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THE MESOZOIC OF SCANIA, SOUTHERN SWEDEN

GUIDE TO EXCURSIONS NOS A 21 AND C 16

By

FRITZ BROTZEN

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Excursion leaders:

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Stockholm 1960. Kungl. Boktr. P. A. Norstedt & Söner

Introduction. Geological review of the Province of Scania

Scania is the southernmost part of Sweden and the only area in this country where Mesozoic rocks occur. In general it could be interpreted as a transition zone between the Scandinavian Shield and the Middle European Mesozoic syncline. Beginning with the Archean of Fennoscandia, there follow southwards:

Precambrian sediments
Cambrian sandstone and shales
Ordovician limestone and shales
Silurian limestone and shales
Permian volcanic rocks
Triassic sandstones and conglomerates
Jurassic continental and marine sediments
Various sediments of the Cretaceous
Marine sediments and volcanic rocks of the Lower Tertiary

The main direction of the border region is NW to SE, continuing from the northern part of Jutland in Denmark through Scania to the Danish island of Bornholm in SE. The entire region is characterized by a mosaic of tilted blocks. Its tectonic history began as early as the Precambrian and continued up to recent time. The changing of thickness and facies of the different sediments makes it certain, that during all post-Archean times the entire region was the hinge between a sediment basin and an elevated block, which delivered the material for the sediments. The tectonic picture we meet today can be dated to Middle Tertiary. Its present morphological structure was formed in the Younger Tertiary and finally modified by the Quaternary ice. Naturally the gravimetrical measurements show the same general strike as the geological maps. In the north a gravimetric minimum introduces the sedimentary area of Scania. A well marked maximum of gravity strikes with an axis from the NW-corner of the province to its south-eastern corner and decreases further to the south with about 30 mgl. into a tectonic unit, filled with more than 6 000 m of Paleozoic and Mesozoic sediments. Further southwards elevated blocks are known.

In 1929 E. Voigt tried to give a general picture of the tectonics of Scania. In his opinion a series of tilted blocks follows from SW to NE. A large uplift along a zone from NW to SE is broken in separate blocks with faults and overthrusts (see the map p. 15). This direction represents the hinge-line for the main movements. The southernmost unit studied during the excursion is the Malmö—Ystad syncline containing up to 6 000 m of sediments. The upper part, about 2 500 m, belongs to the Mesozoic, the lower part is the Cambro-Silurian. The highest stage of this region is the Danian. At a few places thin Paleocene is preserved. The next unit to the north is the Romeleåsen and the Hälsingborg-syncline with Jurassic, Triassic, and Paleozoic sediments on the Archean basement. The Paleozoic and elder Mesozoic is flexured or overthrust to the SW against the Danian syncline and the Mesozoic of the latter unit is raised. All details of the section and tectonic structures are known by drillings. But already the local outcrops give a general picture of the

structure of the hinge between the geological units of Middle and Northern Europe. The southwestern edge of the Hälsingborg—Romeleås unit is uplifted against the Danian syncline. In its northern part Triassic, Jurassic and Cretaceous form a special syncline, on which the next unit is overthrust: the Simrishamn—Båstad block. Its southern edge consists of Archean bedrocks in the Ängelholm region (see the map p. 15). In the southern part of the block the Archean surface dips slowly to the SW and is covered by Cambrian, Ordovician and Silurian. In the NE and SE occur two Cretaceous synclines, the Båstad and Kristianstad Synclines. In these the Cretaceous is lying on Archean bedrocks, in the Kristianstad region often forming a fossil archipelago, with Archean islands surrounded by the Cretaceous limestones.

Road log

(See map on p. 15.)

First day (Aug. 11th and Aug. 29th). The northern part of the Malmö—Ystad syncline, no outcrops visible. Crossing the overthrust near Landskrona, and the Triassic-Jurassic syncline into its central part at Höganäs *(Localities 1—4)*.

Route: Malmö—Vallåkra—Fjärestad—Kågeröd—Hälsingborg—Pålsjö—Höganäs.

Second day (Aug. 12th and Aug. 30th). The Båstad—Simrishamn block with granitic-gneissic bedrocks. Cretaceous sediments in the Kristianstad region *(Localities: 5—8)*.

Route: Höganäs—Hässleholm—Ignaberga—Ringelslätt—Balsvik—Kristianstad.

Third day (Aug. 13th and Aug. 31st). The Cretaceous of the Kristianstad region, the Cambro-Silurian part of the Båstad—Simrishamn block, the overthrust zone, bordering the Cretaceous area of the south-eastern part of the Hälsingborg—Romeleås block *(Localities 9—10)*.

Route: Kristianstad—Ivö—Kristianstad—Brösarp—Tranås—Eriksdal—Stora Herrestad—Ystad.

Fourth day (Aug. 14th and Sept. 1st). The southern coast of Scania with some outcrops of the Danian, the deep drilling at Höllviken, and the Danian type-sections at Limhamn near Malmö *(Localities 11—15)*.

Route: Ystad—Höllviken—Klagshamn—Limhamn—Sallerup—Malmö—Copenhagen.

Description of the localities visited

LOCALITY NO. 1: *Vallåkra* (14 km SE of *Hälsingborg*) by Britta Lundblad

Horizon: Triassic (Lowermost Rhaetic and adjacent beds)

Description: Clay has been quarried in open-cast workings at Vallåkra by the Höganäs—Billesholm Co. The sequence of strata in the western wall of the quarry is the following, according to observations made by Troedsson in 1938:

Moraine (Quaternary)	3.00 m
White sandstone	3.00
Grey shale	0.95
Greyish white sandstone	1.00
Carbonaceous shale with bands or stripes of coal	1.20
Black shale	1.00
Grey clay	1.03
Bank of siderite	0.50
Grey clay	3.00

The strata below the carbonaceous shale, which according to Troedsson correspond to the lower coal bed of the Mining district (B), are termed by this author the V a l l å k r a formation, which thus represents the Lowermost Rhaetic. According to the said author, its thickness is 25—30 m. The economically important Vallåkra clay is a dark, unstratified, montmorillonite clay. The presence of a siderite bank among the clayish layers of the Vallåkra beds should be noted. It contains sphaeroidal grains (iron oolite), 1—2 mm in diameter, which are embedded in grey clay.

Fragmentary plant-remains are known from Vallåkra.

P r i n c i p a l r e f e r e n c e s :

TROEDSSON, G., 1943. Om rät och lias vid Vallåkra. — Geol. Fören. Stockh. Förh. Bd 65.

— 1951. On the Höganäs Series of Sweden (Rhaeto-Lias). Lunds Univ. Årsskr. N. F. Avd. 2. Bd 47. No. 1. Lund.

LOCALITY NO. 2: *Bälteberga* (10 km NE of *Landskrona*) by BRITTA LUNDBLAD

H o r i z o n : Triassic (Keuper)

D e s c r i p t i o n : This is one of the main localities of the Kågeröd formation, which is regarded by Brotzen (1950, 1958) as representing the upper part of the Keuper. It is exposed in a ravine in the northern part of the park at the mansion of Bälteberga. The section is 11—15 m high, and shows a series of sandstones, conglomerates, and shales, usually red in colour. The strata are in some places horizontal, in others disturbed.

P r i n c i p a l r e f e r e n c e s :

HADDING, A., 1929. The Pre-Quaternary sedimentary rocks of Sweden, III. Lunds Univ. Årsskr. N. F. Avd. 2. Bd 25. nr 3. Lund.

TROEDSSON, G., 1942. Bidrag till kännedomen om kågerödsformationen i Skåne. — Geol. Fören. Stockholm Förhandl. Bd 64.

LOCALITY NO. 3: *Hälsingborg* by BRITTA LUNDBLAD

H o r i z o n : Liassic (Hettangian, Lias a_1—a_2)

D e s c r i p t i o n : Open-cast workings have for a long time been carried out at Hälsingborgs Ångtegelbruk, a clay quarry east of the southern part of the town. The rock is a grey shale, which may contain fine layers of sandstone, and is used as fire-clay. It is exposed in a profile about 20 m high, with several small faults. The strata are practically horizontal. In the middle of the profile there is a coal-bed, about 15 cm thick. Clay ironstone occurs in the quarry, as well as lenses of calcareous sandstone. Ripple marks, worm trails, and marl developed

as cone-in-cone structure, are not infrequent. The marine fauna of the "*Pullastra*" Bank was found by Erdmann and Lundgren above the coal-bed. At a somewhat lower horizon, Troedsson found a *Hybodus* spine and numerous specimens of *Ostrea hisingeri*. Determinable plant fossils are very rare.

Liassic strata are exposed for some hundred meters along the highroad at Tinkarp, at the hillside just N of Hälsingborg. The rocks consist of shales and sandstones, which are partly ferruginous (through impregnation with siderite). Thin beds of coal and coaly shale are known from this section but plant fossils are rare.

Principal references:

TROEDSSON, G., 1947. Berggrunden inom Hälsingborgs stad. — Geol. Fören. Stockholm Förh. Bd 69.
— 1951. On the Höganäs Series of Sweden (Rhaeto-Lias). — Lunds Univ. Årsskr. N. F. Avd. 2. Bd 47. nr 1. Lund.
MOHRÉN, E., 1958. Hälsingborgstraktens stenkolsförande lager. — Stenkol och lera, 2. Uppsala.

LOCALITY NO. 4: *Höganäs* by BRITTA LUNDBLAD

Horizon: Rhaeto-Lias (and Keuper)

Description: The succession of strata in the Höganäs district comprises the upper part of the Kågeröd formation[1] (Keuper), which is followed by the Rhaetic and the Lower Liassic. The lowermost Rhaetic is represented by the Vallåkra beds[2]. The topmost Rhaetic stratum of the mining district is mostly the upper coal bed (A). The main coal bed of the Höganäs district is the lower one (B), which belongs to the Rhaetic.

The strata of the Höganäs district are dipping towards the SSE. Consequently, outcrops of the Kågeröd and Vallåkra formations are found to the north (at Margreteberg). Coal-bearing rocks of the Rhaetic occur, too, near the surface north of Höganäs, where most of the old shafts are situated. The main shaft now in use is "Prince Gustaf Adolf", which is situated 3 km SE of the centre of the town, and where the lower coal bed is found at a depth of about 100 m, sinking further towards the SE. Faults are frequently met with in the Höganäs district, the main directions being NW to SE and W to E. Attention should be called to the presence of a long fault just W of the town, running towards the SSE and showing a vertical displacement of 160—180 m.

The rocks of the Kågeröd formation at Margreteberg are clays showing red, green, and grey colours, with intercalations of greenish sandstone.

The transitional Vallåkra formation contains grey to black clays and greyish-green sandstones.

The Rhaetic rocks above the Vallåkra beds consist of well stratified sandstones and shales, the latter mostly dark due to the presence of carbonaceous material. The true Rhaetic of NW Scania does not exceed 30 m in thickness.

The predominating Liassic rocks of the Höganäs district are light-grey or white, often fine-grained sandstones, and grey or black shales or clays, with all transitions. Ferruginous, brownish sandstones and clays are met with in several horizons (partly as clay ironstone) but calcareous beds are rare. The Basal

[1] see no. 2 Bälteberga.
[2] see no. 1 Vallåkra.

Liassic beds were named by Troedsson the Boserup beds and represent according to this author a well-defined unit. They consist of cross-bedded arkosic sandstones and white to light kaolin clays in alternation.

The lower coal-bed (B) only is mined at Höganäs. The upper coal-bed (A) is thin and inconstant. Some narrow coal-beds occur in the Lower Liassic, but are of no practical value. — The main coal bed consists of alternate layers of coal and coaly shale, of a total thickness of about 1.5 m (approximately 50 % coal). The bottom clay, which is used as fire-clay, is of dark colour, greyish-black to almost black.

Ripple marks are frequently observed in many horizons, for instance in the roof of the coal-bed B in the "Gustaf Adolf" shaft, from where Bölau also reported saurine footprints (1952). Carbonized wood is often seen in the mines, but opportunities to make good collections of specifically determinable impressions and "compressions" of plant fossils are rare. The floras from Höganäs described by Nathorst in the 19th century were obtained from old mines which are now abandoned.

Principal references:

ERDMANN, E., 1909—1915. De skånska stenkolsfälten och deras tillgodogörande. — Sveriges Geol. Undersökn. Ser. Ca 6. Stockholm.

TROEDSSON, G., 1951. On the Höganäs Series of Sweden (Rhaeto-Lias). — Lunds Univ. Årsskr. N. F. Avd. 2. Bd 47. nr 1. Lund (With bibliography).

NORIN, R., 1953. Skånes stenkolsfält. — Stenkol och lera, 1. Uppsala.

BÖLAU, E., 1959. Der Südwest- und Südostrand des baltischen Schildes (Schonen und Ostbaltikum). — Geol. Fören. Stockholm. Förh. Bd 81.

LOCALITY NO. 5: *Ignaberga*

Horizon: Lower Campanian

Description: The Ignaberga quarry is situated south of a little village with the same name on the main road from Hässleholm to Kristianstad. The locality belongs to the Cretaceous syncline of the Kristianstad region and is situated on its NW corner. Archean gneisses of the Nävlinge-åsen border the Cretaceous SW of the quarry along a fault line, possibly with a slight overthrusting in the direction to the NE.

The crest of the Nävlinge-åsen follows the road to Kristianstad in the direction NW—SE. In the Cretaceous near to the ridge conglomerates between the limestone-layers indicate interruptions of sedimentation, uplifts and transgressions during the sedimentation. The fine shell-fragment limestones of the quarries of Ignaberga belong to the lower Campanian, which is characterized by *Actinocamax mammillatus*. Besides these belemnites, occurs rarely *Belemnitella* sp., possibly belonging to the group of *Bel. senior*.

Other fossils are more or less common (see Lundegren 1934 and Hägg 1947). The fragment limestone is locally called "skalgruskalk" which means calcarenit (Grabau). The rich literature on the occurrence is given in A. Lundegren 1934

Principal references:

VOIGT, E., Die Lithogenese der Flach- und Tiefwassersedimente des jüngeren Oberkreidemeeres. Jahrb. Halleschen Verb. Erf. Mitteld. Bodensch. Vd. 8. 1929.

LUNDEGREN, A., Die Kreidebildungen des Kristianstads-Gebietes. Geol. Fören. Förhand. Vol. 56, 1934.

HÄGG, R., Die Mollusken und Brachiopoden der schwedischen Kreide. Teil 3. Das Kristianstadgebiet. Sveriges Geol. Undersökn. Ser. C 485, 1947.

LOCALITY NO. 6: *Ringelslätt*

Horizon: Emscherian.

Description: About midway between Hässleholm and Kristianstad the excursion visits a small quarry named Ringelslätt near the railway-station Önnestad. This is the only locality in the Kristianstad Cretaceous region, where the typical fossil of the Emscherian *Actinocamax westfalicus* occurs together with *Actinocamax verus*. Even this occurrence is situated beside the Nävlinge-åsen, which limits the Ignaberga-Cretaceous to the SW.

In the same way as already demonstrated at Ignaberga an intersedimental conglomerate occurs in the Emscherian. The limestone is a calcarenit containing small fragments of all kinds of molluscs, bryozoa and others. The rich fauna named by Hägg 1947 contains *Inoceramus* and many species of *Ostrea*. The microfauna is poor but characterized by *Cibicides complanata* and other *Cibicides* species.

Literature as for locality no. 5.

LOCALITY NO. 7: *Hanaskog*

Horizon: Upper Campanian

Description: The quarries at Hanaskog are situated about 15 km N of Kristianstad. The thick-bedded limestone is characterized by several layers of flint and the occurrence of a large *Belemnitella* group *senior*. In the deeper part of the quarry the limestone is grey, in the higher part yellow. The fauna in both layers is more or less the same. The layers range to the Upper Campanian. Below the Upper Campanian strata Lower Campanian limestones and conglomerates occur in water-wells N of the quarries. Thus directly on the layers with *Actinocomax mammillatus* the Hanaskog limestones follow. In general the limestone of this locality has a smaller grain-size than the calcarenit of the Lower Campanian, and its character is halfway between the typical calcarenit limestone and a typical chalk. The content of Ca CO_3 is 97—98 %, and the content of Fe-Al-oxide is generally less than 1 %. The flint layers at this locality are often extremely well developed, with large nodules (diameter 1 meter or more). Fossils except the belemnites are rare. *Ostrea haliotoidea* Sow.; *Ostrea vesicularis* Lam.; *Ostrea semiplana* Sow.; *Pecten undulatus* Nils. are observed. Literature: as for locality no. 5.

LOCALITY NO. 8: *Balsvik*

Horizon: Lower Maastrichtian, Upper Campanian, Upper part of Lower Campanian.

Description: The quarry at Balsvik is situated about 6 km NNE of Kristianstad. This locality is one of the few which show three different stages of the Upper Cretaceous: the Lower and Upper Campanian, and the Lower Maastrichtian (= Moenian). The section begins with an abundance of *Actinocamax balsvikensis* n. sp., which is clearly distinguished from *A. mammillatus* by its deep alveole. According to its vertical and horizontal occurrence it is a good guide fossil of the uppermost zone of the Lower Campanian. Together with the *A. balsvikensis, Belemnitella* sp. belonging to the group of *B. senior*

is very rarely found. The foraminiferal fauna is rich and characterized by *Neoflabellina leptodisca.*

A massive limestone (5—6 m) occurs above the greensand. At the base of this zone a conglomerate can be present. Fossils except foraminifera are rare in this zone. Belemnites are found rarely and seem to belong to the group of *B. langei.* Besides *Neoflabellina leptodisca* occur *N. numismalis* and *Boliv. decorata-decorata.* The stratigraphical range of this part of the section must be Upper Campanian.

On the top of the Upper Campanian strata an interruption of sedimentation can be followed around the entire quarry, indicated by a slight change of the rock type, deep corrosion-holes and tubes of worms. The fossil fauna changes suddenly at this level. Above the hiatus begins the occurrence of *Belemnella lanceolata typica, Neoflabellina reticulata* and *Bolivinita delicatula.* This part of the section has a thickness of 18 meters and clearly belongs to the Lower Maastrichtian = Moenian.

The different conglomerates and the break of sedimentation are not restricted to this locality only. In the same position in the sections they occur in the entire Kristianstad region and also in all sections in the Malmö-syncline, where they are found in many deep wells. It seems that in the latter area, far away from the Cretaceous coast lines marl and sandlayers occur instead of the limestone-sedimentation. In the central part of Scania the sandstones become more pure and real conglomerate layers are intercalated between the marls and sandstones. In the region near to the Romeleåsen Upper Campanian conglomerates and sandstones are transgressing over Liassic or elder formations. Therefore the section of Balsvik is typical for the history of the Upper Cretaceous in the hinge between the Scandinavian Shield and the Middle European sedimentation region. Except the belemnites and the foraminiferal fauna fossils are rare, here and there a big *Gryphea* can be found. The locality is known by certain reptil-bones generally belonging to *Mosasaurus,* usually found at the base of the Moenian.

Principal references: See loc. no. 5 and

Brotzen, F., Maastrichtian in Lexique stratigraphique international Vol. I Europe Fasc. 20: Suède. 1958.

LOCALITY NO. 9: *Ivö*

Horizon: Lower Campanian

Description: The island of Ivö is situated near the NE-margin of the Kristianstad Cretaceous region, about 25 km ENE of Kristianstad. In this region the Archean bed-rock formed hills and ridges in Pre-Cretaceous time. During the Cretaceous the sea transgressed into this previously formed landscape. The hills emerged as islands, and their older surface was slightly remodelled. Loose boulders were rounded, but large ones were not transported far from their original positions. At Ivö such an Archean hill is surrounded by the Lower Campanian sediments. The section begins with a deep kaolin-weathering. On its base, large granitic boulders are only peripherally weathered and the higher part contains pure kaolin. Above the kaolin a sandy layer occurs, with thickness between a few centimeters to a little more than 1 m. The age of this

layer is uncertain, but Upper Cretaceous plant-remains and pollen are found and described. On the sandstone there follow limestones embedded in conglomerates, which cover the sides of the Archean hill. By quarrying, the largest parts of the limestone were removed, and today only conglomerates and few limestone relics are preserved. It seems that the Cretaceous layers were sedimented during a slow transgression in Lower Campanian time. This sea has been extremely rich in molluscs, bryozoans and other bentonic organisms. The fossils often reach extremely large sizes. Today, when only relics of the limestones exist after many years of intensive quarrying, all fossils are weathered and give not the real picture of the original situation. Voigt 1927 and Lundegren 1934 have described the quarry in its former appearance and given the details of the occurrence. The fauna is described by Hägg 1947. Today the most common fossils are: *Actinocamax mammillatus, A. quadratus* and *Ostrea diluviana. Belemnitella* sp. belonging to the group of *B. senior* is extremely rare.

References see locality no. 5.

LOCALITY NO. 10: *Eriksdal*

Horizon: Triassic, Liassic, Middle Jurassic, Upper Jurassic, Infravalanginian, Valeanginian, Emscherian.

Description: The excursion continues to SW from Kristianstad, crosses the central and southern part of the Kristianstad Cretaceous region and passes the central block, the Båstad—Simrishamn unit, with the Archean on its northeastern side and the Cambro-Silurian on its southwestern side. The fault-line and the border region between this central block and the next block, the Hälsingborg—Romeleås unit, is very well exposed near the locality Eriksdal. The elder parts of the sections were already the theme of an excursion during the Intern. Congress in 1910. But an intensive quarrying for glass-sand and fire-clay during the last years resulted in the exposition of the younger stages of the section.

Eriksdal is situated about 20 km N of Ystad. The Mesozoic formations are tilted more approximately vertically or slightly overthrust to the SW on the border of the Cambro-Silurian block.

Upper Triassic and Rhaetic. In the valley south of the main section occur reddish sandy clays, which surely belong to the Kågeröd formation already visited in the locality no. 2 on the first day of our excursion, representing the upper parts of the Keuper. The layers are only a few meters thick. It is possible that only parts of this formation took part in the tectonical movement and that its real thickness has been much greater in an undisturbed position. A drill hole some kilometers south of Eriksdal in the direction of Ystad penetrated nearly 200 m of this Triassic formation.

Rhaetic and Lower Liassic are very incompletely exposed. There occur dark clays with plant remains which possibly belong to the Rhaetic or lowermost Liassic.

Liassic and Middle Jurassic. Ferruginous sandstones with a rich fauna of molluscs are fairly well exposed in the section and even on a short visit it is possible to collect some samples. The fauna is described by Moberg in 1888, Reyment revised the ammonites in 1959. According to him ammonites of the

upper part of the Sinemurian and the lower part of the Pliensbachian occur at this locality. Today the beds are too badly exposed and it is impossible to give a detailed profile. On the top of the fossil-bearing formation further ferruginous sandstones occur, with a stratigraphical range not certainly known. Hadding in 1933 described the upper part of the sandstones containing beds with siderite and chamosite. Possibly the sandstones without fossils already belong to the Middle Jurassic.

Upper Jurassic. On the top of the iron-bearing sandstones follow clays, coal-clays, coal and sandstones. The flora studied by Halle and Möller 1910 has failed to give full evidence of the exact stratigraphical range of this part of the section. It is possible that the layers belong to the Dogger, Upper Jurassic, or to the lowermost Cretaceous. The clays and coalbeds are quarried and there exists a little mine.

Infravalanginian and Valanginian. The boundary between the Jurassic and the lowermost Cretaceous, based on fossils has not yet been fixed. Fine-grained glass-sand, containing some kaolin, follows the coal beds and sand and clay. The glass-sand is being intensively quarried. Blackish lenses occur, scattered in the glass-sand, possibly remains of bituminous matter, but its nature has not been studied in detail. Probably the kaolin of the glass-sand can be connected with the deep-going kaolin-weathering observed in the Kristianstad region below the Upper Cretaceous. Above the glass-sand greenish and dark coloured clays represent the last member exposed at this locality. In the clays occur molluscs, described by Hägg 1940 as *Cyrena, Gervillia, Ostrea* a. o. This fauna is not significant of a certain stratigraphical range. In the deepest part of the fossiliferous layers, however, another mollusc fauna occurs together with many ostracods, the latter indicating an age of Upper Valanginian. Therefore the glass-sand may belong to the deeper part of the Valanginian or to the Infravalanginian. Higher parts of this Lower Cretaceous were found in a drill-hole west of this occurrence, below Upper Cretaceous beds.

The Upper Cretaceous. At present no Upper Cretaceous is exposed. The old quarry, known from the description of Hägg and Brotzen, is filled up with Quaternary sand and gravel and is situated north of the glass-sand quarry.

Lundegren in 1935 describes a drill-hole through the Upper Cretaceous, which reaches a total thickness of 640 meters. The deepest part belongs to the Turonian and Lower Emscherian and the rock near the surface to the Upper Santonian.

References:

Brotzen, F., 1936: Foraminiferen aus dem schwedischen, untersten Senon von Eriksdal. Sveriges Geol. Undersökn. Ser. C 396.

— 1958: Jurassic, Liassic, Wealden. In Lexique stratigraphique international. Vol. I. Fasc. 2 c: Sweden.

Hägg, R., 1935: Die Mollusken und Brachiopoden der schwedischen Kreide 2. Kullemölla, Lyckås, Kåseberga und Gräsryd. Sveriges Geol. Undersökn. Ser. C 385.

Lundegren, A., 1935: Die stratigraphischen Ergebnisse der Tiefbohrung bei Kullemölla. Sveriges Geol. Undersökn. Ser. C 386.

Reyment, R. A., 1959: On Liassic ammonites from Skåne. Stockholm Contrib. in Geol. II, 6.

LOCALITY NO. 11: *Östratorp*

Horizon: Danian

Description: Half-way betwen Ystad and Höllviken on the southern coast of Scania exist some outcrops of the uppermost part of the Cretaceous, directly on the shore or some decimeters above the sea, consisting of Danian limestones and flint-beds with few but characteristic Echinoids and microfossils. At Smygehuk (former Östratorp) such outcrops occur around the port. 2 km N of the coast the Danian limestone was quarried some years ago. The rock in the quarries belong to the transition-beds between the middle and Upper Danian, about 60 meters above the top of the uppermost Maastrichtian. Because of the numerous flintbeds the exploitation of the limestone ceased some years ago. An abundant fauna was found here with well preserved spongia and urchins, but typical guide fossils were rather rare. Single spines of *Tylocidaris brünnichi* of the types occurring only in the highest part of the Middle Danian and the lowest part of Upper Danian occur here together with spines of *Tylocidaris herupensis* from the Upper Danian. The layers of limestone are extremely rich in foraminifera characteristic for the lower part of Upper Danian.

Principal references:

Brotzen, F., 1949: Blottningar av äldre delar av danienformationen i Sverige. Geol. Fören. Stockholm Förh. Bd 79.

— 1959: On Tylocidaris species (Echinoidea) and the stratigraphy of the Danian of Sweden. Sveriges Geol. Undersökn. Ser. C 571.

LOCALITY NO. 12: *Höllviken*

Horizon: Triassic to Danian

Description: Höllviken is situated on the SW-corner of Sweden. The Geological Survey of Sweden sited three deep wells here for exploring the possibilities of oil and salt occurrences. The general geological results from these borings are published. Because of certain circumstances it was necessary to drill two of the wells by diamond drilling through the entire section. Therefore it is now possible to show the cores from the different formations of the Mesozoic. The sections are shown in tables, demonstrated on the excursions.

Principal references:

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LOCALITY NO. 13: *Klagshamn*

Horizon: Paleocene, Upper Danian

Description: The locality Klagshamn is situated about 10 km south of Malmö. The Limestone has been quarried here about 20 years ago for a cement factory. The occurrences of thick and numerous flint-beds hindered a modernisation of the quarry. Therefore the quarry today is filled with water and only the top of the Danian and the Paleocene are visible. The lowermost Paleocene is preserved on the top of the Danian on the northern wall of the quarry. The Paleocene consists of a bottom conglomerate and 50—90 cm clayish greensand above the conglomerate. Corrosion-holes and tubes of worms, filled with glauconitic sand of the Tertiary, reach 3 m deep down into the Danian.

Except microfossils the fauna of the Paleocene is poor. Danian *Echinocorys obliqua* is found abundantly, and also other Danian fossils occur in secondary positions. Klagshamn is the only locality in Sweden where the Paleocene-Danian contact is now exposed. All other localities are either drill holes or pits for building work, no longer accessible.

Principal references:

Brotzen, F., 1940: Flintrännans och Trindelrännans geologi. Sveriges Geol. Undersökn. Ser. C 435.
— 1948: The Swedish Paleocene and its foraminiferal fauna. Sveriges Geol. Undersökn. Ser. C 493.
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LOCALITY NO. 14: *Limhamn*

Horizon: Stevnsian, Danian.

Description: Limhamn is a southern suburb of Malmö and the famous quarry is situated on its outskirts. The uppermost part of the Maastrichtian, the Stevnsian, is exposed at the bottom of the quarry. Above the Stevnsian follows the Danian, which is here divided into four zones:

Upper Danian, zone of *Tylocidaris herupensis*
Upper part of the Middle Danian, zone of *Tyl. brünnichi*
Lower part of the Middle Danian, zone of *Tyl. rosenkrantzi*
Lower Danian, the zone of *Tyl. ödumi*

The Lower and the Middle Danian are represented by bryozoan fragment limestone developed as a series of irregular bioherm ridges. The general direction of the bioherm ridges is WNW to ESE. On the flanks of the bioherms in some places lenses of coral limestones occur. The Upper Danian shows a very different facies with bryozoans as abundant fossils, but not at the dominant material of the limestones. Contrarily to the Lower and Middle Danian the Upper Danian is regularly bedded. A detailed description of the quarry and its stratigraphy can be found in Brotzen 1959.

Principal references:

Brotzen, F., 1959: On Tylocidaris species (Echinoidea) and the stratigraphy of the Danian of Sweden. Sveriges Geol. Undersökn. Ser. C 571.

LOCALITY NO. 15: *Sallerup*

Horizon: Stevnsian

Description: Few km W of Malmö the surface of the Danian dips down into a tectonically pre-formed valley, filled with Quaternary sediments. In the town of Malmö the surface of the Danian will be found a few meters above the sea-level, in the center of the syncline some kilometers east of Malmö however about 80 m below the sea-level. In the Quaternary terrain there occur smaller and larger units of Cretaceous, embedded in the boulder clay and mainly belonging to the upper and middle part of the Stevnsian. They have been transported by the Quaternary ice from south to north. South of the Swedish coast the Danian disappears and Stevnsian reaches the surface. Several such "giant boulders" are known west of Malmö and were quarried for many years. Size and facies of such "boulders" are today easy to study at southern Sallerup, where the Cretaceous is well exposed. The chalk forms here an irregular and fairly compressed lens. Fossils, except microfossils, are rare. Well known from these occurrences are well preserved spongiae, described by Schrammen.

Principal reference:

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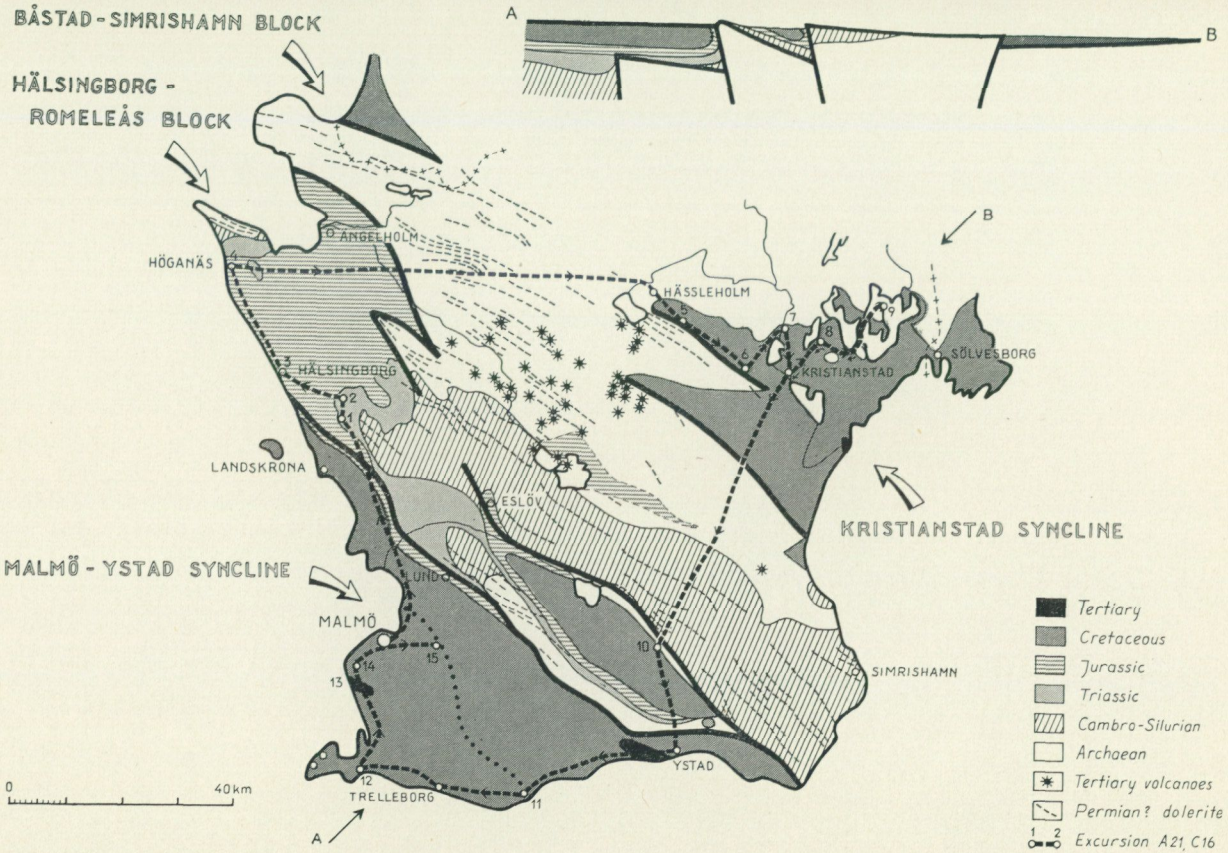
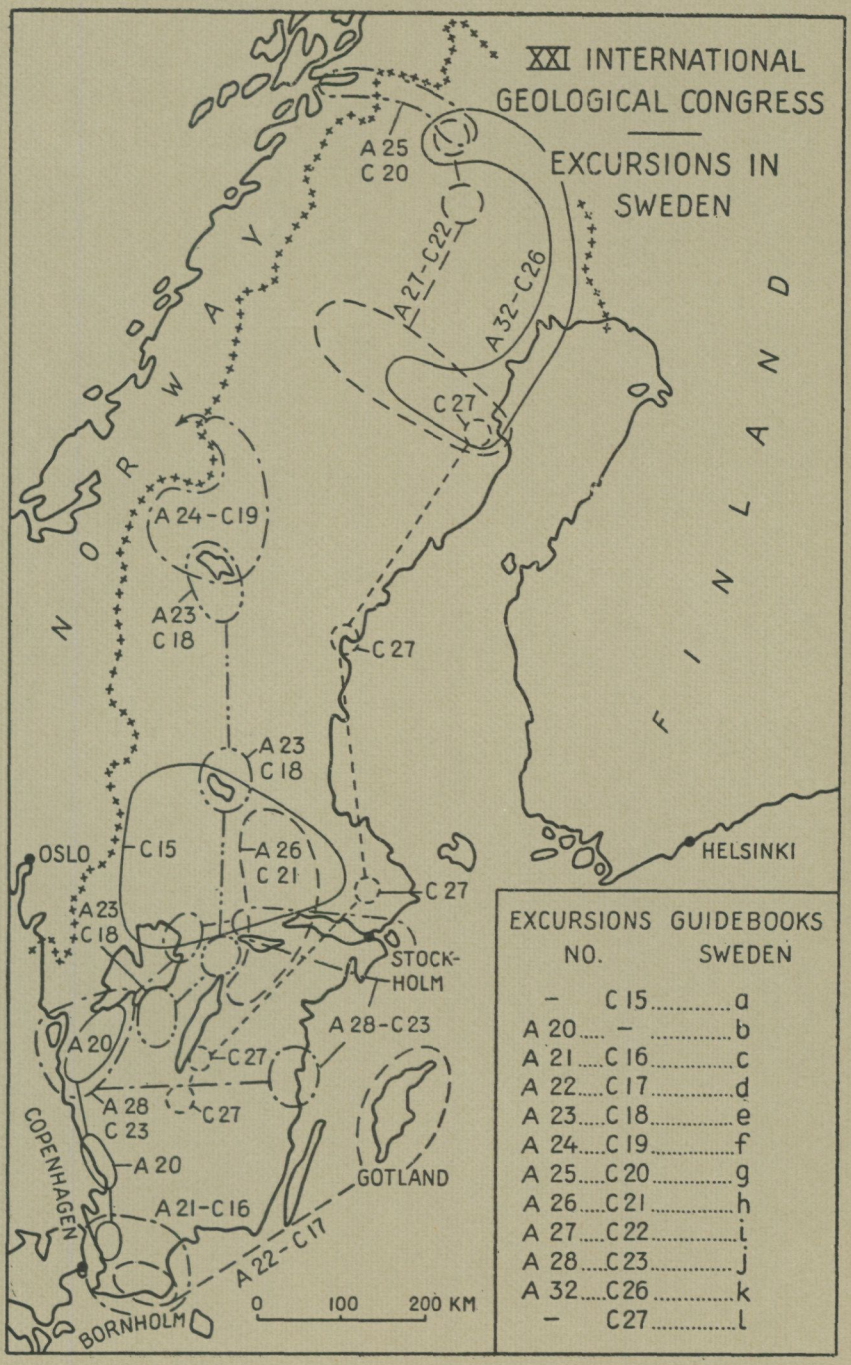


Fig. 1. Map of Scania with the route of the excursion and numbers of the localities.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