species like *Oxytoma scanica* and *Trigonia* sp. would indicate the same age. The fauna is embedded in a sandstone deposited directly upon the Archaean, several boulders containing weathered angular pieces of a light red iron gneiss of the same kind as that found in situ in the same region. This basal breccia contains the same fossils as the sandstone (Fig. 8).

At Foresta and Färingtofta, 6 and 7.5 km. S.E. of Brandsberga, the Archaean is weathered with a sheet of kaolin, partly covered with arkoses and sandstones, the later with *Cardinia follini*. More extensive deposits of this kind are preserved N. and E. of Lake Ringsjön, the Höör and Hörby districts. In the Höör district a great many quarries have been worked since the early Middle Ages, but all of them are abandoned now. They have yielded a rich flora, investigated by SVEN NILSSON, A. BRONGNIART, A. G. NATHORST, etc., and are divided into a lower part, the arkose or the Millstone, and an upper, the Building stone, a rather pure

Fig. 8. Basal conglomerate of the Brandsberga sandstone, with pebbles of weathered gneiss. Nat. size. Paleontological Institute, Lund.

sandstone, which in places contains *Cardinia follini.* A good section was received in 1939 at Hörby, S.E. of Lake Ringsjön.

Hörby, core-drilling No. 280, made by the Höganäs-Billesholm Co., 700 m. W. of the church.

Geological Succession	Thickness in metres	Total depth in metres
Quaternary deposits	25.10	25.10
Lias: Building-stone, light grey, fine-grained, pure	6.9	32.00
Grey sandstone, laminated with clay	13.00	45.00
" " with clay galles	4.80	49.80
Clay, dark grey or brownish, with small nodules (probably clay-ironstone), and a coal seam 0.1 m.	0.45	50.25
Sandstone of varying grain-sizes, arkosic and rich in kaolin, cross-bedded, uniting the characters of the Mill-stone and the Boserup beds	3.30	53.55

Geological Succession	Thickness in metres	Total depth in metres
Clay, arenaceous, grey, rich in kaolin, downwards gradually purer and lighter	0.94	54.49
Rhaetic: Clay, dark or black	0.36	54.85
Bituminous shale (= Coal Bed A)	0.13	54.98
Clay, dark, partly bituminous	0.34	55.32
" , greyish brown, arenaceous	0.32	55.64
Sandstone, argillaceous, arkosic, with sandy clay beds	6.71	62.35
" , same kind, with plant remains and black clays	4.89	67.24
Clay, dark grey, slicken-sided, spherosiderite at 68.5 m.	2.01	69.25
Kågeröd: At 84.10—91.10 a coarse conglomerate with well-rounded Lower Cambrian sandstone pebbles or cobbles (8 or 10 cm. in diameter)	38.50	107.75
Archaean, strongly weathered	9.95	117.70

Summary:

Quaternary	25.10	25.10
Lias: Building stone (with *Cardinia follini*)	24.70	
Clay with coal	0.45	
Boserup beds (with the Millstone)	4.24	54.49
Rhaetic (including the Vallåkra facies, 13.93 m.)	14.76	69.25
Kågeröd facies	38.50	107.75
Archaean	9.95	117.70

This core is easily correlated with the succession of the coalfields and the Höör district. The Building-stone is typically developed with clay in the lower part as at several places in the Höör district. Its leading fossil, *Cardinia follini*, though not yet met with at Hörby, helps to connect the Höör-Hörby region with the Höganäs basin.

Below this sandstone comes a clay bed with a thin coal seam — in exactly the same position as the plant-bearing clay of the Höör district, which has yielded the major part of the rich and famous Höör flora. According to Nathorst the latter represents a big hiatus in the succession. Indeed, it corresponds to all the beds between the *Cardinia* Bank and the Boserup beds of the Höganäs-Helsingborg region which contain not only the Helsingborg and Pålsjö floras — both of which occur in the Höör flora — but also the *Mytilus* Bank.

The plant-bearing clay is underlain by the Boserup beds with the Millstone 3.3 m., and greyish white clay (corresponding to the roof-clay of the coal mines with *Equisetites gracilis* and *Chladophlebis*).

The Rhaetic-Liassic boundary is situated at 54.49 m.

The Rhaetic succession is most similar to that at Stabbarp (see below).

The Mine beds are represented by only 0.83 m. dark clays.

The Vallåkra beds amount to 13.93 m. and contain bituminous clay with indeterminable plant remains — as at Stabbarp — and the characteristic Vallåkra mineral, the spherulitic siderite.

The Kågeröd beds are interesting on account of the coarse sandstone conglomerate exactly similar to the so-called Kycklingahus conglomerate. This was previously known only as boulders, which occur in large masses at Kycklingahus, E. of Ringsjön, just where its bedrock ought to have its outcrops. In the coral district (Skromberga), too, this conglomerate is traceable in the drilling-cores.

The Hörby district is situated in the south-eastern continuation of the Engelholm trough. Along its south-western side it is down-faulted, while to the north it is continuous with the Höör district. This Liassic region forms a part of the bottom of Lake Ringsjön and thins out north-eastwards on the Archaean. In the south-easterly direction the trough ascends gradually and finally disappears, though a small outlier of black clay and coal has been found at Önneköp, 14 km. S.E. of Hörby.

A more complete description of the Rhaetic-Lias of Central Scania, with a sketch-map, was given by the writer in 1940. (Geol. Fören. i Sthlm Förhandl. 62, P. 245.)

3. The Höganäs Trough

The Höganäs trough embraces not only the Höganäs basin proper and the Stabbarp coalfield, but also their continuation towards S.E. Scania and Bornholm. The latter regions are treated only for purposes of comparison (Page 122).

A. The Höganäs Basin Proper

The Northern Limb (Höganäs District)

Just N. of Höganäs, at Margreteberg, where the coal used to be quarried in open-cast workings the outcropping basal Rhaetic makes contact with the underlying Kågeröd clay. Dipping slowly and unevenly south or south-west, it is disturbed by numerous faults, some of them rather important, the maximum displacement being about 180 m. At the deepest part of the trough, at Viken and Svanebäck, the Rhaetic reaches a depth of nearly 300 m., but the present coal mining at Höganäs is carried on at a depth hardly below 125 m.

The geology of the Höganäs district is well-known through the valuable publications by E. Erdmann, the last of which appeared in 1915. Therefore, only some new facts throwing light upon the stratigraphy will be added.

One of the most characteristic and wide-spread rock units of the Höganäs Series occurs just above the Upper Coal Bed. It consists of cross-bedded arkosic sandstones and white or light kaolin clays in rapid alternation, and is rich in nodules of iron clay and iron sandstone but totally devoid of shells. Since this member has already been fully described by Hermelin in the year 1773 from Boserup, it has received the name of Boserup beds (Troedsson 1940, p. 250).

The Boserup beds were soon followed all over the coal-bearing region with a rather constant thickness of 10 or 20 m., and in 1936 the writer had occasion to identify them in the shaft "Gustaf Adolf" at Höganäs, where the succession of strata was studied from the elevator. At this place the sandstones are more fine-grained than at the typical localities, but the badly stratified, ferruginous, and kaolin-dotted sandstones are very characteristic. This identification was corroborated in 1946 by a drilling-core (No. 293) at Tjörröd, Höganäs, where the Boserup beds are 8.28 m., directly covered by Quaternary deposits. The entire thickness of this division at Höganäs is slightly more than in the eastern coal-fields, or 17—23 m. The upper limit is generally marked by a thin bed of dark clay or coal.

The position of this characteristic formation above the Upper Coal Bed in the whole of the Höganäs basin is of great stratigraphic value, since it forms the Liassic base and simplifies the identification of the Rhaetic-Liassic boundary.

The Upper Coal Bed, "Countess Ruuth", is not mined at Höganäs. It is situated about 25 m. above the Lower Coal Bed, or "Mrs Bagge", which is the main coal bed at Höganäs and is accessible in the open-cast workings at Margreteberg.

From Höganäs are derived two distinct floras, according to NATHORST (1878). The lower one was derived from the Lower Coal Bed and from a clay ironstone of about the same age. It belongs to the zone of *Lepidopteris Ottonis* of the Rhaetic. The upper one belongs to the zone of *Dictyophyllum acutilobum* (the Helsingborg flora), a Liassic or *Thaumatopteris* flora, whose exact stratigraphic position, however, is unknown. NATHORST suggests it is derived from a small coal seam which occurs 42 m. above "Countess Ruuth" in the shaft "Prins Carl". The same flora has been met with, however, in a clay immediately above the Boserup beds at Stabbarp, Vallåkra, and with certainty at the same level also at Helsingborg. A corresponding position at Höganäs should be about 20 m. above the "Countess Ruuth". In fact, according to ERDMANN there are plant-bearing clays in the shaft Ahlströmer, Höganäs, between 12 and 22 m. above that coal bed.

Several pieces of a brown iron-sandstone, gathered at Höganäs by some unknown collector in the year 1833 and preserved in the secondary school at Helsingborg, were found there in the attic 100 years later by the present writer just when about to be scrapped. They are crowded with *Liostrea hisingeri* and contain also *Modiola hillana*, *M. ruuthi*, *Tancredia arenacea*, *Cardinia* sp., *Pholadomya* cf. *coticulae*, and *Platymya aquarum*. According to the labels attached they were derived from the coal mine at a depth of 21 fathoms (= 35.4 metres). A hard, grey calcareous sandstone in the same collection, crowded with *Ostrea hisingeri*, was collected in 1844 at a depth of 49 fathoms (about 87 metres), and labelled by the same person; this depth, however, was hardly then arrived at, or it was perhaps just touched in the coal district of Höganäs at that time, wherefore the statements as to the depths may be considered as doubtful. The labels are carefully written and pasted on each stone but are in a bad condition on account of damp. It is very probably that the fossil-bearing brown rock was found on the ground close to a shaft during construction, perhaps one of the two rod-pits at Ryd, Höganäs, which were constructed in the years 1832—33 and 1829—34, to a depth of 80 and 83 metres, or at least 20 metres below the Upper Coal Bed. That written on the labels was probably the depth, just arrived at, on the day of collecting.

The fauna assigns the age to the lowest Lias (Hettangian). Thus the fossiliferous beds must be situated above the Upper Coal Bed. In the shafts "Oscar II" and "Alströmer", situated 500 m. to the E. and 1 km. to the N.E., respectively, of the Ryd rodpits, there is a calcareous, hard and heavy, brown, ferruginous sandstone at 33 or 36 m. above the Upper Coal Bed. This is the only brown-coloured rock mentioned in the drilling section records. It is not at all impossible that this horizon is the origin of the *Ostrea*-bearing rock, which should thus belong to a marine bed, somewhere above the zone of *Dictyophyllum acutilobum*.

This statement is of a somewhat wider interest. In his monograph of 1878 LUNDGREN described as "Boulder No. 1", a brownish red sandstone, rich in fossils, collected at Höganäs by N. P. ANGELIN. The boulders now preserved in the Riksmuseum, Stockholm, consist of exactly the same brown iron-sandstone as described above and contain the same fauna. LUNDGREN has recorded *Ostrea hisingeri* (most common), *Mytilus* sp. (= *Modiola ruuthi* n. sp.), *Gervillia* sp. (= *G. scanica* ?), *Myacites* sp. (cf. *Pholadomya coticulae* LUNDGR. sp.), and *Pleuromya striatula* AG. (= *Platymya aquarum* LUNDGREN sp.). In addition there are *Modiola hillana* and a cast of *Cardinia follini*. There is no doubt that these boulders are derived from the same bed. ANGELIN has no further notes about the locality. His collections were made no earlier than in the fifties, or about 20 years later than those preserved in Helsingborg.

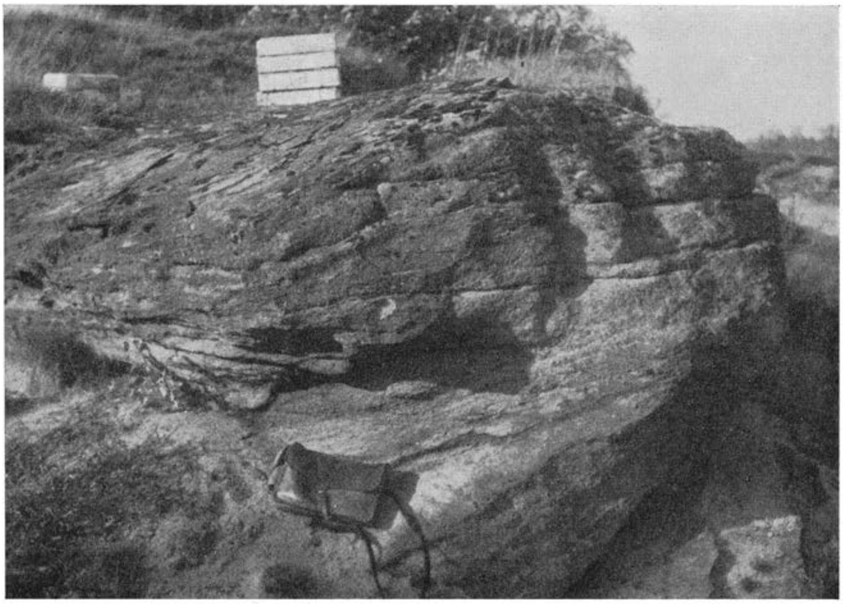
LUNDGREN was of the opinion that the Boulder No. 1 belonged to the *Ostrea* Bank at the top of the Helsingborg Stage. But the above interpretations as well as the fauna, which is most allied to that of the *Mytilus*, *Cardinia*, and *Pullastra* Banks, indicate the lower part of the Helsingborg Stage.

The Döshult District

Döshult is situated in the deepest part of the Höganäs basin,[1] where the topmost sediments, the Döshult beds, are preserved. These are distributed over the entire region from Hjelmshult to Viken, more especially along the southern side of the syncline, while the northern part is covered by thick Quaternary deposits. The most striking sediment is a coarse sandstone, accessible in roches moutonnées, sandpits and in the tilled fields of Döshult, Hjelmshult, Kristinelund, Vikens Ryd, Flundrarp and many other places. The sandstone is sometimes hard and quarried, but more often loose, probably on account of weathering, and dug out as sand. The latter is the case at the type locality of Döshult (Loc. 35, Figs. 9—10), where the quartz sand is brown from iron oxide and well stratified in undisturbed, cross-bedded layers. It is rather coarse with well rounded pebbles, 10—20 mm. in diameter, scattered in the sand or concentrated at certain horizons. The only fossils are silicified pieces of wood. Another large sandpit has been dug at Hjelmshult, where exactly the same material is exposed. Small sandpits of white sand are common to all the region. When exposed to the air the sand soon becomes yellow or brown through oxidation, and burning sometimes turns it brownish-red. In the tilled fields the humus is crowded with quartz grains and pebbles derived from the rock beneath. In this reducing environment the quartz retains its white colour and stands out distinctly against the black humus, the distribution of the Döshult sandstone being thus easily recognized in the field, as soon as the glacial drift is absent and the bed rock directly covered by the humus.

The "roches moutonnées" are exactly similar to those in the Archaean districts, when seen at some distance. They represent the most resistant rock in the Döshult

[1] TROEDSSON 1938 a, the map P. 508.

S  N

E  W

Figs. 9 and 10. Cross-bedding in Döshult sandstone at the type locality.

Stage but in reality they are badly cemented and disintegrate easily. About fifteen such exposures have been mapped in this region. In the prehistoric age they were used for grinding stone implements and are still, in places, covered with grinding furrows.

From the Döshult beds Bernhard Lundgren (1881) described a fauna, mainly consisting of ammonites and lamellibranchs, obtained from marl pits, most of which are now covered and inaccessible. The pits were dug in calcareous clay and sandstone. The fossiliferous ones are seen on the map (Fig. 11, Nos. 65, 66, 70, 169, and 170).

A list of the fossils may be given here, principally according to Lundgren:

Oxytoma sinemuriensis (d'Orb.)
Pseudomonotis subaequivalvis Lundgren
Gervillia ? sjögreni Lundgren
Radula pectinoides (Sow.)
Chlamys janiformis (Lundgren)
Gryphaea arcuata (Lam.)
Coroniceras bucklandi (Sow.)
" *bisulcatum* (Brug.)
" *sauzeanum* (d'Orb.)
Agassiceras striaries (Quenst.)
Arnioceras falcaries (Quenst.)
Agassiceras scipionianum (d'Orb.)
Nucula ? sp., *Cardinia* sp., *Pleuromya* ? sp., "*Ammonites*" sp., "*Belemnites*" sp., Gastropods, *Rhynchonella* sp.

The present writer has met with this fauna partly in pebbles close to an old marl pit at Kristinelund (loc. 152), and partly in the core at Oregården (Page 27).

At Kristinelund the following fossils have been met with:

Oxytoma sinemuriensis
Pseudomonotis subaequivalvis
Gervillia sjögreni
Radula pectinoides
Chlamys janiformis, very common
Gryphaea arcuata, common
Entolium ? sp.
Coroniceras sauzeanum
Dentalium sp.
Rhynchonella sp.
Serpula sp.

The relation of this horizon to the Döshult sandstone was never settled, because the fossiliferous localities are few and scattered, without any direct contact with the sandstone. But there seem to be some possibilities of tracing the different

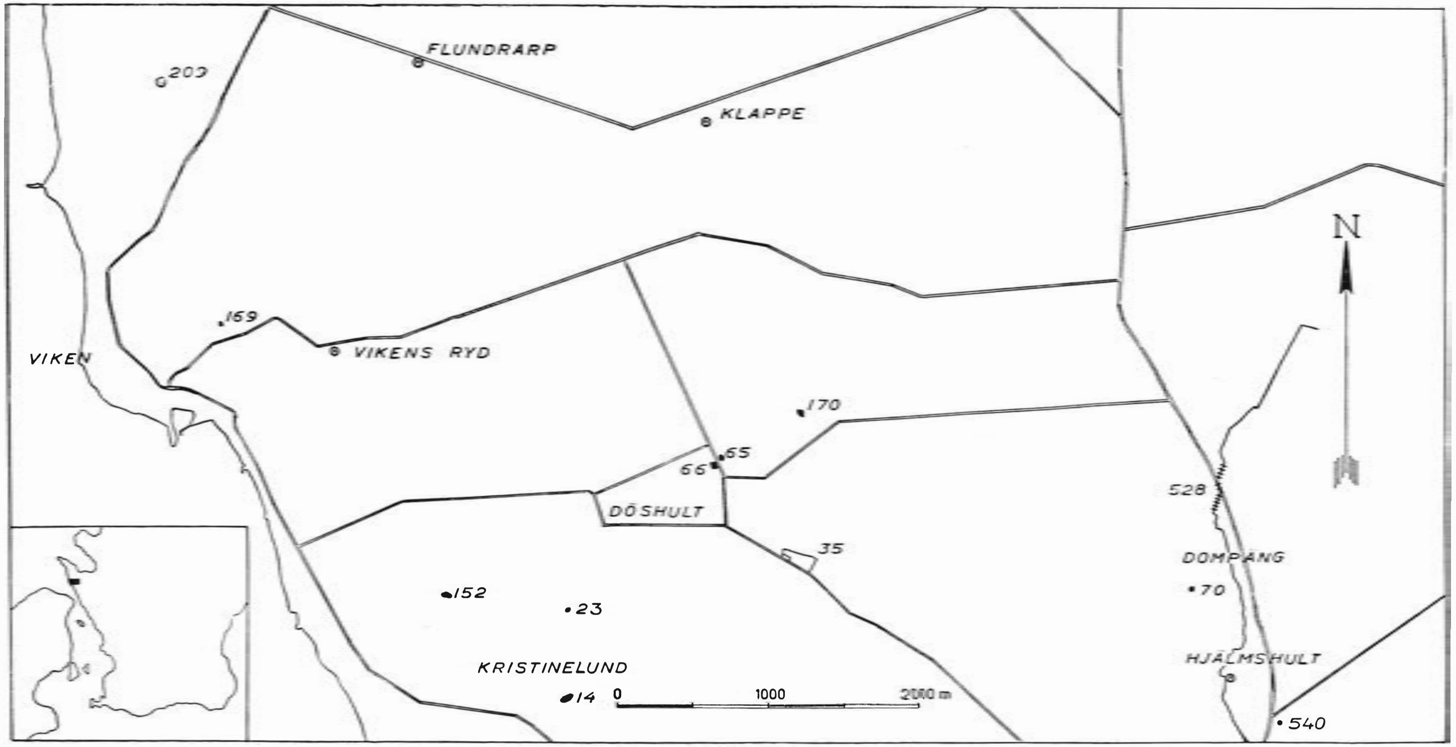


Fig. 11. Sketch-map of the Döshult district, showing the position of the core-drillings at Klappe and Svanebäck (209); the cable-tool drillings at Vikens Ryd, Flundrarp, and Hjelmshult; LUNDGREN's classical localities with the Ammonite Bank at Nos. 169 (Viken), 65—66 (Döshult), 170 (Djuramåsa, perhaps not this but another marl pit 300 m. to the north), and 70 (Dompäng); the new locality in the Dompäng brook, 528; the sand pit at Hjelmshult, 540; the type locality of the Döshult sandstone, 35, and the new localities, 14, 23, and 152, at Kristinelund.

horizons at Hjelmshult, where these beds are likely to have been pierced in an old borehole, executed in the years 1813—1814 to a depth of 150.80 metres. Below a cover of Quaternary beds, 2.08 metres, came (1) a series of sandstones, coarse and fine, hard and loose, white and dark, in all 12.16 metres, (2) coal 0.30 m., (3) grey clay 0.66 m., (4) white coarse sandstone 1.78 m., (5) grey clay shale 4.65 m., (6) fine sandstone 20.4 m., &c. The coarse sandstones belong to the Döshult Stage.

Close to this bore-hole there are three localities with fossils, viz. locs. 70, 528, and 540 (Fig. 11).

Loc. 70. A marl pit at Dompäng. This is one of the classical localities with the Ammonite Bank fauna. It is situated on the western hillside of the Dompäng brook, but is now filled with water and inaccessible. According to LUNDGREN the strata dip slightly S.W.

Loc. 528. In the Dompäng brook, where it crosses the highway, N. of Hjelmshult, outcrops of quite undisturbed fossiliferous Liassic beds were uncovered in the year 1906, but are now inaccessible. Collections made in the southern part of the section in a typical Döshult sandstone were rich in lamellibranchs and are preserved in the paleontological museums of Lund, Stockholm, and Upsala. The rock consists of sandstone, with thin beds of quartz granule or pebble gravel, and mudstone, both with lamellibranchs. Judging by the position, these beds come below the Ammonite Bank at loc. 70. The fauna, too, seems to be more connected with that of the *Avicula* Bank. The following fossils have been identified:

Cardinia kullensis n. sp., the most common species,
Tancredia arenacea (NILSSON),
Oxytoma sinemuriensis (D'ORB.), and
Modiola hillana SOW.,

all of which are also known from the type locality of the *Avicula* Bank at Kulla Gunnarstorp.

Loc. 540. Sandpits in the coarse and loose Döshult sandstone at the cross-road 1.6 km. S. of loc. 528. Here the same fauna was found by Professor Erik Stensiö in the year 1925. The strata seem to be practically horizontal, except for an irregular cross-bedding.

Loc. 70 is placed 600 m. S.S.W. from loc. 528, and 300 m. W.S.W. from the line connecting the localities 528 and 540. Furthermore, the bore-hole at Hjelmshult is situated 200 m. to the west of the same line. If there are no faults between these places, it is obvious that the fossiliferous Döshult sandstone at locs. 528 och 540 is represented in the upper part of the bore-hole at Hjelmshult, while the Ammonite Bank of loc. 70 comes above the bore-hole.

In the northern part of loc. 528 there is an arenaceous shale with plant fossils determined by NATHORST, viz. *Nilssonia polymorpha*, *Sagenopteris Nilssoniana*, *Pityophyllum longifolium*, *Baiera* cf. *taeniata*, and *Equisetites* sp., all of which occur also in the Pålsjö flora. This seems to be the last occurrence of the *Thaumatopteris* flora in Sweden.

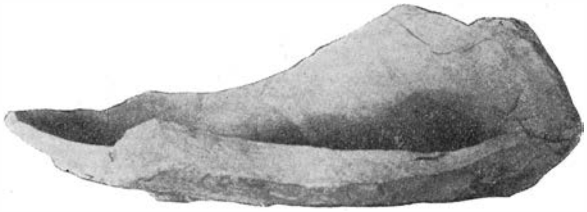


Fig. 12. Folded sandstone layer. Slusås, near Kristinelund. Size × 0.2.

From the above we conclude, that the *Avicula* Bank comes below the Ammonite Bank, and that the Pålsjö flora extends at least up to the base of the Döshult Stage.

A series of outcrops along a small creek near Kristinelund in the southern part of this region exhibit greatly disturbed beds, folded (Fig. 12) and faulted, sometimes in an almost vertical position. Only two of these localities, Nos. 14 and 23, have yielded fossils, though only in pebbles. At loc. 14 only fragments have been met with, but at loc. 23 slabs of a fine sandstone at the bottom of the creek contained plenty of "*Cyclas*" *nathorsti*, and more or less fragmentary specimens of *Cardinia follini*. Both are characteristic species of the Lower Helsingborg Stage of the shore section, N. of Helsingborg.

Bore-holes of the Döshult District

Several deep borings have been carried out within the deepest part of the Höganäs basin and its northern limb. Since the Rhaetic part of the succession is rather well known through mining and through the sections of the coal-bearing beds from Erdmann's publications, we are here going to pay attention mainly to those borings that are able to throw light upon imperfectly known parts of the succession, more especially the Liassic column. The Rhaetic part will be treated here only in order to elucidate the stratigraphy of the whole series.

Amongst old borings for coal are to be mentioned those at Vikens Ryd 236.69 m., Flundrarp 162.64 m., Hjelmshult 150.80 m., and L. Tornhult 199.34 m., all of which are published by Erdmann.

From the beginning of this century up to the year 1924, the Höganäs-Billesholm Co. carried out a series of cable-tool drillings (Nos 1—26), between the stations Ingelsträde and Stureholm along the Höganäs railway, thus extending beyond the limit of the Engelholm basin (at Mjöhult, P. 29), partly S. of Höganäs; these have provided valuable information as to the stratigraphy, thanks to the carefully made records of the strata. Besides Mjöhult No. 10 (see above), may be mentioned Nos. 22 and 25 at Brandstorp (depths 164 and 186.5 m.), Nos. 23 and 26 at Buskeröd (208 and 160.58 m.), and No. 24 at Gödstorp (176.25 m.), all situated south of Höganäs. Especially important is the diamond boring at Klappe, 517.81 m. deep, executed in the year 1919 by the Swedish Diamond Drilling Co. at the request of

Höganäs-Billesholm Co. and under the supervision of the late Professor K. A. Grönwall. In this boring 271 m. of Kågeröd beds were pierced. The Kågeröd was certainly reached also in the Vikens Ryd boring and undoubtedly in Nos. 22 and 24 above.

Finally the Höganäs-Billesholm Co. has placed two of its modern core-borings close to Viken, viz. the important No. 209 at Svanebäck (267.65 m. deep), and No. 210 at Lerberget.

In these bore-sections — as far as they reach a sufficient depth — the Lower Coal Bed is relatively well developed, the Upper one only scantily, and the distance between them varies but averages 25 m., and the lower part of the Lias is especially rich in sandstones.

Only the bore-holes at Klappe and Svanebäck will be treated more fully below.

Klappe, core-drilling, situated 6 km. S.E. of Höganäs (see the map. Fig. 11). The core is preserved in the Geological Institute, Lund, where the author had the opportunity of studying it for a few days in the summer of 1937.

Geological Succession	Thickness in metres	Total depth in metres
Quaternary deposits	12.95	12.95
Döshult beds (?)	7.35	20.30
Helsingborg Stage	209.87	230.17
Rhaetic	15.11	245.28
Brecciated zone (Hiatus)	1.48	246.76
Kågeröd formation	271.05	517.81

Until 17.65 m. there are no samples, but in the record the lower boundary of the Quaternary is placed with reserve at 12.95 m.

12.95—20.30 m. Greenish grey beds of sandstone and argillaceous shale, a few coal seams, and clay shale with plant remains; of the latter "*Gutbiera*" and *Dictyophyllum* have been identified. It is uncertain whether these beds belong to the Döshult or to the Helsingborg Stages.

The Helsingborg Stage.

20.30—48 m. Mostly sandstones. In the upper half with calcareous and ferruginous beds; at the middle a clay with "*Gutbiera*", *Dictyophyllum* and other plant remains.

48—68 m. Mainly clays with thin coal seams, and plant remains at several horizons.

68—73 m. Sandstone with two calcareous beds.

73—97 m. Two groups of clay with coal seems and plants.

97—120 m. Mainly sandstone.

Down to 120 m. no invertebrate fossils have been found, according to the record, but from 120 m., down to the Rhaetic, beds with plants and lamellibranchs alternate.

120—125 m. Clay with clay ironstone, cone-in-cone marl, fish scales, and squeezed, thin-shelled lamellibranchs, similar to *Eotrapezium*.

125—128 m. Clay with plant fossils.

128—131 m. Sandstone with *Modiola hillana*, *Liostrea hisingeri*, and *Cardinia ingelensis*. Probably the same horizon as the grind sandstone at Ingelsträde, Brandstorp and Täppeshusen, and in the Oregården core at 190—195 m.

131—132 m. Clay with plant fragments.

132—144 m. Sandstone. Indeterminable lamellibranch at 139 m.

144—148 m. Clay with plant remains.

148—151.6 m. Sandstone.

151.6—163 m. Clays. Plants in the upper and lower parts, *Modiola hillana* and *Liostrea hisingeri* between.

163—165 m. Sandstone, in the lower part grindsandstone with *Cardinia follini*.

165—186 m. Clay beds with plants at 8 horizons, cone-in-cone marl, clay-ironstone and beds of sandstone.

186—217.65 m. Sandstone with beds of clay shale and arenaceous clay; plants at 191.5 m. and 202—206 m.; *Liostrea hisingeri* at 193—196 m.

217.65—230.17 m. Boserup beds, upwards arenaceous, downwards argillaceous and slicken-sided.

The Rhaetic (230.17—245.28 m.): The topmost bed is a thin black shale with *Modiola* sp. The Upper Coal Bed is likely to be represented by another black shale at 231.70—231.91 m. The Lower Coal Bed is missing, probably due to a big fault represented by the

Brecciated zone. This dips 62° and contains fragments from the Vallåkra and the Kågeröd beds. A considerable part of the succession, estimated to 35 metres, has been lost in the fault.

The Kågeröd beds, from 246.76 m. to the bottom at 517.81. For further information as to this part of the column refer to HADDING (1929) and TROEDSSON (1942).

Below 170 m. the strata show an increasing degree of dipping when approaching the fault, and in this lower part the clays are commonly slicken-sided. At 171 m. the dip is 3°, at 180 m. 8° or 9°, at 215 m. 20°, and at 225—243 m. 28°—45°. In the Boserup beds there is a breccia with a dip of 80°. Farther down the strata gradually become more or less horizontal: at 321 m. the dip is 10°, at 358 m. 6° or 7°.

Hjelmshult. According to this old bore-hole, made by the Höganäs Co. in the years 1813—1814 to a depth of 150.80 m., coarse sandstones should occur in the upper 17 metres, and at a depth of 71—84 m. As already mentioned the first one belong to the Döshult series, while the lower sandstone horizon is likely to be correlated with the Fleninge beds.

Svanebäck, core-drilling No. 209, situated south of Höganäs (See map, Fig. 11), carried out by the Höganäs-Billesholm Co. in 1927. Depth 267.65 m.

Geological Succession	Thickness in metres	Total depth in metres
Quaternary deposits	2.20	2.20
Döshult Stage	57.06	59.26
Helsingborg Stage	180.08	239.34
Rhaetic	28.31	267.65

The Döshult Stage contains about 40 m. of coarse sandstones in two horizons, the lower one, 30 m. thick, being a typical Döshult sandstone. Between these sandstones there is a series of fine sandstones including beds of clay and clay ironstone.

The Helsingborg Stage is definitely fine-grained: argillaceous sandstones and shales, coal seams and clay ironstone. The basal Boserup beds (18.3 m.) are composed of slicken-sided clays, rich in kaolin and sand; sandstones, and clay ironstone.

The topmost bed in the Rhaetic is a dark clay with *Modiola* sp. The Upper Coal Bed is a bituminous clay followed downwards by fine sandstones and clays. The boring did not reach the Lower Coal Bed.

Fossils have been found at different horizons.

The *Modiola* sp. just mentioned is assigned to the Rhaetic on account of its position below the Boserup beds. It is very plentiful, but all specimens are squeezed and crushed, and therefore cannot be determined.

At 193.60—195.40 m. is a light, fine-grained sandstone with *Liostrea hisingeri* and *Modiola* sp.

At 179.50—179.80, a thin sandstone layer with indeterminable fragments of lamellibranchs. These two horizons undoubtedly belong to the marine Pålsjö series found also at Klappe. Finally, at 65.33—66.30 m., thus at the very top of the Helsingborg Stage, a thin-bedded clay, intercalated with sandstone, contains plenty of ganoid scales.

L e r b e r g e t core-drilling No. 210. N.W. of Svanebäck. Depth 55.93 m. Below the 21 m. thick Quaternary cover, argillaceous beds with thin coal seams prevailed — the whole succession probably pertaining to the top of the Helsingborg Stage. No fossils met with.

Shore Section North of Helsingborg

(Pålsjö-Hittarp-Kulla Gunnarstorp)

The outcrops along the shore, north of Helsingborg, really belong to the Vallåkra trough, but at their northern part they are closely connected with the Höganäs basin and show a typical Döshult facies. Hence it seems most appropriate to treat them in connection with the Döshult region.

The southern part of the section (containing the classical fossiliferous beds at Pålsjö, Gravarna, and Sofiero in the northern part of Helsingborg) is described

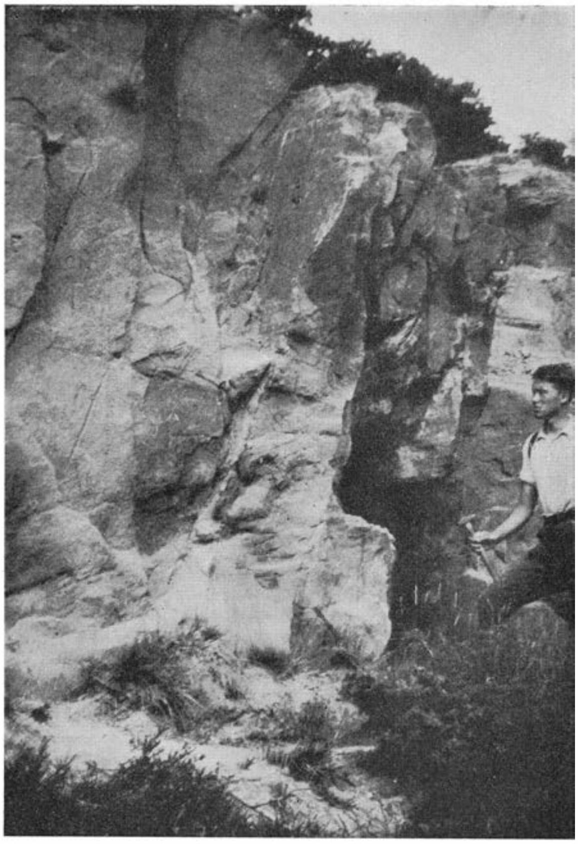


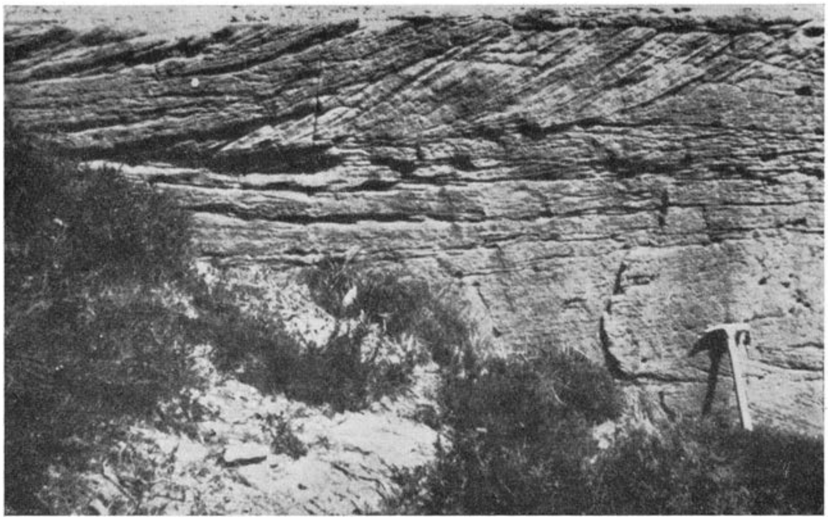
Fig. 13. Brecciated Döshult sandstone at the big fault, loc. 327, Laröd.

in a previous paper (Troedsson 1947 b) with a complete succession of strata and a diagrammatic section made up of the Lower Helsingborg Stage. The Upper Helsingborg is almost missing at this place, owing to two fault lines running N.E.—S.W. and cutting the cliff at right angles to the shore-line, in the northernmost part of the village Laröd. The total displacement is 120 to 180 m. The northern fault is visible in the raised cliff as a brecciated zone, 15 m. broad, consisting of angular blocks of Döshult sandstone (Fig. 13). Besides the fault plane is polished and striated and dips 40° N.W. The southern one dips 60° in the same direction. They are 450 m. apart and the intervening space is occupied by soft grey, strongly-folded clays devoid of fossils, but apparently belonging to the Upper Helsingborg Stage.

Just north of the faults, typical coarse, ferruginous, cross-bedded Döshult sandstone forms the cliff at Laröd and Hittarp (Fig. 14) and is clearly visible there for a distance of several hundred metres, as well as in the intersecting ravines and in

Fig. 14. The cliff at Laröd-Hittarp. The large breccia, loc. 327, is seen at the top of the cliff, above the car.

the water line. The beds dip west and show beautiful structures on the weathered surface (Figs. 15—16). Hard beds of iron sandstone occur at different horizons. The shore exposures (Fig. 17) continue northwards for about 800 m. At Hittarp, 1250 m. N.W. of the faults, a truncated edge of sandstone, covered with sand and gravel, forms a spit, the so-called Hittarp reef, that projects out into the Sound at right angles to the shore-line, and is visible for a length of about 400 m., at least at low water. North of this "reef" the rock is still covered for a distance of 700 m. as far as the fossiliferous beds at Kulla Gunnarstorp, though in the space between a thin coal bed has been dug out under the water, which is rather shallow here. Accordingly the "reef" forms an isolated ridge with its nearest exposures 450 m. to the south and some hundred metres to the north. Its own strata are rarely exposed and have never been seen by the present writer. But occasionally, when not covered by the waves they are accessible at especially low water. Thus LUNDGREN has found a grey, fine sandstone or arenaceous shale with small pieces of coal and plant fragments, together with "*Pholadomya*" *expansa* (= *Cardinia expansa*). And in a shale above the aforesaid coal bed "*Pholadomya elevato-punctata*" (= *Cardinia follini*) has been met with. Both these species are characteristic of the Grind sandstone (the *Cardinia* Bank) at Pålsjö, Gravarna, and Sofiero. This indicates a considerable fault along the southern side of the "reef". Another displacement must have taken place between the "reef" and Kulla Gunnarstorp, where the coarse Döshult beds appear anew after a hiatus of 1150 metres along the



Figs. 15—16. Döshult sandstone at Laröd. Weathered surface showing cross-bedding.

shore. This hiatus is occupied by an uplift, which has brought the Lower Helsingborg beds into light, though their softness and the accumulation of sand and gravel have made them almost totally inaccessible.

At Kulla Gunnarstorp (Loc. 202, Fig. 17) the beds dip south. The lowest bed accessible is the so-called *Ostrea* Bank. This is met with in the southernmost exposure, where the beds form a low anticline with axial dip towards W.N.W. and

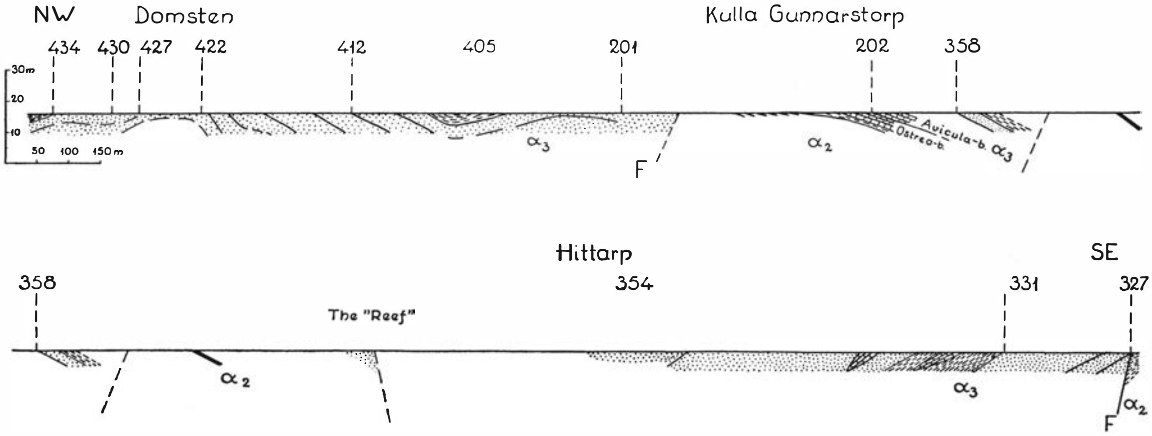


Fig. 17. Shore section between Domsten and Laröd, with the *Ostrea* and *Avicula* Banks at Kulla Gunnarstorp. α_2, upper parts of Helsingborg Stage; α_3, lower parts of Döshult Stage. The figures are the localities recognized during the field work. (This section is continued south-eastwards by Fig. 10 in Troedsson 1947 b, p. 413.)

are well exposed in the shore-line (Fig. 18). The youngest beds consist of Döshult sandstone, coarse-grained, cross-bedded, and rich in iron sandstone (Fig. 19). They are exposed at the water level as outcropping edges about 100 m. off the present shore and then farther N.W. along the shore (Locs. 201, and 400—434, Fig. 20).

Succession of strata (from above):

7. Coarse Döshult sandstone (in the peripheral exposures).

6. The *Avicula* Bank, a fine-grained sandstone, grey and loose in the upper part; downwards brown or reddish, ferruginous, thick-bedded, and rich in fossils: *Cardinia kullensis*, *Tancredia securiformis*, *T. arenacea*, *T. erdmanni*, *Homomya venulithus*, *Oxytoma sinemuriensis*, *Oxytoma* ? sp., *Chlamys janiformis*, *Entolium hehli* ?, *Plicatula* sp., *Modiola hillana* Sow. (?), and *Dentalium* ? sp. Thickness 1.8 m.

5. Argillaceous shale, black or dark grey. Thickness 0.45 m.

4. The *Ostrea* Bank, an arenaceous shale with carbonized bedding planes and 2 or 3 fossiliferous beds of iron sandstone, averaging 30 cm. in thickness, the uppermost one conglomeratic with cobbles of iron sandstone, reaching 15 cm. in diameter. The fossils are rare and occur in the matrix. The following species are met with: *Liostrea hisingeri*, *Gervillia hagenowi*, *Anomia pellucida* (?), and *Modiola hillana*. Thickness 1.3—1.7 m.

3. Sandstone, grey, loose, with *Gutbiera* (according to Lundgren). Thickness 1.15 m.

2. Argillaceous shale 1.0 m.

1. Arenaceous shale with carbonized bedding planes 1.0 m.

The *Avicula* and *Ostrea* Banks are ferruginous and contain marine fossils. They are only separated by a thin bed of shale (see above) or sandstone (Lundgren). The differences are essential, however, and indicate a break in the succession.

Fig. 18. The shore section at Kulla Gunnarstorp. The *Ostrea* Bank in the foreground. At the spit across the small bay is the outcropping Döshult sandstone seen in Fig. 19.

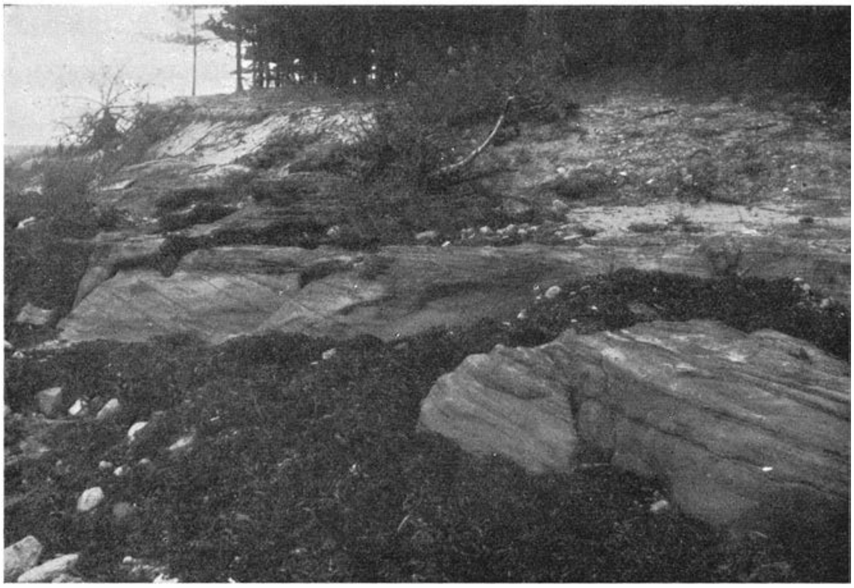


Fig. 19. Döshult sandstone at the shore NW of the *Ostrea* Bank at Kulla Gunnarstorp.

Fig. 20. Outcropping Döshult beds at the shore, Domsten.

Firstly, no species are common to these beds, except *M. hillana*, which occurs with typical specimens in the *Ostrea* Bank but is represented by small questionable ones in the *Avicula* Bank. On the other hand, some of the species of the *Ostrea* Bank are characteristic of all the Helsingborg Stage, for instance *Liostrea hisingeri* and the typical *M. hillana.*

In his first paper (1878) LUNDGREN listed the index fossil of the *Avicula* Bank as *A. sinemuriensis* and reported *A.* cf. *sinemuriensis* from the *Ostrea* Bank (l. c., p. 24, 40, and 42). The latter statement was derived from a pebble, found by LUNDGREN at the same place and referred to the *Ostrea* Bank on lithological grounds. According to LUNDGREN it contained *Avicula* cf. *sinemuriensis*, *Myacites* sp., and *Pecten* sp. The present writer has had occasion to study the rock specimen preserved in the Paleontological Museum of Lund (LO 320). The fossils are not well preserved, it is true, but there is one typical external mould of a left valve of *Oxytoma sinemuriensis*, and a few other *Oxytoma* valves, also a right one, presumably belonging to the same species, further *Pleuromya* sp. (cf. *P. forchhammeri*) and a fragment of a pectinid, most probably *Chlamys textoria.* Finally, there are several incomplete casts of an ostreid, which seems to belong to *Gryphaea*, and an external mould of a small astartid (?), similar to those in bed 5, Katslösa. This fauna indicates a distinctly younger horizon than the *Ostrea* Bank, probably the *Avicula* Bank. Accordingly *Oxytoma sinemuriensis* has not yet been found in beds below the *Avicula* Bank.

Secondly, the break between the *Ostrea* and the *Avicula* Banks is pronounced lithologically, the topmost bed of the former being developed as a coarse conglomerate with large pebbles of iron sandstone. A similar conglomeratic iron sandstone is accessible in the Döshult beds of the shore section, 200 m. to the north (Loc. 201), but no fossils have been met with there.

This lithological and faunistic hiatus is of interest, since it forms the boundary between the Helsingborg and the Döshult Stages or between the Hettangian and the Sinemurian. The *Ostrea* Bank is a wash-out zone at the top of the Helsingborg Stage, and the *Avicula* Bank introduces a new marine transgression immediately above it, higher up followed by open-sea forms, such as ammonites, met with in the Döshult region and in the bore-hole at Oregården. At Kulla Gunnarstorp the coarse Döshult sandstones come above the *Avicula* Bank. This is probably also the position of these sediments at Laröd, where the *Avicula* Bank is not accessible. In the Döshult Basin the *Avicula* Bank is represented by beds with *Cardinia kullensis* which do not differ lithologically from the Döshult beds in which they are enclosed. About 20 m. above these *Cardinia* beds comes the Ammonite Bank at Dompäng. At Oregården the Ammonite Bank is about 15 m. thick and is followed downwards *inter alia* by a Döshult sandstone, only 8 m. thick. A sandstone with *Tancredia arenacea* and *T. erdmanni* at 95 m. is probably a facies of the *Avicula* Bank. It appears 32 m. below the fossiliferous base of the Ammonite Bank. Still further down, at 110—111 m., comes the *Ostrea* Bank. This increasing thickness of intercalated beds from Kulla Gunnarstorp to Oregården, from the S.W. to the N.E., is seen from the table below. It is contemporaneous with a marked diminishing of grain-sizes in the same direction and a thinning out of the Döshult sandstones.

	Laröd	Kulla Gunnarstorp	Svanebäck	Dompäng	Oregården
Ammonite Bank	—	—	—	present	15 m.
Döshult sandstone, coarse	> 50 m.	> 20 m.	40 m.	> 20 m.	8 m.
„ „ , fine		—	17 m.	—	24 m.
Avicula Bank	not accessible	present	?	present	present
Intercalated beds	„ „	0 m.	?	plant-bearing	15 m.
Ostrea Bank	„ „	present	?	—	present

At Oregården the coarse sandstones are restricted to the beds between the *Avicula* and the Ammonite Banks, and this is their main distribution also at Laröd, Kulla Gunnarstorp, Svanebäck, and Dompäng (Hjelmshult), though it is not altogether impossible, that they may recur above the Ammonite Bank; and, to judge from the record of the old boring at Hjelmshult, they should already appear in the Helsingborg series. This, however, needs to be corroborated.

Grind Sandstones

Until the beginning of this century a wellknown grind sandstone was quarried at Pålsjö and other places in the northern part of Helsingborg. It was from there that Hébert and Lundgren got the specimens of *Cardinia follini.* Grind sandstone was quarried also at several places in the Höganäs basin, viz. at Täppeshusen, 9 km. S.E. of Höganäs, and at Brandstorp and Ingelsträde, which are respectively 5 and 4 km. distant from the latter town. Quarrying operations are still going on at Ingelsträde, where the thickness of the sandstone is 1.6 m., out of which 1.35 m. is used for stone slabs for gardens, or for whetstones. The strata are practically horizontal or dip 2° or 3° N.W. or N.E. In a thin bed in the middle of the sandstone occurs a lamellibranch, *Cardinia ingelensis* n. sp., sometimes sparsely, sometimes plentifully.

In his second monograph (1881) Lundgren claims that *C. follini* was found at Täppeshusen and Brandstorp by Hjalmar Lundbohm. The present writer has had the opportunity of studying Lundbohm's specimens from Täppeshusen amongst the collections of the Geological Survey of Sweden. There is one, referred to in the paleontological part as *Cardinia* sp., which "has much in common with *C. follini*, but is relatively longer" and certainly specifically different. The remaining specimens are badly preserved but seem to belong to *C. ingelensis*. In any case, they are quite different from *C. follini*.

From the above it is evident that the *Cardinia* Bank with *C. follini*, met with *i. a.* at Pålsjö and in the Klappe boring, is stratigraphically different from the sandstone with *C. ingelensis* at Täppeshusen, Brandstorp, and Ingelsträde.

Petrographically these sandstones are very similar. Thin sections of the Ingelsträde sandstone show particle diameters of 0.05—0.13 mm., and angular and rounded quartz grains. The Pålsjö sandstone is slightly finer, the grain diameter rarely exceeding 0.05 mm., and is fairly rich in feldspar. For analyses, see P. 20.

According to measurements from the coal mine, which is now worked just beneath the quarry at Ingelsträde, the Ingelsträde grind sandstone is situated 147 m. above the Lower Coal Bed, i. e. about 117 m. above the Rhaetic-Liassic boundary, while the grind sandstone at Klappe lies only 65 m. above the same boundary.

Accordingly, there are two horizons with grind sandstone, both with *Cardinias*, the lower one with *C. follini*, belonging to cycle No. 6, and the upper one with *C. ingelensis*. Since the latter species has also been met with in the drilling cores at Oregården and Klappe, viz. in cycle No. 8, it is likely to be a leading fossil of that cycle.

The Eastern Colliery Districts

(The region Ormastorp-Skromberga)

The main colliery districts of N.W. Scania — Ormastorp, Gunnarstorp, Bjuv, Risekatslösa, Skromberga, formerly also Hyllinge, Billesholm and Bosarp — form a continuous coal-bearing region, 5 or 6 km. wide and 20 km. long, in the eastern limb of the Höganäs trough, along the horst Söderåsen. The strata belong to the basal part of the Rhaetic-Liassic column, but are mostly covered by heavy deposits of Pleistocene age. Proceeding from the western limit of the coalfields, the upper surface first cuts the lowest Lias, then deeper and deeper horizons — the Rhaetic, the Kågeröd, and probably the Lower Paleozoic, all of which form small strips of bedrock along the foot of the Archaean horst.

Generally the Rhaeto-Liassic sediments are highly arenaceous close to the horst, independently of their age. Thus, at Gunnarstorp the sediments between the coal beds are coarse-grained and very similar to the Boserup beds. This is especially the case in the adits running towards the horst. There is a strip between the coalfields and the horst, east of Bjuv, where the old borings report only sandstone, more than 40 m. thick, above the Kågeröd. This sandstone certainly corresponds to the Rhaetic, at least partly. But it contains only one coal bed, which is sometimes rather thin, and sometimes not evident at all.

In the coal districts the normal succession is as follows:

1. Lowest Lias, mainly sandstones, Boserup beds at base. No coals.
2. Rhaetic
   1) The Upper Coal Bed (A), mostly thin, but at places thick enough for mining.
   2) Sandstones and clays between the coals.
   3) The Lower Coal Bed (B), the most valuable and most exploited one in the coalfields.
   4) Clays and sandstones below the Lower Coal Bed.
   5) The Vallåkra beds, without coal, badly stratified.
3. The Kågeröd red beds, badly stratified.

The rocks and the geological conditions, especially in connection with the coal-beds, were fully described by ERDMANN in 1915. Since that time, however, a great many new facts have come to light, thanks chiefly to the core drillings, which have added much to our knowledge of the stratigraphy of the whole basin. Since it is impossible to quote all the records from these drillings, I think it more appropriate to choose a few typical ones, and with their guidance discuss the stratigraphy.

Fleninge No. 265, core drilling, situated 1150 m. N.E. of the church. Depth 75.71 m.

Geological Succession	Thickness in metres	Total depth in metres
Quaternary deposits	19.08	19.08
Lias (Boserup beds 10.92 m.)	20.26	39.34
Rhaetic	36.12	75.46
Kågeröd, red-spotted arenaceous clay ..	0.25	75.71

Just above the Boserup beds there are two thin coal seams, at 28.31 and 26.88 m. The Boserup (28.42—39.34 m.) consists of light, grey, kaolin clay, partly arenaceous; badly stratified clays and coarse cross-bedded sandstones (Fig. 21) with white granules of kaolin; nodules and beds of clay ironstone. The lowest part, from 37.17 to 39.34 m., is a white kaolin clay, as in the coal mine at Ormastorp.

At contact with the coal the clay becomes gray, slicken-sided and crowded with plant remains, (mostly carbonized), compressed stems and pieces of glossy, fibrous coal. The Upper Coal Bed is developed as a black bituminous shale and dark clay, 0.31 m. thick. Underlying it is sandstone, mostly fine-grained, but at 45 m. — or 0.3 m. above the Lower Coal Bed — there is a coarse, black sandstone, 0.10 m., with quartz grains 3 or 4 mm. in diameter. This type of sandstone is very rare in the Rhaetic-Liassic beds of Sweden, the nodules and layers of sandstones embedded in the coal being, as a rule, purely white. The black colour may be due to organic matter. The Lower Coal Bed is only 10 cm. thick. Then follow sandstone, gray and fine-grained, partly laminated with clay, 9 m., and dark clay laminated with sand, to 61.32 m. Between 61.32 and 62.03 no core was obtained. Here the Vallåkra beds begin, with non-stratified clays. The following beds were distinguished (from above):

1.	Arenaceous clay, slicken-sided, stratification hardly visible, colour grey with faintly reddish tone; in the lower part spherosiderite	5.20 m.
2.	Dark clay, slicken-sided, with a slight tone of purple	0.25 m.
3.	Arenaceous clay with green and yellow spots, reddish tone, no trace of bedding; spherosiderite in the upper two-thirds	7.98 m.
4.	Clay, mottled red (the Kågeröd)	0.25 m.

The lowest bed, which was hardly more than touched upon, is most probably the Kågeröd, the Vallåkra thus being about 14 m. From 65 to 72 m. the latter contains spherosiderite of precisely the same structure as at the type locality. The size of the spherulites varies from bed to bed. At 70—72 m. the spheres are 2 or 2.5 mm. in diameter; higher up only 0.5 or 1.0 mm. Sometimes they occur sparsely in the clay, sometimes they are crowded together and dominate the bed, forming a hard weighty ore. Below 70 m. the clay becomes lighter in colour. In this section the Vallåkra is devoid of green sandstone and is entirely built up of clays. The thickness of the spherosiderite (about 7 m.), exceeds any other known occurrence of this mineral in N.W. Scania. Yet it is a fact that records from the borings through the Vallåkra usually label the siderite banks as sandstones.

Fleninge No. 266. Core-drilling, situated 1.6 km. E.N.E. of No. 265 and 2.7 km. N.E. of the church. It was carried out in 1935. Depth 180 m.

This bore-hole is separated from the former by the Hyllinge fault line, which runs in N.W.—S.E., and is placed on the downthrown N.E.-block. The displacement at Fleninge is about 100 m.

Geological Succession	Thickness in metres	Total depth in metres
Quaternary deposits (Glacial clay 22 m., Glacial drift 15 m.)	37	37
Lias (Boserup 10.29 m. at base)	114.97	151.97
Rhaetic (Vallåkra 8.77 m. at base)	26.75	178.72
Kågeröd	1.29	180.01

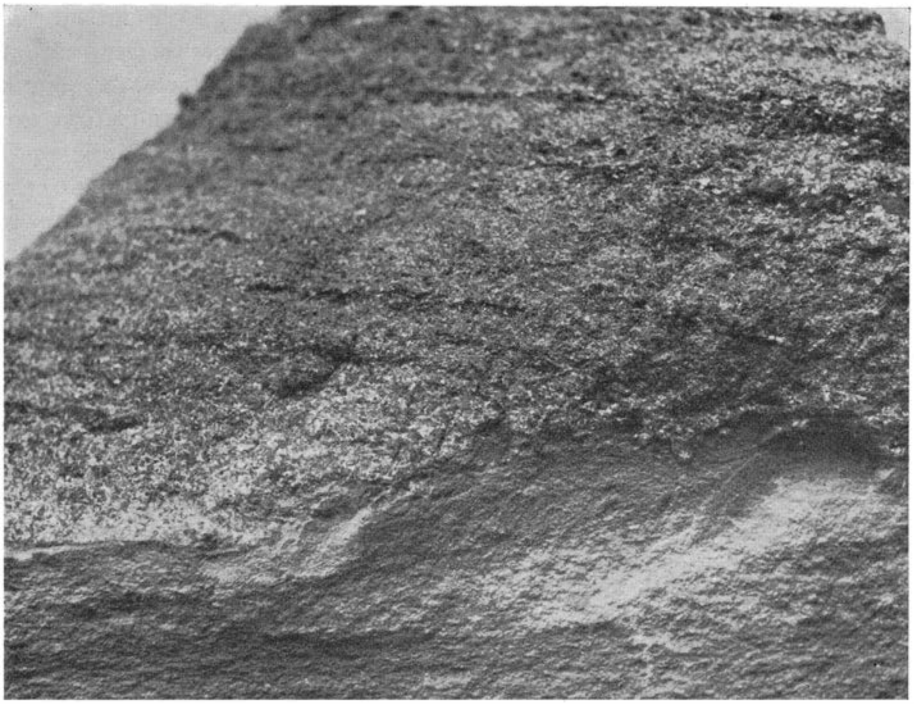


Fig. 21. Drilling-core with Boserup beds. Bore-hole No. 265, Fleninge. Nat. size. Paleontological Institute, Lund.

The Liassic part belongs entirely to the Helsingborg Stage. The upper part consists of sandstones down to 93 m., with several clay beds at 52—65 m. This argillaceous and arenaceous succession also contains calcareous and ferruginous layers and is finished upwards by a white calcareous sandstone, almost 1 m. thick, with carbonized bedding planes, covered by plant remains, rounded pebbles of brown clay ironstone or fine iron sandstone, and fish-teeth. The pebbles are of exactly the same type as in the bonebed at 133 m. (see below), and this sandstone, too, is partly developed as a bonebed. At 56.58 m. are beds with clay ironstone and cone-in-cone marl, and at 65 m. grey clay with plant remains, belonging to the genera *Nilssonia*, *Dictyophyllum* and *Equisetites*.

Below 65 m. appears a sandstone, 28 m. thick, in its upper part very similar to the Boserup beds and consisting of cross-bedded layers of coarse, loose sand, embedded in the common fine-grained argillaceous sandstone. This is a recurrent Boserup facies, called the Fleninge beds. Underlying it is fine sandstone, 20 m., of the usual type.

Then from 93 to 126 m. comes an argillaceous series with plant remains (*Dictyophyllum*, &c.), cone-in-cone marl and thin coal seams, in the upper and lower parts, and sandstone with lamellibranchs (*Eotrapezium menkei*) and calcareous sandstone in the middle; in the lower part, also, a bed with vertical "plugs" of clay ironstone, the latter met with previously in contemporaneous beds of the Pålsjö beds at Helsingborg (Troedsson 1947 b, p. 413). As a rule the plants are indeterminable, but a few fragmentary leaves have been found, for instance *Dictyophyllum nilssoni* (?) between the depths of 95 and 123.50 m., and probably also at 132.50 m. The sandstones are fine-grained, often folded, even in wrinkled and broken layers.

At 133.21—133.38 there is a clay ironstone in which the upper 8 cm. are conglomeratic with pebbles of the same rock, small as peas, in a black matrix with bone fragments and rare fish-teeth. This "bone-bed" is followed downwards by fine-grained, cross-bedded, argillaceous sandstone and arenaceous clay, rather different from the underlying Boserup beds, which were struck at 141.68 m.

The Boserup Beds. The topmost bed is an unstratified brown or greyish green, irregularly mottled, kaolin clay, having pieces of coarse kaolin-spotted sandstone and numerous indeterminable plant remains. Clay dominates the topmost 3 m. and the basal bed. The sandstones in between are rather coarse, and contain beds and nodules of clay ironstone or fine-grained and laminated iron sandstone. They are rich in weathered feldspar. At 147—148 m. they are especially coarse with a maximum diameter of 3.6 mm. for the quartz and the feldspars, and one bed is cemented by lime. The basal bed is a grey, plant-bearing clay in contact with the Upper Coal Bed. The plants could not be identified. The thickness of the Boserup is 10.29 m.

The Rhaetic. The Upper Coal Bed is only 0.05 m. thick (151.97—152.02 m.), the Lower Coal Bed more than one metre (162.71—163.79 m.), though richer in clay than in coal. Between these beds, at 159.30 m., there is a fine seam of pure bituminous coal, 0.06 m., which seems to be widely distributed in the coalfield, to judge from the borings. At 156.80—156.92 m. is found a dark, coarse sandstone, which is certainly an out-thinning of the coarse sandstone or arkose between the coal beds at Gunnarstorp, near Söderåsen. The remaining part of the stratified Rhaetic series is fine-grained and consists mainly of sandstone, with a well stratified black clay shale, 0.18 m. It continues down to 169.95 m., where the Vallåkra follows abruptly, with badly washed, non-stratified clays and sandstones. The contact is uneven and rough, and covered in places with sand, which has introduced a new sedimentation. In one sample, 5.5 cm. thick, a dark coarse sand fills up a cavity, 2 cm. deep, in the Vallåkra clay, and an elevation of brown Vallåkra clay, 6 cm. wide, is surrounded by the stratified black clay. The latter also contains small lenses of Vallåkra clay. There are no traces of sliding at the contact (Cfr. the same contact at Farhult 270, P. 26, and Fig. 5).

The Vallåkra embraces the core between 169.95 and 178.72 m. The upper part, 6.29 m., is argillaceous, while sandstones dominate the lower part 2.48 m. The clays are mostly greyish brown, sometimes plastic and slicken-sided, though often arenaceous and rough. At 171.10—171.30 there is a bed of spherosiderite, at 176.24 a hard green sandstone, dotted with white kaolin, passing downwards into a coarser grey one of the same type. These gradual changes in the sediment are the only evidences of stratification.

The Kågeröd. The boring was finished at 180.01 m., after hardly more than one metre of brown and red Kågeröd clay had been pierced.

Rosendal. Bore-hole No. 264. Depth 96.19 m.

Geological Succession		Thickness in metres	Total depth in metres
Quaternary deposits		15.20	15.20
Lias, mainly sandstones and clays		67.01	82.21
Rhaetic: Coal Bed A	0.01 m.		
Mainly clays	5.46 m.		
Coal Bed B	0.50 m.		
Mainly sandstone	> 8.01 m.	> 13.98	96.19

The uppermost 10 m. of the Lias consist of sandstone, apparently corresponding to that below the coarse Fleninge beds in No. 266. Then follow clays and sandstones, from about 32 to about 52 metres rich in plant and animal fossils, most of which, however, are fragmentary and indeterminable. At 31.90—31.95, i. e. the very top of the fossiliferous beds, *Eotrapezium pullastra*, *Liostrea hisingeri*, and *Modiola* sp. have been found.

At 36.67—37.87 m. is a loose, fine sandstone, with fragments of *Cardinia follini*. This is probably equivalent to the grind sandstone at Pålsjö, Gravarna, and Sofiero, which, however, is more consolidated and somewhat coarser.

At 41.59 m. a ferruginous and rather coarse arenaceous layer in the clay with several indeterminable fragments, inter alia coleopter wings (?).

At 45.61 m. a fragmentary valve of *Modiola*.

At 52.0 m. *Gervillia angelini* and *Modiola hoffmanni* (= *M. hillana* Sow.).

In addition, plant fragments have been met with at nine different horizons at least; thus, a laminated clay at 43.8—44.2 is crowded with plants, and a sandstone at 42.71—42.76 is full of flattened and rounded stem fragments.

The fossiliferous column just described — 20 m. argillaceous and arenaceous, fine-grained sediments, highly ferruginous at different horizons and with thin beds of calcareous sandstone and cone-in-cone marl — represents an out-thinning facies of the main part of the Lower Helsingborg Stage, and has to be parallelized with the fossiliferous sequence at Helsingborg (at Pålsjö, Kärnan, and Ramlösa). (See Table I, P. 113.)

Below these beds comes a barren series composed mainly of clays, with a band of calcareous sandstone, three beds of thin coal, and a few of sandstone. At the contact with the Boserup a fault breccia, 27 cm. wide, cuts the core at acute angles, the fault plane dipping 50°. The hanging wall of the breccia consists of slabs from the layers above, arranged parallelly to the fault plane. The footwall of the breccia is composed of fragments from the Boserup beds. Only a few metres are lacking in the breccia, 7 m. of the Boserup being preserved below the breccia.

The Boserup beds do not differ from the typical facies: cross-bedded sandstones, rich in kaolin, white slicken-sided clays, ferruginous lenses and beds, all entirely barren in fossils, except for plants. The latter are crowded, as usual, in the bottom bed, i. e. the roof clay of the miners. They belong to the zone of *Equisetites gracilis*, but are only partly determinable.

It should be mentioned that among the Rhaetic beds there is a thin layer or lens of kaolin-dotted coarse sandstone, well stratified and partly cemented by lead (at 87.30—87.32). The Vallåkra beds were not reached in this bore-hole.

Ormastorp No. 204, situated 3.5 km. N.E. of No. 266. Depth 105.65 m.

Geological Succession			Thickness in metres	Total depth in metres
Quaternary deposits			35.10	35.10
Lias (Boserup beds 18.20 m.)			63.44	98.54
Rhaetic.	The Upper Coal Bed (A)	0.81 m.		
	Sandstone, partly coarse	3.78 m.		
	The Lower Coal Bed (B)	1.27 m.		
	Arenaceous clay	1.25 m.	7.11	105.65

The topmost Liassic stratum is a sandstone which is correlated with the lower part of the Fleninge beds, also met with in bore-hole Nos. 264 and 266. The remaining part of the Liassic succession coincides in detail with the pre-Fleninge beds in the same bore-holes, as is seen from the table Page 61.

The writer has not seen the core of No. 204, so nothing is known as to its content of fossils.

The drilling-cores described above belong to the northern and deepest part of the region. Here the core-drillings are rare, but earlier cable-tool drillings are closely set in certain districts and have afforded a multitude of information regarding the succession of strata. Farther to the south, the coal beds are nearer the surface, the Liassic column accordingly being short, and the bore-holes are shallow, also because they rarely penetrate beds below the Lower Coal Bed. In a few borings, however, the underlying beds, too, have been pierced. Thus, in the boreholes No. 3 (Bjuv), 25 (Åstorp), 11 (Rosendal), and in Nos. 3, 57, 272, and 273 (Skromberga) the Kågeröd beds have been penetrated down to respectively 181.5 m., 68, 63, 52, 115, 55, and 78 m. In the last one and probably also in the first the Silurian bottom of the Kågeröd was reached (Cf. Troedsson 1942).

Thus along the western side of the horst Söderåsen it is mainly the Boserup beds and the Rhaetic that it was possible to study in the borings.

It is of course impossible to present details of all the material received from borings and coal mines. In order to show the vertical and horizontal changes of

Bore-hole No. 264 - - 4 km. - - - - - No. 266 - - - - - 3,5 km. - - - - - No. 204

Clays with { clay ironstone cone-in-cone marl 6.3 m.	Clays with { cone-in-cone-marl, 2 coal seams 12.6 m.	Clays with { clay ironstone, calcareous sandstone, 2 coal seams 10.4 m.
Sandstone with *E. pullastra* 1.0 m.	Sandstone with *Eotr. menkei* 1.0 m.	Thin sandstone layer 0.1 m.
Clay with plants and coal 1.4 m.	Clay with plants and coal 5.7 m.	Clay 2.5 m.
Sandstone 2.8 m.	Sandstone 0.2 m.	Sandstone 4.2 m.
Sandstone with *Cardinia* & *Modiola*	Calcareous sandstone	Clay ironstone, calcareous
Argillaceous beds with coal, plants and clay ironstone 15 m.	10 m.	10.6 m.
Fine sandstone with clay and coal 18 m.	Fine sandstone with plant-bearing clay 9.2 m.	Fine sandstone 10.3 m.
Boserup cycle { Coal 0.2 m.	Bonebed 0.2 m.	Clay ironstone 0.2 m.
Boserup cycle { Clays with coal seams 4.5 m.	Clays and sandstone 10 m.	Medium sandstone 4.2 m.

sedimentation within this district the author has compiled a series of maps, which will be referred to in the following pages. But meanwhile we shall study a few typical sections, of the different regions, in order to get an idea of the general mode of sedimentation.

Section Ramlösa-Mörarp-Åstorp. This section crosses the Höganäs basin at right angles. It begins at Köpinge, near Ramlösa, in the Vallåkra basin, but otherwise all the places named are situated in the Höganäs trough. The following borings are considered (their mutual distances are given in brackets): Köpinge 3 (3.5 km.) Påarp (6 km.) bore-hole 221 (0.3 km.) Mörarp shaft (1.6 km.) bore-hole 220 (0.7 km.) bore-hole 219 (1.9 km.) Bjuv shaft III (1.2 km.) bore-hole 213 (0.6 km.) Gunnarstorp shaft (0.8 km.) bore-hole 205 (1 km.) bore-hole 212. The three last-mentioned belong to the Broby concession, close to Åstorp.

Discussion of the section. The uppermost beds are present only in the borings at Köpinge and Påarp. At Påarp a thick sandstone occurs 60 m. above the Rhaetic-Liassic boundary. It corresponds apparently to the coarse sandstone at about the same horizon in bore-hole 266 at Fleninge (distance 11.5 km.). At Köpinge this horizon is argillaceous and shows no coincidence with the Fleninge beds.

The Boserup beds are argillaceous at Köpinge and Påarp, while coarse sandstones either dominate or play an important role in the remaining part of the section. The coarse-grained part is less than 10 m. at Mörarp and Bjuv but amounts to 12 or 13 m. in the Broby concession.

The Rhaetic coal beds are uniformly developed, though at Köpinge the Upper Bed is missing, and at Köpinge and Påarp the Lower Bed is represented by a bituminous clay. The vertical interval between the coal beds is shown on the map, Fig. 31. It is remarkably small in bore-hole 212, — less than one metre. This bore-hole is situated in that part of the Ormastorp coal-mine, where both coal-beds are excavated together. The country rock between the coalbeds consists mainly of clay at Köpinge and Mörarp, of argillaceous sandstones in the boreholes 218, 219, and 220, and of pure sandstones in 205 and 213.

The beds beneath the Lower Coal Bed are rarely penetrated to any great extent. As far as they can be considered they are totally argillaceous at Köpinge, where they are directly underlain by the Vallåkra clay. At Påarp the coalbed is underlain by clay sandstone, which is followed downwards by the marly top of the Vallåkra. In the districts of Mörarp and Bjuv the coalbed is underlain by clay which is mostly a fire-clay and not very thick, but otherwise sandstones dominate the space between the coal and the Vallåkra. In the easternmost bore-holes even the under-clay is replaced by sandstone.

This section cuts across the Bjuv coalfield, which is of interest on account of the fossils met with in the Rhaetic beds. In a sandstone included in the Lower Coal Bed, *Cercomya carlsoni* Lundgren and *Liostrea hisingeri* Nilss. have been found. And the layers above have provided several beautiful specimens of stego-cephalians and ganoids.

To sum up, the grain-size of the sediments along this section diminish from the N.E. towards the S.W. Thus, the coarse sediments of the Boserup beds occur only in the eastern districts, arenaceous beds in the east change into argillaceous in the west, and the coalbeds disappear or change into bituminous clays in the same direction. Fire-clays are mostly connected with coal seams embedded in fine sand-stones, while coarse-grained and argillaceous facies are usually devoid of fire-clays.

A section in the Boserup-Billesholm region. The new shaft at Rise-katslösa (Shaft Malmros) was constructed in 1942 between the abandoned coal mines of Billesholm and Boserup and close to the publicly-defrayed core-drilling No. 246. The shaft was sunk in the years 1941—1942. Depth 59.70 m. Both coal-beds were penetrated but no Vallåkra.

Geological succession	Thickness in metres	Total depth in metres
Quaternary deposits, glacial drift	2.10	2.10
Lias. Sandstone, grey, fine, partly laminated	0.23	2.33
Clay, upwards grey, laminated; downwards black bituminous and slicken-sided	2.12	4.45
Coal seam	0.10	4.55
Clay with clay ironstone, grey, including a black slicken-sided clay with coal	3.33	7.88
Coal seam	0.31	8.19

	Thickness in metres	Total depth in metres
Clay, grey, downwards black and bituminous	2.11	10.30
Iron sandstone, brown	0.35	10.65
Arenaceous clay with iron sandstone	5.30	15.95
Clay, dark or black, partly slicken-sided, plant fossils at base	3.95	19.90
Laminated sandstone	2.75	22.65
Dark clay with plant remains (*Nilssonia*)	0.90	23.55
Sandstone, loose, fine, in the middle calcareous, in the lower part ferruginous	10.70	34.25
Coarse sandstone, in the top layer intercalated with kaolin clay, in all beds rich in nodules of clay ironstone (the Boserup beds)	10.95	45.20
Clay, grey, slickensided (Boserup clay)	0.06	45.26
Rhaetic. The Upper Coal Bed, including a bed of plant-bearing grey clay (A)	0.29	45.55
Sandstone, upwards coarse and loose, downwards fine, hard, and laminated with clay, slicken-sided	7.40	52.95
Clay, laminated with sand	3.20	56.15
The Lower Coal Bed (B)	0.66	56.81
Clay, black with plant remains	0.42	57.23
Sandstone, fine, with vertical stems of plants	2.47	59.70

This section is rather typical for the region around Boserup and Billesholm. The rock between the coalbeds A and B consists mainly of sandstones, with clays in the lower part. The coarse Boserup beds are about 10 m., argillaceous at the top and covered by fine sandstones, which in turn are followed by clays. Plant remains are common, especially in the Rhaetic — the *Lepidopteris* flora. Even the basal white or grey kaolin clay of the Boserup beds is plantbearing. It is transitional between the Rhaetic and the Lias, and contains *Equisetites gracilis*, several species of *Chladophlebis*, and finally a few species met with also in typical Rhaetic and Liassic floras. Plants also occur higher up in the Lias but they are mostly indeterminable.

Animal fossils have been met with occasionally in the Rhaetic at Boserup, as well as at Bjuv and Hyllinge (Troedsson 1948), but not in the Lias of this region.

Skromberga. Core-drilling No. 273. Depth 104.62 m. Höganäs-Billesholm Co. 1938.

Geological Succession	Thickness in metres	Total depth in metres
Quaternary deposits	2.90	2.90
Lias. Boserup beds, cross-bedded sandstones, sandy clays, white, rusty and light green. Rich in kaolin and clay ironstone. The lowest 0.38 m. is white clay with plant remnants	7.12	10.02
Rhaetic. Upper Coal Bed (A)	0.09	10.11
Clay and sandstone of varying thickness	5.04	15.15
Lower Coal Bed (B)	0.60	15.75
Grey clinker clay, and repeatedly alternating beds of coal, clay, and sandstone	4.27	20.02
Kågeröd. Green, white, and red, non-stratified clays, arkoses and conglomerates. A thin basal bed with weathered pieces of Silurian shale	78.65	98.67
Silurian. Soft shales, upwards weathered and green, downwards black or brown, bituminous with a thin bed of greyish white bentonite	5.95	104.62

In the Skromberga coalfield hardly more than the Boserup and the Rhaetic beds are preserved. These form a thin tongue-shaped syncline, extending towards the S.E. from the old Boserup field and measuring 6 km. in length by 2 km. in width.

The Boserup beds are typically coarse-grained with a white clay at the base. The coal beds are separated by 4 or 5 m., mostly clay. A clinker clay is dug out below the Lower Coal Bed. It has yielded remains of lamellibranchs, ostracods, and fishes.

This district has been treated in a preceding paper together with a section of the Rhaetic beds (Troedsson 1948 b, P. 545).

B. The Stabbarp Outlier

South-east of Skromberga the Höganäs trough has outcrops of only Pre-Rhaetic rocks, for a distance of almost 20 km. Then comes the deep Stabbarp depression with at least 200 m. of Rhaeto-Liassic beds. The Rhaetic division is accessible at a moderate depth along the north-eastern side of the depression. Towards the south-east this outlier is directly connected with the Lias of S.E. Scania.

The Vallåkra beds contain spherosiderite as usual and their thickness is about the same as in the north-west. But the coal-bearing part of the Rhaetic is even thinner than at Skromberga, while the Lower Coal Bed is missing or replaced by a fire-clay. Some coal has been exploited at Stabbarp, but it belongs to the Liassic column, where two coal beds have been wrought in the top of the Boserup. Above the Boserup there is a succession of about 20 m. of clays with bituminous or carbonaceous beds which represent an out-thinning of the lower part of the Helsingborg Stage. A marine bed with *Eotrapezium pullastra*, *Platymya aquarum*, and *Modiola hoffmanni* occurs 17 m. above the Rhaetic-Liassic boundary. At Ramlösa this zone is situated 100 m. above the same boundary. The plant-bearing zone with *Thaumatopteris Schenki* comes 3.5 m. above the Rhaetic, at Helsingborg and Vallåkra about 20 m.

The upper part of the Liassic column at Stabbarp belongs to the Upper Helsingborg. It is arenaceous and does not differ essentially from the corresponding strata in the north-west. In recent borings south-east of Eslöv, the deep-seated strip connecting the Stabbarp field with the Lias of S.E. Scania, typically developed Döshult beds with ammonite fragments have been discovered.

Stabbarp, Skromberga and Bjuv have afforded the main part of the Rhaetic flora described by NATHORST.

A detailed description of the geology of the Stabbarp coal field was published in 1947 (TROEDSSON).

4. The Vallåkra Trough

Beyond the Belteberga anticline, which is a continuation of the Romeleås, the strata dip towards the south-west into the Vallåkra trough. This is partly buried under Cretaceous deposits, but the N.E.-limb with Höganäs and Kågeröd beds is accessible at several places between Vallåkra and Helsingborg and the beds have also been penetrated in several bore-holes in the same district.

At Vallåkra the Lower Coal Bed has been exploited but has little value. The most valuable product is the Vallåkra clay, a dark unstratified, montmorillonite clay with beds or lenses of spherosiderite and green sandstone, the latter consisting of angular and corroded medium-sized grains of quartz. For further information as to this interesting locality, see Troedsson 1913 and 1943 b.

At Helsingborg the Rhaetic is not accessible, since the outcropping beds belong exclusively to the Helsingborg Stage of the Lias. Of special interest is the so-called *Pullastra* Bank, placed by earlier writers in the Rhaetic, but in reality situated about 100 m. above the Rhaetic-Liassic boundary. In the southern part of Helsingborg it is easily accessible. The writer has found several new localities with this horizon, beyond the old localities at Ramlösa and the Brickyard, also N. of Helsingborg (P. 112). Since he has already dealt with the Helsingborg region (Troedsson 1947 b) and the *Pullastra* Bank (Troedsson 1948 b) in detail, there is no reason to enter on these subjects now.

The Upper Helsingborg Stage seems to be well developed between Kvistofta and Raus with clays predominating, judging by the well-drillings. Fossils are not known.

At Gantofta these beds are followed by coarse sandstones and clays belonging to the Döshult Stage. Beds of sandstones, clays, and iron oolites still younger than these were occasionally accessible a few years ago at Katslösa, in the dip direction from the Gantofta outcrops. These will be treated in the following pages.

The Section at Katslösa

In the summer of 1945 the author alighted upon a fossiliferous section of Liassic beds at Katslösa, S. of Helsingborg, younger than any other Liassic sequence known from N.W. Scania. The section was occasionally exposed at the bottom of a freshly-made ditch, in a region well covered by Quaternary deposits. The strata were exposed at a length of 400 m. and amounted to about 175 m. in thickness.

Much time was spent in collecting fossils in the summer and autumn of that year, and careful measurements of the strata were made by Drs Fritz Brotzen,

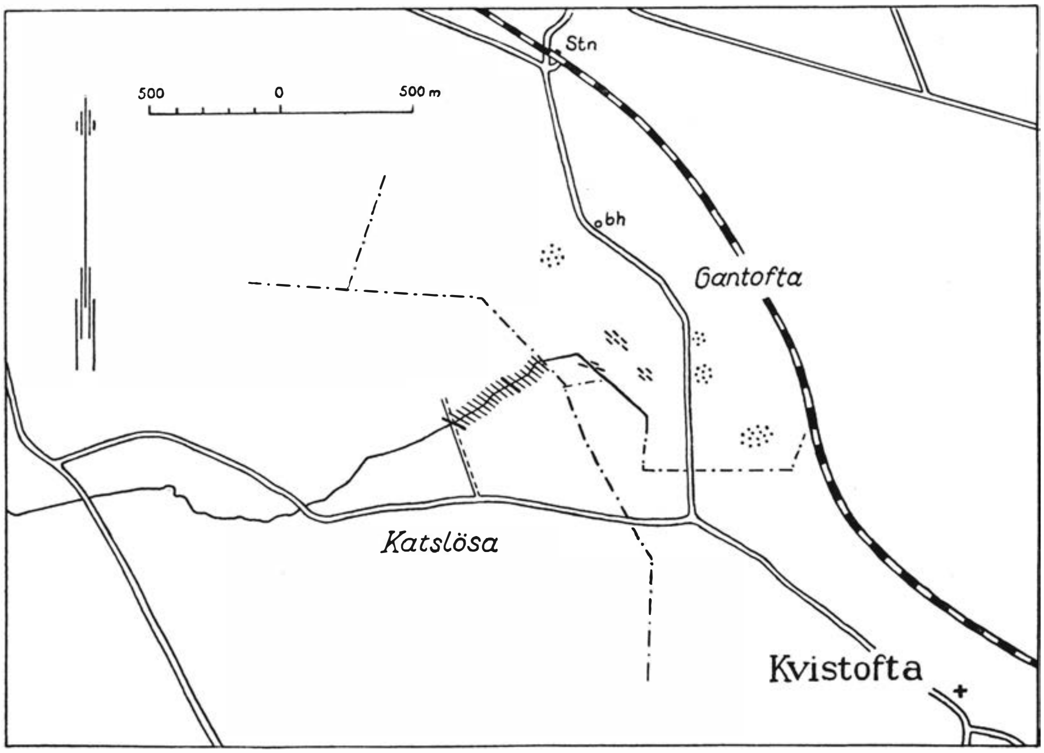


Fig. 22. Sketch-map showing the outcropping bedrock of the Katslösa-Gantofta region, south of Helsingborg.

Stockholm, and Erik Mohrén, Lund, for which funds were provided by the Geological Survey of Sweden. The following year the section was already covered by mud and overgrown, and for the present nothing is to be seen there.

Throughout the entire section the beds dip S.W., the base occurring just at the boundary between the villages Gantofta and Katslösa (Fig. 22). In Gantofta the underlying beds outcrop beneath the glacial drift. Several borings have been made between Gantofta and Helsingborg in search of water. One of them is shown in the figure. It cut through pure clays and sandy clays for the upper half and, in all probability, did not reach the Rhaetic before it finished up at 150 m. Consequently, the whole column is attributable to the Helsingborg Stage. The strata here dip slowly S.W. At a distance of 180 m. in this direction there is a pit dug in a loose sandstone. In the strike direction from this place the same sandstone, 40 m. thick, has been met with in a boring 300 m. to the N.W.; and in the opposite direction it outcrops at several places, charted in the Geological map-sheet "Helsingborg", the most distant one being situated in the ravine 1200 m. S.E. of the sandpit and remarkable for its ancient grind furrows. Between the outcrops along this line there are places where only clay has been proved and no sandstone. This might be due to faults, but it is more probable that the sandstone occurs in lenticular bodies, which also explains the irregular sequences known from borings in this region. The sandstones contain scattered, well-rounded quartz-grains, 3 or 6 mm. in diameter, but the main mass consists of angular irregular grains of quartz and weathered feldspar with an average diameter of 0.5 mm., embedded in a matrix of still finer sand. The structure and general aspect is that of the Döshult sandstone, though the sand is richer in weathered feldspar and badly washed. However, as far as can be judged from the sequence of strata, this bed seems to be equivalent to the Döshult sandstone.

The sandstone in the sandpit dips 15° S.W. It is followed in the dip direction by a dark clay, which occupies the whole space until the Katslösa section, or about 200 m. in the direction of the dip. In the middle this clay belt was penetrated down to 2.5 m. Near the surface the clay was disturbed and weathered brown or yellow. At about one metre there was an almost black shale with small gastropods. It dipped 30° S.W. (27° and 35° were measured on different bedding planes). At the same place was bored to a depth of 32 metres without reaching the bottom of the clay. According to the geological chart "Helsingborg", marl pits used to be sunk in this clay, which was said to contain cone-in-cone marl, but no fossils are mentioned. Stratigraphically it holds the same position as the marl clay at Viken, Döshult, and Dompäng, with the Ammonite Bank fauna, referred to above (P. 40). If the dip is constant and there are no faults the entire thickness should amount to about 100 m.

This clay is then followed by the Katslösa section in the ditch, running through Gantofta and Katslösa (Fig. 23). This ditch is 1 km. long and was made in the summer of 1945, as a deepening of the upper part of a small brook, which discharges its water into the Sound. At a length of 400 m., almost totally within Katslösa, strata of sandstone, clay, and siderite were unearthed. The eastern half of the ditch runs in the direction of the strike and has only scanty exposures. The western part, however, bends at right angles towards the S.W., following the direction of the dip. Owing to the angular bend at the middle of the ditch the lowest beds were hit twice, viz. at 360 m. (counting from the east end of the ditch), within Gantofta, and at 600 m. within Katslösa. The boundary between these villages is situated at 570 m.

The localities are given below with their distance from the east end of the ditch, in accordance with the diagrammatic map. Fig. 23.

The following dips have been measured:

At	600 m.	38°	S 24° W.
"	680 m.	42°	S 32° W.
"	745 m.	40°	S 40° W.
"	825 m.	37°	S 25° W.
"	840 m.	30°	S 28° W.
"	1000 m.	28°	S 22° W.

Excepting for a hiatus of 30 m. in the lower part of the succession — between the points 650 and 680 — there is a continuous section at a length of 400 metres.

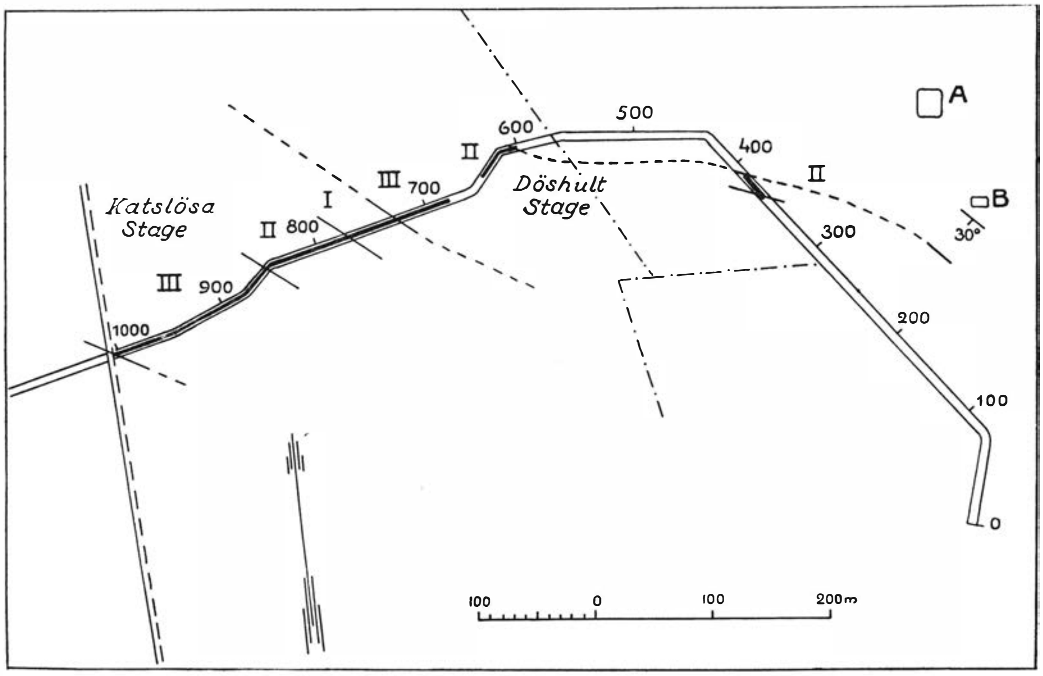


Fig. 23. Sketch-map showing the succession of strata of the Döshult and Katslösa Stages with the different zones (I, II, III) at Katslösa. A, marl pit. B, 32 m. deep bore-hole in clay shale of the Ammonite Bank.

The average dip seen from the above table, is 36.4° S 29.4° W, and the line connecting the locs. 600 and 1000 runs in S 68° W. From these figures we get a total thickness of 176.5 m. The thickness of each bed has been calculated from the measurements of Drs. Mohrén and Brotzen with regard to the variations of dip and strike, and the bends of the ditch. The thickness of the whole section, obtained in this way, amounts to 174.25 m. (Cf. TROEDSSON, G. F. F. 1948 a, p. 233).

The lowest beds are accessible partly at 360—392 m. and partly at 600. In both places a coal seam and a thin bed of coarse sandstone, of the Döshult facies, were visible. At 360 the section was 32 m. in the length direction of the ditch and the dip was 10° S 22° W. The entire thickness was 3.5 m. and the following succession was measured (from below):

		Length in the section in metres	Thickness in metres
1.	Grey clay	> 2	> 0.22
2.	Coal	2	0.22
3.	Grey clay	3	0.33
4 a.	White, loose, coarse sandstone of the Döshult type	21	2.31
4 b.	Green argillaceous sand	> 2	> 0.22
5.	Grey clay with a thin layer of sandstone (1 cm.), rich in fossils	2	0.22
	Total thickness in metres		3.52

From loc. 392 the strata were covered for 200 m. in the strike direction and beyond the angular bend of the ditch and the Katslösa boundary till loc. 600. From there an almost uninterrupted section in the dip direction was investigated — only the space between 650 and 680 being still covered in the bottom of the ditch. Here the following section was measured and numbered from below. Beds 1—5, being situated nearly in the strike direction from locs. 360—392, are considered to be identical with beds 1—5 above, though neither green argillaceous sand nor fossils were met with.

Bed No.	Geological Succession (Fig. 24)	Horizontal extension in metres	Thickness in metres
1.	Grey clay with sandstone layers (loc. 600)	> 12.50	> 4.50
2.	Coal	0.46	0.29
3.	Clay shale	0.56	0.35
4.	Coarse sand of Döshult type	2.20	1.36
5.	Clay shale, laminated with sand	31.00	19.20
6.	No outcrops	30.00	(14.60)
7.	Clay shale laminated with sand	20.00	8.30
8.	Sandstone, grey or white, hard, calcareous weathered brown and loose, rich in fossils (loc. 700)	2.00	0.82
9.	Clay with sandstone layers	26.60	10.60
10.	Red clay (loc. 727)	0.60	0.24
11.	Loose sandstone, weathered yellow	14.00	5.75
12.	Ferruginous sandstone, weathered reddish yellow (loc. 742)	0.40	0.16
13.	Sandstone, loose, weathered yellow	2.80	1.15
14.	Conglomerate; well rounded pebbles of quartz, 1 or 2 cm. in diameter, in a sandy loose matrix (loc. 745)	1.00	0.41
15.	Sandstone, fine, argillaceous	5.00	2.05
16.	Grey clay	5.00	2.05
17.	Sandy clay	11.60	4.60
18.	Iron sandstone (loc. 768)	2.00	0.80
19.	Sandy clay	2.60	1.04
20.	Iron sandstone (loc. 773)	0.30	0.12
21.	Sandy clay	4.60	1.84
22.	Iron sandstone (loc. 778)	0.60	0.24
23.	Plastic clay	13.00	5.10
24.	Sandstone (loc. 792)	0.80	0.31
25.	Clay with lenticles of clay ironstone	15.00	5.85
26.	Calcareous sandstone (loc. 808)	0.50	0.20

Bed No.	Geological Succession (Fig. 24)	Horizontal extension in metres	Thickness in metres
27.	Sandy clay with fossils	17.00	6.50
28.	Iron oolite with scattered quartz grains (loc. 825)	0.25	0.10
29.	Sandy clay with *Pentacrinus*	13.50	5.15
30.	Iron oolite (loc. 840), sandy	1.00	0.38
31.	Clay	9.50	5.40
32.	Iron sandstone (loc. 850)	0.30	0.17
33.	Clay	5.60	3.18
34.	Ferruginous sandstone (loc. 856)	0.40	0.23
35.	Clay, slightly arenaceous	20.00	11.40
36.	Iron sandstone (loc. 875)	2.00	1.00
37.	Argillaceous sandstone	5.60	2.80
38.	Greenish sandstone (loc. 885)	0.15	0.08
39.	Sandy clay, weathered greenish	16.60	7.67
40.	Ferruginous sandstone (loc. 900) rich in fossils ..	1.00	0.45
41.	Sandy clay shale, weathered greenish, with beds of ferruginous sandstone (loc. 925)	52.00	20.95
42.	Iron sandstone with clay beds, rich in fossils (loc. 955)	5.00	1.45
43.	Arenaceous shale, weathered brown	15.00	4.35
44.	Argillaceous iron sandstone, weathered brown ..	25.00	7.25
45.	Ferruginous sandstone, hard, green, crowded with shell fragments (loc. 1000)	7.00	2.03
46.	Clay	> 6.00	> 1.74
		407.72	174.25

Additional remarks. Bed 4 a, Döshult sand, is coarser than that found in the sandstone strip at Gantofta, the largest grains being 1 or 2 cm. in length. The latter are well rounded and consist of quartz, but there are also weathered pieces of feldspar and granite.

Bed 4 b was mapped as arenaceous clay. In reality it is a loose, green, argillaceous matrix, with scattered, fairly large quartz grains, about 2 mm. in diameter; accordingly, an argillaceous continuation upwards of the "Döshult" sandstone. The colour weathers from green to brown.

Bed 5, loc. 390. Close to the base is a thin layer of sandstone, crowded with moulds and impressions of small lamellibranchs and other fossils. The following fossils were recognized:

Serpula sp.

Cardinia ? sp., a small specimen.

Astarte ? sp. Small specimens, mostly impressions of the exterior, with a few concentric lines of growth.

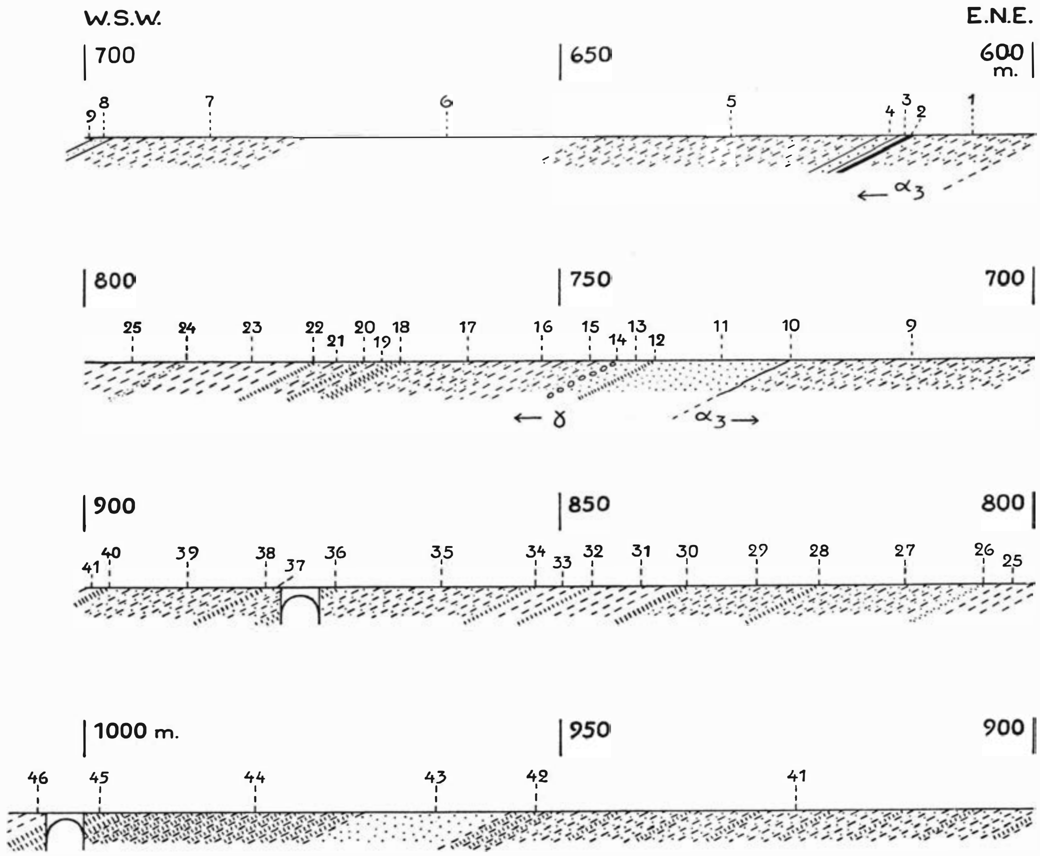


Fig. 24. The Katslösa section between locs. 600 and 1000. α_3 is the Döshult Stage. γ, Katslösa Stage. For explanation of the beds 1—46, see the description on P. 70.

Pecten ? sp.
Lamellibranchs, numerous fragments, indeterminable.
Gastropods.
Coroniceras sauzeanum d'Orb. (?), fragment.
Fish tooth.

Bed 7. The sandstone layers are thin and occur sparsely in the clay. They are hard, fine-grained, and calcareous; sometimes conglomeratic with clay galls. More rarely they contain fossils, such as ganoid scales and lamellibranchs, inter alia *Homomya venulithus* and a fragmentary *Tancredia*, similar to that in bed 8.

Bed 8 (Loc. 700). Hard, white, partly fissile, calcareous, very fine sandstone, at places rich in pyrite. Bedding planes covered with fossils, especially lamellibranchs, mostly without test. Rare pebbles of clay or clay ironstone. Surface weathered to a loose, light-brown, earthy mass, full of hollows and fissures caused by removal of the soluble shells. Occasionally, in unweathered rock, the shell substance is substituted by pyrite, with the external sculpture preserved in detail.

One of the most common species is a small, indeterminable gastropod which is sometimes crowded in the bedding planes, especially in a thin layer of the sandstone. The main part of the latter is a veritable shell breccia with *Homomya venulithus* as the dominating species, sometimes in competition with *Entolium* and *Oxytoma* (Pl. II).

The following species have been met with:

Tancredia erdmanni
Protocardia oxynoti
Homomya centralis
" *venulithus*
Pleuromya forchhammeri
" cf. *corrugata*
Oxytoma sinemuriensis
Isognomon sp.
Radula duplicata
Plagiostoma ? sp.
Chlamys janiformis
" *subulata*
Chlamys textoria
Entolium calvum
" *cingulatum*
Dimyodon sp.
Terquemia arietis
Liogryphaea arcuata
Modiola cf. *tenuissima*
" sp.
Arietites sp.
Chemnitzia sp.
Small gastropods.

Bed 9. At locs. 719 and 724 thin layers of a grey, fine sandstone.

Loc. 719. A slab of sandstone with impressions and internal moulds of small lamellibranchs, probably *Homomya*, and short cylindric fossils (*Dentalium*?). No determinable species. The calcareous matrix is dissolved, together with the shells.

Loc. 724. Sandstone with ripple marks and coprolites (Fig. 25). The preserved rock specimen shows a part of the rippled surface with moulds of coprolites. The latter, as a rule, are best preserved in the ridges. The coprolites themselves are destroyed, but one of the coprolite impressions shows a badly preserved internal cast of a keeled lamellibranch, surely a *Protocardia*. This is of the same size as *P. oxynoti* in Bed 8 but has stronger keel, which, however, may be due to the state of preservation.

Bed 10 (loc. 745). The reddish arenaceous clay is grey around carbonized rootlets.

Beds 11 and 13. Unconsolidated sand without fossils. Eolian (?).

Bed 14 (loc. 745). The conglomerate is loose and argillaceous with a high content of gravel. The largest pebbles are 2 cm. in diameter, oblong and flattened in shape. Quartz pebbles are in the majority and they are well rounded. Crystalline and sedimentary rocks are rare.

Bed 18 (loc. 768). A bank of grey, coarse sandstone with layers and concretions of a hard, grey, iron-sandstone, weathered brown. Both types of sandstone are coarse with single rounded grains of quartz, 3—5 or even 10 mm. in diameter, pieces of Archaean rocks, calcareous sandstone of the type described at loc. 700, and white clay, all of the same size, mostly about 5 mm.

A thin section of the iron-sandstone shows that angular fragments of quartz dominate, besides which there are a few grains of feldspar (mikrokline), quartzite and granite. The grains are sometimes rounded. Average diameter 0.1—0.3 mm. The matrix is brown without any visible structure. The fossils:

Pentacrinus scalaris
Serpula cf. *raricostati*
Zeilleria cf. *perforata*
Rhynchonella deffneri
Astarte angelini
" *scanensis*
Oxytoma inaequivalvis ?
Chlamys tullbergi
" *textoria*
Terquemia arietis
Passaloteuthis alveolata
Pseudohastites charmouthensis (?)
Bairdia amalthei
Hybodus ? sp.

Bed 19 (between locs. 768 and 773). In the section there is outcropping clay with a great many small belemnites. At the same locality Brotzen and Mohrén have collected hard pieces of iron sandstone, similar to those in bed 20, and probably derived from the latter bed. Fossils:

Serpula quinquesulcata
Worm trails
Chlamys textoria
Passaloteuthis alveolata
Pseudohastites charmouthensis
Bairdia amalthei
Bairdia dispar.

Bed 20 (loc. 773). Red-brown sandstone with large grains of well rounded quartz and mostly angular pieces of white kaolin. Fossils:

Passaloteuthis alveolata
Pseudohastites charmouthensis
Bairdia amalthei.

Bed 21. Arenaceous clay with

Passalotheuthis alveolata (Werner)? and
Pseudohastites charmouthensis (Mayer).

Bed 22 (loc. 778). Grey sandstone, rather loose, rusty through weathering. Fossils:

Grammatodon cypriniformis (cast) and
Pseudohastites charmouthensis.

Bed 23. Plastic clay with *Chlamys textoria* and *Pseudohastites charmouthensis.*

Bed 25. Clay with lenticles of clay ironstone. Here *Chlamys tullbergi* (?).

Bed 26 (loc. 808). Fine, dark grey, hard, calcareous sandstone with pyrite crystals and cone-in-cone structure. Single pieces of light clay or kaolin. Here only *Pseudohastites charmouthensis* has been met with.

Bed 27. Arenaceous clay with lamellibranchs, gastropods, and belemnites:

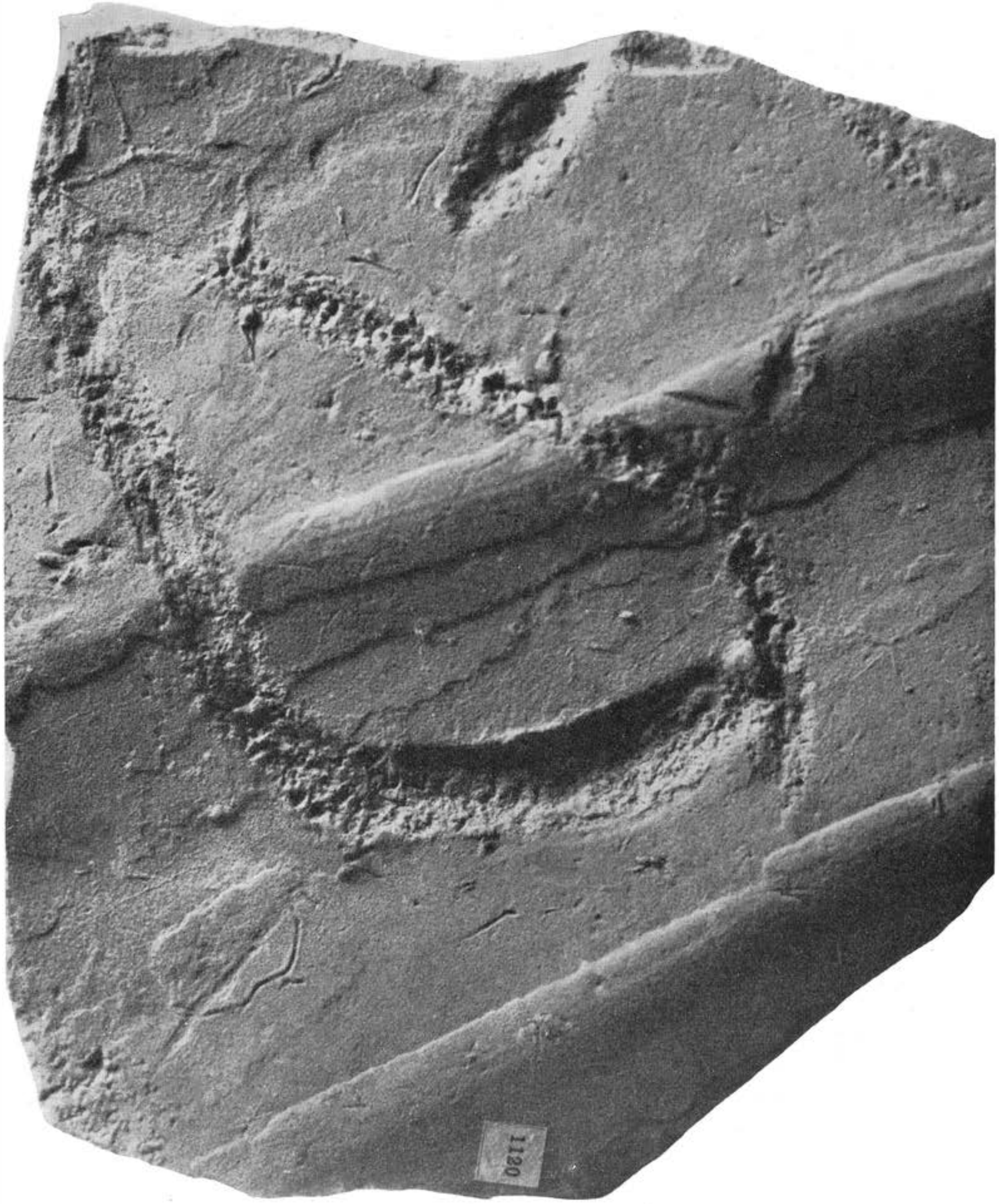


Fig. 25. Ripple marks with impressions of coprolites. At the right end of the large impression is a specimen of *Protocardia oxynoti.* The Döshult Stage, Bed 9. Nat. size. S.G.U. Museum.

Palaeoneilo galatea
Chlamys textoria
Liogryphaea sp.
Plicatula spinosa
Ptychomphalus cf. *expansus* (?)
Pseudohastites charmouthensis.

Bed 28 (loc. 825). Iron sandstone, not particularly hard, greyish yellow, fine-grained, with well rounded grains of quartz up to 3 mm. in diameter, and with pieces of carbonized tree. Thin sections show a ground mass of iron oolites with scattered angular quartz grains, 0.1 mm. in diameter, and foraminifers. Fossils:

Pentacrinus cf. *basaltiformis*
Worm trails
Palaeoneilo galatea
Nuculana zieteni
Grammatodon cypriniformis
Anisocardia luggudensis
Oxytoma inaequivalvis
Chlamys textoria
Katosira craticia
Bairdia amalthei

Bed 29. Arenaceous clay with Pentacrinus stems and belemnite rostra rather common:

Pentacrinus basaltiformis
Serpula quinquesulcata
Chlamys textoria
Ptychomphalus cf. *expansus* (?)
Passaloteuthis apicicurvata
Pseudohastites charmouthensis

Bed 30 (loc. 840). A bank of heavy ferruginous sandstone with scattered, well-rounded grains of quartz, hardly exceeding 4 mm. in diameter. In thin sections the ground mass is an iron oolite, irregularly intermingled with quartz fragments, about 0.1 mm. in diameter. A great many species, mostly lamellibranchs, have been obtained from this horizon:

Pentacrinus sp.
" cf. *subteroides*
Serpula quinquesulcata
Worm trails
Zeilleria cf. *numismalis*
Spiriferina walcotti var. *münsteri*
Palaeoneilo bornholmiensis
" *galatea*
" *oviformis*
Nuculana zieteni
Rollieria bronni
Nucula distinguenda
Grammatodon cypriniformis
" (*Catella*) *sinuatus*
Barbatia pulla ?
Trigonia modesta
Astarte angelini
" *fructuum*
" *scanensis*
" *fortuna*
" *deltoidea*
" *oerbyensis*
" *ryensis*
" sp.
Tutcheria cingulata
Tutcheria cf. *richardsoni*
Pseudopis sp.
Sphaeriola kurremolinae
Protocardia truncata
Pleuromya corrugata
Homomya librata
Arcomya decora

Arcomya cf. *elongata*
Goniomya heteropleura
Oxytoma inaequivalvis
Gervillia sp.
Plagiostoma succincta
Limea katsloesensis
" *acuticostata*
Chlamys tullbergi
" *textoria*
Entolium lundgreni
Plicatula orbiculoides ?
" *spinosa*
Terquemia arietis
Liogryphaea regularis
Modiola scalprum
Mytilus cf. *lamellosus*
Myoconcha decorata
Actaeonina nathorsti
" cf. *striata*
Katosira craticia
Trochus cf. *imbricatus*
" *laevis*
Dentalium elongatum
" *hexagonale*
? *Uptonia jamesoni*
Passaloteuthis apicicurvata
Pseudohastites cf. *arundineus*
Bairdia amalthei
Otolithus bornholmiensis

Bed 32 (loc. 850). A grey, soft mudstone with well preserved fossils. Unfortunately this rock weathers easily into a brown, loose, earthy mass with destroyed fossils, and only small pieces of the fresh rock have been obtained. Fossils:

Pentacrinus basaltiformis
Serpula quinquesulcata
" *terquemi*
Worm trails
Palaeoneilo bornholmiensis
" *galatea*
" *oviformis*
Nuculana (*Ryderia*) *doris* (?)
Rollieria bronni
Grammatodon cypriniformis
Trigonia modesta
Astarte angelini
" *scanensis*
" *oerbyensis*
Tancredia johnstrupi
Oxytoma inaequivalvis
Limea acuticostata
Chlamys textoria
Entolium cingulatum
" *lundgreni*
Plicatula orbiculoides ?
" *spinosa*
Liogryphaea regularis
Chrysostoma cf. *solarium*
Trochus laevis
Dentalium elongatum
" *hexagonale*
Pseudohastites sp. (cf. *P. arundineus*)

Clay beds, Nos. 29, 31, 33, and 35. During field work plenty of fossils were collected from material dug out from the ditch and thrown up along the sides. As a rule they were easily localized as to their stratigraphical position with the aid of the attached rock. But specimens collected in clay could not be classified in the same way. This was particularly the case with the relatively rich fauna derived from the clay beds 31, 33, and 35, and, probably, 29. Here were also found pieces of a coarse sandstone, rich in fossils, mostly fragments, preserved in pyrite. The following fossils are derived from these beds:

Pentacrinus cf. *basaltiformis*
Palaeoneilo galatea
Astarte scanensis
" *deltoidea*
" *oerbyensis*
Tancredia johnstrupi
Chlamys textoria
Pseudopecten aequivalvis
Plicatula orbiculoides ?
Passaloteuthis apicicurvata

Bed 36 (loc. 875). Iron oolite with a high content of quartz and a layer of greenish clay. The rock is partly conglomeratic with well rounded pebbles of quartz and green clay, 5 or 10 mm. in diameter, and with shell fragments, vertebrate remnants and plant remains; probably some kind of bonebed. The following species have been identified:

Serpula terquemi
Nuculana (*Ryderia*) *doris* ?
Astarte angelini
Tutcheria cingulata
Tancredia johnstrupi
Anisocardia luggudensis
Oxytoma inaequivalvis
Limea acuticostata
Chlamys textoria
Entolium lundgreni
Pseudopecten aequivalvis
Plicatula spinosa
" sp. (cf. *P. suecica*)
Terquemia arietis
Liogryphaea regularis
Modiola scalprum
Ptychomphalus cf. *expansus*
Dentalium elongatum ?
Passaloteuthis apicicurvata
Hybodus ? sp.

Bed 40 (loc. 900). Ferruginous sandstone with fragmentary fossils, mostly indeterminable:

Oxytoma inaequivalvis
Chlamys textoria
Entolium lundgreni
Pseudopecten aequivalvis
Plicatula spinosa
Liogryphaea regularis
Myoconcha decorata

Bed 41 (loc. 925). Thin sections of the ferruginous sandstone show a matrix of iron oolite richly intermingled with quartz grains, partly angular (about 0.1 mm. in diameter), and partly rounded (1 or 2 mm.). In addition there are plenty of fossil fragments and microfossils. The following macrofossils have been identified:

Serpula quinquesulcata
" *terquemi*
Rollieria bronni
Astarte angelini
" *oerbyensis*
Tutcheria cingulata
Oxytoma inaequivalvis
Limea acuticostata
Chlamys textoria
Entolium cingulatum
Entolium lundgreni
Plicatula orbiculoides ?

Plicatula spinosa
Myoconcha decorata
Chrysostoma cf. *solarium*
Trochus laevis
Passaloteuthis cf. *virgata*
Bairdia amalthei
Hybodus ? sp.

A thin bed of white sandstone, similar to that in Bed 8, contained *Tancredia lineata*.

Bed 42 (loc. 955). Hard, dense, light brown calcareous sandstone, rich in fossils. Thin section: a rather homogeneous, calcitic matrix with irregularly scattered quartz grains. The latter are etched and surrounded by a thin margin of matrix with high refraction. Foraminifers and shell fragments are common. The following macrofossils have been identified:

Serpula terquemi
Worm trails
Nuculana sp. ind.
Grammatodon (Catella) sinuatus
Barbatia pulla ?
Trigonia primaeva
Astarte angelini
" *fortuna*
" *deltoidea*
" *ryensis*
Tutcheria cingulata
Tancredia johnstrupi
Anisocardia luggudensis ?
Homomya librata
Arcomya decora (?)
Oxytoma inaequivalvis
Limea acuticostata
Chlamys textoria
Entolium lundgreni
Plicatula spinosa
Myoconcha decorata
Actaeonina sp.
Ptychomphalus cf. *expansus*
Dentalium elongatum ?
Passalotheuthis cf. *virgata*
Bairdia amalthei
Acrodus sp.

A pebble of a somewhat different rock, crowded with fossils, was collected at the same place and may be derived from the same horizon (Bed 42 b, loc. 955 b). It contained:

Grammatodon (Catella) subrhomboidalis
Barbatia pulla ?
Trigonia primaeva
Astarte deltoidea
" *ryensis*
" *oerbyensis*
Tutcheria cingulata
Protocardia truncata ?
Oxytoma inaequivalvis
Chlamys interpunctata
Plicatula orbiculoides ?
Ptychomphalus cf. *expansus*

Bed 45 (loc. 1000). Green sandstone with well-rounded fragments of lamellibranchs. The sandstone is fine-grained with a matrix of iron oolite. The main part of the lamellibranchs are pectinids, only a few of which are determinable. All of them are in secondary position, the rock being most appropriately classified as a conglomerate, redeposited from a shell beach. The following fossils have been recorded:

Worm trails	*Gervillia* sp.
Nuculana (*Ryderia*) *doris*	*Terquemia arietis*
Tancredia johnstrupi	*Liogryphaea regularis*
Protocardia truncata	*Bairdia amalthei*

In the lower part of the Katslösa section the sandstone beds are fine-grained and calcareous, but upwards they become increasingly ferruginous and more or less conglomeratic. At 600—742 m. the rock weathers light brown or yellow, thus being poor in iron. At 742—778 m. (beds 12, 18, 20, and 22) there are sandstones cemented by iron-oolite. But still higher up, from bed 28 (at 825 m.), the quartz content decreases, the hard beds being sometimes made up of iron-oolite with scattered quartz grains, at others of well-worn shell fragments and quartz-pebbles cemented by iron-oolite. The ferruginous beds are rather thin, especially in the lower part, where they never exceed one metre in thickness; in the upper part of the section they are thicker and more crowded; cf. for instance the beds 40 (0.45 m.), 42 (1.45 m.), 44 (7.25 m.), and 45 (2.03 m.). The most ferruginous part of the section (beds 17—46) is 100 m. thick and contains, in all, 14.3 m. of iron sandstones and iron-oolites, of which 11.18 m. are crowded into the topmost 40 m. of the section (beds 40—46). The ferruginous beds accordingly total about 28 % in the uppermost 40 m. and 5 % in the 60 m. thick succession next below.

The sandstone beds of the lower part of the section bear evidence of shallow water conditions, such as ripple marks, clay galls and worm trails. Here, too, the thin shelly matter of the lamellibranchs, the abundance of specimens but low number of species, indicate "sarmatic" facies with low salinity, perhaps an estuary.

On the other hand the upper part with its clays and ferruginous beds is a marine deposit, more or less off-shore. The oolitic beds contain rounded pebbles of quartz, sometimes also of sandstone derived from the underlying strata, or well-rounded shell fragments (beds 40 and 45) from some adjacent syngenetic or pre-existent shell bed. These indurated beds were certainly deposited not far from the coast, which delivered the coarse material. The intercalated clays are more off-shore deposits, possibly derived from a large river.

Fossils occur abundantly in the indurated rock, while the clay beds were less suitable for collecting purposes. Most of the fossils were picked up from loose pieces of rock in the embankments of dug-out material. Since the various iron-sandstones and other hard rocks are well characterized petrographically, the fossils derived from them were easily recognized as to their stratigraphical position. Nevertheless, the most fossiliferous beds, (for instance, Nos. 8 and 30) were broken up, as far as possible, from their bedrock for collecting purposes. The clays were too poor in fossils to allow similar methods, and when picked up from the loose stuff the fossils of the clay beds could only be determined as to their horizon from their place in the earth wall, which, in some cases, has proved to be inadequate.

5. On Rhythmic Sedimentation

The main divisions of the Rhaetic and the Lias α, represent a sequence of cyclic sedimentation, of which each cycle is characterized by coarse-grained sediments at the base and fine clays and coal beds towards the top. The sediments are mainly non-marine, and probably deltaic or fluviatile. But as referred to above, thin beds, mostly calcareous or ferruginous, with marine shells occur at several horizons. According to the old conception marine beds should dominate the Lias, while the Rhaetic should be entirely non-marine. Moreover, the Rhaeto-Liassic boundary was wrongly placed in the upper part of the Lower Helsingborg Stage. Careful investigations, however, of a great many sections and drilling-cores in the coal basin have brought to light a number of marine beds in the Rhaetic as well as in the Lias. These occur at horizons traceable over the whole basin and correlated by means of leading fossils, such as *Cardinia follini*, *Eotrapezium pullastra*, and *Cardinia ingelensis*, each of which occurs only in one bed. A thorough study of the successions in several drilling-cores has shown that these marine beds form boundaries between cycles of a lower rate, probably corresponding to the stratal terms epiboles or Teilzonen.

In reality the lower part of the Höganäs Series is made up of a rhythmic succession of arenaceous and argillaceous beds. The former are sometimes rather coarse, either barren or contain undeterminable plant remains, and not rarely, coal pieces. The latter contain for the most part a coal bed or a few thin coal seams, and are generally followed upwards by clay or fine sandstone — often calcareous or ferruginous — with marine shells. The coal may be lacking, the marine fossils also, but the rhythmic character is nevertheless obvious. This is especially emphasized by the sudden introduction of the non-marine sandstone phase, which is thus considered to introduce the cycle, while the topmost sediments with the marine shell fauna terminate it.

The Rhaetic consists of three such small cycles, and the Helsingborg Stage of nine, viz.: four in the lower and five in the upper part. Each of these Liassic cycles is terminated above by marine beds with *Ostrea hisingeri* and sometimes *Modiola hoffmanni* Nilss. The non-marine parts also have their characteristic fossils, chiefly plants. The lowest Rhaetic cycle, the Vallåkra, contains, in every known exposure and drillhole, one or two beds rich in spherulitic siderite. The spheruliths average one mm. in diameter and show radiating structure. They may be considered as characteristic, for they do not occur elsewhere. The cycles of the Lower Helsingborg Stage are well characterized by fossils, while those of the Upper Stage have only yielded rare specimens. This is due to the fact that the latter covers a much smaller area, where there are hardly any exposures. Moreover they have been pierced by very few drillings, because the beds worked — coal and clays — being situated in the Rhaetic, have hitherto been exploited only in areas where they are fairly near the surface and where the upper stages are missing.

One of the most perfectly developed boundaries between two cycles is that between the Rhaetic and the Lias. The Rhaetic ends with the Upper Coal Bed (A) and the Lias is introduced by the Boserup beds. However, in the borings at Svanebäck and Klappe, a black clay with lamellibranchs (*inter alia Modiola*) comes above the coal, and at the Köpinge bore-hole No. 3, there are about 12 m. of calcareous beds — marine Rhaetic? — above the Upper Coal Bed.

The best method of forming an idea of the rhythmic sedimentation of the Höganäs Series is to study some of the columns obtained from borings, especially those from the core-drillings, for which purpose it seems most convenient to start with boring No. 3 at Köpinge, S. of Hälsingborg. This was carried out in the year 1876 to a depth of 256 m. during a search for coal, when the Kågeröd beds were struck at 223 m., perhaps even at 208.5 m. The section has been described and figured by ERDMANN (1915, Atlas, Pl. 13):

1. The Vallåkra Cycle consists mainly of grey clays with carbonaceous clays at the top. It may be considered the basal member of the following cycle, the upper boundary not being well defined, though probably situated at .... 197 m.

2. The B-Cycle begins with fresh-water sediments (the coal bed with accompanying clays and sandstones) and terminates with fine sandstones, calcareous at the top .... 197—166 m.

3. The A-Cycle: Sandstone with coal strips, the Upper Coal Bed (A) at 159 m., and finally laminated clay, calcareous sandstone, clay ironstone and calcareous shale .... 166—146 m.

4. The Boserup Cycle is made up of sandstone and arenaceous shale at base, clay ironstone, laminated clay, and calcareous sandstone at top .. 146—112.5 m.

5. Sandstone below, carbonaceous clay and laminated clay at top.. 112.5—93 m.

6. Sandstone with coal particles, sandstone shale, clay shale and calcareous sandstone .... 93—77.5 m.

7. Argillaceous beds with coal, arenaceous clay shale, argillaceous sandstone shale, and dense calcareous sandstone .... 77.5—49 m.

8. Sandstones with coal strips, clay shale, calcareous sandstone .. 49—25.5 m.

9. Only the basal argillaceous part is preserved.

The Upper Coal Bed comes at 159 m., and the *Pullastra* Bank at 50 or 60 m. — judging by exposures in the immediate vicinity — i. e. most probably in the cycle No. 7.

Core-drilling No. 264, Rosendal (See P. 59) contains several fossiliferous horizons. The Vallåkra Cycle was not reached.

2. The B-Cycle: sandstone, coal bed (B), clay shale .... 96.19—87.68 m.

3. The A-Cycle: sandstone cemented by galena, black clay (underclay), coal (A) ...... 87.68—82.21 m.

4. The Boserup Cycle: Boserup beds (cut by a fault, where a part of the section is lost); clay shale with coal seams .... 82.21—58.15 m.

5. Sandstone, clay shale, calcareous sandstone and finally sandstone with lamellibranchs ("*Avicula nilssoni*" and *Modiola* cf. *hoffmanni*) ...... 58.15—51.93 m.

6. Clay shale with plants and an undeterminable lamellibranch; sandstone, clay ironstone, clay shale containing beetle wings and plant remains, and finally, loose sandstone with *Cardinia follini* (the *Cardinia* Bank) .... 51.93—36.69 m.

7. Sandstone and clay shale with plants, sandstone with *Liostrea hisingeri*, *Modiola* sp., *Eotrapezium pullastra*, cone-in-cone marl, clay shale, clay ironstone .... 36.69—25.12 m.

8. Only the basal part preserved (Sandstone 9.92 m.).

Core-drilling No. 266, Fleninge (See Page 56).

1. The Vallåkra Cycle: the lower part is coarse sandstone, partly green; the upper part consists of brown clay with a 20 cm. thick bed of spherosiderite, black shale .... 178.72—169.57 m.

2. The B-Cycle: clay laminated with sand, and sandstone with clay laminae, fire-clay (underclay), coal .... 169.57—162.71 m.

3. The A-Cycle: coarse, loose sandstone with coal seams and clay ironstone; laminated fine sandstone; coal; dark roof-clay .... 162.71—151.62 m.

4. The Boserup Cycle: coarse, badly stratified, impure sandstones and fine sandstones with clay ironstone; at the top a conglomeratic bonebed 151.62—133.21 m.

5. Plant-bearing clay with *Dictyophyllum nilssoni* and *Equisetites*; sandstone; clay ironstone .... 133.21—126.31 m.

6. Clay with sand laminae, coal and plant remnants (*Dictyophyllum*, *Equisetites*); sandstone with ripple marks and vertically situated taps of clay ironstone; argillaceous sandstone; calcareous sandstone .... 126.31—112.83 m.

7. Clay with sandstone laminae, coal and plants; sandstone, partly rather coarse with rounded or angular pieces (5 mm. in diameter) of sandstone, clay ironstone, black chert, lignite and black fibrous coal. In places the sandstone is rich in red feldspar and white-spotted from kaolin, and is reminiscent of the Boserup sandstone. The sandstone contains steinkerns of *Eotrapezium menkei*, fish scales, ostracods and plant remains. Then follow clays with coal seams and plants, clay ironstone and cone-in-cone marl .... 112.83—96.76 m.

8. Clay with *Nilssonia*; a heavy sandstone, with the so-called Fleninge beds at the top; clay with *Nilssonia*, *Equisetites*, and *Dictyophyllum*; fine sandstones; clays with clay ironstone and cone-in-cone marl; the top bed is a white, partly conglomeratic, calcareous sandstone with ovoid pebbles, 0.5—1 cm. in length, of a rusty fine sandstone, coal pieces, and a vertebrate tooth (bonebed) 96.76—52.59 m.

9. Only the basal sandstone, 15 m., is preserved.

Core-drilling No. 270, Farhult (See P. 24). Above the Kågeröd, 7.61 m., comes:

1. The Vallåkra Cycle: conglomeratic and coarse sandstones, 17 m., with a bank of spherosiderite in the upper part, then fine argillaceous sandstones .... 123.93—98.00 m.

2. The B-Cycle: thin conglomerate, sandstone, carbonaceous clay, coal (B) .... 98.00—93.10 m.

3. The A-Cycle: sandstone with a thin bed of carbonaceous clay, coal (A) .... 93.10—84.49 m.

4. The Boserup Cycle with clay at the base, rather fine Boserup sandstone with nodules of clay ironstone; light grey clay; sandy below, soft and clean upwards .... 84.49—70.91 m.

5. Sandstone, sandy clay with clay ironstone; clayey sandstone with lamellibranchs .... 70.91—63.30 m.

6. Clayey sandstones, upwards more and more rich in clay and clay ironstone, and sandy clays of the Boserup type with rootlets at the top; sandstone with *Equisetites* and coal films; bonebed with fish fragments and *Modiola* sp. .... 63.30—49.85 m.

7. Plant-bearing clay; white, loose sandstone with *Eotrapezium pullastra* .... 49.85—47.09 m.

8. Sandstone and clay with clay ironstone, thread-coal and *Gutbiera*; black clay, clay ironstone, arenaceous clay and argillaceous sandstone .... 47.09—41.35 m.

9. Cross-bedded conglomeratic sandstone, clay of the Boserup type, and calcareous sandstone; clayey sandstones and kaolin clay with clay ironstone, coal, and plant remains (cycle incomplete).

Core-drilling No. 271, Oregården (See P. 27).

Cycle No. 7. At the top a clay with clay ironstone and numerous lamellibranchs, e. g. *Eotrapezium pullastra* and *Modiola hoffmanni* (= *M. hillana*) .... 235.19—203.19 m.

Cycle No. 8, the Fleninge Cycle, is prevailingly arenaceous, but argillaceous with much clay ironstone at the top. The marine invasion is characterized by

Cardinias, viz. *C. ingelensis* and *C.* sp. in the sandstone — same species as in the grind sandstone at Ingelsträde and Brandstorp — and fish scales in the top clay ...... 203.19—182.09 m.

The *Ostrea* Bank Cycle, No. 12, starts with sandstones and coalbearing clay and terminates with calcareous and ferruginous sandstone and clay, the former with *Gervillia hagenowi*, *Modiola hoffmanni*, and *Liostrea hisingeri*, corresponding to the *Ostrea* Bank at Kulla Gunnarstorp .... 134.97—110.88 m.

The *Avicula* Bank Cycle, No. 13, which is rather incomplete at Kulla Gunnarstorp, where it is restricted to the marine ferruginous bank with *Oxytoma*, etc., at the very base of the Döshult sandstone, is well developed at Oregården, where its basal part contains a thin clay ironstone conglomerate, superimposed by clay with vertical plant remnants, sandstone with *Tancredia arenacea* and *T. erdmanni*, and is terminated by a clay-ironstone at 79.81 m. .... 110.88—79.81 m.

The coarse Döshult sandstone forms the base of an entirely marine sedimentation with less conspicuous cyclic character.

The Klappe core (See P. 44) shows the same cycles as No. 271. The Rhaetic-Liassic portion amounts to 246.76 m. but the Rhaetic part is more or less missing, owing to faults. Thus, the Vallåkra and both coal beds (A and B) are lacking, but the A-cycle terminates upwards by a thin black clay with *Mytilus* and *Pinna* (according to the record).

The Boserup Cycle is typically sandy low down, the middle contains plant-bearing clays, and high up come calcareous sandstones with *Liostrea hisingeri* ...... 230.17—191.75 m.

Cycle No. 6: The middle part shows several clay beds with *Nilssonia* and *Dictyophyllum*, while the top bed is a grind sandstone with *Cardinia follini* .... 183.20—163.30 m.

Cycle No. 7 contains two oscillations, as is the case in many other sections. Its lower one (7 a) terminates with a dark clay shale with clay-ironstone and *Liostrea hisingeri* .... 163.30—146.85 m.

Cycle No. 8 starts with a plant-bearing clay. Then follows a sandstone, 17 m., showing fragmentary steinkerns of lamellibranchs in its lower part, and in the upper — where the rock is rather coarse, yellowish white, kaolin-dotted — pebbles of clay ironstone with *Modiola hoffmanni*, *Liostrea hisingeri*, and *Cardinia ingelensis*. At the top comes a thin-bedded, pure clay shale with cone-in-cone marl, and clay ironstone, crowded in some layers with fossils, the latter, however, are badly preserved. According to the record this fauna consists of "*Estheria*, lamellibranchs (abundantly), ostracods (abundantly), and fish scales". Among the lamellibranchs there are specimens closely resembling the *Eotrapezium* species at Ramlösa, which might indicate an Upper *Pullastra* Bank (as already claimed by Lundgren) .... 146.85—119.75 m.

Cycle No. 9: The lower part consists of sandstones, the upper of clays with "*Gutbiera*" and fish scales. The topmost bed is a calcareous sandstone 119.75—86.12 m.

Cycle No. 10: The lower part contains *Cyrena*? (in the record) and plant fragment (e. g. *Cyparissidium*), at the top calcareous sandstone .... 86.12—69.65 m.

Cycle No. 11 contains plants ("*Gutbiera, Cyparissidium, Equisetum*") in the lower part and terminates in a calcareous sandstone at .... 46.14 m.

Cycle No. 12 starts with a loose sandstone, followed by a thin coal seam, plant-bearing clay, and calcareous and ferruginous sandstones ...... 46.14—20.30 m.

The topmost part of the core consists of carbonaceous clays, and sandstones with *Gutbiera* and *Dictyophyllum*. They are tentatively ranged with the Döshult Stage.

The Svanebäck core, No. 209 (See P. 45).

The B-Cycle is incomplete; its top beds consist of clays and clay ironstone.

In the A-Cycle the sandstones predominate. Above the coal bed (A) comes — as at Klappe — a dark clay crowded with indeterminable shell fragments of a mytilid (*Modiola minuta*?).

The Boserup Cycle is strongly arenaceous with a few clay beds upwards. Cycle No. 6, too, is ruled by sandstones, which are calcareous and coarse-grained at the base. The top part is fossiliferous and contains *Liostrea hisingeri* and *Modiola* sp. (the *Mytilus* Bank). Upper limit brecciated. The *Cardinia* Bank was not identified in this section.

Cycle No. 7 contains, in its upper part, indeterminable lamellibranchs.

No determinable fossils have been met with above the latter horizon.

In summarizing the facts obtained from borings and natural sections, the following generalized succession of the Rhaetic and Helsingborgian cycles may be given:

III. The Upper Helsingborg Stage.

(12) The *Ostrea* Bank Cycle, mainly at Oregården.
Calcareous sandstone and siderite. The *Ostrea* Bank with *Liostrea hisingeri*, *Modiola hoffmanni*, and *Gervillia hagenowi*.
Clay with fish-scales, coal, and plants (*Gutbiera*, *Dictyophyllum*).
Sandstone.

(11) Mainly at Svanebäck and Klappe.
Calcareous sandstone and siderite.
Clays with coal seams and plants (*Gutbiera* and *Equisetites*).
Sandstone.

(10) Calcareous sandstone and siderite.
Clay with fragmentary plants and coal seams.
Sandstone, partly feldspathic.

(9) Calcareous sandstone and siderite, gastropods, lamellibranchs.
Clays with scales, plants (*Gutbiera*), and coal.
Sandstone.

(8) The Fleninge Cycle:
Clay with scales and ostracods; or bonebed.
Calcareous sandstone, siderite, and sandstone with *Ostrea hisingeri*, *Modiola hoffmanni*, and *Cardinia ingelensis*.
Clay with coal and plants (*Nilssonia* and ferns).
The coarse Fleninge beds.

II. The Lower Helsingborg Stage.

(7) The Ramlösa Cycle:
Calcareous sandstone and siderite with the *Pullastra* bank.
Clay with coal.
The zone of "*Cyclas*" *nathorsti*.
Sandstone with a recurrent Pålsjö flora.

(6) The Pålsjö Cycle:
Calcareous sandstone and siderite. Bonebed. *Modiola*.
Grind sandstone with *Cardinia follini* (the *Cardinia* Bank).
Sandstone with *Modiola* and *Ostrea hisingeri* (the *Mytilus* Bank).
Clay and sandstone with plants (The Pålsjö flora).
Coarse sandstone.

(5) In most sections badly developed and thin.
Calcareous sandstone and siderite, *Ostrea hisingeri*, *Modiola*.
Clay with coal seams.
Sandstone with plants.
Coarse sandstone at Halalid, Helsingborg.

(4) The Boserup Cycle:
Calcareous sandstone, siderite or bonebed. *Ostrea hisingeri*.
Clay with the Helsingborg flora.
The coarse Boserup beds.

I. The Rhaetic.

(3) The A-cycle:
Calcareous sandstone.
Clay with *Mytilus* (or *Modiola*).
Dark clay with *Lepidopteris Ottonis*.
The Upper Coal Bed (A) with *Lepidopteris Ottonis*.
Underclay.
Sandstone, partly coarse.

(2) The B-Cycle:
Calcareous sandstone and siderite.
Clay with fishes, stegocephalians, and lamellibranchs.

The Lower Coal Bed (B).
Underclay with the *Lepidopteris* flora.
Sandstone.

(1) The Vallåkra Cycle:
Clay with the *Avicula contorta* fauna.
Spherulitic siderite.
Basal sandstones and clay with undeterminable plants.

In the beds above the Helsingborg Stage marine conditions predominate, the rhythm thus being less conspicuous. Yet in parts of the basin the same kind of rhythmic sedimentation as in the lower beds was still proceeding for a while. Thus in the core at Oregården the 13th cycle with the *Avicula* Bank fauna is about 30 m. in thickness. Near its base is a thin conglomerate, followed by 9 m. of sandstones and mudstones of the same facies as in the Boserup, white or light colours, high content of kaolin, weathered feldspar, and siderite — though generally finer-grained; the upper part contains lime, coal and two species of the *Avicula* Bank fauna, viz. *Tancredia arenacea* and *T. erdmanni.* This cycle is succeeded by the coarse Döshult sandstone.

A sedimentary cycle of the kind here described starts as a rule with coarse non-marine sandstones and impure kaolin clays or mudstones of the Boserup facies, often intermingled with carbonized plant remnants. Then follows a series of dark clays, coal seams or coalbeds. The coal is mostly in contact with fire-clay below (underclay) and a roof-clay above, which latter sometimes shows a shelly marine fauna. As a rule, however, the marine shells first appear in the following sandy beds, which may be calcareous and ferruginous. Sometimes these beds are strongly washed and even conglomeratic, not rarely reminiscent of bonebeds, though always poor in vertebrate remnants.

The main part of this succession is non-marine, though the shelly beds sometimes amount to half the cycle or perhaps still more. The marine invasion no doubt introduced a new facies, but the change wrought in the sedimentation is only gradual. Not seldom the marine part of the cycle is entirely lacking. On the other hand, the non-marine seems to start suddenly in all or most of the cycles, and is well marked in the sections by coarse sandstone or beds of the Boserup facies. These beds are therefore considered as the basal sediments of the different cycles.

Summary. The subject of rhythmic sedimentation in coal measure deposits has attracted much interest during the last 20 years. As a rule, the thickness of coal-bearing formations is considerable, though all were laid down in shallow water — even in river deltas and river plains above the sea-level. This was made possible by regional subsidence. In a recent paper Haites and Thiadens, dealing with the Dutch (Carboniferous) coal field, interpreted the repetition of coal beds as river deposits laid down in a region of slow, continuous subsidence, combined with periodically faster subsidence by compaction of coal and other sediments. The coals were frequently split up by meandering, and very often the beds were washed out by the rivers. The intervening sediments (the country rock) do not, in effect, really separate the different coal beds. Over sufficiently large areas the coals become reunited via "splits", thus joining up to form a thick series of strata between two major marine transgressions. This interesting theory is in direct opposition to the prevailing ideas regarding rhythm in coal basin sediments. The rhythm is, in fact, a mere show, independent of any kind of rhythmic process in the earth's crust. The present writer unhesitatingly agrees with the above authors in their interpretations of the Dutch coal field, and considers it quite probable that this kind of sedimentation took place in most coal fields containing thick non-marine sediments. In regions where the sea invaded a basin repeatedly, however, we cannot ignore intermittent changes of level. In the lowest Lias of Sweden, moreover, there is another important factor to be taken into account, viz. the up-warping of the Archaean borders and their denudation.

The Rhaetic-Liassic sediments of N.W. Scania were deposited in a region of intermittent crustal movement, resulting in a cyclic succession of strata about 250 metres thick. The coal basin was surrounded by Archaean rocks in the north-east and probably also in the south-west. Each upheaval of the Archaean borders initiated a new phase of rapid sedimentation, finally resulting in silting up of the basin. Then owing to subsidence the sea inundated the more lowlying parts and remained there until fresh upheaval of the margin reintroduced a new cycle, with continental deposits at the base. — The marine waters were assuredly very shallow and the salinity low, as indicated respectively by the thin sedimentary cycles (mostly about 20 metres) and the scanty thin-shelled lamellibranch faunas.

6. Stratigraphy

A. The Rhaetic

The Rhaetic beds rest upon the arid Kågeröd formation and begin with the non-stratified Vallåkra beds, followed by the coal-bearing formation.

The term "Vallåkra" was established by the present writer in 1935 to embrace the beds between the red Kågeröd clay and the well stratified, coal-bearing Rhaetic; Erdmann had already pointed out some characteristic features of the clays in his boring records, the beds being listed as transitional between the Kågeröd and the Rhaeto-Lias, though more related to the latter. It was in 1915 that Erdmann referred the oolitic clay ironstone (= spherosiderite) at Höganäs to the Rhaeto-Lias. The same rock at Vallåkra has been classified as Rhaeto-Lias (Troedsson 1913 and 1943 b) and Kågeröd (Hadding 1933).

It has been difficult to obtain accurate information concerning the Vallåkra beds, because they have been rarely penetrated in bore-holes. This is due to the fact that the borings are always arrested, as soon as the Lower Coal Bed has been located. In cases of only one coal bed, the boring is apt to strike the Vallåkra. This may be recognized on account of its green sandstones and its brownish-grey clay, which falls easily into angular pieces — so-called "dice-clay". But then the boring will be stopped as soon as the Kågeröd is recognized by means of its red stained bore-water. In such a case a complete section of the Vallåkra will have been achieved.

The Vallåkra member forms a thin sheet of badly washed sediments (Fig. 26), which hardly exceed 30 m. in thickness. It shows white, grey, green, black or slightly brown colours but never red ones, except in clays at the very base, where red spots occur sometimes, probably derived from the underlying Kågeröd clay. It is preserved in places where it is covered by the upper Rhaetic or has been so until recent times.

In the Archaean region, to the east of the Variscan fault, the Rhaetic with the Vallåkra occurs only in places. Here, too, red-coloured clastics occur below the Vallåkra. They are about as thick as the latter, sometimes thinner or even absent, and consist of clays, sandstones, arkoses and conglomerates, and grade downwards into weathered Archaean rock. Petrographically they coincide with the Kågeröd and are generally considered to be the residual out-thinning of the latter. In the Vallåkra coarse clastics dominate the column, especially downwards, a bed of sandy clay usually forming the top, as for instance, at Hörby. At Klippan and

Fig. 26. Non-stratified Vallåkra in contact with stratified Rhaetic beds above. Skromberga, core-drilling 272. Paleont. Inst., Lund. Size $\times$ 2/3.

Färingtofta green arkoses predominate, while Farhult, close to the fault line, has very coarse arkoses and (at the top) sandstone but hardly any clay. At Oregården the lower part consists of green sandstones, superimposed by clay. At Vilhelmsfelt coarse clastics below the coal-bearing Rhaetic amount to less than 10 metres; at the base the colours are red as in the Kågeröd, while the upper part is made up of greenish, grey, and brownish sandstones and brownish-grey clay with spherosiderite.

To the west (or S.W.) of the Variscan fault line the Kågeröd rests upon Silurian or Ordovician (Stabbarp) shale and attains thicknesses from a few tenths up to at least 300 m. The main part consists of arkoses, sandstones and conglomerates, while red clays generally form the topmost beds which amount to about 30 m. — sometimes less — in the whole region. The Vallåkra resting upon these clays is strikingly fine-grained, with green sandstones in the lower parts and spherosiderite-bearing beds in the upper. Yet, the sediments change rapidly from place

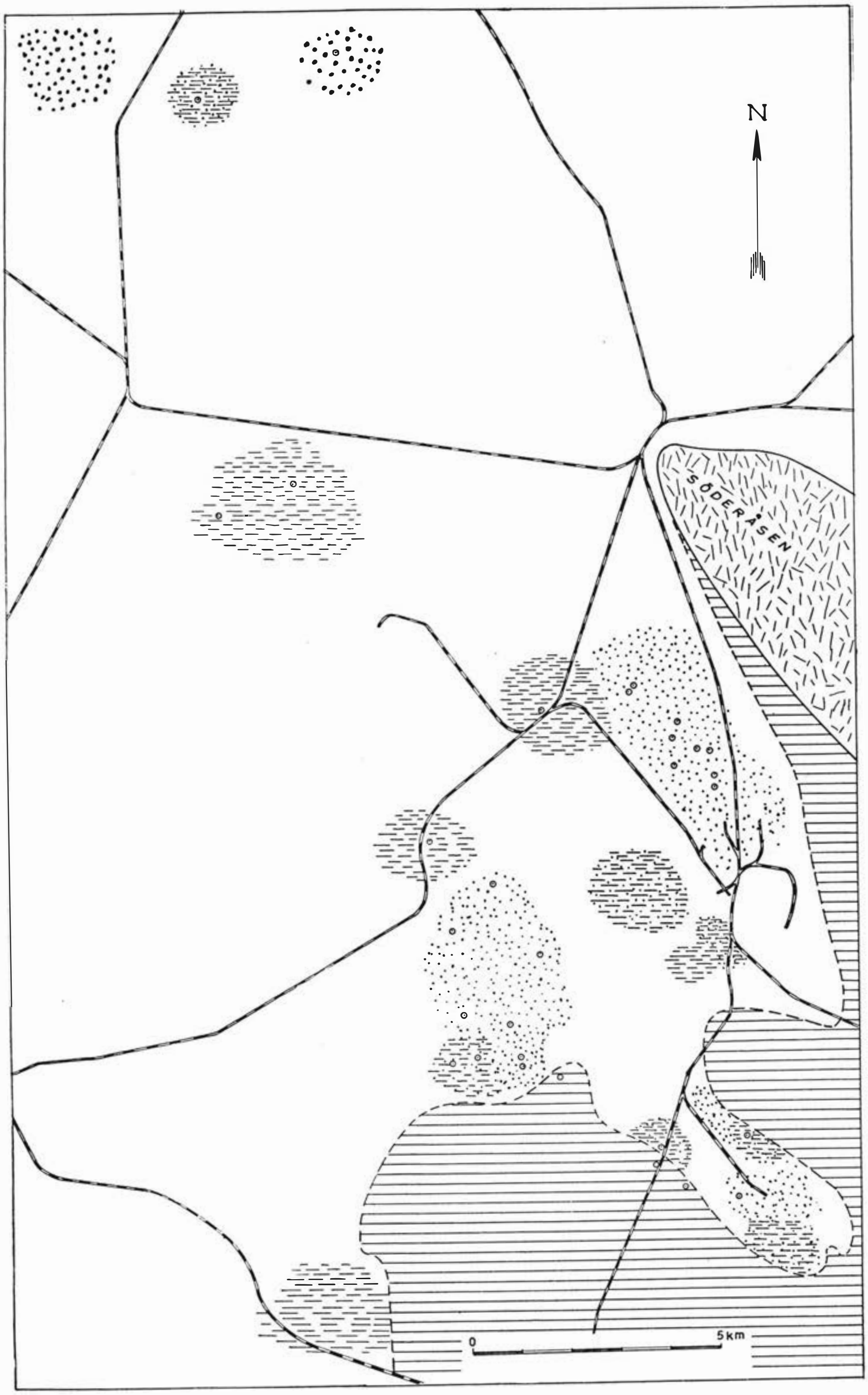


Fig. 27.

to place, especially the beds of sandstone and spherosiderite. The sandstones tend to disappear westwards. Thus at Vallåkra and Höganäs they form rapidly outthinning lenses in the clay, while in the vicinity of the big fault the arenaceous rock predominates. At Skromberga the Vallåkra member is thin, with sandstone at the base, clay upwards. The clays dominate at Ramlösa (Köpinge), Mörarp (borehole 221), Fleninge (265 and 266), Bjuv (Nos. III and 218), and W. of Billesholm (Fig. 27), the sandstones at Hesslunda (bore-holes 290—292) and in the region E. of the line Bjuv-Billesholm, where even coarse sandstones are met with, as for instance, at Selleberga (bore-holes 215, 216). In the diamond drilling at Påarp (P. 61) the lower part is argillaceous, while the upper is said to be a ferruginous sandstone (spherosiderite?), with a marl bed at the top (marine?). The arenaceous beds are always badly washed with angular and corroded quartz grains (TROEDSSON 1913, Fig. 2).

As pointed out by BÖLAU (1949) three divisions are recognizable in the northwesternmost outcrop of the Vallåkra at Margreteberg, all consisting of clay, though with sandstones in the lower beds. The Vallåkra clays are especially rich in montmorillonite (TROEDSSON 1948, NORIN 1949) and are used for clinkers (Skromberga), and ceramics (Vallåkra and Höganäs).

The Vallåkra clastics are of local origin, being derived from the underlying rocks. Accordingly, they are rich in arkoses within the Archaean region, and prevailingly argillaceous in the sedimentary belt, W. of the Variscan fault, where they are made up to a large extent of redeposited material. In the latter region they differ from the underlying Kågeröd through the absence of true arkoses. The Vallåkra beds also are devoid of red colours. On the other hand they contain remnants of plants, and the iron occurs as ferrous carbonate. In other words, they have been deposited in a reducing environment. The ferruginous beds are consequently green, grey, or white, but, when mixed with organic matter, all sediments assume dark brown or black colours. Occasionally even thin coal beds occur, as for instance, at Stabbarp (TROEDSSON 1947, p. 277) and Rögle (BÖHLAU 1949). In all these respects the Vallåkra coincides with the overlying Rhaeto-Liassic, but differs from it in being non-stratified and badly washed. Sediments of the same type, however, are met with in basal beds at different horizons of the Lias (cf. below). Of special interest is the spherosiderite.

The spherosiderite occurs in clays and consists of shot of radiately crystallized siderite 1 or 2 mm. in diameter. They were found at Vallåkra in 1912 during a geological excursion conducted by the late Professor J. C. Moberg and were described and figured for the first time in 1913 (TROEDSSON); but rock specimens, preserved in the Museum of the Geological Survey of Sweden, were collected

Fig. 27. Sketch-map showing the main facies types of the Vallåkra. The arenaceous facies (coarse and fine stipple), as a rule, is marginal. The sandy area at Hesslunda (in the lower-middle part of the map) is owing to a pre-Rhaetic upheavel and denudation of the Kågeröd beds in this region (TROEDSSON 1942, p. 316). Ruled areas are bedrock older than the Rhaetic.

by P. A. Geijer at Margreteberg in 1907 and by Hj. Lundbohm at Danhult in 1881. Later on, a great many localities with these spherulites were found, but exclusively in the Vallåkra beds. In fact, this mineral seems to be so characteristic to the Vallåkra that, to the author's knowledge, it is not lacking in any complete section or boring examined through the Vallåkra. Except at the above localities it has been met with in drilling cores at Fleninge (Nos. 265 and 266), Farhult, Oregården, Vilhelmsfält, Hesslunda, Skromberga, Stabbarp, and Hörby. Hitherto it has never been found in other parts of the Rhaetic or the Lias of Sweden, nor in the Kågeröd.

Chemically the spherosiderite is a rather pure ferrous carbonate. A thin section (Troedsson 1913, Fig. 3) shows scattered, diffuse particles, probably clay minerals, and rare quartz grains (Fig. 28) in a radiatingly-crystallized siderite. The latter consists of a central nucleus, surrounded by a thick concentric crust, but separated from it by a dark film. The crust is often covered with a coat of ferric hydroxide, due to oxidation, which is visible also in the open sections of the quarries, where the spherulitic beds are easily recognized on account of their rusty surface.

The spherosiderite is restricted to the fine-grained clastics and is syngenetic. Its relative purity can with certainty be attributed to precipitation of ferrous carbonate within the bottom ooze, where the small particles were dispersed and only occasionally, therefore, included in the concretions.

Einar Naumann (1922) has emphasized the great importance of humus for the transport of ferrous and ferric ions in solution. Thus, precipitation takes only place within the limits $Fe_2O_3 : 0.2$ humus and $Fe_2O_3 : 3$ humus. If the humus totals less than one-fifth of the iron oxide, there is no precipitation. And if the amount of humus is too high, precipitation takes place at dilution. This explains much of the mode of occurrence of the iron concretions in the Höganäs Series. They are not evident in the coal beds but occur frequently in sandstones and clays of this formation. This applies not only to the spherosiderite of the Vallåkra but also to the frequent nodules and beds of siderite in the whole series — which has always a certain content of organic matter derived from plants. On the other hand, the Kågeröd beds, which are entirely devoid of organic matter, are poor in iron — in spite of the prevailing red and green colours.

To sum up, the Vallåkra with its siderite beds and plant remains was formed during conditions essentially different from those controlling the Kågeröd beds, where siderite and plants are quite absent and ferric oxides relatively scarce.

The coal-bearing or the Mine formation is well accessible in the colliery districts, as far as concerns the coal beds, but in the same region the main part of the core-drillings have been executed and have given much detailed information about the vertical and horizontal distribution of the strata. We are here dealing with the coal beds, the intercalated beds of sandstone and clay, and the fire clays.

The coal beds. In a small area, only a few square kilometres in size, between Bjuv and Söderåsen, both coal beds are split up into two or three thin ones separated by sand or clay, all together reaching a thickness of 4 or 5 metres.

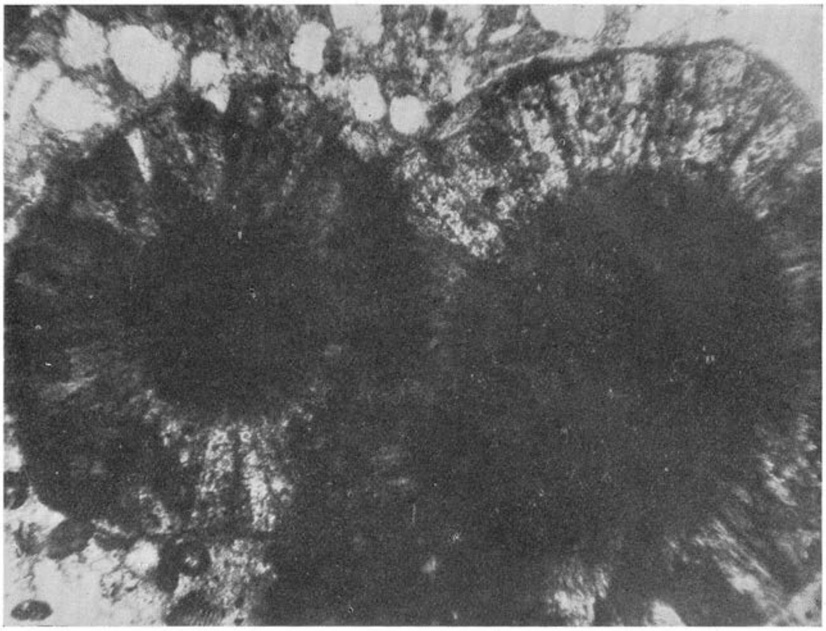


Photo R. Norin.

Fig. 28. Spherulitic siderite from the Vallåkra beds at Stabbarp. Core-drilling No. 282. Size × 45.

The extension of these splits is practically the same in both coal beds. Towards Söderåsen the Lower Coal Bed (Fig. 29) is split up by sandstone (I) which thins out in the opposite direction, then being replaced by clay (II). In the peripheral belt (III) the coal bed has its normal thickness. Fig. 30 shows the corresponding conditions in the Upper Coal Bed. Within a central half-circle facing Söderåsen the intercalated beds consist of sandstone, which is replaced by clay south-westwards. The latter begins as thin layers in contact with the coal seams and increases in thickness at the cost of the sandstone, until it finally dominates the space between the coals. In the peripheral part of the fan-shaped split the coal is usually characterized as a unitary one but contains further thin layers of bituminous shale and fire-clay.

The country rock intercalated between the main coal beds also varies in thickness, though in a different way (Fig. 31). In a part of the coalfield at Ormastorp the intervening rock is less than one metre thick but increases south-westwards to 10 m. at Hyllinge, 4 km. distant, from where it decreases again in the same direction. But still farther to the west and north-west, at Helsingborg and Höganäs, the intervening beds are 25 or 30 m. thick. The areas of greatest thickness form shallow troughs or synclines which, apparently, were important for the accumulation of the sediments.

In adits and core-drillings arkosic sandstones (similar to those in the Boserup)

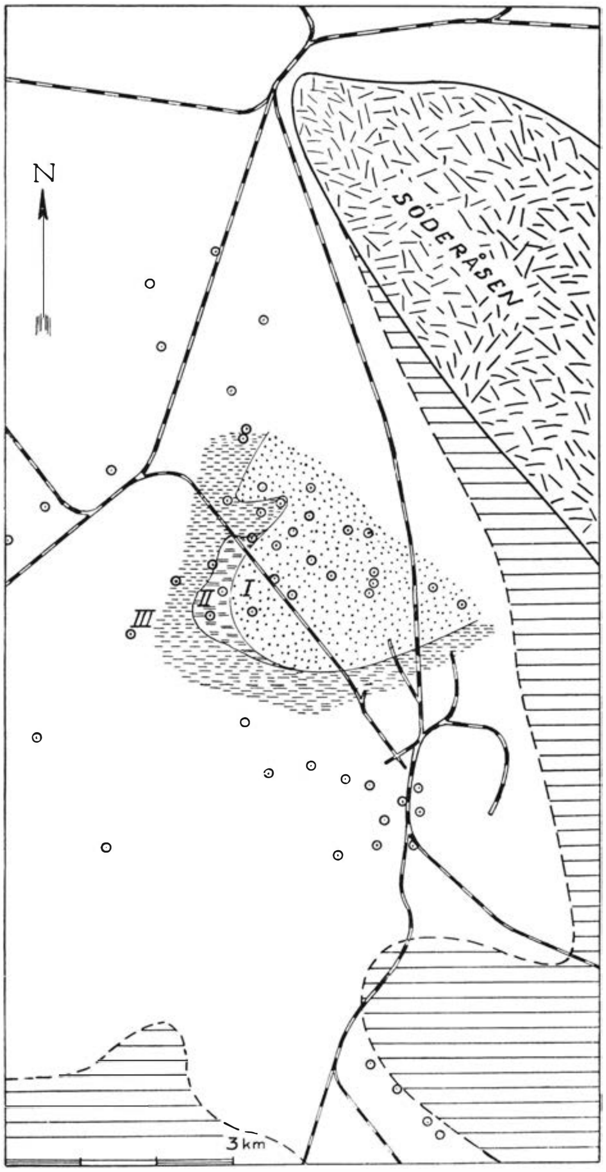


Fig. 29. Development of the Lower Coal Bed in the eastern coalfields. I and II, regions where the coal bed is split up into two coal seams separated by sand, resp. clay. III, region of undivided coal bed. Ruled areas, bedrock older than the Rhaetic.

have been recorded as an ordinary sediment, intercalated between the main coal beds and forming a strip along Söderåsen, with a north-westward continuation towards Kullen. Even below the Lower Coal Bed there are coarse sandstones in the same belt but, as a rule, no arkoses. South-westwards the coarse clastics change first into fine sand and then become more and more rich in clay (Fig. 32).

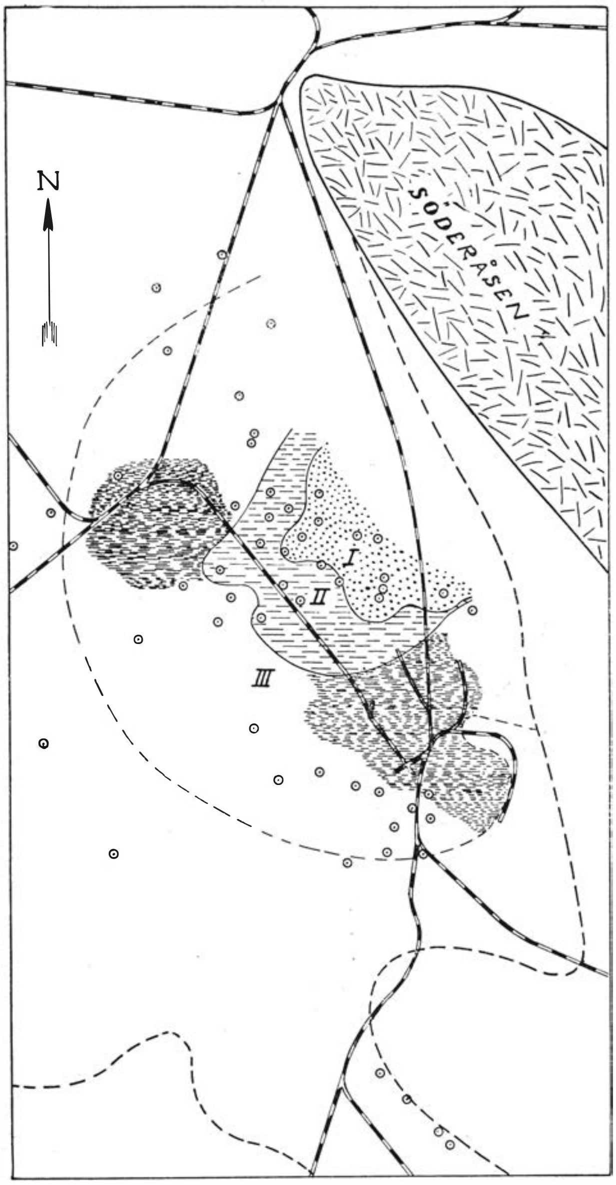


Fig. 30. The development of the Upper Coal Bed in the eastern coalfields. I—II, regions where the coal bed is divided into two coal seams, separated by intercalation of sand, resp. clay. III. The upper coal seam replaced by clay. Within the dark shaded fields the clay of the coal bed has been worked as fire-clay.

Fire clays and clinker clays occur at different horizons: 1) just above the Upper Coal Bed at Skromberga, Billesholm and Hyllinge, 2) within the same coal bed at Bjuv, Billesholm, and Gunnarstorp, and 3) immediately below it at Boserup; 4) above the Lower Coal Bed at Mörarp and in a small district at Billesholm, and

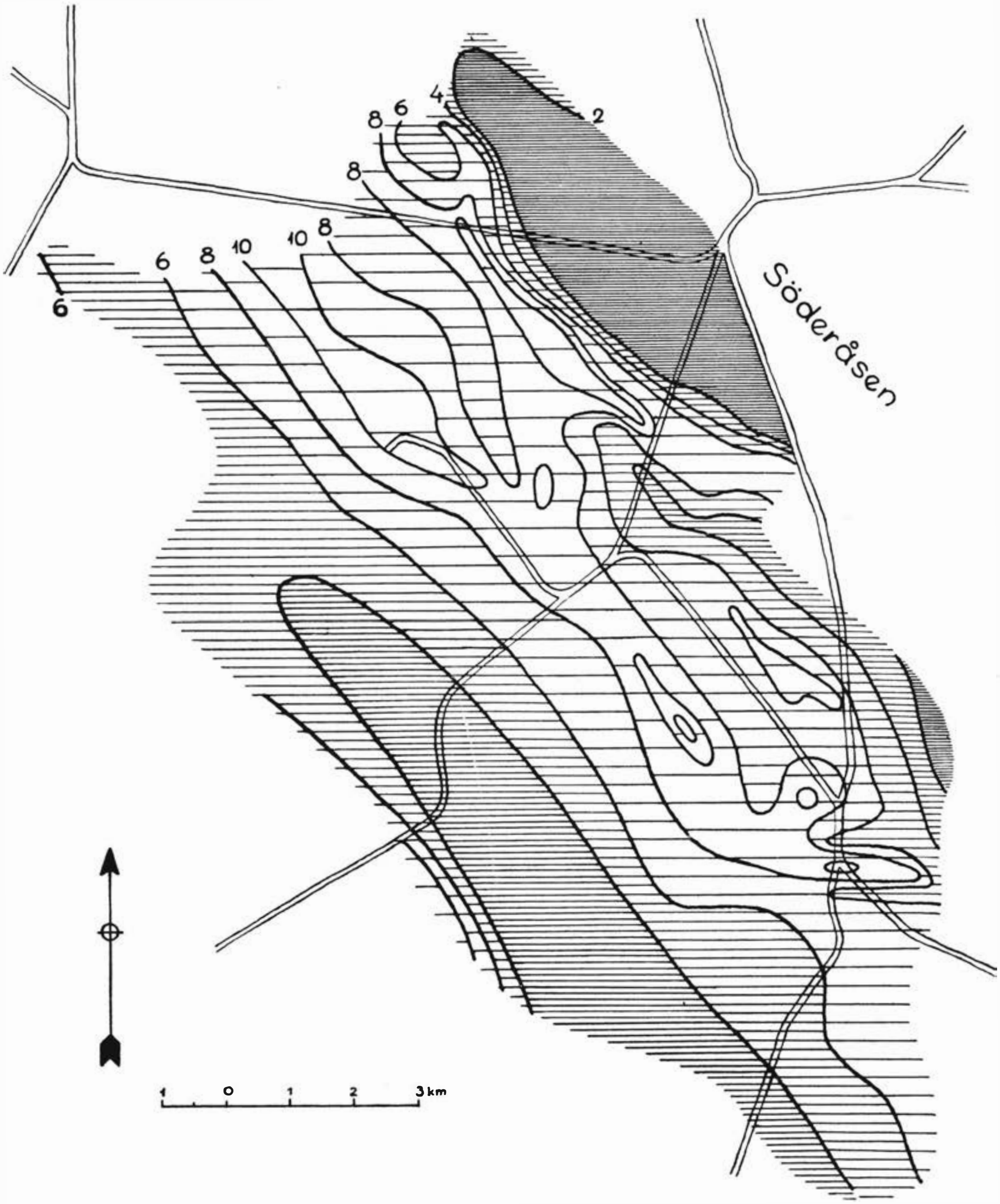


Fig. 31. Sketch-map of the eastern colliery districts showing the varying thickness (in metres) of the sediments between the Upper and Lower Coal Beds.

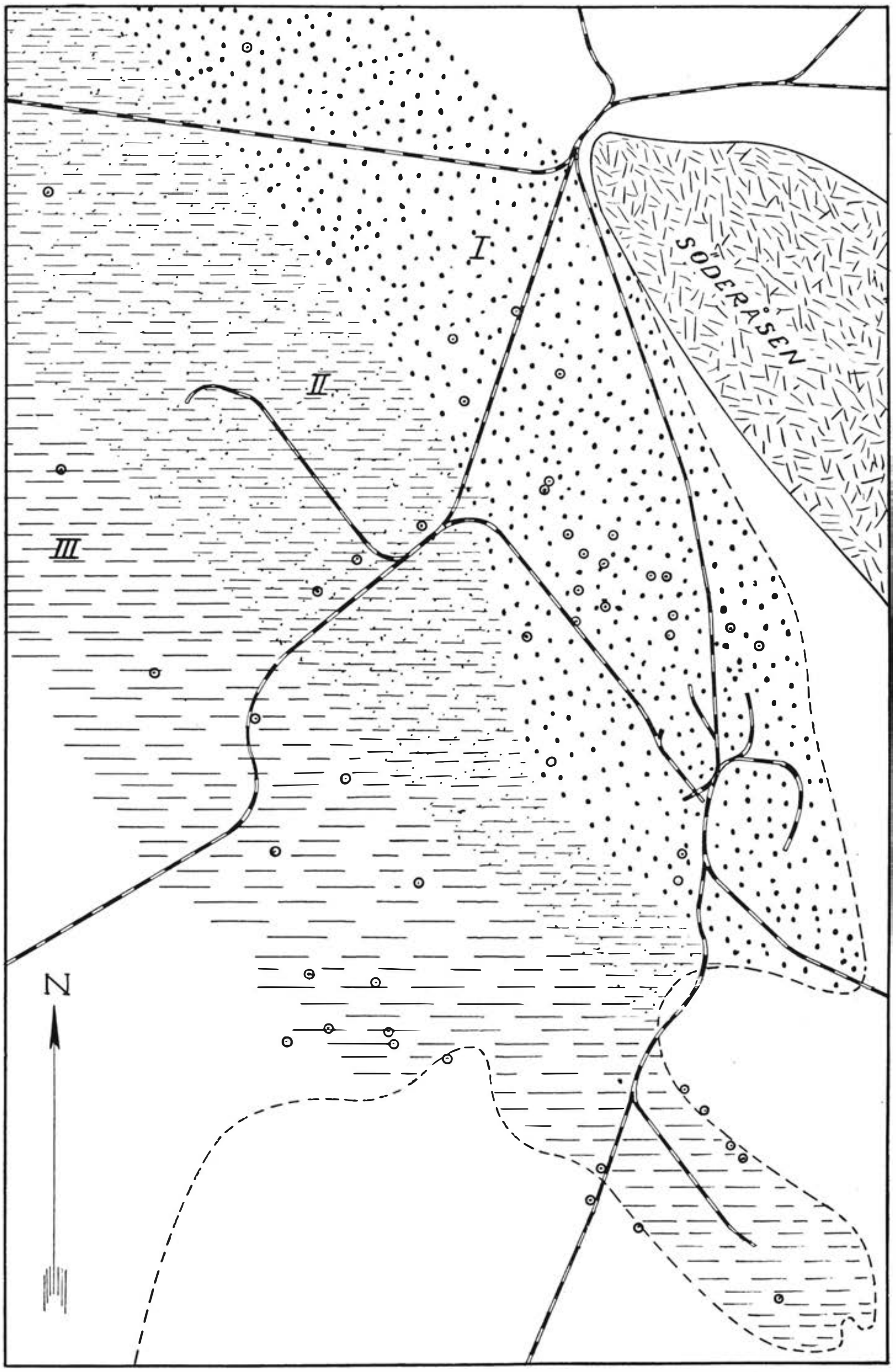


Fig. 32. Sketch-map of the eastern colliery districts, showing marginal sedimentation of the Rhaetic. I, Coarse sand near Söderåsen (Ormastorp, Gunnarstorp, and Billesholm). II, Predominating fine sand and clay (Bjuv). III, Predominating clays. Oblique, short dashes, Archaean.

5) below it in all coalfields, except at Ormastorp. The last-named wide-spread clay belongs partly to the Vallåkra beds, the first-named to the Boserup. The majority of these clays occur in two minor synclines of the Höganäs trough, viz. that from Skromberga to Boserup and that beneath Billesholm, Bjuv, and Hyllinge, both of which are also rich in coal. A third syncline of this minor class is strictly marginal close to Söderåsen. It includes the collieries at Gunnarstorp and Ormastorp, which have good coals, embedded in coarse sandstones, but no clays to exploit.

The Rhaetic flora was described mainly by A. G. Nathorst in a well-known series of papers, though he attributed a great part of the Liassic flora to the Rhaetic.

The Vallåkra beds contain only undeterminable plant remains, the main part of the flora being collected in clays connected with the coal beds. On this account the coal seams have played an important rôle in correlation, especially in the Rhaetic and the lowest Lias. Thus Nathorst recognized the following plant-bearing zones which were related to the coal beds and originally referred to the Rhaetic:

	Pålsjö	The Tinkarp Coal Bed, underlain by zone No. 8 with *Nilssonia polymorpha* and *Dictyophyllum Nilssoni*;
LIAS	Stabbarp	John Ericsson Coal Bed and Jean Molin Coal Bed, underlain by zone No. 5 with *Thaumatopteris Schenki*; zone No. 4 with *Equisetites gracilis*, immediately underlain by
RHAETIC	The coal mines	the Upper Coal Bed (A); this is underlain by zone No. 3 with *Lepidopteris Ottonis*; the Lower Coal Bed (B), containing zone No. 2 with *Camptopteris spiralis*, and underlain by clay with zone No. 1 with *Dictyophyllum exile*.

At Stabbarp the Upper Coal Bed is represented by the "Nya undre gruvan" ("New lower mine") Coal Bed. It is underlain by clays, such as, clay No. 10, which contains a flora with *Lepidopteris Ottonis*, *Dictyophyllum exile* &c., and was correlated by Nathorst with the zone of *Camptopteris spiralis*, though the latter species does not occur there. Nathorst was already aware of the poor evidences for the zone of *Dict. exile*, and, as far as Stabbarp is concerned, Johansson (1922) recognized only one zone below the Upper Coal Bed. In fact, it is questionable whether more than one zone is to be distinguished anywhere in this part of the succession of N.W. Scania. This is the *Lepidopteris* zone of Harris (1931), that contains the true Rhaetic flora and "corresponds to part or the whole of the marine Rhaetic".

Rhaetic invertebrate fossils have been met with at different horizons and localities in N.W. Scania.

At Östraby, near the western margin of the Engelholm trough, a dwarf fauna was collected from a piece of typical grey Vallåkra clay received from a drilling. The fauna contains several species characteristic to the *Avicula contorta* zone, though the leading fossil has not been identified. The following species are described in the paleontological part:

Nuculana cf. *oppeli* Rolle.
Protocardia rhaetica Meran.
Protocardia sp.
Pleuromya suevica Rolle?
Gervillia praecursor Quenst.
Pecten sp.
Modiola minuta Goldf.
Lamellibranch incertae sedis.
Chemnitzia sp.

This clay also contains foraminifers.

At Skromberga, a fossiliferous bed has been found at about the same horizon. The section is as follows:

10.	(At the top) Boserup beds (Lias) with the zone of *Equisetites gracilis*.	
9.	Upper Coal Bed (A)	0.18 m.
8.	Dark clay, partly slicken-sided	2.50 m.
7.	Sandstone	0.60 m.
6.	Dark clay, partly slicken-sided	2.00—2.50 m.
5.	Lower Coal Bed (B)	0.70—0.80 m.
4.	Light clinkers clay	0.80—1.00 m.
3.	Boundary bed with fossiliferous sandstone nodules	0.01 m.
2.	Dark clinkers clay, arenaceous, laminated	0.60 m.
1.	" " " pure, darker downwards, finally black.	

The boundary bed (3) has yielded fish scales, ostracods, shell fragments, reminiscent of *Estheria*, though without the characteristic sculpture of that genus; further *Modiola minuta* and *Pleuromya suevica* (?).

Hyllinge Coal mine. In a grey sandstone bed below the Lower Coal Bed a large lamellibranch, *Ceratomya stensioei*, has been found. While in the layers above this same coal bed, and together with a ganoid fish, *Hyllingea svanbergi* Aldinger, a small lamellibranch — *Eotrapezium hyllingense* — was found.

Bjuv, another coalfield of the Höganäs basin, has afforded several vertebrates, viz. ganoids and stegocephalians, from the layers above the Lower Coal Bed. In a sandstone lens within the same coal bed *Cercomya carlsoni* and *Liostrea hisingeri* have been collected.

Bosarp, or Boserup, an old coal mine, now closed down, has yielded some of the oldest known fossils from the Scanian coal district, e. g. an undeterminable lamellibranch (NILSSON 1824) and a bony fish, *Semionotus nilssoni* AGASSIZ.[1] (As to other vertebrate fossils in the Rhaetic beds, see page 135.)

Finally in a black shale just above the Upper Coal Bed of the drilling cores at Svanebäck and Klappe there have been found crushed and squeezed lamellibranchs, hesitatingly referred to *Modiola* sp. and *Pinna* sp. Very likely they belong to the Rhaetic part of the succession.

To sum up, the Rhaetic contains one plant-bearing zone, viz. that of *Lepidopteris Ottonis.* — Invertebrate fossils occur at three horizons, each corresponding to the top beds of the three sedimentary cycles of the Rhaetic.

B. The Helsingborg Stage

The Boserup Beds

During the years 1933—35, when the author first had the opportunity of following the core-drillings of the Höganäs region, he was struck by the regular occurrence of a characteristic series of arkoses and kaolin clays always at the same horizon, viz. immediately above the Upper Coal Bed, and of a rather constant thickness — about 10—15 metres. They were soon recognized as the very base of the Lias, and in the earliest papers they were simply called the Lias base or Basal Lias. But in order to avoid a name, too suggestive of the age, before the latter was definitely settled, the term Boserup has been in use since 1940. At Boserup or Bosarp, close to Billesholm, coal was dug up from open pits during the 18th century, and here the beds are still easily accessible — at least by digging. It was this place that supplied the data for Baron S. G. HERMELIN's small paper, written in 1773, entitled "Om Boserups stenkolsgrufva och öfriga stenkolsförsök uti Skåne" (Notes on the Boserup coal mine and other coal prospectings in Scania) and printed in the Proceedings of the Swedish Academy of Science (K. V. A. Handl. 1773): "Light grey sandstone, 3 or 4 fathoms in thickness, at the top rather coarse-grained and loose: but the farther it goes down, the finer and more consolidated it becomes. It consists of a conglomeration of quartz grains of varying sizes with clay-material, some of which are semitransparent, and as large as hempseed or

[1] The only specimen was figured by SVEN NILSSON (1823) as a "Fish belonging to the Acanthopterygii". According to LUNDGREN it was sent to L. AGASSIZ "for examining, new figures, and a full description". These were executed in 1843 (AGASSIZ, Recherches sur les poissons fossile. 3. Neuchâtel). But LUNDGREN adds: "Since this specimen seems to have got lost, I have figured the small piece of the original slab which is still preserved" (LUNDGREN, 1878, P. 32).

However, AGASSIZ brought the holotype with him to Harvard University, where it is preserved in the Museum of Comparative Zoology. It was redescribed and refigured by EASTMAN in 1905 (See W. E. SCHEVILL, Fossil types of fishes, amphibians, reptiles and birds in the Museum of Comparative Zoology. Bull. Mus. Comp. Zool. 74: 4 Cambridge, Mass. 1932).

smaller." — — — "Within this sandstone bed are five special ashen or reddish-brown, hard, argillaceous strata, separated by sandstone 4 to 6 inches thick. They contain more than 20 per cent of iron and consist of consolidated clay-ironstone which comes off in flakes in the same way as the bedded ores, which are used for production of iron at several places in England" (translated from the Swedish).

A hundred years later ERDMANN recorded the same rock from Boserup (1872, p. 44, and 1915, p. 263 ff., p. 431, fig. 286), Bjuv (1915), Mörarp (1915), and Billesholm (1872).

Curiously enough, the writer's first confrontation with these beds occurred just in the Boserup concession during the years 1933—34, when seven core-borings were made in that region, the costs of which were defrayed by the State.

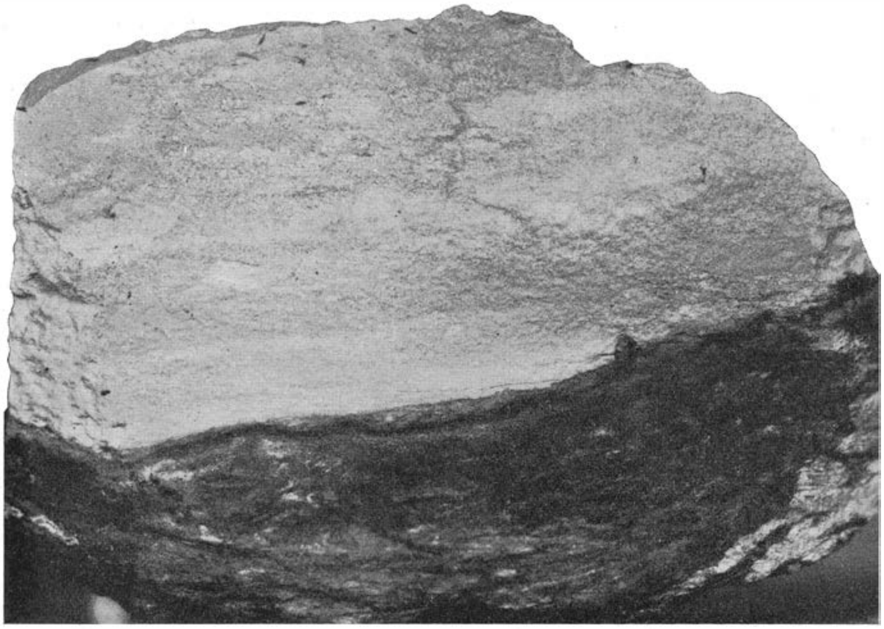
The beds above the Upper Coal Bed at Boserup are described by ERDMANN as "a sandstone that is dark grey and somewhat coarse-grained just above the coal, but light grey, well stratified, and very loose in the upper parts. A great many nodules of clay-iron occur here." According to HERMELIN the thickness is 18—24 feet or 5.4—7.2 metres in an incomplete section at Shaft "Adolf Fredrik" (Boserup):

[Quaternary:] clay and sand	3.6 m.
[Liassic:] Boserup beds (the lower part only)	5.4 —7.2 m.
[Rhaetic:] The worked coal bed (The Upper one)	0.15—0.3 m.
" Sandstone and clay shale	3.7 —5.5 m.
" The Lower Coal Bed	0.3 —0.75 m.
" Shale clay	about 12 m.

In his description of the shaft at Mörarp ERDMANN (1915, P. 436) says: "The white kaolinized sandstone between the depths of 34 and 47 m. is entirely similar to the sandstone above the Upper Coal Bed in shaft No. 1 at Bjuv. During the sinking of the shaft the percolating water became milk-coloured from the washed-out kaolin particles."

To these descriptions may be added that the coarse Boserup sediments are rich in half-weathered feldspar. The grains are angular and mixed with powder and pieces of kaolin, the stratification is irregular, sometimes cross-bedded, at others invisible. Yet sand and clay alternate, though very irregularly. The clays are sticky. They feel like talc and have often been referred to in the bore-hole records as talc-like or larditic. The pure ones consist mainly of kaolin, are white, and sometimes used for fire-clay. But the majority of these clays are grey, impure, and blended with grains of quartz and feldspar. Very often they are slicken-sided — probably due to the compaction of the coal beneath. The arenaceous varities show all transitions to sandstone, the boundary being often difficult to decide. The bore-water generally becomes milky. All sorts of sediments, except the coarsest sandstones, may be cemented by siderite.

The Boserup beds are non-marine and have a wide distribution. They occur within all the Rhaetic-Liassic region, or from Hörby and Stabbarp in the south to Vilhelmsfält and Höganäs in the north. They are underlain by the Upper Coal



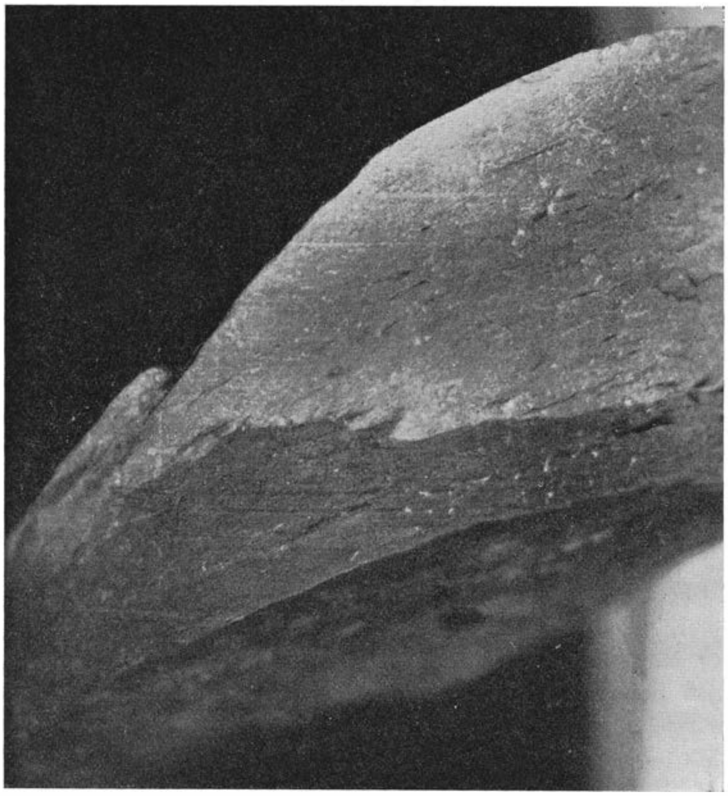


Fig. 33—34.

Bed or an equivalent carbonaceous clay; in the Höör district it may sometimes be the Archaean. The "Mill-stone" at Höör (Brongniart's arkose) is a coarse variety of the Boserup sandstone (Troedsson 1940). The coarsest arkosic varieties of the Höganäs trough, which are very similar to the Mill-stone, are met with at the collieries close to Söderåsen, especially at Ormastorp, Gunnarstorp and Vram; but here already the initial sediment consists of plant-bearing white and light grey, sticky clays, the coal miner's roof-clay of the Upper Coal Bed. These light clays have been exploited as fire-clay at several places (for instance at Hyllinge, Billesholm, and Skromberga) and represent the earliest Liassic sediment, consisting of kaolin clay deposited directly upon the plant bed, that developed into coal. The contact between the black coal and the white clay is largely straight and sharp but markedly uneven in detail (Figs. 33 and 34). The lowest part of the clay is crowded with plant remains, often well preserved. They belong to the zone of *Equisetites gracilis*, and are especially rich in leaves of *Chladophlebis*, which sometimes form beautiful ceiling decorations in the coal mines, as at Ormastorp, for instance.

The top layer of the Boserup beds, too, is a clay. At a distance of a few kilometres to the west of the hill Söderåsen clay layers also appear within the sandstone part of the column. The clay content thus increases rapidly up to one-fourth or a half of the whole member, the sandstones contemporaneously decreasing in thickness and coarseness. This transition is seen on the accompanying outline of the thickness of the Boserup beds (Fig. 35). On the whole it runs parallell to the horst, but bends westwards at its north end. It is close to the horst that the coarseness is most pronounced. As the clays begin to predominate, they generally become darker, often greenish, and slicken-sided.

Except for the plant remains the Boserup beds seem to be entirely barren.

The upper limit for the Boserup beds is often strongly marked in the cores, because the overlying beds are well stratified, sometimes laminated, in contradiction to the cross-bedding and coarse, irregular lamination of the Boserup. In addition, there is a clear difference as to colour and mineral composition. However, most of the borings are known only through records founded on cuttings from cable-tool drillings. In these the boundary is less distinct and sometimes rather difficult to fix.

In about 40 core-borings in the region between Farhult, Mörarp, Skromberga and Söderåsen the average thickness is about 14 metres. In a narrow strip about 2 km. wide along Söderåsen it is more than 15 metres, even the maximum, 19.85 m. in borehole 235, being too small, because the Boserup beds are directly covered by the Quaternary. From this strip the thickness decreases regularly down to

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Figs. 33—34. The Rhaetic-Liassic boundary in two drilling-cores. Rhaetic part, bituminous clay or coal (black); Liassic part, white Boserup clay. Fig. 33, Assartorp Core-drilling No. 260. Fig. 34, Oregården 271. The distance between the two borings is 16.5 km. Paleont. Inst., Lund. Nat. size.

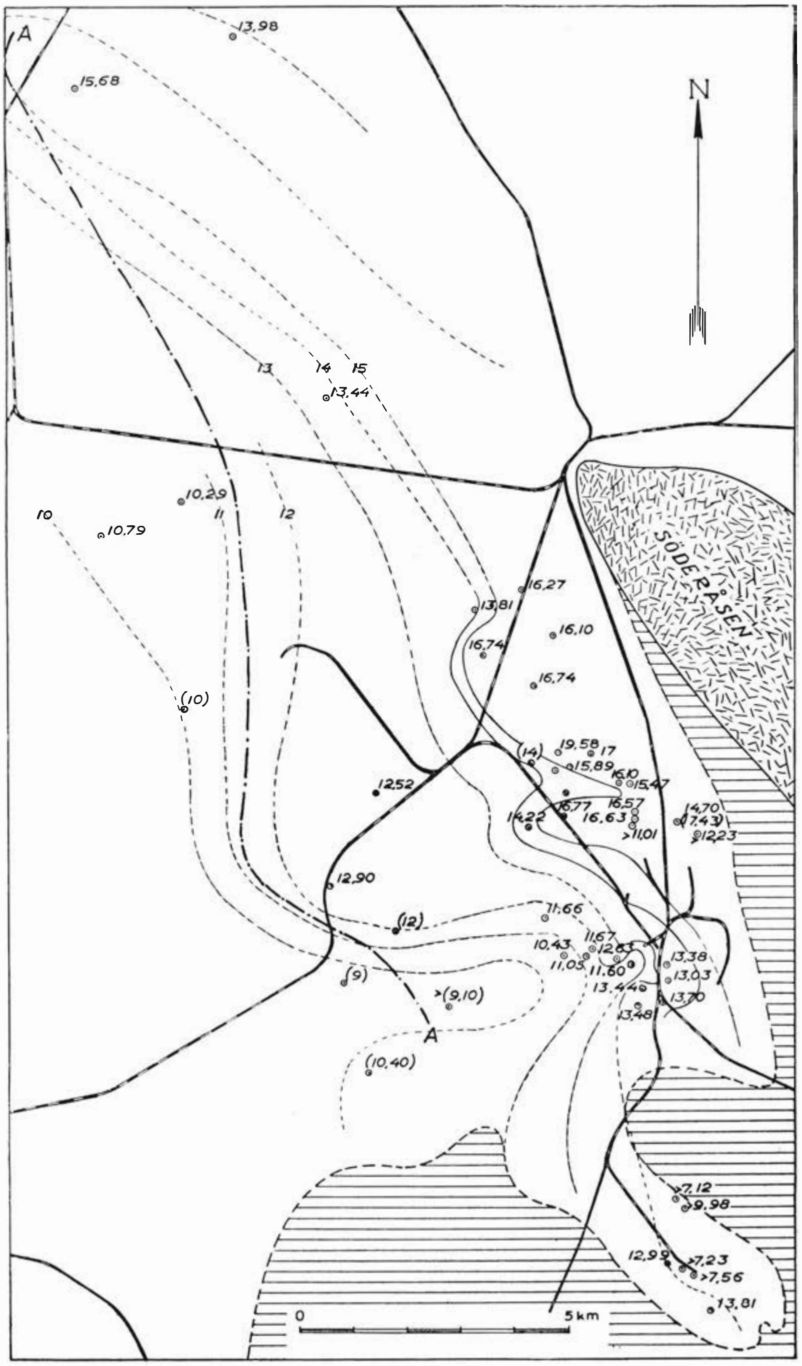

Fig. 35. Sketch-map, showing the thickness in metres of the Boserup beds west of Söderåsen. The line A—A divides the region into an eastern part in which the Boserup is mainly made up of sandstones, and a western where the clays predominate. Ruled, bedrock older than the Rhaetic.

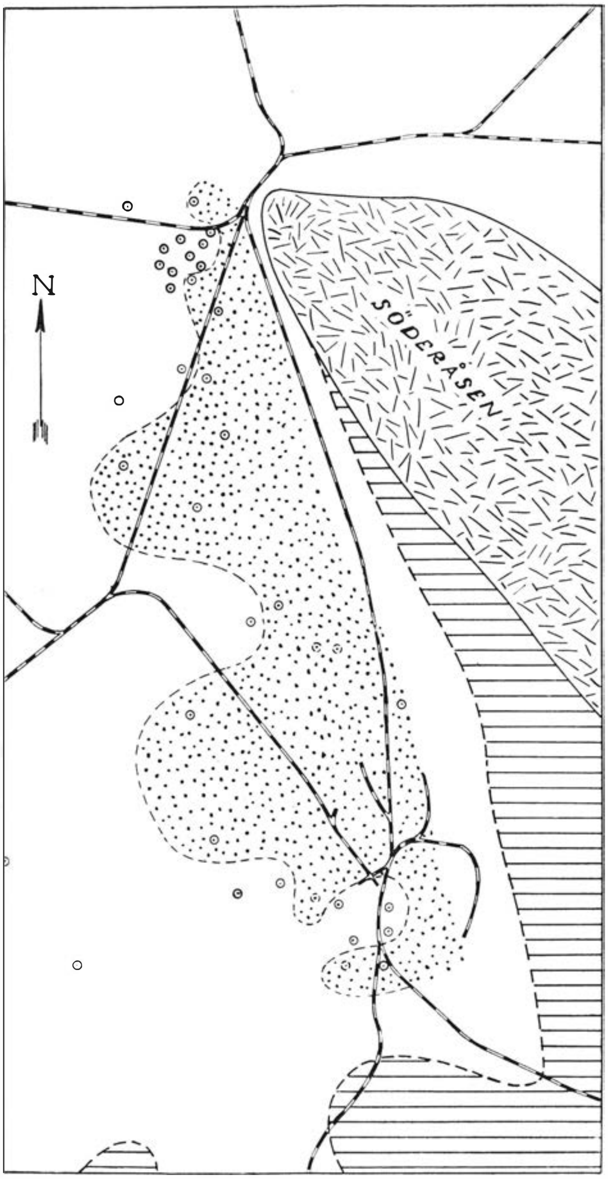

Fig. 36. Sketch-map, showing the distribution of the recurrent Boserup facies of the eastern colliery. Ruled, bedrock older than the Rhaetic.

10 m. at the line Skromberga—Mörarp. Farther to the west the sedimentation seems to have been sub-aquatic, which has made the upper boundary less distinct, though the characteristic features of the sediment are still easily recognizable, for instance at Höganäs and in the borings at Svanebäck and Klappe. In the north-western elongation of Söderåsen, now hidden beneath the sediments the thickness

and coarseness of the Boserup beds are noteworthy, being 13.58 m. at Farhult, 15.68 m. at Oregården, and 13.98 m. at Vilhelmsfelt. See Text-Fig. 35.

This normal series of Boserup beds is sometimes followed by a much thinner, recurring series, only about 4 or 5 metres in thickness, viz. in the vicinity of Söderåsen (Text-Fig. 36).

At Stabbarp the zone of *Thaumatopteris Schenki* is represented by clays at the top of the Boserup beds. It is equivalent to the zone of *Dictyophyllum acutilobum* (the Helsingborg flora), described by NATHORST from some unknown localities at Helsingborg and Höganäs, and found by the writer at Vallåkra about 17 m. above the Rhaeto-Liassic boundary, or at the very top of the Boserup beds (TROEDSSON 1913, 1943).

Summary. The Boserup beds are introduced by a white bed of kaolin clay, with plants belonging to the zone of *Equisetites gracilis*. The major part consists of cross-bedded arkoses and light clays, the coarseness and thickness decreasing with the distance southwest-wards from Söderåsen. The topmost beds contain the *Thaumatopteris* flora.

Mode of formation. The Boserup beds have been washed out from an Archaean surface with deep decay (probably also from the Kågeröd arkoses). The light plant-bearing clays, as well as the coarse, impure sandstones, have been transported only for a short distance, the last-named not in running water but probably as mud-flows, in the same way as the Kågeröd arkoses. The horst Söderåsen probably played an important rôle in delivering the detritus, certainly not in its present state of horst, but as the elevated border of the Archaean region. Such an elevation at the transition between the Rhaetic and Liassic times is suggested also by the coal beds, as referred to below. In the middle of the coalfield at Bjuv and Billesholm the deposition of the country rock between the two coal beds amounted to a thickness equal to the compaction of the Lower Coal Bed. At the present eastern margin, however, where the thickness of the coal is about the same as in the centre of the basin, the country rock between the coals amounts to practically nothing (Fig. 31). An elevation of the marginal regions is therefore indicated at about the same amount as the compaction of the Lower Coal Bed. This rising took place contemporaneously with the compaction.

It is remarkable that the white kaolin clay forms the very base of the formation just in the region most adjacent to Söderåsen. This seems to be a natural phenomenon, when a deeply decayed Archaean rises and starts to deliver sediments. Cf. TWENHOFEL, Treatise on sedimentation 1926, p. 95—96:

"Larger quantities of material under average conditions are likely to be transported from a region of considerable than from one of little elevation, and the transportation from the region of high elevation is likely to be the greater to the extent that the uplifted areas prior to uplift were land surfaces with deep decay giving a large volume of material available for transport. Such a condition means large transportation and possibly great thickness of deposit which is more apt to be fine than coarse. At any rate, the finer materials would dominate in those first transported, and after these were removed coarse sediments might follow. Thus the assumed sequence is reversed."

The Fleninge Beds

In the drilling-core No. 266 Fleninge a series of coarse sandstones — the Fleninge beds — were met with at a depth of 67.07—74.44 m., or nearly 80 m. above the Rhaetic-Liassic boundary, in a 28 m. thick sandstone. This seems to have a wide distribution in the region between the north-end of Söderåsen and the borings at Hjelmshult and Mjöhult.

The Fleninge beds bear a striking resemblance to the Boserup beds at the base of the Lias. A careful measurement of the Fleninge beds in the core showed 22 layers, varying in thickness from 0.03 to 2.65 m. As to their grain-sizes they were grouped as follows:

1) Coarse sand, 12 layers, thickness 0.03—1.19 m.,	total	3.60 m.
2) Fine sandstone, mostly laminated with clay, 8 layers, 0.03—2.65 m.	"	3.61 m.
3) Laminated clay, 2 layers, 0.08 m.	"	0.16 m.
	Total	7.37 m.

The layers of coarse sand, though hardly amounting to 50 % of the total thickness of the Fleninge beds, represent a strange element in the monotonous succession and are striking enough to characterize the whole stratum. They give a strong impression of a basal sediment, suggesting the vicinity of an Archaean denudation region.

The Fleninge beds seem to be better washed than the Boserup. As the latter they contain clay ironstone. The coarse sandstones are quite unconsolidated, when not cemented by siderite. The grain-dimension varies rapidly in adjacent layers from $^1/_4$ to 2 mm., some single grains amounting to 5 mm. in diameter. Quartz predominates, but white and red feldspars, always strongly weathered, are common, the sandstone being thus kaolin-dotted. Furthermore there are coal fragments of the same size as these minerals or even larger. The mineral grains are always angular, neved rounded. The matrix is scanty and does not fill the pores between the grains, the rock thus being porous and loose and certainly able to supply plenty of water.

It is the fine-grained arenaceous layers that predominate, however, and they are laminated with clay and clay ironstone. In vertical sections the clay laminae are densely crowded, fine, and sharply limited in a regular and straight bedding.

At a first glance the division of coarse sandstones in the exposed core at the drilling-place made a strange and extraordinary impression, since no such beds were ever known above the Liassic base. Similar beds, however, have since been met with at about the same height above the Rhaetic-Liassic boundary at Helsingborg (Troedsson 1947 b, pp. 396, 408, and 425) and in the boring-core from Klappe. The latter contains a series of clays — non-stratified, arenaceous and impure, quite similar to those of the Boserup beds — and coarse sandstones, between 129.07 and 131.91 m. The sandstones at the top of the series are fossiliferous and consist mainly of quartz-grains averaging 0.25 mm. in diameter; but larger grains of quartz or weathered, red or white feldspar, 1 or 2 mm. in diameter, occur interspersed or in groups. The fossils (which are not well preserved) belong to *Cardinia ingelensis*, or the same species as in the Upper Grind Sandstone at Ingelsträde and Brandstorp. The mentioned Klappe beds are situated 101 m., the grind sandstone at Ingelsträde and Brandstorp 117 m., and the coarse beds at Helsingborg about 85 m. above the Rhaetic-Liassic boundary. The correlation with the Fleninge beds is favoured also by the cyclic sedimentation.

Coarse beds of sandstone have also been cut in the cable-tool drillings at Hjelmshult and at Mjöhult (No. 10) viz. at the depths 71—84 and 115—150 m. Since, however, no samples have been preserved the correlation with the Fleninge beds naturally remains uncertain.

Much more interesting is the tracing of the Fleninge beds towards the east (Fig. 37). In this direction the denudation has truncated the whole series down to the Archaean, which is exposed in the horst Söderåsen. Accordingly, the Liassic formation thins out rapidly in this direction, the Fleninge beds thus being preserved only within a small region. Thanks to the numerous boring records preserved, it has been possible to trace these beds as far as their outcropping beneath the Quaternary mantle. In the bore-holes given below, beds of coarse sandstone have been recorded about 60 m. above the Rhaetic-Liassic boundary (+ signifies incomplete series: the sandstone is directly covered by Quaternary deposits).

In the Broby concession, bore-holes nos. 14 (7.58 m. thick), 15 (9.54 m.), and 46 (1.35+ m.).

In the Strövelstorp concession, bore-holes nos. 22 (9.72 m.), 24 (5.53+ m.), and 34 (2.50+ m.).

In the Nygård concession, bore-holes nos. 34 (4.30 or 16.10 m), 37 (9.30), and 39 (25.80 m.).

In the Ausås concession, bore-hole no. 6 (6.40 m.).

To these records may be added such informations as "loose sandstone", "sandstone mixed with coal", or "sandstone", out of which about a dozen seem quite plainly to be Fleninge beds. As a rule, the thickness does not exceed 10 metres; in most cases it is less. The maximum 25.80 m. is remarkable. Apart from this an increasing thickness towards the horst may be noted.

Another interesting detail is the fact that the interval between the Fleninge beds and the Rhaetic-Liassic boundary increases towards the west or north-west from 50 or 60 m. in their outcropping within the Ormastorp and Gunnarstorp coal mines, to 80 m. at Fleninge, and 100 or 117 m. at Klappe and Ingelsträde in the central part of the basin.

The Fleninge beds consist of rock débris, removed from a deeply weathered

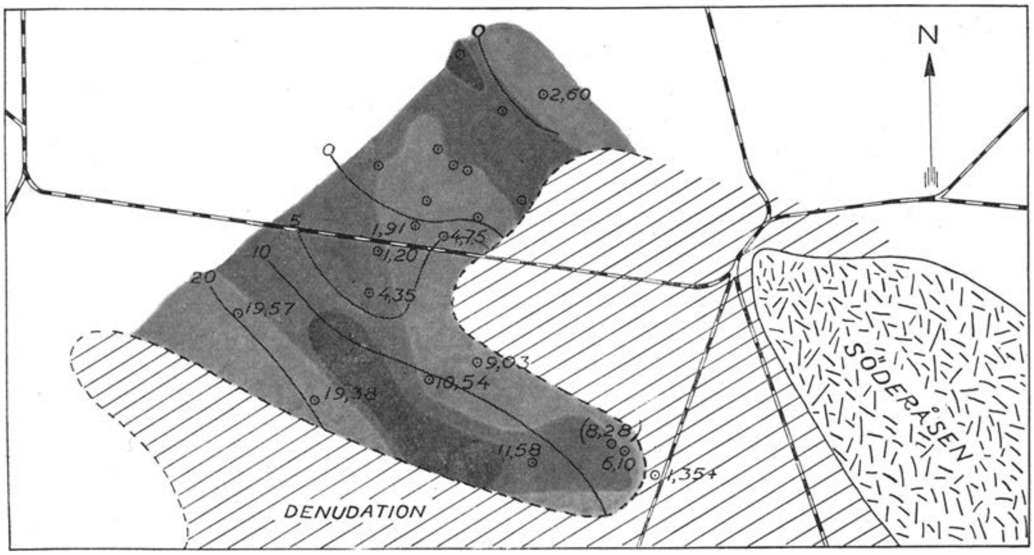

Fig. 37. Sketch-map showing the distribution and thickness of the Fleninge beds (grey areas) at the north end of Söderåsen. The curves, 0—20, indicate the thickness of the beds intercalated between the top of the Lower Helsingborg Stage and the Fleninge beds. Gray areas: light, medium and dark indicate resp. < 10, 10—20, and > 20 m. of thickness of the Fleninge beds. Within the ruled area the Fleninge beds are removed by denudation.

Archaean region and spread over the adjacent sedimentary plain. The deposition of the most typical, badly washed, non-fossiliferous, coarse material has taken place above the sea level. The Fleninge beds are similar to the Boserup as to mineral composition, structure, stratification and general view, and may with certainty be said to represent a recurrent Boserup facies, but the distribution is of minor extension and also less regular.

The Fossiliferous Beds

The remaining sedimentation of the Helsingborg Stage is fine-grained and consists of sandstones, grey and dark clays, coal seams and calcareous and ferruginous beds. Except for the outcropping Lower Stage at Ramlösa and along the shore north of Helsingborg, these beds are known mainly from borings, as for instance, the drilling cores at Klappe, Svanebäck (No. 209) and Oregården (No. 271).

The lower part of the Helsingborg Stage contains the Helsingborg and Pålsjö floras — the zone of *Dictyophyllum acutilobum* (= z. of *Thaumatopteris Schenki*) and that of *D. Nilssoni* and *Nilssonia polymorpha* — united by Harris into the *Thaumatopteris* flora, which should also include the very basal plant bed or the zone of *Equisetites gracilis.* It also embraces the *Mytilus*, *Cardinia*, and *Pullastra*

Banks and the zone of "*Cyclas*" *nathorsti* or the main part of the invertebrate fauna described by B. LUNDGREN in 1878.

The upper part of the stage, though thicker than the lower, is much poorer in fossils and contains only one of the fossiliferous horizons of the schedule given by LUNDGREN, or the *Ostrea* Bank.

The *Thaumatopteris* flora in fact, runs all through the stage, though it is mostly preserved in clays. The main part of this flora was described from the lower division (The Helsingborg, Pålsjö, and Höör floras). The upper division is rather poor in species, the most common ones belonging to the genera *Dictyophyllum*, *Equisetites*, *Nilssonia* and "*Gutbiera*". Plant remains of the *Thaumatopteris* flora have thus been met with in every one of the nine cycles recognized in the Helsingborg Stage (See Table I).

The invertebrate fauna of the Helsingborg Stage consists mainly of lamellibranchs — though badly preserved as a rule. Of course, the past 70 years, since the issue of LUNDGREN's monograph, have yielded a great many specimens, but these have not contributed very much to our knowledge of the fauna, most of the species having already been described by LUNDGREN. The most important contributions are those concerning the vertical and horizontal distribution of the species, but the new collections have also allowed a more detailed investigation of the generic and specific characters, though many questions still remain unsolved.

As shown by the present writer the *Mytilus* and *Cardinia* Banks and the zone of "*Cyclas*" *nathorsti* can hardly be regarded as separate and independent horizons. At the type localities along the shore at Helsingborg the "banks" are in close contact, and in the case of drilling-cores only one, as a rule, is developed. This *Mytilus-Cardinia* horizon has been struck in the borings at Svanebäck 209 (*Liostrea hisingeri* at 193.6 m.); at Rosendal 264 (*Cardinia follini* at 36.67—37.87 m.), and at Klappe, where *Cardinia follini* was met with at 165 m. and *Liostrea hisingeri* 10 m. higher up. *Cardinia follini* seems to be a well defined, index fossil, restricted to Cycle No. 6 — or the *Cardinia follini* Cycle —, met with in remote parts of the Höör and Höganäs regions (the Lower Grind sandstone). The next highest horizon, the *Pullastra* Bank, has a similar distribution, with *Eotrapezium pullastra* and other species of *Eotrapezium*. This bed, which belongs to Cycle No. 7, has its type locality at Ramlösa, but has been met with at several other places in the southern part of the present Helsingborg, as well as at Esperöd, near Höganäs, and in drilling cores from Farhult 270 (at 47.09—48.06 m.), Oregården 271 (together with *Modiola hoffmanni* at 206.01—206.54 m.), at Rosendal 264 (together with *Liostrea hisingeri* and *Modiola hoffmanni* at 31.90—31.95 m.) and at Stabbarp 284. To the same horizon belong the sandstone with *Tancredia arenacea* at loc. 230 Gravarna, the fauna at Kärnan, described by MOBERG in 1907, and a horizon in the Fleninge drilling core 266 (at 106.2) with *Eotrapezium menkei*.

The Upper Helsingborg Stage is poor in fossils, as already stated. It is introduced by the coarse Fleninge beds, which form Cycle No. 8 and contain the Upper Grind sandstone, with *Cardinia ingelensis* and *Cardinia* sp., at Ingelsträde, pre-

Table I

The Cyclic Development of the Lower Part of the Höganäs Series

<table>
<tr><td rowspan="5">Upper Helsingborg Stage 125 m.</td><td>12</td><td>Ostrea Bank
Thaumatopteris flora IX</td><td rowspan="12">Hettangian (Lias α_1—α_2)</td></tr>
<tr><td>11</td><td>Calcareous beds
Thaumatopteris flora VIII</td></tr>
<tr><td>10</td><td>Calcareous beds
Thaumatopteris flora VII</td></tr>
<tr><td>9</td><td>Gastropods, lamellibranchs
Thaumatopteris flora VI</td></tr>
<tr><td>8</td><td>Cardinia ingelensis, Liostrea
Thaumatopteris flora V
Fleninge basal beds</td></tr>
<tr><td rowspan="4">Lower Helsingborg Stage 60—90 m.</td><td>7</td><td>Pullastra Bank (Ramlösa)
Z. of Taeniodon ? nathorsti
Thaumatopteris flora IV</td></tr>
<tr><td>6</td><td>Cardinia Bank
Mytilus Bank
Thaumatopteris flora III (Pålsjö)</td></tr>
<tr><td>5</td><td>Liostrea hisingeri, Modiola
Thaumatopteris flora II</td></tr>
<tr><td>4</td><td>Liostrea hisingeri
Thaumatopteris flora I (Helsingborg)
Boserup basal beds and
z. of Equisetites gracilis</td></tr>
<tr><td rowspan="3">Rhaetic 10—60 m.</td><td>3</td><td>Black shale with Modiola
Upper Coal Bed and clays with Lepidopteris flora II</td></tr>
<tr><td>2</td><td>Beds with stegocephalians, fishes, and lamellibranchs
Lower Coal Bed and clays with Lepidopteris flora I</td></tr>
<tr><td>1</td><td>Vallåkra clay with contorta-fauna
Spherulitic siderite, sandstones and arkoses</td></tr>
<tr><td>The Kågeröd</td><td colspan="2"></td><td></td></tr>
</table>

viously also worked at Brandstorp and Täppeshusen, N. of Helsingborg. *C. ingelensis* has been recorded also in the core at Oregården at 195 m., or about 100 m. above the Rhaetic-Liassic boundary.

At the very top of the series the *Ostrea* Bank is accessible at the shore at Kulla Gunnarstorp as a coarse ironstone conglomerate with *Liostrea hisingeri*, *Modiola* *hillana*, and *Gervillia hagenowi.* The same fossils have been found at 111 m. in the core at Oregården in a fine, hard, calcareous sandstone, presumably at the same horizon. At Kulla Gunnarstorp the *Avicula* Bank is directly superimposed upon the *Ostrea* Bank, but at Oregården first, at about 16 m., come basal sediments of the Boserup type and then, at 95 m., a fine loose sandstone with *Tancredia erdmanni* and *T. arenacea*, correlated with the *Avicula* Bank.

The Helsingborg Stage corresponds to the Lias α_1—α_2 of the German succession, or the Hettangian.

C. The Döshult Stage

The youngest beds in the coal basin pertain to the Döshult Stage. They usually begin with the coarse Döshult sandstone, and are more pronouncedly marine than the cyclic sediments of the Helsingborg Stage. The Döshult Stage embraces the two uppermost "banks" of the Lundgren-Nathorst stratigraphical table, the *Avicula* and the Ammonite Banks, and the Myacid Bank of the Katslösa section, all belonging to the Lower Sinemurian or the Lias α_3 (Arieten-Lias), though the latter probably carries the upper boundary of the Döshult Stage beyond the base of the Upper Sinemurian. The Döshult Stage differs mainly from the underlying Helsingborg Stage in that it carries foraminifers, ammonites, belemnites and brachiopods and other purely marine invertebrates, which have never been found in the Helsingborg Stage.

The Döshult beds are accessible in the central part of the basin.

The Döshult sandstone is the most outstanding rock of this Stage, and seems to occur at varying horizons. It is well exposed in the raised shore cliffs at Hittarp, in the present shore at Kulla Gunnarstorp and Domsten, in roches moutonnées at Viken, Vikens Ryd, and Döshult, and in sand pits at Döshult, Hjelmshult and other places in the Viken syncline, and finally at Gantofta, S. of Helsingborg. It differs not only from the common fine Liassic sandstones of this region but also from the coarse basal sediments met with in the Vallåkra, Boserup and Fleninge members. Thus kaolin pieces are entirely absent, feldspar is rare and the grains are well rounded. This is especially the case with the larger grains or pebbles, 5 or 20 mm. in diameter, which are rather common, even crowded sometimes, mostly flattened and elongated, and consist of quartz or crystalline rock. The rock is cross-bedded, frequently poor in cement, and even quite unconsolidated, used for sand and exploited in a great many sand pits. But there are also hard beds, cemented by siderite. The fresh rock is greenish, the exposed sands are yellow or white, which colours are turned into red or brown by burning. The iron mineral occurs in a fine clay, firmly attached to the quartz grains, more or less filling the pores between the grains.

The greatest thickness has been measured at Svanebäck, viz. 57 m., with 36 m. coarse sandstones, mainly in the lower part.

At Hjelmshult this sandstone forms part of the soil and has been pierced to at least 15 m. In a hard fine sandstone with thin conglomeratic layers of quartz the *Avicula* Bank fauna occurs at Dompäng with *Cardinia kullensis* as the dominating fossil.

The coarse Döshult beds are absent at Klappe and at Mjöhult (borehole No. 10). But at Oregården a loose, coarse sand was met with at 71.90—79.81 m., apparently an out-thinning of the Döshult sandstone. If present at Vilhelmsfelt the latter is only represented by arenaceous clays. The raised cliffs at Laröd and Hittarp expose only a part of the coarse series, probably not more than 20 or perhaps 30 metres, though, to judge from the dipping there exist covered loose beds of at least the same thickness as at Svanebäck.

In consideration of the fact that these coarse beds decrease in thickness and grain-size from the S.W. towards the N.E. and finally thin out or grade into clays, the writer inclines to the theory of transport of the Döshult sandstones from a land in the S.W. (Denmark), probably an Archaean region, now covered by younger sedimentary formations (TROEDSSON 1938).

In the shore section at Kulla Gunnarstorp the *Ostrea* Bank conglomerate is superimposed by the *Avicula* Bank at the base of the coarse Döshult sandstone.

Cardinia kullensis is rare in the *Avicula* Bank at Kulla Gunnarstorp and only represented by thin-shelled specimens. The main occurrence of this species is at Dompäng, a little below the Ammonite Bank, where the shells are thick and much larger. This indicates more pronounced marine conditions at the latter place, and may indicate a difference in age, too.

In the Hjelmshult region the *Avicula* Bank, represented by the Döshult sandstone or conglomerate with *C. kullensis* and *Oxytoma sinemuriensis*, is covered by marl beds belonging to the Ammonite Bank.

In the drilling at Oregården the Döshult stage is introduced by a series of white clays and kaolin-dotted sandstones (Boserup facies), 15 m., followed by the *Avicula* Bank with *Tancredia arenacea* and *T. erdmanni* at 95 m. Typical coarse Döshult sandstone occurs at 80—70 m.

At about 63 m. (62.88—63.48 m.) the rock is crowded with *Oxytoma sinemuriensis* and *Gryphaea arcuata*. Other fossils are:

Chlamys janiformis LUNDGREN
Pleuromya forchhammeri LUNDGREN
Coroniceras sauzeanum D'ORB.
C. bucklandi (?) SOW.
Dentalium parvulum RICHARDSON
and undeterminable specimens of *Pleuromya*, *Nuculana*, *Astarte* and small gastropods.

The topmost beds have not yet been studied in detail, but the foraminifer fauna indicates beds transitional to the Lias β, according to Dr. Brotzen (verbal communication).

The drilling-core at Vilhelmsfelt is believed to contain a rather complete succession through the Lias of Sweden.

In comparing the Katslösa sequence with that of the Höganäs basin we have to take into account both the fauna and the facies.

Fauna. The thick clay with gastropods below Bed 1, Gantofta, belongs probably to the Ammonite Bank.

Bed 5, Gantofta, contains *Coroniceras sauzeanum* (?), which indicates the α_3 or the β, and half a dozen species of other molluscs, mostly small lamellibranchs, which have not yet given any clue to correlation. For the moment this bed is tentatively classified with the Ammonite Bank.

Bed 8, the shelly breccia, is built up of thin shells with a sandy matrix. Only about 20 species have been recorded, but several of these occur in great abundance, especially the Myacids, e. g. *Homomya*. On this account Bed 8 may be named the Myacid Bank, in accordance with the stratigraphical name type introduced by LUNDGREN.

Of the fauna met with in the Myacid Bank only five species have been recorded from the Döshult region, viz.

Tancredia erdmanni,	in the *Avicula* Bank	
Homomya venulithus	" " " "	
Pleuromya forchhammeri	" " " "	
Oxytoma sinemuriensis	" " " "	and the Ammonite Bank
Chlamys janiformis	"	" " "

To these may be added the few neanic specimens of *Liogryphaea* in the Myacid Bank, that were tentatively referred to *L. arcuata.* The main distribution of this species is in the Lower Sinemurian (cf. the *Gryphaea* bed at Oregården), though it has been recorded also from the Upper Sinemurian. However, neanic specimens are hardly determinable. *Oxytoma sinemuriensis* is known from both the Upper and the Lower Sinemurian. The remaining species are not known outside Sweden (or Bornholm).

There remain two more species of stratigraphical interest.

The Myacid Bank has yielded a fragmentary cast of an ammonite belonging to the genus *Arietites*, which is typically Lower Sinemurian, though met with also in the Upper Sinemurian (Cf. JOLY, 1936). And finally a few specimens of *Protocardia oxynoti* have been met with in this bank. *P. oxynoti* used to be considered typical for the Upper Sinemurian, but is now known to occur also in the Lower Sinemurian.

These facts give little help towards the decision as to the age of the Myacid Bank, though according to field observations this bed comes above the Ammonite Bank, and the fauna gives the impression — though vaguely — of being younger than that of the latter bank.

The facial conditions in these regions differ from one another. The Ammonite

Bank of the Höganäs and Engelholm basins is typically marine with a wealth and size of *Oxytoma*, *Liogryphaea*, and *Coroniceras*, comparable with those of Western Europe. The *Avicula* Bank, too, has a marine facies. On the other hand, the minute fauna of the Clay Band No. 5 of the Katslösa section indicates lagoon or brackish water facies, and also the Myacid Bank with its tiny thin-shelled forms of *Oxytoma*, *Liogryphaea*, and *Homomya* certainly proves a water of low salinity. This probably explains a part of the faunistic differences but it does not explain why species like *Protocardia oxynoti* are rather common in the Myacid Bank and quite absent in the sections at Oregården, Dompäng, Kristinelund, and other localities of the Höganäs—Engelholm region.

To sum up, the lowest part of the Katslösa column has no coincidence with the Helsingborg Stage, but shows a near relation to the Döshult Stage. Bed 5 might belong to the Ammonite Bank division, while the bulk of the fauna of the Myacid Bank would suggest a somewhat later age, at least one species indicating the Upper Sinemurian.

For this reason the author is inclined to range Bed 8 at Katslösa with the top of the Lower Sinemurian, or with the lowest part of the Upper Sinemurian, and assign it to the top of the Döshult stage. The latter will then be divided as follows:

Döshult Stage	Myacid Bank:	Lower/Upper	Sinemurian	at Katslösa.
	Ammonite Bank:	Lower	”	
	Avicula Bank:	”	”	in the Döshult region.

D. **The Katslösa Stage**

The red clay, Bed 10, contains carbonized cylindrical plant remains and indicates a break in the succession, probably a weathered land surface with an old soil.

It is succeeded by a fine loose sandstone (Beds 11—13), 7 m. in thickness, weathering yellow or reddish, and containing a thin, ferruginous bed. Then comes an unconsolidated gravel of well-rounded, quartz pebbles up to 20 mm. in diameter (Bed 14). This is the coarsest conglomerate met with in the whole of the Höganäs Series of N.W. Scania. It is 0.4 m. in thickness and certainly forms part of the transgressional phase of the iron-bearing formation of the Katslösa section.

The conglomeratic sandstone (Bed 18) contains a mixed fauna. Besides the wave-rolled and worn specimen of the Lower Sinemurian species *Rhynchonella deffneri*, which was imbedded secondarily, there are Sinemurian species like *Zeilleria* cf. *perforata*, Upper Sinemurian forms like *Pentacrinus scalaris* and *Serpula* cf. *raricostati*, and the topmost Upper Sinemurian or Lower Pliensbachian belemnite *Passaloteuthis alveolata*. Some worn fragments of a slender belemnite have been doubtfully referred to *Pseudohastites charmouthensis*, but this identification needs corroboration.

As far as can be judged from this scanty fauna it should either belong to the topmost Sinemurian or possibly be transitional between the Sinemurian and the

Pliensbachian. Thus, there is a break in this section within the Upper Sinemurian (Lias β). The beds below the break are closely connected with the Lower Sinemurian and are therefore included in the Döshult Stage. They are probably equivalent to the topmost marine strata of the Oregården core, whose foraminifer fauna has been claimed to be transitional between those of the α_3 and the β. On the other hand, the beds above the break are similarly connected with the Lower Pliensbachian and are here ranged with the Katslösa Stage.

The beds next above, Nos. 19—21, are poor in fossils and do not differ essentially from No. 18. *Passaloteuthis alveolata* is the most characteristic fossil of these beds.

In Bed No. 22 *Grammatodon cypriniformis* appears for the first time. This species runs through the beds 22—32 and is a leading fossil of this part of the section.

The iron oolite bed No. 30 with its 60 species completely dominates, as far as the fauna is concerned. It also contains a great deal of the fauna described by Moberg in 1888.

The same fauna occurs in Bed No. 32, which is richly crowded with fossils, unusually well preserved in the fresh rock. But the rock weathers too easily, the outcrops in the bottom of the creek being earthy and crumbled, giving only fragmentary fossils. Unfortunately, this was not realized at the time of collecting, so only small pieces of the fresh rock were obtained. In spite of this drawback 27 species have been identified, the most common being *Plicatula orbiculoides*? It is interesting to compare the frequency of the most common species of Beds 30 and 32:

	Bed 30		Bed 32	
Grammatodon cypriniformis	140	specimens	3	specimens
Oxytoma inaequivalvis	14	”	18	”
Limea acuticostata	43	”	12	”
Chlamys textoria	48	”	19	”
Plicatula spinosa	44	”	8	”
” *orbiculoides?*	4	”	56	”
Bairdia amalthei	42	”	—	”

The comparison is affected by the insufficient material from Bed 32, unless we bear in mind that *Plicatula orbiculoides?* is many times as common in Bed 32 as *Grammatodon cypriniformis* in bed 30.

There is no essential faunistic change above Bed 32, except that several species are lacking higher up, and a few new ones added. The first, however, is due mainly to a general diminution of the fossil content, the most fossiliferous Beds Nos. 36, 41, and 42 showing only 20, 19, and 31 species, respectively. Of course, the missing species are first and foremost the rare ones, though a fact of stratigraphical importance is the disappearance of *Grammatodon cypriniformis*, one of the most common species in the beds next below.

The additional species, 8 in number, are rare and mostly new to science, but there are two rather common ones, which might be used as local index fossils, viz. *Pseudopecten aequivalvis* and *Ptychomphalus* cf. *expansus.*

Thus the Katslösa Stage might be divided into the following zones or subzones, from above:

zone of *Pseudopecten aequivalvis* and *Ptychomphalus* cf. *expansus*. Beds 33—45.
zone of *Grammatodon cypriniformis*. Beds 22—32.
zone of *Passaloteuthis alveolatus*. Beds 14—21.

Fossils characteristic of considerable parts of the Katslösa Stage are:

Tutcheria cingulata, Beds 30—42, rare at Katslösa, but common in the corresponding beds of S.E. Scania, which are referred to as the *Cardium* Bank on account of the common occurrence of this fossil (Syn. *Cardium multicostatum*).

Oxytoma inaequivalvis, Beds 28—42, not very common.

Chlamys textoria, beds 8—42. Very common, but already occurs in the Döshult Stage.

Plicatula spinosa, beds 27—42. Common. This is probably the most significant index fossil of the Katslösa Stage.

Entolium lundgreni, Beds 30—42. Rather common.

Beyond point 1000 no further strata are accessible on account of the heavy Quaternary deposits. Accordingly, the upper limit of the Katslösa Stage is not yet known.

E. Summary of Stratigraphy

The Rhaeto-Liassic beds are in every respect different from the underlying Kågeröd, as regards minerals, grain-size, colour, stratification, organic remains, etc. Consequently the transition between the Kågeröd and the Rhaeto-Lias indicates a remarkable break in the succession, which break is here considered to be the lower limit of the Jurassic system.

There is nevertheless a tendency for the Rhaeto-Liassic beds to develop "Kågeröd" facies at certain horizons. These, however, are quite devoid of red colouring, they are badly stratified, and often cross-bedded, with angular grains of quartz and weathered feldspar, which not infrequently exceed 5 mm. diameter. As a rule, they are rich in white clay and contain lenses of siderite, coalgrains and plant remains, but are entirely lacking in animal fossils. They form basal sediments and provide a convenient key to the classification of the strata.

Thus, four or five main divisions are distinguishable in the lower part of the Rhaeto-Lias, each beginning with characteristic basal beds.

1. The Rhaetic — 30 or 50 metres in thickness — begins with the Vallåkra member, a re-deposited Kågeröd sediment. Then follow well stratified sandstones and clays, with two coal beds which are worked in the coal mines. The upper coal bed forms the topmost Rhaetic stratum in most places, but it is sometimes succeeded either by a thin dark clay with Rhaetic plants, or by marine clays with

lamellibranchs. The Rhaetic or *Lepidopteris* flora is rich in species and occurs at several horizons, mostly in close relation to the coal beds. Nathorst distinguished 3 plant-bearing zones, but it is doubtful whether they exist outside a rather narrow margin of the basin. Animal fossils have been encountered at three horizons, of which two, at least, are marine. One of these contains the *Pteria contorta* fauna.

2 a. The lower part of the Helsingborg Stage introduces the Lias and begins with the cross-bedded, coarse Boserup member. It continues with sandstones and clays containing thin coal seams and the Helsingborg and Pålsjö floras. These provided the basis for the four plant-bearing zones of NATHORST's stratigraphical table. Only three may stand, however. All belong to the *Thaumatopteris* flora. In addition, marine beds such as *Mytilus*, *Cardinia* and "*Pullastra*" Banks, occur at different horizons, all characterized by *Liostrea hisingeri*.

2 b. The upper part of the Helsingborg Stage begins with the basal Fleninge member, which is similar to the Boserup. Fine sandstones and clays, with coal seams of little economic value, form the remainder. Several horizons with poorly-preserved plant remains occur, and marine beds with scanty lamellibranch faunas — mostly *Ostrea hisingeri* and *Cardinia* — are also known.

The leading fossils of the Helsingborg Stage are *Liostrea hisingeri* and species of *Cardinia* and *Modiola*, *Gutbiera angustifolia*, *Thaumatopteris Schenki* (in the lower part), and species of *Nilssonia* and *Dictyophyllum*.

The thickness is about 200 metres, the upper division, being somewhat thicker than the lower.

The two divisions of the Helsingborg Stage correspond to the Cardinien-Lias or the Lias α_1 and α_2 of the German succession. It is, however, impossible to determine whether or not their mutual boundary actually coincides with that between the *planorbis* and the *angulatum* zones.

3. The Döshult Stage is characterized by coarse, cross-bedded sandstones, which introduce the stage in several places but reappear higher up. Thus, while appearing for the first time in the *Avicula* Bank division, they seem to be especially well developed at the base of the Ammonite Bank. The Döshult beds are marine, deposited during one period of subsidence. The lower division, or the *Avicula* Bank, represents the transgressional phase in which the marine conditions did not attain full evidence. The middle division, or the Ammonite Bank, is characterized by a typically marine fauna and belongs to the maximum of submergence. It was during the last regressional phase that the Myacid Bank division was deposited.

Thickness: 170 m. at Gantofta-Katslösa, 70 m. at Oregården.

The Döshult Stage corresponds largely to the Lower Sinemurian (the Arieten-Lias or α_3) but may extend slightly higher. At Katslösa it is followed by a break in the marine succession which corresponds to the main part of the Upper Sinemurian (the Lias β). The break contains non-marine deposits, viz. red clay, covered by a loose sand.

4. The Katslösa Stage embraces mainly the ferruginous part of the section

Table II

Stratigraphical Table of the Höganäs Series

Jurassic System	Katslösa Stage (115 m.)	Marine clays with beds of iron oolites	Z. of *Pseudopecten aequivalvis* and *Ptychomphalus* cf. *expansus* Z. of *Grammatodon cypriniformis* Z. of *Passaloteuthis alveolatus*		Lower Pliensbachian (Lias γ)
	—	—	Hiatus		Upper Sinemurian (Lias β)
	Döshult Stage (70—170 m.)	Marine sandstones clays and marls	Myacid Bank Ammonite Bank *Avicula* Bank		Lower Sinemurian (Lias α_3)
	Helsingborg Stage (200 m.)	Rhythmic sedimentation of sandstones clays, coal, and calcareous and ferruginous beds	Beds with *Liostrea hisingeri*, *Modiola hillana* *Eotrapezium* and *Cardinia*	*Thaumatopteris* flora (Pålsjö, Helsingborg, Höör)	Hettangian (Lias α_1—α_2)
	Rhaetic 10—60 m.		Coal measures Vallåkra beds	*Lepidopteris* flora (Bjuv, etc.)	*Contorta* beds
	Kågeröd formation				

at Katslösa, the beds, poor in iron, belonging to the Döshult Stage. It is divided into three zones with the aid of the molluscs. Thickness 115 m. Top not known. By comparison with the European standard, the Katslösa Stage probably begins at the top of the Upper Sinemurian but corresponds largely to the Lower Pliensbachian or the Lias γ.

In dealing with the stratigraphy of the Höganäs Series we have to rely mainly upon the lamellibranchs which do not allow of the same degree of accuracy in dividing the column into zones and subzones as do the ammonites. The rock and time units, recognized during the field and laboratory work, are rather well established locally, but there still remains no little uncertainty as to their exact correlation with the European standard.

7. Comparison with S.E. Scania, Bornholm, and North Germany

S.E. Scania. The Höganäs Series of S.E. Scania is strongly dislocated, the beds — which are raised vertically or even overturned — forming the eastern limb of a syncline, that has been pressed against the more rigid Silurian belt to the east. The syncline contains Cretaceous deposits at its centre, and the outcropping Höganäs Series forms a narrow strip on the map, between the Silurian and the Cretaceous. This strip can be traced for about 60 km., viz. from Eslöv in the south-eastern corner of the Stabbarp field to Tosterup, and is again found on the island of Bornholm but in a much more intricate pattern. The entire distance Eslöv—Bornholm is 120 km.

In the Stabbarp field the bedding is only slightly disturbed, the structures being of the same kind as in the coal basin, with faults and slow dips. But recent bore-holes in the southern part of Eslöv have yielded substantial evidence of vertical or overtilted beds of coarse sandstone and arenaceous clay belonging to the Döshult Stage. In a sample of the latter a piece of *Coroniceras* sp. was found.

Outcropping beds are found in Fyledalen and at Tosterup.

At Tosterup red-weathered Silurian *Posidonomya* shale is covered by a sheet of breccio-conglomerate, sandstone, and red clay of Kågeröd facies, only 8 or 10 m. thick. Then follow grey and black clays, and light sandstones of Liassic age. The black clays contain remnants of the *Thaumatopteris* flora, close to the base of the series, thus excluding any room for the Rhaetic. Since the strata are very disturbed, it cannot be decided whether the absence of the Rhaetic division in this place is primary or due to dislocations. However, no trace of Rhaetic beds has hitherto been found in S.E. Scania. Even the Lower Lias seems to be incomplete, as compared with N.W. Scania. Thus, marine beds of the Helsingborg and Döshult Stages are not apparent. The most complete sections of Liassic beds are to be found in Fyledalen. But the only exposed rock is a heavy sandstone formation with ferruginous beds, containing siderite and chamosite, more or less oolitic; the latter are described by Hadding (1933) and Palmqvist (1935) as iron ore deposits, though not yet exploited. The iron ores can be followed 32 km. in the strike direction and have a probable extension within Scania of about 60 km. (Hadding).

In this formation Moberg (1888) collected a fairly rich fauna of about the same assemblage as in the Katslösa Stage, with a majority of lamellibranchs. 64 species were found in all, the main part, or 59 species, at Kurremölla in Fyledalen, and the remaining ones from the south-easternmost localities, Rödmölla and Tosterup. The rock unit was classified after one of the most characteristic fossils, *Cardium multicostatum* PHILL. [Syn. *Tutcheria cingulata* (GOLDF.)], as the *Cardium* Bank. The latter "represents a summing up of the beds with *Am. Bucklandi*, *Am. ziphus*, and *Am. Jamesoni*; though an important number of Lower Liassic species occur in this fauna, its most characteristic elements speak more in favour of its ranging with the lower part of the Middle Lias" (MOBERG, 1888, p. 80, translation from the Swedish), i. e. the Lower Pliensbachian, since "Middle" Lias here is used in the German sense.

As far his latest interpretation is concerned, MOBERG was certainly right, but his statement about "the beds with *Am. Bucklandi* and *Am. ziphus*" needs closer examination. In reality MOBERG has clearly shown that in these beds there "is nothing especially characteristic to the zone of *Am. ziphus*" (l. c., p. 80). On the other hand, the *bucklandi* zone should be proved by the following species: *Gryphaea arcuata*, *Leda renevieri*, *Protocardia philippiana*, *Turbo solarium*, and *Acrodus nobilis*. However, as referred to in the paleontological part, the four first-named species are either uncertain or wrongly identified; as to the last one the writer has not had any occasion to study this species. From this we must conclude that the *bucklandi* zone is not at all represented in the so-called *Cardium* Bank. The latter therefore falls entirely within the Lower Pliensbachian.

MOBERG's main locality, Kurremölla, as well as his remaining finds in Fyledalen, coincide well, in respect of the fauna, with Bed 30 and the adjoining ones at Katslösa, more than 30 species being common to both. Among these are *Grammatodon cypriniformis*, *Palaeoneilo bornholmiensis*, and "*Leda*" *subovalis* (= *Rollieria bronni*), which, at Katslösa, are restricted to the zone of *G. cypriniformis*. The still lower zone, that of *Belemnites alveolatus*, seems to be absent at Kurremölla.

At Rödmölla, situated in the Tosterup district, Liassic pebbles in a Senonian conglomerate have yielded a somewhat different fauna, viz. according to Moberg:

Avicula lecta MOBERG (?)
" *anserina* MOBERG
Pseudomonotis ? *oblonga* MOBERG
Trigonia primaeva TROEDSSON (?)
Astarte erdmanni MOBERG, and
Tancredia lineata MOBERG

From the "Western boundary of Tosterup" MOBERG has 10 species, among which are *Pseudopecten aequivalvis* and *Ptychomphalus expansus*.

A small collection made by von Schmalensée in the conglomerate at Rödmölla as far back as 1879 is preserved in the Museum of the Geological Survey of Sweden. The rock is of hard, greyish-brown, conglomeratic sandstone with

Oxytoma inaequivalvis,
Entolium lundgreni, specimens of normal size and one especially large,
Limea acuticostata.

The last three species occur in the two uppermost zones at Katslösa. *Pseudopecten aequivalvis* and *Ptychomphalus expansus* are restricted to the topmost zone, the remaining species at Tosterup occurring in both. Of the six species found by Moberg at Rödmölla, *Trigonia primaeva* and *Tancredia lineata* are restricted to the topmost zone at Katslösa, *Oxytoma anserina* is suggestive of beds adjoining the Upper Pliensbachian, and *Astarte erdmanni* is closely allied to *Astarte oerbyensis* of the highest part of the Katslösa column. The remaining two species have little bearing in stratigraphy.

These facts are suggestive of two different zones of Katslösa Age in S.E. Scania: Kurremölla and other localities in Fyledalen belong to the zone of *Grammatodon cypriniformis* and probably the lower part of the zone of *Ptychomphalus expansus* and *Pseudopecten aequivalvis*.

The localities of the Tosterup district belong to the last named zone.

As far as known the iron-bearing formation of S.E. Scania has no fossiliferous horizon other than the *Cardium* Bank; and the fossils, as a rule, are preserved in haematite or otherwise connected to the ferruginous beds. Since the fossil fauna of the Katslösa Stage is embedded in the iron-oolitic beds, too, and the Katslösa is the only iron-bearing formation of N.W. Scania, it is quite probable that these two formations are largely equivalent.

If the fact that the Katslösa Stage was incompletely uncovered at Katslösa (see P. 119) be disregarded, the thickness of these beds increases from $\geqq$ 115 m. at Katslösa to nearly 200 m. in Fyle Valley (Fyledalen). Contemporaneously the rocks grow more arenaceous, the main rock being clay shale at Katslösa, sandstone in S.E. Scania. Even the fauna changes, the most striking dissimilarities being the total absence of brachiopods and the rarity of belemnites in S.E. Scania. These differences, being due to more agitated water and a lower degree of salinity, indicate that the southeastern sedimentary area was closer to the land area, whence the detritus was removed.

The *Cardium* Bank is succeeded by about 600 m. of non-marine deposits which contain plants of Jurassic or Wealden age. They are likely to be much younger than the ferruginous beds and are generally referred to the Wealden, which, however, needs to be corroborated.

Bornholm. The distance between Katslösa and Fyledalen is about 80 km. Proceeding for the same distance and in the same direction we arrive at the island of Bornholm, the S.W. coast region of which has sedimentary rocks of Liassic age. The strata are much disturbed, so the stratigraphy is intricate and not yet unravelled. No true Rhaetic fossils have been found, so the Rhaetic is probably absent as in S.E. Scania. The oldest fossils met with are plant remains at Munkerup and Vellengsby and they belong to the *Thaumatopteris* flora of the Lower Lias.

The Helsingborg Stage is indicated also by the occurrence of *Cardinia follini* at Galgelökken, S. of Rönne, and the *Nilssonia polymorpha* at Nebbe Odde. The Döshult Stage is very likely absent.

As in Scania, no Upper Sinemurian fossils have been recorded.

The Katslösa Stage is developed as ferruginous sandstones containing the *Myoconcha* Bank at Stampen, 4 km. S.E. of Rönne. This horizon has yielded 46 determinable species, mainly lamellibranchs, of which 24 are common to the *Cardium* Bank of S.E. Scania — among them *Grammatodon cypriniformis* of the Middle Katslösa Stage. There are also marked differences, however. While *Uptonia jamesoni* was found in the *Cardium* Bank (MOBERG 1888), *Aegoceras centaurus* var. *bornholmiensis* MALLING & GRÖNWALL has been met with in the *Myoconcha* Bank. For this reason MALLING and GRÖNWALL ascribed the latter to a slightly later age than that of the *Cardium* Bank. This is corroborated by other species, for instance *Ptychomphalus expansus* and *Pseudopecten aequivalvis*, which also prove the equivalence of the *centaurus* zone with the uppermost zone of Katslösa. Considering the entire faunal assemblage at Stampen the writer is inclined to correlate the latter with both the *jamesoni* and the *centaurus* zones — or with the Middle and Upper Katslösa zones. According to MALLING (1911) a similar fauna has been met with in the Hasle sandstone on Bornholm.

HÖHNE (1933) has described some new discoveries of ammonites from the Pottery at Rönne, Bornholm, viz. *Aegoceras taylori* var. *bornholmiensis* HÖHNE, suggestive of the *jamesoni* zone, *Aeg.* m. f. *valdeni-maugenesti* D'ORBIGNY, [claimed to be identical with *Aeg. centaurus* var. *bornholmiensis* and an index fossil of the *ibex* zone (= the *centaurus* z.)], and two fragments of *Amaltheus* cfr. *spinatus* BRUG. which he states to be a leading fossil of the Upper part of the Lias δ, in spite of its varying somewhat from the typical form. The finding of *Phylloceras heterophyllum numismale* QUENST. at the Pottery, Rönne, seems to be his only proof of the *davoei* zone, which he claims to be present on Bornholm.

KAJ HANSEN (1939) divides the Jurassic beds of Bornholm as follows:

3. Upper fresh water division, from Lias δ to the Wealden.
2. Marine division, or the Lias γ and δ (partly).
1. Lower fresh water division, or the Lias α and β.

The Upper fresh water series contains plants of Jurassic or Lower Cretaceous age and corresponds more or less to the above mentioned so-called Wealden formation of S.E. Scania, which is disconformably separated from the *Cardium* Bank.

The only fossils met with in the "Lower fresh water" deposits are plants belonging to the *Thaumatopteris* flora, and two lamellibranchs, viz. *Cardinia follini* and "*Cyrena*" *menkei*. Since all these fossils belong to the Lower Helsingborg Stage, there is no fossil evidence of the Upper Helsingborg Stage, nor of the Döshult Stage, nor of the Lias β, on Bornholm. A comparison with the different parts of Scania may be given here:

N.W. Scania	Central Scania (Höör)	S.E. Scania	Bornholm	W. Europe
—	—	Wealden ?	Upper fresh water series and Lias δ	L. Cretaceous and Jurassic
— *Exp.-aequiv.* z. *Cyprinif.* z. *Alveolatus* z. (Katslösa Stage)	— Brandsberga ? — —	— *Exp.aequiv.* z. *Jamesoni* z. —	? *Centaurus* z. *Jamesoni* z. —	*Davoei* zone, *Ibex* zone: Lias γ *Jamesoni* z.
Hiatus	—	—	—	Lias β
Myacid B. Ammonite B. *Avicula* B. (Döshult Stage)	— — —	— — —	— — —	*Arietites* or *Bucklandi* z.: Lias α_3
Upper Helsingborgian Lower ,,	— Höör sandstone and arkose	— *Thaumatopt.* fl.	— *Cardinia* *Thaumatopt.* fl.	Lias α 2, 1
Rhaetic	Rhaetic	—	—	Rhaetic

At Tuel Skov near Sorö, Zealand, Denmark, an erratic pebble of ferruginous sandstone with large quartz grains and a rich fauna has been found. The latter was described by Skeat and Madsen in 1898. As pointed out by Malling and Grönwall the fauna ranges it with the *jamesoni*-zone. Judging by the description, the rock is probably undistinguishable from the oolitic sandstones of the zone of *Grammatodon cypriniformis* at Katslösa.

Pomerania is situated in the continuation of the N.W.—S.E. trend through Scania and Bornholm, on the southern coast of the Baltic Sea. According to Frebold the successive advance of the Jurassic Sea did not reach this region until in Late Lower Pliensbachian, the *centaurus*-zone being the oldest marine bed of Jurassic age in Pomerania.

The Lower Lias of Northwest Germany has much in common with the Scania-Bornholm region. First and foremost, the well-known Liassic fauna of Halberstadt, described by Dunker 100 years ago, is very similar to that of the Helsingborg Stage. Another point of interest is the iron-oolitic development of the Lower Pliensbachian, which thus shows a rather constant facies, in 1) N.W. Scania—Bornholm, and 2) N.W. Germany (Teutoburger Wald—Quedlinburg), both running N.W.—S.E., but 500 km. apart. The English Cleveland ores come in the next higher stage, or the Upper Pliensbachian.

8. Paleogeographic Conditions of the Höganäs Series

The Rhaetic sedimentation in the coal basin is dominated to a high degree by the formation of the two coal beds. The coals of the eastern colliery district occur in shallow synclines, running N.W.—S.E., not quite parallelly to Söderåsen. They rarely amount to as much as one metre in thickness, this as a rule being in the middle of the synclines. This feature is still more emphasized in the varying thickness of the country rock between the coal beds as seen in Text-Fig. 31. As far as concerns the eastern colliery districts the greatest thickness of the coal beds occurs where the intercalated rock is thickest, and the outthinning of the country rock is largely coincident with the out-thinning of the coal beds. The implication is that both coal beds were formed in one and the same basin and that this underwent very little change from the Lower to the Upper Bed. The main coal basin was a narrow strip, shaped somewhat like a lagoon, extended in N.W.—S.E. and with the Archaean coast along its north-eastern margin.

Since each of the coal beds was deposited practically at a water level, the variation of thickness indicates a change of level, that took place in the interval between their deposition. This vertical movement was mainly due to compaction of the peat, and shows that the compaction of the Lower Coal Bed took place even before the deposition of the Upper one. The thickest part of the peat bog was in the deepest part of the basin, and here the compaction left more room for new sediments than in the shallow, lateral parts of the basin. The same basin was thereby enabled to receive one coal bed after another. However, the growth of the sedimentary column was possible only during a continuous subsidence of the region loaded with sediments. Thus, there was 1) a continuous slow subsidence of the region and 2) periods of compaction, due to loss of water and to carbonization, both together causing intermittently slow and rapid subsidence. But there are also indications of intermittent rising of adjacent regions, whence parts of the sediments were derived.

Such a rising is evidenced by the conditions at the north end of Söderåsen in a part of the Broby concession where the interval between the coal beds is less than one metre. In this region a compaction of the coal took place, as in the adjacent collieries, but in spite of this the interjacent beds of the country rock are as thin as the present coal beds. This can hardly be explained without tectonic movements: the eastern border of the basin, along Söderåsen, rose just about as much as the compaction. This rising has brought into erosion the weathered

Archaean which had already been spread as a local arkose in the close vicinity of the horst (at Gunnarstorp) in the time between the formation of the two coal beds. And after the formation of the Upper Coal Bed the Archaean was probably lifted still more, thus giving rise to the wide-spread Boserup beds which show beautifully the diminishing of the grain-size from the east towards the west.

The changes in the sediments south-westwards from Söderåsen is a striking feature in all parts of the Rhaetic as well as in the Lias.

Fig. 27 gives an idea of the distribution of the arenaceous and argillaceous facies of the upper Vallåkra beds. The sandy character of the sediments east of Bjuv is striking already at this horizon, and the clay content increases towards the west or south-west.

In the Skromberga and the Stabbarp coalfields the landward coarse sediments are either absent or out-thinning. They are certainly represented by the contemporaneous coarse sediments of the Höör district to the north-east. These have most likely spread south-westwards over the intervening Silurian region, from which the Rhaetic-Liassic beds have been entirely removed.

Fig. 32 shows the horizontal distribution of the coarse sandstones between the Rhaetic-Liassic boundary and the Vallåkra beds. They form a narrow zone which runs along Söderåsen and then continues north-westwards towards Kullen. The southern part is well corroborated by a great many bore-holes, which facilitate the tracing of the beds between the coal beds, from coarse sand near Söderåsen to fine sand and finally clay in the south-west.

The thickness of the Boserup decreases regularly south-westwards from Söderåsen. Thus, east of Bjuv it attains to 20 metres, but only to 10 m. at Mörarp (Text-Fig. 35).

The Boserup beds have a recurrent, coarse-grained horizon above the main column, only a few metres thick, within a zone along the hill from Åstorp to the south of Billesholm. This zone has a lobate boundary towards the west and extends in four places beyond the railway Åstorp—Bjuv—Billesholm—Ekeby (Text-Fig. 36).

These facts prove a detritus transport in N.E.—S.W., at right angles to the Variscan fault line, in Rhaetic and earliest Liassic times (Fig. 38).

Higher up in the series the influence of the Archaean is also well established. For instance, the Fleninge beds are developed mainly near the present north-western end of Söderåsen (Fig. 37). At Fleninge they are situated 80 metres above the Rhaetic-Liassic boundary. On account of their high stratigraphic position they have been removed within a rather vast area in the marginal part of the basin near Söderåsen. They have, however, also been identified at several places in Helsingborg, where the coarse beds are rich in pebbles of siderite and coal.

Still higher up, the coarse Döshult sandstones have been followed in the field in outcrops and borings from the coast, S. of Höganäs, to the vicinity of Engelholm. In this direction they become gradually thinner and finer-grained and finally merge into clay. This undoubtedly indicates a transport direction quite opposite to that in the lowest part of the column (Troedsson 1938, Fig. 4).

Another important thing is the fact that the section in the western part of the Engelholm basin is built up of clays with only a few thin sandstone beds, while sandstones dominate the Liassic succession in the Höganäs trough.

Arenaceous sediments in the north-eastern part of the Engelholm basin indicate a lateral deltaic deposition, the true age of which, however, is not known yet (Fig. 7).

Here also the local "erratics" at Brandsberga and Kolleberga should be mentioned. They show that Rhaetic and Lower Liassic deposits at this place — if there have ever been any — were removed at least at the Lias γ time. Thus there probably existed areas of Archaean rock uncovered by sediments in Early Liassic time, only 15 or 20 km. east of the present coalfield.

To sum up, the mineral composition of the c o a r s e sediments indicates derivation from Archaean rocks (or the Kågeröd arkoses) of the close vicinity. Further, the sediments clearly originated in the basin borders to the east or west, the latter — in Denmark — being now covered with younger Mesozoic sediments. Since the coarsest sediments are restricted to special members of the succession, intermittent uplift of the borderland occurred.

A similar picture will be received when mapping the finest sediments.

Close to Söderåsen the arenaceous sediments are coarse and contemporaneously badly graded and badly washed. The clays deposited in this environment are impure and of no value. The same is the case with the kaolin clays in the Boserup beds, with one exception: the lowest white clay, which forms the roof of the Upper Coal Bed and contains the *Equisetites gracilis* flora, is soft and pure at a sufficient distance from Söderåsen and used as a fire-clay. This clay represents the first Liassic sediment, removed from a deeply weathered Archaean region in the north-east. Close to the fault line it was still arenaceous and impure, but further to the south-west it soon became free from sand and finally thinned out. It covered and killed the previous vegetation and was in return covered by the remaining Boserup beds which were spread all over the sedimentary area. The Boserup formation indicates the beginning of a new sedimentary cycle and is certainly due to a rising of the adjoining Archaean region.

The fire-clay within the Upper Coal Bed has been traced as an out-thinning bed of those sandstones and clays, which split up this coal east of Bjuv. According to ERDMANN the clay has been exploited at Gunnarstorp, Bjuv, and in the northern shafts of Billesholm. These intervening beds spread out like a fan from Söderåsen. It is thinkable that the half-circle may be completed by occurrences in the region between Bjuv and Billesholm unknown to the writer. The relation of this deltaic deposit to Söderåsen is seen in Fig. 30. Similar conditions were ruling in the Lower Coal Bed (Fig. 29).

The clinker-clays and fire-clays beneath the Lower Coal Bed belong partly to the Vallåkra, for instance at Skromberga. They occur mostly at some distance from the Archaean border, particularly in the small syncline striking from Skromberga to Hyllinge, though a clay of this character has also been found at Gunnarstorp. Furthermore, they are well developed at Stabbarp.

As stated above (P. 62) fire-clays are mostly connected with coal seams in fine sandstones. Not only coarse sandstones, but also sequences of argillaceous sandstones or arenaceous clays are devoid of fire-clay. The latter is probably due to sedimentation ruled by the presence of electrolytes in the water, i. e. a sedimentation in sea water. In other words, the coarse sands were deposited in agitated, presumably non-marine waters, the argillaceous beds in off-shore waters; in both instances there was no possibility to produce fire-clay. But in the intervening belt other conditions ruled: the fire-clay was undoubtedly laid down in undisturbed fresh water, probably in small lakes or lagoons. There the clay was succeeded by deposits of organic detritus and by a vegetation that encroached upon the water body and finally replaced it in much the same way as Late-Glacial fresh water clay was covered by the Post-Glacial vegetation in the recent peat-bogs.

There remain, however, in the Höganäs Series a majority of sediments — fine sandstones, sandstones laminated with clay, and clays laminated with sand — which cannot be derived from the near vicinity. They carry all characteristics of being far transported sediments. For these and other sediments of the Höganäs series previous authors have claimed general transport from the present Archaean region in the east, north-east, or north. Yet, this is true only as far as concerns the local marginal deposits, while the materials which have undergone long transportation, certainly were carried along the main tectonic lines, i. e. in a north-west—south-east trend.

Is such transport likely to have taken place from the north-west or from the south-east? The distribution of the marine beds in the Rhaetic and the Lower Helsingborg Stage — indicated in the Fig. 38 by the letters A and B — shows that the sea invaded the basin from the north-west. Transport must accordingly have occurred from the south-east. In this direction only small remnants of these stages are represented or preserved. Thus in the small Stabbarp outlier the Rhaetic chiefly consists of non-stratified Vallåkra beds with a thin bituminous series at top, the Lower Helsingborg Stage is remarkably thin and was only reached by one marine invasion, that of the *Pullastra* Bank, while the Upper Helsingborg Stage has a thickness comparable with that in the type region. Furthermore, the Ammonite Bank of the Döshult Stage has been recognized in this outlier, just south of Eslöv.

Going further in the same direction towards S.E. Scania and Bornholm we find no Rhaetic at all, the basal beds containing the *Thaumatopteris* flora. Marine facies of the Helsingborg and Döshult Stages may be developed, though no other fossils have been met with than *Cardinia follini* (Bornholm). The Upper Sinemurian corresponds to a hiatus (emergence) as in N.W. Scania. And the Lower Pliensbachian is a well developed marine stage, with iron oolites interbedded with clays in N.W. Scania, sandstones in S.E. Scania and Bornholm. This submergence reached Pomerania before the end of the Early Pliensbachian.

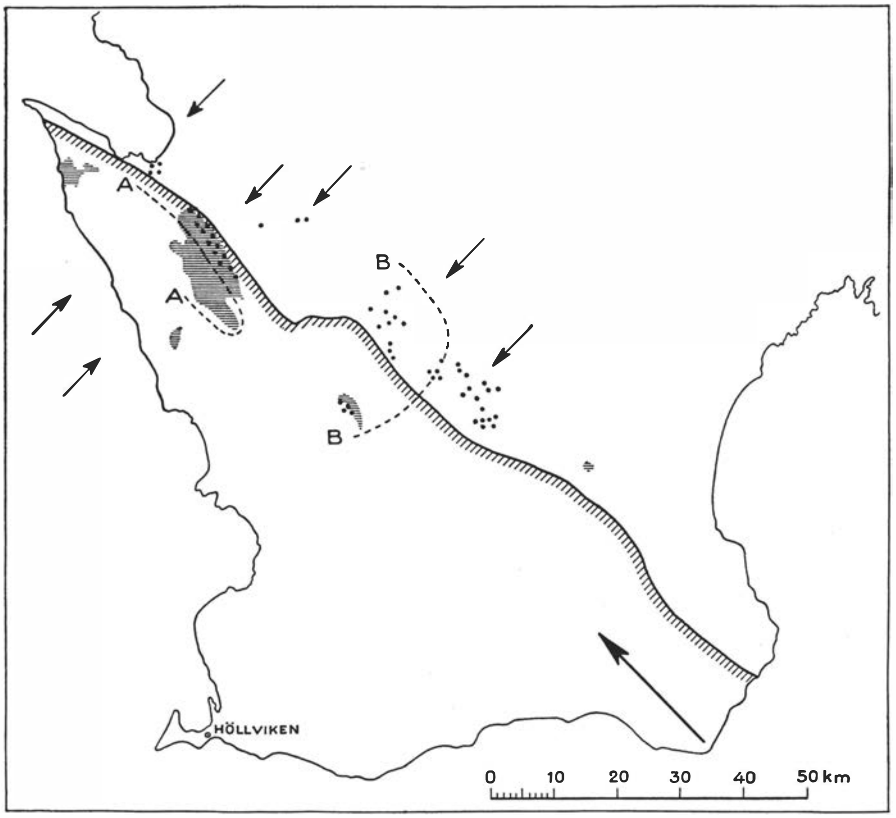

Fig. 38. Sketch-map of Scania showing the Variscan fault line and the transport directions of the sediments of the Höganäs Series.
Stipples, coarse clastics in the Rhaetic and Basal Lias. Ruled areas, bituminous clays in the Rhaetic. A—A, maximum transgression of the *contorta* fauna. B—B, maximum transgression of the *Pullastra-Cardinia* faunas.

Accordingly the Pre-Rhaetic surface was overstepped south-eastwards by non-marine Rhaetic and Lower Liassic beds. These in return were overlapped by the Lower Pliensbachian. This development coincides well with the above interpretation on the transport direction and the origin of the sediments.

The marine submergence in the Early Pliensbachian probably had a wide extension. But the preceding sedimentation certainly took place within a narrow basin probably an estuary bordered on one side by the still uncovered Archaean of Scania and on the other by old rocks now covered by heavy Cretaceous deposits (Pompeckische Schwelle). In a recent boring at Höllviken in the south-western corner of Scania the Pre-Rhaetic surface (Triassic) was reached at a depth of 1496 m. (Brotzen). The Höganäs Series was represented by 51 m. of sandstones and clays, mainly Rhaetic in age, up to 1450 m. containing *Lepidopteris Ottonis* and some other Rhaetic plant remains (Lundblad). It was nonconformably covered by non-marine beds, referred to the Wealden (171 m.) and followed by marine Lower Cretaceous (about 30 m.) and Upper Cretaceous (more than 1200 m.).

The development of the oldest Jurassic strata in the Scania-Bornholm region is in some degree reminiscent of the present day conditions at the mouth of the Baltic. Nowadays the Baltic Sea receives tributaries from the Archaean of the Baltic Shield. This was certainly already the case in the Early Mesozoic times, though then the Baltic did not exist but was undoubtedly preceded by a large river system. This latter "Baltic river" drained the Archaean region and transported detritus of Archaean and Paleozoic origin towards the continental margin. It has removed vast areas of Cambro-Silurian rocks, once covering the present Archaean land surface and the region off the S.E. Swedish—S. Finnish coast-line facing Öland—Gotland—Estonia, and has eroded the whole Archaean surface to the east of the Scandinavian High Mountains. Tremendous amounts of sediments from this permanent land area must have been emptied into sedimentary basins and synclines to the south or south-west during the periods from the Caledonian time up to the present, but movements within this fault region have forced the mouth of the "Baltic river" in one direction or another. In the Rhaetic and the Helsingborgian its southern end was turned towards the north-west from Bornholm to the Höganäs region. During this time the sea invaded the region at the mouth intermittently. But then the Döshult and the Katslösa Stages represent more evidently marine transgressions, the latter reaching not only S.E. Scania and Bornholm, but finally also the region beyond the Baltic Sea. Contemporaneously the area of unloading of the inorganic detritus moved towards the south-east, probably to the vicinity of S.E. Scania and Bornholm, where heavy clastics came into deposition in the Katslösa Age.

Similar conditions were probably ruling during the Wealden (?), when sands and clays were piled up to a thickness of about 600 m. in S.E. Scania, disconformably with the Lias of the same region.

Part II

DESCRIPTION OF SPECIES

Introductory Remarks

The following descriptions deal with the new finds of Rhaetic and Liassic fossils of Sweden, the former from Östraby and Skromberga, the latter from Katslösa. Of the fossil fauna from the beds between — i. e. from the Helsingborg and Döshult stages, well-known through the works of SVEN NILSSON and LUNDGREN — only lamellibranchs of stratigraphical value are treated. Thus it has been necessary to examine and redescribe most of the species established by LUNDGREN. On the other hand no attention will here be paid to fossil groups represented by rare specimens which — on this account — are of little value for stratigraphical purposes, for instance vertebrates and insects.

Among the vertebrates recognized in the Rhaetic may be mentioned the stegocephalian *Gerrothorax rhaeticus* T. NILSSON, and the fishes *Semionotus nilssoni* AGASSIZ, *Saurichtys acuminatus* AG., *Scanilepis dubia* (WOODWARD), and *Hyllingea Svanbergi* ALDINGER. As far back as 1878, HEER described eight fossil coleopters, all new species, "aus der rhaetischen Formation Schonens". As pointed out by LUNDGREN (Fossil faunas 1888) only 6 are Rhaetic in age, the remainder Liassic, viz. those from Sofiero and Kulla Gunnarstorp. There are still some fossil insects in the collections of the National Museum of Natural History (Riksmuseum) that are undescribed. They are from presumed Rhaetic beds at Bjuv, Skromberga and Hyllinge, and from the Liassic base at Stabbarp.

Another most interesting fossil is *Limulus nathorsti* JACKSON (1906) from the Liassic sandstone at Höör. Only a fragmentary cast of the cephalothorax is preserved.

1. Rhaetic Fossils

Foraminifera

A few foraminifers, for instance *Frondicularia* sp., have been recorded in the Vallåkra clay at Östraby, Kattarp.

Mollusca

Nuculana cf. *oppeli* ROLLE

1858. *Leda oppeli* ROLLE, K. Akad. Wiss. Wien, Sitz.-ber. Math.-Naturw. Cl. 26. 1857. P. 25, Pl. 1, Fig. 8.

One incomplete, internal cast of a left valve, 3 mm. in length, with indications only of the growth lines but with a mould of the hinge showing the teeth along the anterior hinge line. The angle between the latter and the anterior margin is obtuse and the lines of growth suggest the same ventral margin as in *Leda oppeli* ROLLE, which belongs to the Rhaetic fauna of Swabia.

Locality. In the Vallåkra clay at Östraby near Kattarp, Sweden.

Eotrapezium hyllingense n. sp.

Pl. III, Fig. 1

Material. One internal mould, the holotype, R.M. Mo 6445, showing the entire right side, with impressions of the teeth, and the damaged left side.

Description. Equivalve, inequilateral, subcircular or subovate, the umbo placed just in front of the middle. Hinge line curved; there is one long posterior lateral tooth (P 1), and one shorter anterior lateral (A 1); cardinals broken, at least one (3 b) developed. Surface of shell with growth-lines.

Size. Length 4.7, height 3.7, thickness 2.0 mm.

Remarks. The reference of this species to the genus *Eotrapezium* seems to be well founded. It differs from the Lower Liassic forms (see below) as to the outline, being more rounded, not triangular as in the latter. — The small pits seen around the umbo in the figured specimen are due to secondary influences.

Horizon and locality. The only specimen was found in the beds above the Lower Coal Bed at Hyllinge, together with the ganoid fish *Hyllingea svanbergi* ALDINGER.

Protocardia rhaetica MER. sp.

Pl. III, Figs. 2—4

1868. *Protocardia rhaetica* PFLÜCKER, Z. d. d. geol. Ges. 20. 1868, p. 417.

Description. Posterior part of shell provided with radiating striae. No carina between the striated and smooth portions of the shell. Number of ribs 14—15; the posterior ribs are very faint, with a minute transverse striation. The shell, being preserved in clay, is more or less compressed.

Size. The largest specimen (Fig. 2) is rather compressed and consists of the posterior portion of both shells, showing the sculpture; height 5 mm. As a rule, other specimens do not exceed 3 mm. in height or 3.5 mm. in length. According to PFLÜCKER, the length varies between 5 and 22 mm., commonly 10.5—17 mm. and the height between 4.5 and 20 mm., 9—14 mm. being most common. Thus our specimens are exceedingly small, which, however, is a feature peculiar to the whole fauna.

Remarks. Several specimens coincide with the description given by PFLÜCKER. PFLÜCKER recorded two additional species from the Rhaetic at Göttingen, viz. *P. ewaldi* and *P. praecursor*, but these are devoid of the radiating striae of the posterior area.

In typical specimens of *P. rhaetica* the carina is missing. For keeled specimens, earlier referred to *P. philippiana*, PFLÜCKER established a new species *P. carinata*. On the other hand, BRAUNS (1871, P. 42) claims that the keel is due to compression (Verdrückung), and does not accept the latter species.

As a rule authors distinguish between *P. rhaetica* and *P. philippiana*. But STOPPANI (1860—1865, P. 48) and JOLY (1907, P. 28) unite these species. Our material is too deficient to allow of any decision regarding this question.

Locality. A rather common species in the Vallåkra clay at Östraby, N. of Kattarp, Scania.

Protocardia sp.

Description. Three internal casts close together, all incomplete. From the umbo a well-marked ridge runs obliquely backwards, behind which the surface is covered with fine but sharp, radiating ribs. On the remaining part of the surface there is a faintly indicated concentric striation. The casts are somewhat flattened.

Remarks. If the ridge between the striated and smooth parts of the surface be due only to compression, as claimed by WINKLER (1861) and BRAUNS (cf. above), these specimens should be ranged with *P. rhaetica*. But though all shells in the fine clay at Östraby are more or less deformed by compaction, there are typical specimens of *P. rhaetica* preserved without any trace of the ridge. For this reason I am not quite convinced by BRAUNS statement and prefer to keep the present specimens separate, at all events provisionally.

Locality. Vallåkra clay at Östraby, Kattarp.

Pleuromya suevica Rolle?

Pl. III, Figs. 5—7

1858. *Pleuromya suevica* Rolle, Akad. Wiss. Wien, Sitz.-ber. Math.-Naturw. Cl. 26. 1857, P. 23, Figs. 2—3.

Description. Equivalve, inequilateral, regularly arched, sub-quadrangular, one and a half or almost twice as long as high. Umbo about one-fourth the length distant from the anterior end of the shell. Margin in front of the umbo concave, ventral margin slightly curved. One specimen (Mo 6724), preserved in galena, shows a coarse concentric striation of growth lines impressed upon the internal mould, while other moulds have smooth or more or less crumpled surface, often cut through by irregular fissures. A low, rounded ridge extends from the umbo towards the postero-ventral corner.

Size: Riksmuseum	Mo 6727	Mo 6726	Mo 6725	Mo 6724	
Length	7.0	9.9	10.5	14.6	mm.
Height	3.9	6.8	6.5	9.5	"

Remarks. This species coincides in many respects with *Pleuromya suevica* Rolle from the Rhaetic beds of Swabia, but differs in its oblique umbonal ridge and in being devoid of the mesial depression from the umbo towards the ventral margin. However, such a depression seems to be also absent in Rolle's second specimen (l. c. Fig. 3), which differs further in being more triangular in outline. The Swedish specimens show the same variation as to outline, but bear no indication of the lateral depression. It is quite probable that they represent a new species, but on account of their bad state of preservation I prefer to range them provisionally — with a mark of interrogation — with *Pleuromya suevica.*

It is not impossible that the "snail shells", recorded by Sven Nilsson in 1823 from the coal mine at Bosarp, belong here.

Horizon and localities. In the bonebed below the Lower Coal Bed at Skromberga (several specimens) and in the Vallåkra clay at Östarp.

Ceratomya stensioei n. sp.

Pl. III, Fig. 14

1948. *Ceromya stensioei* Troedsson, Rätiska fossil, P. 544 ff.

Material. The only specimen is a cast of a left valve without any trace of the test, but with thin and faint impressions of growth lines in its peripheric portion. Length of specimen 52 mm., height 40 mm.

Holotype. R.M. Mo 6719.

Description. Outline oval, dorsal margin straight, ventral margin forms a half-circle together with the anterior and posterior ones. Umbo broad and high, near the anterior margin, with a concave outline in front. The shell has certainly been more convex than in the fossil specimen, which shows radiating fissures, presumably due to crushing and flattening. From the umbo a straight ridge continues obliquely towards the posterior margin.

Remarks. This species is very similar to *Ceratomya ludovicae* Terquem from the Hettangian of Belgium and France. It differs in its broader umbo and its oblique ridge close to the dorsal margin.

Ceratomya gibbosa Etheridge from the *bucklandi* zone in the neighbourhood of Belfast ought to be mentioned here, too. It has "longitudinal, or highly inclined, slightly impressed ribs" on the cast near the ventral margin recalling the "radiating fissures" mentioned above, though probably of a different nature.

Occurrence. Collected by Professor Eric Stensiö at Hyllinge coal mine, derived from the Rhaetic, certainly below the Lower Coal Bed.

Cercomya carlsoni (Lundgren)

Pl. III, Figs. 8—9

1881. *Anatina carlsoni* Lundgren, Molluskfaunan, P. 47, Pl. 1, Figs. 1—3.

Original diagnosis: Testa ovata, rugis concentricis praedita; umbones paullo prominentes, fere mediani.

Remarks. This species much resembles the *Anatina suessi* described by Oppel (1858, P. 10, Text-Fig. 1) from the Rhaetic of Swabia, especially as to the posterior part of the shell with curved ridge, concave dorsal margin, and the ear-like extension of the postero-superior corner. It also shows a central depression of the shell from the umbo to the ventral margin, but this is much fainter than in Oppel's figured specimen. In spite of this difference the writer is not altogether convinced that these forms can be kept separate and regarded as different species.

Occurrence. A few specimens have been found in a sandstone lens in the Lower Coal Bed at Bjuv together with *Ostrea hisingeri* (?).

Gervillia praecursor Quenstedt

Pl. III, Figs. 12—13

1858. *Gervillia praecursor* Quenstedt, Jura, P. 29, Pl. 1, Figs. 8—11.
1861. " " Moore, Q.J.G.S. 17, P. 500, Pl. 15, Figs. 6—7.

A right valve (Pl. III, Fig. 12) somewhat damaged, with projecting umbo, convex anterior margin without excavation, and an obtuse ridge crossing the valve obliquely. Outline as in *Gervillia praecursor*. In spite of the bad state of preservation this shell coincides well with the figures given by Quenstedt and Moore. Length of shell 5, height 2.5 mm.

Another right valve (Pl. III, Fig. 13) has a long, straight hinge-line, and well developed ear in front of the umbo. Shell gently arched with a very fine concentric striation. Umbo and posterior margin damaged. Length about 4, height 2 mm.

In addition, two casts of the umbonal region with the hinge-line have been found, one belonging to a right, the other to a left valve.

Locality. Vallåkra clay at Östraby, Kattarp.

Pecten sp.

Undeterminable fragments with coarse ribs, similar to those in *P. valoniensis* DEFR.

Östraby. Vallåkra clay.

Liostrea hisingeri (NILSS.)

1878. *Ostrea* conf. *pictetiana* LUNDGREN, Studier etc., P. 38, Pl. 2, Fig. 64.

The specimen figured by LUNDGREN as *Ostrea* cf. *pictetiana* MORT. is rather incomplete and cannot be distinguished from *Liostrea hisingeri*. According to LUNDGREN, several fragmentary specimens have been met with in a sandstone lens.

Horizon and Locality. Rhaetic. Lower Coal Bed at Bjuv.

Modiola minuta GOLDF.

Pl. III, Figs. 10—11

1837. *Mytilus minutus* GOLDFUSS, Petr. Germ. 2, P. 173, Pl. 130, Fig. 6.
1856. *Mytilus minutus* OPPEL and SUESS, Kössener Sch. Pl. 1, Figs. 6—7.
1858. *Modiola minuta* QUENSTEDT, Jura, P. 29, Pl. 1, Fig. 14.
Non Mytilus minutus HÉBERT 1869.
Non Mytilus minutus LUNDGREN 1878.
Non Modiola minuta MOBERG 1907.

Material. One crushed right valve, preserved in clay, and several fragmentary specimens from sandstone nodules.

Remarks. In spite of their bad state of preservation these specimens coincide well with *Modiola minuta*, as far as comparison is possible with the aid of available figures and descriptions and museum specimens. The relation between this species and the Swedish Liassic *M. hoffmanni* is treated below under the head of *M. hillana* (see P. 228).

Size:	Pl. III, Fig. 10	Mo 6723	6720	6722	6721
Length	4.5	12.5	—	> 14	20 mm.
Height	1.7	5.0	6	7	8.5 mm.

Occurrence. *Modiola minuta* has a wide-spread distribution in the zone of *Avicula contorta*, and has been met with in the Alps, France, Germany, and Belgium. It has also been recorded from the lowest Lias. The Swedish specimens are from the Vallåkra clay at Östraby and from the boundary bed, 1 m. below the Lower Coal Bed at Skromberga.

Modiola sp.

Material. A great many crushed specimens in black clay.

Description. Test thin. Shell surface with a dense concentric striation of growth lines and still finer radiating striae, hardly visible to the naked eye. Umbonal region of *Modiola* type. Measurements cannot be given on account of the fragmentary state of preservation.

Remarks. The shells are rather crowded in a thin layer but broken and crushed, so that their real shape cannot be reconstructed, neither the entire outline nor the arching being preserved.

Locality. In a thin layer of black shale in the drilling core No. 209 at Svanebeck; depth 239.34—240.10 m.

Horizon. Just above the Coal Bed A, thus probably at the very top of the Rhaetic.

Undeterminable Lamellibranchs

A number of small shells, which seem to have been quite smooth and without characteristic features, have been found in the grey Vallåkra clay at Östraby. They cannot be identified.

Chemnitzia sp.

Pl. III, Fig. 12

(cf. *Chemnitzia nitida* MOORE 1861, *non* LYCETT).

The figured specimen, preserved as a cast with 5 whorls, has faint tranverse costae on the whorls, but is otherwise smooth. Very similar to the type figured by Moore, but only half as high.

The interior cast of another specimen of the same size and shape may belong to the same species.

Locality. Östraby. Vallåkra clay.

Arthropoda

Subclass **Ostracoda**

Ostracods are rare, but at least three species may be distinguishable, all of which occur in pebbles of brown sandstone, derived from the conglomeratic layer below the Lower Coal Bed at Skromberga.

Vertebrata

Scales of bony fishes occur in great number in the fossiliferous bed at Skromberga, below the Lower Coal Bed.

Table III

Distribution of the Rhaetic Fauna

	Vallåkra Cycle			B-Cycle		A-Cycle
	Östraby	Skromberga	Hyllinge	Hyllinge	Bjuv	Svanebäck
Frondicularia sp.	+					
Nuculana cf. *oppeli*	+					
Eotrapezium hyllingense	—	—	—	+		
Protocardia rhaetica	+					
,, sp.	+					
Pleuromya suevica ?	+	+				
Ceratomya stensioei	—	—	+			
Cercomya carlsoni	—	—	—	—	+	
Gervillia praecursor	+					
Pecten sp.	+					
Liostrea hisingeri	—	—	—	—	+	
Modiola minuta	+	+				
Modiola sp.	—	—	—	—	—	+
Lamellibranch *inc. sedis*	+					
Chemnitzia sp.	+					
Ostracods	—	+				
Fish scales	—	+				

2. Liassic Fossils

A. Protozoa

Order FORAMINIFERA

A microfauna of foraminifers occurs in the clay beds at Katslösa where the *Pentacrinus* stems and some other fossils have also been found. The main part of the fauna described in this paper is derived from the hard beds of sandstone and iron oolite, where, too, some foraminifers have been recorded. Foraminifers also occur in the Ammonite Bank of the Engelholm and Höganäs troughs. Since this part of the fauna has been handed to a specialist for investigation it will not be treated in this paper.

B. Echinoderma

Class **Crinoidea**

Genus *Pentacrinus*

Pentacrinus scalaris Goldfuss

1826—1833. Goldfuss, Petref. Germ. I, P. 173, Pl. 52, Fig. 3.
1875. Quenstedt, Petrefactenkunde. Bd 4, P. 209, Pl. 98, Figs. 1—28.
1926. Beringer, Jahresh. Verein. vaterl. Naturk. in Württemberg. 82. P. 27.

One segment of the stem, showing "treppenartige Vertiefungen in den Ausschnitten der sternförmigen Trochiten" (Beringer), has been referred to *P. scalaris.*
Katslösa Bed 18.

Pentacrinus basaltiformis Miller

Pl. XV, Figs. 1—10

1821. Miller, Crinoidea etc., P. 62, Pl. 2.
1826—33. Goldfuss, Petref. Germaniae, P. 172, Pl. 52, Fig. 2.
1875. Quenstedt, Petrefactenk. 4. P. 219, Pl. 98, Figs. 52—76.
1926. Beringer, Jahresh. Ver. Vaterl. Naturk. Würt. 82, P. 27.

More than 30 stem portions, with from one to thirteen columnals, coincide with those described by Quenstedt as *P. basaltiformis.* They are pentagonal in outline, with more or less edged corners and have "quer über der Vertiefung der Seiten genau in der Mitte der einzelnen Glieder eine Reihe feiner Knötchen" (Quenstedt).

Katslösa. Common in the clay Beds 29 and 32.

Pentacrinus cf. *basaltiformis* Miller

Pl. XV, Figs. 11 a—b

1888. Moberg, Lias i SÖ Skåne, P. 24, Pl. 3, Fig. 14.

A narrow, small columnal, pentagonal in outline, with sligthly concave sides and rounded edges was referred by Moberg to *P.* cf. *basaltiformis*. Several additional specimens have been met with at Katslösa. They are devoid of the transverse granulation met with in typical forms, and may be specifically different.

Locality. Katslösa, in Beds 28, 30, and the clays between Beds 30 and 36.

Pentacrinus cf. *subteroides* Quenstedt

Pl. XV, Figs. 12—13

1888. *Pentacrinus* cfr *subteroides* Moberg, Lias i SÖ Skåne, P. 25, Pl. 3, Fig. 16.

Columnals circular, or slightly pentagonal with the sides vertically concave, were described by Moberg from Kurremölla. Two specimens met with at Katslösa, one consisting of two columnals.

Katslösa Bed 30.

C. **Vermes**

Genus *Serpula* L.

Serpula quinquesulcata Münster

Pl. XV, Figs. 14 a—b

1826—1833. *Serpula quinquesulcata* Goldfuss, Petref. Germ. I, P. 226, Pl. 67, Fig. 8.
1876. *Ditrypa quinquesulcata* Tate & Blake, Yorkshire Lias, p. 438.
1888. *Serpula quinquesulcata* Moberg, Lias i SÖ Skåne, P. 28, Pl. 1, Fig. 11.
1909. *Serpula quinquesulcata* Malling og Grönwall, Medd. Dansk geol. Foren. Vol. 3, P. 275.

Occurs from the *bucklandi* zone up into the *spinatus* zone (Tate & Blake). Typical specimens at Katslösa in Beds 19, 29, 30, 32, and 41.

Serpula terquemi Moberg

1888. *Serpula Terquemi* Moberg, Lias i SÖ Skåne, P. 28, Pl. 1, Figs. 12, 13.

Original description: Tube free, pentagonal, with flat, almost concave sides of varying width; slightly curved at posterior end, gradually straightening towards the aperture; wound throughout its entire length, though only slightly — about half a turn in 30 mm. Surface crossed by numerous transverse lines; edges irregular. Opening surrounded by a rounded callosity, divided by shallow longitudinal furrows into five tubercles. Interior of tube rounded. Shell rather thick.

Remarks. MOBERG identified this species with *Serpula pentagona* TERQUEM & PIETTE (1868, *non* GOLDFUSS). The present writer does not agree with MOBERG in this respect, since the figures given by TERQUEM & PIETTE show a species with deep longitudinal sulci, rather different from the Scanian form but similar to *S. quinquesulcata.* The specimen figured by MOBERG as No. 12, being rather complete, is here designated as the holotype. It is preserved in the Riksmuseum, Stockholm.

Occurrence. *Serpula terquemi* is a rare species in the Katslösa Stage. The holotype is from Kurremölla in S.E. Scania. A few specimens have been found at Katslösa, viz. in Beds 32, 36, 41, and 42.

Serpula cf. *raricostati* QUENSTEDT

Pl. XXIV, Fig. 10

1858. *Serpula raricostati* QUENSTEDT, Jura, P. 111, Pl. 13, Fig. 18.

Only one specimen met with (S.G.U. Museum).

Description. *Serpula* attached at its entire length, though possibly free at the anterior end, semicircular in cross section with well rounded free surface. Length of specimen over 27 mm.

Remarks. This species is probably the same as *S. raricostati*, but since only one incomplete specimen has been met with the identification remains uncertain. The QUENSTEDT specimens were collected in the Lias β, where they are attached to *Arietites raricostatum.*

Horizon and Locality. The present specimen has been collected in Bed 18 at Katslösa and is attached to a shell of *Chlamys tullbergi.*

Worm Trails

Trails and tubes of varying sizes, apparently belonging to worms, have been met with in several horizons at Katslösa. The largest specimen is 20 mm. in cross section, flattened, about 20 cm. in length. It was found in Bed 32.

A narrow trail, 3 mm. wide and 55 mm. long, is quite independent of the bedding plane (Bed 42; similar specimens in Bed 45).

Medium sized trails in Beds 19 and 28.

Fragments of a longitudinally striated cylindric tube, 5 mm. in diameter, have been found in Bed 30.

D. **Brachiopoda**

Brachiopods are very rare in the Liassic beds of Sweden. Lundgren found some fragmentary specimens, which he defined as *Rhynchonella* sp., at Brandsberga, Dompäng and Döshult. Small shells, attached to a *Cardinia*, were described as *Discina* sp.? They are now referred tentatively to *Anomia*. No brachiopods have been recorded from the Lias of S.E. Scania.

At Katslösa, Beds 18 and 30, some additional specimens have been met with. In Bed 18 there are fragmentary shells, referred below to *Zeilleria perforata*, and a small rolled and worn specimen of *Rhynchonella deffneri* in secondary position. In Bed 30 there are a ventral valve of another *Zeilleria*, together with several fragments apparently of the same species (cf. *Zeilleria numismalis* Lam. sp.) — and a rather well preserved specimen of *Spiriferina*.

Thus all the brachiopods met with hitherto in the Liassic beds of Sweden belong to the order Telotremata of the class Articulata, though they are representatives of three different superfamilies.

Superfamily TEREBRATULACEA

Genus *Zeilleria* Bayle

Zeilleria cf. *perforata* (Piette)

1856. *Terebratula perforata* Piette, Bull. Soc. géol. Fr. (2) 13, P. 206, Pl. 10, Fig. 1.
1936. *Zeilleria perforata* Joly, Lias inférieur, p. 157.

Remarks. One specimen with perforate shell, somewhat fragmentary but with the elongate shape of *Z. perforata* has been referred, though rather hesitatingly, to this species. Several fragments have been met with in the same bed.

Distribution. *Z. perforata* has a wide distribution and has been recorded from the Lower Lias of Germany, England, Belgium and France. In Germany it is found in the lower part of the Lias α, but in Belgium its main distribution is in the Sinemurian, both in the upper (β) and in the lower parts (α_3).

Locality. Katslösa 768, Bed 18.

Zeilleria cf. *numismalis* (Lamarck)

Pl. XV, Fig. 15

1858. *Terebratula numismalis* Quenstedt, Jura, P. 99, Pl. 12, Fig. 11.

Description. A ventral valve (R.M. Br. 5118) with rounded anterior outline, small foramen and rather flattened shape, might be referred tentatively to *T. numismalis*. It has not the pentagonal outline of the typical form but answers well to a specimen figured by Quenstedt (see above).

Distribution. *Zeilleria numismalis*, the dominating index fossil of the so-called *numismalis* marl of Swabia (Lias γ) occurs from the Lias α to the δ.

Locality. Katslösa Bed 30.

Superfamily SPIRIFERACEA

Genus *Spiriferina* d'Orbigny

Spiriferina walcotti Sow. var. *münsteri* Davidson

Pl. XV, Figs. 16 a—d

1851. *Spirifer Münsterii* Davidson, Monogr. Brit. Oolitic and Liasic Brach., P. 26, Pl. 3, Figs. 4—6.
1915. *Spiriferina münsteri* Rollier, Synopsis, P. 64.
1927. *Spiriferina Walcotti* Sowerby sp., var. *Münsteri* Corroy, Ann. de Paléont. 16. P. 26, Pl. 4, Figs. 13—16.
1936. *Spiriferina Walcotti* Sow. var. *Münsteri* Joly, Lias inférieur, P. 149.

Material. One entire specimen, somewhat depressed and deformed (R.M. Br 5111), and one fragmentary interior mould, showing the inside of the dorsal valve.

Description. Dorsal valve, width almost double the length; one mesial fold, 4 or 5 lateral plications on each side, small area. Ventral valve with projecting umbo; high area, slightly arched; deltidium elongate; surface with a deep median sinus and 4 plications on each side. Hinge-line straight. Shell punctate.

Size. Length 15.8, width 18.4, and thickness 10 mm. (1 : 1.16 : 0.63).

Remarks. In spite of its deformed shape the figured specimen agrees well with *Spiriferina münsteri* Davidson (1851). This species was referred by Rollier to the phylum of *S. walcotti* and claimed to be of Lower Charmouthian Age. According to Corroy and Joly it is a variety of the latter species.

Occurrence. *S. walcotti* var. *münsteri* is known from the Upper Sinemurian of Austria, Lorraine, and Belgium; from the Lower Charmouthian of Alsatia; and from the Middle and Upper Charmouthian of England. The Swedish specimens are from Katslösa 840 (Bed 30).

Superfamily RHYNCHONELLACEA

Genus *Rhynchonella* Fischer de Waldheim

Rhynchonella deffneri Oppel

Pl. XV, Figs. 17 a—c

1861. *Rhynchonella Deffneri* Oppel, Zeitschr. d. d. geol. Ges. 13, P. 535.
1882. *Rhynchonella Deffneri* Haas and Petri, Brach. d. Juraform. P. 165, Pl. 2, Figs. 1—19.
1885. *Rhynchonella Deffneri* Haas, Brach. rhét. et jurassiques, P. 36, Pl. 3, Figs. 32, 37, 45—46.
1917. *Rhynchonella Deffneri* Rollier, Synopsis, P. 103.

Material. Only one specimen met with (S.G.U. Museum). This is a coarsely crystallized internal mould, preserved in calcite.

Description. Outline subtriangular, plications few and developed only anteriorly. The ventral valve has a faint mesial plication and two lateral folds on either side. In the dorsal valve the plications are still less marked; a small fissure from the septum is visible.

S i z e. Length 6.1, width 5.4, thickness 4.1 mm.

R e m a r k s. In spite of the incomplete state of preservation the identification of this specimen seems to be well founded, since the number and the position of the plications coincide with those in *Rh. deffneri.* Of course the internal mould ("Steinkern") has much fainter plications than the exterior surface. In this case the plications are probably still fainter, since the steinkern seems to have been abraded before its final embedding. It was found in a conglomeratic sandstone together with well-rounded quartz grains of about the same size, all embedded in a matrix of sand. There is no doubt that the fossil has been removed from its original sediment, then washed and rolled, and finally embedded into the sandstone.

D i s t r i b u t i o n. *Rh. deffneri* occurs in the Gryphiten-band of Swabia, in the same horizon in England, Alsace, and Lorraine, and in the Sinemurian of the Vaudois Alps.

H o r i z o n a n d L o c a l i t y. The present specimen was found in a secondary position at Loc. 768 (Bed 18), Katslösa.

E. **Mollusca**

Class **Lamellibranchia**

Family CTENODONTIDAE

Genus *Palaeoneilo* HALL.

T y p e s p e c i e s. *Nuculites constricta* CONRAD.

G e n e r i c c h a r a c t e r s. Shell sub-elliptical, more or less inequilateral, with broad, depressed, and only slightly incurved umbones placed between the middle and the anterior quarter of the length; frequently somewhat cuneiform, with a bluntly pointed posterior end. Hinge-line arcuate or sub-angular, with numerous small taxodont teeth which may be arranged in an uninterrupted row, although there is a slight change in their orientation or a break in their alignment below the umbo. Ligament external. Adductor scars subequal, situated below the extremities of the hinge-line. Pallial line simple; valve margins closed.

R e m a r k s. Though this taxodont genus was founded upon a Devonian species, it soon became evident that it survived into the Mesozoic. In 1895 A. BITTNER showed that several Triassic species of *Palaeoneilo* had been referred to "*Leda*" or *Nucula.* And BORISSIAK (1904) described five new species from the Volga Stage. However, these interpretations seem to have been totally neglected by authors until 1937, when L. R. Cox was able to refer the well-known Jurassic species "*Leda*" *galatea* and "*L.*" *phillipsii* to *Palaeoneilo.* In a following paper (1940) he added two new Jurassic species from India.

In the present paper *Palaeoneilo galatea* is for the first time recognized in Sweden. It is accompanied by two additional species of this genus, viz. "*Leda*" *bornholmiensis* v. SEEBACH and *Palaeoneilo oviformis* n. sp.

The genus *Palaeoneilo* differs from other taxodonts in the absence of a ligament-pit beneath the umbo, in having an external ligament, and in having the teeth arranged in an uninterrupted series. The last-named feature is well shown in a figure of "*Leda*" *bornholmiensis*, given by MOBERG (1888, Pl. 1, Fig. 49 b). This specimen also shows the absence of the ligament-pit beneath the umbo. On the other hand all three species possess a shallow furrow along the posterior hinge margin, probably the attachment for the external ligament. The ranging of *P. oviformis* n. sp. with this genus is mainly owing to the external features, which coincide well with those in *P. bornholmiensis* and *P. galatea*.

Palaeoneilo galatea (D'ORBIGNY)

Pl. XVI, Figs. 1, 2, 6, (9—11?)

1850. *Leda Galatea* D'ORBIGNY, Prodrome, 8e ét. no 152.
1858. *Nucula inflexa* QUENSTEDT, Jura. P. 110, Pl. 13, Fig. 41; P. 187, Pl. 23, Fig. 15.
1869. *Leda Galatea* DUMORTIER, Études paléontologiques, 3. P. 120, Pl. 19, Figs. 5—6.
1871. *Leda Galathea* BRAUNS, Unt. Jura, P. 374.
1876. *Leda galathea* TATE and BLAKE, The Yorkshire Lias. P. 383, Pl. 11, Fig. 5.
1898. *Leda Galathea* SKEAT and MADSEN, Jurassic Boulders, P. 83.
1936. *Nuculana* (? *Rollieria*) *galatea* COX, Q.J.G.S. 92. P. 465, Pl. 34, Figs. 11, 12.
1937. *Palaeoneilo galatea* COX, Proc. Malac. Soc. 22. P. 191, Pl. 15, Figs. 4—7.

Material. 28 specimens, a few ones with preserved test.

Description. Shell taxodont, inequilateral, the umbo inflated, situated at one-third the shell length from the anterior end. Dorsal end bluntly rounded, ventral margin strongly curved, dorsal margin: posterior part straight, anterior part slightly concave. Shell surface with thinly placed concentric lines. Dorsal margin with a thin furrow behind the umbo, bounded outwards by a low ridge.

Size of figured specimens (Pl. XVI):

	Figs. 1	9	2	10	11	6
Length	4.5	5.0	5.5	5.5	6.0	9.0 mm.
Height	2.7	3.2	2.7	3.9	3.6	4.0 "

Remarks. *P. galatea* seems to vary considerably, to judge from the figures given by different authors. The above differences as to the relative proportions is partly owing to the mode of preservation, some specimens being devoid of shell. Thus the internal casts in Figs. 9—11 are uncertain; the umbo is inflated as in *P. galatea*, but the general outline and the proportions would favour an identification with *P. oviformis* n. sp. In the present collection there is no specimen that shows the entire hinge-line. *P. galatea* is closely allied to *P. bornholmiensis* but differs in its more projecting preumbonal part (see also the latter species).

Occurrence. *P. galatea* is mainly a Lower Pliensbachian species and has a wide distribution in Western Europe. It has not been recorded before in Sweden

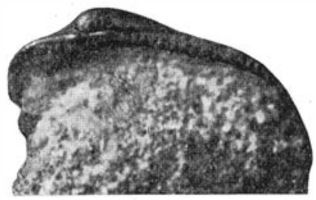

Fig. 39. *Palaeoneilo bornholmiensis* von Seebach, showing the hinge-line. (Same specimen as in Moberg 1888, Pl. 1, Figs. 48, 49.) Size × 4.

but was found in an erratic boulder at Tuel Skov in Sealand, Denmark, together with a rich fauna belonging to the *jamesoni* zone (Skeat and Madsen). In all likelihood this boulder has its origin in the Katslösa region.

Locality. Katslösa Beds 27, 28, 30, and 32.

Palaeoneilo bornholmiensis (v. Seebach)

Pl. XVI, Fig. 3; Text-Fig. 39

1865.	*Leda Bornholmensis*	von Seebach, Geol. von Bornholm, P. 344.
1879.	" *Bornholmiensis*	Lundgren, Jura på Bornholm, P. 20, Fig. 27.
1888.	" "	Moberg, Lias i SÖ Skåne, P. 44, Pl. 1, Figs. 48, 49.
1909.	" "	Malling og Grönwall, Medd. D.G.F. 3, P. 282.
1911.	" "	Malling, ibid. P. 630.

Material. 18 specimens, mostly internal casts, but a few shells are preserved.

Description. Shell strongly inequilateral, the umbo being placed at one-fourth the shell length from the anterior end. Posterior end bluntly rounded. Ventral margin gently curved. Dorsal margin straight behind the umbo, concave in front of it. Surface covered with fine but distant concentric lines. Hinge consists of an uninterrupted row of teeth, which decrease in size from both ends towards the umbo. There is no ligament pit beneath the umbo. Behind the umbo the hinge is bounded dorsally by a shallow furrow, which probably was the attachment for the external ligament.

Size. Length of figured specimen 7.5 mm., height 4 mm.

Remarks. In *P. bornholmiensis* the umbo is placed closer to the anterior end than in *P. galatea*, and the posterior part of the shell is more extended. But in other characters, for instance the sculpture, it comes close to the latter species.

Occurrence. *P. bornholmiensis* has been collected at Kurremölla and Kullemölla in S.E. Scania as well as on the island of Bornholm. The present collection is from Katslösa Bed 30 (13 specimens) and Bed 32 (5 specimens).

Palaeoneilo oviformis n. sp.

Pl. XVI, Figs. 7, 8, 12, and 17

Material. Nine specimens, some of which are devoid of shell, only the internal cast being preserved.

Description. Shell taxodont, subovate, inequilateral with pointed, slightly projecting umbo. Umbo forwardly directed, situated not far from the middle of the shell. Posterior portion of shell decreases rapidly backwards; anterior one semicircular in outline. Dorsal margin: posterior portion slightly convex, anterior one convex, forming part of the semicircular outline of the preumbonal part of the shell. Hinge-line (Fig. 12) not visible in its entire length; it seems to form a regular curve, in lateral view partly concealed by the umbo. Ligament external. Surface with rather irregular concentric lines of growth, more crowded than in the preceding species.

Size of figured specimens (Pl. XVI).

	Figs. 17	7	8	12	
Length	4.5	4.6	4.9	6.6	mm.
Height	3.2	3.1	2.9	3.9	"

Remarks. This species is referred to the genus *Palaeoneilo* on account of its external ligament and other external characters. It differs from *P. galatea* in its convex dorsal outline and more pointed posterior end. As mentioned above it is uncertain whether the internal casts Figs. 9—11, Pl. XVI, belong here or to *P. galatea.*

Occurrence. Katslösa, Beds 30 and 32.

Family NUCULANIDAE

Genus *Nuculana* Link

Nuculana zieteni (Brauns)

Pl. XVI, Figs. 13—16

1832. *Nucula inflata* Ziethen, Württemb. Verst. Pl. 57, Fig. 4 (*non* Sowerby).
1837. *Nucula acuminata* Goldfuss, Petref. Germ. 2, P. 155, Pl. 125, Fig. 7 (*non* Ziethen).
1871. *Leda Zieteni* Brauns, Untere Jura, P. 373 (*non* d'Orbigny 1850).
1898. *Leda Zieteni* Skeat and Madsen, Jurassic boulders, P. 82.

Material. 10 specimens.

Description. Shell pear-shaped, ornamented with fine concentric lines, sometimes effaced posteriorly. Umbo just in front of the middle. Ventral margin strongly convex; pre-umbonal part of dorsal margin almost straight, post-umbonal part concave. Posterior part of shell decreases rapidly in width, posterior end rounded.

Size:	Length (incomplete)	Height	Thickness
R.M. Mo 6222	5.3 mm.	3.2 mm.	—
R.M. Mo 6224	4.0 "	3.4 "	2 × 1.0 mm.
Fig. 16 (S.G.U.)	5.5 "	3.7 "	—
Fig. 15 (S.G.U.)	5.6 "	3.8 "	—

Remarks. The specific name *Leda zieteni* was given already in 1850 by D'ORBIGNY in order to replace *Nucula amygdaloides* ZIETEN (*non* SOWERBY). This species, however, being quite different from *Leda zieteni* BRAUNS, is probably a synonym of *Palaeoneilo galatea*, as suggested by Cox (1937, P. 191).

Distribution. *Nuculana zieteni* is a Middle Liassic species of Germany, England and the Rhone basin, though in England it appears already in the *oxynoti* zone and occurs also in the *raricostatum* and the *jamesoni* zones. It has not been met with before in Sweden, but was found in the erratic boulder at Tuel Skov, Denmark.

Locality. The Katslösa specimens are from Beds 28 and 30.

Subgenus *Ryderia* WILSON

Nuculana (Ryderia) doris (D'ORBIGNY)

1837. *Nucula complanata* GOLDFUSS, Petrefacta Germ. 2, P. 156, Pl. 125, Fig. 11 (*non* PHILLIPS, 1829).
1850. *Nucula doris* D'ORBIGNY, Prodrome, P. 253.
1858. *Nucula complanata* QUENSTEDT, Jura. P. 110, Pl. 13, Figs. 39, 40; P. 186, Pl. 23, Figs. 9—10.
1871. *Leda complanata* BRAUNS, Untere Jura, P. 372.
1909. *Leda complanata* MALLING & GRÖNWALL, Medd. D.G.F. 3. P. 282, Pl. 10, Figs. 9—10.
1936. *Nuculana (Ryderia) doris* COX, Q.J.G.S. 92. P. 466, Pl. 34, Fig. 16.
For further synonyms see COX, l. c.

Material. The elongated posterior portion of a right valve and a young specimen, the latter referred here only with hesitation.

Description. The posterior portion narrows off gradually. The area is bounded outwards by a rounded border, which extends backwards. Behind the area it turns over to the lateral side and forms a thickening of the dorsal margin in the posterior end of the shell. The tooth-bearing interior margin of the valve is elevated and separated from the exterior border by a shallow longitudinal groove. It forms the right half of the roof-like elevation within the area.

Remarks. This species has a long narrow "tail"-like extension of the shell, also met with in species like *Nuculana renevieri* (OPPEL) and *N. texturata* (TERQUEM & PIETTE). All these species have also been stated to occur in the Lias of Scania or Bornholm. In 1879 LUNDGREN identified *Leda texturata* in pebbles belonging to the *Myoconcha* beds of Bornholm (Lias γ), mainly by reason of the sculpture. To judge from the figure (LUNDGREN, l. c. Fig. 25), this sculpture does not exclude an identification with *N. doris*. In 1888 MOBERG described *Leda* *renevieri* from the *jamesoni* beds of S.E. Scania. And, finally, MALLING and GRÖNWALL recorded *L. complanata* (= *Nuculana doris*) from solid rock at Stampeaa, Bornholm, together with a rich Lias γ fauna. The two latter authors recognized the longitudinal roof-like elevation of the area, which is characteristic of this species. A thorough study of the specimens figured by MOBERG shows the same feature. According to MOBERG the area should be concave and bounded by a sharp border. The preserved types, however, show rounded exterior borders of the area. Inside of this there is a narrow concavity, while the inner border is elevated, forming a roof-like convexity with the elevated border of the opposite valve. These facts indicate a close affinity to *Nuculana doris*.

In England, France, and Germany *N. texturata* and *N. renevieri* are restricted to the lowest Lias, *N. texturata* being recorded from the Lias α, *N. renevieri* from the Lias α and β beds, while *N. doris* belongs to the Lias β—δ.

Horizon and Locality. In Beds 32 and 45 at Katslösa.

Genus *Rollieria* COSSMANN, 1920

= *Nuculopsis* ROLLIER, 1912, (*non* GIRTY, 1911)
= *Isoleda* ROLLIER, 1923 (*non* DE RYCKHOLT, 1853)
= *Isonuculana* COX, 1925

Rollieria bronni (ANDLER)

Pl. XVI, Figs. 4—5

1837. *Nucula subovalis* GOLDFUSS, Petref. Germ. 2, P. 154, Pl. 125, Fig. 4 (*non* ROEMER, 1836).
1858. *Nucula palmae* QUENSTEDT, Jura. P. 110, Pl. 13, Fig. 42; P. 187, Pl. 23, Figs. 16—17 (*non* SOWERBY, 1824).
1858. *Leda Bronni* ANDLER, N. J. f. Min. etc. 1858, p. 644.
1869. " *palmae* DUMORTIER, Études 3, P. 120, Pl. 19, Figs. 3, 4.
1879. " *subovalis* LUNDGREN, Jura på Bornholm, P. 19, Fig. 23.
1888. " " MOBERG, Lias i SÖ Skåne, P. 46, Pl. 1, Figs. 53—56.
1898. " " SKEAT and MADSEN, Jurassic boulders, P. 83.
1909. " " MALLING og GRÖNWALL, Medd. D.G.F. 3, P. 282.
1936. *Nuculana (Rollieria) bronni* COX, Q.J.G.S. 92, P. 464.

Material. 15 specimens.

Remarks. The specific name *subovalis* GOLDFUSS (1837), constantly used in the Swedish literature since 1879, is not valid, since it was preoccupied for a species from a different horizon, published by ROEMER in 1836. According to COX the earliest valid name for this species appears to be *Leda bronni* ANDLER. As to the generic name, *Rollieria* COSSMANN has to stand, as is understood from the above list.

As pointed out by MOBERG the Swedish specimens referred to *Leda subovalis* are very variant as regards the exterior outline. They are more or less ovate, but, in young specimens, especially, the outline is circular or subtriangular. The umbo is acute and small, and projects a little beyond the margin. Posterior part of shell, as a rule, more elongate and lower than the anterior. Surface with fine, concentric growth lines.

Size:

		Length	Height
Fig. 5 (R.M. Mo 6200)	......	13.7 mm.	8.0 mm.
Fig. 4 (S.G.U. Museum)	......	3.0 "	2.1 "

Distribution. According to MOBERG, this Lower and Middle Liassic species is rather common in S.E. Scania, especially at Kurremölla. It has been met with also on the island of Bornholm. The Katslösa specimens are from Beds 30, 32, and 41.

Family NUCULIDAE

Genus *Nucula* LAMARCK

Nucula distinguenda MOBERG

Pl. XVIII, Figs. 7 a—c

1888. MOBERG, Lias i SÖ. Skåne, P. 42, Pl. 1, Figs. 43—45.

Original description (in translation): Small, thick, subovate; ventral margin slightly curved. Posterior and anterior parts of hinge line meet at an angle of more than 100°; the former is rather long, slightly convex; the latter short, concave. Anterior end somewhat truncated, obliquely from below upwards. The truncation is not quite straight. Umbo rather strong, bent forwardly. Lunule large and wide, well defined. In entire specimens it is almost flat, or slightly elevated along the middle. Area deep, long and narrow, not well defined. One entire specimen is 5.5 mm. long and 4.5 mm. high and 3 mm. thick. Largest specimen 6 mm. long and 4.5 mm. high.

Material. One entire specimen.

Size:

	Length	Height	Thickness
Pl. XVIII, Fig. 7	4.5 mm.	3.3 mm.	2.0 mm.

Locality. Katslösa 840 (Bed 30).

Family GRAMMATODONTIDAE

Genus *Grammatodon* MEEK & HAYDEN 1860

Grammatodon cypriniformis (LUNDGREN)

Pl. XVII, Figs. 1—15; Pl. XVIII, Fig. 1

?1860. *Arca cucullata* ANDREE, Z. d. d. geol. Ges. 12. P. 587, Pl. 14, Fig. 8.
1865. *Arca* cf. *cucullata* v. SEEBACH, Geol. d. Insel Bornholm, P. 344.
1879. *Cucullaea cypriniformis* LUNDGREN, Juraformationen på Bornholm, P. 19, Figs. 29, 35.
1888. *Macrodon cypriniformis* MOBERG, Lias i SÖ. Skåne, P. 39, Pl. 1, Figs. 41—42.
1909. *Macrodon cypriniformis* MALLING and GRÖNWALL, Medd. D.G.F. 3, P. 283.

Original diagnosis. This species was originally described by B. LUNDGREN, who found his specimens in the Lias of Bornholm. "Only moulds preserved" ...

"From the umbones there runs backwards and downwards a rather sharp keel, behind which the shell is suddenly depressed; in front of it the shell surface bends gradually towards the anterior margin. The latter is rounded, the posterior one somewhat more abruptly cut off. To judge from external casts the test seems to have been provided with more or less well marked growth lines without any radiating ribs or more prominent ornamentation."

Lundgren also claims that young stages of this species were more elongated, while the adult is more rounded-quadrangular with more projecting umbones.

Additional features. Moberg has given a careful and detailed description of this species. According to him the shell has not only concentric growth lines but also a faint radiate striation, best visible in front of the anterior keel but also behind the posterior keel and even on other parts of the shell, though in most cases this fine ornamentation seems to have been destroyed. Moberg was also well acquainted with the great variation which he — like Lundgren — attributed to different growth stages, the adult being relatively and gradually lower in the posterior end, and the posterior keel becoming more and more effaced near the inferior margin.

Moberg's specimens are 8—10 mm. in length, 6—7 mm. in height and 4—5 mm. in thickness (entire specimens). One specimen is 13, another 16 mm. in length.

Description. The Katslösa specimens show all the characteristic features of *Cucullaea cypriniformis*, even the fine radiate striation. The two valves are not alike, however, in this respect.

Left valve. The field in front of the anterior ridge is covered with a few (3 to 5) rather strong ribs which diverge from the umbo but do not cover the antero-superior corner of the shell. The umbo is crowded with thin vertical ribs. In the field behind the posterior keel a few ribs are visible close to and along the keel.

Right valve. This is covered with thin, closely-set ribs in the umbonal region as well as in front of, and behind, the umbo. Sometimes two or three ribs in front of the umbo — especially in young specimens — are rather wide apart and rather prominent. They do not reach the margin.

Both valves. All ribs begin at the umbonal crest or its vicinity and tend to disappear towards the margins.

Exception. The coarse anterior ribs of the left valve are well visible even close to the margin. Young specimens have more widely-spaced and relatively stronger ribs.

Variations. The Katslösa specimens also show marked variations in the external shape of the shell, as observed by Lundgren and Moberg, though these are not due to difference in age. The first impression is that they belong to different species, and the present writer has made fruitless efforts to classify the great multitude of these shells. There are extreme forms, it is true, but these are connected by intermediate ones and all of them show the characteristic ornamentation of the left valve.

Size. In order to get an idea of the most striking variations the writer has measured the length and height of a series of well preserved specimens, with and without the test. The ratio height : length, multiplied by 100, gives a suitable index for comparisons:

1. Specimens without test (internal moulds):

	No.	Valve	Height	Length	Index
Pl. XVII, Fig. 1	Mo 6624	L	3 mm.	6 mm.	50
" " 3	Mo 6181	R	3.5 "	6.5 "	54
" " 4	S.G.U. Museum	L	4 "	7.5 "	53
" " 2	Mo 6176	R	4.5 "	9 "	50
" " 6	Mo 6189	L	5 "	10 "	50
" " 5	Mo 6191	R	5 "	10 "	50
" " 7	Mo 6242	L	5.5 "	10.5 "	52

2. Specimens with test:

	No.	Valve	Height	Length	Index
Pl. XVII, Fig. 9	S.G.U. Museum	R	2.5 "	4 "	63
" " 10	Mo 6181	L	3.1 "	4.5 "	69
" " 11	Mo 6178	L	3.7 "	6 "	62
" " 12	Mo 6177	L	4 "	6.2 "	64
" " 13	S.G.U. Museum	L	4.2 "	6.5 "	65
" " 14	S.G.U. "	R	4.2 "	6.5 "	65
Pl. XVIII, " 1	S.G.U. "	L	7.5 "	11.5 "	65

As is seen from the table the internal moulds are about half as high as they are long, while specimens with test are proportionately higher. On account of the arching of the shell the presence of a thick test will certainly increase the ratio height : length, in relation to the same ratio in the mould. This well explains the appearance of long and short forms of this species at Katslösa. Accordingly, the variation referred to may not indicate any specific difference. Nor does it indicate different growth-stages, as earlier writers have suggested.

Discussion of the genus. *Cucullaea cypriniformis* Lundgren has three long teeth in the posterior part of the hinge, parallel to the hinge-line, and a number of small ones in the anterior part. The shell is subquadrangular with almost mesial umbones and the surface is covered with growth lines and a fine radiate striation. These characters unite this species with *Grammatodon* Meek and Hayden.

There has been much confusion about *Grammatodon* and allied genera. For a long time species belonging here have been listed as *Macrodon* Lycett MS 1845, preoccupied. In 1930 Arkell gave a review of the generic position and phylogeny of some Jurassic Arcidae. He claimed that *Parallelodon* was the true substitute name for *Macrodon* and divided it into the subgenera *Parallelodon*, *Beushausenia* (= *Cosmetodon* Branson), and *Grammatodon*. In a more recent paper, Branson (1942) shows that *Grammatodon* Meek and Hayden 1860, has six years' priority over *Parallelodon* MEEK & WORTHEN 1866, and consequently the arcid subgenera treated by ARKELL have to be grouped in the genus *Grammatodon.*

The present species belongs to the subgenus *Grammatodon*, which has a much shorter hinge line and more mesial umbones than in the other subgenera, the external shape being quite similar to that in *Cucullaea.* In the latter, however, the teeth are short and arranged symmetrically on both sides of the umbo.

Discussion of the present species. The Bornholm specimens recorded by VON SEEBACH (1865) as *Arca* cf. *cucullata* do not differ from *Grammatodon cypriniformis*, according to LUNDGREN (1879) and MOBERG (1888). It is not at all impossible that our species also embraces the *Arca cucullata* described by ANDREE (1860) from Jurassic pebbles at Stettin and Königsberg, as suggested by MOBERG. The true *Arca cucullata* (MÜNSTER) is Middle Jurassic in age and has much stronger ribs than our species.

The fact that the coarse ribs on the pre-umbonal part of the shell are best visible on the left valve is an important feature which distinguishes *G. cypriniformis* from all other species. It is even most interesting, since it points 1) towards the Middle Jurassic species *Grammatodon inaequivalvis* (GOLDFUSS), in which such ribs cover the whole surface of the left valve but only anteriorly in the right, and 2) towards the Middle Jurassic species *Grammatodon concinnum* PHILLIPS, which has strong ribs only in front of the umbo in both shells. In *G. cypriniformis* the anterior ribs in the right valve are already indicated.

Two specimens have retained colour markings in the shape of concentric dark bands at regular distances and parallel to the growth lines.

Distribution. *Grammatodon cypriniformis* (LUNDGREN) has been met with in the *Myoconcha* Bank on Bornholm, the *Cardium* Bank of S.E. Scania (Fyledalen) and abundantly in the Katslösa Stage of N.W. Scania, where it occurs from Bed 22 up to Bed 32, but is especially common in Bed 30.

Subgenus *Catella* HEALEY

Grammatodon (Catella) sinuatus n. sp.

Pl. XVIII, Figs. 3—5

Material. One left valve (Fig. 4) and two internal casts (Figs. 3 and 5) are preserved (S.G.U. Museum).

Description. Umbo strong and wide, not especially high, divided by a broad and deep sulcus into one anterior smaller and one posterior portion. The sulcus widens downwards and flattens, but continues to the ventral margin, thus in reality dividing the whole shell. Shell surface covered with vertical ribs, which are rather strong and prominent in the most arched parts of the valve, i. e. on either side of the sulcus — but weak and thin in the sulcus itself and near the anterior and posterior margins. The ribs are crossed by coarse, elevated lines of growth. Outline of ventral and posterior margins semicircular, except for a shallow ventral sinus where the sulcus reaches the margin. Anterior and dorsal margins damaged in the holotype, the hinge-line not being visible. In spite of this, there is no doubt of the generic position, since two internal casts of the same size, and with the characteristic broad and deep sub-median sulcus, definitely belong to the same species. In one of these casts (Fig. 5) the straight hinge-line and the anterior margin meet at right angles, and in the post-umbonal part of the hinge-line there are casts of several small teeth, which are perpendicular to the hinge-line. In the other specimen (Fig. 3) the anterior hinge-line portion is preserved with its three teeth, almost parallel to the dorsal margin.

Size:

Length of holotype, Pl. XVIII, Fig. 4	.... 2.7	mm.,	height	1.8	mm.	(incomplete)
" " internal cast " " 3	.... 3.3	"	"	1.8	"	"
" " " " " " 5	.... 3.8	"	"	2.5	"	"

Remarks. The subgeneric name *Catella* was established in 1908 by HEALEY for those *Grammatodon* species in which the valves are "short at the anterior end, high and produced at the posterior end, and characterized by a strong internal rib, which divides the umbo into two nearly equal parts and continues downwards, usually dying out just before reaching the ventral margin. The position of the rib is marked externally by a shallow mesial sulcus, and it leaves a deep groove on the internal cast" (ARKELL 1930). Dentition and other features as in *Grammatodon.* Rhaetic, Lower Liassic and Triassic species have been referred to this subgenus.

Horizon and Locality: Katslösa, Beds 30 and 42.

Grammatodon (Catella) subrhomboidalis n. sp.

Pl. XVIII, Fig. 2

Diagnosis. *Catella* with sub-rhomboidal shell, rounded posterior ridge and coarse concentric ribs.

Description. Umbo at one-fourth the shell-length from the anterior end, provided with a mesial sulcus which disappears downwards. Posterior ridge rounded. Hinge-line, two-thirds the length of the shell, meets the posterior margin at an obtuse angle. The posterior margin is slightly concave; postero-ventral corner is rounded. The ventral margin forms a gentle curve, and in front it converges slightly with the hinge line. Anterior margin well rounded. Test thick. Surface with a coarse striation of growth-lines. No radial striation. Teeth not visible.

Material. The holotype (S.G.U. Museum).

Size. Length of shell 9.5 mm., length of hinge-line 6.5 mm. Height at the posterior end of the hingle-line 5.5 mm., at the anterior 4.0 mm.

Remarks. This species is closely allied to *Grammatodon (Catella) trapezium* Cox but differs mainly in being more elongated with much smaller divergences of the ventral and dorsal margins.

Occurrence. *G. (C.) subrhomboidalis* has been collected in the shell breccia pebbles at Katslösa 955.

Genus *Barbatia* GRAY

Barbatia pulla (TERQUEM)?
Pl. XVIII, Fig. 6

1855. *Arca pulla* TERQUEM, Mém. Soc. Géol. France. (2) 5, P. 307, Pl. 21, Fig. 1.
1888. *Macrodon pullus* MOBERG, Lias i SÖ. Skåne, P. 41, Pl. 3, Fig. 20.
1930. *Barbatia pulla* ARKELL, Jurassic Arcidae, P. 349.

Material. Two specimens.

Description. A very small arcid was described by Moberg from S.E. Scania and identified with the Lower Liassic species *Arca pulla* TERQUEM, though with some hesitation. The following is a translation of his description:

"Lamellibranch, small, thin, tapezoidal, elongated. Inferior margin longer than the hinge, almost straight, though mostly with a slight mesial sinus. Hinge-line meets the anterior and posterior margin at almost right, respectively obtuse angles. Anterior end rounded downwards and somewhat lower than the posterior one, which is truncated. Umbones situated at the anterior third of the shell, broad but flattened, only slightly projecting beyond the hinge-line: they are acute, incurved, but do not touch. Area concave, hardly visible. From the umbo a sharp ridge or keel extends towards the postero-ventral margin, leaving behind it a triangular concave field. Anteriorly also the umbo is well defined though without any keel. From the topmost part of the umbo a rather strong furrow runs to the ventral margin parallel to the posterior margin. In that direction it widens gradually and becomes shallower, giving the shell a dilated appearance on both sides of the furrow, especially at the umbonal part. Surface covered with strong concentric lines and fine radiating striae, which increase in number by intercalation of new ones.

Size: length 1.5 mm., height 1 mm., thickness (of entire shell) 0.75 mm. Another specimen is 2.25 × 1.25 × 1.0 mm."

Remarks. As pointed out by Moberg, the Swedish form differs from *Arca pulla* TERQUEM in having a higher umbo. The Katslösa specimens show the same difference. The consequent uncertainty of the identification is still further emphasized by the fact that the dentition of our specimens is unknown. *Barbatia*, to which *Arca pulla* is referred, has a somewhat different dentition from that in *Grammatodon*. In conclusion, I consider it best, until more complete specimens have been met with, to hold to the identification made by Moberg, though with a mark of interrogation.

Horizon and locality. One specimen met with at Katslösa Bed 30, and another, badly preserved one, at Katslösa Bed 42.

Family CARDINIIDAE

Genus *Cardinia* AGASSIZ

The genus *Cardinia* is well represented in the Helsingborg Stage (= the *Cardinien* Lias), but the shells, being for the most part replaced by sandstone, rarely show good generic characters. As a rule, the exterior sculpture of growth lines and intervening concentric ribs is rather well developed. Sometimes, however, the shell matter is quite dissolved, thus both external moulds and internal casts being left. Sometimes the internal sculpture, usually well visible in casts, is concealed by the external sculpture, which is impressed upon the internal cast. These conditions do not concern this genus only. It is rather difficult, therefore, to recognize the generic characters of the lamellibranchs of the Helsingborg Stage, as is also understood from LUNDGREN's and HÉBERT's paleontological studies. In fact the present situation is much the same.

The first known species of *Cardinia* was *C. follini*, described by HÉBERT as *Cypricardia ? nilssoni*. The error was corrected by LUNDGREN. Under the head of *Pholadomya expansa*, LUNDGREN (1878) described two poorly-preserved specimens which are now tentatively referred to the genus *Cardinia*. One of them (l. c. Fig. 34) may be considered as the holotype of *Cardinia (?) expansa*, though its state of preservation is decidedly inferior for the purpose. The other specimen (l. c. Fig. 35) is still worse but evidently belongs to the same species. Here also belong two of the specimens figured by LUNDGREN under the head of *Modiola coticulae*. The remaining specimen, the holotype (LO 425 T) of *Modiola coticulae* LUNDGREN, may be a *Pholadomya*.

Pholadomya elevato-punctata LUNDGREN is a *Cardinia*, tentatively referred below to *C. follini*.

All these species — "*Modiola*" *coticulae*, "*Pholadomya*" *expansa*, "*Pholadomya*" *elevato-punctata*, and *Cardinia follini* — have about the same vertical distribution, being practically restricted to the *Cardinia* Bank.

It is quite probable that the *Cardinias* just referred to have to be restricted to one single species, but the material available does not allow us to decide anything with certainty on this question. We therefore retain the following specific names:

Cardinia follini LUNDGREN and
" *(?) expansa* LUNDGREN sp.

Finally, *Cardinia ingelensis* n. sp. is described from the Upper Helsingborg Stage and *C. kullensis* n. sp. from the *Avicula* Bank of the Lower Sinemurian.

Cardinia follini LUNDGREN

Pl. VII, Fig. 7

1869. *Cypricardia? nilssoni* HÉBERT, Ann. Sci. Géol., 1, P. 134, Pl. 2, Fig. 20 (*non Cardinia nilssoni* CHAPUIS & DEWALQUE).
1878. *Cardinia follini* LUNDGREN, Studier, etc., P. 50, Figs. 15—18.
1878. *Pholadomya elevato-punctata* LUNDGREN, ibid., P. 53, Figs. 19, 20.
1881. *Cardinia follini* LUNDGREN, Molluskfaunan, P. 39, Pl. 4, Figs. 1—3.

D e s c r i p t i o n. Shell thick, sub-rectangular, elongate; umbo near the anterior end; surface covered with concentric growth lines. Anterior adductor impression deep, posterior rather faint. Hinge margin thick, forming a deep dorsal excavation on the internal casts. Ligament external, behind the umbo. Length of shell slightly more than twice the height. Average length 25 mm.

Remarks. This species is easily recognized on account of its general shape, the dorsal and ventral margins being almost parallel. A similar form has been figured by DUNKER among his specimens of *Cardinia elongata* (1846, Pl. 6, Figs. 5—6); this, however, is shorter and more ovate in outline. *Cardinia* sp. (below) is almost three times as long as it is high.

Pholadomya elevato-punctata LUNDGREN is a thin-shelled *Cardinia*, presumingly identical with *C. follini*. The specimens figured by LUNDGREN are compressed and flattened, but the posterior lateral is well visible. In spite of the deformation, the general aspect and outline are clearly seen to be similar to *C. follini*. This is especially the case with the specimen Fig. 20 (LUNDGREN 1878), which is less deformed and shows the parallelism of the ventral and dorsal margins. Even the position of the umbo, the concentric striation and the relative proportions coincide with those in *C. follini*. The muscle scars are only slightly indicated and hardly visible, owing to the thinness of shell, as already stated. Lundgren recognized this species on account of the small tubercles which cover a part of the shell surface. Hence the name *elevato-punctata*. But most of the bedding plane on which this fossil is preserved is covered with such "tubercles", though smaller than the ones on the shell surface. A closer study has shown that these are nothing but crystals of gypsum, formed probably to the detriment of the lime in the shell, which has quite disappeared.

"*Pholadomya elevatopunctata*" was found by Nathorst in a dark shale above the Pålsjö flora at Pålsjö; in the top beds of the *Cardinia follini*-zone at Sofiero; in a dark shale at Kulla Gunnarstorp above a thin coal bed (probably belonging to the Pålsjö beds) and in a pebble together with *Cardinia follini*. It might be restricted to the *Cardinia* Bank, though occurring only in a black shale facies. This explains the different mode of preservation, as compared with the typical *C. follini*.

Occurrence. *Cardinia follini* seems to be restricted to a narrow bed — the *Cardinia* Bank — in the lower part of the Helsingborg Stage (Cycle No. 6), where it has a rather wide distribution. Thus it has been found at different localities N. of Helsingborg (Pålsjö, Gravarna, Sofiero, Laröd, and Hittarp, in drilling cores at Klappe and Rosendal, and in loose pebbles at Slusås (together with "*Cyclas*" *nathorsti*). Finally it occurs at several places in the Höör district.[1]

Cardinia (?) expansa (LUNDGREN)

Pl. VI, Fig. 3

1878. *Pholadomya expansa* LUNDGREN, Studier, P. 53, Figs. 34 and 35 (?)
1881. *Modiola coticulae* LUNDGREN, p. p., Molluskfaunan, P. 36, Pl. 1, Figs. 7—8 (*non* Fig. 6).

Original diagnosis. Testa elongato-ovata, antice abbreviata, postice expansa rotundata, plicis ornata; umbones antici.

[1] LUNDGREN 1881, P. 41; TROEDSSON 1940.

Holotype. LO 316 T (Paleontological Institute, Lund), an external cast, somewhat damaged. A much better specimen was figured by LUNDGREN as *Modiola coticulae* (1878, Fig. 7, LO 427 t), and is refigured here in dorsal view.

Description. Shell rather thin, inflated at the umbonal region. Surface with rather coarse growth-lines. Umbo is placed near anterior end and continued backwards by an oblique ridge. Ventral margin straight or slightly concave; dorsal margin straight and short, behind the umbo, but together with the anterior and posterior margins it forms a curved line, interrupted by the umbones. Ligament external, rather long, behind the umbo. Inside of shell not known.

Size:		Holotype	LO 427 t	LO 426 t
	Length	18.9 mm.	26.1 mm.	26.0 mm.
	Height	11.5 "	13.3 "	15.0 "

Remarks. The present species was originally referred partly to *Pholadomya* and partly to *Modiola.* Its ranging with *Cardinia* is, however, only tentative and is owing to its external similarity to *C. follini.* From the latter species it differs in being shorter in relation to its height and in its umbones which are placed more forwards. The badly preserved specimen LO 317 t (LUNDGREN 1878, Fig. 35) is probably *C. follini.*

Distribution. *C. (?) expansa* was collected in the *Cardinia* Bank at Pålsjö and Hittarp.

Cardinia ingelensis n. sp.

Pl. V, Figs. 1—3; Pl. VII, Fig. 16

1947. *Cardinia listeri* TROEDSSON, Geol. För. Förh. 69, P. 404, Fig. 7.

Diagnosis. *Cardinia* with subovate outline; umbo wide and rather high in front of the middle; greatest height of shell behind the umbo. Concentric striation.

Holotype. Mo 6549, Riksmuseum.

Description. Length of holotype 29, height (behind umbo) 17 mm. Outline subovate. Dorsal margin dips forwards, anterior and posterior ends are gently curved, ventral margin is straight or slightly convex. Umbo wide, forming the main part of the arched part of the shell. Cardinal teeth rudimentary. In the right valve is a shallow socket and two(?) cardinals below the umbo; anterior lateral only partly preserved. In the left valve there is a long posterior lateral tooth. Anterior adductor impression well developed. Surface covered with a coarse concentric striation.

Remarks. This species differs from other *Cardinias* in its subovate outline, and the great height of the shell behind the umbo. It belongs to the group of species, which BRAUNS fused under the head of *C. listeri.* Among these it most nearly resembles the *Cardinia depressa,* figured by QUENSTEDT in his Jura, Pl. 3, Fig. 12. In an earlier paper (1947 b) the present writer placed it with *C. listeri.* It is more accurate, however, to consider it as a new species.

Cardinia ingelensis sometimes occurs in large quantities in a fine, pure sandstone, a grind-sandstone, at the type locality. Owing to the position at the moment of embedding the shells have been compressed in different ways, thus showing a rather striking variation as to the exterior. This, however, being quite a secondary feature, is of no specific value. Cfr. the figures.

Horizon and localities. In the upper part of the Helsingborg series (the Upper Grind sandstone) at Ingelsträde and Täppeshusen, S.E. of Höganäs. At Oregården, bore-hole No. 271, 190—195 m. below the surface. Also in a sandstone pebble from the shore at Svanebäck, found by Mr. Tryggve Troedsson.

Cardinia kullensis n. sp.

Pl. VI, Fig. 1; Pl. VII, Figs. 8—10

1878. *Cardinia* ? sp. LUNDGREN, Studier, P. 51, Fig. 53.

Holotype (Pl. VII: 10). Paleontological Institute, Lund.

Specific name. Derived from the Kulla district (Kullabygden), i. e. the lowland between Kullen and Helsingborg, partly occupied by the Viken syncline, where the localities with this fossil are situated.

Material. 30 or 40 specimens, mostly steinkerns and exterior moulds, belonging to the Paleontological Museums of Lund, Upsala, and Stockholm.

Diagnosis. Umbo close to the anterior end; shell decreasing gradually in width backwards; dorsal and anterior margins partly straight.

Description. Shell with coarse striae of growth, elongated-ovate, the maximum height being at umbo, from where it decreases rapidly forwards, slowly and gradually backwards. Outlines of both ends well rounded, ventral margin straight in the middle, slightly convex at the ends; dorsal margins meet at obtuse angles at the umbo: the posterior part is straight but curves gently into the posterior end of shell; the anterior part is straight and slopes abruptly forwards, joining the rounded anterior margin. Posterior lateral tooth of left valve is thick and rounded in cross section and extended over half the length of the shell. Anterior lateral of the right valve rather strong. Anterior adductor impression deep, well defined, and subcircular in outline; anterior adductor only slightly indicated, ovate, situated at about one-third the shell length from the posterior end.

Size. Average height to length as 3 to 8.

	—	Holotype	Pl. VII: 9
Height	14	18	24 mm.
Length	38	48	64 ”

Remarks. The genus *Cardinia* had its main distribution in the lowest Lias (Lias α), where it occurs in great variation, a multitude of species being described. BRAUNS tried to group these into three species, viz. *C. concinna* (embracing the elongate shells), *C. crassiuscula* (the short shells with a centrally placed umbo), and *C. listeri* (the short shells with the umbo near the anterior end). *C. concinna* included not only the typical forms of medium length but also such elongate forms as *C. copides* DE RYCKH., *C. elongata* DUNKER and *C. gigantea* QUENSTEDT. Joly has described several species of the *copides*-group. They differ from *C. kullensis* in general outline, in their straight dorsal margin, and the widening of the shell behind the umbo. *E. elongata* is relatively shorter.

C. kullensis is the largest Swedish species of *Cardinia*. It is also more thick-shelled than the remainder, having coarser sculpture, stronger teeth and deeper adductor impressions, all together speaking in favour of more pronounced marine conditions than in the preceding Helsingborg Stage. It is also the last species of this genus in the Swedish succession.

Horizon and localities. *Cardinia kullensis* n. sp. is a rare species in the *Avicula* Bank at Kulla Gunnarstorp but occurs plentifully in the corresponding strata at Dompäng (loc. 528), probably in the top beds, as indicated by a specimen of *Coroniceras sauzeanum*, the leading fossil of the Ammonite Bank. This was collected at the same place and is now preserved in the Paleontological Institute of Lund. *C. kullensis* has never been found in the rich fauna of the Ammonite Bank.

Cardinia sp.

Pl. VI, Fig. 2

Material. One incomplete internal cast, Mo 6290.

Description. Interior cast, long and narrow with parallel sides, umbo rather close to the anterior end, posterior lateral tooth very strong and well developed, muscle scars well visible. Length of specimen 33 mm., height 13 mm. (ventral margin not entire).

Remarks. This species seems to belong to the *copides* group, but state of preservation is too bad for the relationship to be ascertained. In its subparallel shape it has much in common with *Cardinia follini*, but is relatively longer.

Horizon and locality. In the Grind sandstone at Teppeshusen north of Helsingborg, about 100 m. above the Rhaetic-Liassic boundary, probably in the upper part of the Helsingborg Stage. Together with *Cardinia ingelensis*.

Family TRIGONIIDAE

Genus *Trigonia* BRUGIÈRE

The *Trigoniae* have been treated in detail by several authors, for instance, LYCETT (1872—82), COSSMANN (1912), DEECKE (1925), and LEBKÜCHNER (1932). The earliest representatives of this genus appear in the Lower Lias of South America and Spain; those of the latter country appear already in the *angulatus* zone. Some badly preserved specimens, belonging to the section *costatae*, from the topmost Sinemurian (the *armatum* or *raricostatum* zone) of Yorkshire were described by

TATE (1876, p. 386) as *Trigonia? modesta*. According to MÖRICKE (1894, P. 44), the same species has been collected in somewhat younger beds, or in the *centaurus* zone of the Lias γ of N.W. Germany. Finally it has been met with in the *jamesoni* zone at Katslösa, as referred to below. Nobody — not even DEECKE in Fossilium Catalogus (1925). — seems to have observed that in 1888 MOBERG described and figured another species of *Trigonia* from the *jamesoni*-zone (Lias γ) of S.E. Scania under the preoccupied name *T. modesta*, being certainly unaware of LYCETT's monograph, and TATE's description of 1876. The *T. modesta* MOBERG — for which the name *T. primaeva* is now proposed — belongs to the section *Glabrae* (LYCETT), as does also the still younger species *T. lingonensis*.

Trigonia primaeva n. sp.

Pl. XVIII, Figs. 10—12 (and 13?)

1881. *Trigonia* ? sp. LUNDGREN, Molluskfaunan, p. 38.
1888. *Trigonia modesta* MOBERG, Lias i SÖ. Skåne, P. 48, Pl. 2, Figs. 1—2; Pl. 3, Figs. 23—24 (*non* TATE).

Holotype. MOBERG 1888, Pl. 2, Fig. 1 (S.G.U. Museum).

Description. Shell strongly arched, posteal part extended obliquely downwards. Marginal carina well developed, dividing the shell into two parts, which meet almost at right angles. The posteal part consists of a small escutcheon and a wide concave area separated by the inner carina, which is much shorter than the marginal. There is no median carina nor any median furrow, unless the latter be represented by the concavity of the area. Escutcheon and area are traversed by a fine, dense striation which continues without interruption on the ventral portion of the shell. The latter narrows off anteriorly and is covered by concentric ribs. These are almost effaced in the holotype, but in all specimens with well preserved test — and also in an internal cast — they are rather coarse and somewhat irregular, though always in continuation with the striae of the posteal part. The hinge is not visible in the holotype, but small fragments, found by Moberg together with the holotype, show the typical hinge of *Trigonia*.

Size:	Length	Height	Thickness	Locality
Holotype	12.5	10.4	2 × 5 mm.	S.E. Scania
Pl. XVII, Fig. 11	12.3	—	2 × 4.4 "	Katslösa 955
Pl. XVII, Fig. 12	9.7	7.9	2 × 3.7 "	"

Moberg also reports a specimen from the Rödmölla pebbles (in a Cretaceous conglomerate) more than 20 mm. in length. Ten specimens were collected at Kurremölla in S.E. Scania, and three have now been found at Katslösa.

From the Upper Höör sandstone at Brandsberga, etc., LUNDGREN described two large *Trigonias* under the heading of *Trigonia?* sp., both preserved as internal casts. One of these was 50 × 40 mm., the other 22 × 19 mm. The latter, now preserved in the Riksmuseum (Mo 6705), is rather fragmentary at the umbo. According to LUNDGREN the umbo turns forward as in *Myophoria*, but this cannot be distinctly perceived on account of the bad state of preservation. Escutcheon, area, and other external features, also the striation of the shell surface, coincide with those in *T. primaeva.*

The other specimen is 42 mm. in length and 36 mm. in height. The test is preserved on a part of the anteal portion, and is covered with low concentric plications, crossed by densely set and very fine radiating striae. Umbo broken at the apex but appears to be directed posteriorly. Marginal carina strong, area concave, obliquely crossed by a dense striation. Inner carina well visible. Escutcheon much narrower than the area.

This specimen, too, seems to belong here. In accordance with the general character of the Brandsberga fauna it attains a considerable size, as compared with the specimens of the ferruginous beds at Kurremölla and Katslösa.

Remarks. *T. primaeva* is closely allied to *T. lingonensis* of the highest beds (the *spinatus* zone) of the Upper Pliensbachian (Middle Lias) and the basal part of the Upper Lias. The difference lies mainly in the escutcheon, which is much smaller and narrower than the area. In *T. lingonensis* both are of the same size. This is, of course, a feature, that is apt to change with the individual age, the early growth stages being in such a case represented by *T. primaeva*, the maturity by *T. lingonensis.* Since, however, no large shells have been met with in Sweden, I think it most appropriate to class these early representatives of the "*lingonensis*" type as a separate species. The medium-sized internal cast Mo 6705 belongs to the same growth stage as the small specimens from Katslösa and Kurremölla.

Horizon and locality. The *Cardium* Bank of S.E. Scania at Kurremölla, Bed 42 at Katslösa, and the Upper Höör sandstone at Brandsberga.

Trigonia modesta TATE

Pl. XVIII, Figs. 8—9

1876. *Trigonia? modesta* TATE, Yorkshire Lias, P. 386, Pl. 12, Fig. 4.
1879. *Trigonia? modesta* LYCETT, Fossil Trigoniae, P. 212, Pl. 41, Fig. 13.
Non 1888. *Trigonia modesta* MOBERG, Lias i SÖ. Skåne, P. 48.
1925. *Trigonia? modesta* DEECKE, Fossilium Catalogus I: 30, P. 195.

Material. 14 more or less fragmentary specimens.

Description. Left valve 5 mm. in length, 3 mm. in height, damaged at anterior end, and also incomplete at the posterior. Umbo directed posteriorly. Surface of anteal portion covered with edged, well-marked costae, at least 14 in number, parallel to the ventral margin and bent in a sigmoid curve when approaching the area. Area concave with densely set transverse striae, enclosed between the low, but well-marked marginal carina and the posterior margin; the latter is probably the same as the inner carina, beyond which the shell is not preserved. Escutcheon thus not visible; it is likely to be very narrow. There is a narrow but deep sulcus in front of the marginal carina. Hinge not visible. The area forms a part of the natural arching of the valve, thus being steep near the umbo, flattened at the ventral margin.

In the fragmentary right valve (Mo 6304) the marginal sulcus is missing, and there seems to be no inner carina. However, in both specimens referred to, only the internal mould is preserved, which probably explains the simple structure of the area.

Remarks. This Katslösa species coincides in all essential characters with the British species *Trigonia? modesta* TATE, even as to size, though the proportions seem to differ. The specimen measured does not appear to be complete ventrally, complete specimens certainly being higher. There is therefore no doubt, that the Katslösa form has to be identified with *Trigonia? modesta* TATE. This is a primitive representative of the *Trigonia* stock, and, as already pointed out by TATE, it is rather close related to the Rhaetic species *Myophoria postera.*

Occurrence. *T. modesta* was found in the *armatum* zone of Yorkshire, i. e. the uppermost part of the Sinemurian. The Katslösa specimens are from Beds 30 and 32, the *cypriniformis* zone. And those of N.W. Germany are still later, being met with in the *centaurus* zone.

Family ASTARTIDAE

Genus *Astarte* Sow.

Astarte angelini (MOBERG)

Pl. XI, Fig. 1

1888. *Cardium angelini* MOBERG, Lias i SÖ. Skåne, P. 55, Pl. 2, Figs. 21—22.

Original description (in translation). Umbones slightly in front of the middle, unusually strong in relation to the size of the shell, bent inwards and forwards, acute, especially prominent on account of the deep, heart-shaped, well-defined lunule. The conch is rather thick, especially at the umbones. Shell thick, smooth, with fine lines of growth at varying distances. No trace of radiating striae. Interior margin crenulated. Size: 3.5 mm. in length and height, 2 × 1 mm. in thickness. An entire specimen is 3 mm. in length and height and 1.75 mm. in thickness.

Material. 16 specimens from Katslösa.

Size:	Length	Height			
Fig. 1 on Pl. XI	5.9	5.4 mm.	Internal mould		(S.G.U.)
Katslösa Bed 32	4.8	4.4 "	"	"	(S.G.U.)

The Katslösa specimens seem to be somewhat larger than those from S.E. Scania.

Remarks. MOBERG also figured the inside with the hinge. This is of the same general type as that in *Tutcheria*, though the lateral teeth are not tuberculiform. Thus it is not at all similar to that in *Cardium.* Since the surface ornamentation consists of concentric lines only, the species is here listed with *Astarte.*

H o r i z o n a n d l o c a l i t i e s. The holotype was derived from the "*Cardium*" Bank at Kurremölla in S.E. Scania. The Katslösa specimens are from Beds 18, 30, 32, and 36.

Astarte fructuum MOBERG?

1888. *Astarte fructuum* MOBERG, Lias i SÖ. Skåne, P. 50, Pl. 2, Figs. 6, 7.

O r i g i n a l d e s c r i p t i o n. Small, triangular; umbo median, slightly curved. Anterior and posterior parts of dorsal margin meet at almost right angles. Both are almost straight; the posterior is, however, slightly convex, the anterior faintly concave (not adequately shown in the original figures). Ventral margin slightly curved and passes by gentle curves into the anterior and posterior margins. Posterior end often slightly extended. Ventral margin as a rule densely crenulated. Lunule and area narrow, lanceolate. Valves slightly arched, smooth and glossy, with hardly visible lines of growth. As a rule preserved with both valves connected, very like a pip. Differs from *A. scanensis* in its smaller cardinal angle, more erect umbo, flattened valves and smaller size. In 100 specimens the size varies very little. Length a little more than 1.5 mm., height mostly less, though rather variating, thickness (of both valves) 1 mm. (Translated from the Swedish.)

S i z e:

	Length	Height
S.G.U. No. 126	2.3	2.3 mm.
S.G.U. No. 82	1.4	1.4 "

R e m a r k s. Three specimens from Katslösa 840 are referred more or less doubtfully to this species. As far as can be seen they coincide fairly well with the above description, but they are damaged and in a bad state of preservation.

H o r i z o n a n d l o c a l i t y. In the *jamesoni* zone of S.E. Scania (Kurremölla) and in Bed 30 at Katslösa.

Astarte scanensis MOBERG

1888. *Astarte scanensis* MOBERG, Lias i SÖ. Skåne, P. 49, Pl. 2, Figs. 4, 5.

O r i g i n a l d e s c r i p t i o n (in translation). "Rounded ovate, strongly arched, length greater than height; umbones acute, sub-median, slightly forwardly directed. Anterior and posterior parts of dorsal margin meet at an obtuse angle. Lunule cordate, area [escutcheon] long and narrow. Shell surface smooth, glossy, with fine, concentric striae. Indications of extremely weak concentric ribs or folds are not altogether absent, especially close to the ventral margin. Interior ventral margin either densely crenulated, or smooth with edged borders."

M a t e r i a l. Four specimens met with at Katslösa, all preserved as internal casts, sometimes with small remnants of the test. One of these casts is unusually large. It has, however, the same relative proportions and the same outline as *A. scanensis*. The shell has a fine concentric striation, crenulated ventral margin, and a wide lunule, as described by MOBERG. The large size is probably due to the facies, a coarse sandstone with belemnites, brachiopods, crinoids, and large pectinids, the marine character thus being more salient than in the iron oolitic beds, which have yielded the main part of the faunas at Katslösa.

Size:	Length	Height	Thickness
MOBERG's specimen I	4.25	3.75	2 × 1.12 mm.
" " II	4.00	3.75	2.25 "
S.G.U. Museum (Katslösa Bed 18) ..	c:a 9.5	8.5	2 × 2.1 "
Mo 6232 (Katslösa Bed 30)	5.00	4.3	—
S.G.U. Museum (Katslösa Bed 32) ..	> 4.50 (incomplete)	4.50	—

Remarks. *A. scanensis* is more densely striated than the North German species *A. obsoleta* DUNKER, which occurs in a lower horizon (Lias α). It is similar to *A. striato-sulcata* RÖMER but is more elongated.

Astarte scanensis, *A. angelini* and *A. fructuum* are all small specimens and certainly closely allied. The first-named is subovate, length slightly exceeding height, umbo narrow and small; the lunule is cordate, much wider than the escutcheon. *A. angelini* has a rather strong and thick umbo, length just about equal to the height, lunule hardly defined. *A. fructuum* is triangular and very small, rarely exceeding 1.5 mm. in length and height.

Horizon and localities. *A. scanensis* was described from the *jamesoni* zone of Kurremölla, S.E. Scania. The present specimens are from the Beds 18, 30, and 32 at Katslösa.

Astarte (Neocrassina)? fortuna n. sp.

Pl. XI, Figs. 2—4

Material. Four valves, of which three are collected in one small piece of rock, and one internal cast.

Holotype. S.G.U. Museum, Pl. XI, Fig. 3.

Diagnosis. Aequivalve, strongly inequilateral, ovate with well-rounded margins. Umbo slightly projecting, turned forwards, and situated at about one-fourth the length from the anterior end. Dorsal margin concave in front of the umbo, straight or slightly convex behind it. Lunule longitudinally striated, though not well defined. Surface covered with rather fine concentric striation. Hinge only incompletely known. The left valve has a rather strong posterior lateral tooth, extended far backwards and divided partly by a longitudinal furrow. Furthermore, there are indications of two cardinals in the interior mould. Right valve also with a posterior lateral. Anterior laterals not proved.

Dimensions:	Length	Height	Thickness
Holotype	13.4 mm.	9.5 mm. (70 %)	2 × 4.0 mm. (60 %)
Pl. XI, Fig. 4	9.9 "	7.6 " (77 %)	2 × 3.4 " (70 %)

Specific name. *Fortuna*, a small fishing-village close to Katslösa.

Remarks. Since the hinge is imperfectly known the reference of this species to *Astarte* is, of course, not firmly established. In its external shape it also differs from most species referred to this genus, though, in this respect, it seems to come close to *Neocrassina*, established by P. FISCHER in 1887 as a subgenus of *Astarte*, mainly on account of its exterior shape. The sub-generic rank of such forms was denied by ARKELL (1934), who has shown a great variation in the same direction within a sole species, viz. *A. ovata* SMITH. In a recent paper A. CHAVAN (1945) ranges the latter species with *Neocrassina*, which he has studied carefully and shown to differ somewhat from *Astarte sensu stricto* also in respect of the hinge characters, the posterior laterals being longer and more pronounced, the anterior ones shorter and less marked. These features, together with the anterior position of the umbones, coincide well with the conditions in *A. fortuna*. Our species differs in being more elongate and in the less extreme position of the umbones.

The subgenus *Neocrassina* has not been recorded before in beds below the Middle Jurassic.

Horizon and locality. In Beds 30, 32, and 42 at Katslösa.

Astarte deltoidea MOBERG

Pl. XI, Fig. 5

1888. *Astarte deltoidea* MOBERG, Lias i SÖ. Skåne, P. 48, Pl. 2, Fig. 3.

Material. Six specimens collected at Katslösa.

Original description. "Nearly triangular with straight, acute, almost median umbones. Cardinal angle 90°. Anterior hinge-line long and straight; posterior one also straight but a little shorter. Ventral margin slightly curved, except at the anterior and posterior margins; at the latter place the curvature is somewhat greater than at the former. Lunule and area are long and narrow. Entire shell very flattened. Interior ventral margin densely crenulated. Test rather thick, ornamented with 6—8 strong, rounded concentric ridges, separated by intervals of the same width. Ridges and intervals provided with fine, densely placed, concentric striae." Dimensions of holotype: length 4.5, height 4, and thickness 1.5 mm. Most characteristic features: triangular outline, flattened shell, and a few strong concentric ridges.

Remarks. This species has the same sculpture as *A. extensa* PHILLIPS of the Upper Jurassic (Corallian beds) of England and is similar to this species in other respects too, but is much smaller and more flattened (Cfr. ARKELL, Palaeontogr. Soc. 1932, P. 237, Pl. 34, Figs. 21—30). MOBERG has described two species carrying this kind of sculpture, viz. *A. deltoidea* and *A. erdmanni*, both from the *jamesoni* zone of S.E. Scania. Of the latter only the holotype is known. It was found in a pebble of the Senonian conglomerate at Röddinge. This pebble belongs to a type of rock that has yielded several species, also met with in the *jamesoni* zone at Kurremölla, the age of which is discussed on Pp. 123—124. The holotype of *A. erdmanni* is 10.5 mm. in length, thus being considerably larger than *A. deltoidea*, though it has only 5 concentric ridges. *A. erdmanni* has not been met with at Katslösa.

The figured specimen is 4.2 mm. in length and 5.3 mm. in height. Though damaged it shows the triangular shape and 7 concentric ridges and seems to have the same low arching as the holotype.

Horizon and localities. The holotype was derived from the *jamesoni* zone of Kurremölla, S.E. Scania.

The Katslösa specimens are from beds 30 and 42, and from Loc. 955 b.

Astarte oerbyensis n. sp.

Pl. XI, Figs. 6—9

Material. Eight specimens.

Holotype. Pl. XI, Fig. 8, Katslösa 955 b. Both valves preserved.

Description. Equivalve, inequilateral, subtriangular. Umbo forwardly directed. Preumbonal margin concave, postumbonal one convex, ventral margin strongly curved. Lunule smooth, rather wide, well defined laterally by an elevated margin. Escutcheon long, narrow. Surface covered with thick concentric ribs, about 10 in number. Hinge not visible.

Size of holotype. Length 4 mm., height 3.5 mm., and thickness of entire specimen 1.8 mm.

Specific name from Örby, a small village close to Katslösa.

Remarks. This species differs from *A. deltoidea* in its wider lunule and inequilateral valves. *A. erdmanni* is three times as high but has only half as many concentric ribs.

Horizon and locality. Katslösa Beds 30, 32, 41, and 42 b.

Astarte ryensis n. sp.

Pl. XI, Figs. 10—13

Material. Eight specimens.

Holotype. Pl. XI, Fig. 12 (S.G.U. Museum).

Diagnosis. Subtriangular, almost equilateral, well arched. Umbones strong, bent inwards and slightly forwards. Surface with a few coarse concentric growth-halts, 6 in the holotype. Well preserved specimens also show a fine concentric striation. A young specimen (Fig. 10) has only one growth-halt. Hinge unknown.

Named after Rya, a small village near Katslösa.

Size:

	Length	Height	Thickness
Pl. XI, Fig. 10	2.3	2.5	2 × 1.0 mm.
" " 11	2.8	2.8	2 × 1.2 "
" " 13	3.8	3.8	2 × 1.5 "
" " 12	5.0	5.5	2 × 1.07 "

Remarks. The ranging of this species with *Astarte* remains of coarse, uncertain, since the hinge is not known. In external shape *A. ryensis* reminds on certain species of *Astarte* with the same kind of surface ornamentation, for instance the Upper Jurassic *Astarte curvirostris* RÖMER (cf. ARKELL 1934, P. 244, Pl. 31, Fig. 2, Pl. 34, Figs. 15—20), which, however, is much larger, higher, and markedly inequilateral.

Horizon and locality. Katslösa Beds 30 and 42.

Astarte ? sp.

Pl. XI, Fig. 14

Strongly prosogyrous and inequilateral, with thick and strong umbo. Shell surface smooth or with faint growth lines, and arched, though with slight indications of umbonal ridges, like *Pseudopis*. There is no trace of radial striation.

RM. Mo 6220, 6221, 6416.

Katslösa 840.

Genus *Tutcheria* COX

Small Liassic lamellibranchs (generally referred to *Cardium* or *Cardita*, but even by some authors to *Isocardia* or *Anisocardia*) have recently been recognized by L. R. COX (1946) as a well characterized group related to the *Astartidae*, and united into the new genus *Tutcheria*, genotype *Cardium submulticostatum* D'ORBIGNY 1850 (= *C. multicostatum* PHILLIPS 1829, *non* BROCCHI). The most important features are the radial ornamentation of the surface and the strong lateral teeth, of which the right anterior and the left posterior are the most prominent, each ending with a tuberculiform projection. A careful description of the hinge is given by COX (l. c., P. 35).

Tutcheria cingulata (GOLDF.)

1837. *Isocardia cingulata* GOLDFUSS, Petrefacta Germ. 2. P. 210, Pl. 140, Figs. 16 a—c.
1837. *Cardium multicostatum* GOLDFUSS, Ibid. P. 218, Pl. 143, Fig. 9.
1888. " " MOBERG, Lias i SÖ. Skåne, P. 53, Pl. 2, Figs. 17—20.
1909. " " MALLING og GRÖNWALL, Medd. D.G.F. Bd. 3, P. 284.
1946. *Tutcheria cingulata* COX, Proc. Malac. Soc. 27, P. 38.

Material. 10 specimens from Katslösa.

The description of the Swedish specimens, given by MOBERG, is as follows (freely translated):

Small, rather arched; an average specimen measures 6.5 mm. in length and height. Teeth and muscular impressions are well developed. Lunule small, cordate, somewhat concave below the umbones; escutcheon longer, very narrow. Both are covered with fine growth-lines. Umbones strong, forwardly directed, acute, and contiguous. Outline of shell rounded-quadrangular, the umbo being situated in one corner. Antero-dorsal margin concave, postero-dorsal margin almost straight, dipping downwards; antero-ventral margin is the longest one and slightly curved; postero-ventral margin gently curved, the ventral margin thus being well rounded. The test is thick and strong, ornamented with fine, well-marked, concentric furrows on the umbonal portion, with narrow radiating furrows and ribs on the remaining part. The latter are curved backwards and do not reach the umbo. Only 3—4 radiating furrows near the posterior margin reach and cross the concentric ones but disappear 0.5 or 1 mm. before the apex. Young specimens are in this respect quite different (MOBERG, *l. c.*, Fig. 19). The ribs are 30 in number, as a rule, though in well preserved specimens there are about 40. This is due to the fact that the middle ribs, which are rather wide, have a faint dividing furrow, only visible in good specimens. The ribs are crossed by numerous, exceedingly fine growth lines and by a few coarse furrows, which vary greatly in size and number. Interior ventral margin is crenulated. Small specimens differ sometimes, especially as to their general habitus and their stronger concentric striation, which is able to give the shell a squamose surface.

Remarks. This description concerns the specimens of the so-called *Cardium* Bank of S.E. Scania, which were treated under the head of *Cardium multicostatum* PHILLIPS. The true *C. multicostatum* PHILLIPS (*non* GOLDFUSS, *non* BROCCHI) has now been made the genotype of *Tutcheria* COX, though with the specific name replaced by *C. submulticostatum* D'ORB. The Scanian form, however, differs from the genotype in its finer ribs and in its more inequilateral outline. In these respects it coincides well with *Cardium multicostatum* GOLDF. (*non* BROCCHI, *non* PHILLIPS), according to Cox a synonym of *Isocardia cingulata* GOLDF. Consequently the latter specific name has to be retained.

Occurrence. *Tutcheria cingulata* is a wide-spread species and occurs in most parts of W. Europe, from England to Swabia in beds belonging to the Lias α_3 and Lias γ, and even Lias δ. The present specimens are from Beds 30, 36, 41, and 42 at Katslösa, all belonging to the Lias γ, as is the case with the specimens from S.E. Scania and Bornholm.

Tutcheria cf. *richardsoni* COX

1946. *Tutcheria richardsoni* COX, Proc. Malac. Soc. 27, P. 40, Pl. 4, Figs. 1—3.

Material. An exterior cast of a right valve (S.G.U. Museum).

Description. Umbo strong, prosogyrous, continued downwards by an obtuse ridge. Another shorter and fainter ridge near the anterior end. Surface with irregular, but strong, growth lines and, near the apex, very faint radiating striae.

Size. Height 2.8 mm., length 3.7 mm.; these measurements are, however, uncertain on account of the poor state of preservation.

Remarks. This specimen represents a transitional form between *Tutcheria* and *Pseudopis*, as does also the British Lower and Middle Liassic species *T. richardsoni*, to which it is also closely allied. The only specimen hitherto found in Sweden is too badly preserved, to be identifiable.

Horizon and locality. In Bed 30 at Katslösa.

Genus *Pseudopis* Cox

Pseudopis sp.

Pl. XI, Figs. 15—16

Material. Three natural internal casts.

Description. The specimen Fig. 16, Pl. XI, bearing remnants of the test near the margin, shows the characteristic features of *Pseudopis* Cox: Outline triangular, umbo-bicarinate, though the carinae are somewhat rounded in the cast. Since the test is missing the specimen cannot serve as a type for a new species. Another cast (No. 76) shows well-developed muscle scars. It probably belongs to the same species.

Horizon and locality. Katslösa Bed 30.

Family TANCREDIIDAE

Genus *Tancredia* Lycett

Tancredia arenacea (Nilsson)

Pl. XI, Figs. 17—19

1832. *Donax arenacea* Nilsson, Djur-petrifikater, P. 355, Pl. 4, Fig. 5.
1837. " " Hisinger, Lethaea Suecica, P. 64, Pl. 19, Fig. 7.
1878. *Tancredia arenacea* Lundgren, Studier, P. 48, Fig. 51.

Material. 18 specimens.

Original diagnosis: "Testa triangularis, subaequilatera, margine posteriori convexo, anteriori subconcavo."

Description. This species is distinguished by its size and a rather coarse concentric striation. It is higher in relation to its length than most cogeneric species. The subtriangular outline, the inflation of the shell, the convexity of the posterior margin, and the bluntly-rounded anterior end of the shell distinguish it from *T. securiformis*, to which it is certainly closely allied.

The locality of the holotype, the *Avicula* Bank at Kulla Gunnarstorp, has yielded the best preserved specimens.

At Dompäng beautiful internal casts have been collected. The figured specimen (Pl. XI, Fig. 17) has a well-marked anterior adductor impression and a fainter posterior one.

Badly preserved specimens occur abundantly in a thin layer, in a rather coarse and loose sandstone (Bed No. 230) at Gravarna, in the northern part of Helsingborg. They are all preserved as natural interior casts, which are partly filled with sand and pieces of fibrous coal, the sculpture thus being almost entirely destroyed. The valves are never crushed or squeezed; they are, on the contrary, well arched or even inflated. The steinkerns are partly covered with a faint concentric striation, indicating a thin shell in the living animal.

The posterior muscle scar is sometimes preserved. The outline is sub-triangular, slightly concave in front of the umbo. Pre-umbonal part of shell narrows off and is longer than the posterior. From the umbo, which is slightly forwardly directed, there runs a faint ridge obliquely backwards, almost parallel to the posterior margin; on its posterior side it has a flat surface with a barely visible striation along the margin. Ventral margin regularly curved. Hinge with impression of the posterior lateral tooth, but no cardinals are preserved. Very often both valves occur together, though widely open at 90° or 180°.

Size:

	Length	Height
Mo 6728 (Gravarna)	19.5	13.4 mm.
Mo 6738 (")	22	14 "
Pl. XI, Fig. 17 (Dompäng)	36	24 "

Remarks. The specimens from Loc. 230 were first referred to *T. securiformis* (Troedsson 1947 b), but they really belong to *T. arenacea*, the most common species at Loc. 230.

It is worth mentioning, that Lundgren has reported *T. arenacea* from a sandstone pebble derived from the *Mytilus* Bank, which is situated about 20 metres below the shell breccia at Loc. 230, and another specimen, though more uncertain, is reported from solid rock of the same horizon.

Occurrence. The holotype was collected in the *Avicula* Bank at Kulla Gunnarstorp. Of the same age are specimens from Loc. 528 at Dompäng and from the drilling at Oregården at a depth of 95.7 metres. Finally *T. arenacea* has been met with in a sandstone pebble at Domsten. All these localities belong to the Lower Sinemurian. The occurrence at Gravarna is in the lower part of the Helsingborg Stage (Hettangian).

Tancredia securiformis (Dunker)

1846. *Donax securiformis* Dunker, Palaeontogr. 1, P. 38, Pl. 6, Figs. 12—14.
1878. *Tancredia securiformis* Lundgren, Studier, P. 49, Pl. 1, Fig. 52.
Non 1879, Lundgren.

Remarks. *T. securiformis* was recorded by Lundgren from the *Avicula* Bank at Kulla Gunnarstorp. His figured specimen seems to be lost, and the writer has not been able to find any others. To judge from the figure the identification is correct.

The specimens referred here by Lundgren (1879) from the *Myoconcha* beds of Bornholm were described later on by Moberg (1888) as var. *lineata* and given specific rank by Malling and Grönwall (1909).

Occurrence. *Tancredia securiformis* is known from the *psilonotus* beds of N.W. Germany, the *angulatus* zone of E. France, and the Hettangian and Lower Sinemurian of Belgium, thus being restricted to the Lias α. The Swedish specimens are from the Lower Sinemurian at Kulla Gunnarstorp.

Tancredia erdmanni LUNDGREN

Pl. XI, Figs. 20—21

1878. *Tancredia Erdmanni* LUNDGREN, Studier, P. 49, Pl. 1, Figs. 54, 55.
1881. " " " , Molluskfaunan, p. 42.

Holotype. LO 302 (Lund).

Original diagnosis. "Testa triangularis, subaequilatera, margine anteriori recto, posteriori subconcavo, margine ventrali paullum curvato."

Description. Shell triangular, rather elongate, the anterior tapering part bluntly ended. Anterior dorsal margin concave, posterior convex and ventral margin gently curved. Surface with concentric ribs, visible on the internal mould.

Size:

	Holotype	Mo 6687
Height	9	11.5 mm.
Length	17.5	19.5 "

Remarks. This species differs from the preceding one in being more elongate; the anterior tapering part is less pointed. The concentric ridges of the shell also help to distinguish *T. erdmanni*. The Katslösa specimens seem to have been very thin-shelled, only the squeezed and flattened internal moulds being preserved.

Occurrence. *T. erdmanni* was described from the *Avicula* Bank at Kulla Gunnarstorp where it is very common, at least in one bedding plane. It has also been met with in the drilling core at Oregården at a depth of 95.73—95.80 m., and is rare in the lower part of Katslösa section, one specimen being found at loc. 675 and eight specimens in the shell breccia at loc. 700.

Tancredia johnstrupi (LUNDGREN)

1879. *Tellina? Johnstrupi* LUNDGREN, Juraformationen på Bornholm, P. 24, Pl. 1, Figs. 19—22.
1888. *Tancredia Johnstrupi* MOBERG, Lias i SÖ. Skåne, P. 52, Pl. 2, Figs. 14—16.
1909. " " MALLING og GRÖNWALL, Medd. D.G.F. Bd. 3, P. 285.

Material. *T. johnstrupi* is rare at Katslösa, only seven specimens having been collected; although they are badly preserved the specific characters are fairly clear.

Description. Umbones placed a little in front of the middle, bent inwards, slightly forwardly directed, projecting somewhat beyond the hinge-line. Ventral margin slightly curved, almost parallel to the dorsal margin, though the shell tapers slowly behind the umbo. From the umbo a well-marked ridge runs obliquely backwards towards the posterior margin. Posterior end obliquely cut, gaping, anterior end elongatedly acute. Hinge with a triangular cardinal tooth in each valve; that in the left valve is the larger one and seems to continue forwards about as far as the anterior lateral. Of the laterals, which are developed in both valves, the posterior are longer but fainter than the anterior ones. Ligament external. At the end of the anterior lateral tooth the inside of the shell has a vertical ridge which continues almost to the ventral margin, leaving a wide and deep excavation near the anterior end of internal moulds (MOBERG, l. c.).

Remarks. This species was originally described by LUNDGREN, who was not able to give any information as to the hinge. Later on MOBERG found better specimens and referred it to *Tancredia*. It is a rather small species, about $2\frac{1}{2}$ times as long as it is high. Two specimens measured by MOBERG are 9—11.5 mm. in length, 3.5—4.5 mm. in height, and each valve is about 1.5—2 mm. in thickness.

As pointed out by MOBERG, it is allied to *Hettangia longiscata* BUVIGNIER.

Distribution. *T. johnstrupi* is rather common in the *Myoconcha* Bank on the island of Bornholm and in the *Cardium* Bank in S.E. Scania. At Katslösa it has been met with in Beds 32, 42 and 45.

Tancredia lineata MOBERG

1879. *Tancredia securiformis* LUNDGREN, Juraform. Bornholm, P. 22, Pl. 1, Figs. 16—18.
1888. " " DUNKER sp. var. *lineata* MOBERG, Lias i SÖ. Skåne, P. 51, Pl. 2, Fig. 11.
1909. " *lineata* MALLING og GRÖNWALL, Medd. D.G.F. 3, P. 284.

Material. Five internal casts, viz. 3 L.V. and 2 R.V.

Remarks. The Bornholm *Tancredia* specimens, identified by LUNDGREN in 1879 with *T. securiformis* DUNKER, were later on referred by MOBERG to his var. *lineata* from S.E. Scania. Finally in 1909 this form was given specific rank by MALLING and GRÖNWALL. It differs from *T. securiformis* in its fine concentric striation; and besides the posterior surface, behind the well-marked keel, is provided with fine radiating striae. As pointed out by Malling and Grönwall the differences are also pronounced in the internal casts, the "Steinkern" being more triangular in *T. lineata* than in *T. securiformis*.

MOBERG described another species, *T. elegans*, from the same horizon and localities. This has a similar ornamentation as *T. lineata* but differs as to the outline, the anterior margin being straight, and the umbo being decidedly postmedian.

Occurrence. *Tancredia lineata* was collected at Kurremölla and in the Liassic pebbles of the Cretaceous conglomerate at Rödmölla, S.E. Scania, both belonging to the *Cardium* Bank, and in the *Myoconcha* Bank at Stampen, Bornholm.

Horizon and locality. The present specimens were found in a thin bed of fine white sandstone at loc. 925 Katslösa (bed 41).

Tancredia ? sp.

Pl. IV, Figs. 1—3

Material. 9 specimens.

Description. Outline subovate or donaciform, anterior end lower than the posterior, umbo turned forwards, pre-umbonal margin concave; post-umbonal margin is convex and passes into the rounded posterior margin. Ventral margin gently curved, anterior bluntly pointed. Hinge unknown.

Remarks. By reason of the general shape these casts are tentatively ranged with *Tancredia*.

Horizon. The Lower Helsingborg Stage at Gravarna and the *Avicula* Bank at Oregården.

Localities. Gravarna Loc. 230. Oregården core at 95.73—95.80 m.

Family LUCINIDAE

Genus *Sphaeriola* Stoliczka

Sphaeriola kurremolinae Moberg

Pl. XI, Figs. 22 a—b

1888. *Sphaeriola Kurremolinae* Moberg, Lias i SÖ. Skåne, P. 50, Pl. II, Figs. 8—10.

Material. Two right valves, somewhat damaged and incomplete.

Original description. Strongly arched, with rounded outline; hinge-line rather straight with rounded corners. Umbones strong, curved forwards and inwards, contiguous, and strictly median at apex. Hinge shows only cardinal teeth, two in the right, one in the left valve; an indication of a second, posterior tooth in the left valve needs to be confirmed. The teeth of the right valve are rather strong, trigonal and very divergent seen from the umbo, where their pointed ends meet. The cardinal of the left valve is large, somewhat post-median, and triangular, with the point at umbo. Test thin, except at the broad, strong hinge. Surface covered with numerous, irregular, rather strong, concentric ribs. Interior ventral margin smooth. One specimen is 11 mm. long, 9.5 mm. in height and 2 $\times$ 4 mm. in thickness.

Moberg compares this species with the *Bathonian Sphaera (Corbis) madridi* d'Archiac, which, however, differs in regard to the umbo, the thickness of the shell, the ornamentation and the proportions in different stages of growth.

Remarks. The present specimens are much smaller than those of the type locality at Kurremölla, but coincide with the latter as to the sculpture and general shape.

Size:

	Length	Height
Mo 6208	3.5	3.0 mm.
Mo 6209	3.0	3.0 "

Horizon and Localities. At Kurremölla in S.E. Scania, common in the *jamesoni* zone. The present specimens are from Katslösa Bed 30.

Family CARDIIDAE

Genus *Protocardia* Beyr.

Protocardia philippiana (Dunker)

1847. *Cardium Philippianum* Dunker, Palaeontogr. 1, P. 116, Pl. 17, Fig. 6.
1871. *Protocardia Philippiana* Brauns, Unt. Jura, P. 324 (*non* Moberg).
1878. *Protocardia suecica* Lundgren, Studier, P. 48, Figs. 7 and 77.

Remarks. The species described by LUNDGREN as *Protocardia suecica* cannot be distinguished from *P. philippiana* DUNKER. Only one of LUNDGREN's type specimens seems to have been preserved (LO 297 T; LUNDGREN Fig. 7). It is an internal cast, somewhat damaged at the umbo but with impressions of the surface ornamentation of radial ribs in the truncated posterior part. In spite of the bad state of preservation of the Swedish specimens I unhesitatingly range them with *P. philippiana*.

Geological age. *P. philippiana* was described from Halberstadt in beds belonging to the *planorbis* zone (α 1).

Locality. Rare in the *Pullastra* Bank at Ramlösa, Helsingborg.

Lundgren, who was of the opinion that the *Pullastra* Bank of Sweden was Rhaetic in age, also described and figured two small shells, which he identified with the Rhaetic *Protocardia Ewaldi* BORNEMANN and *P. praecursor* SCHLOENBACH; but the figures are too bad to allow of identification, and the type specimens have disappeared. According to LUNDGREN the last-mentioned one should occur in great numbers, though in a bad state of preservation. There are not a few small casts of lamellibranchs of different kinds in the sandstone of the *Pullastra* Bank, but they are mostly undeterminable. To judge from the figures given by LUNDGREN, his small *Protocardias* might belong to this group of fossils.

Protocardia oxynoti (QUENSTEDT)

Pl. XIV, Fig. 2

1858. *Cardium oxynoti* QUENSTEDT, Der Jura, P. 110, Pl. 13, Fig. 46.
1871. *Protocardia oxynoti* BRAUNS, Der untere Jura, P. 325.
1876. *Protocardium oxynoti* TATE, The Yorkshire Lias, P. 395.

Material. Nine specimens, all internal casts, sometimes with small remnants of the shell.

Description. Shell sub-circular equivalve, and almost equilateral; umbo projecting, straight or only slightly turned forwards. The posterior, radially striated part of the shell continues without a break into the general arching, but a faint ridge from the umbo divides the striated portion longitudinally, two or three ribs being situated in front of the ridge.

In the figured specimen the truncation is somewhat exaggerated, it is true, but in general it is more developed in internal casts than in specimens with preserved shell.

Size:

	Length	Height	Thickness
S.G.U. Museum	5.5	5.5	2 × 1.7 mm.
R.M. Mo 6745	7.2	6.3	2 × 2.2 "

Remarks. *Protocardia oxynoti* is more circular and more regularly arched than other species of *Protocardia* in the Lower Lias. In *P. philippiana* the radiate striation is confined to the posterior truncated surface, and the shell is more triangular in outline. In *P. truncata* only the posterior part of the striated surface is truncated.

Occurrence. *P. oxynoti* is recorded mainly from the Lias α_3 and β in Germany, and from the *oxynoti* and *armatum* (*raricostatum*) zones in England.

Horizon and Locality. Bed 8, Katslösa.

Protocardia truncata (Sowerby)

Pl. XIV, Figs. 3—5

1827. *Cardium truncatum* Sowerby, Min. Conch. 6, P. 102, Pl. 553, Fig. 3.
1837. *Cardium truncatum* Goldfuss, Petref. Germ. 2, P. 218, Pl. 143, Fig. 10 a—b.
1871. *Protocardia truncata* Brauns, Der untere Jura, P. 325.
1888. " *philippiana* Moberg, Lias i SÖ. Skåne, P. 55, Pl. 2, Figs. 23—24.

Material. 25 specimens in a varying state of preservation.

Remarks. *P. truncata* has a more obvious posterior truncation than *P. oxynoti*, in which respect it is more nearly allied to *P. philippiana*. According to Brauns, it is more flattened than either of these species; the umbo is slightly antemedian and the sculpture coarser, the radiating ribs also being wider and fewer. It should also be much larger. As to the Swedish specimens the size is small, as in all this fauna, and cannot be used as a distinguishing feature. The ribs become gradually finer posteriorly and disappear before reaching the posterior margin, where the surface is smooth; the truncation is slightly developed in specimens with preserved shell, though always well visible, but in internal casts it is strong and well-marked. It embraces only a part of the striated surface, being striated anteriorly and smooth in its posterior part, and there are about five radiating ribs in front of the truncation. The striae are best preserved near the ventral margin. As far as can be seen from figured specimens, this *Protocardia* from Katslösa cannot be distinguished from *P. truncata*. One of the specimens figured by Moberg as *P. philippiana* (1888, Pl. 2, Fig. 23) is quite similar, but in his second specimen the shell is lacking posteriorly, the truncation consequently being rather strong. This is probably why Moberg referred those shells to *P. philippiana*. Moberg also claims that the widening forwards of the radiating ribs distinguishes this species "from *P. truncata* Sow. which in other respects, is closely allied". This feature seems to be overlooked in the descriptions of *Protocardias* and the figures give no help in tracing its occurrence in different species. Anyhow, it is not mentioned in the original description of *P. philippiana* Dunker, nor even able to be seen in the figures, which, however, are not very good. The Swedish specimens of *P. philippiana* and *P. oxynoti* are preserved as internal casts, which show only the anterior ribs. This would suggest a diminishing backwards of the ribs, the most posterior ones probably making no impression upon the internal mould. In specimens of *P. oxynoti* there are indications of very fine ribs in the posterior part of the truncated surface. Accordingly this feature, even if it be present in

P. philippiana, is not restricted to that species. On the contrary, it is well developed, for instance, in *Anisocardia luggudensis*, as mentioned below.

The conclusion is that we must not lay too much stress on the variation in size of the ribs. This being the case, we have to settle, firstly, that the present species is not identical with *P. philippiana* — the latter having a much more pronounced truncation, even more so than in the internal cast figured by MOBERG — and secondly, that it certainly belongs to *P. truncata*, as above mentioned.

Most of the specimens at Katslösa are small, the largest one being of the same size at that figured by MOBERG in his Fig. 23 on Pl. 2. MOBERGS second specimen is considerably larger. In comparing different stages of growth, it is obvious that the specific characters are slightly or hardly developed in young stages but become more and more pronounced with the age. As regards truncation, the young specimens are very similar to *P. oxynoti*, while the large ones come close to *P. philippiana*. But already in the young the radiating ribs cover a part of the surface in front of the truncation. In *P. philippiana* there are no such ribs, in *P. oxynoti* there are two or three, and in *P. truncata* about five.

Anisocardia luggudense shows the same kind of radiate sculpture, but the truncation is hardly visible, and the whole shell is strongly inflated.

Size:	Length	Height	Thickness	Locality
Pl. 14, Fig. 5	5.5	4.5	2 × 1.8 mm.	Katslösa Bed 30
" " 4	6.2	5.3	2 × 2.0 "	" " "
" " 3	7.0	6.3	2 × 2.5 "	" " "
LO 832 t (MOBERG Pl. 2, Fig. 23)	9.5	8.0	2 × 3 "	S.E. Scania
S.G.U. (MOBERG Pl. 2, Fig. 24)	16	15	2 × 5 "	"

The only specimen from 955 b is crushed and broken and is at least 9.5 mm. in length and 9 mm. in height. It is truncated in the posterior part and also radially striated, but the identification remains uncertain.

Occurrence. *P. truncata* ranges through all the Pliensbachian. It has been found by MOBERG in the *jamesoni* zone of S.E. Scania. The Katslösa specimens are from Beds 30 (23 specimens) and 45, and Loc. 955 b.

Family CYPRINIDAE

Genus *Eotrapezium* DOUVILLÉ 1912

Type species: *Mesodesma germari* DUNKER 1846

Mesodesma germari of the Lower Liassic rocks at Halberstadt was well illustrated by DUNKER and has been studied in detail — especially as to the hinge-line — by several authors, who have referred it to different genera of the families *Cyrenidae* or *Cyprinidae*. Thus it has been ranged with *Cyrena* (BRAUNS 1871), *Cypricardia* (PHILIPPI 1897), and *Isocyprina* (BÖHM 1901, ROLLIER 1913, ARKELL

1934). In 1912, too, it was represented by DOUVILLÉ as the type species of a new genus *Eotrapezium*. ARKELL, however, protested that this was based on ignorance of the existence of *Isocyprina*. It is true that the type has the same hinge as *Isocyprina*, but, as pointed out by COX (1947), it differs in external shape from other genera of the *Cyprinidae*. Thus, the genus *Eotrapezium* seems to be well founded. It embraces several species described by BÖHM from the Lias α of Portugal, *e. g. Cypricardia porrecta* DUMORTIER. Four species of *Eotrapezium* have been identified in the Lower Lias of Sweden. In examining the generic characters of these species — mostly badly preserved — the author has collaborated with Professor NILS ODHNER, who has given much help in understanding the hinge-line of *Eotrapezium pullastra* and *E. héberti*.

Eotrapezium germari (DUNKER)

1846. *Mesodesma Germari* DUNKER, Palaeontographica 1, P. 40, Pl. 6, Figs. 20—22.
1871. *Cyrena Germari* BRAUNS, Untere Jura, P. 319.
1878. Osäker bivalv (uncertain bivalve) LUNDGREN, Studier, P. 56, Fig. 78.
1881. *Mesodesma Germari* LUNDGREN, Molluskfaunan, P. 44.
1897. *Cypricardia Germari* PHILIPPI, Zeitschr. d. d. geol. Ges. 49, P. 441, Pl. 16, Fig. 4.
1901. *Isocyprina Germari* BÖHM, Zeitschr. d. d. geol. Ges. 53, P. 242, Text-Figs. 22—28, Pl. 10, Figs. 5—8.
1912. *Eotrapezium Germari* DOUVILLÉ, Bull. Soc. géol. France. (4) 12, P. 455, Text-Figs. 38—39.
1913. *Isocyprina Germari* ROLLIER, Mém. Soc. Paléont. Suisse, 39. P. 157.
1934. *Isocyprina germari* ARKELL, Brit. Corallian Lamellibranchia, P. 264.
1947. *Eotrapezium germari* COX, Proc. Malac. Soc. London, 27. P. 144, Fig. 1.

Remarks. In 1878 LUNDGREN figured an "uncertain bivalve" from a pebble of the *Pullastra* Bank, but later on (1881) he found better specimens which enabled him to recognize *Mesodesma germari*. *E. pullastra* differs from this in having a well-marked ridge running from the umbo backwards, which is only slightly indicated in *E. germari* and hardly at all in *E. héberti*. The latter two species are closely allied, but the former has a slight ridge and is proportionately shorter. as far as can be seen from the original figures given by DUNKER. However, BÖHM has figured Portuguese specimens of *E. germari* with a ridge and an outline rather similar to those in *E. pullastra*, though different from the figure given by DUNKER. Since the present writer has had no opportunity of making a comparison with the holotype, he is unable to decide whether or not BÖHM has figured a true *E. germari*.

Horizon. The *Pullastra* Bank at Helsingborg (Ramlösa) and south of Höganäs (Esperöd).

Eotrapezium pullastra nov. sp.

1869. *Pullastra elongata* HÉBERT, Ann. Sci. géol. 1, P. 134, Pl. 2, Figs. 21, 22.
1870. *Pullastra elongata* HÉBERT, Bull. Soc. géol. France (2) 27, P. 366.
1878. *Pullastra elongata* LUNDGREN, Studier, P. 51, Figs. 1, 2, 80, (*non* 81).
1881. *Pullastra elongata* LUNDGREN, Molluskfaunan, P. 43.
1911—1915. *Pullastra elongata* ERDMANN, Sv. geol. unders. (Ca) 6, P. 25, Text-Fig. 21.

Non 1861. *Axinus elongatus* MOORE, Q.J.G.S. 17, P. 503, Pl. 15, Fig. 18.
Non 1864. *Pullastra elongata* MARTIN, Mém. de l'Acad. Dijon (2) 12, Pp. 227, 277, Pl. 3, Fig. 3.
1948. *Eotrapezium pullastra* TROEDSSON, G.F.F. 70, Pp. 538, 549.

Diagnosis. Shell subtriangular, elongate, keeled; surface with concentric lines. Lateral and cardinal teeth as in *Eotrapezium.*

Holotype: LO 307 T (LUNDGREN, 1878, Fig. 1).

Description. Outline subtriangular, ventral margin gently curved, anterior margin straight in the upper part, curving downwards into the ventral one; dorsal margin about twice as long as the anterior, slightly curved in its posterior part, where it joins the ventral margin in an acute curvature. Umbo low, continued posteriorly by a sharp ridge running towards the posterior end of the shell. Surface covered with fine concentric lines of growth. Hinge-line not visible in the holotype, but in other specimens. Prof. ODHNER succeeded in uncovering the teeth. In a right valve there is one long posterior lateral tooth, one anterior lateral, and one cardinal, thus indicating the genus *Eotrapezium* DOUVILLÉ.

Size. Specimens figured by LUNDGREN (1878):

	Length	Height	Thickness
Fig. 1 (LO 307 T)	12.7	6.8	2 × 1.7 mm.
Fig. 2 (LO 308 t)	12.5	6.6	2 × 1.7 "
Fig. 80 (R.M.)	12	6.8	2 × 2.5 "

Remarks. *Eotrapezium pullastra* is easily recognizable on account of its elongate, triangular outline and its keeled surface. The specimens figured by LUNDGREN (1878) under the heading of *P. elongata* show some variation which might indicate specific differences. Thus, the type specimen of his Fig. 80 differs in the position of the umbo, which is more posterior than in the holotype, the preumbonal portion being rather large.

E. pullastra is the leading fossil of the so-called *Pullastra* Bank of the Lower Lias of Sweden and was recorded for the first time by E. HÉBERT who visited the Rhaetic-Liassic parts of Sweden in 1865 (1869) and identified this fossil with the Rhaetic *Axinus elongatus* MOORE from Beer Crowcombe, though he followed MARTIN in ranging it with the genus *Pullastra.* As already pointed out by LUNDGREN (1878), who had had the occasion of comparing the Swedish specimens with the types preserved in the Museum at Bath, there are marked differences between these forms. The English form is smaller and tapers backwards more, the umbones are placed more to the front, and the keel is less conspicuous. These distinctions would be enough to distinguish a new species. As is evident from the above description, the generic name, too, has to be changed. In an earlier paper the writer proposed the new name of *Eotrapezium pullastra.*

The mistake in identification made by HÉBERT and LUNDGREN has caused much trouble with respect to the stratigraphy. For more than 60 years the so-called *Pullastra* Bank was considered to be Rhaetic. In 1934 the present writer claimed it to be Liassic on geological grounds, and recently (1948) he has shown that the fauna is Early Liassic, not Rhaetic, in age.

D i s t r i b u t i o n. *Eotrapezium pullastra* seems to be restricted to a rather limited horizon of the Lower Lias of Sweden, viz. the *Pullastra* Bank, in the lower part of the Helsingborg Stage (Hettangian). It has been met with at all places where that bank has been identified: at Ramlösa (several localities), Helsingborg, Esperöd (S. of Höganäs), and in drilling-cores at Farhult, Oregården, Rosendal, and Stabbarp.

Eotrapezium héberti (LUNDGREN)

1869. *Pullastra*? sp. HÉBERT, Ann. Sci. géol. 1, P. 136, Pl. 2, Fig. 23.
1878. *Pullastra Héberti* LUNDGREN, Studier, P. 52, Figs. 3, 4, 89.
1881. *Pullastra Héberti* LUNDGREN, Molluskfaunan, P. 44.

O r i g i n a l d i a g n o s i s. "Testa rotundato-oblonga, antice rotundata, postice attenuata, umbones antici satis prominentes; lunula distincta."

H o l o t y p e: LO 311 T (LUNDGREN 1878, Fig. 3).

S i z e. Specimens figured by LUNDGREN in 1878:

	Length	Height	Thickness
Fig. 81 (R.M.)	12.1	7.2	2 × 2.3 mm.
Fig. 89 (R.M.)	16.5	9.4	2 × 3 "
Fig. 3 (LO 311 T)	22.2	11.8	2 × 2.4 "
Fig. 4 (LO 312 t)	23	9.7	2 × 2.8 "

The varying proportions are largely due to the method of preservation. It is especially difficult to get an idea of the thickness on account of compression.

R e m a r k s. *E. héberti* differs from the genotype in being slightly longer in proportion to the height. Furthermore, the ridge or carina, from the umbo backwards, is still less pronounced. The umbo is placed near the anterior end, and the preumbonal margin dips directly towards the ventral margin, being only slightly sigmoid. The affinity to the genotype is very close, indeed, and it is an open question whether these two species really can be kept separate. *E. germari* is generally considered to be higher. According to DUNKER it has the relative proportions of 100 : 60 : 40, while typical specimens of *E. héberti* have the proportions 100 : 53 : 38. But there are all variations between, and even the specimens of the holotype, figured by DUNKER, show some variation.

E. pullastra has the same relative proportions as *E. héberti*, but is distinguished on account of its carinated shell. As a rule the Scanian specimens of *E. héberti* are larger, and this has probably induced LUNDGREN to range the small specimens with *E. pullastra*. Thus his Fig. 81 on Pl. 2 (1878) is not *E. pullastra*, but *E. héberti*. It is an internal mould, devoid of keel, but coincides with *E. pullastra* as regards size.

O c c u r r e n c e. *Eotrapezium héberti* occurs in the *Pullastra* Bank of the Lower Helsingborg Stage. It has been recognized at several localities in the southern part of Helsingborg (Ramlösa, &c.), at Allerum (N. of Helsingborg), and at Esperöd (S. of Höganäs).

Eotrapezium menkei (DUNKER)

Pl. IV, Figs. 4—7

1846. *Cyrena Menkei* DUNKER, Palaeontographica, P. 40, Pl. 6, Figs. 23—25.
1871. " " BRAUNS, Untere Jura, P. 318.
1897. *Cypricardia Menkei* PHILIPPI, Zeitschr. d. d. geol. Ges. 49, P. 441.
1901. *Isocyprina Menkei* BÖHM, Zeitschr. d. d. geol. Ges. 53, P. 238, Figs. 19—21.
1913. " " ROLLIER, Mém. Soc. paléont. Suisse. 39, P. 157.

Material. About 30 specimens all more or less deformed.

Description. Shelled specimens (Ö. Ramlösa) coincide well with the figures given by DUNKER, as far as concerns the external characters, such as size, outline, proportions, shell surface, &c. Even the same variation is represented by the Swedish specimens. But the hinge is not well preserved. — Internal casts from Fleninge have a rough surface and are deformed, too, though rather inflated. An umbonal ridge, well defined anteriorly in its upper part, continues obliquely backwards until about one-third or the middle of the shell, where it becomes effaced. Surface with concentric growth lines. Hinge-line not visible, but there are indications of long posterior-lateral teeth in the cast. Outline and general shape are precisely the same as in *Cyrena menkei* DUNKER and show the same variations. The identification being founded mainly upon this external character remains, of course, uncertain, but is favoured by the fact that there are no other lamellibranchs with the same external features in the Lower Lias, as far as is known hitherto.

Size:	Length	Height	Thickness (of both valves)	
Pl. IV, Fig. 5	14.5	12.3	9.3 mm.	(100 : 85 : 64)
" " 6	15.1	10.7	8.0 "	(100 : 71 : 53)
" " 4	18	13.1	8.9 "	(100 : 73 : 49)
Ö. Ramlösa	19.5	14.4		(100 : 74)

Horizon and Locality. The internal casts are from the core-drilling No. 266 at Fleninge at a depth of 106.67 m. or 47 m. above the Rhaetic-Liassic boundary, and from a loose sandstone at Esperöd, S. of Höganäs. The shelled specimens are from the shell breccia pebbles found at Ö. Ramlösa. All specimens belong to the *Pullastra* Bank.

Genus *Anisocardia* MUN.-CHALMAS

Anisocardia luggudensis n. sp.

Pl. XIV, Figs. 1 a—c

Holotype. S.G.U. Museum.

Mode of preservation: Internal cast of entire specimen, with remnants of the shell. The valves are partly separated, but close together at the umbo. Hinge accordingly hidden.

Description. Shell tumid, high, oval or subtriangular in outline, equivalve, inequilateral. Umbones prominent, forwardly directed. Hinge partially visible. Left valve: two divergent cardinals separated by a deep pit, the anterior one strong and hardly separated from the rudimentary anterior lateral. The pit between the divergent cardinals is bounded inwards by a high, pointed, cone-shaped tooth, joined at its base with the anterior lateral; posterior part of hinge hidden in the rock. Right valve: only a thin posterior lateral tooth visible, separated from the margin by a narrow groove. Surface of shell with a dense striation of growth-lines and with vertical striae or ribs in the posterior part. These are broad and flat anteriorly, separated by narrow furrows; towards the posterior margin the ribs gradually become narrower and the furrows wider. The vertically striated portion is slightly concave in cross section and bounded anteriorly by a blunt and low ridge, running from the umbo towards the ventral margin.

Material. Except the holotype, one internal cast and two external moulds have been referred tentatively to this species.

Size of the holotype. Height 23, length 22.4, thickness of both valves 18.2 mm.

Remarks. The hinge of this species seems to be most similar to that in *Anisocardia*, though some shell features indicate a relation to the *Cardiidae*, especially the genus *Protocardia*, for instance, the cone-shaped tooth referred to above, and the vertical striation of the posterior part of the shell. Its reference to *Anisocardia* is of course, only tentative, and is mainly due to its external similarity to *Anisocardia globosa* (Roemer) of the Corallian beds (Upper Jurassic). The latter has the same vertical striation, but the striated portion is truncated, the shell more globose, and the dentition more typical.

No other species of this genus has been met with hitherto in the Lias of Sweden.

Occurrence. The holotype has been collected at Katslösa 825 (Bed 28). Additional, badly preserved casts, have been found at Katslösa 875—955 in Beds 36, 39, and 42.

Family PHOLADOMYIDAE

Genus *Pholadomya* G. B. Sowerby

Pholadomya coticulae (Lundgren)

Pl. V, Fig. 4 (Cf. also Pl. XII, Figs. 1 and 3)

1878. *Myacites* sp. Lundgren, Studier, P. 55, Fig. 74.
1881. *Modiola coticulae* Lundgren, p. p., Molluskfaunan, P. 36, Pl. 1, Fig. 6 (*non* Figs. 7—8).

Original diagnosis. Testa fabiformis, striis et rugis concentricis praedita; regio anterior satis magna, regio pallealis sinu exiguo notata.

Holotype. LO 425 T (Lundgren 1881, Fig. 6).

Material. Four additional specimens, slightly aberrant.

Size:

	Holotype	Mo 6758	Mo 6790	—
Length	27.3	33.2	34.9	35.6 mm.
Height	14.5	17.0	17.8	18.2 "
Thickness	—	9.0	11.2	— "

Remarks. Under the head of *Modiola coticulae*, LUNDGREN figured three specimens from the Grind sandstone at Pålsjö, all of which, at first sight, seem to be specifically different. Thus his first specimen (LO 425 T) — the holotype — has very fine, radiating furrows on the posterior part of the shell, similar to those in *Pholadomya*, though especially weak. They are not visible in the figure given by LUNDGREN. The umbo is placed at one-third the shell length from the anterior end, and does not project beyond the dorsal margin, which, then, forms a strongly curved line from one end of the shell to the other. The ventral margin is slightly concave; growth-lines are thin; height of shell is at maximum behind the umbo. There is an indication of angularity between the posterior and dorsal margins.

In LUNDGREN's Figs. 7 and 8 the umbo is placed closer to the anterior end and is more projecting. His Fig. 7 has a straight dorsal margin, which forms an obtuse angle with the posterior one; ventral margin slightly convex. In his Fig. 8 the margins are somewhat different, but this is due to damage, as is shown by the preserved type. Consequently the specimens Figs. 7 and 8 belong to one and the same species and are referred above to *Cardinia* (?) *expansa* (LUNDGREN).

Pholadomya coticulae is recognized on account of the faint radiating folds and furrows, which range it with the genus *Pholadomya*. Other, better preserved specimens, showing the same feature have been collected in the reddish or brown "Pebble No. 1" from Höganäs. They show the same concentric striation as *P. coticulae* and the same position of the umbones. But the shell is more inflated and the umbones are more projecting, thus giving a rather different aspect of the dorsal outline. These differences, being only partly owing to the mode of preservation, may have specific value. The lunule and the escutcheon as well as the external ligament area are well visible behind the umbones. In one specimen the right valve projects beyond the left one; in another the valves have moved reversely. This indicates the absence of teeth or other processes apt to keep the valves in their right position.

The ranging of these specimens with the genus *Pholadomya* is mainly founded on the weak radiating sculpture of the shell surface, it is true, but, as seen from the above remarks, this identification is supported by other characters obtained from the available material.

Occurrence. *Pholadomya coticulae* has been met with in the *Cardinia* Bank at Pålsjö. Uncertain specimens were found in "Pebbles No. 1" at Höganäs.

Genus *Platymya* AGASSIZ

Platymya aquarum (LUNDGREN)

Pl. XII, Fig. 2

1878. *Pleuromya striatula* LUNDGREN (*pro parte*), Studier, P. 55, Fig. 75 (*non* Figs. 49 and 50).
1881. *Pleuromya aquarum* LUNDGREN, Molluskfaunan, P. 46, Pl. 1, Figs. 10—12.

Material. Four specimens.

Original diagnosis. "Testa anterius et posterius aequaliter rotundata; umbones prominentes, antemediani; pars anterior posteriore paullo minor."

Holotype. LO 428 T (Paleontological Institute, Lund).

Description. Shell elongate, length about twice the height. Umbo rather prominent, situated at one-third the length from the anterior end. Hinge without teeth. Ligament external, behind the umbo, supported by well developed nymphs. Lunule ovate, well defined, escutcheon wide, bounded by a diffuse ridge on each valve. Dorsal margin in front of the umbo straight or slightly convex, dipping forwards, that behind the umbo concave; anterior and posterior ends well rounded, ventral margin convex, parallel to the growth-lines. Shell surface with growth-lines, crossed by very faint radiating striae.

Size:	LO 428 T	LO 429 t	LO 430 t	Mo 6759
Length	25	25	25	41 mm.
Height	13	13	13	20 "

Remarks. This species is closely allied to *Platymya subrugosa* DUNKER (*sub Thracia*), syn. *Pleuromya dunkeri* PIETTE, from the Hettangian of Halberstadt and Hettange. It was founded upon three specimens from the *Pullastra* Bank at Ramlösa. In one of the original figures (LUNDGREN, l. c., Fig. 11) there is a central depression running from the umbo towards the ventral margin. This, however, is not visible in the type specimen, which is rather fragmentary. The ranging with the genus *Platymya* seems to be well-founded on account of the hinge region.

One of the specimens, referred by LUNDGREN to *Pleuromya striatula*, viz. that collected in his "Pebble No. 1" at Höganäs, belongs undoubtedly here.

Horizon. The lower part of the Helsingborg Stage.

Localities. In the *Pullastra* Bank at Ramlösa and in "Pebble No. 1" at Höganäs together with *Liostrea hisingeri* and an external mould of *Cardinia follini.*

Genus *Homomya* AGASSIZ

Since most of the *Myas* of the pure sandstones are preserved as internal casts (Steinkerns) the author had to rely, to a great extent, upon the studies of this group undertaken by GISELA BENDER (1921). The following species are referred to the genus *Homomya* mainly on account of the edentulous hinge and the position of the umbo.

Homomya ovalis (LUNDGREN)

Pl. IV, Fig. 8

1869. *Anatina Stoppanii* HÉBERT, Ann. Sci. géol. T. 1, P. 138, Pl. 2, Fig. 29 (excl. synonyms); *non* MARTIN 1864.
1878. *Myacites ovalis* LUNDGREN, Studier, P. 53, Fig. 8.
1878. *Myacites elongatus* LUNDGREN, ibid. P. 54, Fig. 13.
1878. *Myacites* sp. LUNDGREN, ibid. P. 55, Fig. 76.
1881. *Myacites elongatus* LUNDGREN, Molluskfaunan, P. 47.
Non Myacites elongatus v. SCHLOTHEIM.
Non Lutraria elongata GOLDFUSS.

Material. 3 internal casts.

Holotype. LO 318 T (Paleontol. Inst. Lund). This is an internal cast, rather badly preserved.

Description. Outline subovate, concave in front of the umbo. Umbo inflated, projecting slightly beyond the dorsal margin, situated at two-fifths the length from the anterior end of the shell.

Size:

	Holotype	Mo 6765	LO 319 T
Length	12.5	16.5	20.4 mm.
Height	7	9.5	10.7 "

Remarks. The species *Anatina stoppanii* Hébert (preoccupied) was founded upon a badly figured lamellibranch from the Helsingborg region. Later on Lundgren replaced the name by *Myacites ovalis* and figured a new specimen (LO 318 T) which, however, seems to differ somewhat from that figured by Hébert. The latter is narrower and more elongate. Accordingly Lundgren's type specimen is here chosen as the holotype of *Myacites ovalis.*

The *Myacites elongatus*, described by Lundgren as a new and rare species in the *Pullastra* Beds of Sweden, is probably indistinguishable from his *Myacites ovalis.* It has the same position of the umbo and the same general outline, though both figured specimens are badly preserved internal casts. Lundgren was unaware that the specific name *elongatus* was already preoccupied in 1822.

The *Myacites* sp. Lundgren 1878, Fig. 76, belongs here too.

Occurrence. *Homomya ovata* was collected in the *Pullastra* Bank at Ramlösa.

Homomya venulithus n. sp.

Pl. XII, Figs. 4—17; Pl. XIII, Figs. 2—3

1831. *Venulith* Nilsson, K. Vet. Akad. Handl. P. 355, Pl. 4, Fig. 6.
1837. *Venus*? Hisinger, Lethaea suecica, P. 65, Pl. 19, Fig. 10.
1878. *Pleuromya striatula* Lundgren, Studier (*pro parte*), P. 55, Figs. 49, 50 (*non* Fig. 75).
? 1878. *Myacites* sp. Lundgren, ibid., P. 54, Fig. 41.

Holotype. LO 145, left valve. Paleontological Institute, Lund. Pl. XII, Fig. 8.

Diagnosis. Umbo at one-third or two-fifths of the shell-length from the anterior end, rather broad and flattened, somewhat projecting, the preumbonal dorsal margin being concave, the postumbonal one sigmoid: slightly concave near the umbo then convex before the broadly-rounded posterior end. Ventral margin well curved. Postumbonal portion of the shell distinctly higher than that in front of the umbo. From the umbo a gentle flat depression extends obliquely forwards to the ventral margin. A rounded ridge runs from the umbo obliquely backwards but is effaced before reaching the postero-ventral corner. The surface is covered with concentric growth-lines of varying strength.

Size. Length of holotype 37 mm., height 18 mm.

Remarks. According to Lundgren his *Pleuromya striatula* was met with in the *Avicula* Bank at Kulla Gunnarstorp, and in "Pebble No. 1" at Höganäs. The latter quotation, however, is incorrect and concerns a specimen belonging to *Platymya aquarum* (LUNDGREN), as referred to under the head of the latter species.

The specimens from Kulla Gunnarstorp — the *Avicula* Bank — are not well preserved. That figured by SVEN NILSSON as "*Venulith*" was later identified, only with the aid of this figure, by K. VON FRITSCH as *Pleuromya striatula* AGASSIZ, and this was confirmed by LUNDGREN. The Swedish specimens, however, are quite different, the umbo being placed nearer to the middle and less projecting, and the general shape more elongate.

To this species probably also belongs the *Myacites* sp. figured by LUNDGREN (1878, Fig. 41) from the *Avicula* Bank at Kulla Gunnarstorp. It is, however, incomplete, and not quite determinable.

The shell breccia, Bed 8, at Katslösa contains thousands of specimens, which I have identified with *H. venulithus* in spite of their smaller size. They are mostly crushed and deformed, which has caused a secondary dissimilarity as to outline. Thus in most specimens the umbo is more projecting than in the holotype, causing a markedly concave outline of the dorsal margin on both sides of the umbo. In order to show these secondary features, nine entire specimens have been figured on both sides. Only one specimen in the whole collection (Pl. XIII, Fig. 3) has attained a size similar to that found in the *Avicula* Bank, but it is pressed and broken. The test seems to have been thin and fragile and has not yet been found in any specimen, except for some fragments in the last one near the margin. The small size and thinness of the valves characterize all the fauna in this bed at Katslösa — cf. for instance *Oxytoma sinemuriensis*, the *Entolium* specimens and many others — and is owing to the facies.

The Katslösa specimens, in spite of only having been preserved as internal casts, provide some additional features to the above diagnosis. The shell gapes at both ends, especially the back one. The posterior part of the shell surface has a dorsal excavation, bounded ventrally by an obtuse ridge which runs from the umbo backwards and downwards, and is effaced before reaching the postero-ventral corner. No traces of teeth or tooth-like bosses have been found. In the complete internal casts both valves are largely disturbed or dislocated, either the right or the left one being projected dorsad beyond the other. This indicates edentulous hinge. The postumbonal part of the hinge has a narrow, flat depression bounded on each side by a low ridge, corresponding to the external ligament fossa and the nymphs and indicating a very thin shell.

On account of the thinness of the shell the growth-lines are always impressed upon the internal casts, thus destroying the inside shell sculpture.

Size of Katslösa specimens:

		Length	Height	Thickness
Pl. XII,	Fig. 9	16.1	9.3	5.0 mm.
"	" 10	19.1	10.4	6.0 "
"	" 11	17.8	9.0	5.0 "
"	" 12	17.6	8.8	4.7 "
"	" 13	19.6	10.8	5.1 "
"	" 14	20.5	11.3	6.6 "
"	" 15	21.7	11.6	6.1 "
"	" 16	24.2	12.3	6.6 "
"	" 17	25	14	7.5 "
Pl. XIII,	" 3	41	20	— "

The largest specimen is 41 mm. long, but its identification is not certain. As a rule, the length does not exceed 25 mm. the average being about 20 mm.; the height is slightly more than half as much, and the thickness scarcely exceeds half the height.

H. venulithus is similar to *Platymya aquarum*, but differs in its more rounded ventral margin and more projecting umbo, the preumbonal dorsal margin always being concave in *P. venulithus*, and straight in *P. aquarum.*

Homomya librata MOBERG is shorter in proportion to the height and is devoid of the oblique ridge behind the umbo.

Occurrence. *H. venulithus* is restricted to the Döshult Stage. It has long been known from the *Avicula* Bank at Kulla Gunnarstorp and has recently been found in profusion in the *Myacid* or *Homomya* Bank at Katslösa 700 (Bed 8), where it forms the main part of the shell breccia, together with the plentiful but less frequent *Oxytoma sinemuriensis*, *Entolium* spp., and a small gastropod. Young stages, probably belonging to *H. venulithus*, occur in a great number, sometimes with the shell preserved in pyrite.

Homomya centralis n. sp.

Pl. XIV, Fig. 6

Holotype. S.G.U. Museum.

Material. Seven specimens identified, most of them collected in a hard, unweathered calcareous sandstone and accordingly in a good state of preservation. In some specimens the test is changed into pyrite and shows the external features quite well.

Description. Shell almost subtriangular, equilateral. Umbo situated near the middle of the dorsal line, rather inflated and dominates the shell; it projects beyond the margin and is bounded by a rather strong posterior and a less marked anterior ridge, which give the subtriangular aspect of the shell. The ridges diverge at 105° and disappear before reaching the posterior margin. Hinge-line almost straight but rather short. Ventral margin semicircular. Test thin. Surface with a faint concentric striation of growth-lines.

Size of holotype. Length 12.5, height 8.0, and thickness 3.2 mm.

Remarks. The proportions are the same as those in *Myacites ovalis* LUNDGREN, and there is no doubt that these species are closely allied, but the present form differs in its strongly inflated umbo and its well developed posterior ridge.

Occurrence. *Homomya centralis* is a rare species in the shell breccia at Katslösa 700.

Homomya librata MOBERG

1888. *Pleuromya librata* MOBERG, Lias i SÖ. Skåne, P. 57, Pl. 2, Figs. 27—28.

Original description. Elongate, sub-quadrangular, with projecting umbo. Hinge-line not quite straight; ventral margin slightly curved; posterior part of shell almost twice as long as the anterior, relatively thick, with sub-parallel margins, posterior end rounded. Umbo large, broad, strongly bent forwards, apex not visible. From the umbo a rounded but well-developed ridge runs towards the postero-ventral corner. Anterior end is almost half elliptical. Lunule hardly visible. Escutcheon tall, rather narrow. Shell thin, with a number of concentric folds and striae, and probably gaping slightly in the posterior end.

Size:	Length	Height	Thickness	
Holotype	37	22	2 × 8 mm.	
Cotype	22	14	2 × 5.5 "	
S.G.U. Museum				
(Katslösa)	21	13.3	2 × 3.5 "	(specimen somewhat compressed).

Material. Only one specimen and a few fragments of this species have been met with at Katslösa, where it seems to be rare.

Horizon and Localities. *H. librata* was described from the *jamesoni* zone at Kurremölla (S.E. Scania). The present specimens are from Beds 30 and 42 at Katslösa.

Genus *Arcomya* AGASSIZ

Arcomya decora n. sp.

Pl. XIII, Fig. 11

Material. 3 specimens, internal casts.

Holotype. The figured specimen (S.G.U. Museum).

Description. Shell equivalve, inequilateral, elongate, sub-rectangular. Umbo low, strongly curved inwards, almost median. Hinge-line not visible. Escutcheon well developed, smooth, widens backwards, and is bounded laterally by a strong ridge which runs from the umbo obliquely backwards towards the postero-ventral corner where it becomes rounded and tends to be effaced. The remaining part of the shell surface is covered with strong, regular, concentric ridges which become more and more crowded toward the umbo and gradually disappear backwards toward the escutcheon. A shallow lateral impression below the umbo is visible in young specimens but not in the adult.

Size:	Length	Height	Thickness
The holotype	18.7	7.8	3.4 × 2 mm.
Mo 6565	4	2	— "

Remarks. *Arcomya decora* n. sp. is as elongate as *A. elongata*, but in the latter the oblique ridge is more rounded and the escutcheon has the same sculpture as the remaining part of the shell surface.

Horizon and Localities. In the Middle Katslösa Stage at Katslösa 840 and 850 (Beds 30 and 32).

Arcomya cf. *elongata* Agassiz

Pl. XII, Fig. 18; Pl. XIII, Fig. 10

Cf. 1845. *Arcomya elongata* Agassiz, Monogr. Myes, P. 179, Pl. 10^1, Figs. 2—5.

Material. The figured specimens.

Description. Mo 6550 is a laterally compressed left valve, rather incomplete. Shell thin, covered with a dense concentric striation and coarse concentric ribs. The latter, well developed also on the internal cast, are crowded at the umbo but the distance between them gradually widens peripherically. Umbo near the anterior end.

The other specimen (Pl. XII, Fig. 18) is a fragment of the anterior portion of a left valve with the original arching of the umbonal region and the same characteristic sculpture as in Mo 6550.

Remarks. These specimens are certainly related and seem, in turn, to be allied to *Arcomya elongata* Ag. They differ in having fewer and more dispersed concentric ribs. The bad state of preservation does not allow of any closer comparison.

Horizon and locality. In the ferruginous sandstone Bed 30 at Katslösa.

Genus *Pleuromya* Agassiz

Pleuromya forchhammeri Lundgren

Pl. XIII, Figs. 4—8

1837. *Amphidesma donaciforme* Forchhammer, Bornh. Kulf. P. 49 (*non* Phillips).
1879. *Pleuromya forchhammeri* Lundgren, Juraform. på Bornholm, P. 25, Figs. 4—10.
1879. " *tenuis* Lundgren, ibid., P. 26, Fig. 11.
1888. " *forchhammeri* Moberg, Lias i SÖ. Skåne, P. 56, Pl. 2, Figs. 25, 26.
1909. " " Malling og Grönwall, Medd. D.G.F. Vol. 3, P. 285.

Material. Twenty specimens, mostly internal casts.

Description. Shell short and high, posterior margin broadly rounded, ventral margin gently curved. In lateral view the umbo projects beyond the dorsal margin, causing a markedly concave dorsal outline in front of the umbo. Hinge-line straight and scarcely half as long as the shell. Umbo placed near the front. From umbo a rounded ridge runs towards the postero-ventral corner but disappears half-way; it is bounded dorsally by a shallow excavation. Rather coarse concentric impressions of growth-lines on the internal cast, also on the umbo. In one specimen (S.G.U. Museum) the test is preserved. It is very thin and shows concentric striae, which are very fine in the umbonal but rather strong in the peripheric region.

Size:	Length	Height	Thickness
Pl. XIII, Fig. 8	23	14.5	4.7 × 2 mm.
Mo 6655	20.1	13.3	— "
S.G.U. Museum	19.25	12.8	3.7 × 2 " (crushed)
Pl. XIII, Fig. 6	11.8	7.4	— "
Mo 6656	11.2	6.9	— "
Lundgren Fig. 4—5	30.7	18.5	12.2 (6.1 × 2) mm.
" " 6	37	17.2	— "
" " 7	—	19.8	15.5 (7.75 × 2) "
" " 8	30	18	— "

Remarks. The Katslösa specimens coincide in every respect with those described by Lundgren from Bornholm. At a first glance they seem to be flatter but this is owing to crushing. Specimens with the original arching, for instance the first one above in the table, cannot be distinguished specifically from the Bornholm species.

Pleuromya crassa Ag. and *P. galathea* Ag. are two species in the Lias α_3 which are certainly allied to *P. forchhammeri* but taper regularly backwards, while the latter is rather high backwards, the dorsal and ventral margins being almost parallel.

Distribution. *P. forchhammeri* was met with before in the *jamesoni* zone on the island of Bornholm and in S.E. Scania. In N.W. Scania it has only been found in the Döshult Stage. Except an uncertain fragment in a pebble, probably derived from the *Avicula* Bank, the species seems to be restricted to Bed 8, Katslösa.

Pleuromya corrugata n. sp.

Pl. XIII, Figs. (1?), 9, and 12

Material. Three specimens; the holotype (S.G.U. Museum. Pl. XIII, Fig. 9) is incomplete in the posterior end; the other two are laterally compressed.

Description. Shell equivalve, inequilateral, inflated, gapes at both ends. Umbones well curved inwards, though not in contact, only slightly projecting, situated at one-third the shell length from the anterior end. Posterior dorsal margin straight, dipping regularly backward, anterior dorsal margin slightly concave with a steep dip forwards. Behind the umbo there is a deep narrow sulcus for the ligament. Lunule wide with diffuse margins. Surface covered with strong concentric wrinkles. In all specimens the right valve is projected dorsad beyond the left one after embedding.

The fragmentary specimen, Pl. XIII, Fig. 1, may belong to another species.

Size:	Holotype (incomplete)	Mo 6559 (laterally compressed)
Length	> 25.8	41 mm.
Height	17.3	18 "
Thickness	12.3	> 9.7 "

Remarks. *P. corrugata* n. sp. comes in the vicinity of species like *P. unioïdes* (RÖMER) or *P. elongata* AGASSIZ, as far as concerns the sculpture of the shell surface, but it is more elongate and has a less outstanding umbo.

Horizon and locality. The Middle Katslösa Stage at Katslösa, Bed 30 (loc. 840). The questionable fragment is from Bed 8 at Katslösa.

Genus *Goniomya* AGASSIZ

Goniomya heteropleura AGASSIZ

Pl. X, Fig. 16

1845. *Goniomya heteropleura* AGASSIZ, Monogr. Myes. P. 24, Pl. 1 d, Figs. 9—10.
1858. *Myacites rhombiferus* QUENSTEDT, Jura, P. 82, Pl. 10, Fig. 5.
1871. *Goniomya heteropleura* BRAUNS, Untere Jura, P. 308.

Material. One specimen Mo 6295 (Riksmuseum), the only one met with in Sweden hitherto.

Remarks. *Goniomya heteropleura*, easily recognized on account of its horizontally intervening rib portions, has its widest distribution in N.W. Germany, where it occurs from the very base of the Lias up to the *Amaltheus* Beds. In Swabia, the Rhône basin, and Yorkshire it is known only from the Arieten-Lias or the *bucklandi* zone, in East France also from the *angulatus* zone. The latest occurrence seems to be in the *spinatus* zone of England.

Horizon and locality. The sole Swedish specimen is from Katslösa 840 (Bed 30).

Family PTERIIDAE

Genus *Oxytoma* MEEK

Oxytoma sinemuriensis D'ORB.

Pl. IX, Figs. 1—11; Pl. X, Figs. 1—10

1832. *Avicula inaequivalvis* NILSSON, Djur-Petrifikater funna i Skånes Stenkolsbildning, P. 354, Pl. IV, Fig. 1.
1850. *Avicula sinemuriensis* D'ORBIGNY, Prodrome, 1, 7e ét. P. 219, No. 125.
1869. *Avicula suecica* HÉBERT, Ann. sci. géol. T. 1, P. 126, Pl. 2, Figs. 6—9.
1878. *Avicula sinemuriensis* LUNDGREN, Studier, P. 41, Pl. 1, Figs. 44—46.
1881. *Avicula inaequivalvis* LUNDGREN, Molluskfaunan, P. 30 (pro parte).
1881. *Avicula subinaurita* LUNDGREN, ibid., P. 31, Pl. 1, Fig. 15.

D e s c r i p t i o n. L e f t v a l v e well arched, not very oblique; hinge-line straight behind the umbo, but deflected downwards in front of it. Anterior ear small, bordered outwards by a curved line, posterior one much longer with straight dorsal and concave posterior margin. Shell surface covered with radiating ribs; in the main part of it there are 15—16 coarse primary ribs; the intercostal spaces become gradually broader and in their peripheric portion they have a median secondary rib between which and the primary ones there are one or two thin tertiary ribs. Only the primary ones reach the umbonal part of the shell and they continue, though more crowded, into the ears. On the anterior ear there are about 10 ribs, the foremost ones very thin and closely set; the posterior ear has also closely set, radiating ribs, the uppermost ones, close to and almost parallel to the dorsal margin, being rather prominent. The spaces between the ribs are crossed by a fine concentric striation (probably growth lines), which forms a fine net-work when crossing the tertiary ribs. On the posterior ear the concentric striae are strongly curved in accordance with the curvature of the posterior border. Inside of shell has no concentric striation but shows the radiating ribs, except on the posterior ear, which is smooth as seen on internal casts.

R i g h t v a l v e. Very thin and weak more flattened than the left one, and the radiating ribs are much fainter. As a rule the peripheric parts are missing, owing to the bad development of the nacreous layer. This is thickest in the oldest part of the shell, the umbonal region, but thins out peripherically, and seems to be lacking near the ventral margin. Accordingly, the right valve generally met with is the central or umbonal portion of the shell. This is of course much smaller than the left valve and not at all as common; at loc. 700 Katslösa the ratio of frequency of the right and left valves is as 1 : 4. Since the vertical striation of the right valve is only occasionally developed in the umbonal region, the small valves generally met with at loc. 700 seem to have been quite smooth. In the black shale belonging to the Ammonite Bank in the drilling-core No. 271, Oregården, a great many right valves are preserved, more or less damaged, it is true, but the state of preservation of the sculpture is excellent, and in many specimens also the peripheric part is preserved. Such complete right valves are as large as the left ones. The number of ribs is the same as in the left valve, but the ribs are lower and wider, and separated by narrow grooves; sometimes they are divided by thin furrows as are also the interspaces in the left valve. The dorsal margin is straight, extending into a large posterior ear, which is provided with three or four straight, thin ribs along the dorsal border; posterior margin concave, excavated, in accordance with the strongly-bent growth lines on the ear. Anterior ear very small, with a narrow and deep sinus. The incomplete umbonal portions generally met with are almost devoid of sculpture, but the straight dorsal and the concave posterior margins are characteristic as is also the small anterior ear with the sinus. — Muscle scar of the interior is well visible in the posterior part of the shell.

R e m a r k s. This species was the first invertebrate fossil identified in the Lias of Sweden. It was met with by Sven Nilsson at Kulla Gunnarstorp in 1828, demonstrated before a natural history congress in Berlin in the same year, and determined as *Avicula inaequivalvis* Sow., at first mentioned by HOFFMANN (1829) and described and figured by NILSSON in 1831. HÉBERT'S description of *Avicula suecica* was founded upon badly preserved specimens from the same locality (erroneously referred to as Tinkarp in the original description). According to HÉBERT the posterior ear should be smooth, but this interpretation was due to the fact that he had only internal casts at his disposal. In a later paper (1870) he placed his *A. suecica* close to *A. sinemuriensis.* LUNDGREN, in his first paper (1878), went still farther and described *Avicula sinemuriensis* from Kulla Gunnarstorp, regarding *A. suecica* HÉBERT as a synonym, but in his second paper (1881) he went back to SVEN NILSSONS earliest interpretation; and this is why the Swedish *Oxytoma* species of the Döshult Stage has ever since been named *Avicula inaequivalvis* in papers dealing with the *Avicula* and the Ammonite Banks.

In his original description SOWERBY mentions two varieties, α and β, and he figures three shells, viz. Fig. 2 (two shells) and Fig. 3. Under the heading of the description of *Avicula inaequivalvis* he only mentions Fig. 2. It is therefore not clear from the description to which figures the varieties α and β belong: "Var. α is found in the Kelloway's rock; the upper specimens figured [Fig. 2] are from a large mass found at Dursley [Lias]. — — — the other figure [Fig. 3] is from part of a specimen — — — near Kelloway's Bridge." This has caused much confusion to later authors. Thus, there has been a tendency to restrict SOWERBY'S name either to the Callovian form (D'ORBIGNY, ROLLIER) or to that from the Middle Lias (BRAUNS, HÉBERT, WAAGEN). For the Lower Liassic form, figured by GOLDFUSS and ZIETEN, D'ORBIGNY proposed the name *Avicula sinemuriensis.* And ROLLIER (1914, p. 400) has introduced the name *A. phillipsi* for SOWERBY'S Middle Liassic species, thus restricting the term *A. inaequivalvis* to the Callovian form. L. WAAGEN, after a careful study of a great many *Avicula* specimens from various Jurassic horizons, came to the conclusion that all of them were varieties of one and the same species, of which *Oxytoma inaequivalvis* (SOWERBY) was the oldest one described. Among the others he mentions *Avicula sinemuriensis* D'ORBIGNY, *A. suecica* HÉBERT, and *A. subinaurita* LUNDGREN. Mlle. GILLET (1923) has made a similar statement.

In his Monograph on British Corallian Lamellibranchia ARKELL (1933), has given some valuable and welcome information about SOWERBY'S types. From this it is evident that the only one of the preserved types able to be identified with any of his figures (viz. his Fig. 2) is a Middle Liassic specimen. Accordingly ARKELL has designated it as the holotype of *Oxytoma inaequivalvis.* On the other hand, the Kellaways species is described as *Oxytoma expansa*, a name given as early as 1829 by PHILLIPS to a Corallian species which is abundant in the Kellaways.

This latter species is considerably larger than the Liassic *Oxytoma inaequivalvis*; it has a secondary rib in the centre of each interspace separating two primaries as well as a larger number (16—20) of primary ones. "The true *Oxytoma inaequivalvis* from the Middle Lias has only 14 or 15 primary ribs (counting two minute ones at the anterior end), and there are no median ribs of a second order of magnitude in the interspaces." The latter "are covered with very numerous and extremely fine radial threads or riblets (tertiaries). These last ones are the 'striae' of Sowerby" (Arkell, l. c., P. 195).

Returning to the Swedish records of *Oxytoma* we find that this genus is restricted to the upper part of the Höganäs Series. Here it occurs at several horizons, though with its main distribution in the Döshult Stage, where it is especially crowded in two places, viz. at Oregården and Katslösa 700.

In the ferruginous sandstone at Kulla Gunnarstorp, the original *Avicula* Bank of Lundgren, the present writer has found specimens with preserved test, in which the posterior ear has the growth lines crossed by fine radiating ribs. This indicates *Oxytoma sinemuriensis*. And as far as can be gleaned from the collected specimens, there is no other species of *Oxytoma* met with at this locality.

The above description of *O. sinemuriensis* is based upon specimens from the boring at Oregården where, at a depth of 62.88—63.48 m., a veritable *Oxytoma* rock was pierced. This core length of only one metre has yielded thousands of shells of *O. sinemuriensis*. The preservation is unusually good, every detail of the sculpture, even colour bands and other features being intact, but the shells are fragile and easily broken. At a first glance there seemed to be several species, but intensive studies of a great many specimens, right valves as well as left ones, have definitely shown that the dissimilarities are wholly due to the mode of preservation or to differences between growth-stages.

As to the preservation there are both narrow and wide specimens, mostly dependent upon the length of the wing (posterior ear). Yet in all specimens with short wing, the latter has always been broken parallel to a growth line, as is shown by the more or less ragged margin. Lundgren's type specimen of *Avicula subinaurita* is just such a damaged left valve with an extremely short wing, not rudimentary, as suggested by Waagen.

The shells of *Oxytoma* also change distinctly with their age, the ornamentation of the young being made up only of primary ribs, while the secondary and tertiary ones appear in the widening interspaces in later stages. But since this ornamentation furnishes the most important — if not the only — feature for distinguishing different species of this genus in the Lias, it becomes difficult to recognize species like *O. inaequivalvis* and *O. sinemuriensis*, if we only have young specimens before us. This is really the case with the white sandstone bed No. 8 at Katslösa 700. Here the *Oxytoma* shells are rather common, but all the specimens are small, rarely more than 5 mm. in cross section, and most of the lime is dissolved; thus it is chiefly internal casts that are preserved. In these the left valve is rather arched, with about 16 primary ribs and one secondary rib in the interspaces though only in the peripheric portion; the posterior ear is smooth. Right valve small, smooth, and flattened, with a deep sinus in front.

In specimens, even the smallest ones, with well preserved shell the posterior ear has a dense and fine striation of growth lines parallel to the posterior margin. These features indicate *O. sinemuriensis*.

Oxytoma also occurs higher up, though more sporadically, for instance in Bed 30 at Katslösa 840, where it is rare and rather fragmentary, and in Bed 32 which is rich in these shells. In these specimens the intermediate secondary rib is less regular, while a number of tertiaries are to be seen. A rather well preserved specimen of this type from S.E. Scania was figured by Moberg as *Avicula inaequivalvis*. Moberg's type has indications of a secondary rib, but the wide interspaces are practically occupied by the thin tertiary ribs. This being in accordance with the facts stated by Arkell, Moberg's interpretation seems to be correct.

Before his comprehensive studies of the gigantic material of *Oxytoma* from Oregården, the present writer thought it possible to distinguish between *O. sinemuriensis*, *O. suecica*, and *O. subinaurita*. That the last-named species cannot be retained is understood from what has been written. The specific value of *O. suecica* Hébert is also dubious, since the posterior ear is really striated — not smooth, as Hébert believed — and thus not distinguishable from that of *O. sinemuriensis*, as this species was interpreted by Hébert. However, there must be some confusion as to the latter character, since Rollier (1914, p. 398) describes *O. sinemuriensis* with "oreillette posterieure lisse", and perhaps Lundgren is right in his statement that this character is not important enough to be of specific value.

Size:

1. Specimens from Oregården (Paleont. Inst. Lund):

Left valves	Height	Length	Right valves	Height	Length
Pl. IX, Fig. 6	7.5	8.5 mm.	Pl. X, Fig. 2	7.5	7.5 mm.
			" " 1	8.5	8.5 "
—	16	15 "	—	11.5	12.0 "
			No. 1075	12.0[2]	13.5[2] "
No. 364	16[1]	16.5 "	Pl. X, Fig. 4	12.3	13.6 "

2. Specimens from Katslösa 700 (Riksmuseum and S.G.U.):

Left valves	Height	Length	Right valves	Height	Length
S.G.U. Museum	1.5	1.5 mm.	Mo 6718 d	1.1	1.3 mm.
S.G.U. Museum	2.6	2.6 "	S.G.U. Museum	1.2	1.7 "
Mo 6718 b	4.0	3.5 "	"	2.1	2.6 "
Mo 6718 a	5.5	5.5 "	"	2.1	2.6 "
Mo 6717 (Pl. X,			"	2.7[2]	3.8 "
Fig. 9)	5.6	4.5[2] "			
S.G.U. Museum	6.3	6.2 "	"	2.8	3.9 "
Mo 6712	6[2]	7.5 "	Mo 6718 c	3.3	4.0 "
Pl. X, Fig. 6	8.5	8 "	S.G.U. Museum	4.2	5.0 "

[1] In this specimen the hinge-line is 11.5 mm., and the thickness 4.5 mm.

[2] Incomplete.

In summarizing the above I think there are grounds for distinguishing *Oxytoma sinemuriensis* from *O. inaequivalvis* in the Lias of Sweden.

Oxytoma sinemuriensis is less oblique and has a greater number of coarse radiating ribs than *O. inaequivalvis.*

Young specimens: 14 or 15 primary ribs, one secondary rib in most interspaces, no tertiary ribs.

Adult specimens: 15 or 16 primary ribs; 1, 2, 3 or more secondaries at irregular distances in each interspace, as a rule intercalated with ribs of a minor order, the transition between secondaries and tertiaries being gradual and irregular.

Oxytoma inaequivalvis: more oblique; 10—12 primary ribs, interspaces as a rule only showing a fine radiating striation (tertiary ribs); but in some interspaces, especially in the posterior ones, a slightly developed secondary rib is visible. Young specimens are hardly distinguishable from those belonging to *O. sinemuriensis.*

Occurrence. *Oxytoma sinemuriensis* is the leading fossil of the Döshult Stage. It has given the name to the *Avicula* Bank at Kulla Gunnarstorp, where it is the most common fossil. It is especially plentiful in certain beds of the Ammonite Bank, for instance in the *Oxytoma-Gryphaea* bed at Oregården (bore-hole No. 271, at 63 m.) and occurs also frequently, especially as youth stages, in the *Myacid* Bank at Katslösa.

Oxytoma inaequivalvis (Sowerby)

Pl. X, Figs. 11—14

1819. *Avicula inaequivalvis* Sowerby, Min. Conch. 3. P. 78, Pl. 244, Fig. 2.
1879. " " Lundgren, Juraformationen på Bornholm, P. 17, Figs. 32, 33.
1881. " " Lundgren, Molluskfaunan, P. 30 (pro parte), Pl. 5, Fig. 6.
1888. " " Moberg, Lias i SÖ. Skåne, P. 36, Pl. 1, Figs. 34—36.
1914. " *(Oxytoma) phillipsi* Rollier, Mém. Soc. Pal. Suisse. 40, P. 400.
1933. *Oxytoma inaequivalvis* Arkell, Corallian Lamellibranchia, P. 195, Pl. 24, Fig. 9.

Material. About a dozen specimens met with at Katslösa 840.

Description. Left valve rather arched with 10—14 coarse ribs and flat broad interspaces with about half a dozen faint striae of which one is sometimes slightly larger than the others and even visible in badly preserved specimens, especially in the posterior interspaces. These intercostal ribs are, however, all of the tertiary size, no true intermediate or secondary ribs being developed. Anterior ear with a few closely-set ribs, posterior ear long, with thin radiating striae. Hinge-line straight. A fine concentric striation crosses the interspaces between the ribs but is not always preserved.

Right valve quadrangular, smaller than the left, almost flat with faint radiate striation, straight hinge-line and narrow byssial notch.

Size:

	Height	Length	
No. Mo 6538	6.3	8.6 mm.	L.V.
S.G.U. Museum	5.7	6.9 "	"
Pl. X, Fig. 14	5.1	6.5 "	R.V.

Remarks. On account of the gradual diminution of the interspaces near the anterior ear, it is sometimes difficult to ascertain with certainty how many of the anterior ribs there are to be counted. The specimens described by MOBERG from S.E. Scania show about 10 primaries, and the interspaces 5 to 8 riblets with irregular distribution and somewhat varying size; transverse striation well visible; right valve has about 12 ribs. The specimen figured by LUNDGREN (1881) from the Upper Höör sandstone at Brandsberga has 12 costae and indications of intercostal riblets. The writer has found the same species at Kolleberga. Like other lamellibranchs of this fauna it is preserved as sandstone casts, without any part of the original shell, and the coarse sandstone has not preserved the finest sculpture.

There is no doubt that these forms, as well as that described and figured by LUNDGREN from Bornholm, belong to the same species as the Katslösa specimens described above. By reason of their ornamentation they may be kept within the restricted species *Oxytoma inaequivalvis*.

Horizon. The Swedish specimens of *Oxytoma inaequivalvis* are from the beds 28, 30, 32, 36—42 at Katslösa; from Kurremölla, Kullemölla, and other locs. in S.E. Scania; and from Brandsberga and Kolleberga in the Höör district.

Oxytoma scanica (LUNDGREN)

Pl. X, Fig. 15

1881. *Avicula magnifica* LUNDGREN, Molluskfaunan, P. 31, Pl. 5, Figs. 2—5 (*non* DE KONINCK).
1888. *Avicula scanica* LUNDGREN, List of the fossil faunas of Sweden, P. 3.
? 1888. *Avicula anserina* MOBERG, Lias i SÖ. Skåne, P. 38, Pl. 3, Fig. 18.

Original diagnosis: "Valva sinistra convexa, dextra plana; binae valvae tenuissime radiatim striatae et costis quinque validis, radiantibus ornata."

Description. The left valve is convex and has 5 radiating ribs which hardly project beyond the ventral margin. There are no secondary ribs, but the intercostal fields are covered with dense and fine radiating striae. Anterior ear small, posterior one produced and separated from the ventral margin by a rather deep sinus. Right valve rare, more flattened and not as well preserved, with 5 less outstanding ribs and striated interspaces.

Size. According to LUNDGREN, who described this species from the Upper Höör sandstone at Brandsberga, the height ranges between 14 and 56 mm., 40 or 50 mm. being the average size.

Remarks. *Oxytoma scanica* looks like a part of an opened umbrella. In *O. longicostata* STUTCHBURY and *O. cygnipes* YOUNG and BIRD the ribs are spined and extend far beyond the margin. These features are perhaps gerontic in part, but they are well developed in the specimen of *O. longicostata* figured by ARKELL (1933, Pl. 29, Fig. 1) which is of the same size as the largest specimens of *O. scanica*. *O. longicostata* of the Lower Lias has 5—7 ribs, and *O. cygnipes* of the Middle Lias has 6 (according to specimens studied by the author in the British Museum, Nat. Hist.). Most authors unite these species, which certainly are closely allied. ROLLIER claims *O. cygnipes* to be of Robinian age (Lower Pliensbachian), though he groups it with *O. longicostata*, which appears already in the *Pre-planorbis* Beds (ARKELL). DUMORTIER (1869, P. 294) reports the ribs as numbering from four to six most commonly five, rarely six in *O. cygnipes* from the zone of *Pecten aequivalvis* (Lias δ) of the Rhône basin. He also figures two valves, both with five ribs and rather similar to *O. scanica* (l. c. Pl. 35, Figs. 6, 9). The size is about the same, the ribs are smooth and their extension beyond the margin is far less pronounced than in the earlier English specimens. Moreover the growth lines — or the margin — between the costae are concave, but in *O. longicostata* (ARKELL, *l. c.*) and *O. cygnipes* they are straight (PHILLIPS, 1875, Pl. 14, Fig. 3). Finally, the number of ribs seems to be fixed as in *O. scanica*, which indicates a more advanced stage than in *O. longicostata* (or *O. cygnipes* of English authors). These similarities between the Charmouthian French specimens of *O. cygnipes* and the Swedish *O. scanica* are also interesting from a stratigraphical point of view, since they suggest a rather late Charmouthian age of the Brandsberga sandstone, which has not yet been met with in the bedrock.

In 1888 MOBERG described *Avicula anserina* from Liassic sandstone pebbles, derived from a Cretaceous conglomerate at Rödmölla. This can probably not be distinguished from *O. scanica.* Only one specimen, the holotype, has been discovered, but now it cannot be traced. According to the figure and the description given by MOBERG, it was badly preserved, 25 mm. in length, and possessed 5 ribs. The margin was excavated between the ribs, as in *O. scanica*, and the growth-lines showed the same concavity; the rib ends did not project beyond the margin. According to MOBERG the anterior ear should be projecting — not rudimentary (LUNDGREN) as in *O. scanica* —, and the umbo submedian, not strongly antemedian. As to these differences, which are in reality only one (due to the development of the anterior ear), we have not used LUNDGREN's term "rudimentary" in the above description, because the anterior ear is not known with exactitude. It seems to be broken in most specimens and has probably been very fragile. Anyhow this part of the shell has not yet been successfully prepared in the sandstone. The specimen, Fig. 15 on Pl. X, shows an anterior ear more complete than those figured by LUNDGREN. Were it complete it should be similar to that in *Avicula anserina.* In that case the position of the umbo would be submedian, too. Accordingly there seems to remain no specific difference between *A. anserina* and *A. scanica*, but since the holotype of the former species is lost, it is, of course, impossible to state anything with certainty.

Distribution. *Oxytoma scanica* is a common species in the Brandsberga sandstone that occurs as local pebbles at Brandsberga and Kolleberga of the Höör district, Scania.

Family ISOGNOMONIDAE

Genus *Gervillia* Defr.

Gervillia angelini Lundgren

Pl. IV, Figs. 12—14

1878. *Gervillea Angelini* Lundgren, Studier, P. 43, Figs. 14, 84, 86.
1878. *Gervillea scanica* Lundgren, pro parte, ibid., P. 43, Fig. 27 (*non* Figs. 25, 26, 36, 37).
1878. *Avicula Nilssoni* Lundgren, ibid., P. 40, Figs. 11—12.
1881. *Avicula? Nilssoni* Lundgren, Molluskfaunan, P. 33.
1881. *Gervillea Angelini* Lundgren, ibid., P. 34.
1881. *Gervillea scanica* Lundgren, pro parte, ibid., P. 34.
1907. *Avicula? Nilssoni* Moberg, Geol. För. Förh. 29, P. 281, Pl. 7, Figs. 4—6.
1947. *Gervillia angelini* Troedsson, Geol. För. Förh. 69, P. 411, Fig. 9.
1948. *Gervillia angelini* Troedsson, ibid. 70, P. 538, Text-Figs. 5—6.

Original description. "Testa transversa, valde obliqua, fere triangularis, convexa; regio anterior sinuata, posterior rotundata; auricula indistincta."

Material. The holotype LO 276 T (R.V., Lundgren 1878, Fig. 14) and two internal casts, viz. LO 277 t (R.V., ibid. Fig. 84) and LO 278 t (L.V., ibid. Fig. 86). Numerous specimens with well preserved test in the pebbles of calcareous sandstone at Östra Ramlösa.

Description. Umbo high, projecting only slightly beyond the hinge-line, which it meets at an angle of about 40°. Hinge-line is straight, with a series of grooves for the ligament, and forms an obtuse angle with the posterior margin. The latter is straight, not sinuated, the posterior ear thus being less marked than in most species. Only in small or in flattened specimens the dorsal and posterior margins meet at right angles. The small portion of shell in front of the apex is inflated and separated from the umbo by a shallow and wide groove. This inflation also affects the anterior margin, which is convex in its upper part, then makes a shallow sinus, and finally dips obliquely backwards in a straight line, until it continues by a gentle curve into the ventral and posterior margins. Shell surface ornamented with growth lines, which are somewhat irregular, as a rule, but parallel to the anterior, ventral, and posterior margins, and meet the hinge-line at almost right angles. The inflated anterior portion is provided with a few straight, longitudinal furrows, parallel to the length axis of the shell. Greatest width of shell is just behind the hinge-line.

Size of 5 specimens from Östra Ramlösa. I. Length of shell from the anterior inflation to the posterior margin. II. Length of hinge-line. III. Greatest width, measured at right angles to the length.

	I (Length)	II (Hinge)	III (Width)
1)	8.7	5.3	ca. 4.5 mm.
2)	12.4	8.5	7 "
3)	20.5	13.8	11.5 "
4)	28.6	17.8	15.3 "
5)	34	22	18 "

Remarks. In his Studies on the fauna of the coal-bearing formation of N.W. Scania (1878) LUNDGREN gives a description of several species of lamellibranchs, founded upon badly preserved specimens. In many cases he had to rely entirely upon external characters without any knowledge of the hinge. He was consequently very uncertain as to the generic position of many species. Thus he referred to *Avicula* specimens which could equally well belong to *Gervillia*, as far as is shown by the exterior. In the *Pullastra* Bank he found specimens with a typical *Gervillia* hinge line, which he described as *Gervillia angelini*. But quite similar specimens, in which the hinge was not preserved, were referred to the genus *Avicula* and described as *Avicula nilssoni* LUNDGREN. In the same paper he described *Gervillea lamellosa*, on the last page changed, owing to preoccupation, to *G. scanica*. A careful study of his types has shown that this name was applied to at least three species, viz. two from the Mytilus Bank and one from the *Ostrea* Bank (See below, P. 207). One of the former coincides well with *Gervillia angelini* as to surface ornamentation, general outline, and angle between umbo and hinge line, and certainly is identical with this species.

A close comparison of the *Gervillia* specimens figured by LUNDGREN shows that small specimens, in which the hinge is not preserved, were assigned to *Avicula nilssoni*, while the large specimens of the *Ostrea* Bank were classed with *G. scanica* of the same size from the *Mytilus* Bank. Middle-sized specimens found in abundance in the *Pullastra* Bank (then believed to be Rhaetic) were described as *G. angelini*. It is significant that LUNDGREN in his second molluscan monograph (1881) appended a mark of interrogation to the generic name in *Avicula nilssoni*. And in 1907 MOBERG, after having recognized the close affinity between *Gervillia scanica*, *G. angelini*, and *Avicula? nilssoni*, put forward the suggestion that it might be impossible to keep these species apart. As already mentioned the writer prefers to retain LUNDGREN's name *Gervillia angelini* and reject the specific name *(Avicula) nilssoni*, the latter being based upon badly preserved specimens which do not even show the generic characters.

Distribution. *Gervillia angelini* is a characteristic fossil of most localities of the *Pullastra* Bank and occurs also in the *Mytilus* Bank.

Localities. Ramlösa, Östra Ramlösa (pebbles), Fältarp (pebbles), Gåsebäck (pebbles), Terrassen, Gravarna, Sofiero, all situated in Helsingborg. It seems to be restricted to the lower part of the Helsingborg Stage.

Gervillia (?) scanica LUNDGREN

1869. *Avicula* sp. HÉBERT, Ann. sci. géol. T. 1. P. 128, Pl. 2, Fig. 10.
1878. *Gervillea lamellosa* LUNDGREN, Studier, pro parte, P. 43, Fig. 25—26.
1878. *Gervillea lamellosa* preoccupied, replaced by *Gervillea scanica* LUNDGREN, ibid., P. 58, pro parte.
1878. *Gervillea* sp. LUNDGREN, ibid., P. 44, Fig. 73.
1878. *Avicula rectangularis* LUNDGREN, ibid., P. 40, Fig. 24.
1881. *Avicula? rectangularis* LUNDGREN, Molluskfaunan, P. 33.
1881. *Gervillea scanica* LUNDGREN, ibid., P. 34, pro parte.

Original diagnosis. "Testa elongato-ovata, obliqua, planiuscula, lamellis concentricis regulariter ornata; postice sinu obscuro notata."

Holotype. LO 280 t, a cast of the exterior surface, damaged at the umbo.

Description. This species is distinguished by its surface ornamentation of regular concentric lamellae. Umbo less oblique than in *G. angelini*, meeting the hinge-line at about 50°. Posterior ear short; its posterior margin continues directly, without any sinus, into the posterior margin of the shell.

Size:	Length of shell	Width	Length of hinge-line
LO 269 T	16	8.5	9 mm.
R.M. Mo 6766	18	11	11 "
LO 280 t	26	14.5	ca. 13 "

Remarks. Under the head of *Gervillea scanica*, LUNDGREN figured 5 specimens (1878, Figs. 25, 26, 27, 36, 37), all of which were characterized by lines of growth, more or less irregular — accordingly specimens with the test preserved. In other respects — for instance, the obliquity of the umbo, the shape of the growth lines, the general outline, &c. — they varied considerably. In reality they represent three separate species. Thus his Fig. 27 is a typical *Gervillia angelini*, and his Figs. 36 and 37 belong to *G. hagenowi*, the specific name *G. scanica* accordingly being restricted to his Figs. 25 and 26.

The most characteristic feature of *G. scanica* is the angle of divergence between the umbo and the hinge-line, which is 50° or 55°. This same angle is found in "*Avicula*" *rectangularis* LUNDGREN, a species collected at the same horizon and locality and founded upon a specimen without the test. In the author's opinion, "*Avicula*" *rectangularis* and *Gervillia (?) scanica* cannot be kept separate. In the specimen (LO 269 T) figured by LUNDGREN (1878, Fig. 24) the umbo seems to be quite terminal as in *Isognomon (Perna)*. The same feature is met with in a specimen from "Pebble No. 1" at Höganäs (*Gervillea* sp. LUNDGREN 1878, Fig. 73). This indicates a generic affinity to *Isognomon* rather than to *Gervillia*. Since, however, most specimens referred to this species are rather badly preserved, the writer prefers to range it for the present, though with a mark of interrogation, with *Gervillia*.

Occurrence. In the *Mytilus* Bank at Helsingborg, and in "Pebble No. 1" at Höganäs.

Gervillia hagenowi DUNKER

Pl. IV, Figs. 15—16

1846. *Gervillia Hagenowii* DUNKER, Palaeontogr. 1, P. 37, Pl. 6, Figs. 9—11.
1878. *Gervillea lamellosa* LUNDGREN, Studier, pro parte, P. 43, Figs. 36—37 (*non* Figs. 25—27).
1878. *Gervillea scanica* LUNDGREN, ibid., P. 58 (pro parte).
1878. *Avicula laeviuscula* LUNDGREN, ibid., P. 41, Figs. 38—39.
1881. *Gervillea scanica* LUNDGREN, Molluskfaunan, pro parte, P. 34.
1881. *Avicula? laeviuscula* LUNDGREN, ibid., P. 32.

Material. Several specimens, more or less fragmentary, preserved in ferruginous sandstone.

Description. Umbo meets the hinge-line at an angle of 30°. Posterior ear well developed, bounded posteriorly by a sinus, behind which the shell is extended considerably. Surface of shell covered with irregular lines of growth, which are sigmoidly curved near the hinge-line.

Size:	Length	Width (at posterior end of hinge-line)
Mo 6218	9	6 mm.
LO 271 t	ca. 13	9.2 "
LO 270 T	ca. 13.5	9.5 "
Mo 6236	15	10.5 "
LO 282 T	—	20 "
LO 283 t	ca. 48	24 "

Remarks. LUNDGREN (1878) referred two large fragmentary left valves of this species, one anterior (Pl. IV, Fig. 15) and one posterior portion to his *Gervillea scanica*. In a recent paper the present writer suggested their affinity to *G. angelini* (1948, P. 539). However, a closer examination has shown that this certainly was wrong. *G. angelini* has a larger angle between the umbo and the hinge-line, it has no sinus behind the posterior ear, and the growth lines are straight when approaching the hinge-line. In all these respects the specimens mentioned coincide exactly with *G. hagenowi* DUNKER, from which there seems to exist no specific difference.

LUNDGREN also figured the anterior portion of a small left valve (Pl. IV, Fig. 16) and the posterior portion of a small right one, and made them the types of a new

Synonymy of some "Aviculas" and Gervillias described and figured by LUNDGREN *in 1878.*

Lundgren 1878	Specimen	Fig.	Horizon	Troedsson 1951
Avicula Nilssoni	LO 267 T	11	*Pullastra* Bank	*Gervillia angelini*
” ”	LO 268 t	12	Pebble, Fältarp	” ”
Gervillia angelini	LO 276 T	14	*Pullastra* Bank	” ”
” ”	LO 277 t	84	Pebble No. 3	” ”
” ”	LO 278 t	86	” ”	” ”
Gervillea sp.	R. M. Mo 6766	73	Pebble No. 1	” *scanica*
Avicula rectangularis	LO 269 t	24	*Mytilus* Bank	” ”
Gervillea scanica	Unknown	25	” ”	” ”
” ”	LO 280 t	26	” ”	” ”
” ”	LO 281 t	27	” ”	” *angelini*
” ”	LO 282 T	36	*Ostrea* Bank	” *hagenowi*
” ”	LO 283 t	37	” ”	” ”
Avicula laeviuscula	LO 270 T	38	” ”	” ”
” ”	LO 271 t	39	” ”	” ”

species, *Avicula laeviuscula*. There is no doubt that they belong to the same species as the above fragments.

Occurrence. *Gervillia hagenowi* is widespread in the Lower Lias, and has been recorded from Belgium, England, France, and Germany, mainly in beds corresponding to the Lias α. The Swedish specimens are from the *Ostrea* Bank at Kulla Gunnarstorp, and from a calcareous sandstone at a depth of 111 m. in the drilling core at Oregården, where they occur together with *Modiola hillana* and *Liostrea hisingeri*.

Gervillia sjögreni Lundgren

1881. *Gervillea? Sjögreni* Lundgren, Molluskfaunan, P. 35, Pl. 2, Figs. 1—2.

Original diagnosis. Testa nitida, rugis concentricis irregularibus praedita, sub auricula anteriore sinu obscuro notata; auricula posterior parva non in alam producta.

Holotype. LO 434 T (Lundgren, l. c., Fig. 1).

Material. The holotype and 8 additional specimens in different state of preservation.

Description. Test smooth, glossy, with irregular but strong lines of growth. Umbo is pointed and meets the hinge-line at an angle of about 40°. Posterior ear rather small and narrow, not produced into a wing, thus not even bounded by any sinus from the remaining part of the shell. Anterior ear small, bounded downwards by a shallow concavity at the anterior margin.

Size. The holotype is 20 mm. in length and 11.5 mm. in width.

Remarks. *G. sjögreni* has much in common with *G. angelini*. Both have the same obliquity of the umbo and the same general outline. But the present species has a more pointed umbo, coarser growth-lines, and smaller anterior ear, which is devoid of the regular striation seen in *G. angelini*.

Occurrence. *G. sjögreni* is a rare species in the *Avicula* Bank at Kulla Gunnarstorp, and in the Ammonite Bank at Dompäng, Döshult and Kristinelund.

Gervillia sp.

Pl. XII, Fig. 19

Cf. *Gervillia aerosa* Simpson (Tate and Blake, The Yorkshire Lias, 1876, Pl. 14, fig. 6).

Material. Two specimens.

Description. The figured specimen is an internal mould of the right valve with fragments of the test. Very oblique. Hinge-line straight, posterior border of wing concave. Beak projecting beyond the hinge-line at an angle of about 40°. No sculpture of any kind on the mould, but the fragments of the test indicate a smooth surface, at least close to the hinge-line. Size: 16 mm. in length, 11 mm. in width.

Mo 6748, a small specimen with weathered shell, showing lamina of shell structure but no sculpture. Only 6 mm. in length; 4 mm. in width at posterior end of hinge-line.

R e m a r k s. This species seems to be closely allied to *Gervillia aerosa* SIMPSON from the *jamesoni*, *capricornus* and *margaritatus* zones of Yorkshire, but the fragmentary state of preservation does not allow of indubitable identification.

O c c u r r e n c e. Both specimens are from Katslösa, the large one from Bed 30, the small one from Bed 45.

Genus *Isognomon* SOLANDER

Isognomon sp.

Pl. XIV, Fig. 7

Cf. *Perna sublamellosa* LUNDGREN 1881, Molluskfaunan, P. 35, Pl. 6, Figs. 4—6.

M a t e r i a l. External cast of a left valve.

D e s c r i p t i o n. Beak terminal, hinge-line straight, anterior and posterior margins subparallel, meeting the hinge-line at an angle of about 80°. Ventral margin convex. Surface with a fine striation of growth lines, parallel to the ventral margin.

S i z e. Length (from posterior to anterior margin) 4.3 mm. Height (from the ventral margin to the hinge-line) 9 mm.

R e m a r k s. In relative proportions, sculpture, and general outline this form comes close to *Isognomon sublamellosa* (LUNDGREN) from the Brandsberga sandstone pebbles.

H o r i z o n. In the *Myacid* breccia at Katslösa 700.

Family LIMIDAE

Genus *Lima* BRUGUIÈRE

Subgenus *Radula* KLEIN

Lima (Radula) duplicata SOWERBY

Pl. XIX, Figs. 1—3

1827. *Plagiostoma duplicata* SOWERBY, Min. Conch. 6, P. 114, Pl. 559, Fig. 3.
1932. *Pseudolimea duplicata* ARKELL, Quart. Journ. Geol. Soc. 88, P. 160, Pl. 12, Figs. 1—2.
1936. *Radula duplicata* DECHASEAUX, Limidés Jurassiques, P. 8, Pl. 1, Fig. 3 (with synonyms).

M a t e r i a l. Mostly external and internal moulds. Seven specimens in all.

D e s c r i p t i o n. Shells equivalve, obliquely ovate, without teeth, but with at least 16 radiating acute ribs; ribs and intervals of about equal width. This ornamentation is also well visible in natural internal casts, but here the ribs are rounded and the intervals relatively wider and flat.

S i z e:	Length	Height	
Pl. XIX, Fig. 3	6	6	mm. inside of left valve
S.G.U. Museum	7.5	8	" " " right "
Pl. XIX, Fig. 1	8	8.5	" natural internal cast of left valve
Pl. XIX, Fig. 2	8.2	8.4	" external mould of right valve

Remarks. As shown by DECHASEAUX, *Radula duplicata* is difficult to distinguish from *R. hettangiensis* and *R. pectinoides*, but the above proportions between height and length exclude the two last species. However, the Swedish specimens are very small, only 16 ribs having been counted on the shell. This might indicate a new variety, but the specimens are rather fragmentary, and the differences might be due to the state of preservation and the local conditions.

Occurrence. *Radula duplicata* has not been met with before in Sweden. It has a wide distribution in western Europe and runs through the Lower and Middle Jurassic up into the Callovian. The Swedish specimens are from the shell breccia at Katslösa 700.

Lima (Radula) pectinoides SOWERBY

1881. *Lima (Radula) pectinoides* LUNDGREN, Molluskfaunan, P. 27, Pl. 2, Fig. 4.

Fragmentary specimens from the Ammonite Bank at Döshult and Dompäng were referred by LUNDGREN to *L. pectinoides*, on account of their characteristic sculpture. LUNDGREN's type specimen, LO 437 t, has 24 ribs. Additional fragments have been met with at the same horizon at Kristinelund (loc. 152).

Subgenus *Plagiostoma* SOWERBY

Lima (Plagiostoma) succincta VON SCHLOTHEIM

Pl. XIII, Fig. 13

1813. *Lima succincta* SCHLOTHEIM, Mineral. Taschenbuch v. KNORR, 3, Suppl., Pl. 5 d, Fig. 4.
1818. *Lima antiquata* SOWERBY, Min. Conch. 3, P. 25, Pl. 214, Fig. 2.
1858. *Lima antiquata* QUENSTEDT, Jura, P. 78, Pl. 9, Fig. 11.
1867. *Lima succincta* DUMORTIER, Études paleontologiques, 2, Pp. 66 and 212, Pl. 47, Figs. 6—7; Pl. 48, Fig. 1.
1871. *Lima succincta* BRAUNS, Der untere Jura, P. 382.
1881. *Lima (Radula) succincta* LUNDGREN, Molluskfaunan, P. 26, Pl. 4, Fig. 8.
1909. *Lima succincta* MALLING og GRÖNWALL, Medd. D.G.F. Bd 3, P. 276, Pl. 10, Fig. 1.
1936. *Plagiostoma succincta* DECHASEAUX, Limidés Jurassiques, P. 35.
1936. *Plagiostoma succincta* JOLY, Lias inférieur, P. 100.

Material. The umbonal part of a left valve (Mo 6390, Riksmuseum): ears and beak broken, test almost completely destroyed, but the ornamentation is preserved in the external mould.

Description. Shell moderately inflated, inequivalve; ears rather large. Internal cast with low concentric rings. Shell surface with strong somewhat undulating ribs, crossed by concentric growth-lines of varying size and at varying distances.

Size. Width 31 mm. Height at least 35 mm.

Remarks. The described specimen coincides well with the figures of *Plagiostoma succincta*, given by the above authors, in spite of its bad state of preservation.

Occurrence. *Plagiostoma succincta* has been recorded from the Lower and

Middle Lias of Belgium, Germany, France, and England. Furthermore, it has been found in the *Myoconcha* Bank on Bornholm and in the sandstone pebbles at Brandsberga, N.W. Scania. The present specimen comes from Katslösa Bed 30.

Genus *Limea* Bronn

Limea acuticostata Münster

Pl. XIX, Figs. 8—14

1836. *Limea acuticostata* Goldfuss, Petref. Germ., 2, P. 97, Pl. 107, Fig. 8.
1837. *Plagiostoma pectinoides* Forchhammer, Bornh. Kulform., P. 50, Pl. 4, Figs. 23—24.
1871. *Limaca acuticosta* Brauns, Der untere Jura, P. 378.
1879. *Limea acuticostata* Lundgren, Juraformationen på Bornholm, P. 16, Figs. 30, 31.
1888. *Limea acuticostata* Moberg, Lias i SÖ. Skåne, P. 32, Pl. 1, Figs. 23, 24.
1909. " *acuticosta* Malling og Grönwall, Medd. D.G.F. Bd. 3, P. 276, Pl. 10, Fig. 2.

Material. More than 60 specimens.

Preservation. In most cases the test is dissolved, only external or internal moulds being met with. The test is preserved in a few small shells, in which the outside is hidden and only the deeply concave inside is free from rock.

Description. The moulds show the characteristic features, for instance, 10 strong acute ribs, separated by deep furrows, small anterior and posterior ears, hinge-line with teeth, &c. The small specimens have a thick and highly convex shell, straight hinge-line with a number of equal teeth, arranged symmetrically on both sides of the umbo, and diverging upwards. Exterior with strong ribs, well visible at the ventral margin but also translucent and visible from the inside.

The specimens from S.E. Scania have been described carefully by Moberg.

Size. Diameters of a small specimen 3 mm. (height) and 2.5 mm. (length, shell damaged anteriorly). Another specimen 2.5 and 2.5 mm. The largest specimens are 15 mm. in height and length.

Distribution. *Limea acuticostata* is recorded from Lower, Middle, and Upper Lias in England (Woodward 1893) and from Lias γ—δ in Germany (Brauns 1871). The Bornholm specimens were derived from the *Myoconcha* Bank, and those of S.E. Scania from the *jamesoni* zone. The Katslösa specimens are from Beds 30 (44 specimens), 32 (12), 36 (2), 41 (2), and 42 (2).

Limea katsloesensis n. sp.

Pl. XIX, Figs. 4—7

Material. Nine specimens.

Holotype. Mo 6408 R.M., the umbonal portion of both valves.

Description. Umbo widens at right angles and projects a little beyond the hinge-line. The latter is slightly concave in side view and is provided with 3 longitudinal teeth on each side of the beak. Anterior and posterior ears almost alike, narrow, triangular in outline. The test being very thin, the teeth are well visible in internal casts and moulds and are similar to those in *Grammatodon.*

The remaining part of the shell is covered with radiating ribs, which are most developed near the anterior margin but more or less effaced at the middle part of the shell. The ribs are low and flat and are as wide as the interspaces. Furthermore, there are fine lines of growth which, however, do not affect the surface sculpture but are visible in the shell structure.

In order to give a more complete idea of this species three additional specimens are figured. Pl. XIX, Fig. 5 is a natural internal cast with small remnants of the extremely thin test and outline almost entire. It shows impressions of the ribs and interspaces, all of the same width. The counterpart — not figured — shows the inside with translucent colour markings. Anterior margin straight; the remaining three margins form a strong curve, but the general shape is sub-rectangular or sub-quadrangular in outline with rounded anterior and ventral corners.

Colour markings are preserved in the specimen in Pl. XIX, Fig. 7, also.

Size.

	Height	Length
Pl. XIX, Fig. 7	3.4	5 mm.
Pl. XIX, Fig. 6	6.5	7 "
Pl. XIX, Fig. 5	7.5	8 "

Remarks. *Limea katsloesensis* is distinguished on account of its faint radiate striation, its symmetrical beak region, and the teeth which are parallel to the hinge-line.

Horizon and locality. Katslösa Bed 30.

Family PECTINIDAE

Genus *Chlamys* Bolten

Chlamys janiformis Lundgren

1878. *Pecten janiformis* Lundgren, Studier, P. 39, Pl. 1, Figs. 58, 59.
1881. " " " Molluskfaunan, P. 29.

Original diagnosis. "Testa rotundato-ovata, paullum convexa, aequivalvis; valvae diverse ornatae, altera sulcis radiantibus circiter 20, altera striis concentricis tenuissimis numerosis praedita; auriculae inaequales."

Holotype. LO 265 T (Lundgren 1878, Fig. 58), left valve.

Material. 22 specimens (excluding the holotype).

Size of four specimens from the Ammonite Bank at Kristinelund (Loc. 152):

	Height	Length	Apical angle
R.V.	14	14 mm.	83°
R.V.	18	> 16.5 "	83°
R.V.	20.5	> 18 "	—
L.V.	17.5	17 "	86°

Remarks. The radiating ribs are faint and broad with rounded edge and narrow interspaces, thus forming a regular wave-line in cross section. In his first description LUNDGREN figured a right valve with the concentric lines only, and a left valve with the radiating ribs. But later on (1881) right valves with preserved ribs were also reported. The number and width of the ribs — i. e. the general view of the ornamentation — is constant in the specimens met with, but the strength of the ornamentation varies greatly. In some specimens the ribs are well visible, even in internal moulds — certainly due to a thin shell — but in others it is more or less effaced, especially in the right valves.

Chlamys janiformis is closely allied to *C. trigeri* (OPPEL). It has the same apical angle, a deep byssial notch, and lingulate anterior ear of the right valve. In both species the sculpture is made up of radiating ribs and furrows, which are best developed in the left valve, sometimes even missing in the right. But the furrows and ribs are fewer in number and much wider in *C. janiformis.* As a rule the number of ribs is a bad specific character in the pectinids, but since the sculpture described and figured by LUNDGREN seems to be a rather constant feature in the Swedish specimens referred to *C. janiformis*, there are certainly good reasons to regard *C. janiformis* as a distinct species.

Occurrence. *Chlamys janiformis* was described from the Ammonite Bank at Dompäng and Döshult. It has now been recorded in the same horizon at Kristinelund (loc. 152) and Oregården (at 63 m. in the borehole No. 271), all in N.W. Scania. Finally, two fragmentary, questionable small specimens have been found in Bed 8, Katslösa.

Chlamys subulata (MÜNSTER)

Pl. XX, Fig. 17

1836. *Pecten subulatus* MÜNSTER in GOLDFUSS, Petref. Germ. 2, P. 73, Pl. 98, Fig. 12.
1925. *Chlamys subulata* STAESCHE, Die Pectiniden, P. 57, Pl. 2, Figs. 9—10, Pl. 5, Fig. 6.
1936. *Pecten (? Chlamys) subulata* DECHASEAUX, Pectinidés Jurassiques, P. 28.
Non 1888. *Pecten subulatus?* MOBERG, Lias i SÖ. Skåne, P. 36, Pl. 1, Fig. 33.

Material. One right valve.

Description. Right valve with a deep byssial sinus and large anterior ear. The ear is covered with rather coarse striae, parallel to the free margin facing the sinus; it is somewhat damaged at its anterior end, thus looking rather short in relation to its width. Shell surface smooth. Apical angle 87°.

Size. Height of figured specimen 11.5, length 10.5 mm.

Remarks. *C. subulata* is a Lower Liassic species. It differs from *C. janiformis* in being quite smooth, except for a few indications of a concentric striation. The fragmentary shell figured by MOBERG as *Pecten subulatus*(?) is indeterminable. As stated below, it may belong to *Entolium lundgreni.*

Locality. The present specimen was found in the arenaceous shell breccia at Katslösa, Bed 8.

Chlamys tullbergi LUNDGREN

Pl. XXIII, Figs. 5—6

1881. *Pecten Tullbergi* LUNDGREN, Molluskfaunan, P. 28, Pl. 5, Figs. 11—12.

Material. Four right valves and one left, all more or less fragmentary.

Original diagnosis. "Testa fere orbicularis, aequivalvis; valva dextra glabra; sinistra striis obscuris tenuissimis ornata; auriculae anteriores majores; dextra sinu notata."

Description. Right valve rather flat. Anterior ear with a deep sinus for the byssus; surface covered with fine concentric lines. These are well developed in the anterior ear and parallel to the sinus. No trace of radiate striation. An umbonal fragment of the left valve indicates a more pronounced arching; the surface has a dense radiate striation. According to LUNDGREN the left valve has a faint radiate striation, and both valves have the same convexity.

Size of right valve:

	Height	Length	Apical angle
Mo 6523, Katslösa 840	33	31 mm.	89°
Mo 6517, Katslösa 840	36	35 "	88°
S.G.U. Museum, Katslösa 768	43	42 "	88°
LUNDGREN, l. c., Fig. 12	57	51 "	—

Remarks. *Chlamys tullbergi* is recognized on account of its smooth or concentrically striated right valve and vertically striated left one. The vertical striae are much more crowded than in *C. janiformis*. *C. tullbergi* is a rather large pectinid, probably the largest *Chlamys* species in the Lias of Sweden.

Occurrence. The holotype was derived from the Liassic pebbles of the Brandsberga type. The present specimens are from Katslösa Beds 18, 25(?), and 30.

Chlamys textoria SCHLOTHEIM

Pl. XX, Figs. 14—16

1820. *Pecten textorius* SCHLOTHEIM, Petrefactenkunde, P. 229.
1833. *Pecten textorius* GOLDFUSS, Petrefacta Germ. 2, P. 45, Pl. 89, Fig. 9.
1879. *Pecten* sp. LUNDGREN, Juraformationen på Bornholm, P. 14, 15, Figs. 36—39.
1888. *Pecten priscus* MOBERG, Lias i SÖ. Skåne, P. 34, Pl. 1, Fig. 26.
1909. *Pecten priscus* MALLING og GRÖNWALL, Medd. D.G.F. Vol. 3, P. 277, Pl. 10, Figs. 3—5.
1936. *Chlamys textorius* DECHASEAUX, Pectinidés Jurassiques, P. 13, Pl. 1, Figs. 1—4 (with references).

Diagnosis. *Chlamys* with acute radiating ribs, crossed by a fine and dense concentric striation. The number of ribs increases with the individual age by division or intercalation. Later forms have a greater number of ribs than earlier ones (DECHASEAUX).

Description. The Swedish forms have an apical angle of about 90°, about 20 acute ribs, a dense concentric striation, especially in the interspaces between the ribs. The anterior ears have the same ornamentation. That of the right valve is deeply sinuated. Outline ovate, the height being greater than the length. Left valve rather inflated, right valve almost flat.

Size:	Height	Length	Katslösa
Smallest specimen, R.V.	5.2	4.8 mm.	Bed 32
S.G.U. Museum No. 330	6.0	5.7 "	" 29—35
Mo 6519, R.V.	6.5	5.8 "	" 30
S.G.U. Museum, L.V. No. 409	21	ca. 19 "	" 19
Pl. XX, Fig. 16, R.V.	25	23 "	" 27
Largest specimen, L.V.	48	43 "	" 42

Material. More than one hundred specimens, more or less fragmentary, about half of them collected in Bed 30.

Remarks. As is seen from the above as well as from the figures, we have here a typical *Chlamys* species. This is a statement of some importance, since previous authors have referred specimens from the Lias of Bornholm and Scania to *Pecten (Aequipecten) priscus*. The latter differs not only as to the specific characters — faintly visible concentric striation and slightly developed byssial sinus — but the circular outline and wide apical angle (106°—109°) range *Pecten priscus* with the subgenus *Aequipecten*.

The first to discuss identity with *Pecten priscus* was Lundgren in his Bornholm paper (1879). The fragments met with in S.E. Scania and described by Moberg under this name have acute radiating ribs, presumably 22 in number, and a fine but rather prominent concentric striation best developed in the intercostal furrows. Though these features are in reality not at all characteristic of *Pecten priscus*, Malling and Grönwall, in describing specimens from Bornholm, followed Lundgren and Moberg in their interpretation of this species. Among the figured specimens is a left valve (Malling and Grönwall, Fig. 4), "which shows about 21 acute, regularly-distributed, radiating ribs; in their interspaces the characteristic crowded, concentric striation is visible". Another specimen has a large byssial sinus, and the apical angle is 90°, features characteristic of the subgenus *Chlamys*.

Occurrence. *Chlamys textoria* is a wide-spread species found in all Liassic stages of western Europe. It has been collected in almost all fossiliferous beds of the Katslösa succession from Bed 8 up to Bed 42.

Chlamys interpunctata n. sp.

Pl. XX, Fig. 18

Material. Only one left valve met with; ears not preserved, except a small part of the anterior. Posterior part of the shell covered by a specimen of *Trigonia primaeva*. S.G.U. Museum.

Description. Left valve rather flattened, only slightly arched in the umbonal part. Anterior apical margin concave, posterior convex, umbo thus turned forwards.

Apical angle about 100°. Anterior ear with a rather strong but dense striation, parallel to the anterior margin of the ear. Surface of shell with 20 or 22 faint radiating ribs at varying distances, almost effaced at the umbo, and a dense concentric striation of growth lines, the same as those in the anterior ear. In addition to this sculpture, which is all but invisible to the naked eye, there is an extremely fine ornamentation of punctate concentric and radiating lines, which cross each other at right angles all over the shell surface, the radiating ones being thus much more divergent than the ribs. This minute sculpture, too small to be seen in the figure, is similar to that of *Camptonectes*, the fine punctae being situated where the lines cross.

Size. Height of holotype 12, length 10 or 11 mm.

Remarks. This pectinid has the general outline and shape of *Chlamys* and *Camptonectes*. As to the sculpture it is an intermediate form, since its coarse sculpture of ribs and growth lines is the same as in the former genus, while the micro-sculpture is similar to that in *Camptonectes*. From the Lower Lias of Swabia. QUENSTEDT has described another intermediate species, viz. *Chlamys punctatissima*. Of this species, too, only the left valve is known. It differs from ours in being more circular in outline, and having at least twice as many vertical ribs.

Horizon and locality. In a ferruginous pebble at Katslösa 955 b, together with *Ptychomphalus* cf. *expansus*, *Plicatula spinosa*, *Trigonia primaeva*, &c.

Genus *Entolium* MEEK

The genus *Entolium* embraces slightly arched, smooth pectinids without byssial sinus; ears small.

Type species *Pecten demissus* PHILLIPS.

STAESCHE restricted this genus to species in which the ears are of the same size, thus putting *Pecten calvus* into the genus *Chlamys*. He also interpreted a line of development of the Lower Liassic *Chlamys* species *C. trigeri*, *C. subulata*, *C. calva* towards *Entolium hehli* in the Lower Lias. *Chlamys trigeri* still has a radiate striation, but this gradually becomes finer and tends to be effaced in the latest forms. Contemporaneously the byssial sinus becomes shallower and finally disappears entirely. Thus in *C. trigeri* and *C. subulata* the sinus is well developed, in *C. calva* it is hardly visible, but the anterior ear of the right valve is about twice as large as the posterior one, and in *Entolium hehli* both ears are almost alike.

Other authors, including DECHASEAUX, place *Pecten calvus* with *Entolium*, which thus embraces smooth pectinids in which the byssial sinus is missing and the ears are either alike or of different size.

The following species have been identified in the Lias of Sweden:

Entolium hehli, *E. calvum*, *E. cingulatum*, and *E. lundgreni*.

E. hehli (= *E. glaber* HEHL) is a more advanced species than *E. calvum*, according to STAESCHE, the ears being almost of the same size ("nahezu gleich gross"). However, the figures given by STAESCHE (STAESCHE, Pl. 2, Figs. 13, 14) show a decided difference in size. And according to DECHASEAUX "les oreillettes sont inégales; la posterieure est plus grande que l'antérieure; leur form est également différente: l'oreillette antérieure est triangulaire, la postérieure a un contour arrondi, légèrement echancré au contact de la valve".

In *E. calvum* the anterior ear is twice as large as the posterior, the apical margins are straight, the apical angle is about 90°, and the shell is elongate, the height being longer than the width. In gerontic specimens the anterior apical margin becomes concave, the posterior convex, the umbo thus being slightly curved and bent forwards.

E. lundgreni is closely allied to *E. calvum* and is probably only a mutation of the latter with a somewhat later occurrence. Thus, the apical margins are straight and the shell equilateral in young specimens, but the forward bend of the umbo in *E. lundgreni*, appears already in medium-sized specimens. A distinctive character is furnished by the concentric wrinkles of the shell; these are visible in all growth-stages though not always well developed.

E. cingulatum (= *E. proeteus* D'ORBIGNY) is higher than it is long; the ears are small and alike, and the apical angle is about 90°.

The first species of this group recorded from Sweden was a small shell from the *Avicula* Bank at Kulla Gunnarstorp, figured and described by LUNDGREN as *Pecten* sp. (1881, P. 29, Pl. 1, Fig. 5). In 1888 MOBERG described *Pecten lundgreni* from the *jamesoni* zone at Fyledalen. In the present collection from Katslösa *Entolium* is one of the most common genera, and runs through the whole sequence.

Entolium hehli (D'ORBIGNY)?

1830. *Pecten glaber* HEHL in ZIETEN, Die Versteinerungen Württembergs, P. 69, Pl. 53, Fig. 1.
1881. *Pecten* sp. LUNDGREN, Molluskfaunan, P. 29, Pl. 1, Fig. 5.
1925. *Entolium Hehlii* STAESCHE, Die Pectiniden, P. 59, Pl. 2, Figs. 13—15.
1936. *Entolium Hehlii* DECHASEAUX, Pectinidés Jurassiques, P. 60, Pl. 8, Figs. 10—11.

Material. Only one specimen, an external mould, figured by LUNDGREN as *Pecten* sp. (LO 424). Dorsal region damaged. One ear partly preserved.

Description. Outline sub-circular, apical angle 100°—110°. The ears seem to have been rather large and extended dorsally, suggesting an angular hinge-line. Surface with a fine and dense concentric striation. Height 19, length 18 mm.

Remarks. The bad state of preservation does not allow of precise identification, but the circular outline, the large apical angle, and the shape of the ears indicate *Entolium hehli*. The specimen differs distinctly from the remaining Swedish species of *Entolium* treated below.

Locality. In the *Avicula* Bank at Kulla Gunnarstorp.

Entolium calvum GOLDF.

Pl. XX, Figs. 9—13

1836. *Pecten calvus* GOLDFUSS, Petref. Germ. 2, P. 74, Pl. 99, Fig. 1.
1871. " *subulatus* BRAUNS, Der untere Jura, P. 393 (pars).

1925. *Chlamys calva* STAESCHE, Die Pectiniden, P. 58, Pl. 2, Figs. 11—12.
1936. *Entolium calvus* DECHASEAUX, Pectinidés Jurassiques, P. 60.

Material. Some 20 specimens, mostly internal casts.

Description. Rather small and flattened shell, ovate, higher than it is long; anterior ear about twice as large as the posterior, no byssial sinus (young) or only a slight excavation (adult) at the anterior margin of the right anterior ear. The inferior shell layer has a dense concentric striation, covered by the fine radiate structure of the superior shell layer. The concentric striae of the anterior ear run parallel to the anterior margin: in the right valve they are sigmoid, in the left straight. Apical angle does not exceed 90°. In young specimens and in casts of the interior the apical margins are almost straight, the umbo thus being strictly symmetrical. But in the adult the anterior apical margin is mostly concave.

Size:	—	Pl. XX, Fig. 9	Pl. XX, Fig. 10	—	—	Mo 6713/14
Height ..	5.4	8	8	9.7	10.5	23 mm.
Length ..	4.8	7	7.5	9	9.4	20.5 "

Remarks. *Entolium calvum* is very common in the sandstone at Katslösa 700, but as a rule, the test is entirely dissolved; when still present it is almost devoid of sculpture and easily falls off, the interior cast being the common mode of preservation. No sculpture is visible, but the shell structure exhibits both concentric and radiating features.

As far as can be seen, there is no possibility of distinguishing between this Katslösa form and the Middle European species *E. calvum*. *E. lundgreni*, belongs to the same group, but differs as to the shell sculpture and the curvature of the umbo (P. 219).

Occurrence. *Entolium calvum* is known from the Lias α and β in Swabia and from the Hettangian of Belgium and Lorraine. The Swedish specimens are from the *Myacid* Bank at Katslösa 700.

Entolium cingulatum GOLDFUSS

Pl. XX, Figs. 1—3; Pl. XXI, Figs. 11—12

1836. *Pecten cingulatus* GOLDFUSS, Petref. Germ. 2, P. 74, Pl. 99, Fig. 3.
1925. *Entolium proetus* STAESCHE, Die Pectiniden, P. 92, Pl. 6, Figs. 3—4.
1925. *Entolium cingulatum* STAESCHE, ibid., P. 93, Pl. 4, Figs. 3—4.
1936. *Entolium cingulatus* DECHASEAUX, Pectinidés Jurassiques, P. 60.

Material. 17 registered specimens from Katslösa.

Description. Outline somewhat elongate, hinge-line straight; ears small, alike, and obtuse-angled. Internal cast with two marginal impressions from the inside of the shell, which embrace the umbo. Apical angle about 90°.

Size:	No. 835	No. 831	Pl. XXI, Fig. 11
Height	6.5	8	11 mm.
Length	6	7.5	10 "

Remarks. GOLDFUSS recorded this species from the Lias and the Upper Jurassic. For the Liassic forms a new species, *Pecten proteus*, was established by D'ORBIGNY, who was in this respect followed by STAESCHE. Since, however, the main point of difference concerns the age, the writer prefers to include the Liassic specimens under the original specific name, an opinion also held by M^lle^ DECHASEAUX. According to DECHASEAUX, *Entolium cingulatum* differs from *E. calvum* only as regards the ears, which are "presque égales".

Occurrence. *E. cingulatum* is recorded from the Hettangian and the Charmouthian of Lorraine, and from the top of the Lias (STAESCHE) and the Upper Jurrassic.

The Swedish specimens are from Beds 8, 32, and 41 at Katslösa.

Entolium lundgreni MOBERG

Pl. XX, Figs. 4—8

1888. *Pecten Lundgreni* MOBERG, Lias i SÖ. Skåne, P. 35, Pl. 1, Figs. 27—32.
1888. *Pecten subulatus?* MOBERG, ibid., P. 36, Pl. 1, Fig. 33.

Material. 55 specimens from Katslösa, mostly fragments.

Holotype. LO 809 t, Paleontological Institute, Lund.

Original description. Rather small, strongly arched at umbo and exterior margin; remaining part of shell rather flat. Outline circular, anterior apical margin concave, posterior one somewhat convex; apical angle accordingly decreasing from 90° or more at the base to less than 90° at the apex. Umbo slightly bent forwards, strong, and provided with marked concentric wrinkles near the apex. Hinge-line almost straight. Shell equivalve, except that the right valve is sometimes more arched than the left at the ventral margin and the anterior ears differ. That of the right valve has subcircular free margin, though byssial sinus is missing, and the anterior left ear has an angular obtuse margin; dorsal margin is of the same length in both ears. Posterior ears narrow, rather long, obtuse-angled. Test thin and glossy with an exceedingly fine sculpture, hardly visible to the naked eye. The surface is covered by closely set, fine and sharp concentric lines; their interspaces are crossed by a still finer striation, always at right angles with the ventral margin. The ears are ornamented in the same way, but on the anterior ear of the right valve the radiating striae are stronger. In one well-preserved specimen, exceedingly fine striae radiate from the umbo. They are not parallel to the above dense radiating striation. Inside entirely smooth. (MOBERG, l. c. Translation in abstract from the Swedish.)

Size of five specimens:

	1	2	3	4	5	
Height	12	14	15	16.5	23.5	mm.
Length	11.5	13	13	14.5	22.5	"

Remarks. MOBERG has discussed the relation between his *Pecten lundgreni* and allied species. He remarks that, "according to BRAUNS (1871, p. 393), *P. subulatus* is synonymous with *P. glaber* HEHL, *P. hehli* D'ORB., and *P. calvus* GOLDFUSS, and accordingly a highly variating species ... Some forms of the species are rather similar to ours, especially as to general shape and habitus. Its identification with *P. lundgreni* is, however, out of the question, partly on account of the particular cross-striation of the concentric zones, which is characteristic of our species, and partly on account of the different structure of the anterior ear of the right valve. In *P. subulatus* the latter has considerably longer upper (dorsal) than lower margin, the ear being deeply sinuated at the base." (Translation from the Swedish.)

However, these features distinguish the genus *Entolium* from other pectinids but do really not touch upon the specific differences. The latter concern the size of the ears and the apical angle, the shape of the hinge-line and the general outline, the arching of the shell, &c. Thus *Entolium lundgreni* has a smaller apical angle than *E. hehli* and coincides in this respect with *E. calvum* and *E. cingulatum*. As in *E. calvum* the anterior ear is about twice as large as the posterior, but the exterior outline is almost circular, and there are no furrows bordering the umbo in the internal moulds, as in *E. calvum* and *E. cingulatum*.

MOBERG also figured and described a fragment of a large specimen, 25 mm. in width, "thus considerably larger than *P. Lundgreni*". Though the sculpture of the surface coincides well with that in the latter species, he referred the fragment to *Pecten subulatus*. In the collections of the Geological Survey of Sweden there is a specimen of a large *Entolium lundgreni* from Rödmölla (23.5 mm. in height, see above). It is an absolutely typical specimen from exactly the same kind of rock as the above fragment, of the same size, and has the same sculpture. There is practically no possibility of referring these two specimens to different species.

Occurrence. *Pecten lundgreni* was founded upon specimens from the *Cardium* Bank of S.E. Scania, common at Kurremölla, rare at the brickyard Fylan. Other specimens in the old collections are from the same horizon at Rödmölla. Most of the Katslösa specimens have been collected at loc. 840 (Bed 30); but the species has also been identified in Beds 32, 36, 39, 40, 41, and 42.

Genus *Pseudopecten* BAYLE

Pseudopecten aequivalvis (Sow.)

1816. *Pecten aequivalvis* SOWERBY, Min. Conch. 2, P. 83, Pl. 136, Fig. 1.
1834. *Pecten aequivalvis* GOLDF., Petref. Germ. 2, P. 43, Pl. 89, Fig. 4.
1888. *Pecten aequivalvis* MOBERG, Lias i SÖ. Skåne, P. 33, Pl. 3, Fig. 17.
1909. *Pecten aequivalvis* MALLING & GRÖNWALL, Medd. D.G.F. Vol. 3, P. 277, Pl. 10, Figs. 6—8.
1936. *Pseudopecten aequivalvis* DECHASEAUX, Pectinidés jurassiques, P. 59.

Material. 15 fragmentary shells.

Distribution. According to DECHASEAUX this species "est exclusivement un fossile du Charmouthien supérieur connu d'Allemagne et Afrique du Nord". In England and N.W. Germany it already appears in the *jamesoni* zone.

The specimens referred to this species from Bornholm and S.E. Scania are derived from beds belonging to the Lias γ or the lower part of the Charmouthian. To the same age belong the present specimens, collected in the beds between Locs. 850 and 900 (Beds 33—40) at Katslösa.

Family DIMYIDAE

Genus *Dimyodon* Rouault

Dimyodon sp.

Pl. XXI, Fig. 9

Material. A natural internal cast and a mould of the exterior with nacrous fragments of the test, all belonging to a right valve.

Description. Shell surface apparently smooth, subovate, dorsal margin almost straight, ears rudimentary. Teeth small, crenulated, strongly divergent. Attachment surface small, almost circular, well visible in the mould. Muscular impressions faintly indicated in the cast, the posterior rounded and larger than the anterior, which is hardly visible.

Size. Height 11.5, length 8.5 mm.

Remarks. The generic characters of this specimen are not at all obvious, the identification with *Dimyodon* thus being merely tentative. Since the specific features are still less obtainable the fragments cannot be compared with known species of this genus.

Horizon and locality. In the shell breccia Bed 8, at Katslösa 700.

Family SPONDYLIDAE

Genus *Plicatula* Lamarck

Plicatula spinosa v. Schlotheim

Pl. XXI, Figs. 1—8

1819. *Plicatula spinosa* Sowerby, Min. Conch. 3, P. 79, Pl. 245.
1836. " " Goldfuss, Petref. Germ. 2, P. 100, Pl. 107, Fig. 1.
1888. " " Moberg, Lias i SÖ. Skåne, P. 30, Pl. I, Figs. 19—21.

Material. More than 80 specimens, typical shells and casts of varying growth-stages, mostly well preserved.

Description. The surface is ornamented with growth lines, radiating folds, and vertically directed spines. Attachment surface of the right valve rather small. Posterior margin less curved than the anterior.

Measurements (height = largest diameter, length = the shortest diameter).

Right valve	Fig. 1	S.G.U.	Fig. 5	Mo 6439	—	—	—	
Height	2.8	3.2	4.8	7	7.7	10.0	14	mm.
Length	2.4	2.7	3.4	6	6.5	8.9	10.5	"

Left valve	Mo 6441	—	Mo 6429	—	
Height	4.5	8.8	8.5	16	mm.
Length	4.2	6.2	6.5	12.5	"

Remarks. BRAUNS (1871) has merged several Liassic species under the head of *Plicatula spinosa*, thus ascribing to the latter a rather large vertical range, while stating its main distribution to be in the Middle Lias. Some British authors seem to have gone still farther in this direction. Thus, H. B. WOODWARD (1893) has recorded *P. spinosa* from Lower, Middle and Upper Lias in Yorkshire. But according to FOX-STRANGWAYS (1892) *P. spinosa* is abundant in the *jamesoni* zone (Lias γ) and rare in the zone next above (the *capricornus* zone) in other parts of England. ROLLIER has distinguished a great many Liassic species of *Plicatula* with restricted vertical distribution, the *P. spinosa* being a Robinien species (mainly Lias γ).

Occurrence. *Plicatula spinosa* has been met with in the zone of *Uptonia jamesoni* in S.E. Scania and at about the same horizon on the island of Bornholm (the *Myoconcha* Bank). The present specimens are from Beds 27, 30 (abundant), 32, 36, 39, 40, 41, and 42 at Katslösa.

Plicatula orbiculoides (RÖMER)?

Pl. XXII, Figs. 1—16

1836. *Ostrea orbiculoides* RÖMER, Die Verstein. d. nordd. Oolithen-Geb., P. 61, Pl. 3, Fig. 14.
1871. *Plicatula spinosa* BRAUNS, Unt. Jura (pro parte), P. 401.
1917. *Plicatula orbiculoides* ROLLIER, Fossiles nov. et peu connus, p. 509.

Material. Two right valves and 68 left ones.

Description. Shell small, inequivalve and inequilateral. Outline varies widely, but is more or less circular in young specimens. Left valve with fine concentric striation and a few radiating folds; thin, arched, more or less pear-shaped in adult stages; hinge-line rather long with small ears; margin bordered by a flat brim; ligament fossa deep, bounded by the interior borders of the short cardinal fossettes for the opposite valve. Right valve very thin with straight cardinal margin, attached by the whole surface to other shells. Cardinals probably very short, judging by the fossettes of the left valve. Left valves common, mostly preserved as internal casts; only two right valves met with.

Size:	ROEMER's figured specimen	1	2	3	4	5	6	7	
Height	8.2	3.3	3.7	6.2	6.7	6.9	7.0	10.0	mm.
Length	6.0	2.9	3.0	5.3	6.0	5.5	5.5	7.0	"

Remarks. At Katslösa 850 there are a great many specimens, all left valves, most of them preserved only as internal casts. The shell, having been attached by the whole surface of the right valve to other shells, has often received allomorphous sculpture, even on the left valve, which thus exhibits strong ribs of varying number, size, and direction (Figs. 4, 5, 6, 8, 12, 14). This firm attachment of the right valve to larger shells has caused the post-mortem separation of the two valves, the left ones accordingly being transported and not buried *in situ*, as has probably been the case with the right valves.

One of the right valves was attached to *Ptychomphalus* cf. *expansa* (Katslösa 955 b), the other to the left anterior ear of *Chlamys textoria* (Katslösa 925). Specimens with a smooth surface have probably grown upon the large whorls of *Ptychomphalus*, or some other smooth shell decidedly larger than those represented by the main fauna described here. This applies also to specimens with coarse ribs impressed on the left valve; these have been sessile on ribbed shells, though the sculpture has not yet been identified.

This species has been tentatively grouped under *Plicatula orbiculoides* RÖMER. The description of the latter is only scanty and the figures given by RÖMER are bad, but in some essential characters the coincidence is good. Thus the specimens figured by RÖMER are of the same size and have been attached by their entire surface — a rare feature among the Liassic *Plicatulae* — but, they differ as to the outline. This, however, may be due to the fact that their test is preserved and shows the ears, while in our specimens the internal casts dominate. According to RÖMER, *Plicatula orbiculoides* was attached to *Nautilus*. In the present case we have only to state that our specimens were attached to different kinds of shells, which does not constitute a reason for the establishment of a new species.

P. orbiculoides (?) is easily distinguished from *P. spinosa*, on account of the long hinge-line with rudimentary ears, the small cardinal fossettes of the left valve and the rounded or pear-shaped outline, which is less inequivalve than in *P. spinosa*.

Occurrence. *Plicatula orbiculoides* (RÖMER) was originally derived from the Belemnite Beds at Kohlefeld and Willershausen (Lias γ). The present specimens are from about the same horizon in Beds 30, 32 (abundant), 41, and 42 at Katslösa.

Plicatula sp. 1

Cf. 1855. *P. hettangiensis* TERQUEM, Mém. Soc. Géol. France (2) 5, P. 326, Pl. 24, Figs. 3—4.

Material. A fragmentary right valve (R.M. Mo 6751), surface strongly worn, umbonal portion missing.

Description. Attachment surface has been of about the same size as in *P. spinosa*. The remaining surface is still covered with thin but low radiating and undulating ribs, more or less divided into tubercles by a mostly fine concentric striation. The ribs have probably been spinous as in *P. spinosa* or *P. hettangiensis*. They are much more crowded than in *P. spinosa* and in this respect more similar to *P. hettangiensis* TERQUEM.

Horizon and locality. The *Avicula* Bank at Kulla Gunnarstorp.

Plicatula sp. 2

Pl. XXI, Fig. 10

Material. A strongly worn hinge of a large left valve.

Description. Deep ligament-pit, surrounded by a pair of thick elevated borders and extending as far as the dorsal margin. Outside of these borders are two deep sockets for the cardinals of the opposite valve, and finally two, not very prominent, cardinals.

Remarks. Owing to its bad state of preservation and its incompleteness this specimen cannot be identified. It is of interest on account of its great size, which surpasses everything met with of this genus in the Katslösa beds and might be compared with that of *Plicatula suecica* LUNDGREN (1881) of the Brandsberga fauna.

Horizon and locality. Katslösa loc. 875.

Genus *Terquemia* TATE

The genus *Terquemia* is similar to *Ostrea*, but differs in being attached by the right valve, which is convex, while the free left valve is more flattened; the ligament-pit is triangular as in *Spondylus*. Accordingly this genus has to be classed with the *Spondylidae*, not with the *Ostraeidae*.

Genotype: *Ostrea arietis* QUENSTEDT.

Terquemia arietis (QUENST.)

1858. *Ostrea arietis* QUENSTEDT, Jura, P. 85, Pl. 10, Fig. 10.
1888. *Ostrea? domicilii* MOBERG, Lias i SÖ. Skåne, P. 30, Pl. 1, Figs. 17, 18.
1929. *Terquemia arietis* SCHÄFLE, Lias u. Doggeraustern, P. 81, Pl. 6, Figs. 11—12.

Diagnosis. *Terquemia* with well developed radial ribs in the ephebic and gerontic stages, much more numerous and regular than in *Ostrea semiplicata*, which has often been confused with *Ostrea arietis* (cf. BRAUNS 1871, p. 406).

Material. Half a dozen, mostly small specimens from Katslösa.

Description. In well preserved shells the fine radiating ribs are visible. In some specimens there is an indication of folds just at the ventral margin. The attachment surface is sometimes visible in casts of the right valve; muscle scars well visible both on the inside of the valves and in the casts.

Remarks. To this species *Ostrea? domicilii* MOBERG (1888) certainly belongs. MOBERG figured one upper free valve and a cast of the lower attached valve. The latter is deeply concave with strong irregular concentric folding and a longitudinal flat impression of the attachment surface at the umbo. As is seen from the muscular impression situated near the posterior margin, it is a right valve, thus indicating a spondylid species. The left or upper valve is the free one. It is equally arched, with opisthogyre umbo, concentric folds, and numerous radiating, somewhat irregular ribs. This is likely to be a neanic stage of *Terquemia arietis*, in which the strong radiating folding has not yet begun.

Size:	Height	Length		
Kurremölla, Mo 6573, L.V. ..	22	22	mm.	(MOBERG 1888, Pl. 1, Fig. 17)
Kurremölla, LO 802 t, R.V. ..	20	20	”	(” ” ” ” 18)
Katslösa 768, S.G.U. Museum, L.V.	5.5	5.5	”	

Occurrence. *Terquemia arietis* is a wide-spread species. According to SCHÄFLE it is recorded from nearly all Liassic regions in Europe, and ranges through all the Lias, probably up into the *sowerbyi* zone of the Middle Jurassic. The Swedish specimens have been collected in Beds 8, 18, 30, 36, and 45 at Katslösa, and in the *Cardium* Bank at Kurremölla, S.E. Scania.

Family ANOMIIDAE

Genus *Anomia* L.

Anomia pellucida TERQUEM(?)

Pl. VI, Figs. 7—9

1855. *Anomia pellucida* TERQUEM, Mém. Soc. géol. France (2) 5, P. 330, Pl. 25, Fig. 5.
1865. *Anomia pellucida* TERQUEM & PIETTE, Ibid. (2) 8, P. 113.
1878. *Discina* sp.? LUNDGREN, Studier, P. 57, Fig. 42.

Material. One right valve and four entire specimens, all adhering to a shell of *Cardinia* (LO 323). One right valve attached to a fragment of *Gervillia hagenowi*, together with two left valves in a free position (R.M. Mo 6752).

Description. Shell small, circular in outline — when not deformed by adjacent specimens. Right valve flat and thin, in close contact with the substratum, and with a large byssial sinus or foramen. Left valve arched. Both valves have adopted the sculpture of the shell they adhere to (in this case *Cardinia*), thus being covered with a dense striation which runs straight across the *Anomia* shells independently of their position.

The specimens Figs. 7 and 8 in Pl. VI (Mo 6752) are greater in length than height. The allomorphous sculpture is missing in Fig. 7 — probably due to attachment to a smooth shell — but the original concentric striation of growth-lines is preserved. In Fig. 8 the allomorphous structure is much finer than in the specimens sessile on *Cardinia*. Among the latter are three specimens close together, deformed at their mutual contacts (Pl. VI, Fig. 9).

Size:	Riksmuseum Mo 6752 (Two specimens)		LO 323 Pal. Inst. Lund (Three specimens)		
Length	2.3	2.3	2.5	2.5	3.3 mm.
Height	2.0	2.0	3.0	3.2	3.5 "

Remarks. This species is probably not distinguishable from *Anomia pellucida* TERQUEM from the Upper Hettangian and the Sinemurian of Belgium, Luxemburg and adjoining parts of France. The only difference seems to be in the size, which according to TERQUEM is 12 × 12. One of the specimens figured by TERQUEM (5 b) is a left valve, 17.5 mm. high and 14 mm. in length.

Horizon and locality. All specimens have been found in the *Ostrea* Bank at Kulla Gunnarstorp.

Family OSTREIDAE

Genus *Liostrea* DOUVILLÉ

Liostrea hisingeri (NILSSON)

Pl. IV, Fig. 17

1832. *Ostrea Hisingeri* NILSSON, Djur-petrifikater, P. 354, Pl. 4, Fig. 2.
1878. " " LUNDGREN, Studier, P. 36, Figs. 28, 29, 40 (with synonyms).
1929. *Liostrea irregularis* SCHÄFLE, Lias- u. Doggeraustern, P. 16, Pl. 1, Figs. 1—14 (with synonyms).

Original diagnosis. "Testa ovato-oblonga, antice latiore, interdum incurva; valva utraque plicis rugosa, inferiore convexa, superiore plana; rostro adfixo."

Remarks. The genus *Ostrea* embraces Tertiary and Recent species. For the smooth ostreids of the Jurassic and Cretaceous H. DOUVILLÉ (1910) has proposed the generic name *Liostrea*, genotype *O. sublamellosa* DUNKER 1846. As shown by HÉBERT (1869) the latter species is a synonym of *O. hisingeri.* In 1878 LUNDGREN also claimed that *O. liassica* STRICKLAND 1871 was synonymous of *O. hisingeri.*

The wide range of variation of this Lower Liassic species has induced SCHÄFLE (1929) to throw a great many *Liostrea* "species" of this age into one single species, for which he uses the oldest name known to him, viz. *Ostrea irregularis* MÜNSTER 1834. One of his synonyms is "1878 *Ostrea Hisingeri* NILSS. bei LUNDGREN". If, therefore, one specific name may be used to cover all these variations, it should certainly be *Ostrea hisingeri* NILSS. 1832.

Distribution. According to SCHÄFLE this species occurs in beds from the Rhaetic to the Lias α_3, but the main distribution is in the *planorbis* (α_1) and *angulatus* (α_2) zones in all Liassic regions of Europe. In Scania it is a characteristic and common shell of the Helsingborg Stage. It has never been found in the Döshult and only one fragmentary and dubious specimen has been collected in the Rhaetic (P. 140).

Genus *Liogryphaea* P. FISCHER 1886

Type species *Ostrea arcuata* LAMARCK

For Liassic ostreids, in which the left valve is regularly arched and incurved, P. FISCHER introduced the generic name *Liogryphaea.* The different species have been treated by SCHÄFLE (1929), DECHASEAUX (1934), and JOLY (1936), to which is referred for the lists of synonyms.

The species referred to below have been determined in accordance with the descriptions given by SCHÄFLE and DECHASEAUX. The most important features in distinguishing the different species are the degree of curvature in adult specimens, and the general outline, i. e. the relation of height to length. The earlier forms, such as the typical *L. arcuata*, have an anal sinus that disappears in the later ones. The left valve tends to widen backwards, the extension being separated from the main part of the shell by a longitudinal furrow. This feature, sometimes visible in young stages also, appears already in *L. arcuata* var. *lata*, and is characteristic of advanced species such as *L. regularis*, *L. arcuata* var. *cymbium*, etc. In youth stages, where neither the curvature nor the longitudinal furrow have been developed, it is difficult, if not impossible, to determine the species.

The main occurrence of *Liogryphaea* is in the Ammonite Bank of N.W. Scania, especially at Oregården, where *L. arcuata* forms a shell bed ("Gryphite Bank") at 63 m. in the drilling No. 271. Beside the dominating form there are also typical specimens belonging to mutation *lata* ZIETEN (Pl. 8, Figs. 11—13).

In the Katslösa beds the *Liogryphaeas* are rare, and practically only young specimens have been met with. In the lower beds (Loc. 700) they belong to *L. arcuata*, but higher up (Locs. 840—1000) typical specimens of *L. regularis* have been identified, though most specimens are undeterminable. To *L. regularis* belong, also, those described by MOBERG as *Gryphaea arcuata* from the *jamesoni* zone of S.E. Scania.

Liogryphaea arcuata (LAMARCK)

Pl. I; Pl. VII, Figs. 1—6; Pl. VIII, Figs. 1—10

1881. *Ostrea (Gryphaea) arcuata* LUNDGREN, Molluskfaunan, P. 24, Pl. 1, Figs. 13—14.
Non 1888. *Ostrea (Gryphaea) arcuata* MOBERG, Lias i SÖ. Skåne, P. 29, Pl. 1, Figs. 14—16.
1929. *Gryphaea arcuata* SCHÄFLE, Lias- und Doggeraustern, P. 26, Pl. 2, Figs. 7—17; Pl. 3, Figs. 1—4, 9.
1934. *Liogryphaea arcuata* DECHASEAUX, Bull. Soc. géol. France (5) 4, P. 202, Pl. 100, Fig. 1.
1936. *Liogryphaea arcuata* JOLY, Lias inférieur, P. 89.

Material. Both valves of different growth stages. A great many specimens from Oregården, Döshult, Dompäng, Kristinelund, and Katslösa.

Description. Left valve incurved in adult stages; attachment surface is more or less developed and usually disappears in the adult; anal sinus present, or marked by the growth lines; no dorso-ventral furrow in the posterior part of the shell. Right valve more or less circular in outline.

Growth-stages. The abundant collection from Oregården has made it possible to study and compare different growth stages.

The left valve of early youth stages is convex but without curvature, and the attachment area is large and faces outwards. In larger specimens the convexity becomes more pronounced, as well as the curvature of the umbo ("opisthogyre Wirbeleinkrümmung"), the area first facing outwards and upwards and finally posteriorly simultaneously becoming smaller. The size of the area varies independently of the stages of growth. In specimens with exceptionally small attachment area (and these appear in almost all stages of growth) the area is worn, at least at the margins. In other specimens, when there is not actually an object attached, there are often plain impressions of it on the area. These objects consist mostly of shells of other lamellibranchs, very often the left valve of *Avicula sinemuriensis*. As such minute shells cannot retain the large *Liogryphaeas* sessile, these oysters must have been free on the bottom, except during their earliest stages of growth, being biologically similar in this respect to some simple corals.

Size of left valves (millimetres):

	Large area No curvature		Large area Slight curvature				Medium area Medium curvature		Small area Strongly curved umbo			
Height	11.2	13	14.2	18.0	20.0	20.9	24.2	25.9	4.1	17.8	34	mm.
Length	12.0	12.4	11.4	13.0	17.8	16.0	21.7	21.5	4.1	14.4	28.3	"

As shown by these measurements medium-sized specimens and even early growth-stages may be strongly curved at umbo. If so, the attachment area is very small, the specimens thus having lost their attachment at an early growth stage. The table also shows that the height of the left valve is considerably greater than the length, except in the earliest stages, where the case is *vice versa*, or the height and length are equal.

Size of the right or flattened valve (millimetres):

	Neanic stages							Ephebic stages						
Height	3.2	4.6	5.0	5.3	7.5	8.7	9.8	11.0	11.5	12.5	14.8	19.1	19.5	20.5
Length	2.5	4.1	4.3	5.0	7.1	7.2	8.5	9.0	11.0	10.3	13.7	17.0	18.0	19.0

The earliest stage of the right valve is represented by a more or less smooth convexity seen at the apex in the adult and not exceeding 3 mm. in diameter. In later stages the shell becomes concave, with strong concentric callosities (Pl. 7, Fig. 5).

The prodissoconch has not yet been found in this collection of well-preserved specimens.

Occurrence. *Liogryphaea arcuata* LAMARCK is a leading fossil in a part of the Lower Lias of W. Europe. It appears in the *angulatus* zone, is abundant in the Lower Sinemurian (Gryphiten-Kalk), and ranges up into the Upper Sinemurian. The main distribution is in the Lower Sinemurian. In Sweden it is found at Oregården, Dompäng, Döshult, and Katslösa all belonging to the Lower Sinemurian. The Katslösa specimens are rare neanic stages derived from Bed 8.

Liogryphaea arcuata var. *lata* v. ZIETEN 1834

Pl. VIII, Figs. 11—13

1934. *Liogryphaea arcuata* mutation *lata* DECHASEAUX, Bull. Soc. géol. France. (5) 4, P. 210, Pl. E, Fig. 1.
1936. *Liogryphaea arcuata* mutation *lata* JOLY, Lias inférieur, P. 91.

Description. A few of the mature specimens show the characteristically wide and deep left valve of mut. *lata* (Sinemurian age), with an indication of the longitudinal furrow.

Occurrence. Oregården, bore-hole No. 271, at 63 m., together with *L. arcuata.*

Liogryphaea regularis DESHAYES

1888. *Ostrea (Gryphaea) arcuata* MOBERG, Lias i SÖ. Skåne, P. 29, Pl. 1, Figs. 14—16.
1929. *Gryphaea cymbium* SCHÄFLE, Lias- und Doggeraustern, P. 41, Pl. 3, Figs. 11, 12, 14; Pl. 4, Figs. 1—5.
1934. *Liogryphaea regularis* DECHASEAUX, Bull. Soc. géol. France. (5) 4, P. 206, Pl. D.
1936. *Liogryphaea regularis* JOLY, Lias inférieur, P. 92.

Material. One mature specimen, wave-transported and rounded but still well recognizable. More than 40 specimens of young stages.

Description. The large specimen, is nearly boat-shaped, and much less curved than *L. arcuata*. It coincides well with the figures of *L. regularis* presented by the above authors. The left valve in young specimens shows the posterior extension of the shell and the longitudinal furrow. Though this feature is characteristic of several species or varieties, even of the contemporaneous form *L. arcuata* var. *cymbula*, it seems most appropriate to group these immature specimens, at least temporarily, with *L. regularis*, since no other species of this genus has been identified in these beds in Sweden.

Geological age. Upper Sinemurian and Lower Pliensbachian.

Occurrence. The mature specimen was derived from Bed 36, the youth stages from Beds 30, 32, 36, 40, and 45 at Katslösa.

Family MYTILIDAE

Genus *Modiola* LAMARCK

As the close affinity between *Mytilus* and *Modiola* often makes it difficult to discriminate between these genera in the Lower Lias, the literature shows great confusion as to the use of these names, as is seen from the list of synonyms below. ROLLIER, for instance, lays stress upon the terminal or subterminal position of the umbo and has given only subgeneric rank to *Modiola*. However, there are other characters which aid in distinguishing these genera. Thus, the anterior end of *Modiola* is not pointed as in *Mytilus*, but inflated in the oral region, making the anterior end broad and rounded. Furthermore, *Modiola* has no teeth or crenulations of the hinge-line, and the anterior adductor impression is considerably larger than in *Mytilus*.

Modiola hillana Sow.

Pl. IV, Figs. 9—11; Pl. VI, Fig. 6

1818. *Modiola Hillana* SOWERBY, Min. Conch. 3, Pp. 21 and 194, Pl. 212, Fig. 2.
1832. *Modiola Hoffmanni* SVEN NILSSON, Djur-petrifikater funna i Skånes Stenkolsbildning, P. 355, Pl. 4, Fig. 4.
1846. *Modiola glabrata* DUNKER, Palaeontogr. 1, P. 39, Pl. 6, Figs. 17—18.
1853. *Mytilus hillanoides* CHAPUIS & DEWALQUE, Description des Fossiles, P. 185, Pl. 25, Fig. 3.
1855. *Mytilus liasinus* TERQUEM, Mém. Soc. Géol. France (2) 5, P. 312, Pl. 21, Fig. 9.
1855. *Mytilus rusticus* TERQUEM, ibid., P. 312, Pl. 21, Fig. 10.

1858. *Modiola psilonoti* QUENSTEDT, Der Jura, P. 48, Pl. 4, Fig. 13.
1869. *Mytilus Hoffmanni* HÉBERT, Ann. sci. géol. T. 1. P. 129, Pl. 2, Figs. 11—12.
1869. *Mytilus minutus* HÉBERT, ibid., P. 130, Pl. 2, Figs. 13—14.
1869. *Mytilus psilonoti?* Hébert, ibid., P. 131, Pl. 2, Figs. 15—16.
1869. *Mytilus ervensis* HÉBERT, ibid., P. 132, Pl. 2, Fig. 17.
1871. *Modiola Hillana* BRAUNS, Der untere Jura, P. 346.
1878. *Mytilus Hoffmanni* LUNDGREN, Studier, P. 44, Figs. 21—23.
1878. *Mytilus minutus* LUNDGREN, ibid., P. 44, Figs. 9—10.
1878. *Mytilus geniculatus* LUNDGREN, ibid., P. 46, Fig. 30.
1878. *Mytilus guttaeformis* LUNDGREN, ibid., P. 46, Fig. 32.
1878. *Mytilus acuminatus* LUNDGREN, ibid., P. 46, Fig. 33.
1881. *Modiola Hoffmanni* LUNDGREN, Molluskfaunan, P. 37.
1881. *Modiola minuta* LUNDGREN, ibid., P. 37.
1881. *Modiola geniculata*, *M. guttaeformis*, and *M. acuminatus* LUNDGREN, ibid., Pp. 36—37.
1901. *Modiola Hoffmanni* BÖHM, Zeitschr. d. d. geol. Ges. Bd. 53, P. 232, Pl. 9, Figs. 14—15.
1907. *Modiola minuta* MOBERG, G.F.F. Bd. 29, P. 281, Pl. 7, Fig. 1.
1907. *Modiola* spp. I—II MOBERG, ibid., P. 281, Pl. 7, Figs. 2—3.
1914. *Mytilus (Modiola) Hillanus* ROLLIER, Fossiles nouveaux ou peu connus, P. 339.
1936. *Mytilus hillanus* JOLY, Lias inférieur, P. 112.
1948. *Mytilus hoffmanni* TROEDSSON, G.F.F. Bd. 70, Pp. 535 and 549, Text-Figs. 1—3.

General remarks. At a Natural History Congress in Berlin in the year 1828, the Swedish zoologist SVEN NILSSON demonstrated some fossil lamellibranchs, then identified as belonging to the Lias, a formation up to that time unknown in Sweden. They were from what we now call the *Ostrea* and *Avicula* Banks at the shore north of Helsingborg. Later on (1832) he described and figured the fossils, viz. *Avicula inaequivalvis*, *Ostrea hisingeri*, *Modiola hoffmanni*, *Donax arenacea*, and a "*Venulith*", all of which are treated in this paper. The description of *Modiola hoffmanni* was accompagnied by a very bad figure. The same species was redescribed and refigured by HÉBERT (1869) and LUNDGREN (1878, 1881), who claimed it to be synonymous with *Modiola glabrata* DUNKER. On the other hand, *Modiola glabrata* has been classed with *Modiola Hillana* Sow. by OPPEL (1856—1858), BRAUNS (1871), ROLLIER (1914), and JOLY (1936). Indeed, the great variation of *M. hillana* Sow. seems to include most of the *Modiola* "species" described from the Hettangian of W. Europe. The typical broad and short form is represented by *M. hillana* (England), *M. glabrata* (Germany), and *M. hoffmanni* (Sweden, Portugal); a narrow form by *M. liasina* (France) and *M. psilonoti* (Germany), and small specimens by *M. liasina* and *M. rustica* (France).

The Swedish representatives of *Modiola hillana* Sow.

All these variations are met with in Sweden, too, where the narrow form has usually been named *M. minuta*, while the "typical" form has been listed as *M. hoffmanni.*

Modiola hoffmanni was described by SVEN NILSSON as follows: "testa oblonga, curva, antice coarctata, postice compressa, extremitate subtruncata, medio parum latiori, margine inferiori angulato-rotundato". In most specimens the lime has been dissolved, the shells thus being preserved as steinkerns with impressions of the exterior sculpture of growth-lines.

Specific characters. Umbo high, continued backwards by a ridge, which disappears slowly towards the postero-ventral corner and dips rapidly towards the ventral margin. Dorsal margin almost straight; at about the middle of the conch it meets the posterior margin at an obtuse angle or in a gentle curve. Posterior end well rounded, ventral margin slightly concave.

Size:	Length	Height	Relation L : H
LO 1989 *Modiola* sp. II Moberg	5.5	3.2 mm.	1.7
On the same piece of rock	6.7	3.6 "	1.8
LO 285 *M. minutus* Lundgren (1878, Fig. 9) ..	15.0	7.0 "	2.1
LO 1988 *Modiola* sp. I Moberg	19.3	9.0 "	2.1
Höganäs, from an old mine shaft	23.0	10.5 "	2.2
LO 290 *M. geniculatus* Lundgren	26.5	14.7 "	1.8
LO 1990 *M. minuta* Moberg	28.5	12.5 "	2.2
LO 286 *M. minutus* Lundgren (1878, Fig. 10)	30.2	13.4 "	2.2
LO 292 *M. acuminatus* Lundgren .... ca.	32	14.2 "	2.2
LO 287 *M. hoffmanni* Lundgren (1878, Fig. 21)	35.6	16.5 "	2.1
R.M. Mo 6756 *Ostrea* Bank, Kulla Gunnarstorp	46.5	21.7 "	2.1

The relation of length to width is rather constant, except in the smallest specimens, which has not yet received their definite shape, and in the specimen described as *M. geniculatus* Lundgren. The latter is secondarily deformed, as referred to below.

Remarks. The more or less angular or regularly curved dorsal side has given rise to a striking variation of form. Thus, there is the typical *M. hoffmanni*, badly figured by Nilsson. It is rather wide at the middle, the dorsal outline being either strongly curved or obtusely angular. Another form, wrongly referred to *Mytilus minutus* by Hébert and Lundgren, is less outstanding at the dorsal side. There are also other variations, some of which might be due to the state of preservation, especially to deformation by compaction, which has hit the specimens in different positions, thus bringing about secondary features which have been mistaken for primary ones and wrongly used for distinguishing species. Hébert described 5 species from the Mytilus Bank of the Helsingborg region, out of which Lundgren recognized only two, viz. *M. hoffmanni* and *M. minutus*, though in his opinion *M. minutus*, being a Rhaetic species, did not occur in the Liassic *Mytilus* Bank, but only in the *Pullastra* Bank, that he believed to be Rhaetic. In return Lundgren described three additional species from the *Mytilus* Bank. A careful investigation of a great many specimens has shown that all these species are in reality synonymous with *Modiola hoffmanni* (= *M. hillana*).

Thus *M. psilonoti* Hébert is intermediate between *M. hoffmanni* and "*Mytilus minutus*" Hébert.

M. ervensis Hébert is a fragmentary specimen, probably not distinguishable from *M. hoffmanni*.

The *M. lundgrenii* HÉBERT was founded upon a single specimen from the "grès d'Helsingborg". Judging by the figure it represents a rather aberrant form. It has never been found again.

M. geniculatus LUNDGREN is a flattened specimen, extremely wide, due to secondary processes. *M. guttaeformis* is a young specimen. Both belong to *M. hoffmanni*.

M. acuminatus LUNDGREN seems to be a typical *M. hoffmanni*. The type specimen (LO 292 T) is damaged at the umbo, and the posterior end is broken, but a reconstruction will give an outline similar to that of *M. hoffmanni* or "*M. minutus*" LUNDGREN, which is rather different from LUNDGREN's figure of *M. acuminatus*. The umbonal part in this figure is exactly the same as that in HÉBERT's Fig. 11 of *M. hoffmanni*.

In his description of a new fauna at Kärnan in Helsingborg, MOBERG, following the identifications made by LUNDGREN, referred specimens of *Modiola hoffmanni* to *M. minuta*.

Modiola sp. I MOBERG 1907 is an obliquely embedded left valve of *M. hoffmanni* (LO 1988).

Modiola sp. II MOBERG is represented by two left valves, 5 and 7 mm. in length respectively (LO 1989). They are early growth stages of *M. hoffmanni*.

Finally small specimens of the type, described as *M. rusticus* TERQUEM & PIETTE, have been found in the *Avicula* Bank at Kulla Gunnarstorp and Dompäng. They have been referred, but doubtfully, to *M. hillana* SOW.

Occurrence. *Modiola hillana* is a wide-spread and common species in the Hettangian and Lower Sinemurian of W. Europe, and has been met with in Germany, France, Belgium, Luxembourg, England, and Portugal. The bulk of the Swedish specimens ("*M. hoffmanni*" NILSSON) are from the *Mytilus* Bank at Gravarna and Sofiero, but the vertical distribution ranges from the base of the Helsingborg Stage up into the *Avicula* Bank at Dompäng and Kulla Gunnarstorp.

Modiola ruuthi n. sp.

Pl. VI, Figs. 4—5

1878. *Mytilus* sp. LUNDGREN, Studier, P. 47, Fig. 83.
1881. *Modiola?* sp. LUNDGREN, Molluskfaunan, P. 36.

Material. The holotype, R.M. Mo 6755, figured by LUNDGREN, with the external mould R.M. Mo 6756; dorsal margin and anterior end damaged. One incomplete specimen without umbo.

Description. *Modiola* long and narrow, dorsal margin curved, especially in the anterior part, ventral margin slightly concave. Anterior end of shell curved downwards, posterior two-thirds straight and parallel-sided. Surface smooth, except for a fine concentric striation. Anterior extremity with the hinge is missing. Anterior region rather inflated, the maximum inflation being at one-third the shell length from the anterior end. Posterior half of shell decreases gradually in thickness. No ridges in connection with the umbo.

Size. Length 46, width 15 mm.

Specific name. Count Eric Ruuth (1746—1820), pioneer in the coal industry of Sweden.

Remarks. The most striking feature of this species is the narrow, slender shell, almost straight in the middle and posterior parts. In this respect it differs definitely from the gently curved *M. scalprum*, with which it was compared by LUNDGREN. *Mytilus subparallelus* CHAPUIS & DEWALQUE is a true *Modiola* with a similar slender shell, but differs in its dorsal margin, which is almost straight in the anterior part.

Occurrence. The holotype was found in a pebble of brown iron-sandstone at Höganäs ("Pebble No. 1"), together with *Liostrea hisingeri*. The second specimen was found in a piece of the same rock, derived from the coal mine at Höganäs.

Modiola cf. *tenuissima* TERQUEM and PIETTE

Pl. XIV, Fig. 8

1868. *Mytilus tenuissimus* TERQUEM et PIETTE, Mém. Soc. Géol. France (2) 8. P. 94, Pl. 11, Figs. 21, 22.

Specific characters. Thin shell, short and broad, rather inflated, with a regular concentric striation, both ends rounded. Length 8, width 5 mm.

Remarks. Only one specimen met with. This is somewhat damaged at the margins, making determination uncertain.

Occurrence. *M. tenuissima* is a common species in the *bisulcatus* zone of eastern France. The present specimen is from the shell breccia at Katslösa 700.

Modiola scalprum Sow.

Pl. XIV, Figs. 9—10

1819. *Modiola cuneata* SOWERBY, Min. Conch. 3, P. 87, Pl. 248, Fig. 2.
Modiola Scalprum SOWERBY, ibid., P. 186.
1837. *Mytilus scalprum* GOLDFUSS, Petref. Germ. 2, P. 174, Pl. 130, Fig. 9.
1936. *Mytilus scalprum* JOLY, Lias inférieur, P. 113.

Material. 4 young specimens.

Specific characters. *Modiola scalprum* Sow. is a uniformly thick, gently curved, and rather large species, the figures given by SOWERBY and GOLDFUSS measuring respectively 115 and 75 mm. in length, the former $3\,{}^1/_2$ and the latter 3 times as long as wide. It differs from the contemporaneous species *M. numismalis* (OPPEL) in its much finer concentric striation. The straight diagonal ridge running from the umbo to the posterior ventral corner seems to vary in both species.

Remarks. The Katslösa specimens coincide as to ridge and ornamentation with *Modiola scalprum*. The ridge is rather well-marked in the anterior, more effaced in the posterior, in this respect being most similar to the figure given by SOWERBY. They differ, however, in size, the largest specimen being hardly 18 mm. in length, they are less curved, the ventral margin being almost straight. These small specimens are only twice as long as they are wide, though, as shown by the measurements, the relation length/width tends to increase with the age. This is why the writer considers these small specimens to be early growth-stages or dwarf forms of *Modiola scalprum*.

Size:	Mo 6552	Mo 6526	Mo 6525	Mo 6569
Length	4.5	6	11.5	17.7 mm.
Width	2.0	3.5	6.5	7.6 "

Horizon and localities. *Modiola scalprum* is a widespread Lower and Middle Liassic species. The Swedish occurrence is at Katslösa 840 and 875.

Modiola sp.

Material. 10 fragmentary specimens, mostly casts.

Description. Rather coarse concentric striation. General view similar to *Modiola hillana*, but the specimens are too incomplete to allow of certain identification.

Locality. Katslösa 700.

Genus *Mytilus*

Mytilus cf. *lamellosus* Terquem

Pl. XIV, Figs. 11 a—b

1855. *Mytilus lamellosus* Terquem, Mém. Soc. Géol. France. (2) 5, P. 310, Pl. 21, Fig. 5.
1858. *Mytilus psilonoti* Quenstedt, Jura, P. 48, Pl. 4, Fig. 14 (*non Modiola psilonoti* Quenstedt).
1868. *Mytilus lamellosus* Terquem & Piette, Mém. Soc. Géol. France. (2) 8, P. 92.

Material. One natural internal cast. S.G.U. Museum.

Description. Shell equivalve, almost equilateral. Umbones narrow, terminal, turned inwards and forwards. From the lateral view the shell is pointed at the umbo, while the posterior two-thirds are of uniform width with rounded posterior end. Again, in lateral view the anterior half is inflated and the inflation thins out regularly towards the margins of the posterior half of the shell. Anterior adductor scars small, close to the umbo. No trace of shell sculpture preserved.

Size. Length 9.3, width 5.8, and thickness 4.2 mm.

Remarks. This species is very similar to *Mytilus lamellosus* Terq., a rare species only met with in the *angulatum* zone of Luxembourg, Lorraine, and Swabia. In fact, no specific differences can be observed, which may, of course, be due to the deficient state of preservation of our specimen. Since only one has been met with, it might provisionally be placed in the vicinity of *M. lamellosus*.

Occurrence. Katslösa 840.

Family MODIOLOPSIDAE

Genus *Myoconcha* Sow.

Myoconcha decorata Münster

1837. *Mytilus decoratus* Goldfuss, Petref. Germ. 2, P. 174, Pl. 130, Fig. 10.
1868. *Myoconcha scabra* Terquem & Piette, Mém. Soc. géol. France. (2) 8, P. 84, Pl. 9, Figs. 4—6.
1871. *Myoconcha decorata* Brauns, Der untere Jura, P. 334, Pl. 2, Figs. 8—10.
1936. *Myoconcha scabra* Joly, Lias inférieur, P. 114.

Material. 5 fragmentary specimens.

Specific characters. This species is recognizable by its characteristic ornamentation of thin radiating ribs, and wide interjacent fields crossed by a dense concentric striation, angularly broken at the ribs.

Size. The shells seem hardly to have exceeded 10 mm. in length.

Remarks. Malling and Grönwall have described two species from the *Myoconcha* Bank of the island of Bornholm, viz. *M. stampensis* and *M. jesperseni*. The latter seems to be well defined, but *M. stampensis* closely resembles *M. decorata*. According to the above authors the latter is more flattened and narrower. Professor Alfred Rosenkrantz, Copenhagen, has kindly placed at my disposal for comparison, casts of the type specimens, and some additional specimens from the type locality preserved in the Mineralogical Museum. The Bornholm specimens are devoid of the test, but the sculpture is visible in casts, though much fainter than in *M. decorata* figured by Brauns. However, this difference is not necessarily of specific value. The same might be said of the narrowness of the shells which differs considerably within *M. stampensis*. If the flattening of the specimen in Brauns' Fig. 9 is not due to compression it is certainly a good specific character, but his Figs. 8 and 10 show the same arching as do the Bornholm specimens of *M. stampensis*. This makes it doubtful whether it is possible to keep *M. stampensis* separate from *M. decorata*. In the absence of material for comparison the author must leave this question open.

As regards the Katslösa specimens these are very small, attaining only about one-fourth the length of *M. stampensis* or *M. decorata*. One specimen has the test preserved and shows exactly the same sculpture as the type figured by Brauns. The remaining specimens are fragmentary.

Geological age. Sinemurian and Pliensbachian.

Occurrence. Katslösa Beds 30, 40, 41, and 42.

Lamellibranch incertae sedis

Genus *Taeniodon* Dunker

Taeniodon? nathorsti Lundgren sp.

Pl. VII, Figs. 11—5

1878. *Cyclas Nathorsti* Lundgren, Studier, P. 49, Fig. 31.
1881. *Cyclas? Nathorsti* Lundgren, Molluskfaunan, P. 43.

Original diagnosis: "Testa rotundato-ovata, postice paullum latior, striis concentricis tenuissimis ornata."

Material. The holotype LO 303 T. About 30 specimens, all natural internal casts, and several moulds of the exterior.

Mode of preservation. The casts have impressions of the exterior sculpture, which has complicated the umbonal and hinge regions and made it difficult to get any clear idea of their structure.

Description. A thin-shelled lamellibranch, hardly exceeding 10 mm. in length, ovate; umbo low, just in front of the middle. Surface has fine growth-lines. No lateral teeth.

Size:	(1)	(2)	(3)	(4)	(5)	(6)	
Length	11.5	11.5	11.0	10.0	10.0	10.0	mm.
Height	8.0	7.5	7.0	7.0	6.5	6.0	"

Remarks. The genus *Taeniodon* DUNKER embraces only one species, the genotype *T. ellipticus* DUNKER, from the Lower Lias of Halberstadt. DUNKER, BRAUNS (1871), and FISCHER have classified it somewhat doubtfully with the Myidae, but according to PHILIPPI (who has obtained additional material of the hinge), it holds a rather isolated position among the lamellibranchs. Lateral teeth are entirely missing. The ligament is interior; in the left valve it is attached to a plate (lamellen- oder leistenartiger Zahn, DUNKER), which is excavated dorsally. The opposite excavation of the right valve is shallow and divided longitudinally by a thin ridge (dent cardinale, FISCHER). According to PHILIPPI true teeth are missing, and there is no pallial sinus.

In some of the present casts the umbonal region of the right side shows indications of a longitudinal furrow, which might correspond to the "cardinal tooth" of the right valve. Furthermore, the general view and the proportions of the conch are exactly the same as in *Taeniodon ellipticus*. Thus it is certainly difficult to distinguish between *T. ellipticus* and "*Cyclas*" *nathorsti* as to the specific characters. But since the generic position of the Swedish form cannot be established with certainty I prefer to keep it separate — at all events provisionally — until more material is available. For the moment it is evident that this species cannot belong to *Cyclas*. LUNDGREN, too, was uncertain as to the identification of the genus, and in his second paper (1881) he placed a mark of interrogation after the generic name. Its reference to *Taeniodon* also of course remains uncertain.

Horizon and locality. "*Cyclas*" *nathorsti* was described from a specimen (holotype LO 303 T) in clay iron stone at Sofiero, just above the grind sandstone with *Cardinia follini*. Later on additional specimens were found at the same horizon at Pålsjö, some hundred meters distant from Sofiero, and, on this account, LUNDGREN established the zone of *Cyclas nathorsti*. The present author has found this fossil in sandstone pebbles in the small creek at Slusås, where it is rather plentiful and occurs together with badly preserved *Cardinias*.

Class **Gasteropoda**

Actaeonina nathorsti Moberg

1888. *Actaeonina Nathorsti* Moberg, Lias i SÖ. Skåne, P. 66, Pl. 2, Fig. 47.
1909. " " Malling & Grönwall, Bornholms Lias, P. 288.

A few fragmentary specimens have been met with at Katslösa Bed 30.

Actaeonina cf. *striata* (Piette)

Cf. 1856. *Tubifer striatus* Piette, Bull. Soc. géol. Fr. (2) 13, P. 203, Pl. 10, Fig. 22.
Cf. 1868. *Orthostoma striatum* Terquem & Piette, Lias inférieur, P. 41, Pl. 4, Figs. 12—14.
1888. *Actaeonina striata* Moberg, Lias i SÖ. Skåne, P. 67, Text-Fig. and Pl. 2, Fig. 49.

Material. Only one specimen, an internal cast. S.G.U. Museum.

Description. The state of preservation makes it difficult of identification. Our specimen coincides well with those figured by Moberg, as far as the exterior and the proportions are concerned. But the sculpture is not preserved. The identification with Piette's species by aid of the original figures seems, however, to be doubtful and needs corroboration. The typical form is Hettangian in age.

Size. Height of conch. 5.5, width 2.9, last whorl 3.9 mm.

Horizon and locality. Katslösa Bed 30.

Actaeonina ? sp.

A small specimen, similar to *A. nathorsti* Moberg 1888, though damaged, and apparently devoid of the spiral rib of the upper edge of the whorls.

Katslösa Bed 42.

Chrysostoma cf. *solarium* (Piette)

Cf. 1856. *Turbo solarium* Piette, Bull. Soc. géol. Fr. (2) 13, P. 205, Pl. 10, Fig. 16.
1888. *Turbo solarium* Moberg, Lias i SÖ. Skåne, P. 62, Pl. 2, Figs. 37—41.
1909. *Turbo solarium* Malling & Grönwall, Bornholms Lias, P. 286.
Cf. 1909. *Chrysostoma solarium* Brösamlen, Palaeontogr. 56, P. 224, Pl. 18, Fig. 32.

Remarks. The specimens referred by Moberg and after him by Malling & Grönwall, to *Turbo solarium* Piette differ essentially from the type, figured by Piette. In the latter the last whorl dominates the shell, embracing about 4/5ths of the entire height; in our specimens it amounts to only about 2/3rds the height of the shell. According to Moberg this species should variate a good deal, but the present writer inclines keeping the two forms as separate species.

Occurrence. The type specimen was collected in the *angulatum* zone at Aiglemont. It has also been recorded from the corresponding beds in Germany and England, and from the Sinemurian of France and England. The aberrant Scandinavian form is derived from the Lower Pliensbachian (*jamesoni* and *centaurus* zones).

Horizon and locality. A few specimens from Katslösa, Beds 30—35 and 41.

Katosira craticia (MOBERG)

1888. *Chemnitzia craticia* MOBERG, Lias i SÖ. Skåne, P. 65, Pl. 2, Figs. 45, 46.
1909. *Chemnitzia craticia* MALLING and GRÖNWALL, Bornholms Lias, P. 288.

Material. Two fragmentary specimens.

Remarks. As claimed by BÖHM 1901 this species seems to belong to the genus *Katosira* KOKEN, which is characterized by spiral lines on the base of the shell. These are well developed in the holotype. The identification of the present fragments was possible by aid of the coarse sculpture of the whorls.

Occurrence. In Beds 28 and 30 at Katslösa. Also in the *Cardium* Bank of S.E. Scania and in the *Myoconcha* Bank of Bornholm.

Chemnitzia sp.

Pl. XXIII, Fig. 1

R.M. Mo 6654, internal cast, apex damaged.

Last whorl occupies 60 % of the entire height; it does not show any sculpture, but the preceding whorl has an ornamentation of transverse ribs; top of spire only indicated in the specimen.

Height 4.5, width 2.5 mm.

Katslösa Bed 8.

Trochus cf. *imbricatus* Sow.

Cf. 1821. J. SOWERBY, Min. Conch. 3, P. 127, Pl. 272, Figs. 3—4.
Cf. 1909. BRÖSAMLEN, Palaeontogr. 56, P. 209, Pl. 17, Figs. 19—21.

Hardly determinable fragments of a *Trochus* with a beautiful sculpture, composed of closely set spiral lines, crossed by transverse ones, thus forming rows of small knobs or spines. On the base the spiral lines dominate. As far as can be seen from the sculpture, these fragments may be attributed to the Pliensbachian species *Trochus imbricatus* Sow.

Katslösa, Bed 30.

Trochus laevis (v. SCHLOTH.)

1820. *Trochilites laevis* VON SCHLOTHEIM, Petrefactenkunde, P. 159.
1888. *Trochus laevis* MOBERG, Lias i SÖ. Skåne, P. 63, Pl. 2, Fig. 42.
1909. " " MALLING & GRÖNWALL, Bornholms Lias, P. 287.

Material. One entire specimen and three fragments met with at Katslösa.

Remarks. According to BRAUNS *Trochus laevis* SCHLOTHEIM also embraces *T. glaber* DUNKER & KOCH and *T. epulus* D'ORB. It is not mentioned by BRÖSAMLEN, who described a closely allied form, *T. basistriatus*, from the stages γ and δ of Swabia. This may be replaced by *T. epulus* and its relatives, e. g. *T. glaber*, in Franconia, N.W. Germany, France, and the Alps.

The present species belongs to the same group. It is characteristic of the Pliensbachian, especially the lower part. Since the state of preservation does not permit of any closer determination, we prefer the above name, in conformity with BRAUNS, MOBERG, and MALLING & GRÖNWALL.

Occurrence. In the *jamesoni* zone of S.E. Scania and the *centaurus* zone of the island of Bornholm. The Katslösa specimens are from Beds 30, 32, and 41.

Ptychomphalus cf. *expansus* (J. Sow.)

Pl. XX, Figs. 19 a—b; Pl. XXIII, Figs. 4 a—c

Cf. 1821. *Helicina expansa* J. SOWERBY, Min. Conch. 3, P. 129, Pl. 273, Figs. 1—3.
1879. *Pleurotomaria expansa* LUNDGREN, Jura på Bornholm, P. 12, Figs. 2—3.
1888. *Pleurotomaria (Cryptaenia) expansa* MOBERG, Lias i SÖ. Skåne, P. 60, Pl. 2, Figs. 32—35.
Cf. 1907. *Cryptaenia expansa* SIEBERER, Palaeontogr. 54, P. 25, Pl. 1, Figs. 5 a—c.
1909. *Pleurotomaria expansa* MALLING og GRÖNWALL, Bornholms Lias, P. 286.
Cf. 1928. *Ptychomphalus expansus* L. R. COX, Q.J.G.S. 84, P. 236.
Cf. also 1907. *Cryptaenia nodosa* SIEBERER, l. c., P. 26, Pl. 1, Fig. 7.

Remarks. In 1879 LUNDGREN described a gastropod from the Lower Lias of Bornholm, which he identified with SOWERBY's above species. Still better specimens were later on described my MOBERG from S.E. Scania, and more from Bornholm were recorded by MALLING and GRÖNWALL in 1909. At Katslösa also a few have been collected; these are well preserved in part, with thick shell showing the sculpture, but the last whorl is more or less incomplete and provided with knobs of a kind similar to those in *Cryptaenia nodosa* SIEBERER, though less prominent. They are well developed in two specimens but only indicated in the third. The sculpture is the same as that described by MOBERG, and MALLING & GRÖNWALL are of the opinion that it is typical of this species. Yet, it is not mentioned by SOWERBY in his original description, and SIEBERER has established a new species, *Cryptaenia nodosa*, mainly on account of this feature. The irregular and varying development of these knobs of the last whorl is indicative of maturity, and in all probability of no help in distinguishing a new species. However, there are other characters which might distinguish the Scania-Bornholm form from the typical *P. expansus*, above all the shape of the spire, which is much higher in the type, according to the figures given by SOWERBY, than in our specimens.

Occurrence. The holotype was collected in the Blue Lias at Lyme Regis (Hettangian), where the species is rare. Other specimens have been collected in the Belemnite marl (*jamesoni* zone) at Charmouth. The specimens from S.E. Scania and Bornholm are from the *jamesoni*, viz. the *centaurus* zone. At Katslösa this species has been found in the Beds 36 and 42. Three small, badly-preserved specimens (probably young ones) have been collected in the clay beds 27 and 29.

Small gastropods

Pl. XXIII, Figs. 2—3

In the sandstone bed 8 (Loc. 700) at Katslösa there is a thin layer crowded with small gastropods, mostly interior moulds, usually 1.5—2.5 mm. in height. Remnants of the test are preserved in some cases, but no trace of the sculpture is visible. Most of the specimens figured in Pl. XXIII, Fig. 2, have the test preserved. The upper right one has a thick shell ornamented with very faint, transverse ribs crossing the whorls of the spire at interspaces half as wide as the vertical height of the whorl. The last whorl has curved growth-lines, more densely set. Spiral angle 37°. Owing to the bad state of preservation it has not been possible to determine the genus of these gastropods. The best preserved specimens have six whorls, but in most cases the apex is broken, and the spiral angle is small. They probably belong to more than one species, and might be compared with *Turritella nucleata* QUENSTEDT, or *Phasianella cerithiiformis* PIETTE (Bull. géol. Soc. Fr. (2) 13, P. 204, Pl. 10, Fig. 11).

Class **Scaphopoda**

Dentalium elongatum MÜNSTER

1841—44. *Dentalium elongatum* MÜNST. in GOLDF. Petref. Germ. 3, P. 2, Pl. 166, Fig. 5.
1868. *Dentalium elongatum* TERQUEM et PIETTE, Mém. Soc. géol. France (2) 8, P. 67.
1871. *Dentalium etalense* BRAUNS, Unt. Jura, P. 288 (pars).
1888. *Dentalium etalense* MOBERG, Lias i SÖ. Skåne, P. 59, Pl. 2, Figs. 30—31.
1906. *Dentalium elongatum* RICHARDSON, Q.J.G.S. 62, P. 575, Pl. 45, Figs. 17—18.

Material. 35 specimens.

Remarks. In his identification and description of the *Dentalium* specimens from the *jamesoni* zone of S.E. Scania MOBERG followed BRAUNS' description of *D. etalense* which, however, does not agree with the original description given by TERQUEM et PIETTE, as MOBERG also remarked. BRAUNS grouped several species under the head of *D. etalense* and thus gave some incorrect data as to the latter. As already emphasized by TERQUEM et PIETTE, *Dentalium etalense* differs from *D. elongatum* in lacking concentric striae and in being more slender. According to RICHARDSON it is "regularly curved from end to end, whereas *D. elongatum* is usually most strongly curved in the posterior part and nearly straight in the anterior". The specimens figured by MOBERG are gently curved and concentrically striated, and also coincide as to size and general shape with *D. elongatum.* This is a wide-spread species with a rather great vertical distribution. RICHARDSON has recorded its range from the *planorbis* zone up to the top of the Lias, while *D. etalense* is practically restricted to the *angulatum* zone.

It is very probable that the Bornholm specimens, referred by MALLING and GRÖNWALL to *D. etalense*, also belong here.

Horizon and locality. The Katslösa specimens are from Beds 30 (30 specimens) and 32. Some undefinable pieces are derived from Beds 36 and 42.

Dentalium hexagonale RICHARDSON

1906. *Dentalium hexagonale* RICHARDSON, Q.J.G.S. 62, P. 581, Pl. 45, Fig. 1.

Material. 3 specimens.

Description. Shell curved and ornamented by a dense, transverse striation; dorsal side flat, broader than the ventral one; lateral sides converge from the dorsum towards the ventral side and are somewhat inflated, thus giving a hexagonal outline of the transverse section.

Occurrence. This characteristic species was recorded by RICHARDSON from the *oxynoti* up to the *jamesoni* zone.

Locality. Katslösa Beds 30 and 32.

Dentalium parvulum RICHARDSON

1906. RICHARDSON, Q.J.G.S. 62, P. 585, Pl. 45, Figs. 9 and 12.

Two pieces of a curved *Dentalium* with ovate section coincide well with the α-type of *Dentalium parvulum*.

Geological age. Lower and Middle Lias.

Horizon and locality. In the Ammonite Bank at Oregården. Bore-hole 271, at 63 m.

Class **Cephalopoda**

Order AMMONOIDEA

Ammonites are rare in the Lias of Sweden, except in the so-called Ammonite Bank at Döshult, Dompäng, and other places N. of Helsingborg. From there LUNDGREN (1881) has described the following species:

Coroniceras bucklandi Sow. sp.
C. bisulcatum BRUG. sp.
C. sauzeanum D'ORB. sp.
Arnioceras falcaries QUENST. sp.
Agassiceras striaries QUENST. sp.
A. scipionianum D'ORB. sp.

The same fauna has been recorded in the drilling core No. 271 at Oregården at a depth of 53—63 m. or about 240 m. above the Rhaetic-Liassic boundary.

In the Liassic beds of S.E. Scania MOBERG has identified *Uptonia jamesoni* SOWERBY sp.

At Katslösa only fragments have been found. On account of their importance in stratigraphy they have been studied most carefully, but the identifications given below are only tentative and very uncertain.

Coroniceras sauzeanum (d'Orbigny)?

1842. *Ammonites Sauzeanus* d'Orbigny, Paléont. française. Terr. jurass. 1. Ceph. P. 304, Pl. 95, Figs. 4—5.
1881. *Ammonites Sauzeanus* Lundgren, Molluskfaunan, P. 51; Pl. 2, Figs. 5—7; Pl. 3.
1936. *Coroniceras Sauzeanum* Joly, Lias inférieur, P. 55.

Material. Two fragmentary specimens.

Description. A small fragment of an aegoceratid species with two straight ribs crossing the whorl perpendicularly. At the dorsal angle they are slightly swollen, curve slightly forwards and continue dorsally towards the middle as far as the fragment shows, probably not reaching the middle line, which is not preserved.

A second specimen of the same species is a cast showing 5 ribs of the same kind as described above, but not a trace of any dorsal furrow or carina.

Remarks. These specimens belong to the *Coroniceras* group of *Arietites* represented by *C. kridion* (cf. Quenstedt, Jura, Pl. 7, P. 70), *C. bucklandi*, *C. bisulcatus*, and *C. sauzeanum*, all of which are restricted to the Lower Sinemurian.

The fragments seem to be most closely affined to *C. sauzeanum* d'Orb., which is a rather common species in the Ammonite Bank of the Höganäs basin.

Locality. Gantofta 360 Bed 5.

Arietites (*s. l.*) sp.

Pl. XXIV, Fig. 11

Cf. 1881. *Ammonites falcaries* Lundgren, Molluskfaunan, P. 55, Pl. 2, Fig. 8.

Material. A fragmentary internal cast with 5 ribs.

Description. *Arietites* with strong transverse ribs and an unusually high median keel with concave sides.

Remarks. The distance between the ribs is the same as in the *Arnioceras falcaries* described by Lundgren from Döshult, but our specimen differs in having a much more prominent keel, which may partly be due to the state of preservation. Other species with a high median keel are *Arnioceras geometricum* Oppel and *Ammonites herfordensis* Monke.

However, the fragmentary condition of our specimen does not allow any closer comparison.

Occurrence. The main occurrence of the genus *Arietites* is in the Sinemurian.

Locality. In Bed 8 at Katslösa.

Uptonia jamesoni (Sowerby)?

1888. *Ammonites jamesoni* Moberg, Lias i SÖ. Skåne, P. 68, Pl. 3, Figs. 1—3.

A few fragments which might belong to *Uptonia jamesoni* have been collected at Katslösa 840 (Bed no 30).

According to Moberg this species is well represented in the contemporaneous beds of S.E. Scania.

Order DIBRANCHIA

A few, badly preserved rostra of belemnites have been described and figured by MOBERG from the *jamesoni* zone in S.E. Scania as Belemnites sp. I, and B. sp. II. LUNDGREN has mentioned one specimen, with the lime entirely dissolved, from the sandstone at Brandsberga, which might belong to about the same horizon. Finally, LUNDGREN mentions, with a sign of interrogation, "*Belemnites?* sp." from the *bucklandi* zone (α_3) of Dompäng, which, if the determination is correct, is the oldest belemnite met with in Sweden.

In certain parts of the column at Katslösa belemnite rostra are rather common. They have been collected in the clays as well as in the sandstones. The former are mostly broken, but may sometimes be rather well preserved. The first specimens appear in Bed 18 and the last ones in Bed 42. Accordingly they are missing in the lowest 76 and in the uppermost 15 meters of the 174 m. thick series and are restricted to the Katslösa Stage.

The best preserved specimens have been found in the lower part of this "belemnite marl", where *Passaloteuthis alveolata* and *Pseudohastites charmouthensis* have been identified. A great many small pieces in the same beds may belong to the same species. In Bed 30 (ferruginous sandstone) small pieces of a narrow *Pseudohastites* indicate *P. arundineus*. In the adjacent marls *Passaloteuthis apicicurvatus* appears in typical specimens. Also, higher up in the series we find the genera *Passaloteuthis* and *Pseudohastites*, but the species are rather difficult to identify.

In the conglomeratic Bed 36 the rostra are broken and worn and largely undeterminable. They hardly seem to differ, however, from those in the underlying beds. Some fragments show beautiful structures, for instance No. 316 (S.G.U. Museum), which is a phragmocone with the siphuncle. Other specimens, probably belonging to *Passaloteuthis*, are cut obliquely through the alveolus (Pl. XXIV, Fig. 9).

The upper beds of the "Belemnite series" are poor in belemnites and the rostra are mostly fragmentary. But *Passaloteuthis apicicurvata* has been identified in Bed 39, and in Bed 41 there are a few fragments which might belong to *P. virgata* (MAYER).

Passaloteuthis alveolata (WERNER)

Pl. XXIV, Figs. 1—3 and 10

1912. *Belemnites alveolatus* WERNER, Palaeontographica 59, P. 109, Pl. 10, Figs. 2—3.
1937. *Belemnites alveolatus* BURLON, Belemn. in Dünnschliff, P. 31, Pl. 1, Figs. 15—27.

Material. 24 specimens.

Description. The Katslösa specimens coincide well with the description given by WERNER. Apex as a rule weathered and broken. Cross section ovate, compressed laterally. Dorsal and ventral sides parallel in the middle portion but diverge slightly at the alveolus. Apical furrows missing. Wide and shallow dorso-lateral furrows.

Size:

(S.G.U. Museum)	Length	Diameters of the anterior end		Diameters at posterior end of alveolus	
		Width	Height	Width	Height
No. 460	52 mm.	10 mm.	12 mm.	—	—
,, 461	44 ,,	7 ,,	8.5 ,,	—	—
,, 459	38 ,,	—	—	—	8.5 mm.
,, 462	39 ,,	6.8 ,,	7 ,,	6.5 mm.	7.3 ,,
,, 725	>35 ,,	—	—	6.4 ,,	7 ,,
,, 457	>20 ,,	—	5.6 ,,	—	5 ,,

Distribution. *P. alveolata* is not rare in the upper part of Lias β and the basal part of Lias γ in Swabia.

The Katslösa specimens are from Beds 18—21.

Passaloteuthis apicicurvata (BLAINVILLE)

Pl. XXIV, Figs. 4—5 (and 9?)

1827. *Belemnites apicicurvatus* BLAINVILLE, Mém. sur les Bélemnites, P. 76.
1912. *Belemnites apicicurvatus* E. WERNER, Palaeontographica, 59, P. 119, Pl. 11, Figs. 2(?) and 3.
1928. *Passaloteuthis apicicurvata* LANG, Q.J.G.S. 84, P. 205, Pl. 14, Fig. 5; Text-Fig. 2:3, P. 210.

Material. 15 specimens collected at Katslösa.

Size. Specimen Pl. XXIV, Fig. 5: Length (alveolus not entire) 78 mm., diameters at the posterior end of alveolus 11.5 and 12.6 mm.

Distribution. *P. apicicurvata* has been recorded from the Lias γ and equivalent beds of England, France, and Germany. In the Belemnite marls of the Dorset coast it belongs to the top part. The Katslösa specimens belong to the Beds 29—39.

Passaloteuthis cf. *virgata* (MAYER)

Cf. 1912. *Belemnites virgatus* WERNER, Palaeontographica. 59, P. 120, Pl. 11, Fig. 4.
Cf. 1937. *Belemnites virgatus* BURLON, Belemniten in Dünnschliff, P. 35, Figs. 75—82, 88—90.

A few fragments of rostra, indicate *P. virgata*, but do not allow any sure identification. The largest specimen, No 479, is 47.5 mm. long, its anterior end has a 6 mm. deep alveolus, and the broken posterior end has indications of tapering towards the apex; the entire specimen might have been about 80 mm. in length. Height at apex of alveolus 12 mm., width 10.6 mm. The specimen is worn, but dorso-lateral furrows are still visible.

P. virgatus has its distribution in the upper part of Lias γ and is rare in Lias δ. It has been recorded in Swabia, Bavaria, Rhone basin, and Yorkshire.

The Katslösa specimens were met with in the top bed of the Belemnite marl (Beds 41 and 42).

Pseudohastites charmouthensis (Mayer)

Pl. XXIV, Figs. 6—8

1888. *Belemnites* sp. Moberg, Lias i SÖ. Skåne, Pl. 3, Fig. 5.
1912. *Belemnites charmouthensis* Werner, Palaeontographica 59, P. 116, Pl. 10, Fig. 15.
1928. *Pseudohastites charmouthensis* Lang, Q.J.G.S. 84, P. 215, Pl. 15, Fig. 2, Text-Fig. 3:3, P. 214.

Material. Three entire specimens have been found at Katslösa.

Description. Shape of rostrum coincides well with that in *P. charmouthensis.* Apex with a multitude of short furrows which might be due to weathering. Double lateral furrows well visible. Rostrum slightly clavate and compressed laterally.

Size. Specimen Fig. 7 on Pl. XXIV — fragmentary rostrum with entire length of the cast — measures 36 mm. in length, diameters 0.44 and 0.37 mm. at the narrow end of the alveolus. The specimen Fig. 8 is 46 mm. in length and 4 mm. in diameter behind the alveolus. Fig. 6 is 41 mm. in length, 4.6 mm. in height, and 4 mm. in width behind the alveolus, 4.8 and 4.7 mm. resp. at the anterior end.

Fragmentary rostra. In the beds 19—29 — especially in the marls — at Katslösa a great many broken pieces of narrow and slender rostra have been collected. They show the characteristic feature of *Pseudohastites*: laterally compressed with double lateral furrows, and slightly expanded at the alveolar end; average diameter in front of the apex 6 or 7 mm. In one bed (No. 19) 42 pieces have been collected, viz. 14 apices, 14 middle portions and 14 alveoli. Since the pieces rarely exceed 20 mm. in length they would seem to belong to a species of the same proportions as that of *P. charmouthensis.* They have also been referred here — at least provisionally — though their general shape does not allow of identification of the species.

Remarks. Lang has described several species from the Belemnite marl at *Charmouth* but all of them, except *P. charmouthensis*, are much more slender than the present form.

To this species belongs the *Belemnites* sp. from Kurremölla figured by Moberg in his Pl. 3, Fig. 5, as a young individual of *Belemnites* sp. II. The latter is probably a *Passaloteuthis.*

Distribution. *P. charmouthensis* is a Lower Pliensbachian species. In the type locality at the Dorset coast it belongs to the lowest part of the series, in the zone of *Tetraspidoceras*, which is below the zone of *Uptonia jamesoni.* It has also been recorded from the corresponding beds of the Rhone basin and Württemberg. The Katslösa specimens are from Beds (18) 19—29.

Pseudohastites cf. *arundineus* LANG

1928. Cf. *P. arundineus* LANG, Q.J.G.S. 84, P. 213, Pl. 15, Fig. 4; Text-Fig. 3:9, P. 214.

Description. 25 pieces have been collected in the hard ferrugineous sandstone at Katslösa 840, viz. 5 apices, 5 alveoli, and 15 pieces of the intermediate part. Their average length is 13, 13, and 18.7 mm., or — presuming that the intermediate portions represent 5 specimens — 57 mm. According to this interpretation the entire length should be 83 mm. The dorso-ventral diameter of the anterior end of the apical parts is, on the average, 3 mm., that of the middle parts from 3 to 5 mm., and that of the anterior end of the alveolus 5 or 5.5 mm. The cross section is ovate with somewhat flattened sides and traces of lateral furrows; sometimes there is a slight flattening of the ventral side. The anterior end is only slightly expanded, the clavate shape thus being hardly developed.

The proportions of this specimen coincide rather well with that of *P. arundineus*, though the state of preservation does not allow of certain identification.

Distribution. In the British stratigraphic column *P. arundineus* belongs to the same horizon as *P. charmouthensis*. The present specimen have been collected in Bed 30 at Katslösa, just above the last occurrence of *P. charmouthensis*.

F. Arthropoda

Class **Crustacea**

Subclass **Ostracoda**

Bairdia amalthei (QUENSTEDT)
Pl. XXIII, Figs. 7—9

1858. *Cypris amalthei* QUENSTEDT, Jura, P. 200, Pl. 24, Fig. 37 a.
1876. *Bairdia liassica* TATE & BLAKE, The Yorkshire Lias, P. 430, Pl. 17, Figs. 1, 1 a.
1908. " *amalthei* ISSLER, Beiträge zur Stratigraphie und Mikrofauna des Lias in Schwaben, P. 94, Pl. 7, Fig. 338.

More than 100 specimens are listed.

Distribution. In almost all parts of the Lias of England and Germany. The Katslösa specimens are from Beds 18, 19, 20, 28, 30, 41, 42, and 45, or from loc. 768 up to loc. 1000.

Bairdia dispersa TATE & BLAKE
Pl. XXIV, Fig. 12

1876. TATE and BLAKE, The Yorkshire Lias, P. 430, Pl. 17, Fig. 2.

Rare at Katslösa.

This species differs from *B. amalthei* in its more elongated form. There seem to be intermediate forms between these species.

Distribution. *B. dispersa* was recorded from the *bucklandi* and the *annulatus* zones of the Yorkshire Lias. The Katslösa specimens are from Bed 19.

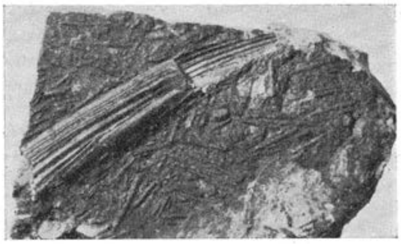

Fig. 40. *Hybodus* sp., fin spine. *Pullastra* Bank, Helsingborg. Nat. size.

G. **Vertebrata**

"*Otolithus*" *bornholmiensis* Malling & Grönwall

1909. *Otolithus bornholmiensis* Malling og Grönwall, Medd. D.G.F. 3, P. 297, Pl. 11, Figs. 14--16.

Material. 20 specimens.

Description. White, calcitic, solid bodies with a fine thread-like texture, and a net-work of fine pores arranged in regular rows on the surface, were described by Malling and Grönwall as otoliths of some unknown fish. They are wedge-like in shape with a triangular outline, ventral side convex, dorsal one concave and folded, posterior margin wide and rather edged, the body thus tapering towards the anterior end.

Remarks. Judging by the exterior shape the main part of the Katslösa specimens belong to the above species, but there are a great many fragments which cannot be determined.

Locality. Katslösa Bed 30.

Acrodus sp.

A small fragment of the crown of a tooth of *Acrodus* has been found in Bed 42 at Katslösa. More complete teeth of this genus have been described from S.E. Scania and the island of Bornholm. They were referred to *A. nobilis* Agassiz (Moberg 1888), resp. *A. minimus* Ag. (Malling & Grönwall 1909).

Hybodus sp. I

Text-Fig. 40

A fin-spine of *Hybodus* was collected in the *Pullastra* Bank at Ångtegelbruket, Helsingborg.

Hybodus ? sp. II

Small acute teeth, probably belonging to *Hybodus*, have been met with in several parts of the Katslösa section, for instance in the more or less conglomeratic ferruginous sandstones at locs. 768, 875, and 925 (Beds 18, 36, and 41).

Fig. 41. Coprolite moulds in sandstone. *Myacid* Bank, Bed 9. Katslösa. Nat. size.

Ganoid Scales

Ganoid scales occur in the white sandstone Bed 8 (Katslösa 700), and have been met with at various horizons of the Helsingborg Stage, e. g. at 160—170 metres above the base in the southern part of Helsingborg, and in the drilling cores at Svanebäck (180 m.), Klappe (145 m.), and Oregården (115 m. above the Liassic base).

Coprolites

Text-Figs. 25 and 41

Moulds of coprolites once buried in the ridges of ripple-marks occur in a sandstone bed at Katslösa 724 (Bed 9).

Table IV

Distribution of the Liassic Fauna

	Page	Helsingborg Stage		Döshult Stage			Katslösa Stage			Brandsberga	S.E. Scania	Bornholm
		Lower	Upper	Avicula Bank	Ammonite Bank	Myacid Bank	11—21	22—32	33—45		Cardium Bank	Myoconcha Bank
Pentacrinus scalaris	143	..	..	..	..	..	+					
" *basaltiformis*	143	..	..	..	..	..	..	+				
" cf. "	144	..	..	..	..	..	..	+	+		+	
" cf. *subteroides*	144	..	..	..	..	..	..	+			+	
Serpula quinquesulcata	144	..	..	..	..	..	+	+	+		+	+
" *terquemi*	144	..	..	..	..	..	..	+	+		+	
" cf. *raricostati*	145	..	..	..	..	..	+					
Worm trails	145	..	..	..	..	..	+	+	+			
Zeilleria cf. *perforata*	146	..	..	..	..	..	+					
" cf. *numismalis*	146	..	..	..	..	..	..	+				
Spiriferina walcotti v. *münsteri*	147	..	..	..	..	..	..	+				
Rhynchonella deffneri	147	..	..	..	..	..	[+]					
Palaeoneilo galatea	149	..	..	..	..	..	..	+				
" *bornholmiensis*	150	..	..	..	..	..	..	+			+	+
" *oviformis*	151	..	..	..	..	..	..	+				
Nuculana zieteni	151	..	..	..	..	..	..	+				
" (*Ryderia*) *doris*	152	..	..	..	..	..	..	+	+			+
Rollieria bronni	153	..	..	..	..	..	..	+	+		+	+
Nucula distinguenda	154	..	..	..	..	..	..	+			+	+
Grammatodon cypriniformis	154	..	..	..	..	..	..	+			+	+
" (*Catella*) *sinuatus*	157	..	..	..	..	..	..	+	+			
" (") *subrhomboidalis*	158	..	..	..	..	..	..	..	+			
Barbatia pulla?	159	..	..	..	..	..	..	+	+		+	+
Cardinia follini	160	+										
" *expansa*	161	+										
" *ingelensis*	162	..	+									
" *kullensis*	163	..	..	+								
" sp.	164	..	+									
Trigonia primaeva	165	..	..	..	..	..	..	..	+		+	
" *modesta*	166	..	..	..	..	..	..	+				
Astarte angelini	167	..	..	..	..	..	+	+	+		+	
" *fructuum*	168	..	..	..	..	..	..	+			+	
" *scanensis*	168	..	..	..	..	..	+	+			+	
" (*Neocrassina*)? *fortuna*	169	..	..	..	..	..	..	+	+			
" *deltoidea*	170	..	..	..	..	..	..	+	+		+	
" *oerbyensis*	171	..	..	..	..	..	..	+	+			
" *ryensis*	171	..	..	..	..	..	..	+	+			
" (?) sp.	172	..	..	..	..	..	..	+				

Table IV (continued)

		Helsingborg Stage		Döshult Stage			Katslösa Stage			Brandsberga	S.E. Scania	Bornholm
	Page	Lower	Upper	Avicula Bank	Ammonite Bank	Myacid Bank	11—21	22—32	33—45		Cardium Bank	Myoconcha Bank
Tutcheria cingulata	172	..	..	..	..	..	..	+	+	..	+	+
" cf. *richardsoni*	173	..	..	..	..	..	..	+				
Pseudopis sp.	174	..	..	..	..	..	..	+				
Tancredia arenacea	174	+	..	+								
" *securiformis*	175	..	..	+								
" *erdmanni*	176	..	..	+	..	+						
" *johnstrupi*	176	..	..	..	..	..	..	+	+	..	+	+
" *lineata*	177	..	..	..	..	..	..	..	+	..	+	+
" (?) sp.	177	+	..	+								
Sphaeriola kurremolinae	178	..	..	..	..	..	..	+	..	..	+	
Protocardia philippiana	178	+										
" *oxynoti*	179	..	..	..	..	+						
" *truncata*	180	..	..	..	..	..	..	+	+	..	+	
Eotrapezium germari	182	+										
" *pullastra*	182	+										
" *héberti*	184	+										
" *menkei*	185	+										
Anisocardia luggudensis	185	..	..	..	..	..	..	+	+			
Pholadomya coticulae	186	+										
Platymya aquarum	187	+										
Homomya ovalis	188	+										
" *venulithus*	189	..	..	+	..	+						
" *centralis*	191	..	..	..	..	+						
" *librata*	192	..	..	..	..	..	..	+	+	..	+	
Arcomya decora	192	..	..	..	..	..	..	+				
" cf. *elongata*	193	..	..	..	..	..	..	+				
Pleuromya forchhammeri	193	..	..	+	..	+	..	..	..	..	+	+
" *corrugata*	194	..	..	..	..	cf.	..	+				
Goniomya heteropleura	195	..	..	..	..	..	..	+				
Oxytoma sinemuriensis	195	..	..	+	+	+						
" *inaequivalvis*	200	..	..	..	..	..	..	+	+	+	+	+
" *scanica*	201	..	..	..	..	..	..	..	..	+	?	
Gervillia angelini	203	+										
" (?) *scanica*	204	+										
" *hagenowi*	205	..	+									
" *sjögreni*	206	..		+	+							
" sp.	207	..		..	..	..	..	+	+			
Isognomon sp.	208	..		..	..	+						
Lima (Radula) duplicata	208	..		..	..	+						

Table IV (continued)

		Helsingborg Stage		Döshult Stage			Katslösa Stage			Brandsberga	S.E. Scania	Bornholm
	Page	Lower	Upper	Avicula Bank	Ammonite Bank	Myacid Bank	11—21	22—32	33—45		Cardium Bank	Myoconcha Bank
Lima (Radula) pectinoides	209	..	..	..	+							
" *(Plagiostoma) succincta*	209	..	..	..	..	..	..	+	..	+	..	+
Limea acuticostata	210	..	..	..	..	..	..	+	+	..	+	+
" *katsloesensis*	210	..	..	..	..	..	..	+				
Chlamys janiformis	211	..	..	..	+	+						
" *subulata*	212	..	..	..	..	+						
" *tullbergi*	213	..	..	..	..	..	+	+	..	+		
" *textoria*	213	..	..	..	..	+	+	+	+	+	+	+
" *interpunctata*	214	..	..	..	..	..	..	..	+			
Entolium hehli?	216	..	..	+								
" *calvum*	216	..	..	..	..	+						
" *cingulatum*	217	..	..	..	..	+	..	+	+			
" *lundgreni*	218	..	..	..	..	..	..	+	+	..	+	+
Pseudopecten aequivalvis	219	..	..	..	..	..	..	..	+	..	+	+
Dimyodon sp.	220	..	..	..	..	+						
Plicatula spinosa	220	..	..	..	..	..	..	+	+	..	+	+
" *orbiculoides?*	221	..	..	..	..	..	..	+	+			
" sp. 1 (cf. *hettangiensis*)	222	..	..	+								
" sp. 2 (cf. *suecica*)	222	..	..	..	..	..	..	..	+	?		
Terquemia arietis	223	..	..	..	..	+	+	+	+	..	+	
Anomia pellucida(?)	224	..	+									
Liostrea hisingeri	225	+	+									
Liogryphaea arcuata	226	..	..	..	+	+						
" " mut. *lata*	227	..	..	..	+							
" *regularis*	228	..	..	..	..	..	..	+	+	..	+	
Modiola hillana	228	+	+	+								
" *ruuthi*	231	+										
" cf. *tenuissima*	232	..	..	..	..	+						
" *scalprum*	232	..	..	..	..	..	..	+	+			+
" sp.	233	..	..	..	..	+						
Mytilus cf. *lamellosus*	233	..	..	..	..	..	..	+				
Myoconcha decorata	234	..	..	..	..	..	..	+	+	..	..	?
Taeniodon? nathorsti	234	+										
Actaeonina nathorsti	236	..	..	..	..	..	..	+	..	..	+	+
" cf. *striata*	236	..	..	..	..	..	..	+	..	..	+	
Actaeonina? sp.	236	..	..	..	..	..	..	..	+			
Chrysostoma cf. *solarium*	236	..	..	..	..	..	..	+	+	..	+	+
Katosira craticia	237	..	..	..	..	..	..	+	..	..	+	+
Chemnitzia sp.	237	..	..	..	..	+						

Table IV (continued)

		Helsingborg Stage		Döshult Stage			Katslösa Stage			Brandsberga	S.E. Scania	Bornholm
	Page	Lower	Upper	Avicula Bank	Ammonite Bank	Myacid Bank	11—21	22—32	33—45		Cardium Bank	Myoconcha Bank
Trochus cf. *imbricatus*	237	..	..	..	..	..	..	+				
" *laevis*	237	..	..	..	..	..	..	+	+	..	+	+
Ptychomphalus cf. *expansus*	238	..	..	..	..	..	..	?	+	..	+	+
Small gastropods	238	..	..	..	..	+						
Dentalium elongatum	239	..	..	..	..	..	..	+	?	..	+	+
" *hexagonale*	240	..	..	..	..	..	..	+				
" *parvulum*	240	..	..	..	+							
Coroniceras sauzeanum(?)	241	..	..	..	+							
Arietites sp.	241	..	..	..	..	+						
Uptonia jamesoni	241	..	..	..	..	..	..	?	..	..	+	
Passaloteuthis alveolata	242	..	..	..	..	..	+					
" *apicicurvata*	243	..	..	..	..	..	..	+	+			
" cf. *virgata*	243	..	..	..	..	..	..	..	+			
Pseudohastites charmouthensis	244	..	..	..	..	..	+	+	..	..	+	
" cf. *arundineus*	245	..	..	..	..	..	..	+				
Bairdia amalthei	245	..	..	..	..	..	+	+	+			
" *dispersa*	245	..	..	..	..	..	+					
Otolithus bornholmiensis	246	..	..	..	..	..	..	+	..	..	..	+
Acrodus sp.	246	..	..	..	..	..	..	..	+	..	sp.	sp.
Hybodus sp. I	246	+										
Hybodus? sp. II	246	..	..	..	..	..	+	+	+	..	..	sp.
Ganoid scales	247	..	+	..	..	+						
Coprolites	247	..	..	..	..	+						

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Explanation of Plates

The figured specimens are preserved in the National Museum of Natural History, Stockholm (R.M.), or in the Museums of the Geological Survey of Sweden (S.G.U.), the Paleontological Institute of Lund (LO), and the Paleontological Institute of Upsala.

G. Ahl, C. Larsson, and I. G. Mars phot. S. Samson ret.

Abbreviations:
R.V. — right valve
L.V. — left valve.

PLATE I

Bedding plane with *Oxytoma sinemuriensis* and *Liogryphaea arcuata*. Core-drilling 271, Oregården, at 63 m. The Ammonite Bank (Döshult Stage). Nat. size.

PLATE II

Bedding plane with natural internal casts of lamellibranchs, especially *Homomya venulithus*. The shell breccia of the *Myacid* Bank, Bed 8, Katslösa. Döshult Stage. Nat. size.

PLATE III

Rhaetic Fossils

Fig. 1. *Eotrapezium hyllingense* n. sp. R.V. Holotype. Black shale above the Lower Coal Bed at Hyllinge. — Mo 6445 (R.M.). × 6. — Page 136.

Figs. 2—4. *Protocardia rhaetica* Mer. sp. — Vallåkra clay at Östraby, Kattarp. — Pal. Inst. Lund. × 10. — Page 137.
Fig. 2: Sculpture of posterior side of both valves.
Figs. 3—4: Two left valves.

Figs. 5—6. *Pleuromya suevica* Rolle(?). — Vallåkra clay at Skromberga. Mo 6724 and 6725 (R.M.). Nat. size. — Page 138.
Fig. 5: Dorsal and lateral views.
Fig. 6: R.V.

Fig. 7. Same species, R.V. — Vallåkra clay at Östraby, Kattarp. — Pal. Inst. Lund. × 5.

Figs. 8—9. *Cercomya carlsoni* (Lundgren). — Bjuv. (S.G.U.) Nat. size. — Page 139.
Fig. 8: Right valve.
Fig. 9: Left valve.

Fig. 10. *Modiola minuta* (Goldf.). R.V. — Vallåkra clay at Östraby. — Pal. Inst. Lund. × 10. — Page 140.

Fig. 11. Same species. R.V. — Vallåkra clay, Skromberga. — Mo 6721 (R.M.). × 1 1/5.

Figs. 12—13. *Gervillia praecursor* Quenstedt. R.V. — Vallåkra clay at Östraby, Kattarp. — Pal. Inst. Lund. × 10. — Page 139.

Fig. 14. *Ceratomya stensioei* n. sp. L.V. Holotype. — Grey sandstone below the Lower Coal Bed at Hyllinge. — Mo 6719 (R.M.). Nat. size. — Page 138.

PLATE IV

Helsingborg Stage

Figs. 1—3. *Tancredia*? sp. Internal casts with impressions of the growth lines. — Loc. 230 Gravarna, Helsingborg. — Mo 6729, 6730, and 6731 a (R.M.). × 2. — Page 177.

Figs. 4—6. *Eotrapezium menkei* DUNKER sp. Internal casts. — Fleninge borehole 266. — Pal. Inst. Lund. × 2. — Page 185.

Fig. 7. Same species. L.V. — Östra Ramlösa, pebble. — Pal. Inst. Lund. × 2.

Fig. 8. *Homomya ovalis* (LUNDGREN), R.V. — The *Pullastra* Bank, Ramlösa. — The Holotype, LO 318 T (Lund). × 2. — Page 188.

Fig. 9. *Modiola hillana* Sow. R.V. — The *Mytilus* Bank, Gravarna, Helsingborg. — LO 287 t (Lund). Nat. size. — Page 228.

Fig. 10. Same species. L.V. — The *Pullastra* Bank, Ramlösa. — LO 286 t (Lund). Nat. size.

Fig. 11. Same species. L.V. — Kärnan, Helsingborg. — LO 1990 t (Lund). Nat. size.

Figs. 12—13. *Gervillia angelini* LUNDGREN. Two left valves. — The *Pullastra* Bank, Ramlösa. — LO 278 t and LO 268 t. Nat. size. — Page 203.

Fig. 14. Same species. R.V. and L.V. — The *Pullastra* Bank, pebble, Gåsebäck near Helsingborg. — Mo 6514 (R.M.). × 2.

Figs. 15—16. *Gervillia hagenowi* DUNKER. L.V. — The *Ostrea* Bank, Kulla Gunnarstorp. — Page 205.
Fig. 15: LO 272 t (Lund). Nat. size.
Fig. 16: LO 270 t (Lund). × 2.

Fig. 17. *Liostrea hisingeri* (NILSSON). R.V. — Höganäs. — Pal. Inst. Lund. Nat. size. — Page 225.

PLATE V

Helsingborg Stage

Fig. 1. *Cardinia ingelensis* n. sp. Slab of the Upper Grind sandstone at Ingelsträde. — Mo 6401 (R.M.). Nat. size. — Page 162.

Figs. 2—3. Same species. L.V. — Ingelsträde. — × 2.
Fig. 2: Pal. Inst. Lund.
Fig. 3: Mo 6549 (R.M.).

Fig. 4. *Pholadomya coticulae* (LUNDGREN). L.V. Holotype. — The *Cardinia* Bank, Pålsjö. — Pal. Inst. Lund. × 1 1/2. — Page 186.

PLATE VI

Helsingborg and Döshult Stages

Fig. 1. *Cardinia kullensis* n. sp. Natural internal mould of L.V. — *Avicula* Bank, Dompäng (loc. 528). — Pal. Inst. Lund. Nat. size. — Page 163.

Fig. 2. *Cardinia* sp. 1. R.V. — Grind sandstone at Täppeshusen. — Mo 6290 (R.M.). Nat. size. — Page 164.

Fig. 3. *Cardinia expansa* (LUNDGREN). Dorsal view. — The *Cardinia* Bank, Pålsjö. — LO 427 T (Lund). Nat. size. — Page 161.

Figs. 4—5. *Modiola ruuthi* n. sp. R.V. — Höganäs. — Page 231.
Fig. 4. Pebble No. 1. — Mo 6755 (R.M.). Nat. size.
Fig. 5. Bedrock in the coal mine. — Pal. Inst. Lund. × 1 1/2.

Fig. 6. *Modiola hillana* Sow. — *Avicula* Bank, Dompäng (loc. 528). — Pal. Inst. Ups. × 2. — Page 228.

Figs. 7—8. *Anomia pellucida* TERQUEM? *Ostrea* Bank, Kulla Gunnarstorp. — Mo 6752—3 (R.M.). × 10. — Page 224.

Fig. 9. Same species. Four specimens attached to a broken lamellibranch shell, from which the sculpture was adopted. — *Ostrea* Bank, Kulla Gunnarstorp. — LO 323 (Lund). × 10.

PLATE VII

Helsingborg and Döshult Stages

Figs. 1—6. *Liogryphaea arcuata* LAMARCK. Growth stages of R.V. — Ammonite Bank. Core-drilling. No. 271, Oregården; depth 63 m. — Pal. Inst. Lund. × 2. — Page 226.
Figs. 1—2: Natural moulds of interior.
Figs. 3—6: Outside of shell.

Fig. 7. *Cardinia follini* LUNDGREN. R.V. — *Cardinia* Bank, Pålsjö. — Pal. Inst. Lund. × 1 1/3. — Page 160.

Figs. 8—10. *Cardinia kullensis* n. sp. Inside of R.V. — *Avicula* Bank, Dompäng (loc. 528). — × 1 1/3. — Page 163.
Fig. 8: Inside. Pal. Inst. Lund.
Fig. 9: Outside. Pal. Inst. Upsala.
Fig. 10: Natural internal mould. Pal. Inst. Lund.

Figs. 11—15. *Taeniodon nathorsti* (LUNDGREN). Pebbles, loc. 23, Slusås, Kristinelund. — Mo 6561, 6551, 6558, 6560, and 6392 (R.M.). × 2. L.V. in figs. 13 and 15. — Page 234.

Fig. 16. *Cardinia ingelensis* n. sp. R.V. — Upper Grind sandstone at Ingelsträde. — Mo 6549 (R.M.). × 1 1/3. — Page 162.

PLATE VIII

Döshult Stage

Liogryphaea arcuata LAMARCK. Eleven growth stages of L.V. — Ammonite Bank at Oregården, drilling-core No. 271, depth 63 m. — Pal. Inst. Lund. × 2. — Page 226.
Figs. 11—13. var. *lata*, one specimen in different views.

PLATE IX

Döshult Stage

Oxytoma sinemuriensis D'ORB. from drilling-core 271, Oregården, at 63 m. (Ammonite Bank). — Pal. Inst. Lund. — Page 195.
Figs. 1—2: Bedding plane with *O. sinemuriensis*. — Nat. size.
Figs. 3—4: " " " " " — × 2.
Fig. 5: L.V. — Nat. size.
Figs. 6—11: L.V. — × 2.

PLATE X

Döshult and Katslösa Stages

Figs. 1—5. *Oxytoma sinemuriensis* D'ORB. R.V. — Ammonite Bank. Borehole 271, Oregården, depth 63 m. Paleont. Inst. Lund. — Page 195.
Fig. 1 a: Outside. × 3.
" 1 b: Inside. × 3.
" 2 and 4: × 2.
" 3: Katslösa loc. 700 (bed 8). — Mo 6718 (R.M.). × 5.
" 5: × 2 1/2.

Figs. 6—9. Same species. L.V. — *Myacid* Bank, Katslösa 700 (bed 8).
Fig. 6: Exterior mould. — S.G.U. × 3.
" 7: Young specimen. — S.G.U. × 5.
" 8: " " — Mo 6718 (R.M.). × 5.
" 9: " " — Mo 6717 (R.M.). × 4.

Fig. 10. Same species(?). R.V. — Katslösa 768 (bed 18). — S.G.U. Nat. size.

Figs. 11—14. *Oxytoma inaequivalvis* Sow. Katslösa 840 (bed 30). × 5. — Page 200.
Fig. 11: L.V. Natural internal cast. — Mo 6538 (R.M.).
" 12: L.V. Exterior mould. — Mo 6537 (R.M.).
" 13: L.V. — Mo 6539 (R.M.).
" 14: R.V. — S.G.U.

Fig. 15. *Oxytoma scanica* (Lundgren). L.V. Pebble, Kolleberga. — Mo 6757 (R.M.). Nat. size. — Page 201.

Fig. 16. *Goniomya heteropleura* Ag. Katslösa 840 (bed 30). Mo 6295 (R.M.). × 4. — Page 195.

PLATE XI

Helsingborg Stage (Figs. 18 and 19)
Döshult Stage (Figs. 17, 20 and 21)
Katslösa Stage (Figs. 1—16 and 22)

Fig. 1. *Astarte angelini* (Moberg). R.V. — Katslösa loc. 768 (bed 18). — S.G.U. Museum. × 5. — Page 167.

Figs. 2—4. *Astarte fortuna* n. sp. — Katslösa 840 (bed 30). — S.G.U. Museum. × 3. — Page 169.
Figs. 2—3: Holotype, both valves.
Fig. 4: L.V.

Fig. 5. *Astarte deltoidea* Moberg. R.V. — Katslösa 955 b. — S.G.U. Museum. × 5. Page 170.

Figs. 6—9. *Astarte oerbyensis* n. sp. — Katslösa. — Page 171.
Fig. 6: R.V. — Bed 30. — S.G.U. Museum. × 6.
" 7: L.V. — " — Mo 6542 (R.M.). × 8.
" 8: Holotype. a) L.V. b) dorsal view. — Loc. 955 b. — S.G.U. Museum. × 5.
" 9: L.V. — Loc. 840 (bed 30). — Mo 6205 (R.M.). × 6.

Figs. 10—13. *Astarte ryensis* n. sp. — Katslösa. S.G.U. Museum. — Page 171.
Figs. 10—11: Loc. 840 (bed 30). × 5.
Fig. 12: Holotype. R.V. — Loc. 955 (bed 42). × 4.
" 13: L.V. — Loc. 955. × 5.

Fig. 14. *Astarte*(?) sp. L.V. — Katslösa 840 (bed 30). — Mo 6221 (R.M.). × 3. — Page 172.

Figs. 15—16. *Pseudopis* sp. — Katslösa 840 (bed 30). — Page 174.
Fig. 15: S.G.U. Museum. × 5.
" 16: Mo 6219 (R.M.). × 6.

Figs. 17—19. *Tancredia arenacea* (Nilsson). — Page 174.
Fig. 17: R.V. — *Avicula* Bank, Loc. 528 Dompäng. — Pal. Inst. Ups. Nat. size.
Figs. 18—19: L.V. — Loc. 230 Gravarna, Helsingborg. — Mo 6515 and Mo 6728 (R.M.). × 2.

Figs. 20—21. *Tancredia erdmanni* Lundgren. — Page 176.
Fig. 20: L.V. — *Avicula* Bank, Kulla Gunnarstorp. — Pal. Inst. Lund. × 3.
" 21: R.V. — *Myacid* Bank, Katslösa 700 (bed 8). — Mo 6657 (R.M.). × 2.

Fig. 22 a—b. *Sphaeriola kurremolinae* Moberg. — Katslösa 840 (bed 30). — Mo 6208 (R.M.). × 6. — Page 178.

PLATE XII

Helsingborg Stage (Figs. 1—3)
Döshult Stage (Figs. 4—17)
Katslösa Stage (Figs. 18—19)

Fig. 1. *Pholadomya* cf. *coticulae* (LUNDGREN). R.V. — Höganäs, pebble No. 1. — Mo 6758 (R.M.). Nat. size. — Page 186.

Fig. 2. *Platymya aquarum* LUNDGREN. R.V. — Höganäs, pebble No. 1. — Mo 6759 (R.M.) $\times 1\,^1/_5$. — Page 187.

Fig. 3. *Pholadomya* cf. *coticulae* LUNDGREN. L.V. — Höganäs, pebble No. 1. — Mo 6760 (R.M.). Nat. size. — Page 186.

Figs. 4—6. *Homomya venulithus* n. sp. — *Myacid* Bank, Katslösa loc. 700 (bed 8). — S.G.U. Museum. Nat. size. — Page 189.
Figs. 4 and 6: L.V.
Fig. 5: R.V.

Fig. 7. Same species. R.V. — *Avicula* Bank, Kulla Gunnarstorp. — Mo 6764 (R.M.). Nat. size.

Fig. 8. Same species. Holotype. L.V. — *Avicula* Bank, Kulla Gunnarstorp. — LO 145 T (Lund). Nat. size.

Figs. 9—17. Same species. Internal casts with impressed sculpture, seen from the right (a) and the left (b), showing stages of growth. All specimens are from the *Myacid* Bank and belong to the S.G.U. Museum.

Fig. 18. *Arcomya* cf. *elongata* AG. L.V. — Katslösa 840 (bed 30). — S.G.U. Museum. Nat. size. — Page 193.

Fig. 19. *Gervillia* sp. R.V. — Katslösa 840 (bed 30). — S.G.U. Museum. $\times 2$. — Page 207.

PLATE XIII

Döshult Stage (Figs. 1—8)
Katslösa Stage (Figs. 9—13)

Fig. 1. *Pleuromya* cf. *corrugata* n. sp. L.V. — *Myacid* Bank, Katslösa 700 (bed 8). — S.G.U. Museum. $\times 2$. — Page 194.

Fig. 2. *Homomya venulithus* n. sp. L.V. — *Avicula* Bank, Kulla Gunnarstorp. — Mo 6762 (R.M.). Nat. size. — Page 189.

Fig. 3. Same species. R.V. — *Myacid* Bank, Katslösa 700 (bed 8). — S.G.U. Museum. $\times 1\,^1/_3$.

Figs. 4—8. *Pleuromya forchhammeri* LUNDGREN. Internal casts with impressed sculpture. — *Myacid* Bank, Katslösa 700 (bed 8). — Page 193.
Fig. 4 a: Right side, b: dorsal view. — Mo 6613 (R.M.). $\times 1\,^1/_3$.
" 5: " " . — Mo 6656 (R.M.). $\times 2$.
" 6: " " . — S.G.U. Museum. $\times 2$.
" 7: Left " . — Mo 6655 (R.M.). $\times 1\,^1/_3$.
" 8: " " . — S.G.U. Museum. $\times 1\,^1/_3$.

Figs. 9 a—b. *Pleuromya corrugata* n. sp., holotype, a) right side, b) dorsal view. — Katslösa 840 (bed 30). — S.G.U. Museum. $\times 1\,^1/_3$. — Page 194.

Fig. 10. *Arcomya* cf. *elongata* AG. L.V. — Katslösa 840 (bed 30). — Mo 6550 (R.M.) $\times 1\,^1/_3$. — Page 193.

Fig. 11. *Arcomya decora* n. sp. L.V. — Katslösa 840 (bed 30). — S.G.U. Museum. $\times 1\,^1/_3$. — Page 192.

Figs. 12 a—c. *Pleuromya corrugata* n. sp. Laterally compressed. a) R.V., b) dorsal view, c) L.V. — Katslösa 840 (bed 30). — Mo 6559 (R.M.). $\times 1\,^1/_3$. — Page 194.

Fig. 13. *Plagiostoma succincta* v. SCHLOTHEIM. Incomplete L.V. — Katslösa 840 (bed 30). — Mo 6390 (R.M.). $\times 1\,^1/_3$. — Page 209.

PLATE XIV

Döshult beds at Katslösa (Figs. 2, 6, 7, 8)
Katslösa Stage

Figs. 1 a—c. *Anisocardia luggudensis* n. sp. a) L.V., b) posterior side, c) dorsal side. — Katslösa loc. 825 (bed 28). — S.G.U. Museum. × 2. — Page 185.

Fig. 2. *Protocardia oxynoti* (QUENST.). R.V. — Katslösa 700 (bed 8). — Mo 6745 (R.M.). × 4. — Page 179.

Figs. 3—5. *Protocardia truncata* (SOW.). — Katslösa 840 (bed 30). — Page 180.
Fig. 3: R.V. — S.G.U. Museum. × 5.
" 4: L.V. — Mo 6704 (R.M.). × 2 1/2.
" 5: L.V. — Mo 6302 (R.M.). × 2 1/2.

Fig. 6. *Homomya centralis* n. sp. L.V. — *Myacid* Bank, Katslösa 700 (bed 8). — S.G.U. Museum. × 3. — Page 191.

Fig. 7. *Isognomon* sp. External mould of L.V. — *Myacid* Bank, Katslösa 700 (bed 8). — × 2. — Page 208.

Fig. 8. *Modiola* cf. *tenuissima* TERQUEM & PIETTE. R.V. — *Myacid* Bank, Katslösa 700 (bed 8). — Mo 6713 (R.M.). × 2. — Page 232.

Figs. 9—10. *Modiola scalprum* SOW. — Katslösa. — × 2. — Page 232.
Fig. 9: L.V. — Loc. 875. — Mo 6769 (R.M.).
" 10: a) R.V., b) L.V. — Loc. 840. — Mo 6525 (R.M.).

Figs. 11 a—b. *Mytilus* cf. *lamellosus* TERQUEM in lateral view (a) and from the margin (b). — Katslösa 840 (bed 30). — S.G.U. Museum. × 2. — Page 233.

PLATE XV

Katslösa Stage (except Fig. 17)

Figs. 1—10. *Pentacrinus basaltiformis* MILLER. Stem portions. — Katslösa bed 29. — S.G.U. Museum. Nat. size. — Page 143.

Figs. 11 a—b. *Pentacrinus* cf. *basaltiformis*. — Katslösa beds 30—35. — S.G.U. Museum. × 3. — Page 144.

Figs. 12—13. *Pentacrinus* cf. *subteroides* QUENST. — Katslösa 840 (bed 30). × 5. — Page 144.
Fig. 12: Stem portion with two columnals. Ec 7240 (R.M.).
" 13: Ec 7230 (R.M.).

Figs. 14 a—b. *Serpula quinquesulcata* MÜNSTER. — Katslösa bed 29. — S.G.U. Museum. × 3. — Page 144.

Fig. 15. *Zeilleria* cf. *numismalis* (LAMARCK). Ventral valve. — Katslösa 840 (bed 30). — Br 5118 (R.M.). Nat. size. — Page 146.

Figs. 16 a—d. *Spiriferina walcotti* var. *münsteri* DAVIDSON. — Katslösa 840 (bed 30). — Br 5111 (R.M.). × 2. — Page 147.
Fig. a: Ventral valve.
" b: Dorsal valve.
" c: Anterior margin.
" d: Lateral view.

Figs. 17 a—c. *Rhynchonella deffneri* OPPEL. Rolled and worn specimen, derived from the Döshult Stage. — Katslösa 768 (bed 18). — S.G.U. Museum. × 6. — Page 147.

PLATE XVI

Katslösa Stage

All specimens figured on this plate are from loc. 840 (bed 30) at Katslösa.

Figs. 1—2. *Palaeoneilo galatea* (D'ORBIGNY). L.V. and R.V. — S.G.U. Museum. × 5. — Page 149.

Fig. 3. *Palaeoneilo bornholmiensis* (v. SEEBACH). L.V. — S.G.U. Museum. × 3. — Page 150.

Figs. 4—5. *Rollieria bronni* (ANDLER). — Page 153.
Fig. 4: Entire specimen in lateral view. — S.G.U. Museum. × 5.
" 5 a—c: Right valve in different views, to show the outline and the arching. — Mo 6200 (R.M.). × 3.

Fig. 6. *Palaeoneilo galatea* (D'ORB.). R.V. — Mo 6563 (R.M.). × 6. — Page 149.

Figs. 7—8. *Palaeoneilo oviformis* n. sp. — S.G.U. Museum. × 5. — Page 151.
Fig. 7: L.V.
" 8: R.V.

Figs. 9—11. *Palaeoneilo galatea* (D'ORB.)? — S.G.U. Museum. — Page 149.
Fig. 10: R.V. — × 4.
Figs. 9, 11: R.V. — × 5.

Fig. 12. *Palaeoneilo oviformis* n. sp. R.V. — S.G.U. Museum. × 5. — Page 151.

Figs. 13—16. *Nuculana zieteni* BRAUNS — Page 151.
Figs. 13—14: L.V. — Mo 6224 and MO 6222 (R.M.). × 8.
Fig. 15: L.V. — S.G.U. Museum. × 5.
" 16: R.V. — " " × 5.

Fig. 17. *Palaeoneilo oviformis* n. sp. L.V. — Mo 6201 (R.M.). × 5. — Page 151.

PLATE XVII

Katslösa Stage

Grammatodon cypriniformis (LUNDGREN). Loc. 840 at Katslösa (bed 30). — Page 154.
Figs. 1—7 are "long" forms without test — internal casts.
" 8—15 are "short" forms — specimens with preserved shell.

Fig. 1. L.V. — Mo 6624 (R.M.). × 6.
" 2. R.V. — Mo 6176 (R.M.). × 5.
" 3. R.V. — Mo 6181 (R.M.). × 3.
" 4. L.V. — S.G.U. Museum. × 3.
" 5. R.V. — Mo 6191 (R.M.). × 3.
" 6. L.V. — Mo 6189 (R.M.). × 3.
" 7. L.V. — Mo 6242 (R.M.). × 3.
" 8. R.V. — Mo 6186 (R.M.). × 6.
" 9. R.V. — S.G.U. Museum. × 5.
" 10. L.V. — Mo 6181 (R.M.). × 3.
" 11. L.V. — Mo 6178 (R.M.). × 3.
" 12. L.V. — Mo 6177 (R.M.). × 3.
" 13. L.V. — S.G.U. Museum. × 5.
" 14. R.V. — " " × 5.
" 15. Posterior end damaged. — S.G.U. Museum. × 5.
a: R.V.
b: L.V.
c: Hinge-line.

PLATE XVIII

Katslösa Stage

Fig. 1. *Grammatodon cypriniformis* (LUNDGREN). L.V. — Katslösa 840 (bed 30). — S.G.U. Museum. × 5. — Page 154.

Fig. 2. *Grammatodon subrhomboidalis* n. sp. Holotype. R.V. — Katslösa 955 b. — S.G.U. Museum. × 3. — Page 158.

Figs. 3—5. *Catella sinuata* n. sp. — Katslösa 840 (bed 30). — S.G.U. Museum. × 5. Page 157.
Fig. 3: Internal cast of L.V.
" 4: L.V. Holotype.
" 5 a—b: Entire internal cast.

Fig. 6. *Barbatia pulla* TERQUEM? R.V. — Katslösa 840 (bed 30). — Mo 6540 (R.M.). × 8. — Page 159.

Figs. 7 a—c. *Nucula distinguenda* MOBERG. Entire specimen from the left (a), right (b), and hinge-line (c). — Katslösa 840 (bed 30). — S.G.U. Museum. × 6. — Page 154.

Figs. 8—9. *Trigonia modesta* TATE. L.V. — Katslösa 840 (bed 30). — × 5. — Page 166.
Fig. 8: S.G.U. Museum.
" 9: Mo 6305 (R.M.).

Figs. 10 a—b. *Trigonia primaeva* n. sp. Holotype. R.V. — *Cardium* Bank, Kurremölla. — S.G.U. Museum. × 3. — Page 165.

Figs. 11—12. Same species. R.V. — Katslösa 955 (bed 42). — S.G.U. Museum.
Figs. 11 a—b: × 2.
Fig. 12: × 3.

Fig. 13. *Trigonia primaeva*? L.V. — Brandsberga pebble, loc. "Ljungby kyrkmur" (ANGELIN). — S.G.U. Museum. × 2. — Page 165.

PLATE XIX

Döshult Stage (Figs. 1—3)
Katslösa Stage (Figs. 4—14)

All figured specimens are from Katslösa.

Figs. 1—3. *Radula duplicata* (SOWERBY). — Loc. 700 (bed 8). — × 3. — Page 208.
Fig. 1: L.V. — Mo 6636 (R.M.).
Figs. 2—3: Moulds of R.V. and L.V. — S.G.U. Museum.

Figs. 4—7. *Limea katsloesensis* n. sp. — Loc. 840 (bed 30). — Page 210.
Fig. 4: Holotype. a) × 3, b) Hinge-line enlarged to show the teeth. × 5. Mo 6408 (R.M.).
" 5: R.V. — S.G.U. Museum. × 3.
" 6: L.V. — Mo 6412 (R.M.). × 3.
" 7: R.V. with colour markings. — S.G.U. Museum. × 6.

Figs. 8—14. *Limea acuticostata* MÜNSTER. — Loc. 840 (bed 30). — Page 210.
Fig. 8: L.V. — S.G.U. Museum. × 6.
" 9: L.V. — " " × 5.
" 10: R.V. — " " × 5.
" 11: L.V. — " " × 5.
" 12: L.V. — Mo 6382 (R.M.). × 3.
" 13: L.V. — Mo 6524 (R.M.). × 3.
" 14: R.V. — S.G.U. Museum. × 3.

PLATE XX

Döshult Stage (Figs. 1—3, 9—13, 17)
Katslösa Stage (Figs. 4—8, 14—16, 18, 19)

All figured specimens on this plate are derived from Katslösa.

Figs. 1—3. *Entolium cingulatum* (GOLDF.). — Loc. 700 (bed 8). — S.G.U. Museum. × 2. — Page 217.
Figs. 1 and 3: L.V.
Fig. 2: R.V.

Figs. 4—8. *E. lundgreni* Moberg. R.V. — Loc. 840 (bed 30). — × 2. — Page 218.
Figs. 4—7: Mo 6495—6498 (R.M.).
Fig. 8: S.G.U. Museum.

Figs. 9—13. *E. calvum* (Goldf.). — Loc. 700 (bed 8). — Page 216.
Figs. 9—10: L.V. — S.G.U. Museum. × 2.
" 11—12: R.V. — " " × 2.
Fig. 13: R.V. — Mo 6713 (R.M.). × 1 1/3.

Figs. 14—16. *Chlamys textoria* v. Schlotheim. — Page 213.
Fig. 14: R.V. — Loc. 840 (bed 30). — Mo 6519 (R.M.). × 2.
" 15: L.V. — Loc. 840 (bed 30). — Mo 6494 (R.M.). × 1 1/3.
" 16: R.V. — Bed 27. — S.G.U. Museum. × 1 1/3.

Fig. 17. *Chlamys subulata* (Münster). R.V. — Loc. 700 (bed 8). — S.G.U. Museum. × 2. — Page 212.

Fig. 18. *C. interpunctata* n. sp. Holotype. L.V. — Loc. 955 (bed 42). — S.G.U. Museum. × 2 1/2. — Page 214.

Figs. 19 a—b. *Ptychomphalus* cf. *expansus* (Sow.). — Loc. 875 (bed 36). — Mo 6607 (R.M.). × 1 1/3. — Page 238.

PLATE XXI

Döshult Stage (Figs. 9, 11, 12)
Katslösa Stage (Figs. 1—8, and 10)

All figured specimens are derived from Katslösa, and are (except Fig. 7) preserved in the S.G.U. Museum.

Figs. 1—8. *Plicatula spinosa* Sow. — Page 220.
Fig. 1: L.V. — Loc. 840 (bed 30). — × 5.
" 2: R.V. a) inside, b) outside. — Beds 31—35. — × 2.
" 3: R.V. a) inside, b) outside. — Beds 31—35. — × 2.
" 4: L.V. — Beds 31—35. — × 2 1/3.
" 5—6: L.V. internal casts. — Loc. 840 (bed 30). — × 5.
" 7: L.V., test partly preserved. — Loc. 840 (bed 30). — Mo 6533 (R.M.). × 2.
" 8: L.V., internal cast. — Loc. 850 (bed 32).

Fig. 9. *Dimyodon* sp. R.V., a) internal cast, b) the mould with remnants of the shell. — Loc. 700 (bed 8). — × 3. — Page 220.

Fig. 10. *Plicatula* sp. 2 (cf. *P. suecica* Lundgren). Hinge of a L.V. of large specimen. — Loc. 875 (bed 36). — × 3. — Page 222.

Figs. 11—12. *Entolium cingulatum* (Goldf.). — Loc. 700 (bed 8). — Page 217.
Fig. 11: R.V., internal cast. Nat. size.
" 12: L.V., internal cast with small remnants of the test. × 2.

PLATE XXII

Katslösa Stage

Plicatula orbiculoides (Römer)? Left valves. — Page 221.

All figured specimens, except that of Fig. 1, are preserved in the S.G.U. Museum.
Fig. 1. Loc. 840 (bed 30). — Mo 6419 (R.M.). × 5.
" 2. " " × 5.
" 3. Inside. — Loc. 840 (bed 30). × 5.
Figs. 4—16 are natural internal casts with impressed sculpture of the *host* shell. All specimens, except that in fig. 6, are from loc. 850 (bed 32).
Enlargements:

Fig. 4: × 6.
" 5: × 5.
" 6: × 5. — Loc. 840 (bed 30).
" 7: × 5.
Figs. 8—16: × 3.

PLATE XXIII.

Döshult Stage (Figs. 1—3)
Katslösa Stage (Figs. 4—9)

All figured specimens are derived from Katslösa.

Fig. 1. *Chemnitzia* sp. — Loc. 700 (bed 8). — Mo 6654 (R.M.). × 6. — Page 237.
Fig. 2. Small gastropods. — Loc. 700 (bed 8). — S.G.U. Museum. × 10. — Page 238.
Fig. 3. Small gastropod. — Loc. 700 (bed 8). — Mo 6652 (R.M.). × 13. — Page 238.
Figs. 4 a—c. *Ptychomphalus* cf. *expansus* (Sow.). — Loc. 955 (bed 42). — S.G.U. Museum. Nat. size. — Page 238.
Figs. 5—6. *Chlamys tullbergi* (LUNDGREN). R.V. — Loc. 840 (bed 30). Nat. size. — Page 213.
Fig. 5: Natural internal cast. — Mo 6523 (R.M.).
" 6: Natural external mould. — Mo 6517 (R.M.).
Figs. 7—9. *Bairdia amalthei* QUENST. — Loc. 840 (bed 30). — Ar 9625 a and b, Ar 9611 (R.M.). × 40. — Page 245.

PLATE XXIV

Döshult Stage (Fig. 11).
Katslösa Stage (Figs. 1—10, and 12)

All figured specimens are from Katslösa. All, except that in fig. 9, are preserved in the S.G.U. Museum.

Figs. 1—3. *Passaloteuthis alveolata* (WERNER). — Loc. 768 (bed 18). Nat. size. — Page 242.
Figs. 4—5. *Passaloteuthis apicicurvata* (BLAINVILLE). Nat. size. — Page 243.
Fig. 4: Bed 39.
" 5: Beds 31—35.
Figs. 6—8. *Pseudohastites charmouthensis* (MAYER). Nat. size. — Page 244.
Fig. 6: Bed 29.
" 7: Bed 19.
" 8: Bed 26.
Fig. 9. *Belemnites* sp. (cf. *P. apicicurvata*). In bed 36. — Mo 6591 (R.M.). Nat. size. — Page 243.
Fig. 10. *Serpula* cf. *raricostati* QUENST. and *Passaloteuthis alveolata*. — In bed 18 (loc. 768). — × 2. — Pp. 145 and 242.
Fig. 11. *Arietites* sp. Internal cast. — Loc. 700 (bed 8). × 2. — Page 241.
Fig. 12. *Bairdia dispersa* TATE & BLAKE. In bed 19. — × 20. — Page 245.

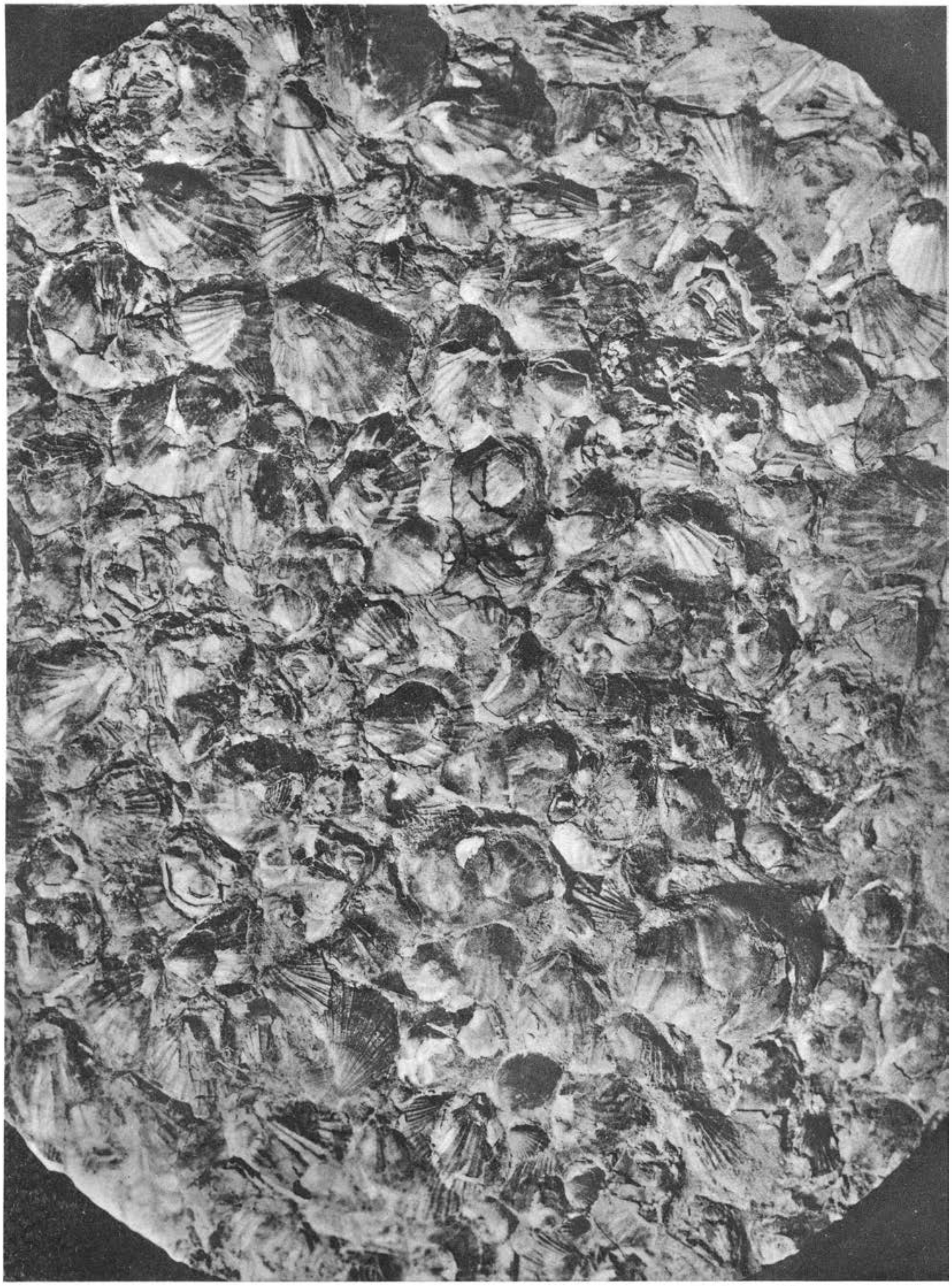
Errata

Page 73, line 32 — For Bed 10 (loc. 745) read Bed 10 (loc. 725).

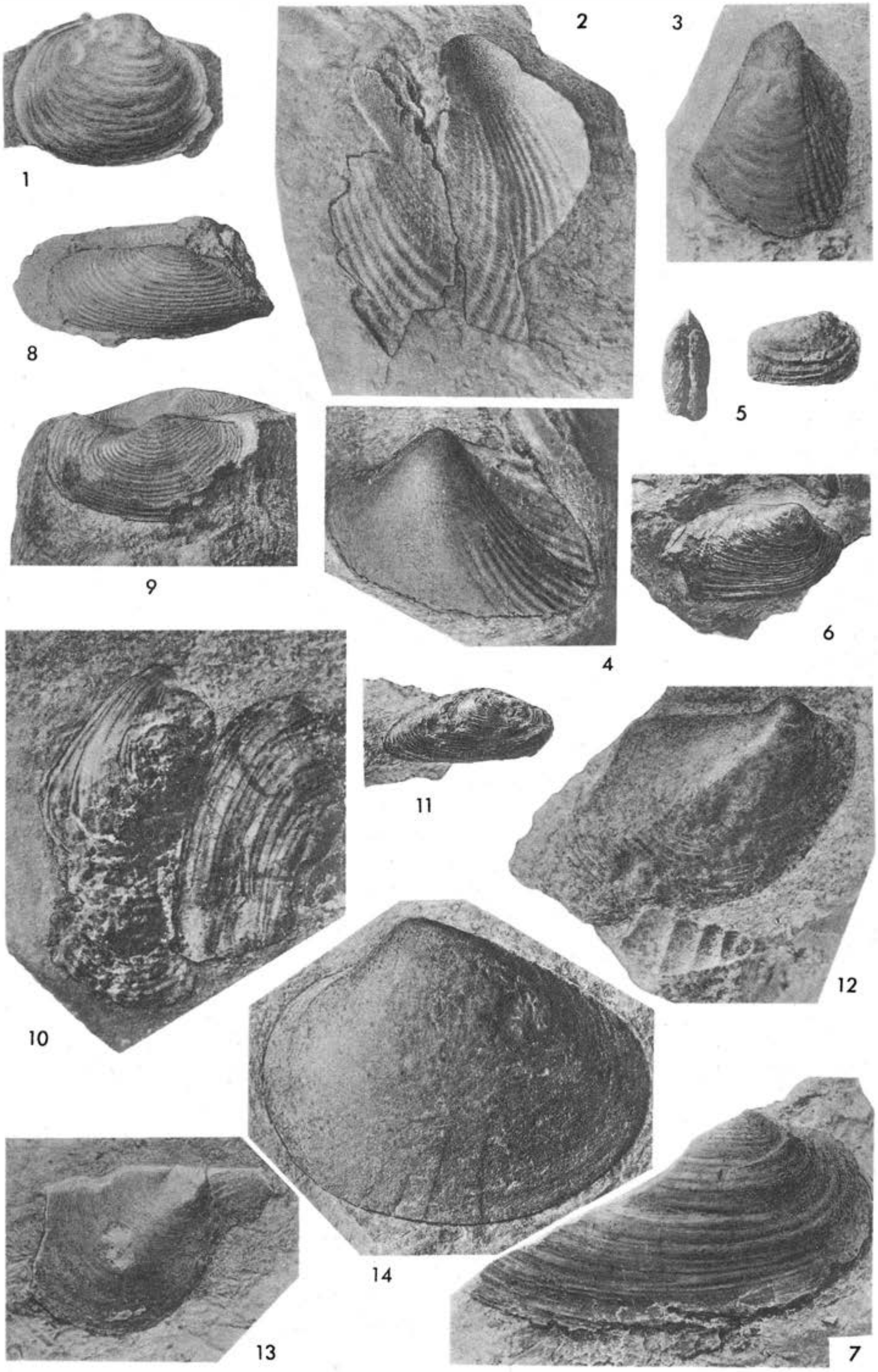
The stratigraphical table, P. 126, should be corrigated in accordance with the text as follows:

N.W. Scania	Central Scania	S.E. Scania	Bornholm	Central and Western Europe
		Wealden? ?	Upper fresh water series and Lias δ	Lower Cretaceous and Jurassic
Katslösa Stage: *Exp.aequiv.* z. *Cyprinif.* z. *Alveolatus* z.	Brandsberga?	*Exp.aequiv.* z. *Jamesoni* zone	? *Centaurus* zone *Jamesoni* zone	*Davoei* zone *Ibex* zone *Jamesoni* z. } Lias γ
				Lias β
Döshult Stage: Myacid B. Ammonite B. *Avicula* B.		Non-fossiliferous beds		*Arietites* or *Bucklandi* z. } Lias α_3
U. Helsingborgian L. ,,	Höör sandstone and arkose	*Thaumatopteris* flora	*Cardinia follini* *Thaumatopt.* fl.	Lias α_1—α_2
Rhaetic	Arkose			Rhaetic

Pl. I



Pl. II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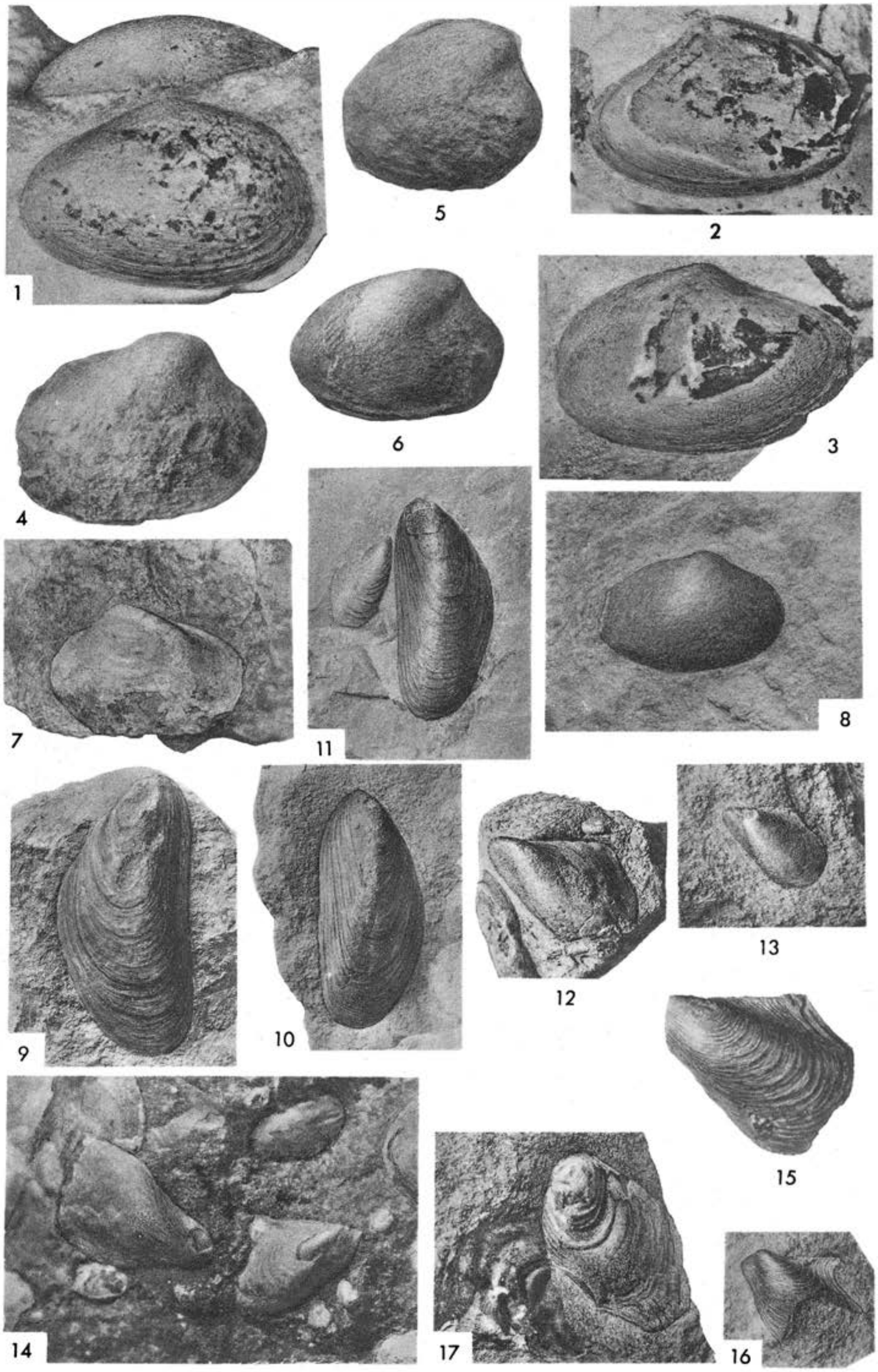
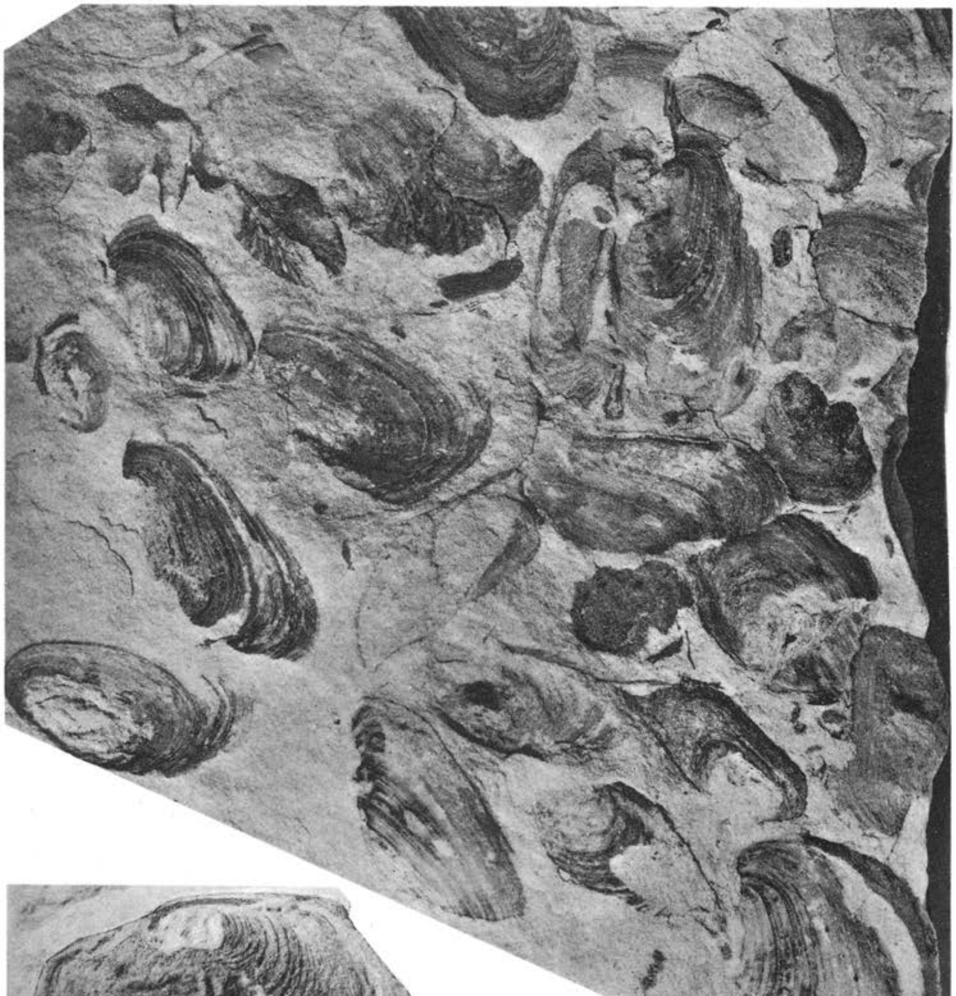
Pl. IV





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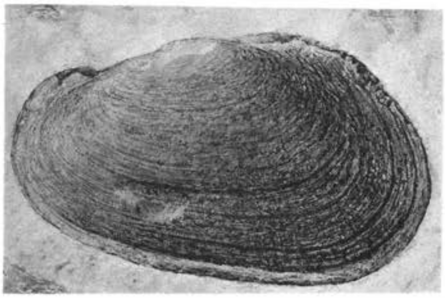

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Pl. VI


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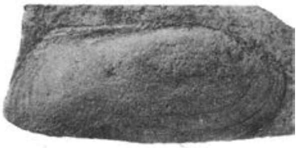
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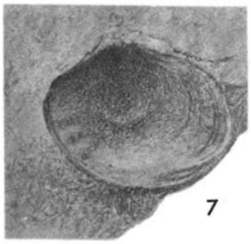
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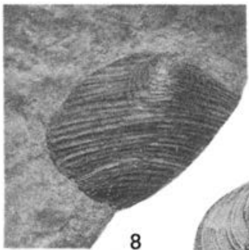
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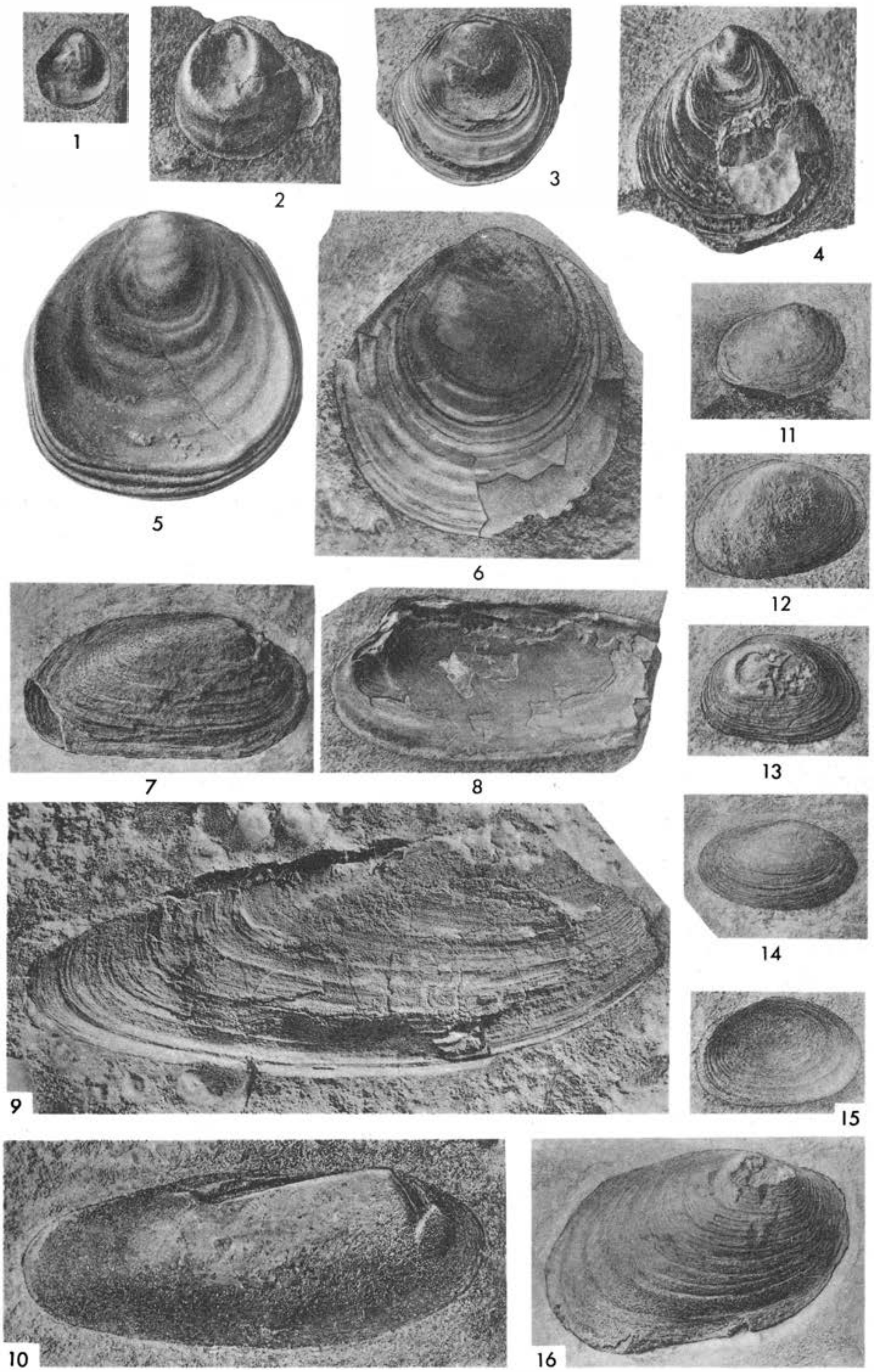
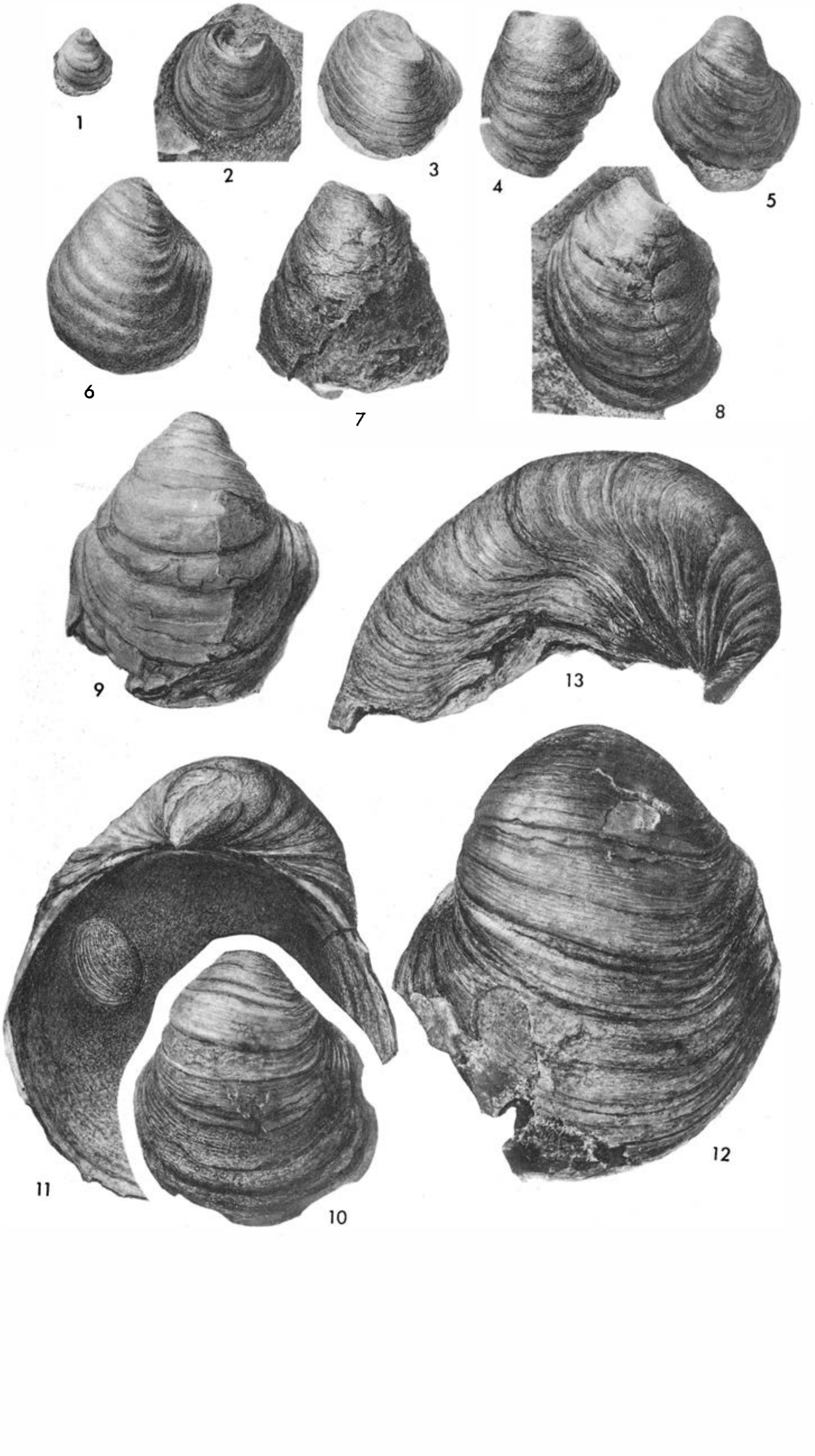
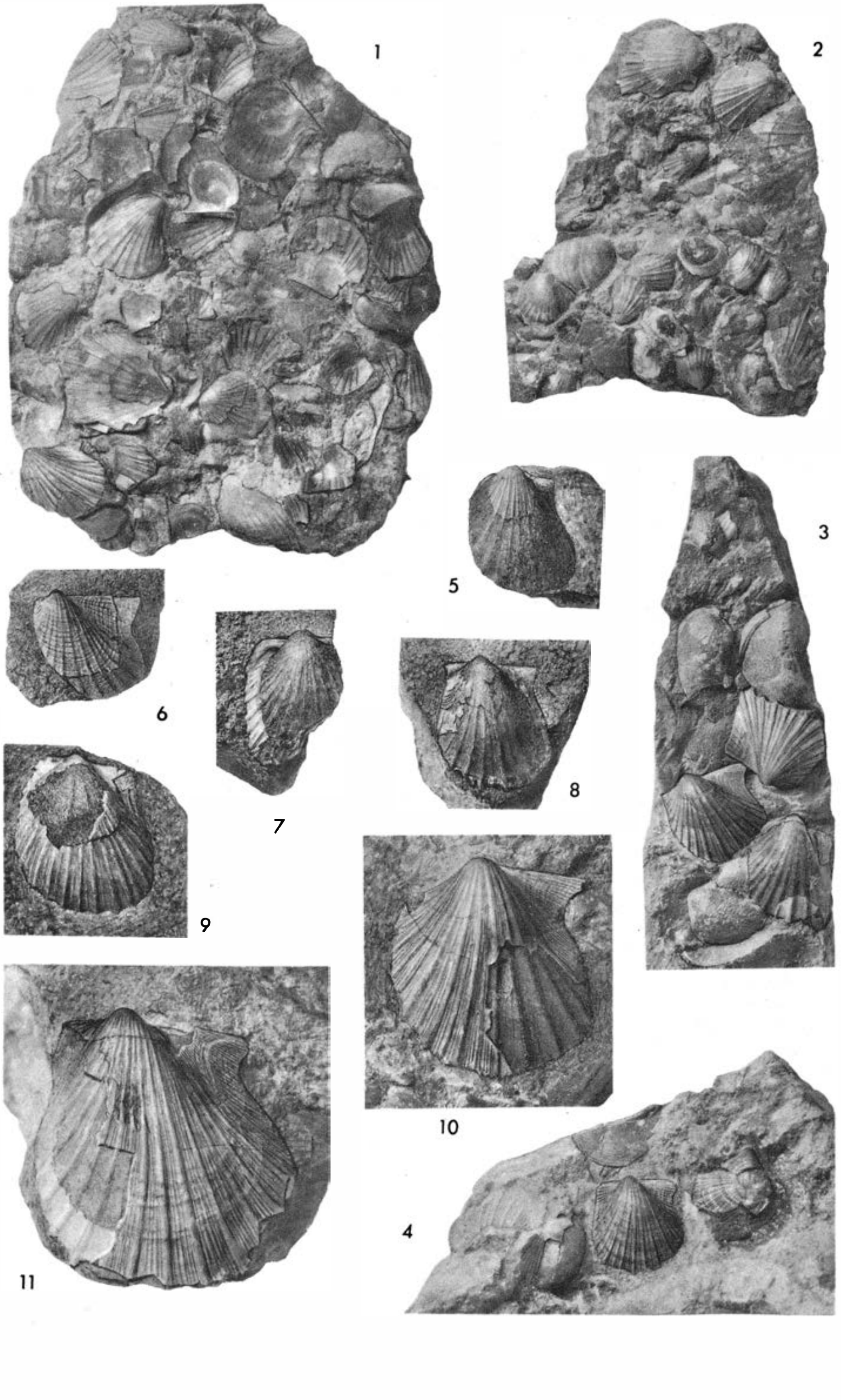
Pl. VII



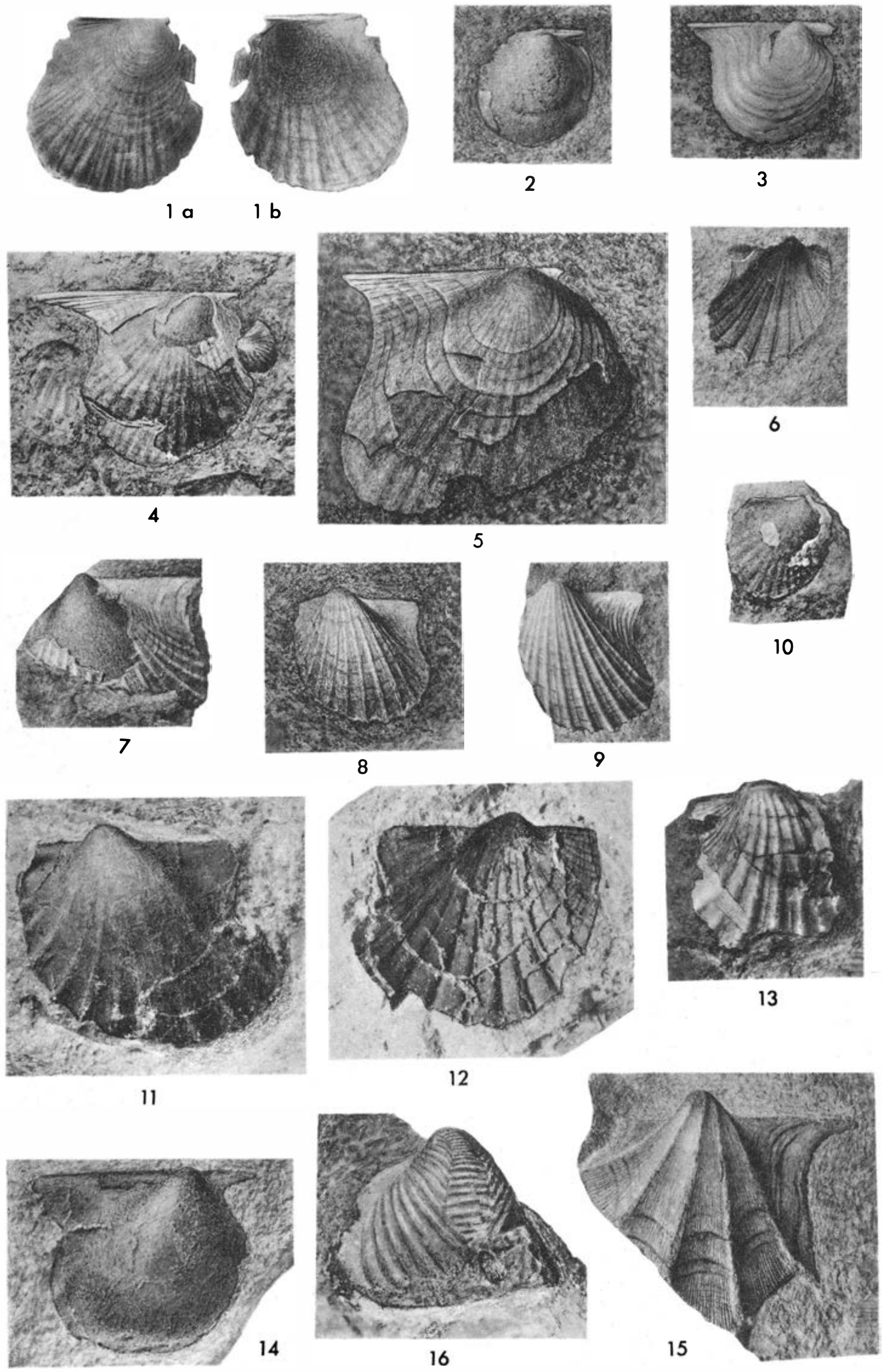
Pl. VIII



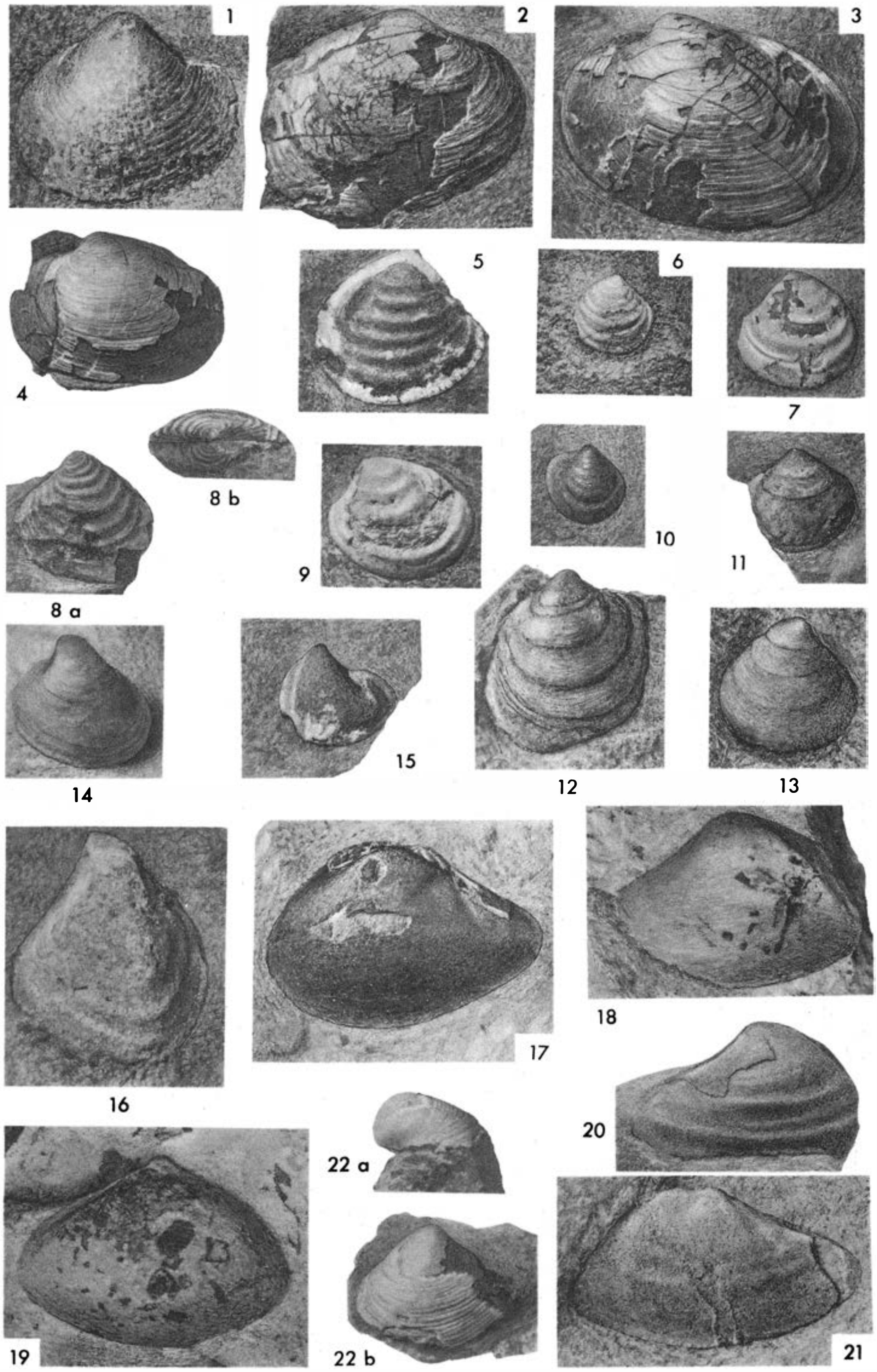
Pl. IX



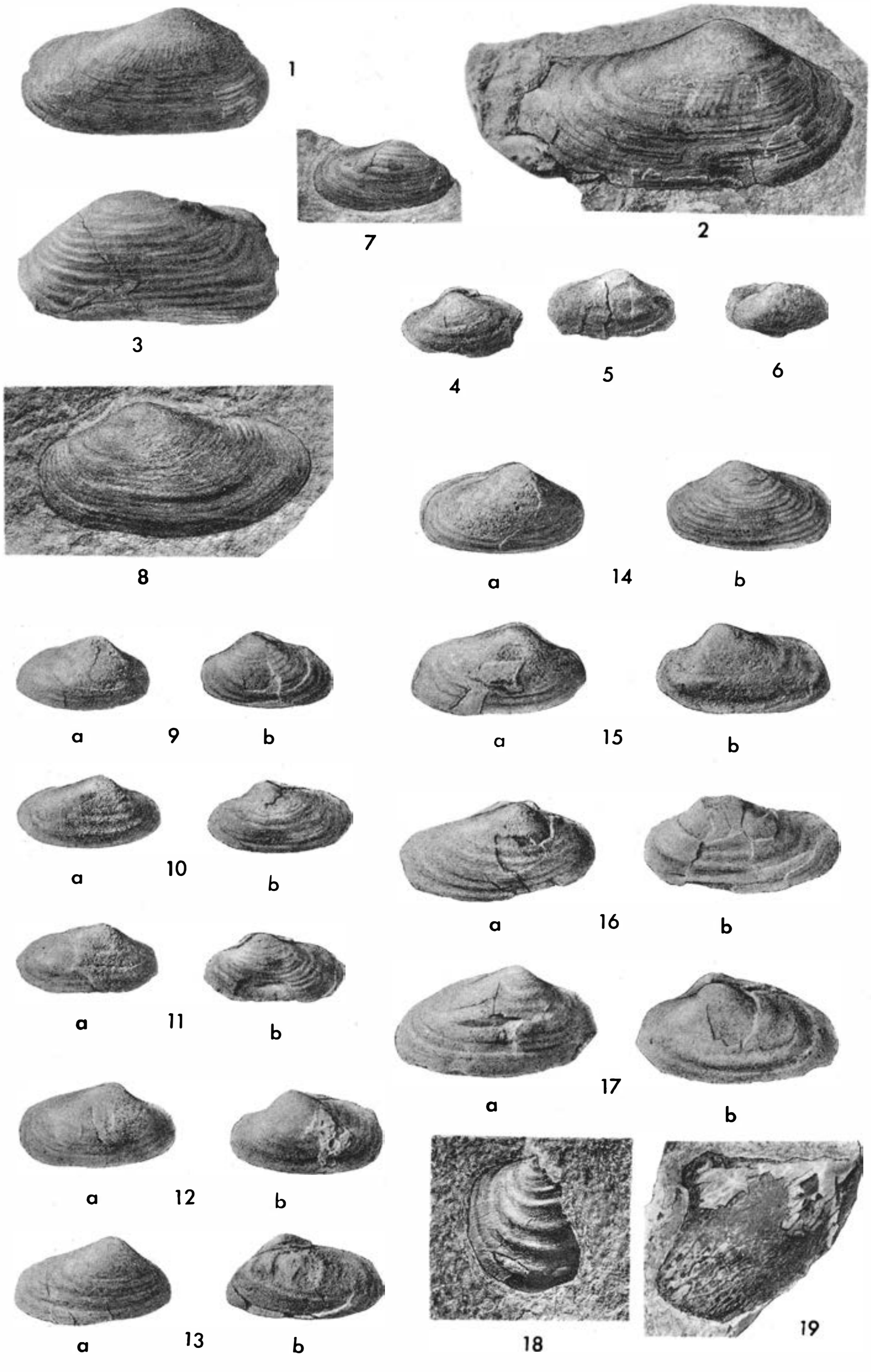
Pl. X



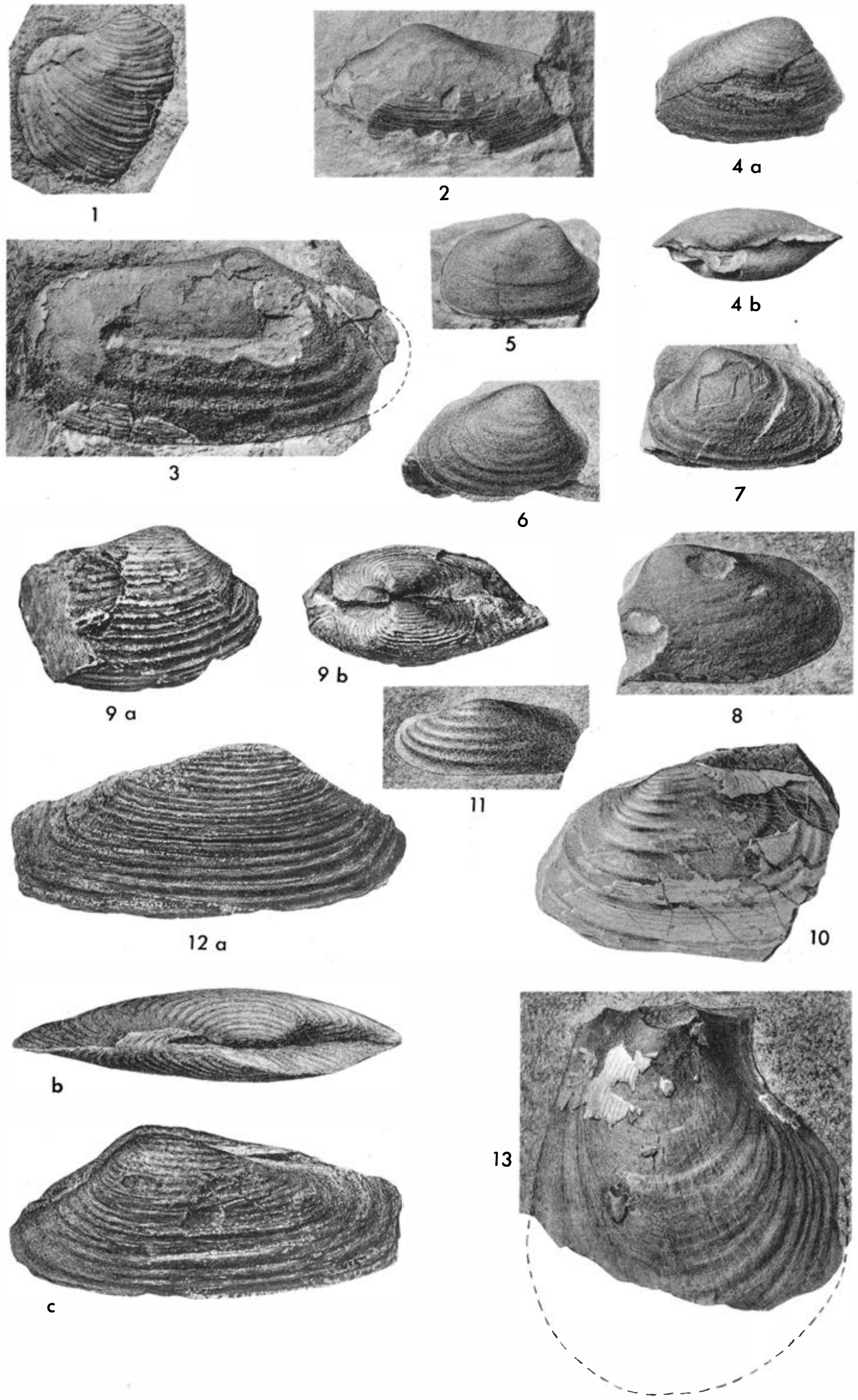
Pl. XI



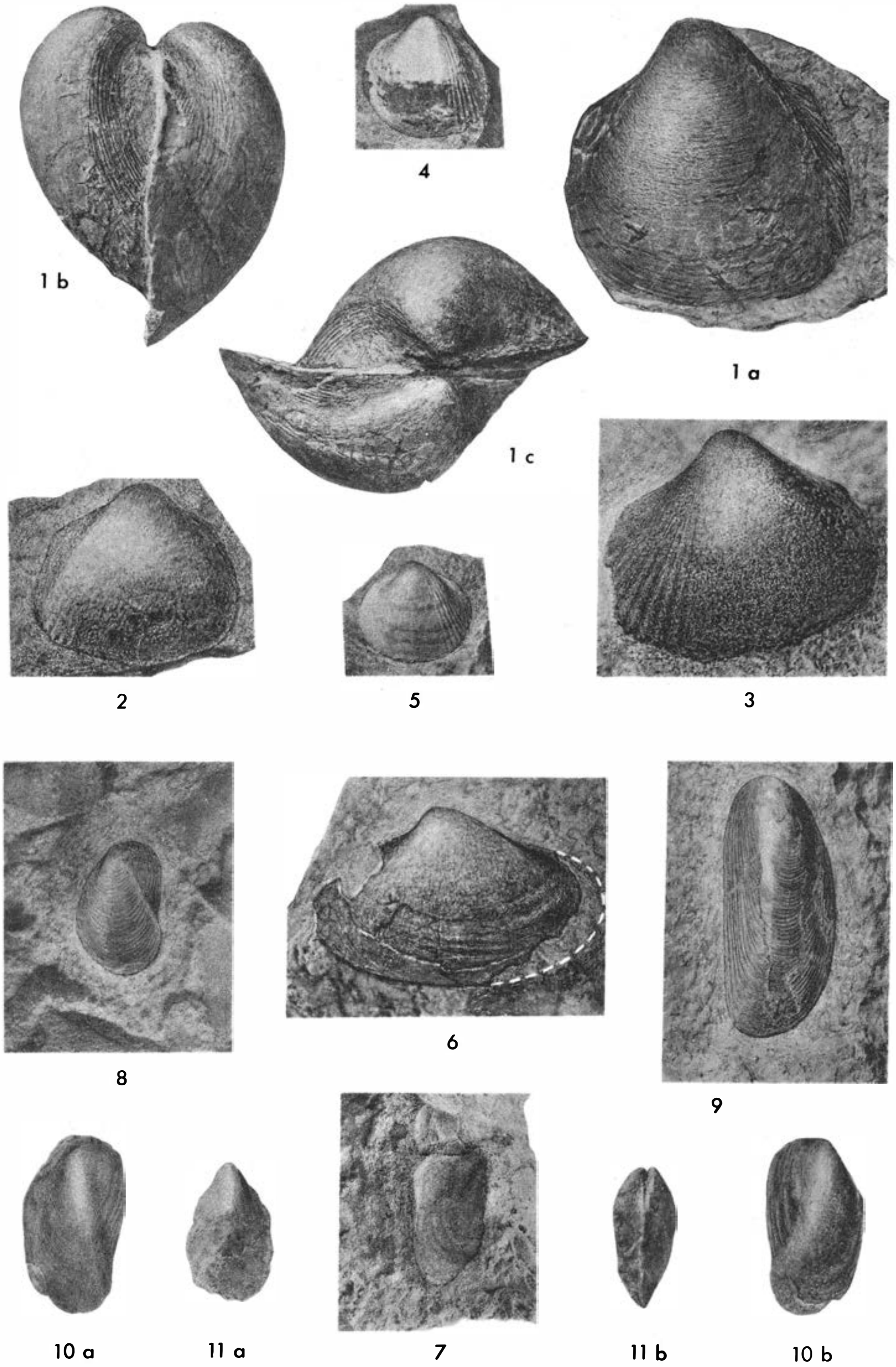
Pl. XII



Pl. XIII



Pl. XIV



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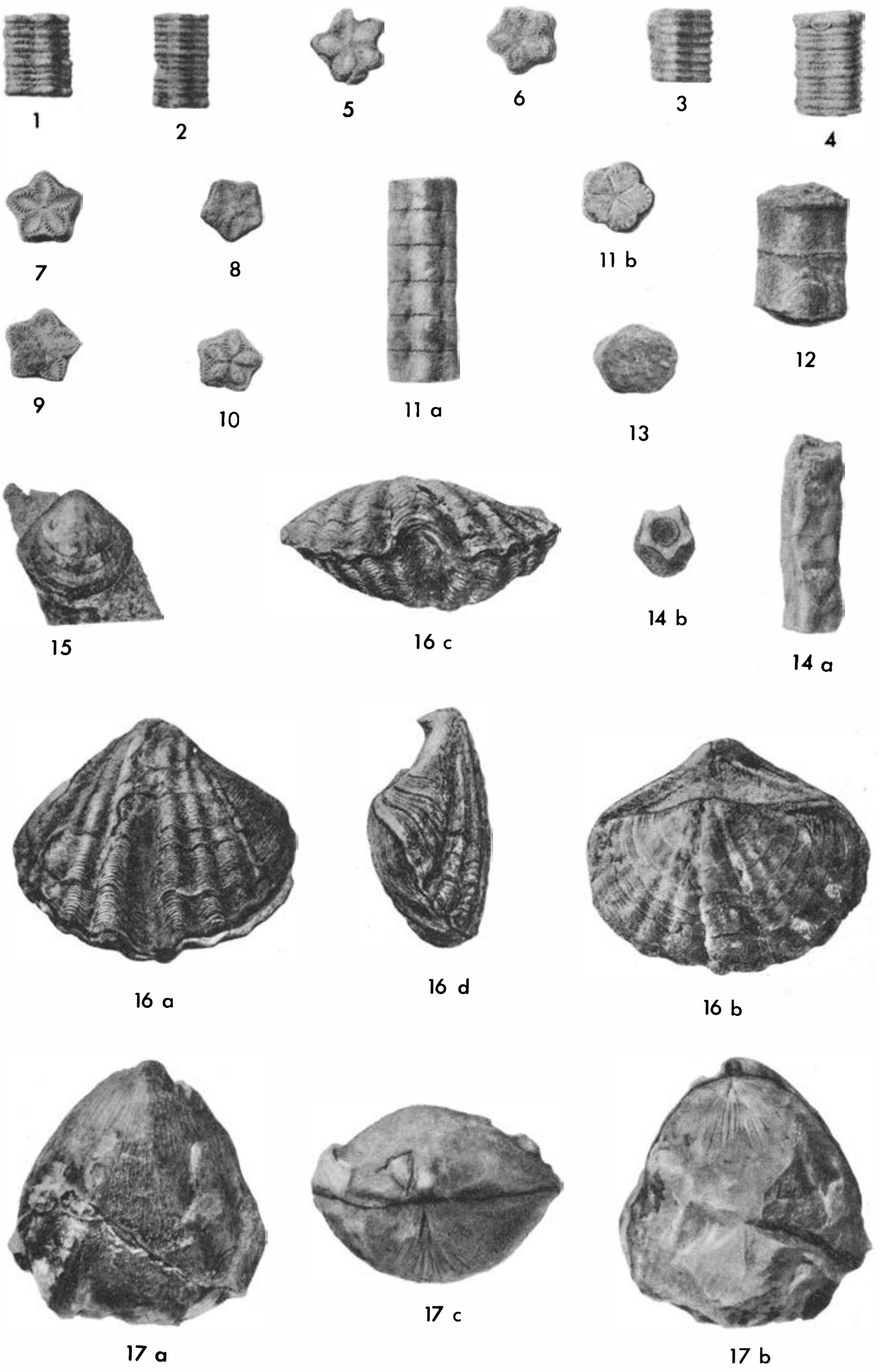
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11 b
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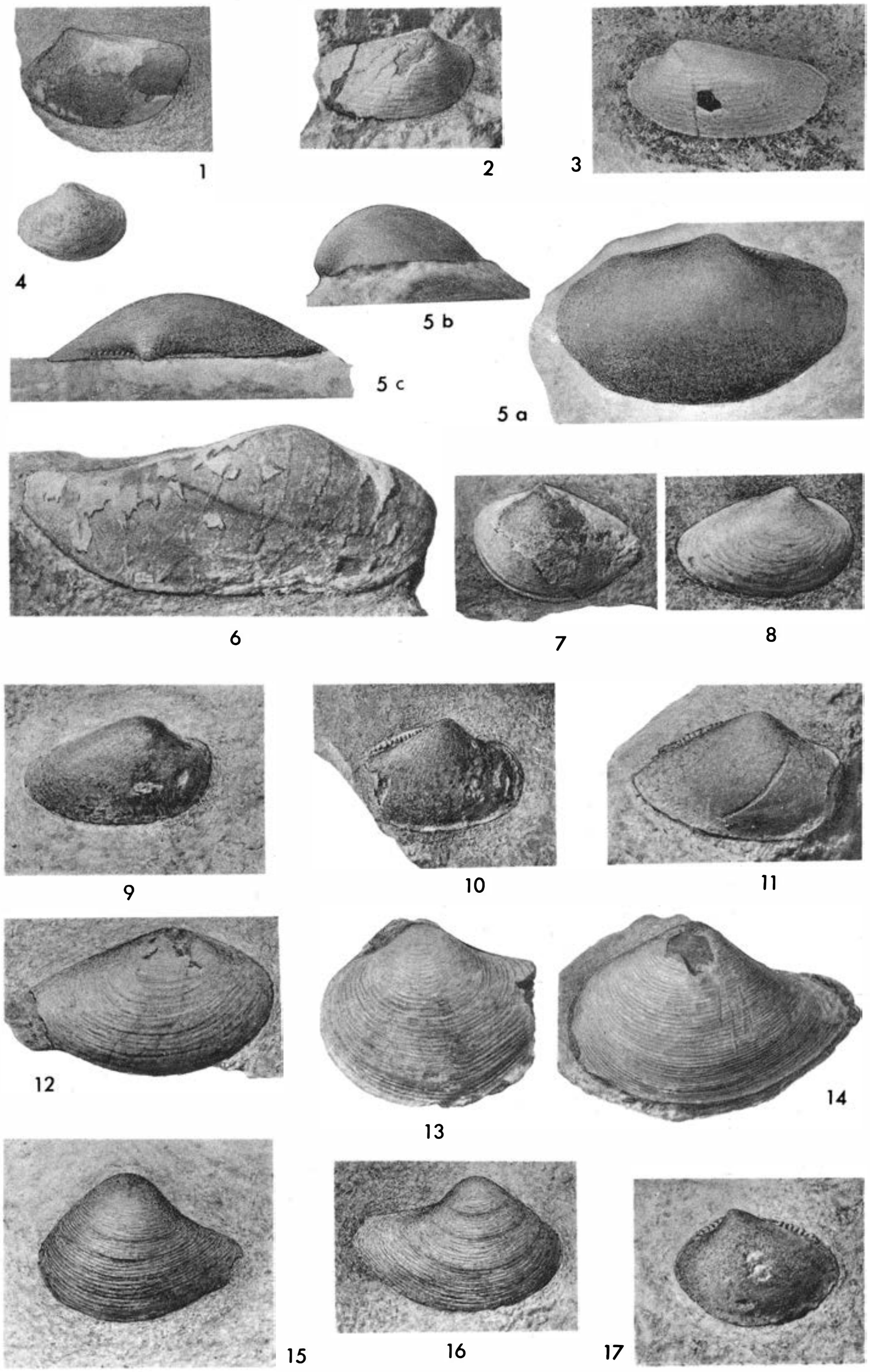
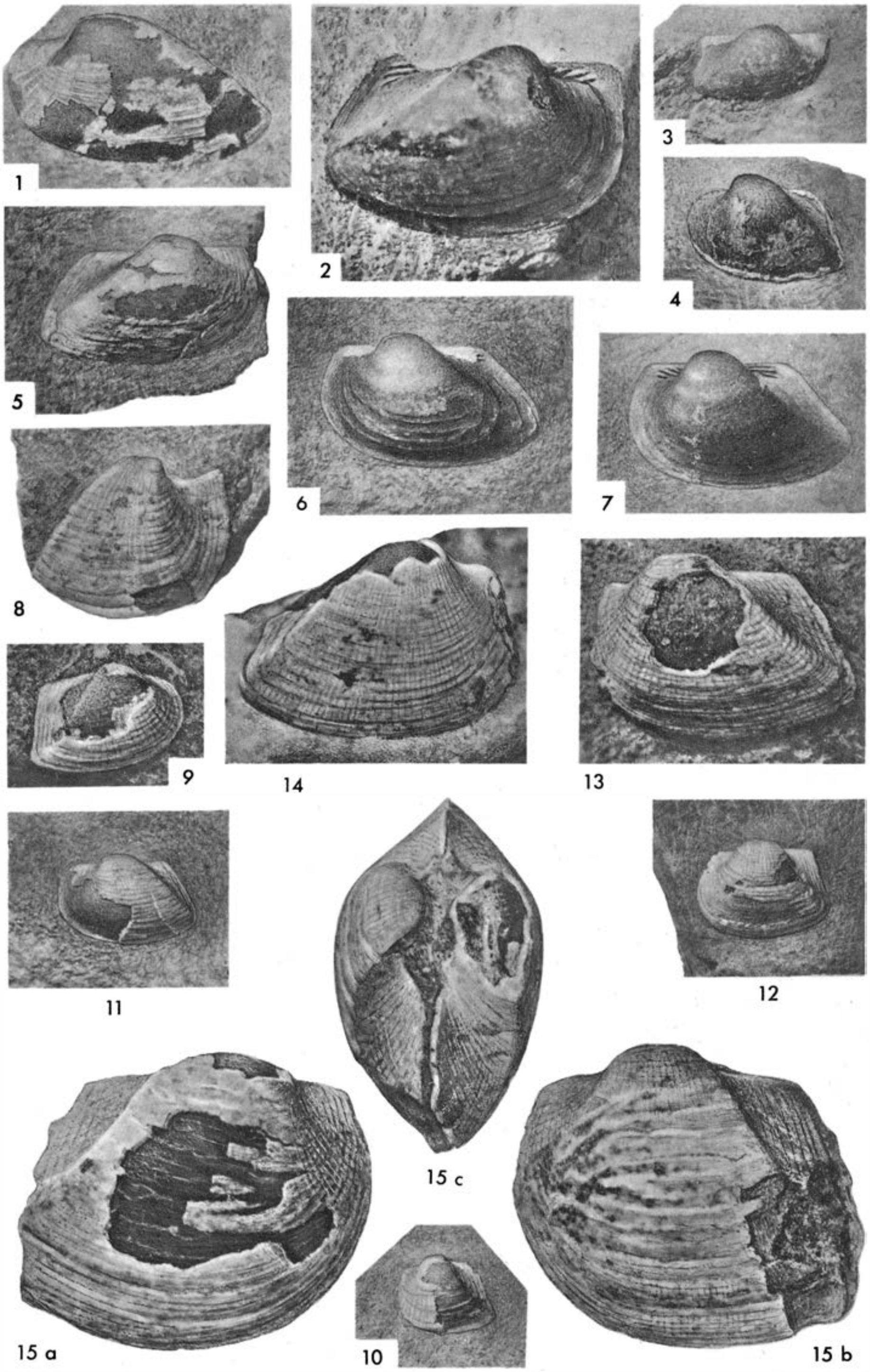
16 c
14 b
14 a
16 a
16 d
16 b
17 a
17 c
17 b

Pl. XVI





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15 c
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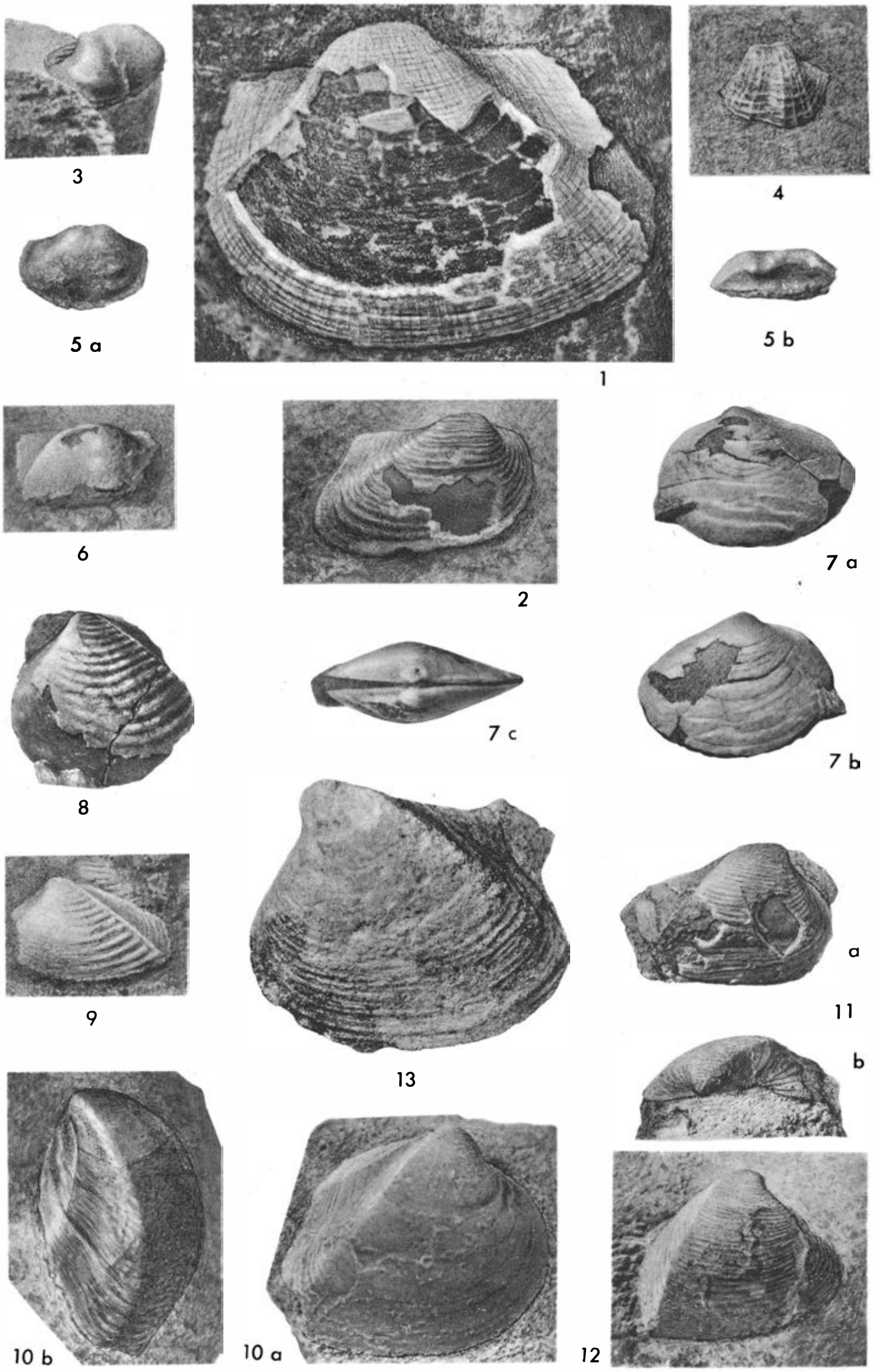
Pl. XVIII



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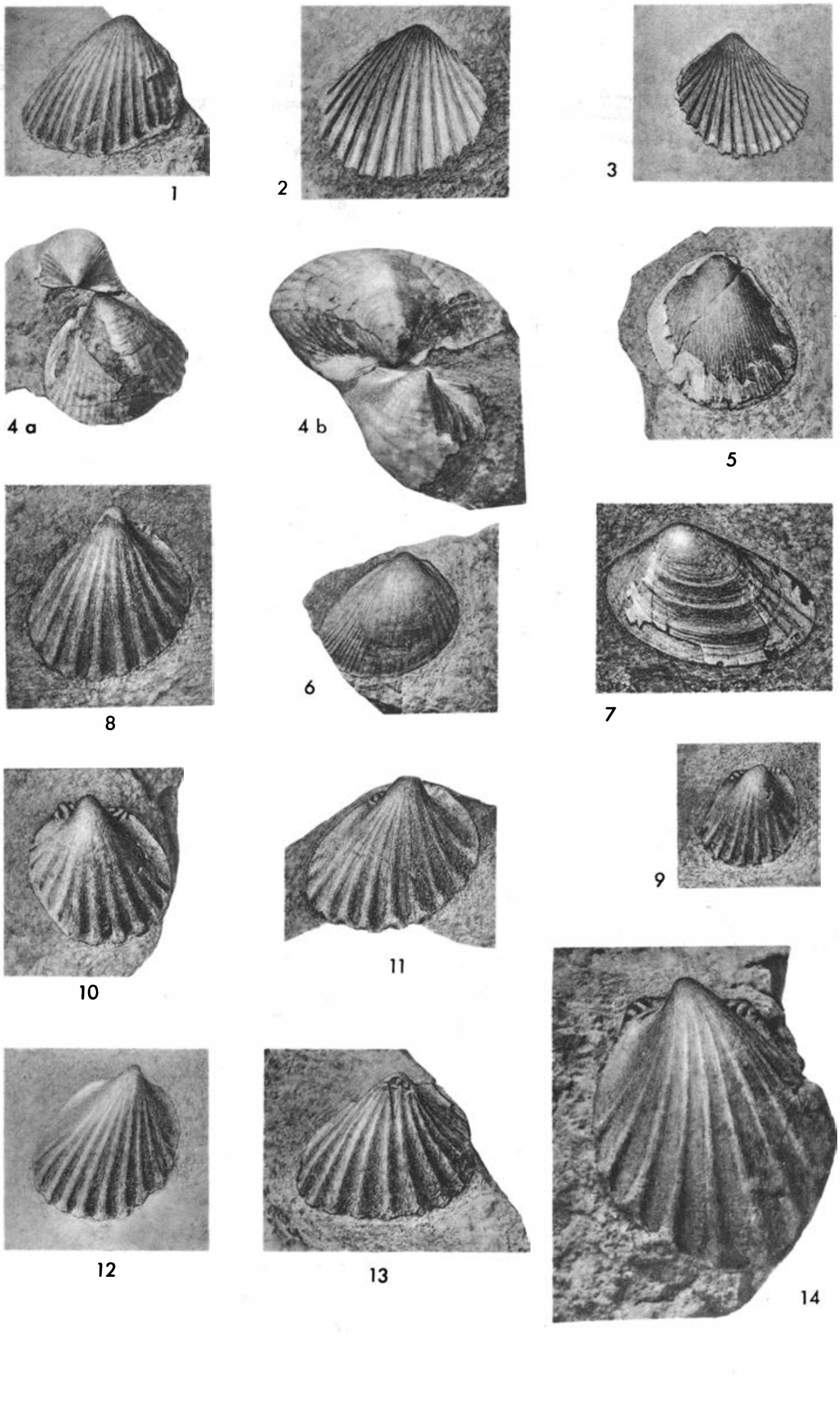
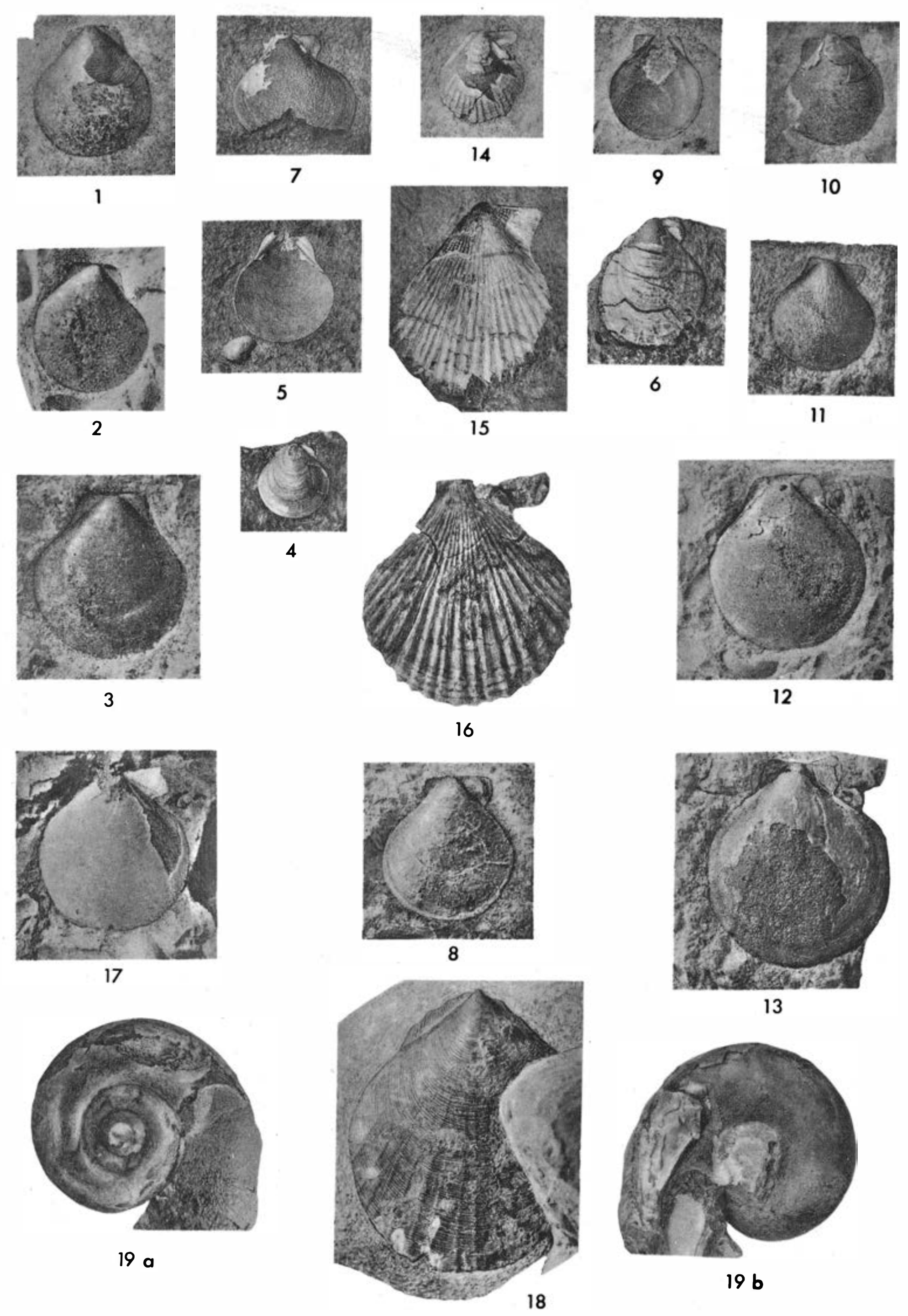


Pl. XX



Pl. XXI

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2 b

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3 b

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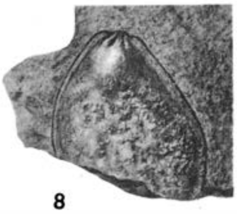

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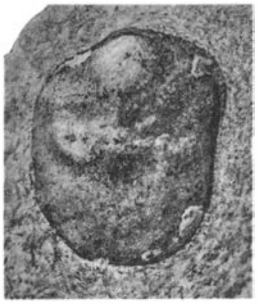
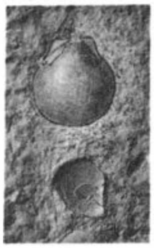


9 a



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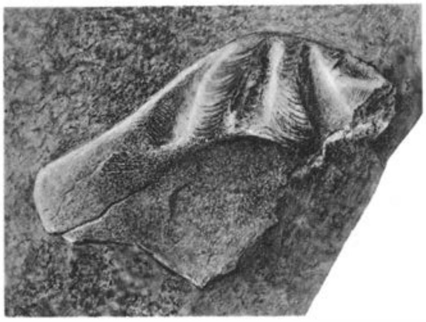
9 b



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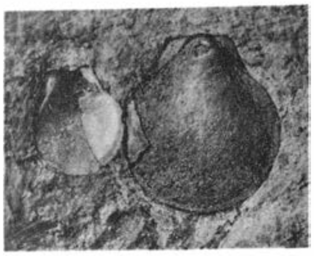

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Pl. XXII


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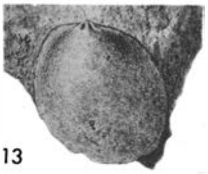
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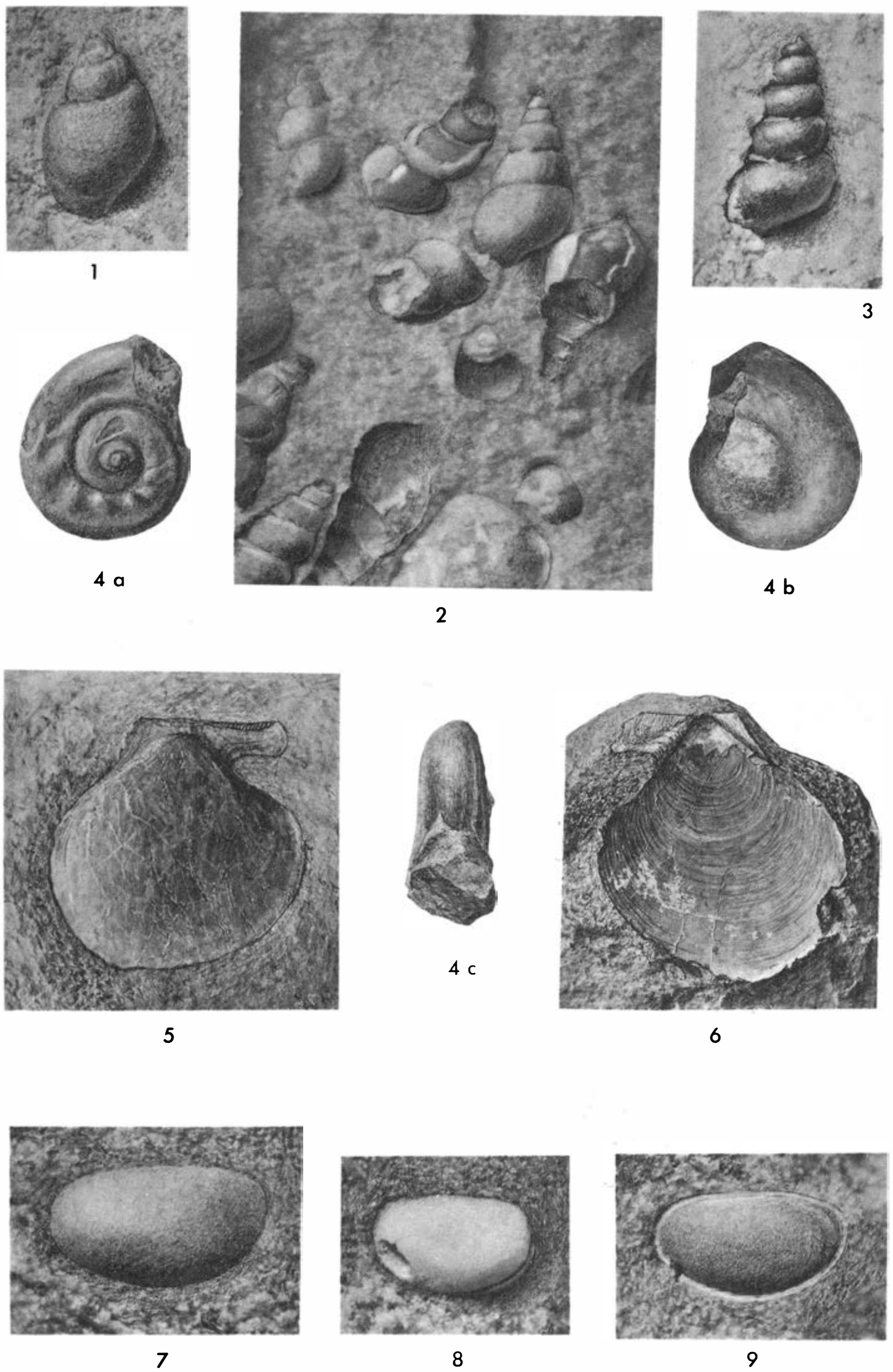
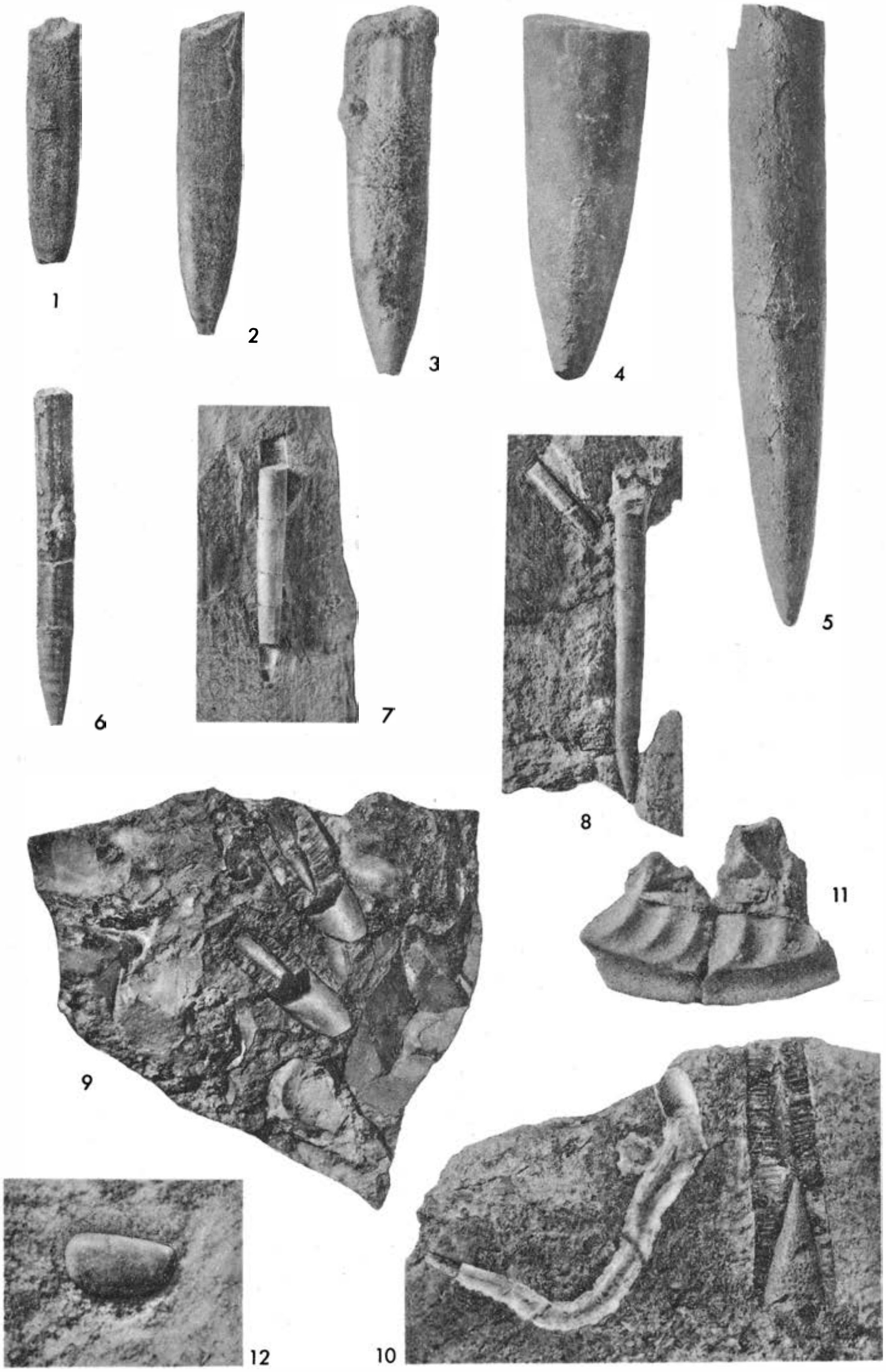
Pl. XXIII



Pl. XXIV



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