Fossil Metasequoia From Mikines, Faroe Islands.

By Jóannes Rasmussen and B. Eske Koch.

I

Description of site.

By Jóannes Rasmussen.

Not very many fossil plants have been found in the Faroes till now. On the island of Suðuroy and on the island of Mykines some impressions of leaves have appeared, and the coals on the Suðuroy display some coalified stems and twigs. In tufaceous clay a few more or less indistinct impressions of fossil plant remains have been observed (NOE-NYGAARD 1940).

Literature on Faroese geology contains only two short treatises dealing with fossil plants. HARTZ (1903) treats and explains the find of fossil plants on the Mykines in 1901 by first lieutenant GODFRED HANSEN, and R. RASMUSSEN (1925) gives an account of the fossil plants taken from the same place, when in spring 1925 a site for a new boat-house was dug into the cliff on the south side of the point of Fjørudalsnev, where the other boat-houses are situated. In summer 1925 R. RASMUSSEN visited the place himself, and it is his material which is developped here.

In order to investigate the present possibilities of collecting some more material, the undersigned writers visited the place in summer 1963. Unfortunately, the chances of getting at the fossil bearing bed appeared to be very poor.

The bed is partly covered with stones and earth, blocks of stones have fallen down from it, and in course of time the outer edge of the bed has been reduced in such a degree that very little remains to be found in the present conditions. However, judging from the few finds that were done this time, the former finds are to all appearance characteristic of the bed.

Of the Faroe Islands the island of Mykines is farthest to the west. It stretches from east to west for abt. 8 kilometres and its full breadth is 2—3 kilometres. The highest mountain is the Knúkur (560 metres). A gorge, the Hólmgjógv, separates the islet of Mykineshólmur from the island. There is a bridge across the gorge. On the islet – to the east, near the Hólmgjógv – is the mountain of Klettur (133 metres).

The beds of the Mykines dip southeastwards (on the Hólmur and on the west side of the island abt. 13°) and east-southeastwards (on the east side of the island abt. 8°). They all belong to the lower basalt sequence, so low that they are to be correlated with the basalt sequence in the southern part of the Suðuroy. As is the case with this island, a little coal is to be seen in several places in the intrabasaltic sediments, f. ex. on the Hólmur, on the Fjørudalsnes, on the north and on the east side of the island, and in the cliffs of the south side. As mentionned above, the fossils treated here have been found on the Fjørudalsnev.

The point of Fjørudalsnes protrudes to the west between the cave of Viðarhelli and the cleft of Lendingsgjógv, near the village of Mykines. The point rises abruptly to the north, to the Viðarhelli, and slopes down to the Lendingsgjógv. The top of the point is sward-covered, with old boat-hoases and boat-house sites. At the very end of the point the sward has fallen down and the subsurface lies uncovered. A section that has been taken gave the following result:

20 – 20,35 metres	Brown clay. 3 thin bands of iron clay stone are to bee seen in the clay. The lowest band is abt. 3 centimetres wide, the upper bands are only a few millimetres.
20,35 – 20,40 metres	Rather fat, dark shale.
20,40 – 21 metres	Blue black shale.
21 – 22 metres	Sandy conglomerate (the grains are smooth, their diametres up to 1/2 centimetre).
22 – 25 metres	Red tufaceous clay, at the top multi-coloured.

Some chips of coal appear in the band 20,35 – 20,40 metres, and the fossil plants already mentionned (HARTZ 1903, RASMUSSEN 1925) and the fossil plants of this treatise have been found here, too. To all appearance, the band on the Fjørudalsnev does not stretch very far. This band and the one disappearing into the water in the Lendings-gjógv seem to be identical.

II

The fossil plants.

By B. Eske Koch.

The described collection consists of 25 shale specimens with plant impressions. It belongs to *Føroya Jarðfrøðisavn* (The Faroe Museum of Natural History), Tórshavn, and it was collected by R. RASMUSSEN in 1925. The numbers refer to the Føroya Jarðfrøðisavn catalogue.

The rock is a fissile, dark brown shale. A part of the impressions is so well preserved that it shows enough details for description and determination. The impressions show exclusively the vegetative parts. The majority of them belongs to *Metasequoia occidentalis* (Newb.) Chaney. The

collection contains also impressions of twigs, with partly coalified remains of these (f. eks. no. 9), together with a few indistinct and fragmentary impressions of dicotyledonous leaves (No. 9, 13, E and F). It is believed that this collection is representative for the bed in question. The authors have visited the locality in June 1963, and the investigation of this fossil bearing bed did confirm this opinion. Only the remains of *Metasequoia* were observed on this occasion.

Metasequoia occidentalis (Newb.) Chaney (Pl. 1 & 2).

The collection in question contains only vegetative parts of the following kinds: long shoots and short shoots. The isolated short shoots are predominant. But on several specimens short shoots are attached in pairs to the long shoots, i. e. they are found in opposite position. So one specimen (no. 8) (pl. 1, fig. 1) demonstrates a long shoot with 4 nodes. At one of these nodes two short shoots are attached to the node and, again, they are in the opposite position. At another node of the same specimen only a small fragment of a short shoot axis is found attached to the long shoot, with an entirely preserved short shoot on the opposite side. At each of the other two nodes one attached short shoot, and presumably an opposite one — the axis of which points towards the node without its very basal part being preserved — can be seen. One of these pairs is located at the lowermost preserved part of the long shoot, and the node itself is just on the edge of the shale specimen. One of these two short shoots has its axis along the very edge of the shale specimen.

On the same shale specimen are two other long shoots, each of them with several attached short shoots. Because the counterprint of this shale specimen is not present in the collection, it is difficult to study both of the paired short shoots at all the nodes. This is particularly the case

with the rock in question which is so crowded with plant impressions, that the shale becomes extremely fissile. Therefore some pieces could easily have been lost.

Some other specimens (No. 7, 10, A, B, C, D and G) (Pl. 1, figs. 2, 3) also contain parts of long shoots with or without short shoots attached. For instance, specimens A, B, C show short shoots, disposed in pairs, while the specimen no. G shows only a fragment of a long shoot.

The long shoots carry leaves between the nodes. These leaves are remote, linear, short petiolate and obtusely rounded terminally and basally. The leaves have relatively large decurrent bases and are opposite, or a leaf may be opposite a short shoot. Their average dimensions are: length 10 mm, width: 1,7 mm. The axes of the long shoots show the impressions of more or less distinct, obliquely decurrent leaf bases which successively overlap from right and left in the manner characteristic of *Metasequoia.* In addition, the long shoots show opposite short shoots or their scars. But the phyllotaxy is best studied on the short shoots.

Well preserved short shoots (which are numerous in the collection) demonstrate that the leaves are opposite and apparently distichous (i. e. no. 11) (Pl. 1, 2). Just as observed on the recent *Metasequoia glyptostroboides* Hu & Cheng, the pattern of the leaf bases demonstrates that the distichous arrangement is only apparent and that originally it was decussate. This can be definitely confirmed by studying the well preserved specimens in this collection (No. 11, 13) (Pl. 1, figs. 1, 3, 4). The characteristic zigzag pattern on the impression of the axis of the short shoots results from the obliquely decurrent bases of the opposite leaves which are decussately arranged. The leaves of the short shoots are closely spaced, short petiolate, linear and obtusely rounded terminally and basally. They have strong, obliquely decurrent bases which enclose the axis and even overlap most of the base of the opposite leaf. In a succession of opposite leaf pairs this successive over-

lapping from right and left produces the zig-zag pattern of the axes, which is so characteristic of *Metasequoia*. This is best demonstrated on the short shoots while the remoteness of the leaves makes this pattern more indistinct on axes of the long shoots. This pattern is the result of twisting to right and left 45° of successive leaf pairs re-arranging the decussate leaf pairs into the pseudo-distichous manner.

The average dimensions of the leaves of the short shoots are: length 8 mm, width 1,5 mm. The midrib of the leaves on the one impressions is strong and shows one longitudinal central groove on some of the best preserved specimens (No. 11) (Pl. 2, fig. 3). On the impressions of the opposite side of the leaves (commonest case) the midrib is a slender protruding strand. The leaf blade is longitudinally striated (No. K) (Pl. 2, fig. 3) and on a few of the well preserved specimens (No. 8) (Pl. 2, fig. 1) a row of small grooves on each side of the midrib can be seen.

On these vegetative organs all the characters which were described by CHANEY (1951) are found, and they ensure the determination of the species as *Metasequoia occidentalis* (Newb.) Chaney.

On quite a few of the well preserved short shoots the leaves are placed in such a manner that they form a large angle with the axis. But, on some other specimens this angle is considerably smaller. The present author does not consider this to be an original characteristic but, in accordance with his previous interpretation of this phenomenon from the fluviatile Paleocene sediments in West Greenland (B. ESKE KOCH, 1963), he regards this as a secondary characteristic, caused by the stream flow during the process of sedimentation. This is in the present case further confirmed by the fact that these short shoots may show similar orientations (No. 7 and L) (Pl. 1, fig. 2).

Metasequoia occidentalis (Newb.) Chaney occurs in the entire Tertiary system. This species can not be used for

dating of the intrabasaltic sediment of Fjørudalsnev, Mikinés.

Metasequoia was originally described and named by means of fossil material (MIKI, 1941). But, a few years later, is was found as a living tree in the mountains of Central China. After this find CHANEY (1951) proved that it is common in the continental facies from Cretaceous and Tertiary. From these systems the remains of Metasequoia had already been described by early investigators and placed within the genera of Sequoia and Taxodium. CHANEY'S work is until now the most comprehensive study of the fossil occurrences of Metasequoia (CHANEY, 1951).

Within the Northatlantic region *Metasequoia occidentalis* (Newb.) Chaney, has been described from Svalbard (A. SCHLOEMER-JÄGER, 1958) and from Greenland [B. ESKE KOCH, 1963 (and 1959)]. Already in O. HEER'S publications (HEER, 1868, 1869, 1870, 1874, 1883) we find pictures of fossil plants which can be recognized as belonging to this species. Tertiary pollen from Scotland has been described and it may derive from *Metasequoia* (SIMPSON, 1949).

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PLATES

Plate 1: *Metasequoia occidentalis* (Newb.) Chaney.

1. Shale specimen showing several long shoots with attached short shoots, some of which are opposite. The arrows mark the fossil specimen described in the text (pag. 86–87). 1: 1. F. J. Cat. no. 8.
2. Fragment of a long shoot with two pairs of attached short shoots. Besides, a few isolated short shoots are seen. 1: 1. F. J. Cat. no. 7.
3. Impression of a long shoot with several attached short shoots. Two pairs of these consist of opposite short shoots. 1: 1. F. J. Cat. no. A.
4. Crowded, detached short shoots. 1: 1. F. J. Cat. no. 13.

Chr. Halkier phot.

Plate 2: *Metasequoia occidentalis* (Newb.) Chaney.

1. A section of the specimen pl. 1, fig. 1 demonstrating the basal part of the fossil specimen marked by arrows. The central area shows

a leaf with a row of delicate grooves along the midrib. The opposite row of grooves is blurred on the photograph. Abt. 3. 5: 1. F. J. Cat. no. 8.

2. Short shoot showing the phyllotaxy. 1: 1 F. J. Cat. no. 11.
3. Enlarged section of a fragment of a short shoot with well preserved leaf impressions on which midrib and longitudinal striation (rather unclear on the photograph) can be seen. Abt. 5: 1. F. J. Cat. no. K.

Chr. Halkier phot.

Steinrunnin Metasequoia í Mykinesi.

Eftir Jóannes Rasmussen og B. Eske Koch.

I

Staðalýsing.

Eftir Jóannes Rasmussen.

Tað er ikki nógv, sum higartil er funnið av steinrunnum plantutilfari í Føroyum. Í Suðuroy og í Mykinesi eru í skifurleirgrýti millum basaltfláirnar funnar trýstmyndir av bløðum og í kolinum í Suðuroy kolaðir bular og kvistar. Í royðuleirgrýti hava menn stundum verið varir við meira ella minni óskilligar og ógreiniligar trýstmyndir av steinrunnum plantulutum (Noe-Nygaard 1940).

Í bókmentum viðvíkjandi føroyskari jarðfrøði eru bara einar tvær smáritgerðir, sum snúgva seg um plantusteinrenningar. Hartz (1903) viðgerð og greiðir frá plantusteinrenningum, sum Godfred Hansen, premierløjtnantur fann í Mykinesi í 1901, og R. Rasmussen (1925) sigur frá steinrenningatilfari, sum tikið varð upp á sama stað, tá Mykinesmenn á vári 1925 høgdu grund fyri nýggjum neysti inn í bakkan sunnantil undir Fjørudalsnevi, har hini neystini

standa. Sjálvur vitjaði R. RASMUSSEN staðið á sumri 1925, og tað er tilfar hansara sum viðgjørt verður í hesari grein.

Til at vita um líkindini enn vóru soleiðis, at meira tilfar kundi fáast til vega og til at kanna fundarumstøðurnar, vitjaðu høvundarnir báðir at hesari grein staðin á sumri 1963. Tíverri vóru líkindini heilt vánalig nú at koma fram at sjálvari fundarflónni. Sumstaðni er rutt oman yvir, og sumstaðni er lopið, og fram við útjaðaranum er gjøgnum árini pilkað so nógv burtur, at lítið er at finna, so sum umstøðurnar eru í dag. Kortini vísti tað sindrið, sum funnið varð hesaferð, at tað tilfar sum fyrr er funnið, helst er eyðkent fyri flónna.

Mykines er vestasta oyggin í Føroyum. Eystur-vestur er hon umleið 8 km; norður-suður, har hon er breiðast, 2—3 km. Hægsta fjallið er Knúkur, 560 m. Ein gjógv, Hólmgjógv, skilir Mykineshólm frá sjálvari oynni, brúgv er um gjónna. Á sjálvum hólminum, eystur móti Hólmgjógv, er Klettur, 133 m.

Fláirnar í Mykinesi halla í landsynning (úti á Hólminum og vestantil á oynni, umleið 13°), og í landsynning eystan (eystantil á oynni, umleið 8°). Tær hoyra allar upp í niðaru basaltfláirnar, so niðarlaga at tær samsvara so tiltaliga við fláirnar í sunnara parti av Suðuroy. Eins og har suðuri sæst mangastaðni í legugrýtinum millum basaltfláirnar smávegis av koli, t. d. úti í Hólminum, í Fjørudalsnevi, norðan- og eystantil á oynni og í berginum fyri sunnan. Tað er sum framman undan nevnt í Fjørudalsnevi, at tær plantusteinrenningar, sum her verður sagt frá, vórðu funnar.

Fjørudalsnevið stingur seg út vestureftir millum Viðarhelli og Lendingsgjógv við bygdina Mykines. Norðureftir, móti Viðarhelli, er berg fyri; suðureftir gongur undan oman móti Lendingsgjógv. Út eftir nevinum er vallað, har standa gomul neyst og neystagrundir. Uttast á er rutt oman av, so tað sæst í benið. Ein mátaður skurður var sovorðin:

20 — 20,35 m	Brúnt leir. Gjøgnum leiri ganga 3 tunnar lindir av leirjarnsteini. Niðasta lindin er umleið 3 cm tjúkk, tær báðar ovaru bara nakrar fáar mm.
20,35 — 20,40 m	Heldur feitt, døkkt skifurleir.
20,40 — 21 m	Blásvart skifurleir.
21 — 22 m	Sand- og eyrgrýti (eyrkornini avbrýnd, tvørmát teirra upp til $^1/_2$ cm).
22 — 25 m	Reytt royðuleirgrýti, ovast ymislitt.

Í lindini 20,35 — 20,40 m síggjast stundum tunnar kola-flísar, og í henni eru bæði tær fyrr umrøddu (HARTZ 1903, RASMUSSEN 1925) og tær í hesari grein viðgjørdu plantu-steinrenningarnar funnar. Lindin í Fjørudalsnevi tykist ikki ganga víða um; tað man vera hon, sum fer í sjógv inni í Lendingsgjógv (RASMUSSEN 1947, 1951).

II

Tær steinrunnu planturnar.

Eftir B. Eske Koch.

Greitt verður frá 25 skifurleirpettum við plantustein-renningum, sum RASMUS RASMUSSEN savnaði í Mykinesi á sumri 1925 og seinri læt til Jarðfrøðisavnið á Føroya Náttúru-gripasavni. Tølini í frágreiðingini vísa til savnskránna hjá Føroya Náttúrugripasavni.

Steinrenningatilfarið eru trýstmyndir í tunnflísaðum mor-reyðum skifurleiri. Trýstmyndirnar eru í mongum førum so skilligar, at væl ber til gjølla at greiða frá teimum og greina tær. Trýstmyndirnar eru allar av vakstrarpørtum. Tær allarflestu eru av *Metasequoia occidentalis* (Newb.) Chaney. Eisini eru trýstmyndir av smáum kvistum, stundum kolaðar leivdir av teimum (t. d. nr. 9) og einstakar óskilligar trýstmyndir av leyvbløðum, sum harafturat eru ófullkomnar (nr. 9, 13, E og F). Savnið tykist vera eyðkennt fyri

flónna, talan er um. Høvundarnir vitjaðu sum nevnt staðið í juni 1963, og styðjaðu kanningarnar á staðnum hesa áskoðan. Í tí lítla, sum nú var eftir og atkomandi av steinrenningarflónni, vóru vit bara varir við leivdir av *Metasequoia*.

Metasequoia occidentalis (*Newb.*) *Chaney* (*1. & 2. talva*).

Í savninum, talan er um, eru bara vakstrarpartar av hesum slagi: langsprotar og stuttsprotar. Stuttsprotar fyri seg eru flestir, men á fleiri eintøkum síggjast stuttsprotar festir til ein langsprota tveir og tveir og andstaddir. Á einum eintaki (nr. 8) (1. talva, 1. mynd) sæst soleiðis ein langsproti við fýra frágreiningum. Við eina frágreiningina síggjast stuttsprotarnir við sjálva frágreiningina tveir og tveir saman, stuttsprotaásarnir báðir festir til langsprotaásin og andstaddir. Við eina aðra frágreining á sama eintaki sæst ein stuttsproti festir til langsprotan og andstatt honum eitt petti av einum stuttsprotaási. Í tveimum førum sæst á sama eintaki ein stuttsproti beinleiðis festur til langsprotan, og sum tað sær út, ein andstaddur stuttsproti, har ásurin peikar beint á frágreiningarstaðið, hóast festið sjálvt ikki er varðveitt. Í øðrum av hesum báðum førum er frágreiningin niðast á tí varðveitta partinum av langsprotaásinum. Tað tykist, sum hoyra stuttsprotarnir her báðir saman, men frágreiningarstaðið er í sjálvum útjaðaranum eins og annar stuttsprotaásurin. Á hesum stuttsprotanum sæst tí bara onnur blaðrøðin. Á sama skifurpetti (nr. 8) (1. talva, 1. mynd) eru afturat tveir langsprotar, hvør teirra við fleiri stuttsprotum festum at sær. Við tað at mótpetti av skifurleirinum er ikki varðveitt, er torført at tekkja báðar stuttsprotarnar við allar frágreiningarnar, serliga í grótslagi sum hesum, sum er so tætt sett við trýstmyndum og tí ógvuliga flísut. Mong onnur petti (nr. 7, 10, A, B, C, D) (1. talva, 2. og 3. mynd) sýna langsprotabrotpetti við stuttsprotum á. Á A, B og C síggjast makaðir stuttsprotar. Okkurt annað langsprotabrotpetti sæst, t. d. á G.

Langsprotarnir bera stundum bløð millum stuttsprotarnar. Hesi bløð eru strikvaksin, men kubbut spísk í oddi og stovni, tey hava heilt stuttan stelk og stóran niðurrendan blaðfót. Langsprotabløðini eru andstødd, men kunnu eisini vera andstødd einum stuttsprota. Meðalstødd teirra er: Longd umleið 10 mm, breidd umleið 1,7 mm. Meira og minni skilliga skrátt niðurrendir blaðstovnar síggjast stundum á trýstmyndum av langsprotaásunum. Hesir blaðstovnar breiða seg skiftandi hvør út yvir annan frá høgru og vinstru, so sum eyðkent er fyri *Metasequoia*. Bestu hugmyndina um blaðskipanina fáa vit kortini við at kanna stuttsprotarnar.

Væl varðveittir stuttsprotar — teir eru mangir í savninum — vísa, at bløðini eru andstødd og tvíraðað (t. d. nr. 11) (1. og 2. talva). Sum hjá *Metasequoia glyptostroboides* Hu og Cheng (nýggj) vísa blaðstovnarnir, at tað bert tykist so, at bløðini eru tvíraðað, tey eru verunliga skiftandi hornrætt andstødd (decusat). Hetta sæst við tað, at blaðstovnarnir eru skrátt niðurrendir og breiða seg skiftandi frá høgru og vinstru inn yvir blaðføturnar á teimum andstøddu bløðunum (t. d. nr. 11, 13) (1. talva 1., 3. og 4. mynd). Úrslitið er eitt eyðkent skák mynstur á trýstmyndini (nr. 8, 11, 13, D og H). Bløðini hava stuttan stelk, tey eru strikvaksin, men kubbut spísk í oddin og stovnin. Við stovnin eru bløðini niðurrend á tann hátt, sum oman fyri er greitt frá. Á einari trýstmynd er miðriv blaðsins skilligt, og stundum sæst ein foyra eftir longdini (nr. 11) (2. talva, 3. mynd). Á trýstmyndum av ranguni á bløðunum (vanligast í savninum) er miðrivið ein klænur framvaksin strongur. Bløðkan er stríput eftir longdini (K) (2. talva, 3. mynd), og á summum eintøkum (t. d. nr. 8) (2. talva, 1. mynd) sæst ein rød av smáum kerum hvørjumegin miðrivið.

Á hesum vakstrarpørtum eru øll tey eyðkenni, sum *Chaney* (1951) greiðir frá, og sum tryggja greiningina til *Metasequoia occidentalis* (Newb.) Chaney.

Á summum væl varðveittum stuttsprotum er hornið

millum bløð og stuttsprotaásin rúmt, men á øðrum er hornið nógv trengri. Høvundurin heldur ikki hetta vera upprunaligt eyðkenni, men sama fyribrigdi, sum hann heldur seg vera komnan fram á í áar-legugrýti frá palæocæn í Vesturgrønlandi, ein lega sum hin rennandi áarstreymurin hevur verið atvold í. Hetta er enn meira trúligt, tá vit leggja til merkis, at summir stuttsprotarnir hava somu legu (sjá nr. 7, L).

Metasequoia occidentalis (Newb.) Chaney er sera væl kend frá allari tertiertíðini og gevur tí eingi líkindi til nágreiniligari tíðarfesting av skifurleirflónni í Fjørudalsnevi í Mykinesi.

Metasequoia var upprunaliga navngreind eftir steinrunnum tilfari (Miki 1941). Nøkur ár seinri varð hon funnin livandi inni í Kina. Eftir henda fund sigur Chaney (1951) hana vera vanliga í jarðløgum frá krit- og tertiertíðini. Frá hesum tíðarskeiði vóru leivdir hennara longu langt framman undan av mongum rannsóknarmonnum greindar sum t. d. slektirnar Sequoia, Taxodium. Viðgerðin hjá Chaney er hin higartil størsta viðgerð av steinrunnum Metasequoiatilfari (Chaney 1951).

Á norðuratlantiska økinum er *Metasequoia occidentalis* (Newb.) Chaney viðgjørd frá Svalbard (A. Schloemer-Jäger, 1958) frá Grønlandi [B. Eske Koch, 1963 (og 1959)]. Longu í viðgerðum hjá Heer (Heer, O., 1868, 1869, 1870, 1874, 1883) eru frá somu økjum myndir av plantusteinrenningum, sum eru sama slagið. Frá Skotlandi er greitt frá sáð (pollen) frá tertiertíðini, sum væl kann vera av *Metasequoiu* (Simpson, 1949).