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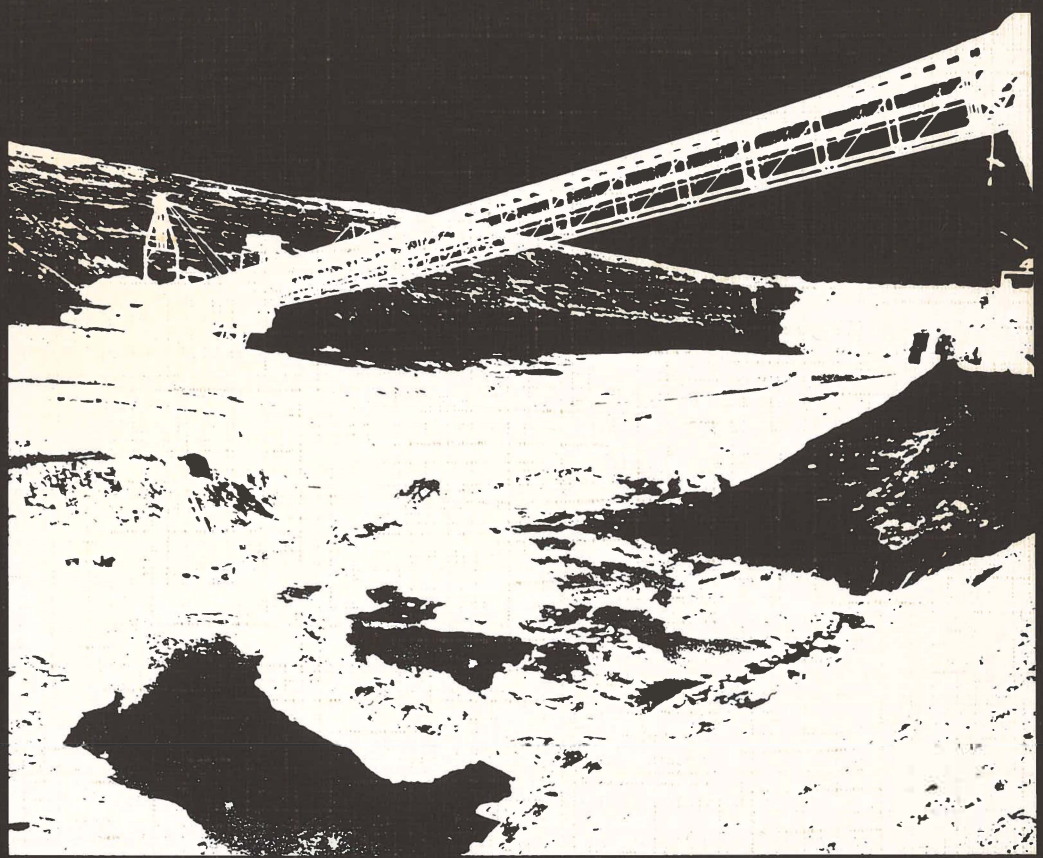

Danmarks Geologiske Undersøgelse · København 1989

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A paleontological and geological investigation on the Miocene browncoal bearing sequence of the Søby-Fasterholt area, Central Jutland, Denmark

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Key words:
Jutland, Denmark, Miocene, paleobotany, stratigraphy, brown coal, deltaic environment, coastal environment, tectonics.

Vignet:
Mining procedure in the former browncoal pit (Carl Nielsen Ltd.) at Fasterholt.

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Contents

This atlas contains 121 photographic pictures, illustrating the text-volume with field information. The pictures (Atlas-Figs) are arranged in a succession which is according to the progression of the text of the text-volume, chapter after chapter, as follows:

Introduction to atlas

Central Jutland is a country of low topography consisting of plains and low, smooth hills modelled in unconsolidated sediments. The pre-Quaternary deposits are often covered by thick Quaternary sediments, especially on the glacio-fluviatile plains. Natural outcrops of the pre-Quaternary geology are small and scattered. So, geological investigation in this region is depending on drillings and mining activity, the latter also sporadical and of small scale. Along with the evolving industrialization in Jutland, during the 1940's the interest for energy resources focused on the brown coal deposits, especially during World War II. Larger mines were established and larger areas were exploited.

When the man-power in Denmark's geological sciences reached a level where personnel became available and a Danish Natural Science Research Council was established with economical resources it was in the latest possible years for a geological investigation of the Neogene browncoal bearing deposits of Jutland. Only the years 1968-1970 were left for systematical geological field work in the mines which at this time was restricted to the Søby-Fasterholt area. The largest and last mine was abandoned in 1970. During the Seventies, supplementary information from the few available outcrops in the abandoned mines of the Lavsbjerg Hill and drillings and probes (ref. text-volume, chapter 1, page 11 ff) was used for additional investigation.

In this way the present information is unique and because the Neogene localities are now inaccessible, covered under deep water or covered by dump or recultivated. So it has been urgent to publish the results and especially the observations of the survey as far as concerns our knowledge at this time, to be suited as a supplement of future studies and regional conclusions.

Hence, it was decided by the editorial board of the Geological Survey of Denmark to supply this publication with an extended Atlas-volume containing 121 photographic illustrations. This atlas covers the topics of the entire publication chapter for chapter with the best representative pictures to give both a survey of the localities and the details of the geology involved.

The Atlas-figures are arranged in the succession following the chapters and are provided often with detailed descriptions and cross-references. The Text-volume is provided with relevant references to the Atlas-figures (121) as well as Text-figures (68) and Plates (2).

The illustrations are accompanied by information on derivation: Photographer: (name) Photo, draftsman or illustrator: (name) del., compilator: (name) comp. Loan from literature: Normal reference, see 6) REFERENCES of Text-volume.

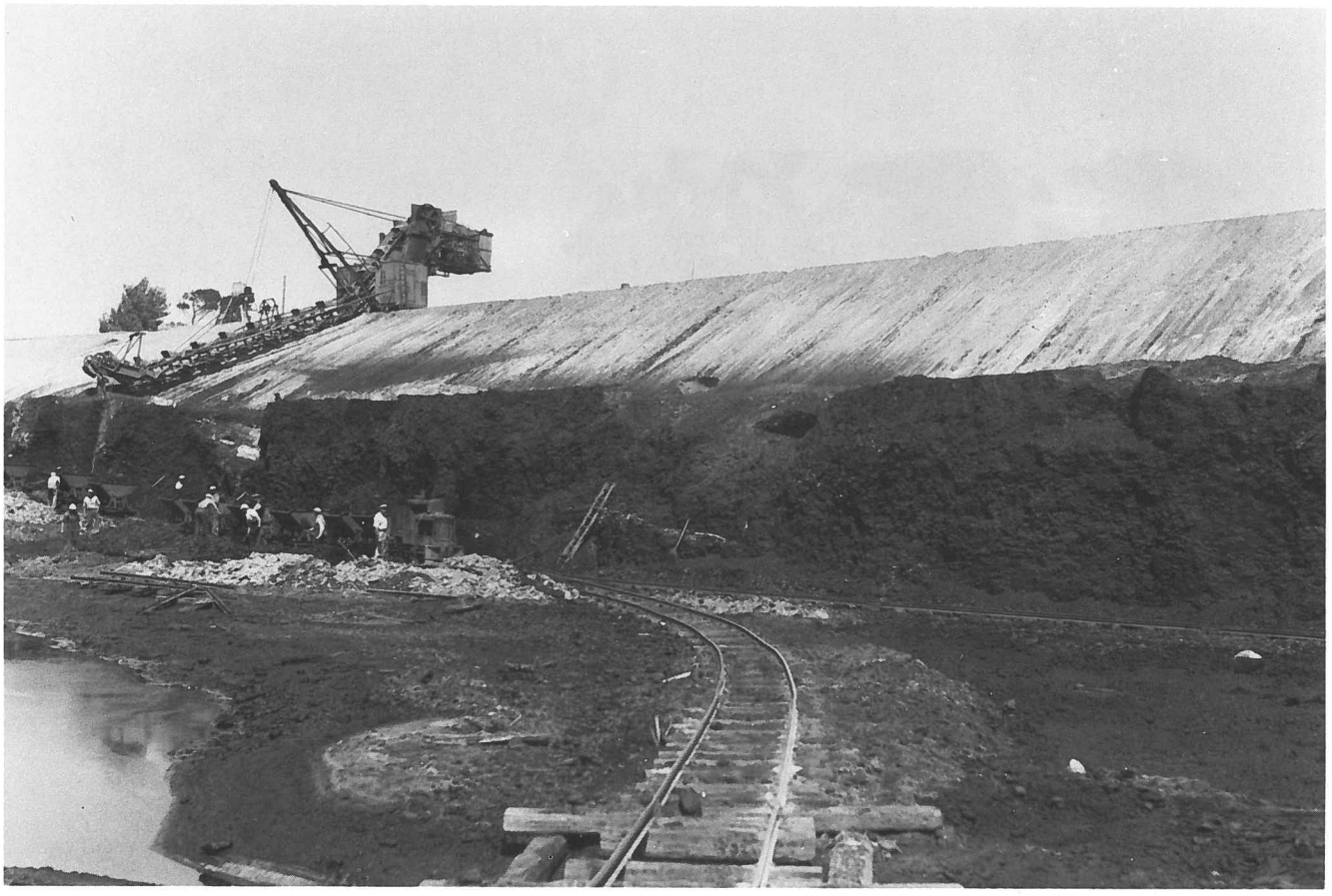
In the texts to the illustrations (Atlas and Text-figures, Plates and Tables) the following abbreviations have been used:

D.G.U.	Danmarks Geologiske Undersøgelse (Geol. Surv. of Denmark).
O.B.B.	O. Bang Berthelsen. Geol. Inst., Univ. of Copenhagen.
E.F.C.	E. Fjeldsø Christensen, Fur Museum.
E.K.	B. Eske Koch, Geol. Inst. Aarhus.
E.T.	Erik Thomsen, D.G.U.
S.B.A.	Søren Bo Andersen, Geol. Inst. Aarhus.
S.R.J.	Steen Røj Jacobsen, Geol. Inst. Aarhus.
W.F.	Walter L. Friedrich, Geol. Inst. Aarhus.

Atlas-Fig. 1. Open pit mining of browncoal; Skærbæk at Nørre Vium, 1918. D.G.U. Photo.

Atlas-Fig. 2. Jepsen's mine, Søby, 1941. D.G.U. Photo.

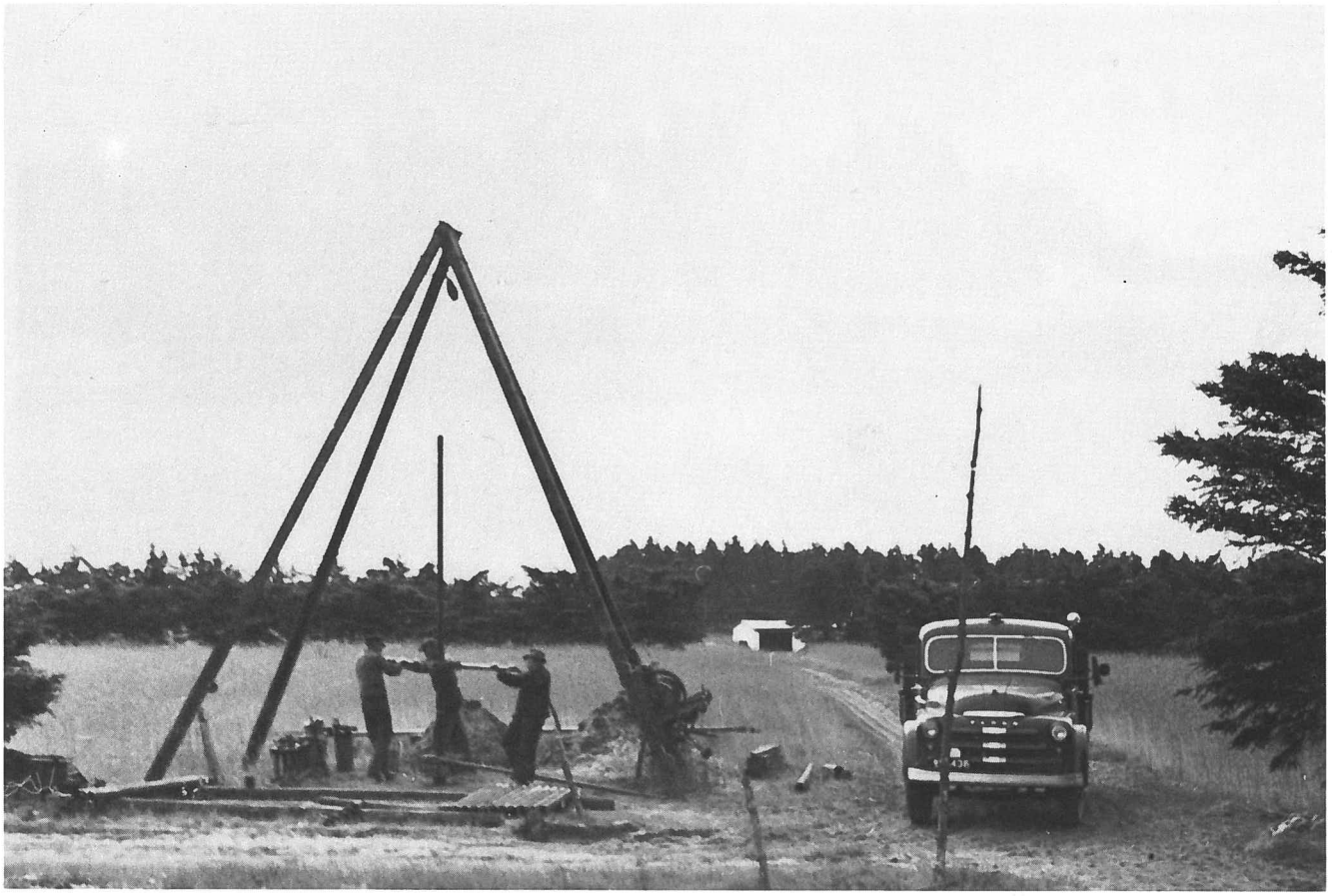
Atlas-Fig. 3. The mine of the Libergreen Successors in the Søby area, 1941. D.G.U. Photo.



Atlas-Fig. 4. The mining front at the Fiskbæk open pit mine, Fiskbæk briquette factory, Videbæk, 1940. Photo D.G.U.

Atlas-Fig. 5. Fiskbæk briquette factory 1935-1959. Courtesy of Fiskbæk Products Ltd. (FIBO), Videbæk.

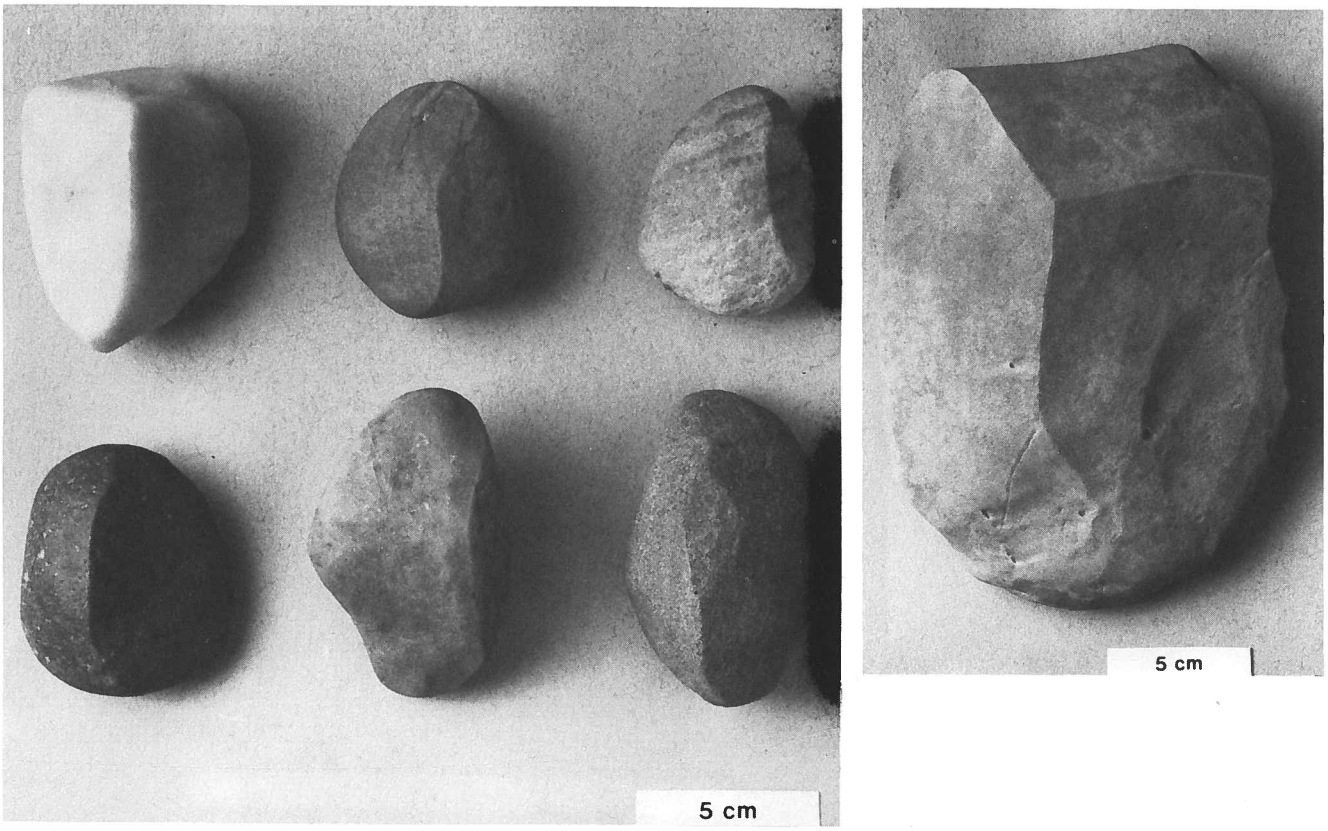
Atlas-Fig. 6. Sample of fossil fruits, seeds and cones of the Fasterholt Flora. After Koch & Friedrich, 1970.



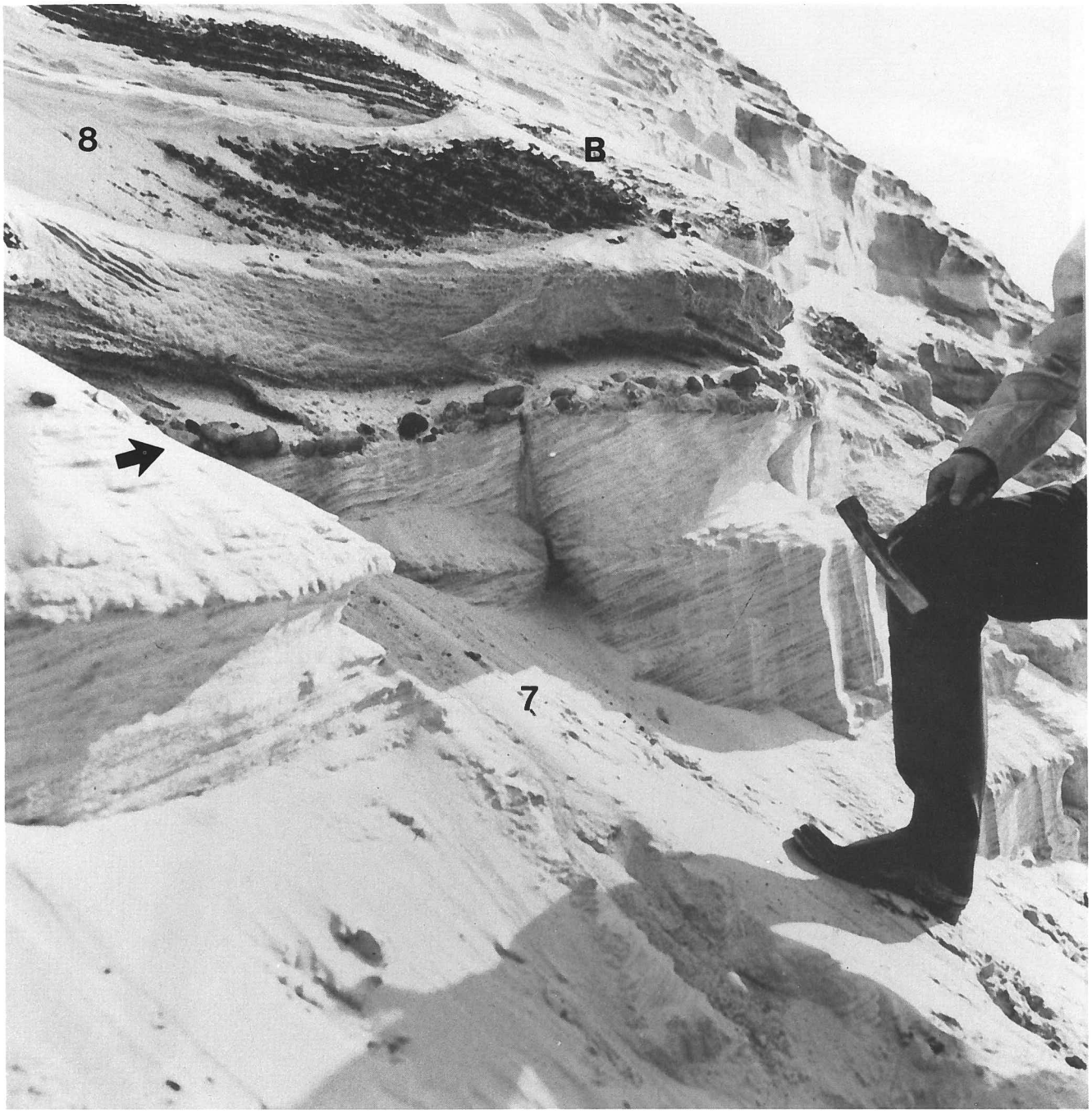
Atlas-Fig. 7. Brown coal prospective drilling (Hjortsballe) by the Geological Survey of Denmark in progress during the Late Forties. Geol. Surv. Denmark. Photo 1950.

Atlas-Fig. 8.
Silicified fossils from the marine Ordovician limestone, located in the Baltic Sea area east of Bornholm (Spjeldnæs in Koch et al 1973 and Koch & Friedrich, 1970). E.K. Photo.

Atlas-Fig. 9. Border relation between the Lavsbjerg Hill and the outwash plain ("hedesletten"). The former surface of the Lavsbjerg Hill on black Hodde Clay (H), and the Quaternary glacio-fluviatile deposits (Q) (white sands on the left, overrides the black Hodde Clay in the border zone). White vertical rule at the surface is 3 meters in length. East front of the Damgaard mine. S.B.A. Photo.



Atlas-Fig. 11. Ventifacts from the Quaternary erosional surfaces in the Carl Nielsen Ltd. pit at Fasterholt. J. Sommer Photo.



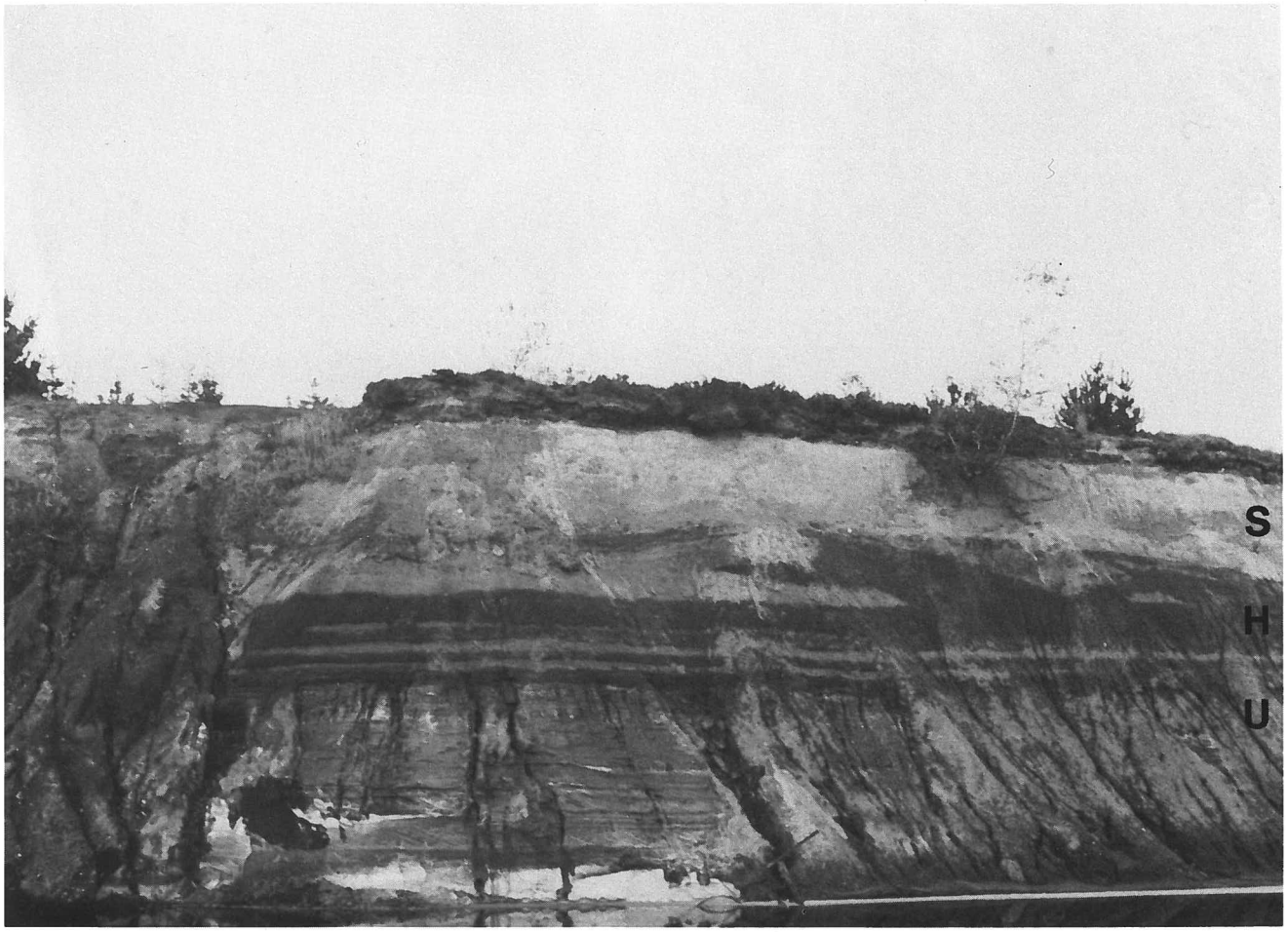
Atlas-Fig. 10. The boundary (arrow) between the "Upper Sands" (7) (Miocene) and the overlying glacio-fluviatile deposits (8)(Quaternary, Weichselian glaciation). The boundary is an erosional surface (pre-Quaternary?) with ventifacts dominantly of crystalline rocks. Note at (B) browncoal pebbles in a cross-bedded sand matrix and the browncoal detritus lamina (black). Location: The Carl Nielsen Ltd. browncoal pit at Fasterholt. E.K. Photo 1968.

Atlas-Fig. 12. The boundary between the Tertiary "Upper Sands" (T) and the Quaternary glacio-fluviatile sands (Q). Cryoturbation of the uppermost zone of the Tertiary deposits with scattered ventifacts on the erosional (boundary-) surface (arrow). Location: The Carl Nielsen Ltd. pit at Fasterholt. E.K. Photo.

Atlas-Fig. 13. The boundary between the Tertiary "Upper Sands" (T) and the Quaternary cross-bedded glaciofluviatile sands (Q). A fossil ice-wedge pseudomorph penetrates from the Quaternary surface into the soil underneath. The soil was developed on top of the Tertiary and has been seen outside the frame of the picture. Location: Between profiles K4-K6 in the Carl Nielsen Ltd. browncoal pit at Fasterholt. E.K. Photo.

Atlas-Fig. 14. Cryoturbation structures in the uppermost layers of the Quaternary glacio-fluviatile sands (Q). These structures are capped by an undulating line (L) which represents an approximately 5 cm thick seam of "loess". H: Lavsbjerg Hill. Location: The west end of the Carl Nielsen Ltd. browncoal pit at Fasterholt. op: Quaternary outwash plane. E.K. Photo 1968.

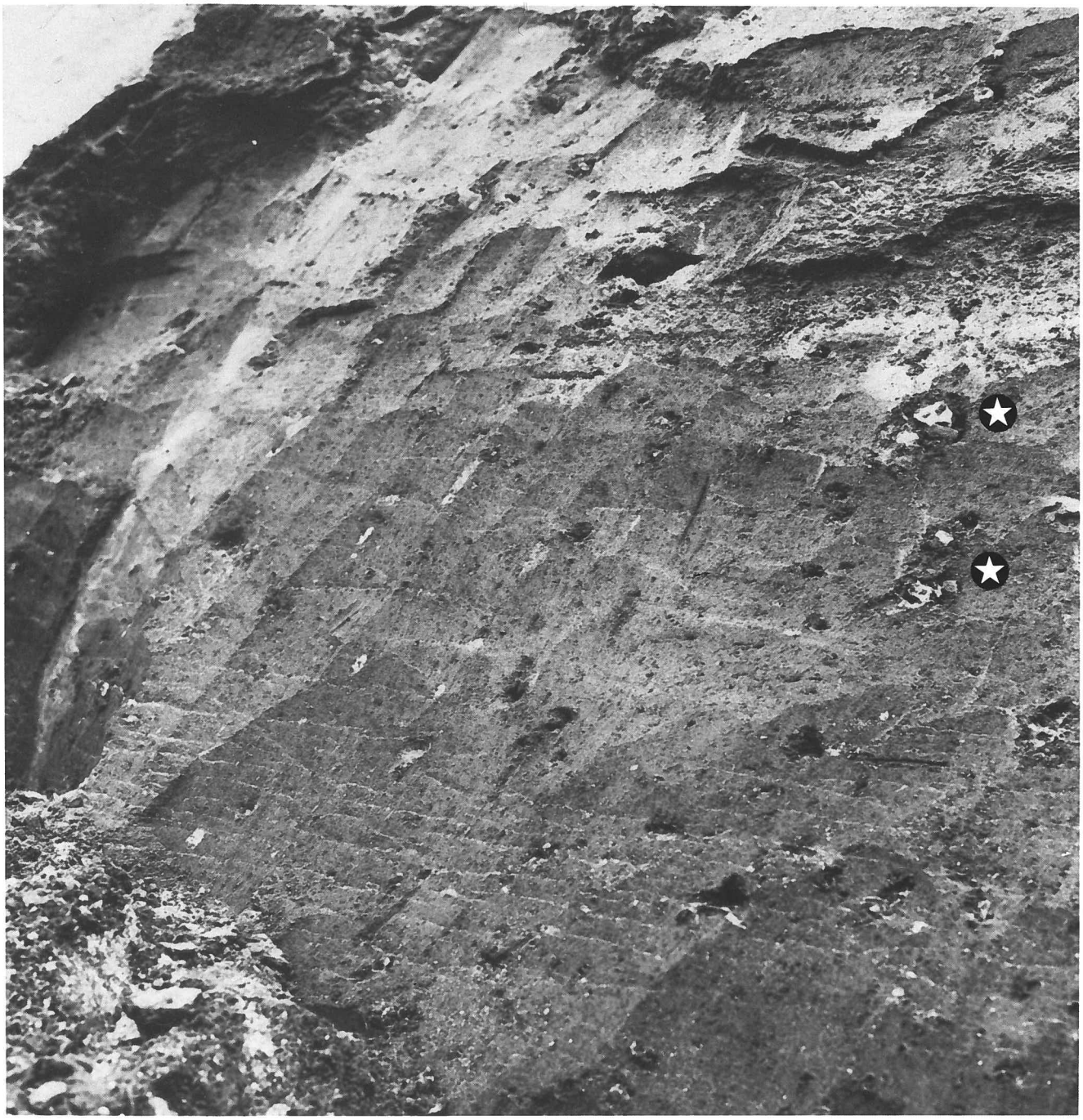
Atlas-Fig. 15. Cryoturbation structure on top of the Quaternary glacio-fluviatile sands (Q) below a soil and a sheet of aeolic sand. Included is an approximately 5 cm. thick seam of "loess" (L). On top is a sheet of aeolic sand (A) followed upwards by modern soil (S). Location: The road trench, the west end of the Carl Nielsen Ltd. browncoal pit at Fasterholt. W.L.F. Photo 1968.



Atlas-Fig. 16. Part of the north front at the former Klynholt mining area on Lavsbjerg Hill. Uppermost (below the soil and vegetation) is a light grey (when dry) solifluction sheet (S), overlying the Hodde Clay (H) (dark grey with distinct bedding in its basal part). U: The cross-bedded "Upper Sands" (Miocene). E.K. Photo 1978.

Atlas-Fig. 17. The north-front in the Søren Pedersen pit at Klynholt cuts the eastern slope of Lavsbjerg Hill, and the outwash plain (to the extreme right). The Tertiary "Upper Sands" (us) is cut off abruptly from the Quaternary outwash sands (Qs) (arrows). The Hodde Clay (H) is cut off by the surface of the slope. The solifluction sheet (s) wedges out at the beginning of the outwash plain. L indicates the forested slope of the Lavsbjerg Point. View to the west. E.K. Photo 1973.

Atlas-Fig. 18. The north front in the Søren Pedersen browncoal pit north of the farm Munkballegaard. The "Upper Sands" (US) overlain by the lower part of the Hodde Formation (H). The Hodde Clay grades upwards into the solifluction sheet (S), the outcrop cuts through the eastern slope of the Lavsbjerg Hill structure. The person on the top of the outcrop holds a vertical measuring rod of 3 meters. S.B.A. Photo 1975.



Atlas-Fig. 19. Solifluction sheet with flow structures containing frost eroded stones. The stars mark two examples where fragments from an originally single stone are still together. Other sharp edged fragments are scattered in the matrix. Location: North front of the former Klynholt mining area on Lavsbjerg Hill. E.K. Photo 1982.

Atlas-Fig. 20. A slightly weathered outcrop of the solifluction sheet containing scattered sharp edged stone fragments. Weathering reveals the flow structure. The outcrop is located at the SW-corner of the Ørken Arboretum. NE corner of the Damgaard mining area. E.T. Photo 1972.

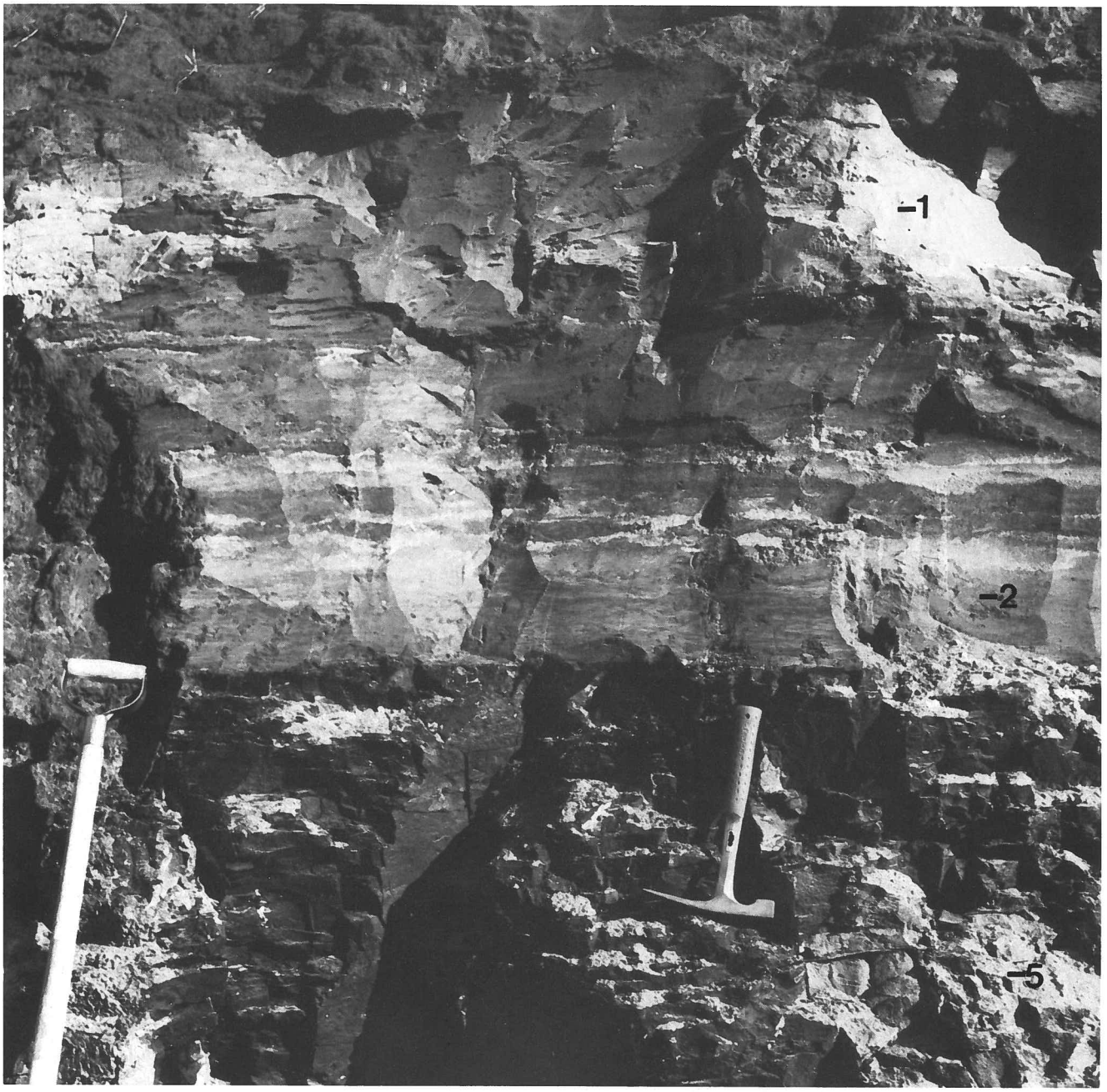
Atlas-Fig. 21. Solifluction (sedentary) deposit with strongly frost eroded stone of flint (star). Location: North front of the Klynholt former mining area. E.K. Photo 1982.

Atlas-Fig. 22. The H-front (between the lowest and middle terrace) at the interval H.11-H.12. Here all of the Fasterholt Member is exposed including the upper (3rd) browncoal seam (6) which is seen on the upper terrace in the background. - The 1st browncoal seam (-5) contains fluviatile sand lenses on its upper surface (black arrow). The numbers indicate the individual beds in accordance with the type section 4B.2.1., profile F 11 (ref. section 4B.2.2.1.Ia: The browncoal seams) and the descriptive text (see section 4B.2.2.1. II). The pair of white arrows point to the Quaternary/Tertiary border. Location: The Carl Nielsen Ltd. browncoal pit at Fasterholt. E.K. Photo 1970.

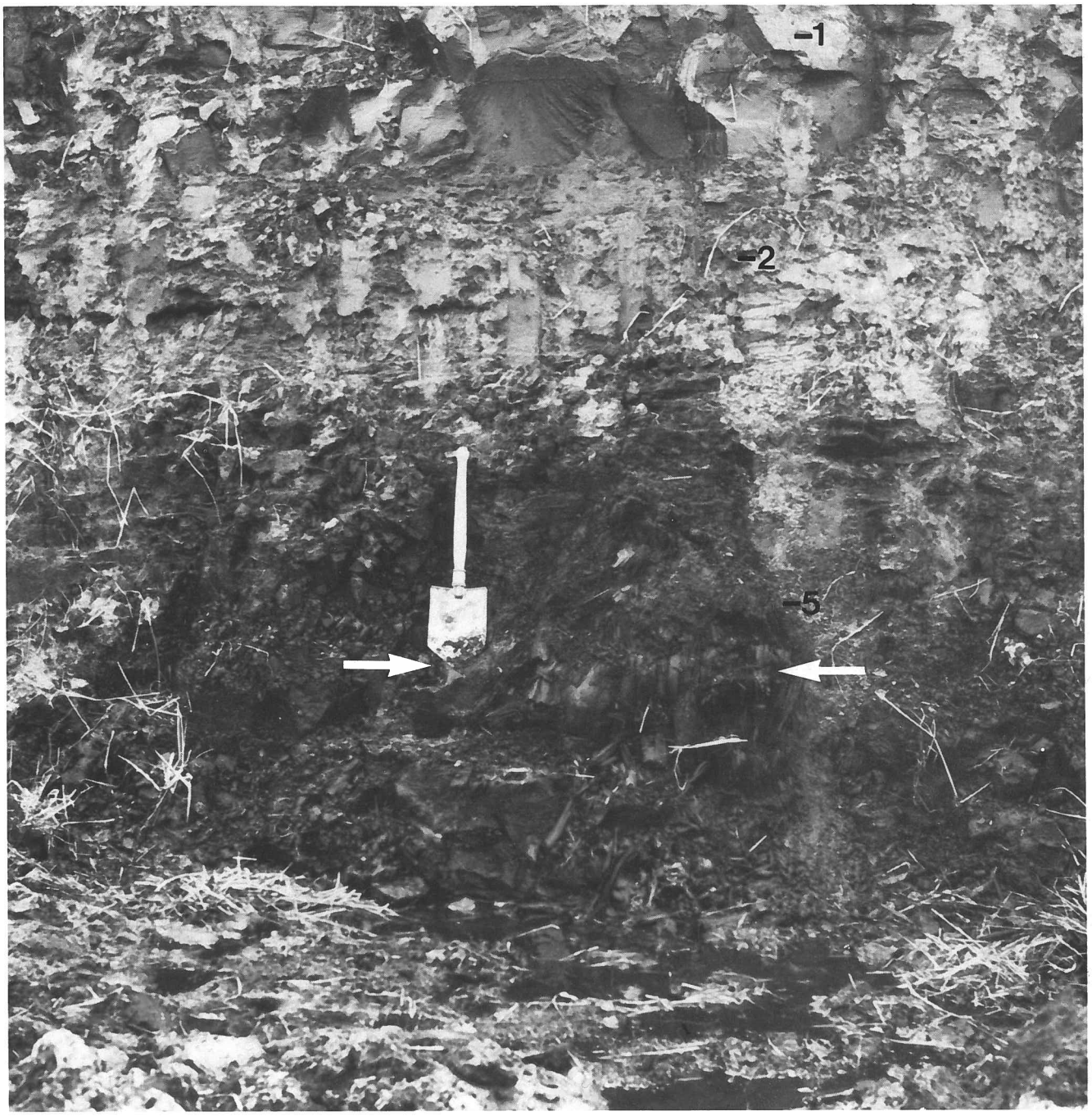
Atlas-Fig. 23. The lower boundary of the Fasterholt Member. The basal bed of Fasterholt Member (-6) contains small lenses of coarse sand interwoven with laminae of browncoal detritus and fossil plant tissue in a sand matrix. Below the basal bed of the F.M. follows an "Intraformational Breccia". It consists of a fossil soil (S) intruded (?) by fine unstructured white sand/silt (quicksand?) which continues into the underlying, cross-bedded, fluviatile sand (BS) ("B-Member"). Remnant traces of root structures can be detected rarely in the unstructured fine sand-silt of (S). The boundary between the Fasterholt Member and the "B-Member" represents a former disconformable surface, which also has been intruded by bodies of sand. Location: Profile F 11, the Carl Nielsen Ltd. pit at Fasterholt. E.K. Photo 1969.

Atlas-Fig. 24. Exposure of the lower boundary of the Fasterholt Member with its lowermost composite bed no. -6 (brown coal detritus and sand lenses). Below the undulating boundary (CU: Culmination; DP: Depression) the disintegrated soil (s) (bed -7) with thin fossil roots (r) and irregular bodies of fine homogeneous white sand. The soil bed constitutes a structure resembling an "Intraformational Breccia". The fine white sand probably is intruded into the boundary -6/-7 and is generally located in the depression. The picture is a 180 cm long x 80 cm wide section of the outcrop. The Carl Nielsen Ltd. browncoal pit at Fasterholt. E.K. Photo 1973.

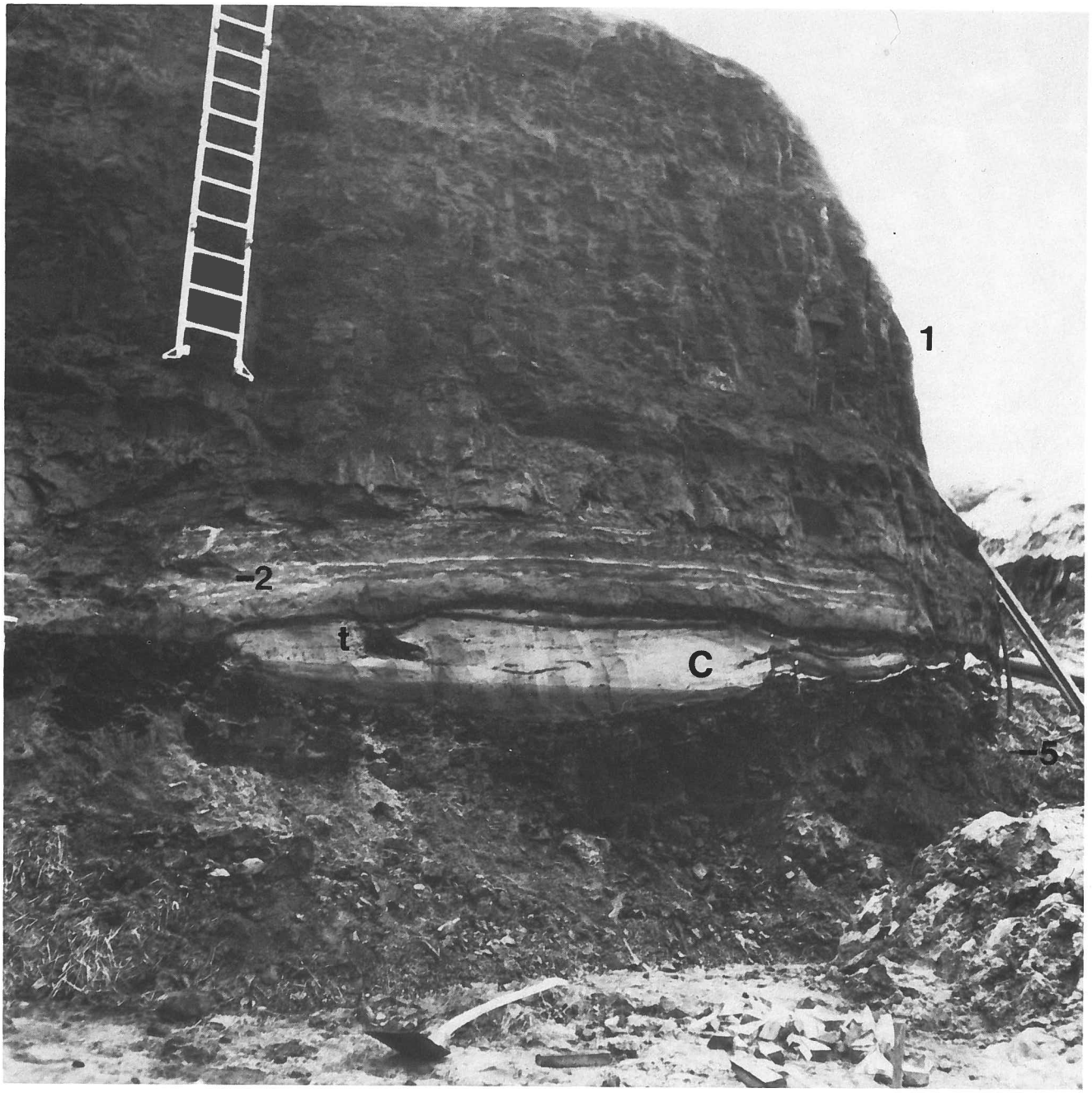
Atlas-Fig. 25. An outcrop of the F-front: At the base the 1st browncoal seam (-5) with a fluviatile sand lens inserted in its upper surface (arrow). 1 and 2 indicate the beds of 2nd browncoal seam. Concerning numbers ref. to sections 4B.2.1. and 4B.2.2.1.Ia of the text. Location: Profile F 11, the Carl Nielsen Ltd. browncoal pit at Fasterholt. E.K. Photo 1969.



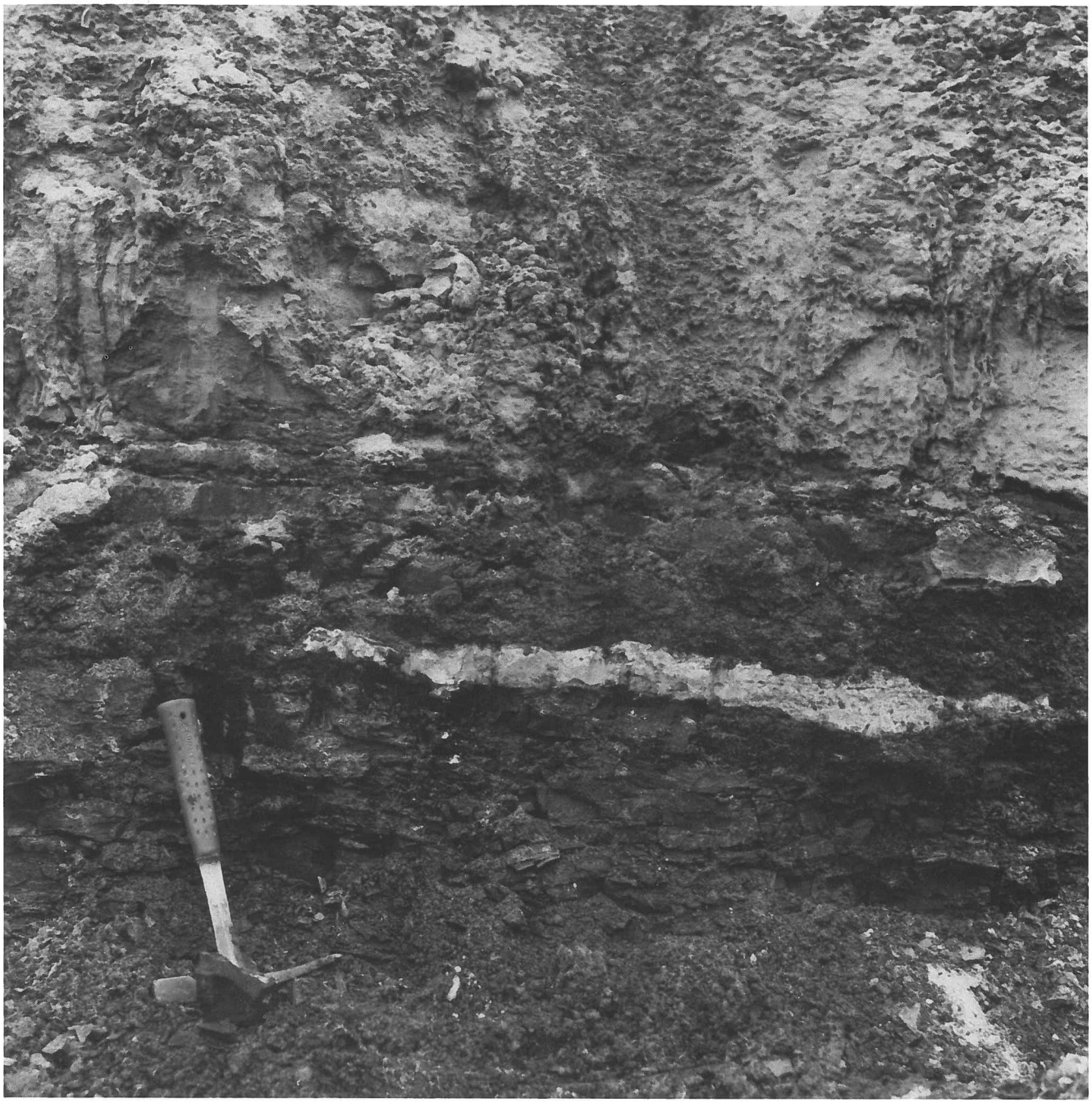
Atlas-Fig. 26. The 1st browncoal seam (-5) is overlain by a bed of intergrading irregular laminae of sand to silt (to clay) (-2) which grades upwards into a fine greenish-grey clay (bed no.-1). Location: The F-front between profiles F 11 and F 12 in the Carl Nielsen Ltd. browncoal pit at Fasterholt. E.K. Photo 1968.



Atlas-Fig. 27. Incoaled stump in the 1st browncoal seam (-5). Swollen stem-base with adhering roots deriving from a large tree. Location: The B-front between the profiles B3-B4 in the Carl Nielsen Ltd. browncoal pit at Fasterholt. E.K. Photo 1968.



Atlas-Fig. 28. The 1st browncoal seam (-5) indicating subsequent river erosion and deposition: A cross-section of a lens of fluviatile channel sand (C). The sand contains incoaled plant detritus and remains of an incoaled driftwood trunk (t) (ref. Text-Fig. 32). A lamina of browncoal detritus marks the transition to open water deposits (bed no -2) consisting of intergrading fine sand-silt-clay. Location: Profile F 11 of the F-front at the entrance of the road trench (to the right) in the Carl Nielsen Ltd. browncoal pit at Fasterholt. E.F.C. Photo 1969.



Atlas-Fig. 29. Small sand lenses (a few cm thick and 70 cm wide) in the uppermost layers of the 1st browncoal seam (-5). Location: The G-front of the Carl Nielsen Ltd. browncoal pit at Fasterholt. E.K. Photo 1970.

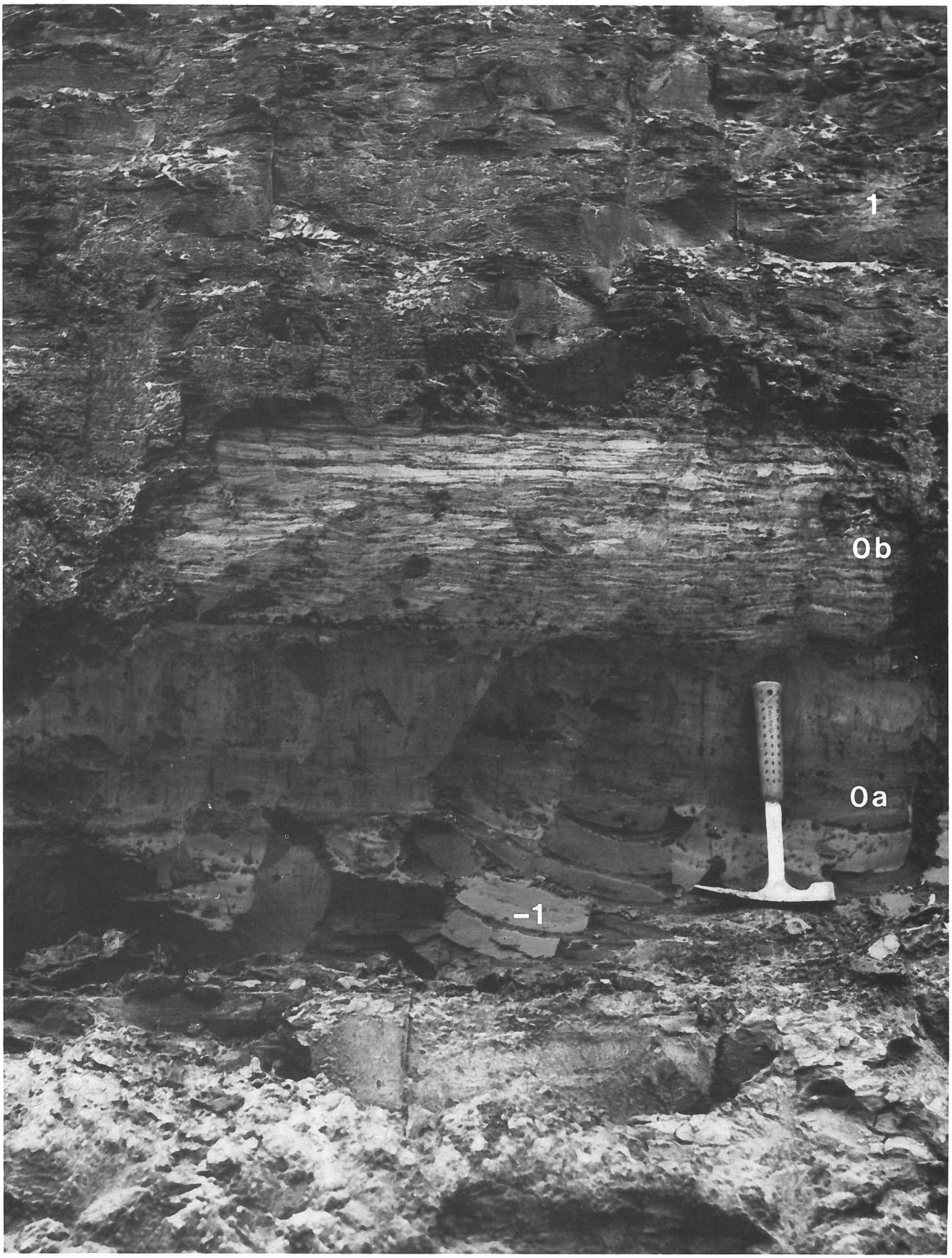
Atlas-Fig. 30. The lower part of profile H 11 exhibiting a river channel sand (c) at the base. The sand is in a lenticular structure (exposed in oblique cross-section) with driftwood (eroded stems devoid of the bark) (arrows) resting upon the 1st browncoal seam (-5) and overlain in succession by the beds nos. -4, -3, -2, and -1. Location: The H-front in the Carl Nielsen Ltd. browncoal pit at Fasterholt. E.K. Photo 1970.

Atlas-Fig. 31. A locality at the west front in the Carl Nielsen Ltd. browncoal pit at Fasterholt located between the junction of the mining trench and the road trench. The bottom floor of the trench is at top level of the 1st browncoal seam and at the level of the local river channel sands (C) (ref. Atlas-Fig. 30, 32). The sands contain exposed, eroded driftwood trunks (at the stars). (For orientation of trunks, see Larsen & Friis, 1973). E.K. Photo 1970.

Atlas-Fig. 32. The profile H-11 of the H-front of the Carl Nielsen Ltd. browncoal pit at Fasterholt. River channel sands are crowded with driftwood (eroded trunks) with N-NW orientation (see Larsen & Friis, 1973). The bed numbers in the figure are according to the type section (see chapter 4B.2.1. in the text-volume). E.K. Photo 1970.

Atlas-Fig. 33. A fossil tree-stem from the 1st browncoal seam (below the surface) penetrating into the composite bed no. -2. Location: The H-front between the profile H 10 and H 11 of the Carl Nielsen Ltd. browncoal pit at Fasterholt. E.K. Photo 1970.

Atlas-Fig. 34. Exposure of bed no. -2 overlying the 1st (lowermost) browncoal seam. Bed no. -2 is a composite bed consisting of schlieric layers of sand and clay. In the lowermost part of bed -2 lenticular depositional structures dominate. These lenses consist of light grey sand interwoven with silt-clay laminae. This grades upwards into schlieric laminae to thin beds of sand, brown humic silt to clay, a couple of regular thin beds of sand and silty clay that again grade upward into the pure greenish grey clay of bed no.-1. The Carl Nielsen Ltd. browncoal pit at Fasterholt. E.K. Photo 1969.

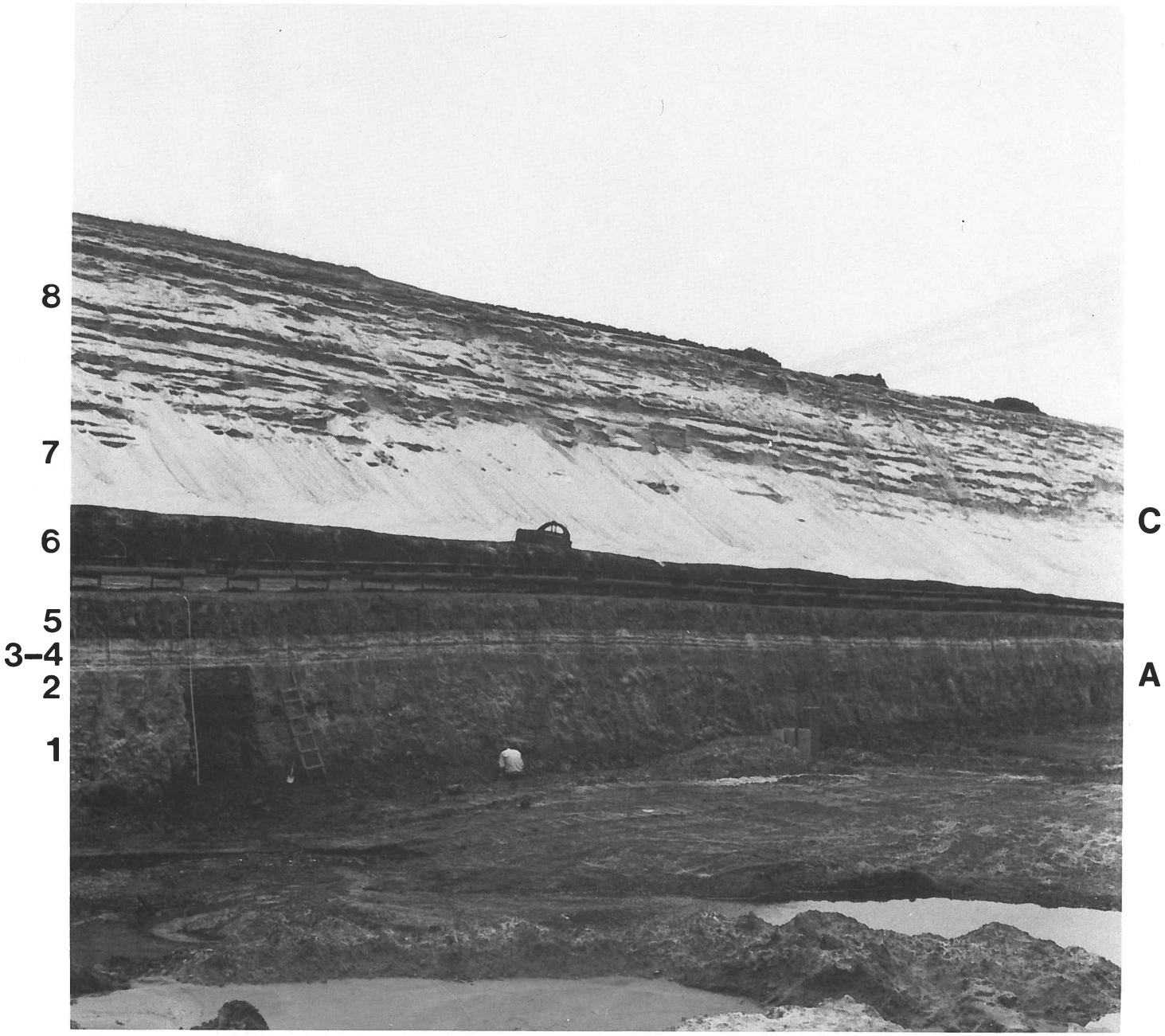


Atlas-Fig. 35. In the profile F 11, a fine clay bed (no.- 1) overlain by a succession of 1) unlaminated, brown silt with fossil roots (bed no. 0a), and 2) a composite bed (no. 0b). Between 0a and 0b is a distinct boundary (discontinuity). Bed no. 0b consists of small lenses of (fine) sand interwoven by laminae rich in organic debris (browncoal). This is again overlain by detrital browncoal (allochtonous) (bed no. 1). Front F, in the Carl Nielsen Ltd. browncoal pit at Fasterholt. E.K. Photo 1969.

Atlas-Fig. 36. The western end of the Carl Nielsen Ltd. browncoal pit at Fasterholt. To the left (foreground) the bottom floor of the mining trench. To the right are two mining terraces. Exposed in mining front E are the deposits of the 2nd rhythmic unit. Above follows the 3rd rhythmic unit (beds 5 and 6). The 3 browncoal seams (beds -5, 1+ 2 and 6) are exposed. The exposure in the foreground cuts the eastern flank of a shallow anticline connected with a syncline in the background. E.K. Photo 1969.

Atlas-Fig. 37. An outcrop demonstrating the upper part of the 2nd rhythmical unit. In the lower part of the 2nd browncoal seam (bed no. 1-2) is 1.5 m of allochtonous detrital browncoal that grades into browncoal clay in the upper part of bed no. 1. In extreme cases sand has been deposited on top (ref. profile B6 and Text-fig. 30, A). The uppermost part of the seam is a xylitic browncoal (bed no. 2) consisting mainly of densely crowded driftwood (trunks and branches). The 2nd browncoal seam is overlain by a bed of cross-bedded sand (bed no. 3+4). The cross-bedding of two orders, consequently dips westwards. Occasionally, also clay and silt laminae occur in this bed. This bed contains the Fasterholt Diaspore Flora. *The lower part (bed no. 3) is brown coloured by humic compounds precipitated by groundwater. The upper part (bed no. 4) consists of white quartz sand. The boundary between bed 4 and bed 3 is a flat surface indicating a "fossil" groundwater level (Larsen & Kuyp 1972). Location: Profile A7, A-front, the Carl Nielsen Ltd. browncoal pit at Fasterholt. E.K. Photo 1968.*

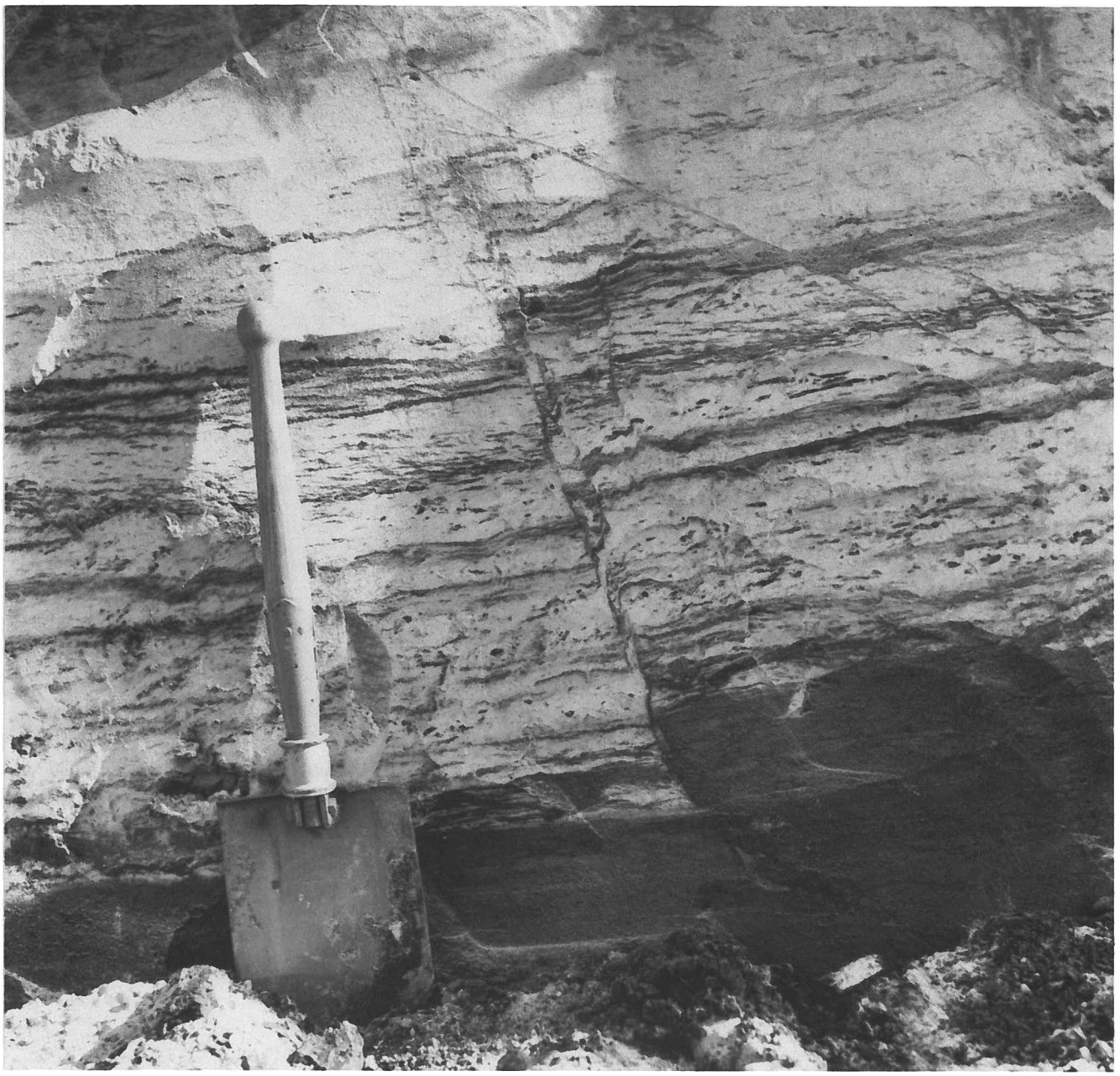
Atlas-Fig. 38. The upper part of the 2nd browncoal seam with the allochtonous detrital browncoal bed (1) at the ground level grades into (overlain by) clay with lenticular-lamellar sand structures (1b). Bed 1b grades upwards into browncoal-clay (gytja) (1c) (ref. Text-fig. 30, A) which is covered by allochtonous browncoal (2). The numbers refer to the units of the type section. Location: Profile B6 of the B-front, the Carl Nielsen Ltd. browncoal pit at Fasterholt. E.K. Photo 1968.



Atlas-Fig. 39. The A-front in the Carl Nielsen Ltd. pit (cleared outcrop to the left at profile A7, see the Atlas-Fig. 37). The 2nd browncoal seam (1+2) is overlain by the fluviatile sand of a small delta (bed no. 3+4) and silty clay (bed no. 5). Behind the middle terrace the 3rd browncoal seam in the B-front (bed no. 6) overlies the silty clay bed no. 5. In the background, the C-front exposes the "Upper Sands" (bed no.7) overlain by Quaternary glacio-fluviatile sands (bed no.8). E.K. Photo 1968.

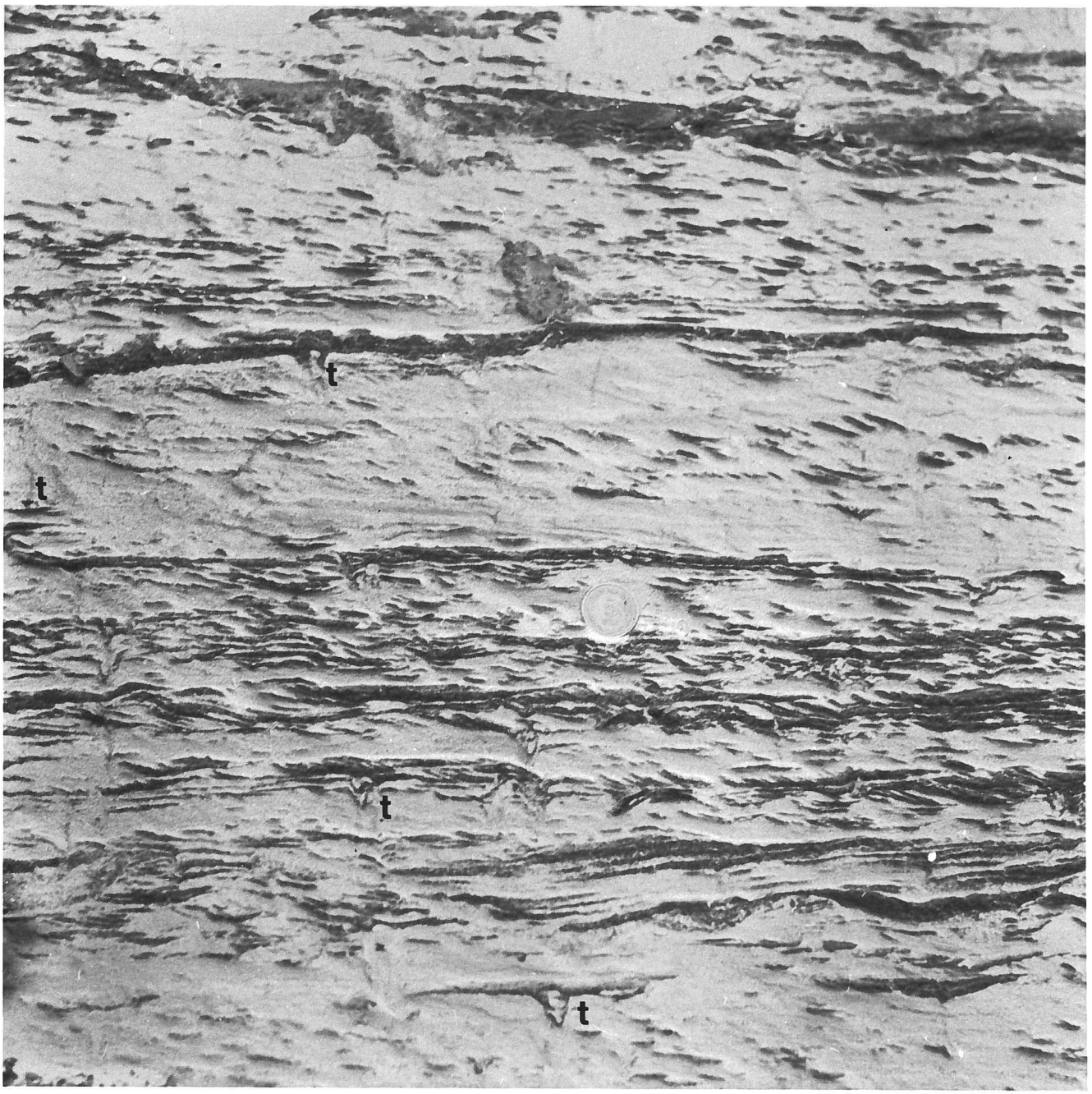
Atlas-Fig. 40. The eastern third of the Carl Nielsen Ltd. browncoal pit, Fasterholt with the ground floor and a drainage channel seen in the foreground. In the middle of the picture the A-front, middle terrace and B-front are seen. The Geology is described in the text to Atlas-Fig. 37, and 39. To the right the cleared outcrop of profile A7 (Atlas-Fig. 37). Lowermost in the A-front can be seen the 2nd browncoal seam (2nd rhythm) (nos. 1-2) overlain by the clastic beds 3+4 (marked 4) and 5. Behind the middle terrace is exposed the 3rd browncoal seam and cut in a vertical section along the B-front. In the background is the C-front with "Upper Sands" and Quaternary glacio-fluviatile sands. Under the transporter is a syncline in the Tertiary sequence which is cut off by the Quaternary sequence producing an unconformity. E.K. Photo 1968.

Atlas-Fig. 41. Profile E 3 from the E-front (100 m west from the eastern end of the Carl Nielsen pit (at the railway)). Below, the 2nd browncoal seam (bed. no.1-2). Upwards follows the cross-bedded sand (bed no. 4) with optimal thickness (1.5-1.2 meters) overlain by 55 cm silty clay (bed no. 5). The small reverse fault (arrow) belongs to a fault system in the flanks of the small "en échelon" synclines (ref. Text-Fig. 64, Atlas-Figs. 109-110, E.K. Photo 1969.

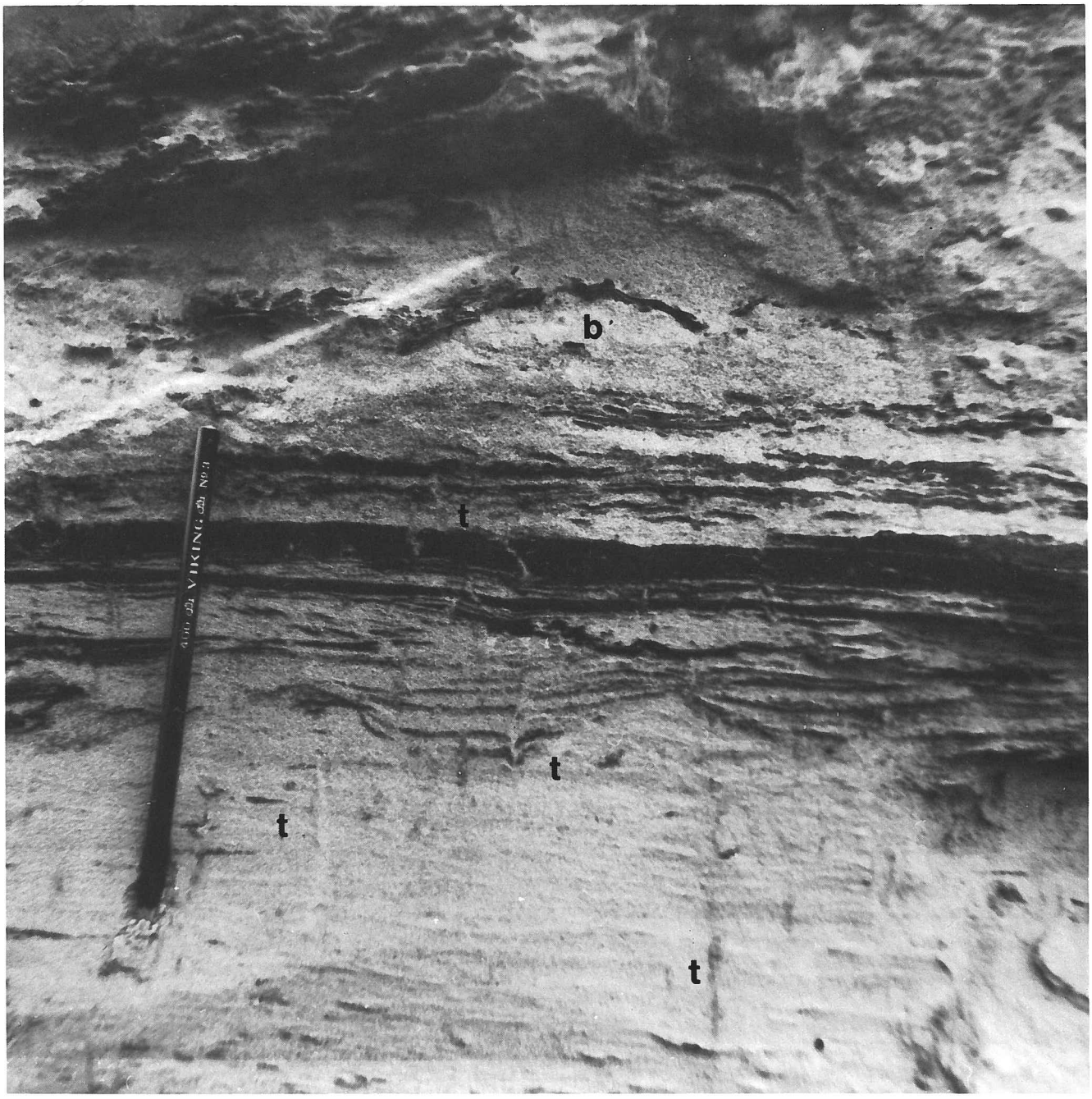


Atlas-Fig. 42. Fluviatile bed (delta) no. 3+4 affected by reverse faulting on the flanks of an "en échelon" syncline. Laminae consist of organic detritus, brown coloured by humic compounds. Numerous black particles are fossil seeds and fruits (Fasterholt Diaspore Flora) *and plant detritus. The basal brown bed (dark bed no. 3) is coloured secondarily by humic compounds, its upper surface indicating a fossil groundwater level which is older than the faulting. Location: Profile E 4a, E-front, the Carl Nielsen Ltd. pit, Fasterholt. E.K. Photo 1969.*

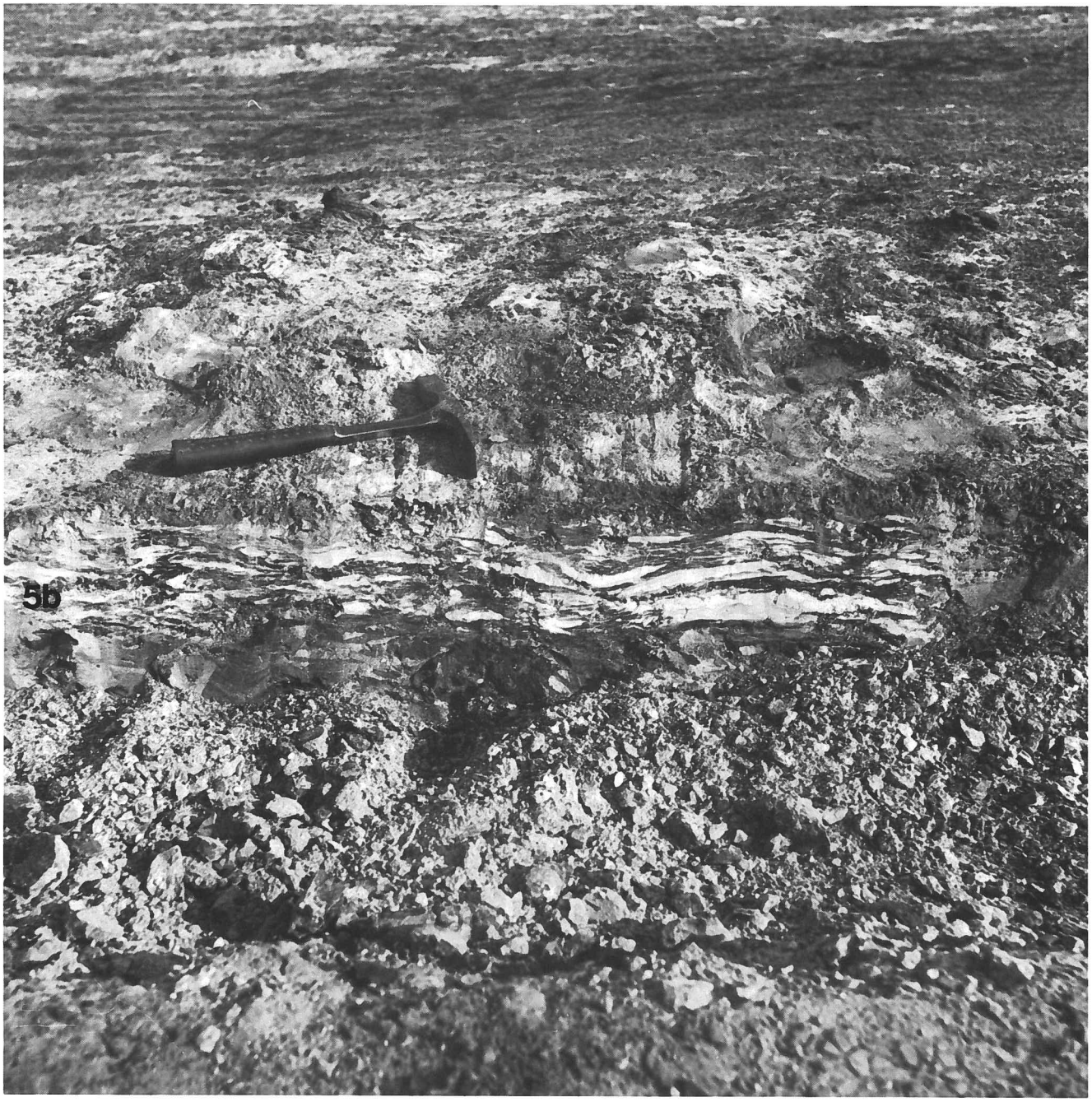
Atlas-Fig. 43. Fluviatile bed no. 4 (delta) with flat lying cross-bedding of the 1st order and laminae with cross-bedding of the 2nd order. Many of the 2nd order laminae locally have a considerable content of silt and clay with brown humous compounds (as seen here). Bed no. 4 is generally medium-fine grained sand. Location: Profile E 5 (E-front) in the Carl Nielsen Ltd. browncoal pit, Fasterholt. E.K. Photo 1969.



Atlas-Fig. 44-45 Details of the delta bed (no. 3+4) from the eastern half of the Carl Nielsen Ltd. pit at Fasterholt. Some of the laminae have a content of humic clay that consolidates the sediment and makes it resistant to the wind erosion affecting the sand (Atlas-Fig. 44). The resulting relief of the exposure reveals sedimentary structures. Fine scale bioturbation (t) is developed (Atlas-Fig. 44) and occasionally vertical bioturbation structures in the sand are obvious (t), also traversing the black lamellae and the thicker dark band (Atlas-Fig. 45). This suggests that the delta bed is at least partly subaquatic (lacustrine). In the uppermost part of Atlas-Fig. 45 are laminae of organic detritus and shells of thick resistant bark (b). Atlas-Fig. 44 was made of a frozen surface in winter. W.F. & E.K. Photo 1969-1970.

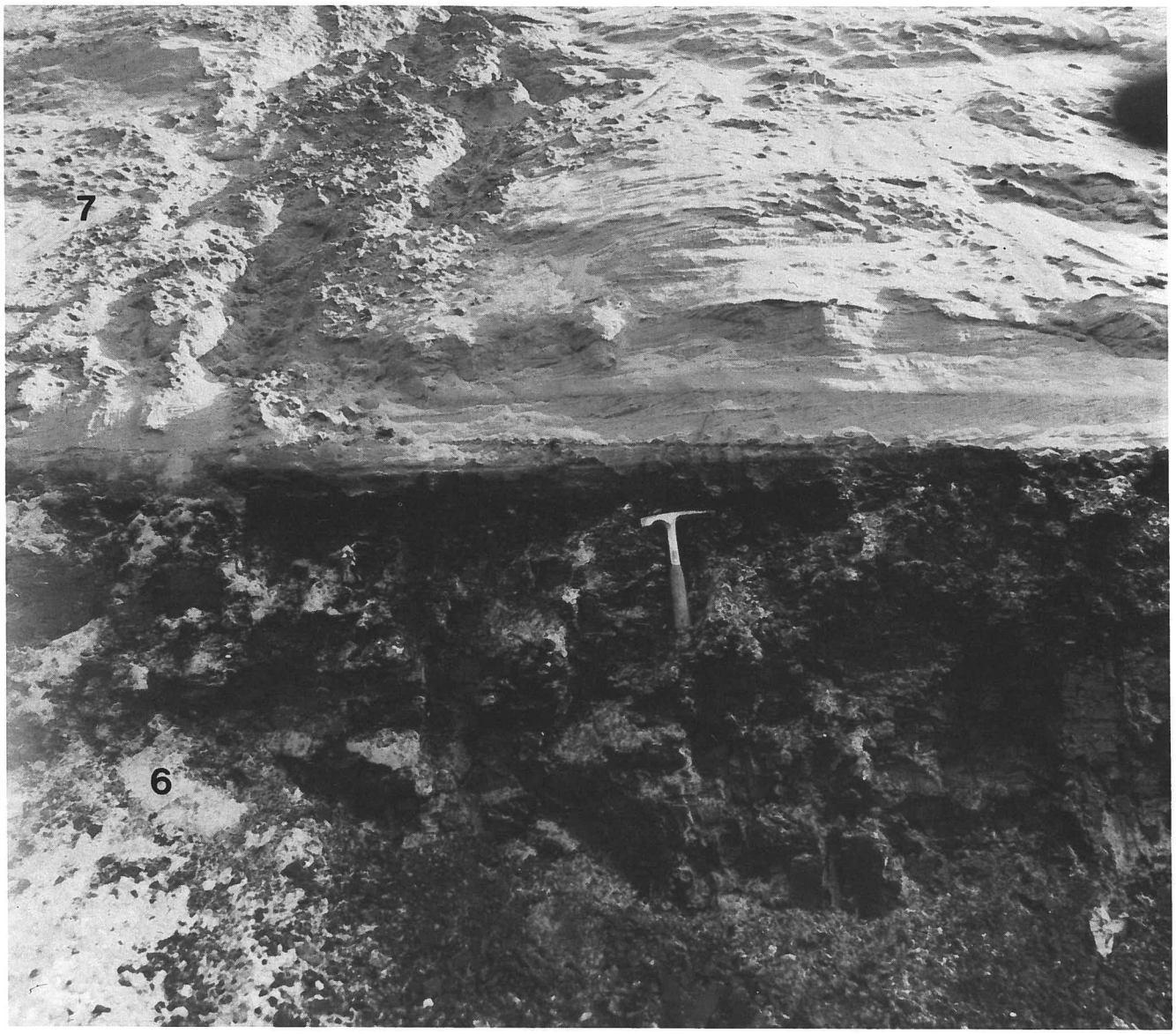

b
t
t
t
t

Atlas-Fig. 46. Exposure of fluviatile sand (bed no. 3+4) at profile F 8 (F-front), Carl Nielsen Ltd. browncoal pit. Here, the thickness, (65 cm), is reduced compared to the easterly profiles (profile E 3: 1.5 m, see Atlas-Fig. 41), reflecting the flat delta wedge. The humous coloured basal part ("bed" 3) is constantly 50-60 cm thick indicating that the groundwater level is synchronous through the entire exposure. The silty clay bed (no. 5) (85cm thick) overlying the fluviatile sand bed shows a reciprocal thickening towards the west. E.K. Photo 1969.



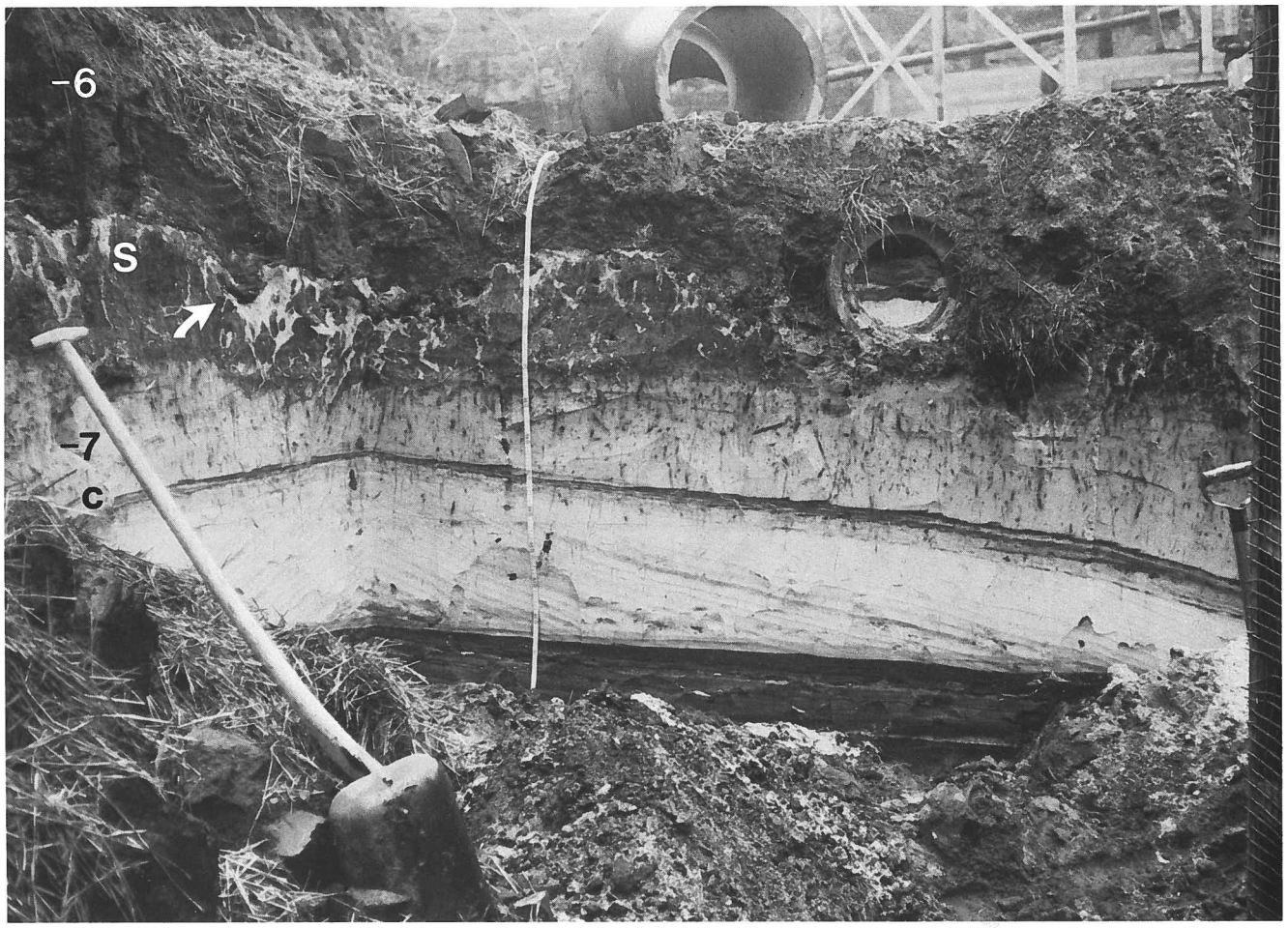
Atlas-Fig. 47. Irregular lenticular structures of sand and silt in a network of browncoal detritus laminae (bed 5b) overlay the silty clay of bed no. 5 (5a) (not exposed). Location: The terrace between the mining fronts H and I. E.K. Photo 1970.

Atlas-Fig. 48. View of the Carl Nielsen Ltd. browncoal pit, Fasterholt from the west to the east end. The 3rd browncoal seam (6) is being mined on the terrace and has been removed in the foreground. To the left is the F-front (F). The conveyor belt is running along the G-front (G). To the right is the south front (H-front) with exposure of the "Upper Sands" (7) and the overlying Quaternary glacio-fluviatile sands (8). In the background: View of the glacial outwash plain. E.K. Photo 1969.



Atlas-Fig. 49. Detail of the south front in the Carl Nielsen Ltd. pit (the east end). The 3rd browncoal seam (6) in contact with the overlying "Upper Sands" (Tertiary) (7) and its basal interdigitating flat lenses of white quartz sand are visible. E.K. Photo 1970.

Atlas-Fig. 50. The south front of the Carl Nielsen Ltd. pit, at the junction with the east end of the pit (to the left). The conveyor belt stands on clay bed no. 5 (the I-front) and behind it the 3rd browncoal seam (6) is exposed (in the J-front). The 3rd seam is overlain by the "Upper Sands" (7) exposed in long cross-bedded, lenticular or tubular structures. On top the Quaternary glaciofluviatile sands (8) in lenticular structures of varying dimensions and often as small narrow lenses. The border between the Quaternary and Tertiary is found in the middle of the outcrop (QT). E.K. Photo 1970.



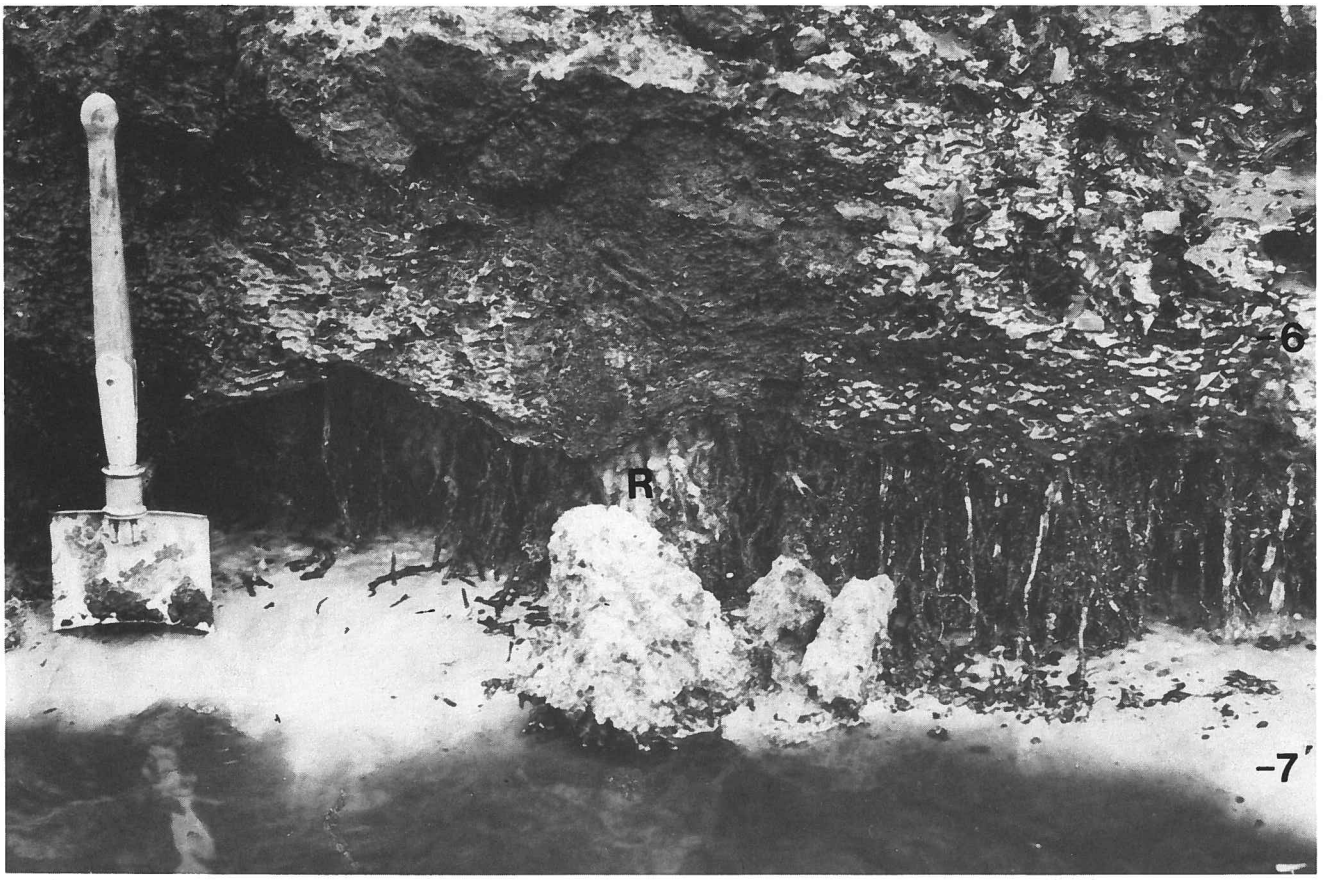
Atlas-Fig. 51. An exposure in a drainage ditch at the base of profile F 11, F-front in the Carl Nielsen Ltd. pit. The basal composite sand and browncoal bed (no. -6) of the Fasterholt Member is seen resting upon a disintegrated fossil soil (S). The undulating surface of this soil is the lower boundary of the Fasterholt Member. The soil resembles an "Intraformational Breccia" and grades downwards into the original "raw" sediment: A cross-bedded, (NE-dipping) 50 cm thick bed of white sand (-7). This sequence is penetrated by vertical fossil roots. Below, a thin, NE-dipping sand with lamina (C) is seen. It is coloured in the upper part of black detritus. The thin bed overlies 65 cm of cross-bedded sand dipping to the NE. The lowermost 30 cm of this sand is brown coloured (humous) up to a horizontal limit indicating a "fossil" groundwater level (ref. Larsen & Kuyp 1971). The measure tape is divided in decimetres. For detailed information see Text-Fig. 35. E.F.C. Photo 1969.


FM -6
B
S
e
d
c
b
a

Atlas-Fig. 53a. The fossil soil (S) directly below the basal bed of the Fasterholt Member (no. -6 seen on top of the picture). The irregularly undulating boundary shows three minor "pockets" with incoaled tree branches or stems (in cross sections). The specimen in the middle of the picture (arrow) has departed from its bark shell. The deformation of these fossils and the surrounding sediment indicates that the woody structures sunk or were pressed into the substratum (the soil) (also see Atlas-Figs. 51, 53). The sand (-7 d) below the soil is cross-bedded (less distinct than in the bed -7 b below) with NE dip. This sand (-7d)is separated from the cross-bedded sand bed below (-7b) by a thin horizontally laminated sand (-7 c) with coaly detritus uppermost. The texts to figs. 50 and 51 are also valid for the present figure. For reference to the Text-Fig. 35, see symbols in the picture and chapter 4B. 2.2.1.III. Location: Outcrop near profile F 11. in the Carl Nielsen Ltd. pit. E.K. Photo 1969.

Atlas-Fig. 52. Detail of Atlas-Fig. 51. (ref. also Text-Fig. 35). Hence, in the irregular undulating surface (arrows) between the overlying sandy browncoal (-6) and the soil (S), numerous intrusions of fine sand (quicksand ?) are seen replacing large areas of the grey to black soil. A large shell (B) of bark of a trunk seen in the trough of the coaly sand/soil interface, contains "intruding" sand within the shell. Roots can be distinguished in the grey soil but not in the intruding sand. In the sand below the soil the thin roots are closely spaced. The roots can be seen (though disintegrated) to penetrate through to the bottom of the outcrop. The letters a-e represent subunits of bed -7 (see Atlas-Fig. 53) The measure tape is divided into centimetres and decimetres. E.F.C. Photo 1969.

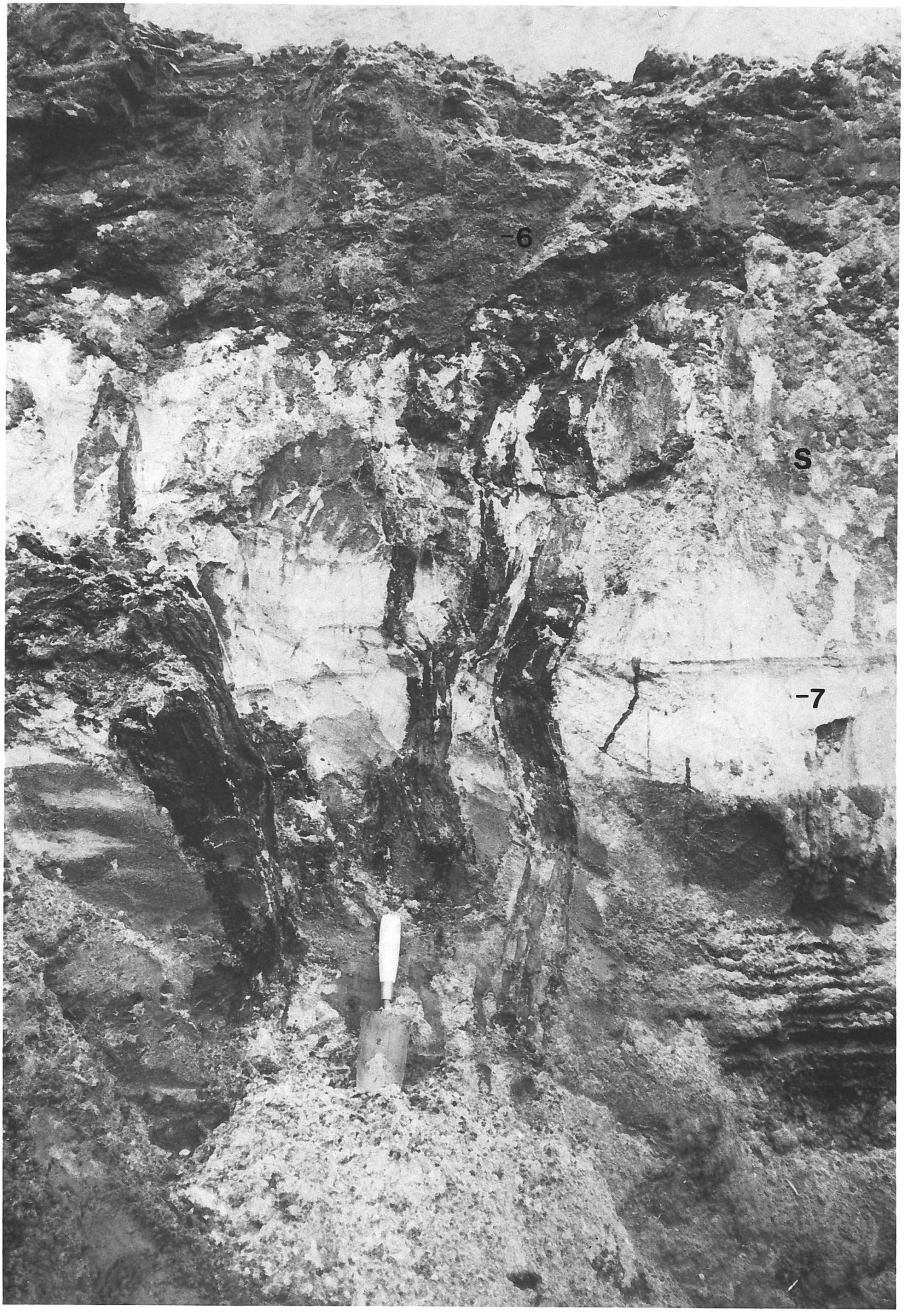
Atlas-Fig. 54. Detail of Atlas-Fig. 53 showing the interrelation between the sandy browncoal bed (lowermost bed in Fasterholt Member) (-6) and the underlying fossil soil (S) ("Intraformational Breccia"): A "pocket" of the overlying bed no. -6 involving a terminal shell (and eventually more fragments) of bark and/or wood (arrow) indicating a branch sunk or had been pressed into the substratum (the soil). Notice that the "bedding" structure of bed no. -6 is affected and parallels the depression of the pocket. The deviation is equalized upwards into bed no. -6 (also see the normal structure of bed no. -6 on Atlas-Figs. 23-24). E.K. Photo 1969.



Atlas-Fig. 55. Exposure in the drainage ditch along the E-front (interval E 10 - E 11) in the Carl Nielsen Ltd. browncoal pit. The modern stream has washed out the sand bed (no. -7) leaving the fossil roots (R) of the root horizon exposed beneath the Fasterholt Member. The basal composite sand-browncoal bed (-6) of the Fasterholt Member is left overhanging the ditch. E.K. Photo 1969.

Atlas-Fig. 56. Detail of Atlas-Fig. 52 showing the cleared outcrop with the units b-c-d of bed no. -7. Numerous thin incoaled roots in the cross-bedded sand (unit -7 d) (d) are exposed by the outcrop, some passing through the laminated thin sand bed (unit -7 c) (c) and the underlying sand (unit -7 b) (b). The Carl Nielsen Ltd. pit at Fasterholt. E.K. Photo 1969.

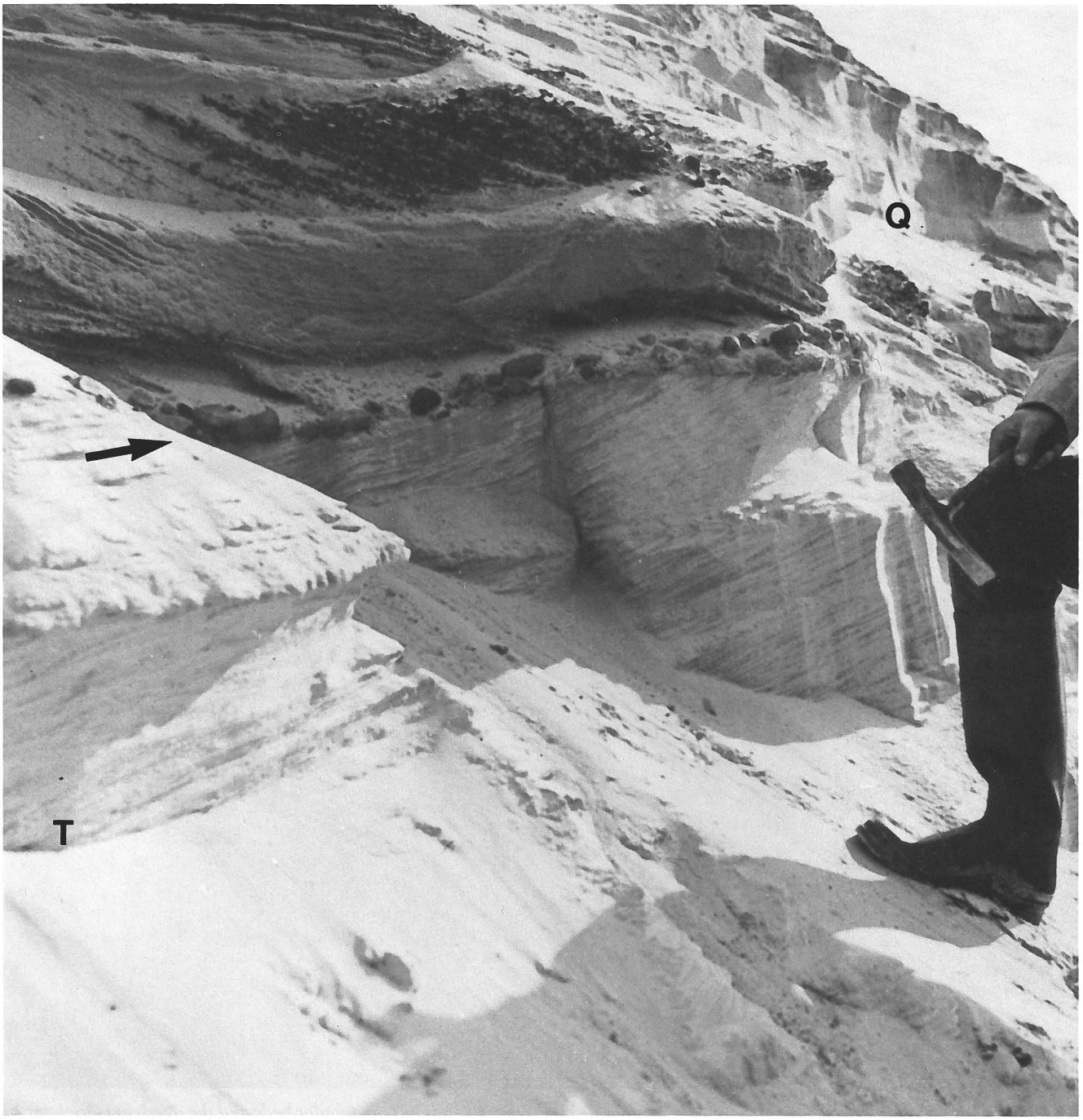
Atlas-Fig. 57. The border (B) between the Fasterholt Member (-6) and the underlying fossil soil (S) ("Intraformational Breccia") developed in the deltaic sand (-7). Incoaled bark cylinder remains of a strongly disintegrated vertical stem are preserved in the paleosoil (arrows). The central wood is totally replaced and the interior is partly filled with "intrusive" sand and remains of younger roots. Location: Profile F 11 ((F-front). The Carl Nielsen Ltd. browncoal pit at Fasterholt. E.K. Photo 1969.


-6
S
-7

Atlas-Fig. 59. Exposure at profile F 11 (F-front) showing the fossil soil (S) ("Intraformational Breccia") and the sand in the ("B-Member") deltaic sequence (-7) just below the Fasterholt Member (-6). Large tree roots (R) penetrate the underlying beds from the original surface (overlain by Fasterholt Member, bed no. -6). E.F.C. Photo 1969.

Atlas-Fig. 58. Exposure of the boundary between the Fasterholt Member (bed no. -6) and the disintegrated fossil soil ("Intraformational Breccia") (s) developed in the deltaic sand ("B-Member", bed no. -7). From the boundary (-6/-7) large tree roots can be seen to penetrate deeply into the substratum. Location: The Carl Nielsen Ltd. pit. E.F.C. Photo 1969.

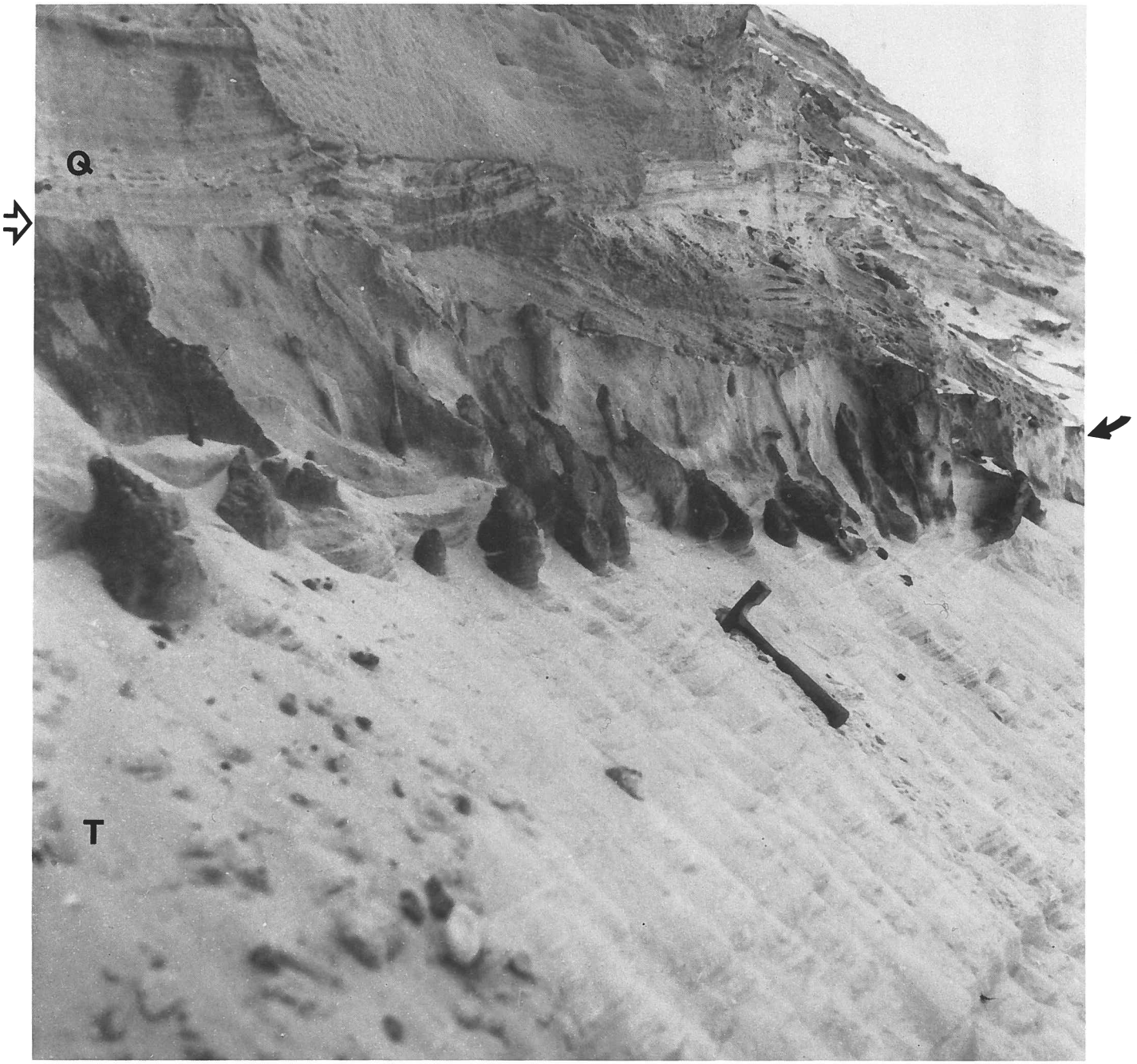
Atlas-Fig. 60. The fossil soil (S) ("Intraformational Breccia") and sands of the ("B-Member") deltaic sequence (-7) of profile F 11 (F-front). Tree roots (R) penetrate from the basal bed of Fasterholt member from the base of a stump, into the substratum bed no. -6. E.K. Photo 1969.



Atlas-Fig. 61. Outcrop demonstrating the boundary between the Tertiary deltaic "Upper Sands" (T) and the Quaternary glacio-fluviatile sands (Q). Crowded ventifacts on the surface of the Tertiary sands mark the boundary (arrow!). The south front (C-front) in the browncoal pit of Carl Nielsen Ltd. at Fasterholt. E.K. Photo 1968.

Atlas-Fig. 62. The boundary (arrow) between the Tertiary deltaic "Upper Sands" (T) in tabular beds and the overlying Quaternary glacio-fluviatile sands (Q) in lenticular cross-bedded structures. A basal lens of the Quaternary sands marked by a thin crust of a possible podsol fills a depression in the Tertiary beds. Location: Profile K6, south front in the Carl Nielsen Ltd. pit at Fasterholt. E.K. Photo 1970.

Atlas-Fig. 63. The boundary (arrow) between the Tertiary white, deltaic "Upper Sands" (T) and the Quaternary glacio-fluviatile ochreous sands (Q). Just below the boundary is a fossil soil (S) (derived from the uppermost Tertiary sand) containing fossil Tertiary pollen and remains of roots (Taxodioxylon gypsaceum (Göppert) Kräusel). Location: Profile K5 in the Carl Nielsen Ltd. browncoal pit. E.K. Photo 1970.



Atlas-Fig. 64. The boundary (arrows) between the Tertiary white, deltaic "Upper Sands" (T) and the Quaternary glacio-fluviatile sands (Q). In the uppermost part of the Tertiary sand, fossil roots (Taxodioxylon gypsaceum (Göppert) Kräusel) are surrounded by remains of a paleosoil (Tertiary) generally destroyed by Quaternary cryoturbation which is represented by a variety of structures at this stratigraphical level (ref. chapter 4A, Atlas-Fig. 12,14,15). Location: Profile K6 (K-front) in the Carl Nielsen Ltd. browncoal pit at Fasterholt. E.K. Photo 1970.

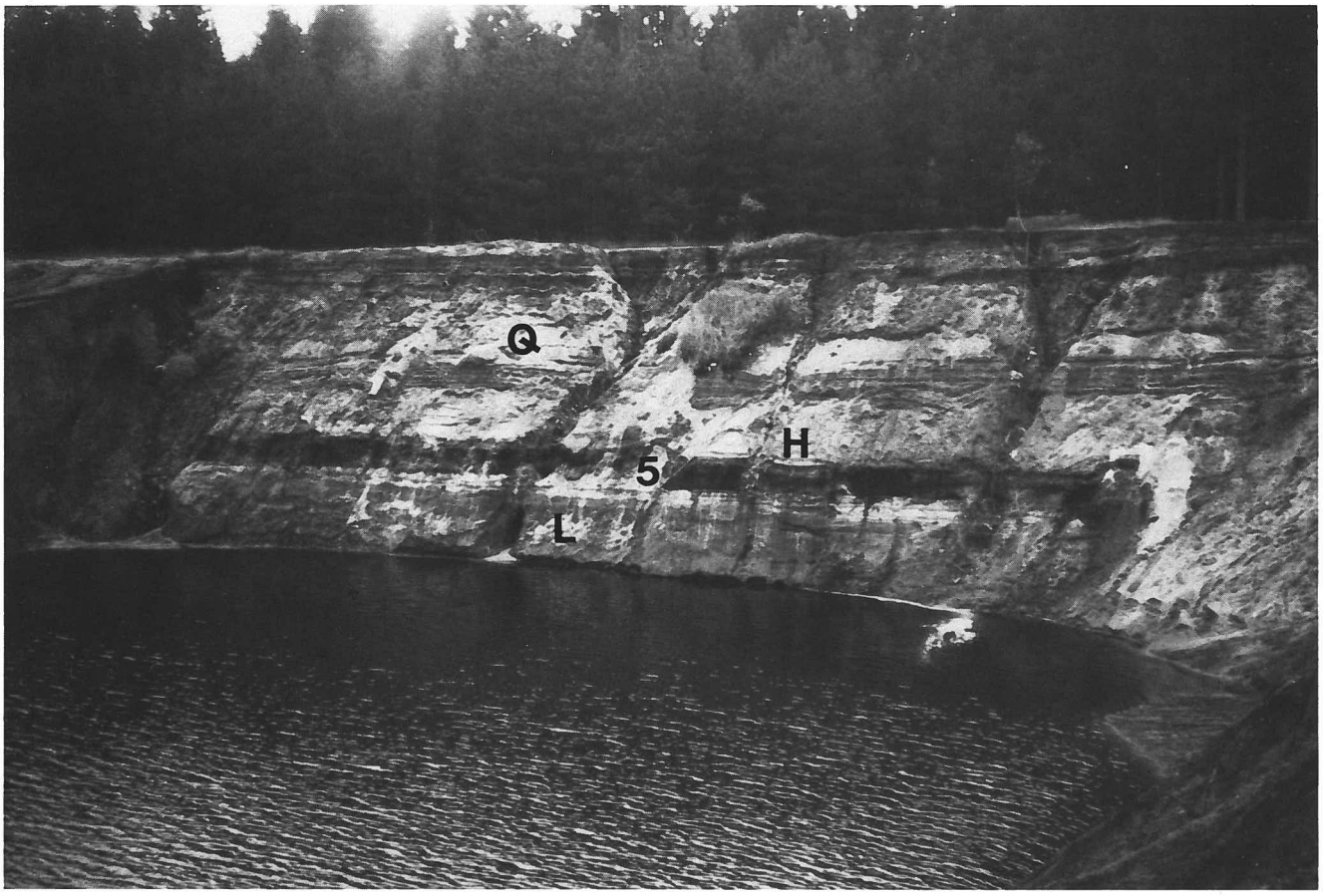
Atlas-Fig. 65. The boundary between the Tertiary deltaic "Upper Sands" (T) and the cross-bedded Quaternary glacio-fluviatile sands (Q). Below the boundary relicts of a Tertiary soil (s) with downwards pointing projections containing fossil tree roots. These soil structures are what remains of a cryoturbated surface from the Quaternary. Location: Between profiles K4-K6, the south front in the Carl Nielsen Ltd. pit. E.K. Photo 1970.

Atlas-Fig. 66. Cryoturbation in the uppermost Tertiary deltaic sand ("Upper Sands") containing Tertiary fossil tree roots surrounded by remains of a paleosoil (arrow). Profile K6, the south front in the Carl Nielsen Ltd. pit at Fasterholt. E.K. Photo 1970.

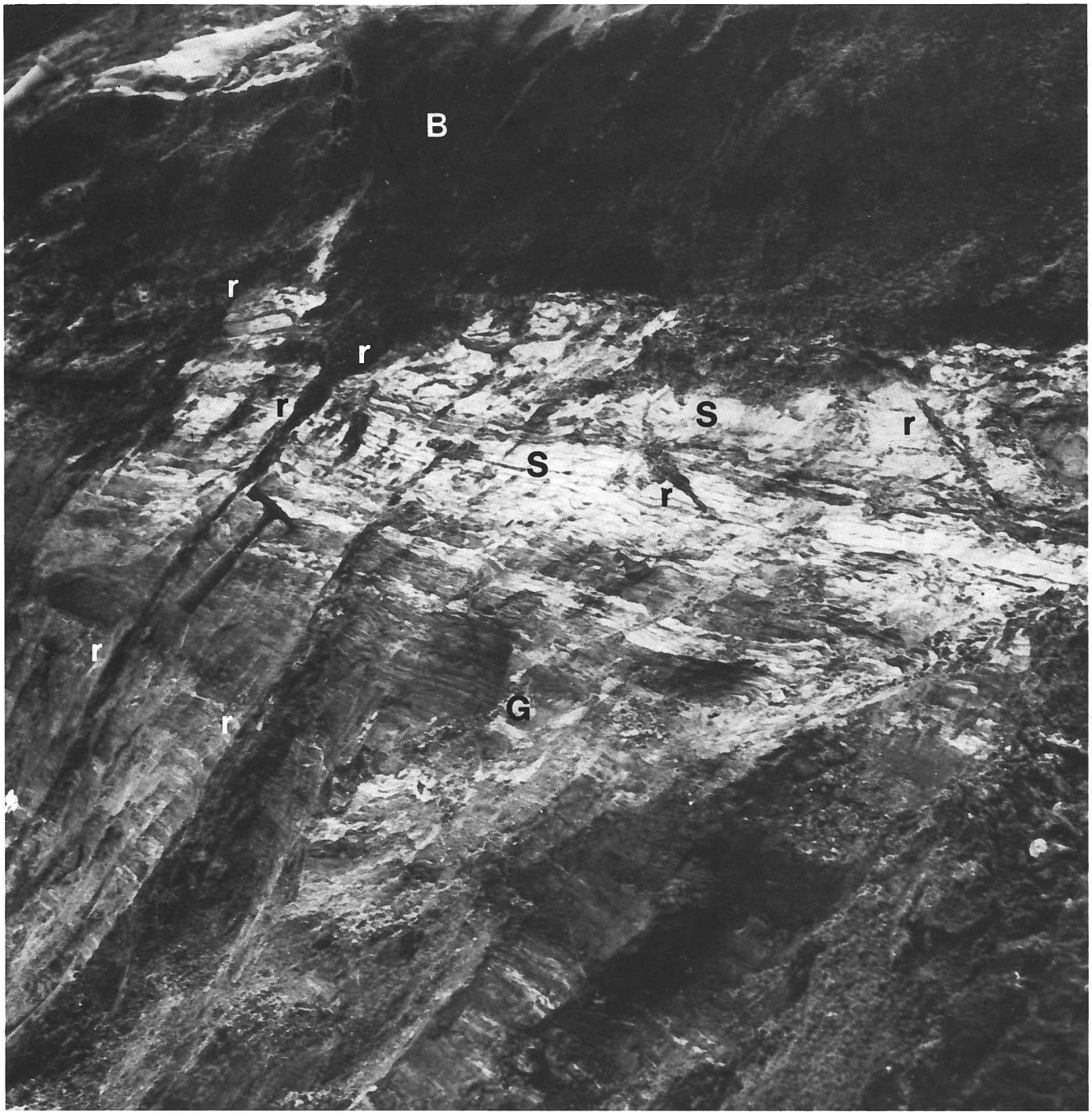
Atlas-Fig. 67. The west front of Søren Pedersens' browncoal mine to the north of Munkballegaard. S: Solifluction sheet: H: Hodde Clay (Miocene); S: Upper Sands (Miocene); L: Point Lavsbjerg (forest-clad). E.K. Photo 1978.

Atlas-Fig. 68. The north front of the abandoned Klynholt brown-coal mining area. The white Tertiary "Upper Sands" (T), just above the water level of the submerged pit are overlain by the distinctly bedded basal Hodde Clay (H). The upper beds of homogeneous Hodde Clay can be recognized above (marked h). Uppermost, more or less covered by vegetation, is a cryoturbation sheet (k). Klynholt, the Lavsbjerg Hill. E.K. Photo 1978.

Atlas-Fig. 69. The boundary between the "Upper Sands" (US) (Odderup Formation) and the Hodde Formation. The boundary is marked by black bars and a triangle pointing west (left). Above the boundary follows the basal bed of gravel, clay and sand (g) overlain by bedded Hodde Clay (7 beds) (Hb). H: Homogeneous Hodde Clay. Location: the east end of the Klynholt north-front, (eastern sector) just below the former Klynholt coal stock. E.K. Photo 1982.

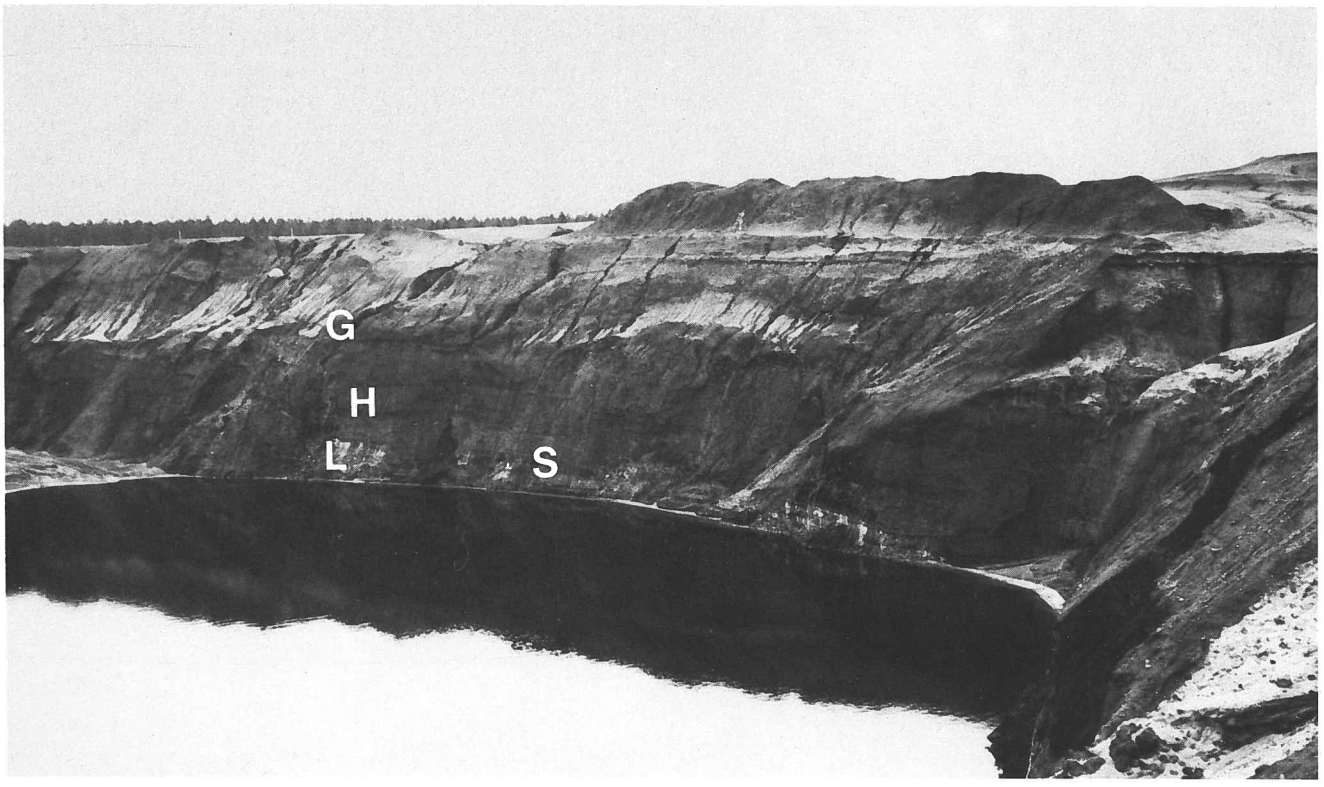


Atlas-Fig. 70. The section EM at the west-front in the Klynholt mining area. The lacustrine deposits (L) (equivalent to the "Upper Sands") are lowermost in the exposure, overlain by the 5th browncoal seam (5). Above this is a white, cross-bedded fine-grained sand (H) equivalent to the basal gravel-sand-clay bed of the Hodde Formation. The uppermost half part of the exposure represents a longitudinal lateral section through a N-S oriented Quaternary (river) channel sand (Q). E.F.C. Photo 1970.

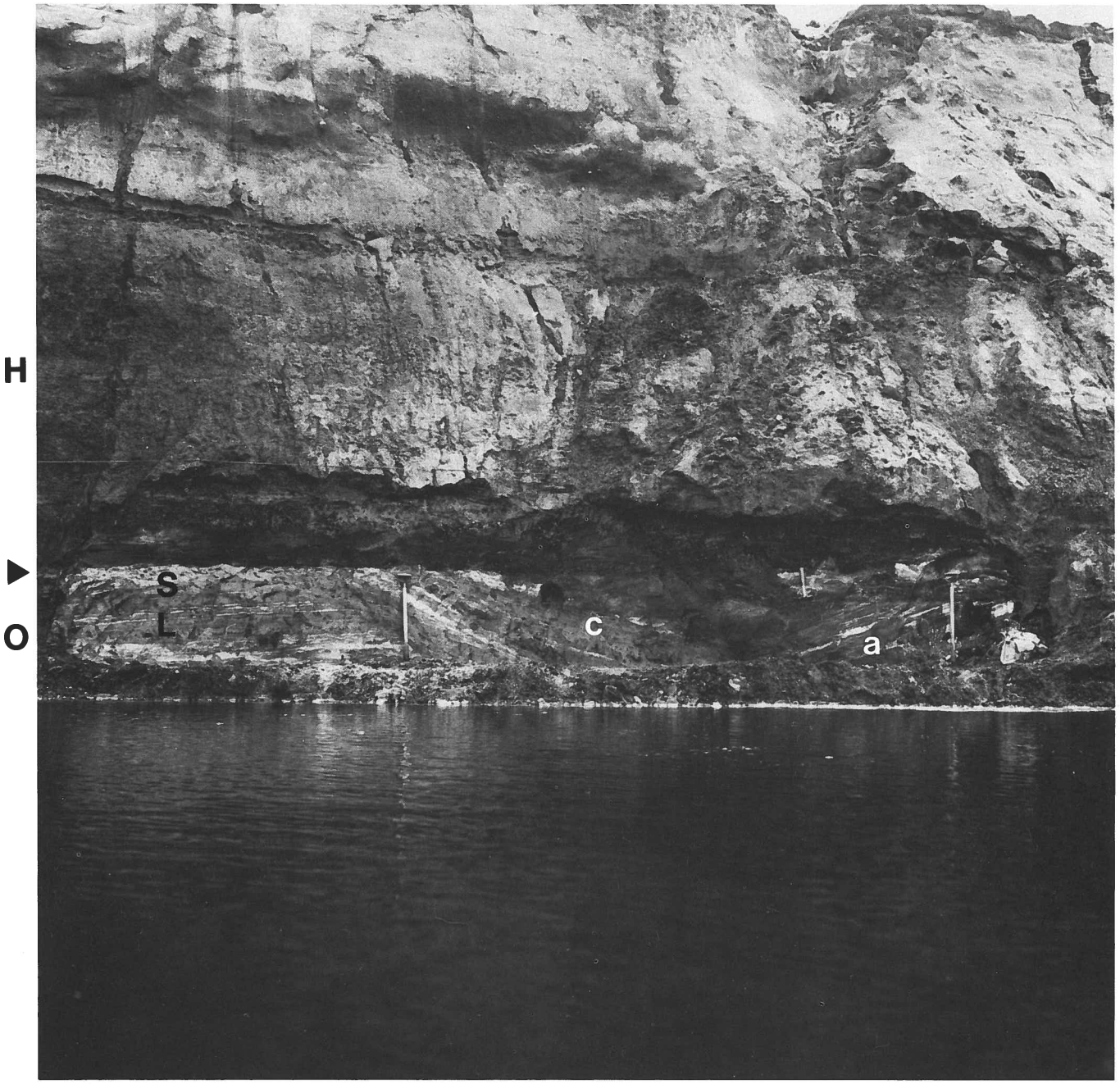


Atlas-Fig. 71. Detail of the section EM, of Atlas-Fig. 70 (the west-front of the Klynholt mining area). The lacustrine upwards-coarsening sequence (equivalent to the "Upper Sands") contains alternating laminated beds of brown clay and silt (G) and grades above into sand-silt (S). The 5th browncoal seam (B) contains tree roots (r) that penetrate into the lacustrine sequence. To the left a system of roots (r) branching from a disintegrated stump which has been absorbed in the 5th browncoal bed. Location: Klynholt Vest. E.K. Photo 1970.

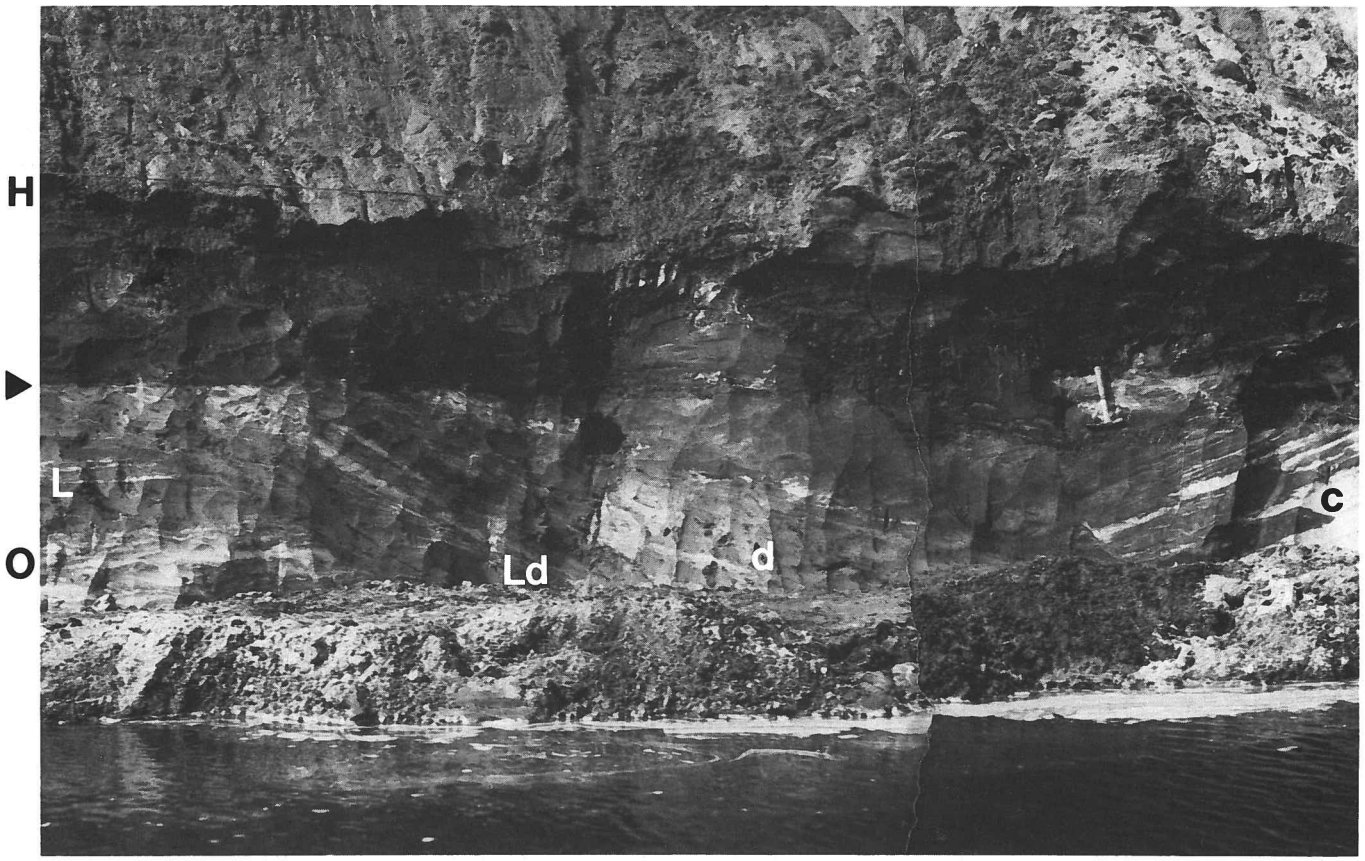
Atlas-Fig. 72. An upwards-fining lacustrine sequence (brown humic clay and silt alternating with white fine sand). The sand tends to dominate in the lower part of the unit. The sequence is overlain by a brown silty clay (C) with abundant fossil leaves and other compressions of plant remains (the Søby-Flora bed). *Location: West front of the Damgaard Nord pit. E.K. Photo 1970.*



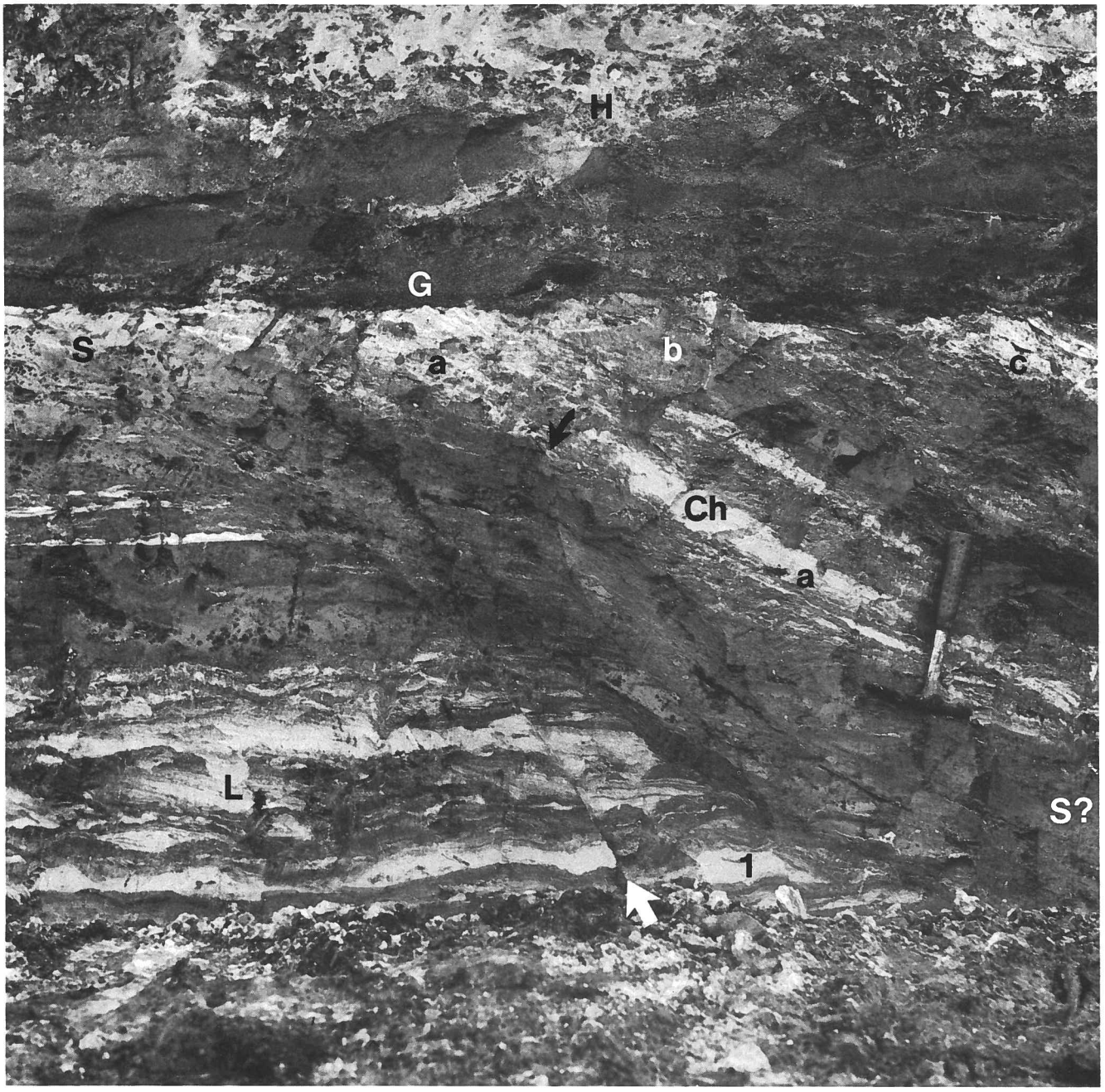
Atlas-Fig. 73. The west front of the Damgaard Nord pit. Lowermost, is the lacustrine sequence (L) overlying the (submerged) Fasterholt Member (the productive browncoal bearing sequence). The lacustrine sequence ends upwards with the Søby-flora *clay (S). Above follows a sequence consisting of the Hodde Formation (H) and the glauconitic clay of the Gram Formation (G). E.F.C. Photo 1972.*



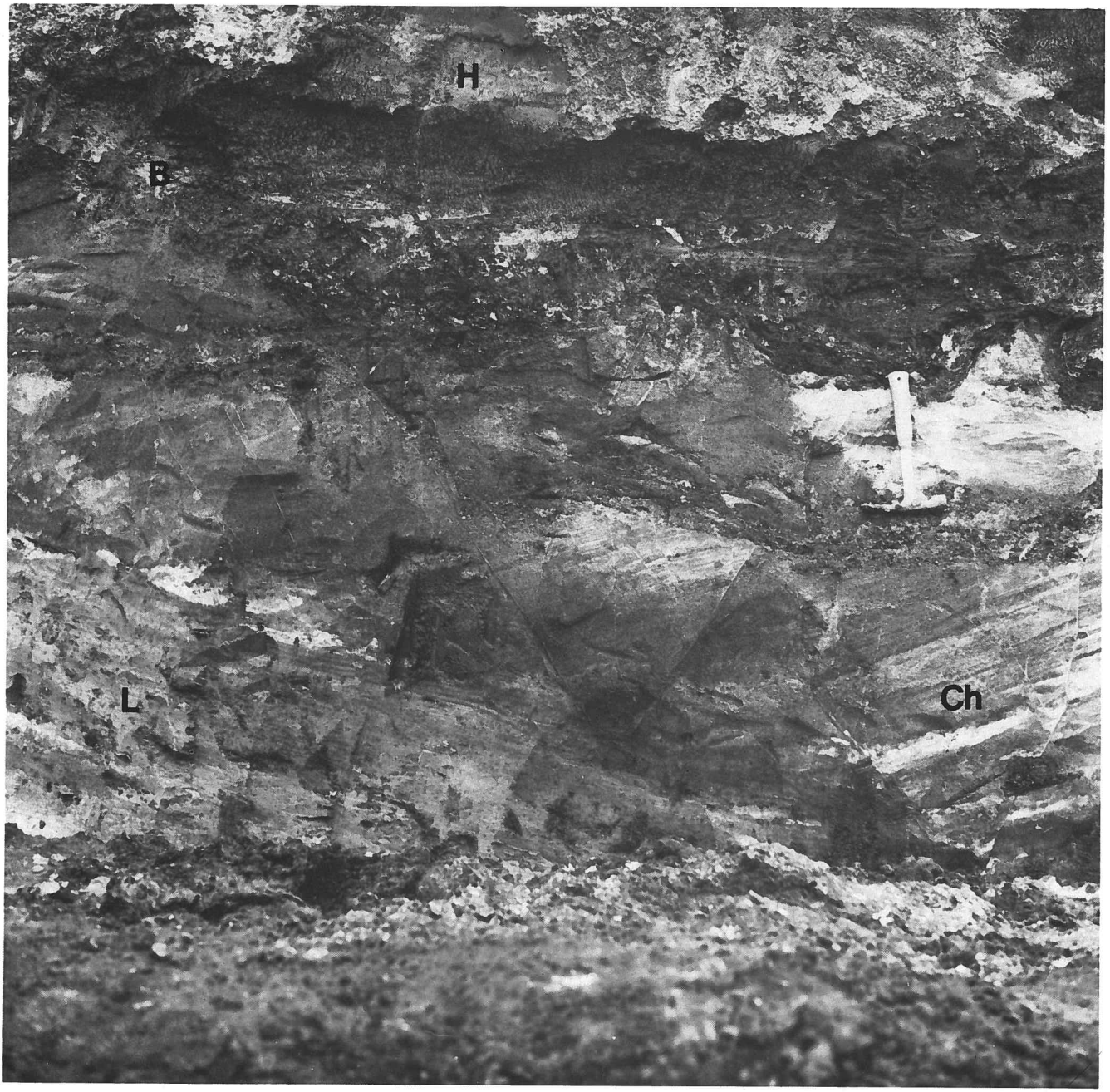
Atlas-Fig. 74. The boundary (arrow) between the Odderup Formation (O) and the Hodde Formation (H). To the left the lacustrine sequence (L) which is substituted along the west front of the Søby-Fasterholt area by the "Upper Sands" (ref. Text-Fig. 37). The uppermost brown clay bed of the lacustrine sequence (Søby-Flora clay) (S) is overlain by the Hodde Formation (H). The lacustrine sequence is cut by channel sediments (C) to the right. Along the edge of the channel structure erosional products of the lacustrine sequence are found tilting and/or downslid (under-mined?) into the river sands. They grade into brown clay and are plastically deformed. These peripheral channel sediments grade eastwards (to the right) into a westerly dipping channel sand (a) which is continuous to the eastern end of this outcrop (ref. Atlas-Fig. 78, 79). The exposure is an oblique longitudinal section through a river channel. Location: North front of the Damgaard Nord browncoal pit. E.K. Photo 1972.



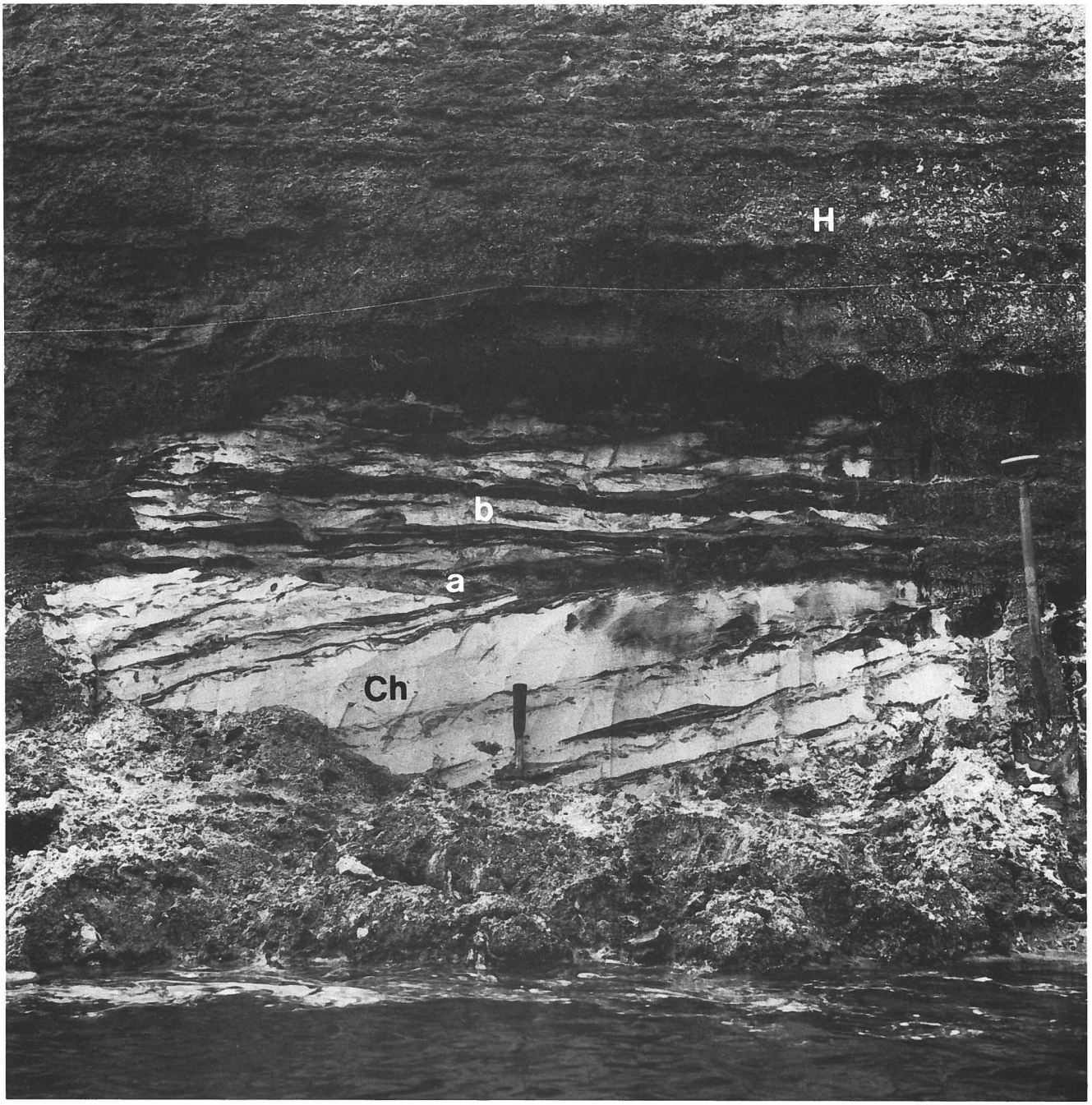
Atlas-Fig. 75. Detail of fig. 71 showing (an outcrop of the North front of the submerged Damgaard Nord pit) the complex border relationship between the components of the Odderup Formation: 1) The lacustrine equivalent to the "Upper Sands" (L) and 2) a younger channel deposit cut into it (Ld, d and C). And 3) their relationship to the overlying Hodde Formation (H). To the left (laterally) in the channel structure, the lacustrine beds appear to be downslid (Ld) and are broken into blocks (Atlas-Fig. 77). Further to the right the (lacustrine) deposits rich in clay are plastically deformed (d). On the extreme right of the picture channel sand (C) is introduced and continues (outside the picture) eastwards through the rest of the exposure (ref. Atlas-Fig. 78, 79). The entire structure of these deposits appears to have been levelled by erosion (by the succeeding transgression) before or during the initial deposition of the Hodde Formation (H). Location: North front of the Damgaard N pit, between the profiles 6 - 7. (Text-Fig. 45). E.K. Photo 1972.



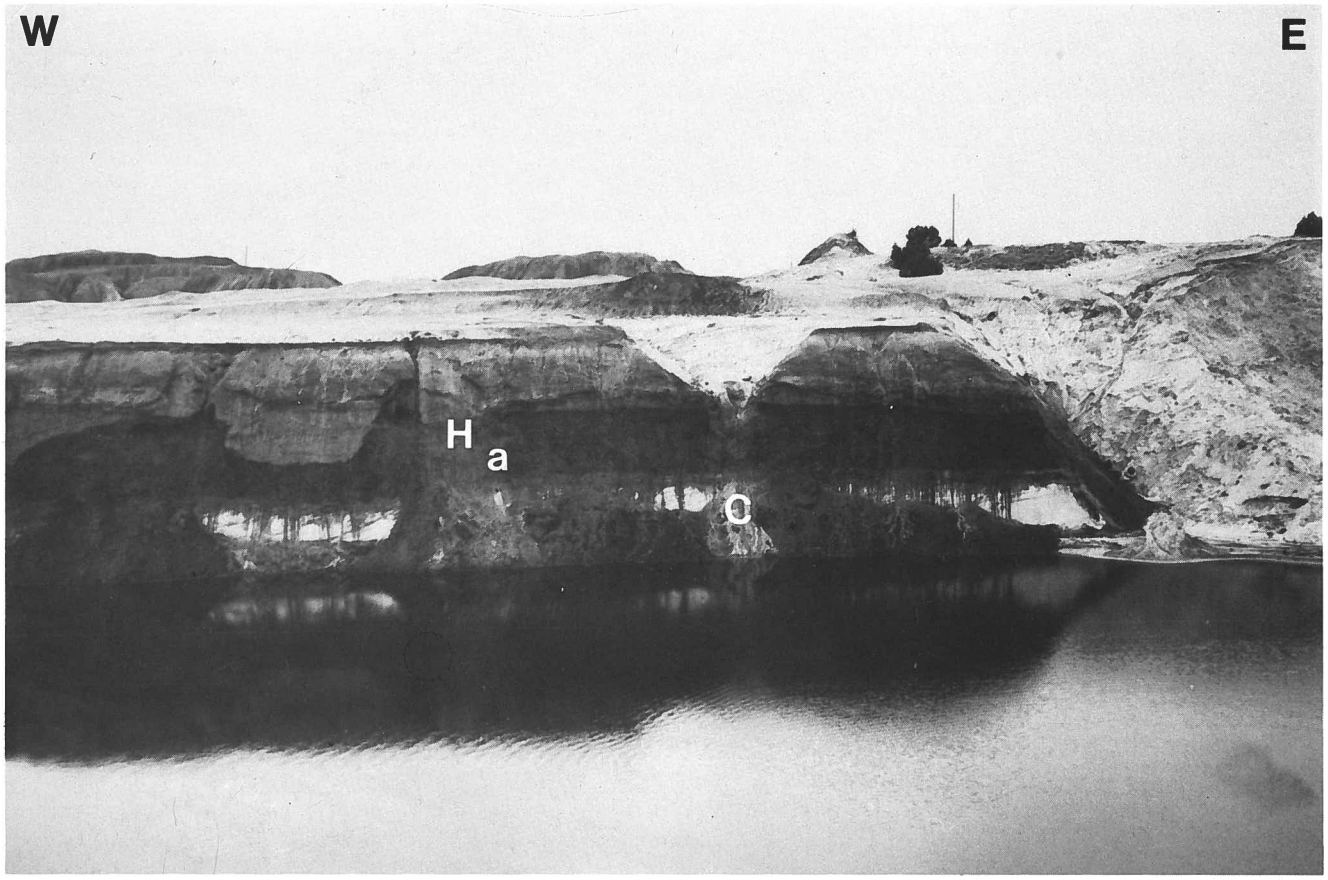
Atlas-Fig. 76. Detail of Atlas-Figs. 74 and 75 demonstrating the triple relationship between two subunits of the Odderup Formation, (1) the lacustrine sequence (equivalent to the "Upper Sands") (L), and (2) the younger channel deposits (Ch), and (3) the Hodde Formation (H). In the latter, the basal gravel can be distinguished (G). The displaced sequence to the right of the lacustrine deposits (L) seems block-kipped and slightly displaced downwards to the right by sliding. This resulted in deformation of the brown Søby-Flora clay (S) (uppermost lacustrine bed) by small scale concave faulting (slumping). This deformed and internally faulted lower block of brown clay (S?) is overlain by another block (a) of alternating sand and brown clay representing another part of the lacustrine sequence, possibly a higher level of the sequence now removed by erosion. Remains of other blocks can be distinguished (b,c,). To the right (outside the picture) in the centre of the channel structure (Atlas-Fig. 75 d), blocks of lacustrine sediments grade into each other and show structures revealing plastic deformation. In the eastern part of the channel structure the clay blocks grade into the secondarily coloured bedding of the channel sand (Atlas-Fig. 75, 78, 79). Faulting (straight arrow) and/or slumping (curved arrow) occur together with primary (?) depositional bedding. Location: North front of the Damgaard N. pit just to the E of point 7 (ref. Text-Fig. 45). E.K. Photo 1972.



Atlas-Fig. 77. Detail of the channel structure to the right of Atlas-Fig. 76. (Ch) is the cross-bedded channel sand of the Odderup Formation, overlain by the basal transgressional sequence (B) of the Hodde Formation. (H) indicates Hodde Clay; (L) the lacustrine equivalent to the "Upper Sands" (see Atlas-Figs. 75, 76). The strongly faulted and secondarily coloured (humous brown) channel sand (Ch) shows westerly dipping cross-bedding (see Atlas-Figs. 78, 79). Location: The Damgaard N. pit, North front to the east of point 7 (see Text-Fig.45). E.K. Photo 1972.

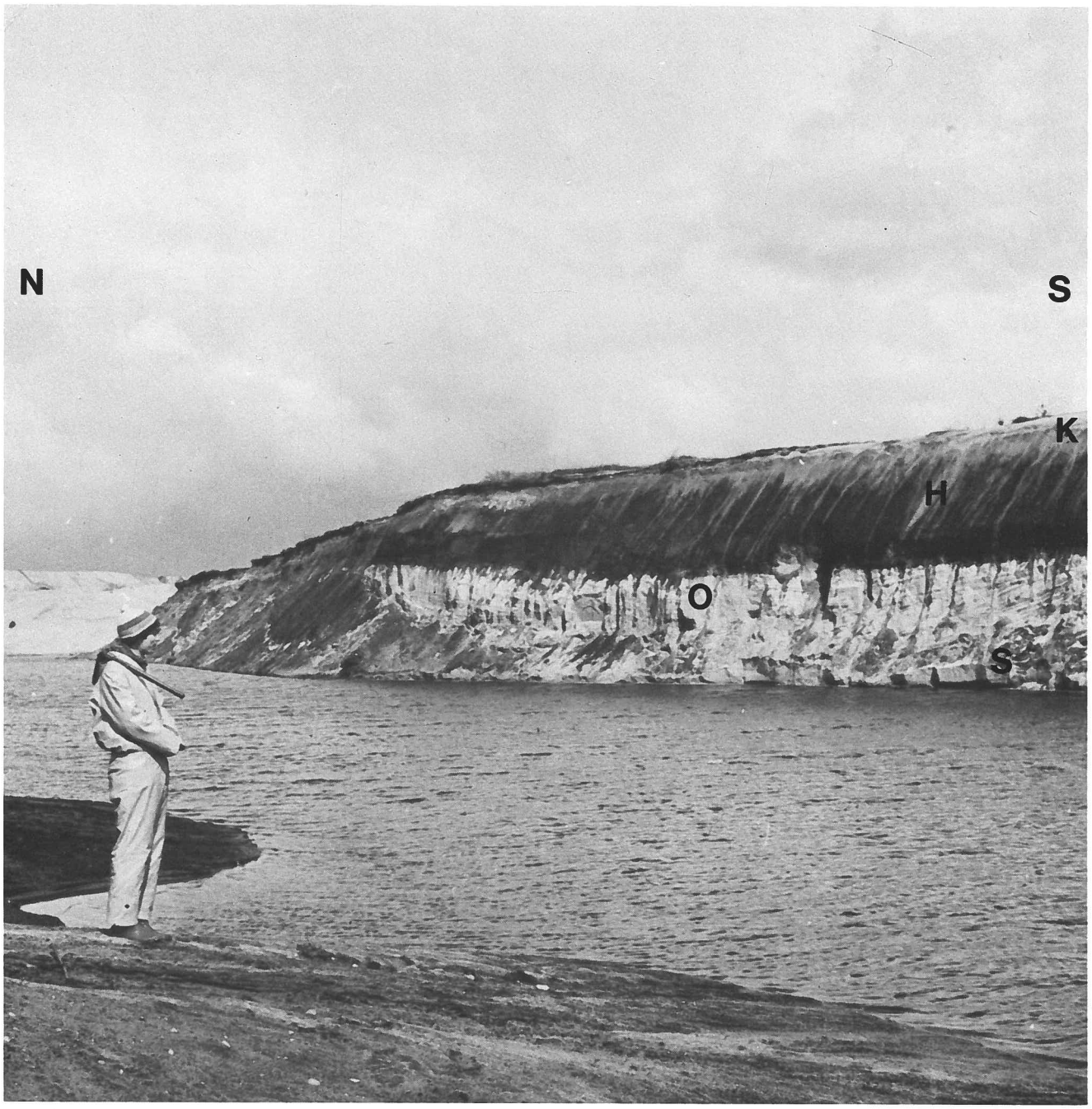


Atlas-Fig. 78. The lower half part of the exposure of the North front of the submerged Damgaard Nord pit (between points 5 and 6 of Text-Fig. 45 and western outcrop of Atlas-Fig. 79). The cross-bedded channel sand (Ch) of the Odderup Formation is separated from the basal, transgressional bed of the Hodde Formation by an unconformity. The basal gravel (a) is overlain by alternating sand and black clay (b). Uppermost is the Hodde Clay (H). The exposure of Atlas-Fig. 75 is to the left. E.K. Photo 1972.

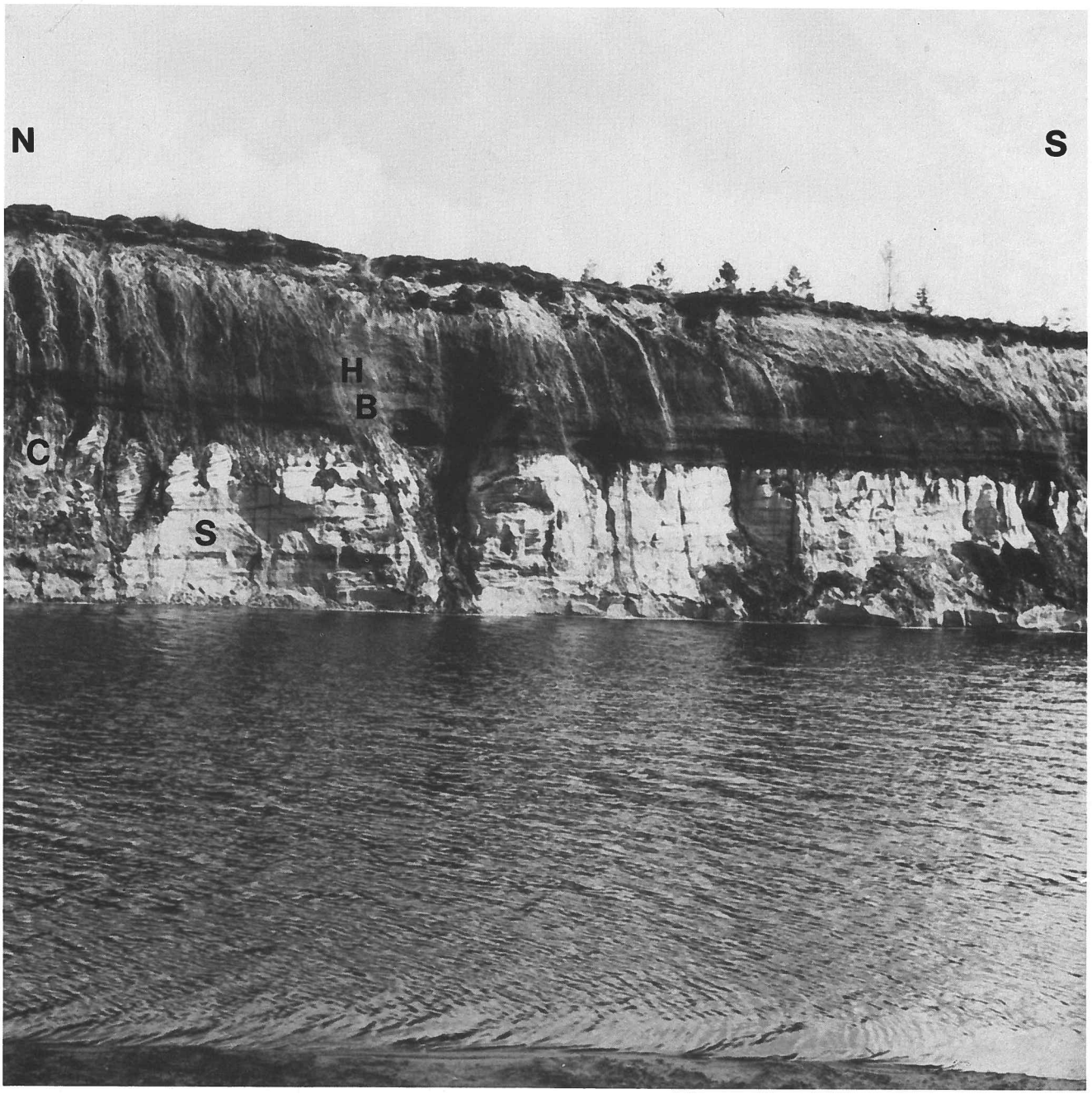


Atlas-Fig. 79. The eastern half of the North-front in Damgaard N browncoal pit. The westerly dipping channel sand of the Odderup formation (C) is overlain by the basal composite bed of the Hodde Formation (a), and the Hodde Clay (H). The Tertiary sequence to the right (east) is abruptly terminated by the Quaternary erosional escarpment of the pre-Weichselian Lavsbjerg Hill towards the glaciofluviatile sand and gravel sequence (slightly modified by mining). In the background the tip of a neighbouring mine. W: west; E: east. E.K. Photo 1972.

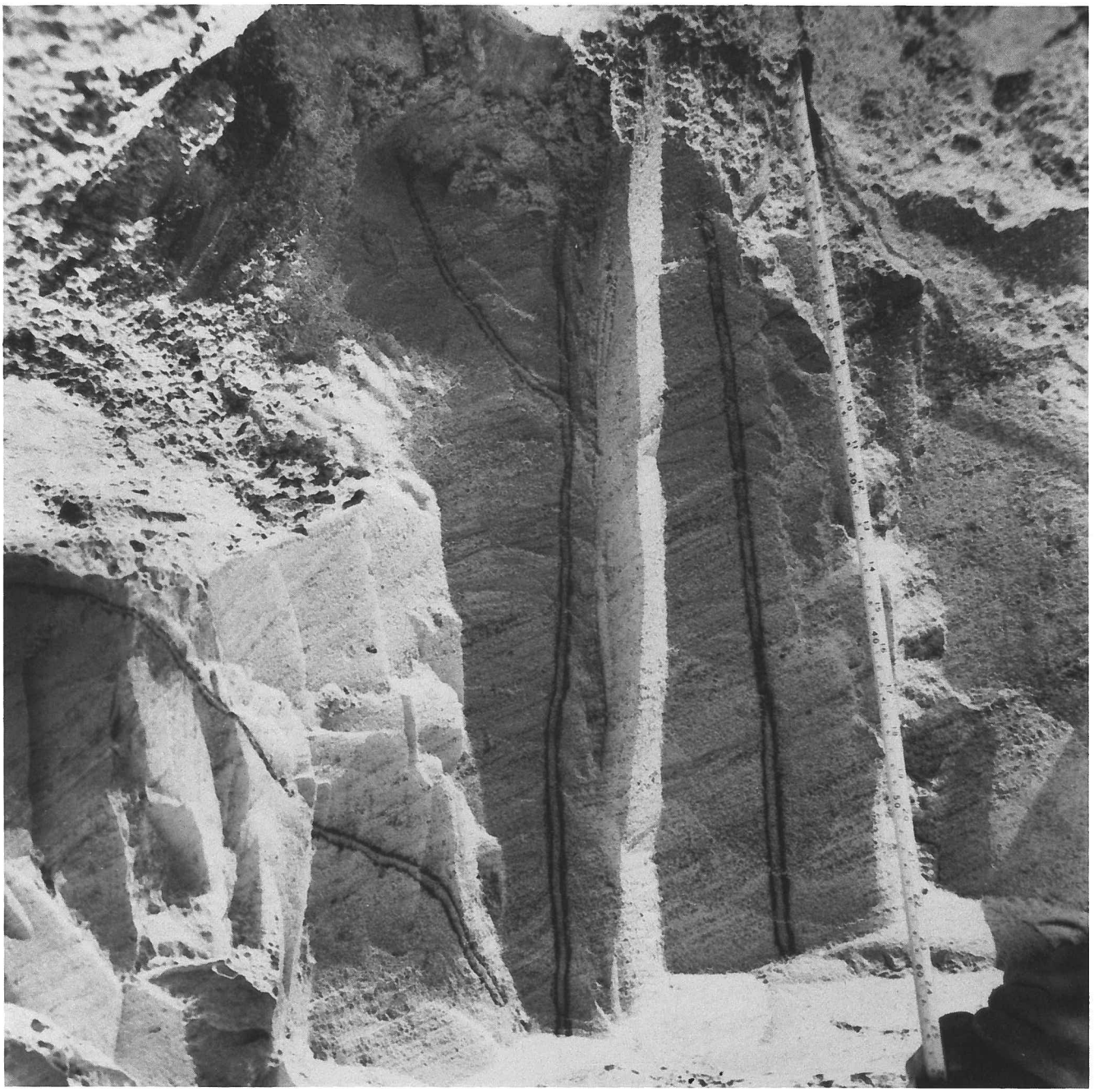
Atlas-Fig. 80. Detail of the basal part of the Hodde Formation composed of alternating gravel (G), sand (S) and clay (C): The lowermost irregularly shaped beds of clay (C) are separated and overlain by sand and gravel. In the middle of the picture is a silt to clay bed totally transformed by meniscus backfilled spatangidean burrows (M) that are filled with sand (white, or grey to black due to coaly particles). In the upper sand bed is a circular cross-section of an Ophiomorpha (Crustacean tunnel) (op). On top a black clay burrowed by Spatangids (Sp) can be seen. The picture covers a 50 cm long x 60 cm wide sector of the outcrop. Location: North front of the Damgaard N pit. E.K. Photo 1972.



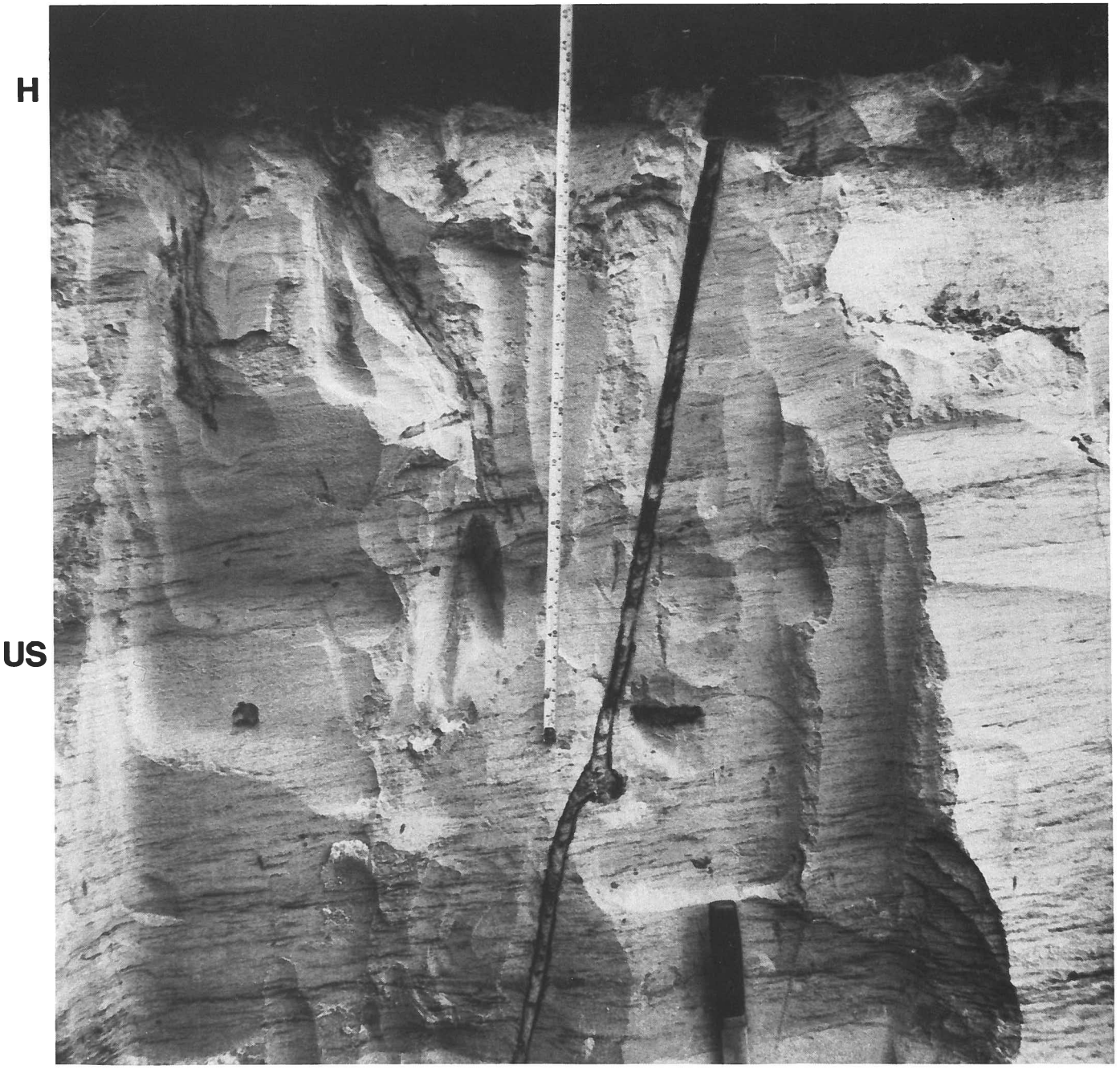
Atlas-Fig. 81. The northern end of the east-front in the Damgaard S partially submerged browncoal pit seen from the tip towards east. The outcrop demonstrates a sand sequence ("Upper Sands") of the Odderup Formation (O) overlain by black clay of the Hodde Formation (H) with a thin sheet of Quaternary gravel and aeolic sand on top (K). The section of the "Upper Sands" shows white sand suggestive of a closed "basin" structure unconformably cutting the shallow NE-dipping bedding of the underlying part of the "Upper Sands" (S). The dip of the beds along the lateral part of the closed structure is steeper than that of the surrounding regional distributed "Upper Sands", and truncated by the Hodde Formation, inferring that the upper part of the sequence has been removed by erosion before or during the following transgression. The closed structure is regarded a "Channel Sand" in cross-section. See Atlas-Fig. 82 for continuation of the structure to the right. Ref. Atlas-Figs. 78-79 for a possible continuation of this structure seen in a longitudinal section in the north front of the Damgaard N pit. E.K. Photo 1972.



Atlas-Fig. 82. The central part of the east front of the Damgaard S submerged browncoal pit showing the "Upper Sands" (Odderup Formation) (S) overlain by the Hodde Formation consisting of the distinctly bedded basal Hodde Clay (B) and the homogeneous Hodde Clay (H). The "Upper Sands" have an apparent shallow dip towards the N (true shallow dip NE). To the extreme left of the picture (north), the "Upper Sands" is cut by the steeper dipping beds of the "channel sand" structure (c) mentioned in Atlas-Fig. 81. Atlas-Fig. 81 continues the present picture to the left. Symbols: N = north; S = south. E.K. Photo 1970.



Atlas-Fig. 83. An 80 cm square area of the "Upper Sands" about 50 cm below the basal gravel of the Hodde Formation. In the cross-bedded sand to gravel vertical to steeply dipping fossil tunnels (Ophiomorpha), lined with a black organic matter penetrate from the former surface of a tidal flat, now the boundary between the Hodde and Odderup Formations. These trace fossils were produced by Crustaceans in the genus Callianassa (Asgaard & Bromley 1974). Location: East-front of the Damgaard S mine. E.K. Photo 1972.



Atlas-Fig. 84. The boundary between the Hodde Formation (H) and the "Upper Sands" (US) with trace fossils, reproduced from a meter square. Vertical tunnels (Ophiomorpha) are seen to penetrate deeply (2.5 m observed) into the sands from the boundary (representing a former tidal flat). The tunnels are lined with coaly matter and at the points of branching the tunnels expand into a globular chamber. The entrances of the tunnels at the former surface are funnel shaped due to continuous collapses in consequence of the restless flow in the active tidal zone. The measuring rod is divided in 5-cm. intervals indicated by numbers. Location: East-front of the Damgaard S mining area. E.K. Photo 1972.

Atlas-Fig. 85. View from the west over the browncoal pit of Hoffmann & Sønner, Kølkær. The mining of two browncoal seams (B) has exposed three fronts with intervening terraces. A third seam is exposed in the drainage ditch in the foreground (b). The productive sequence is overlain by a few meters of white, fluviatile sands ("Upper Sands") (U) in thick cross-bedded units. Quaternary glacio-fluviatile sands (Q) approximately 10 meters thick are exposed in the North front. For numbers see Atlas-Fig. 87. E.K. Photo 1968.

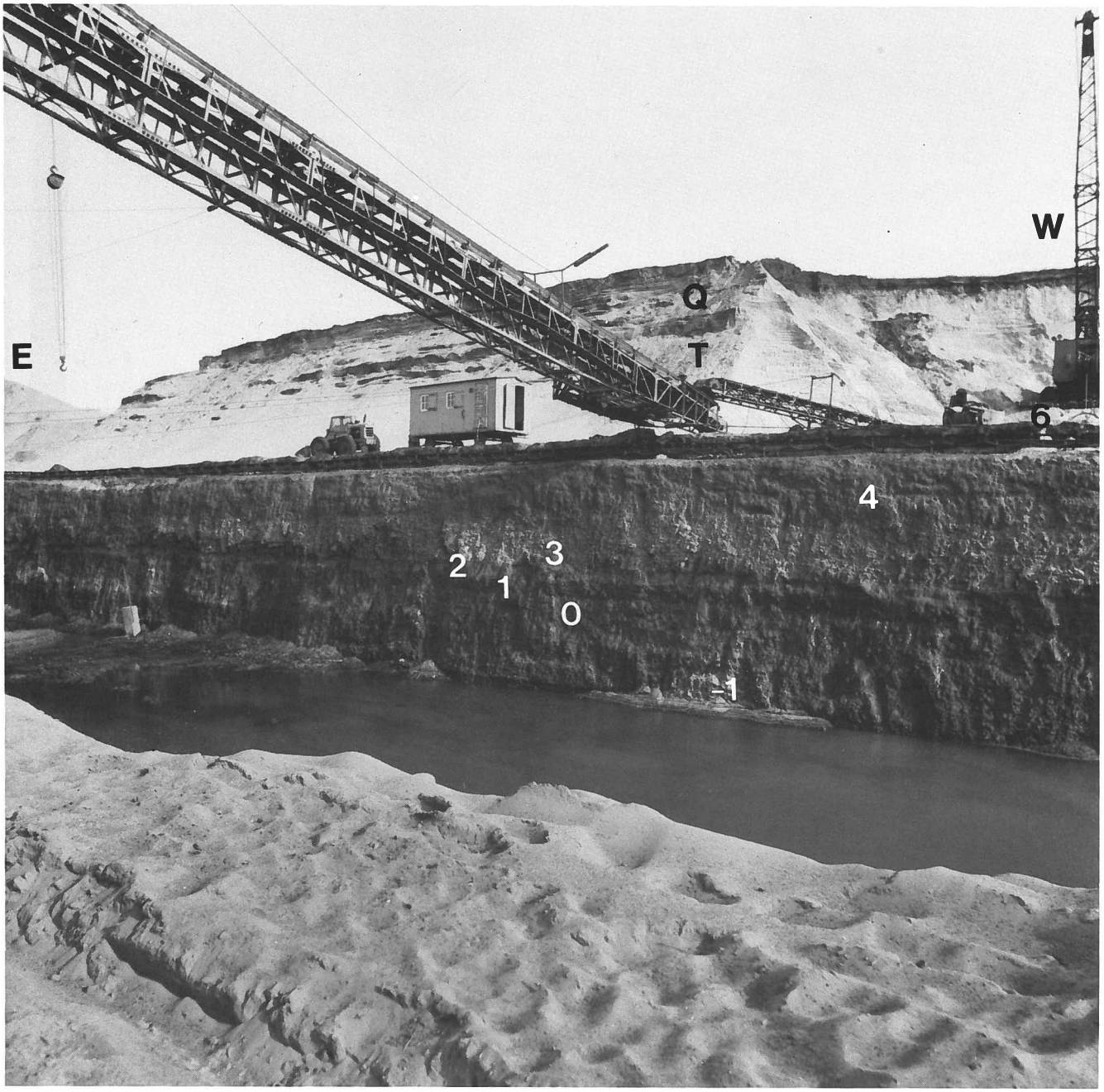
Atlas-Fig. 86. View from the southwest over the browncoal pit of Hoffmann & Sønner at Kølkær. Two browncoal seams (B) with an intervening clay layer are exposed and overlain by a few metres of the "Upper Sands" (S). The "Upper Sands" are overlain by about 10 metres of glacio-fluviatile sands (Q). E.K. Photo 1969. For numbers ref. Atlas-Fig. 87.

Atlas-Fig. 87. Exposures in the central part of the Hoffmann & Sønner browncoal pit at Kølkær (the North front). The succession is as follows:

8:	*Quaternary glacio-fluviatile sands (exposed in the north front).*	*(about 9 m).*
7:	*Tertiary cross-bedded sand ("Upper Sands")*	*(4-5 m).*
	_____ terrace with conveyor belt _____	
6:	*Black, xylitic browncoal*	*(1 m).*
5:	*Brown clay grading into sand*	*(1 m).*
4:	*Compact and homogeneous browncoal*	*(2 m).*
3:	*Micaceous clay with plant fossils*	*(2.5 m).*
2:	*Browncoal (only the upper surface was exposed at the base of the outcrop).*	

Symbols: W. west, E. east.
E.K. Photo 1968.

Atlas-Fig. 88. View from the east over the Hoffmann & Sønner browncoal pit at Søbylund. E.K. Photo 1968.



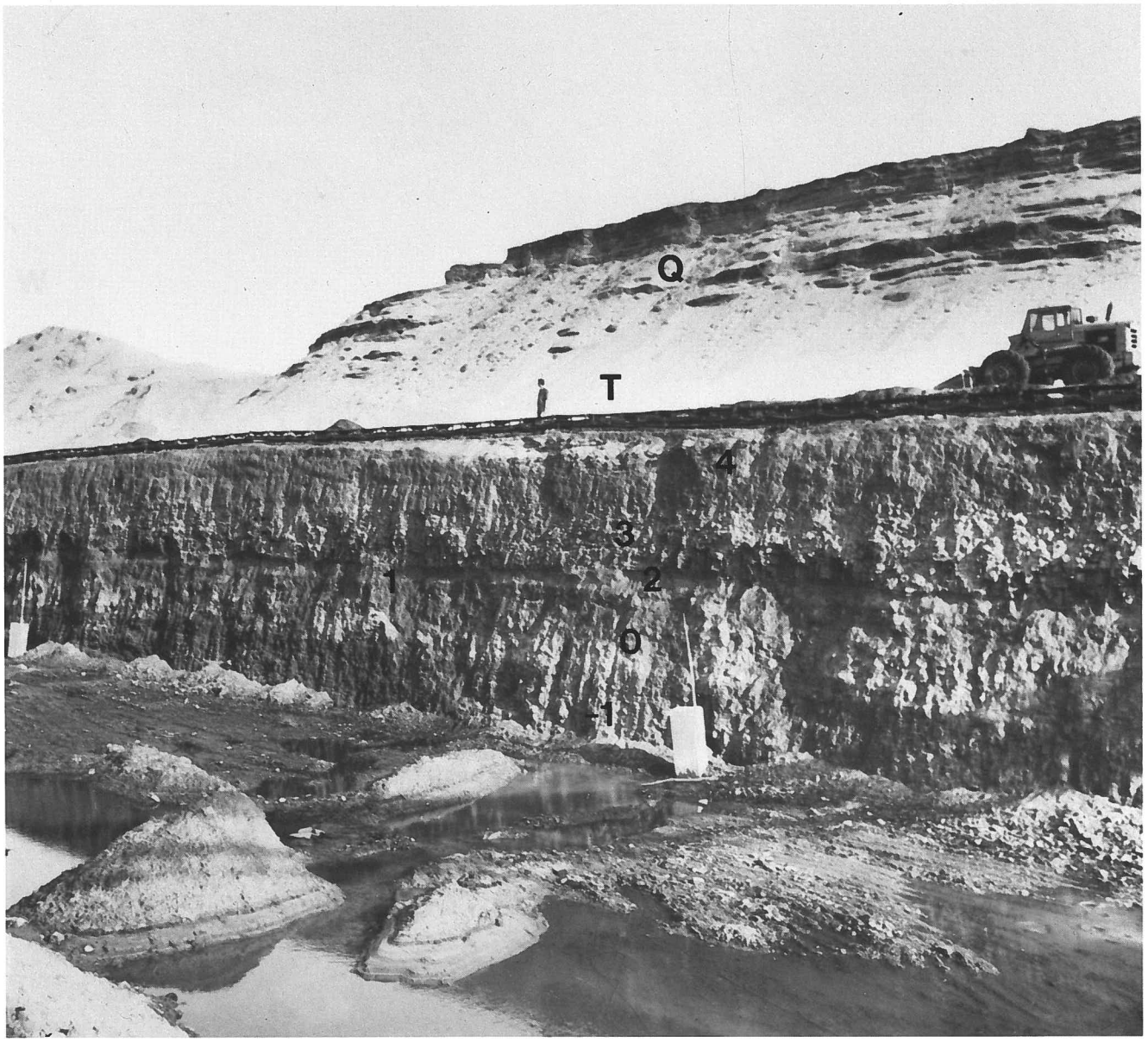
Atlas-Fig. 89. Exposure of the browncoal bearing sequence in the central part of the mining front of the Hoffmann & Sønner browncoal pit at Søbylund. The following units are exposed:
In the south front in the background:

Q: Quaternary glacio-fluviatile sands.
T: Tertiary sands
In the mining front in the foreground:

6:	*Compact, fractured browncoal.*	*(1 m).*
5:	*Laminated brown, coarse, sand (not exposed on this figure).*	*(1 m).*
4:	*Clay grading downwards into the underlying browncoal (3)*	*(1 m).*
3:	*Black to dark brown friable browncoal with conchoidal fracture. Shattered.*	*(2 m).*
2:	*White sand*	*(0.5 m).*
1:	*Dark grey to black clay*	*(0.5 m).*
0:	*Micaceous clay*	*(1.5 m).*
-1:	*Brown, homogeneous, compact browncoal*	*(2 m).*

_____ underlying clay _____

E: east; W: west.
A similar exposure can be seen in Atlas-Fig. 118, chapter 4C. E.K. Photo 1968.

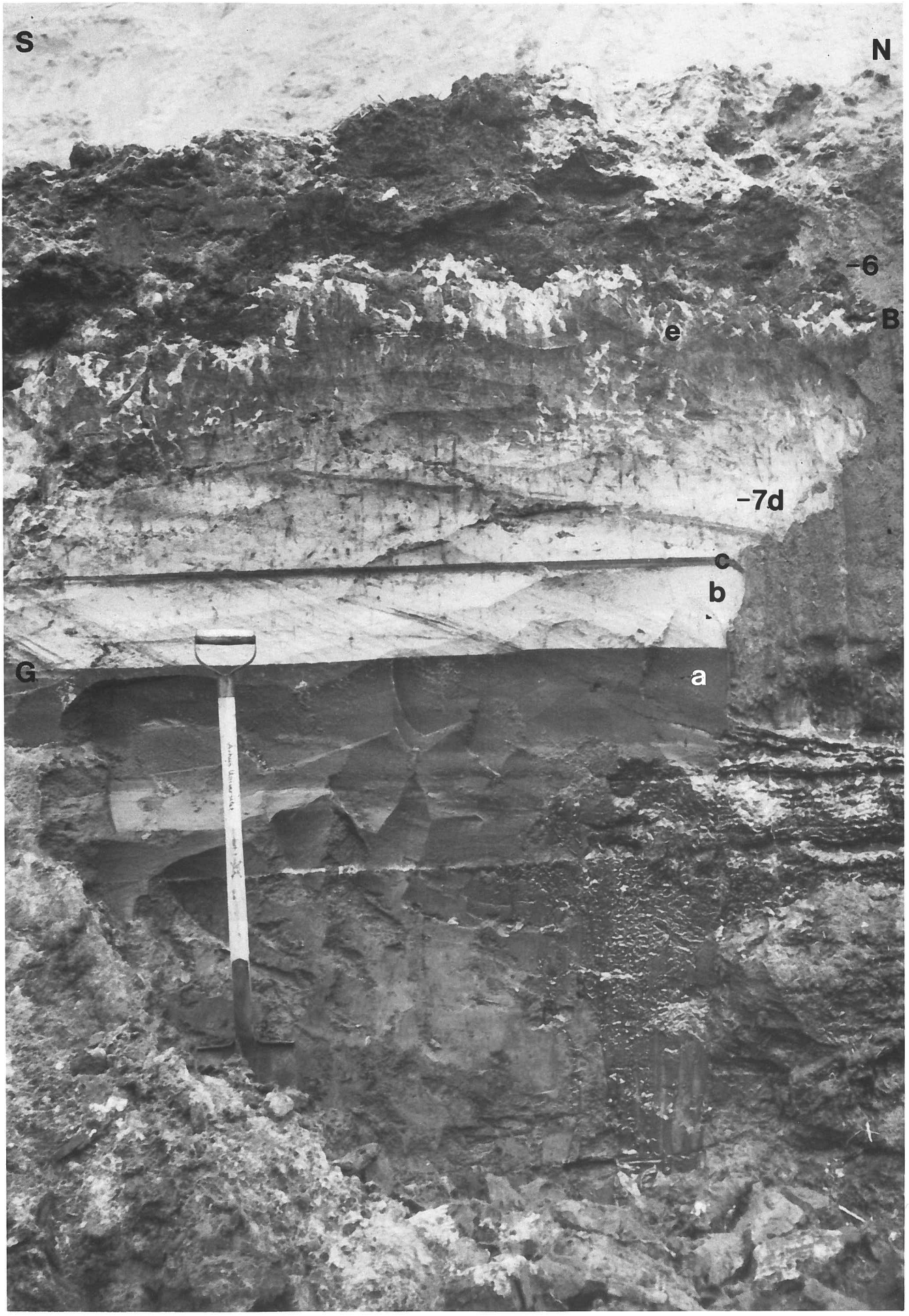


Atlas-Fig. 90. Outcrop of the browncoal bearing sequence from the eastern end of the mining front (central part of the trench in the Hoffmann & Sønner pit at Søbylund.

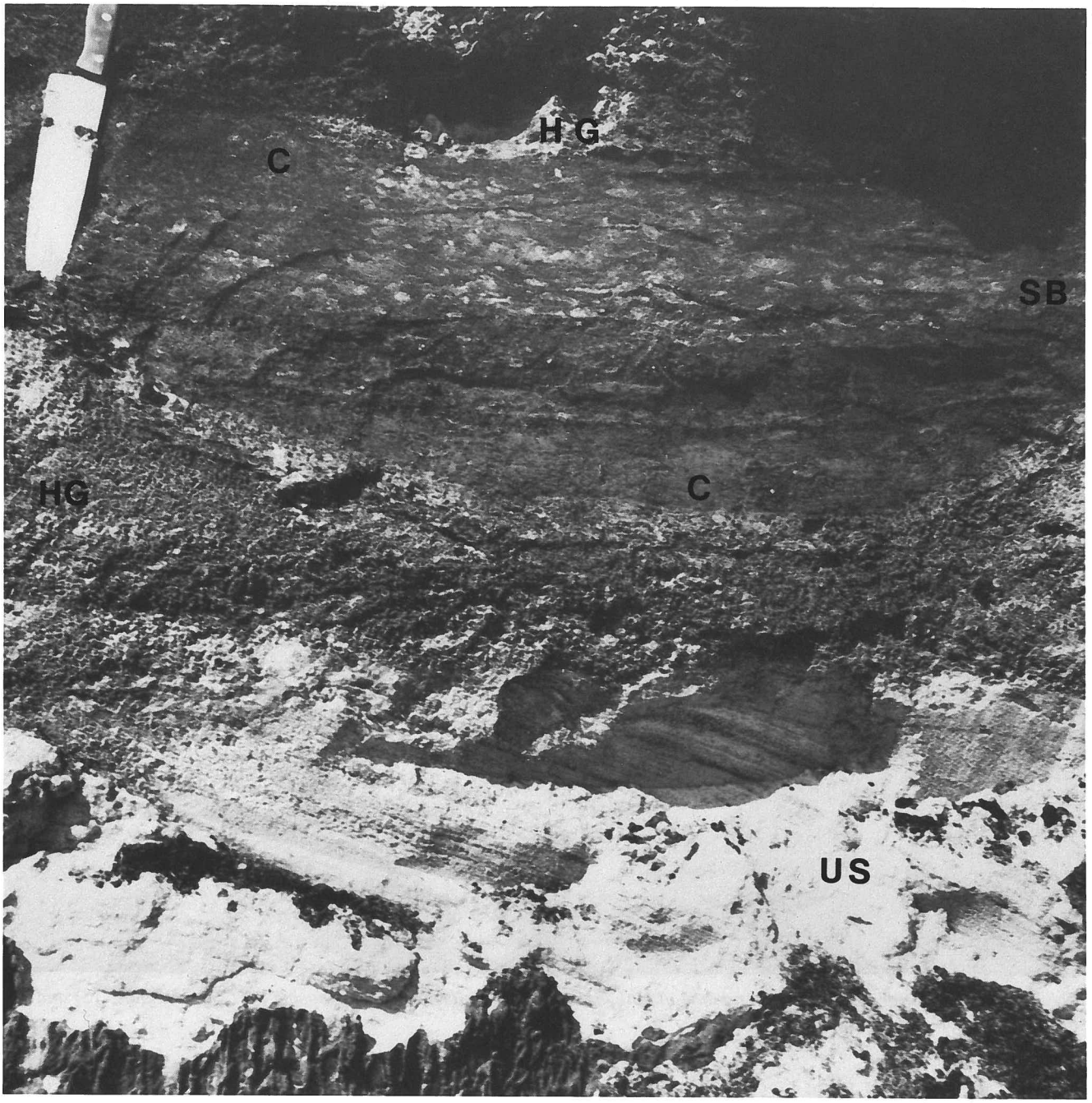
Q: Quaternary outwash sands.
T: Tertiary fluviatile sands ("Upper Sands").
4: Clay grading downwards into brown coal (3).
3: Black to dark brown friable browncoal with concoidal fracture.
2: White sand.
1: Dark grey to black clay.
0: Micaceous clay.
-1: Brown, homogeneous compact browncoal.
The floor of the trench exposes clay. E.K. Photo 1968.

Atlas-Fig. 91. The mining front at the western end of the Hoffmann & Sønner browncoal pit at Søbylund. (-1): browncoal; (0): micaceous clay; (1): dark grey clay; (2): sand; (3): brittle, black browncoal; (4): clay grading upwards into the browncoal bed no. 3; (5): brown, coarse sand; (6): browncoal. Symbols: E: east; W: west. E.K. Photo 1968.

Atlas-Fig. 92. The sequence just below the Fasterholt Member exposed in an east facing outcrop. Included in the picture is the uppermost part of the "B-Member" and the boundary (B) towards the Fasterholt Member (bed no. -6). Beds (-7e) - (-7a), consisting of cross-bedded sand (-7d,b) including a lamina of sand with organic detritus (c). The brown cross-bedded sand (a) lowermost in the outcrop is secondarily coloured by humous compounds. The flat upper boundary of this brown coloured bed, presumably represents a "fossil" groundwater level (G) (Larsen & Kuyp, 1971). The letters are according to Text-Fig. 41. Location: Section F10, the Carl Nielsen Ltd. browncoal pit at Fasterholt. E.F.C. Photo 1970.

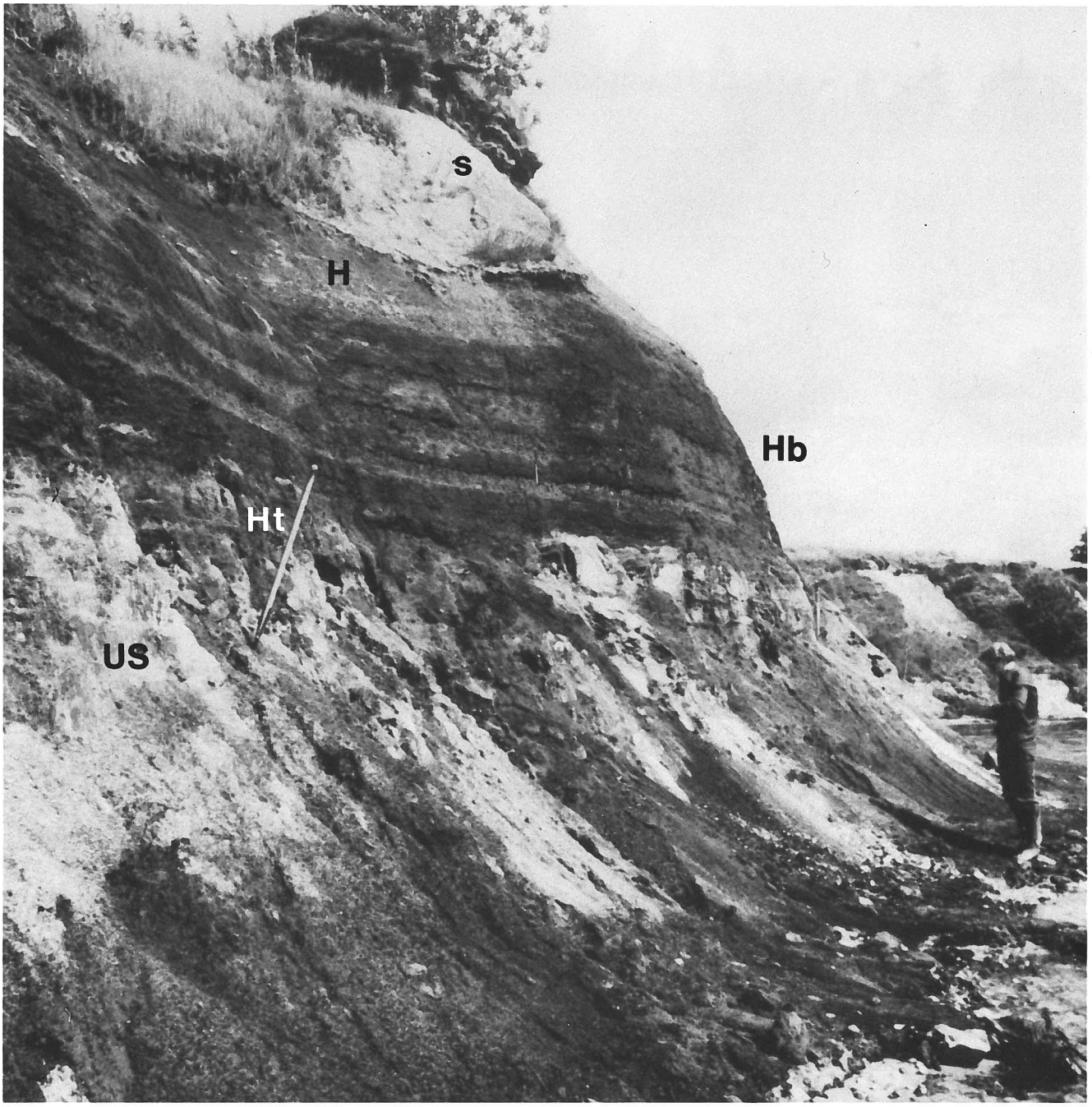

S
N
-6
B
e
-7d
c
b
G
a

Atlas-Fig. 93. Detail of Atlas-Fig. 92, showing the "fossil" ground-water level within the cross-bedded coarse to medium-grained sand. E.F.C. Photo 1970.



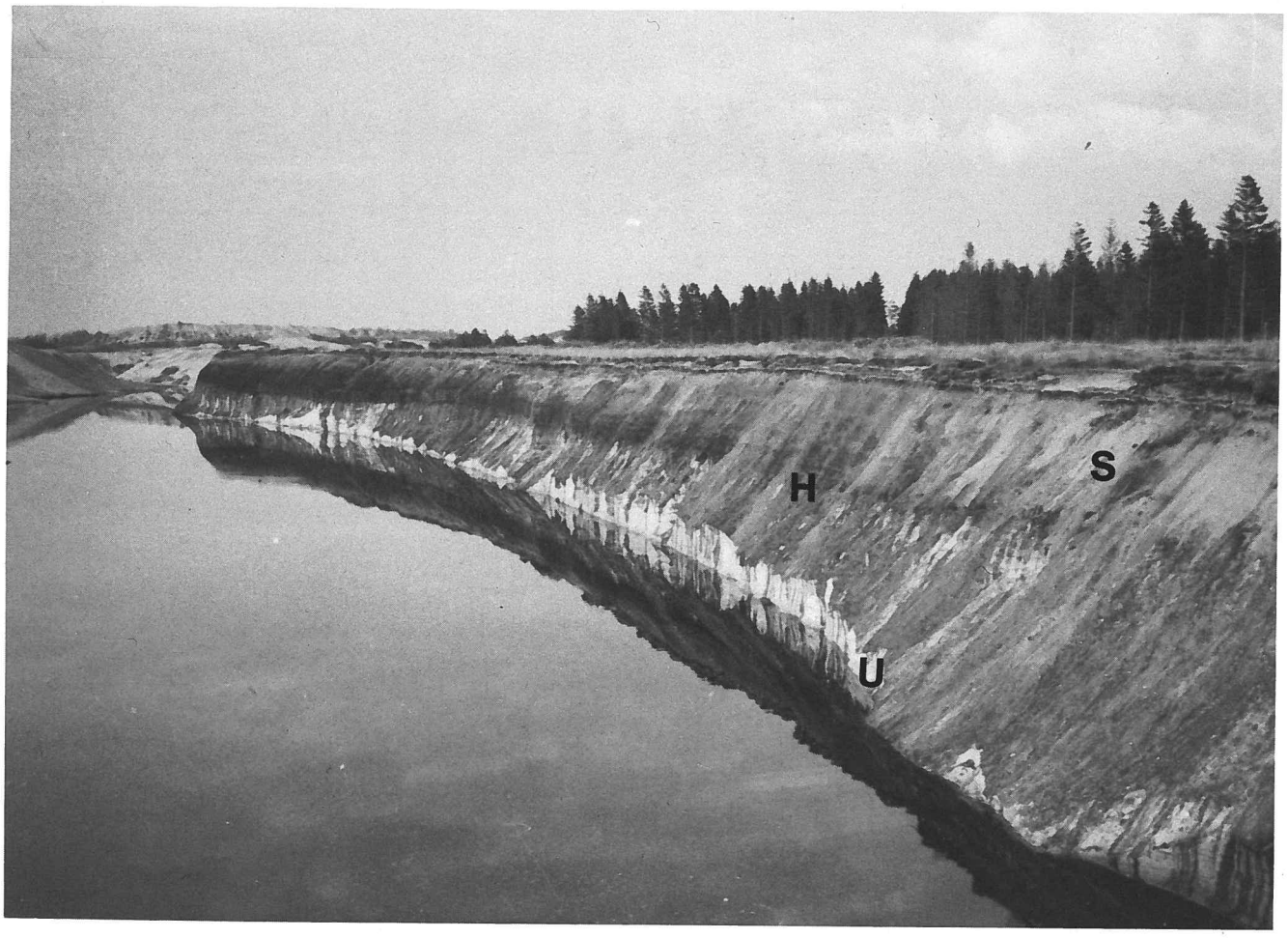
Atlas-Fig. 94. The boundary between the Hodde and Odderup Formations. The cross-bedded sand ("Upper Sands") (US) overlain by a transgressional gravel (Hodde Formation) (HG) with an undulating surface. In the small "basin" follows black clay (C) that is intensely burrowed (SB) by Spatangids. Sand to silt fill the lenticular burrows. Above follows a sand and gravel bed (HG) again overlain by the Hodde Clay (outside the picture). North front of the Søren Pedersen pit, Klynholt. E.K. Photo 1982.

Atlas-Fig. 95. The north front in the abandoned mining area of Klynholt (central part) exposing the "Upper Sands" (S) and the Hodde Formation (H). E.K. Photo 1970.



Atlas-Fig. 96. Outcrop showing the "Upper Sands" (US) overlain by the Hodde Formation (transition marked by a triangle). At the bottom of the Hodde Formation is a transgressional zone of gravel, sand and clay (deposited in laminae or lenses) (Ht) overlain by a sequence of 7 beds (Hb). Three of these beds are silty humic clay alternating with three to four beds of fine black clay. The uppermost is often deviating in composition. The two uppermost beds are thicker than the rest. Above this follows a thick homogeneous fine black clay (H). On top is a Quaternary solifluction sheet (S). Location: North-front of the Klynholt mining area, the east end. E.K. Photo 1982.

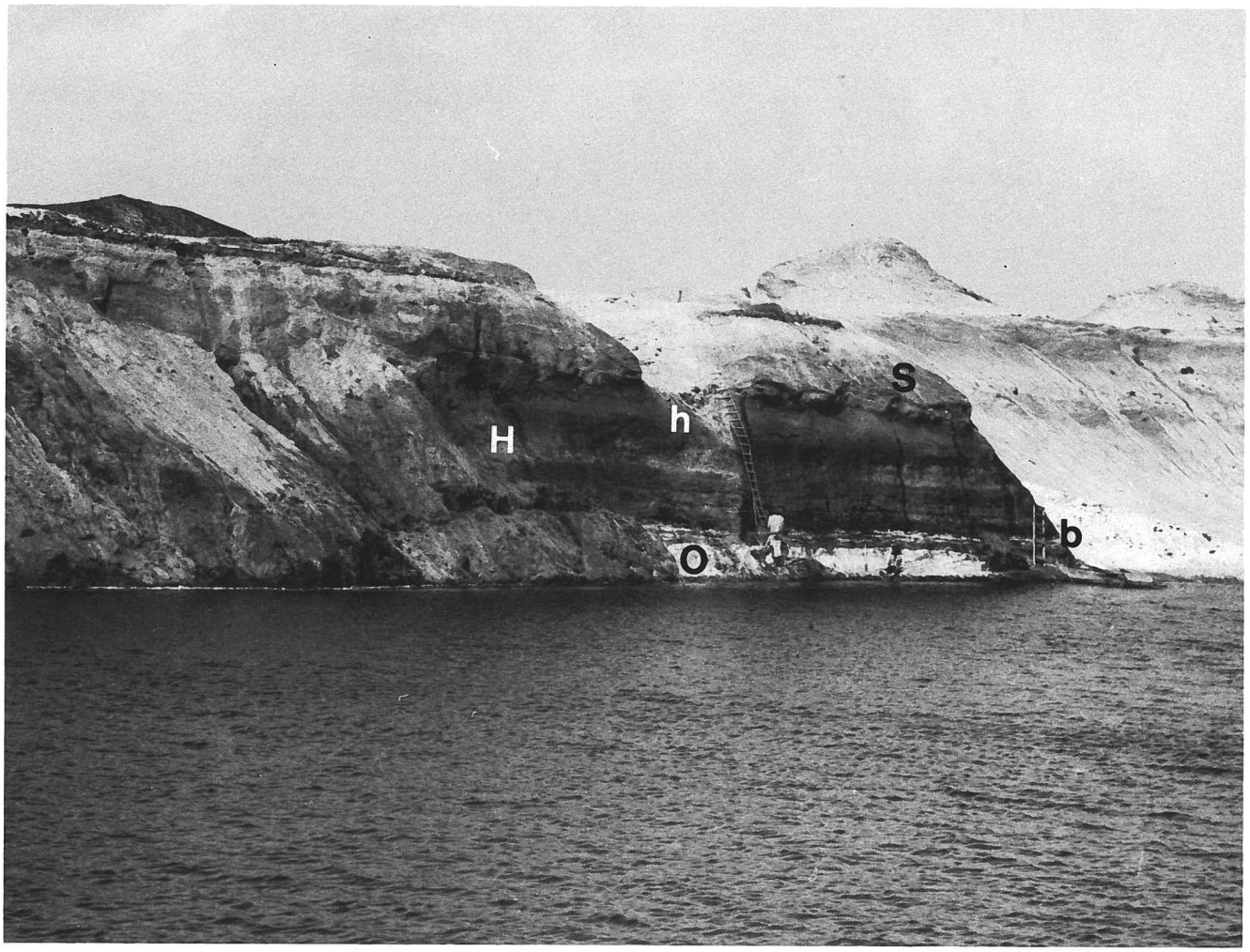
Atlas-Fig. 97. The north front in the abandoned mining area of Klynholt (western part) displaying the "Upper Sands" (S) as a single thick cross-bedded sand unit overlain by the distinctly bedded lower Hodde Clay (H). The person above the front holds a measuring rod of 3 meters. S.B.A. Photo 1975.



Atlas-Fig. 98. The east front in the abandoned Damgaard S pit (as seen from the south) presenting the "Upper Sands" (U) (Odderup Formation) overlain by the Hodde Formation (H). On top of the front is a solifluction sheet (Quaternary) (S). The boundary between the two formations apparently dips to the north reaching the lowest position of a shallow syncline in the distance at the end of the visible part of the front (ref. Atlas-Fig. 81). E.F.C. Photo 1970.

Atlas-Fig. 99. The east front in the abandoned Damgaard S pit (as seen from the west) exposing the "Upper Sands" (U) and the Hodde Formation (H). The distinctly bedded northwards dipping basal unit of (H) is well exposed to the left of the picture. On top (to the left) the solifluction sheet (S) is found as a wedge on the east slope of Lavsbjerg Hill (see also Atlas-Fig. 98). The person on the left side of the picture holds a measuring rod 3 meters long. S.B.A. Photo 1975.

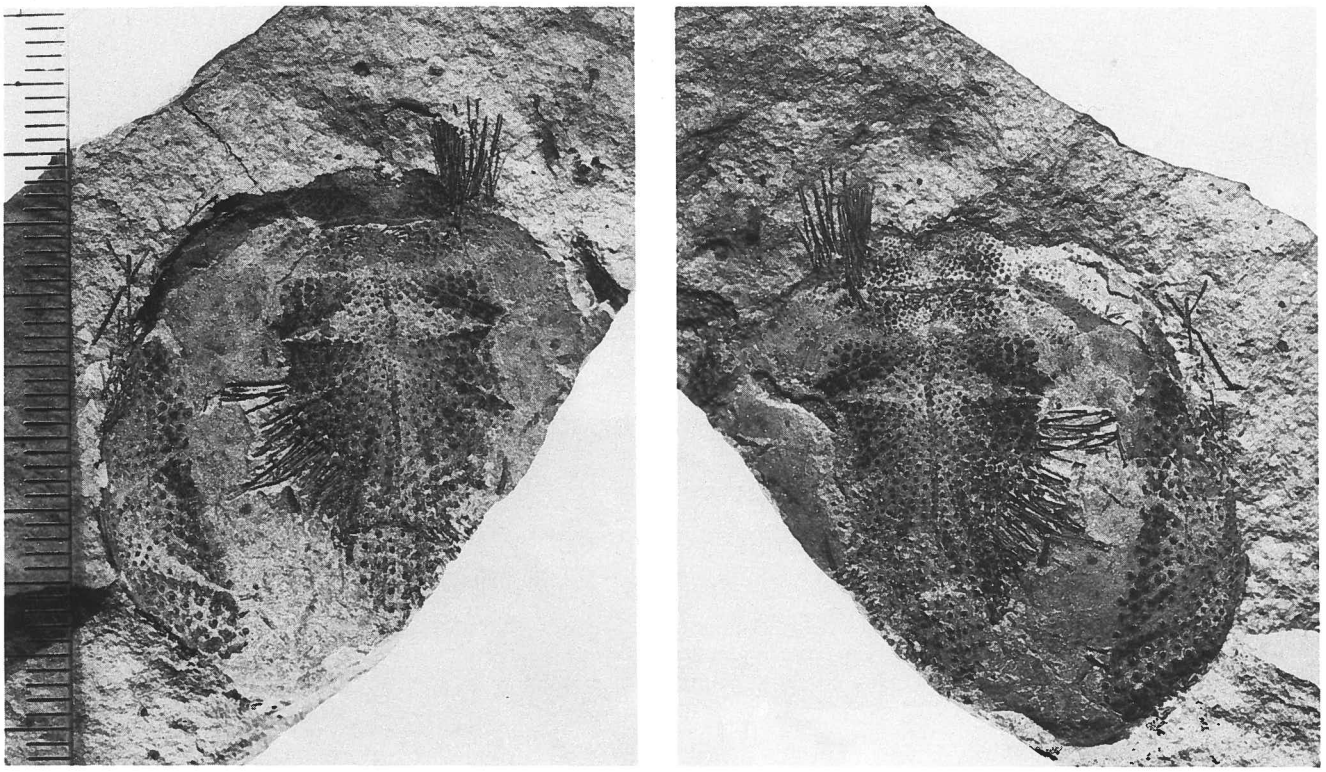
Atlas-Fig. 100. The south-western corner of the abandoned Damgaard mining area revealing the "Upper Sands" (U) overlain by the distinctly bedded basal Hodde Clay (H). E.K. Photo 1973.



Atlas-Fig. 101. The north front in the abandoned Damgaard Nord pit(central part). The outcrop shows the Odderup Formation ("channel sand" with westerly dipping cross-bedding) (O). This is overlain by the Hodde Formation (H) which is made up of the basal transitional sand-clay bed (b) and the overlying Hodde Clay (H). The latter is divided into a lower distinctly bedded clay and an upper homogeneous clay (h). The outcrop is abruptly cut off to the east (right) and approximately represents the Weichselian (Würmian) erosional front (escarpment) on the Lavsbjerg Hill towards the glacio-fluviatile plain, later filled up with the Quaternary glacio-fluviatile sand-gravel sequence which is now replaced by the former tip of the mine. S: Solifluction sheet. E.K. Photo 1972.

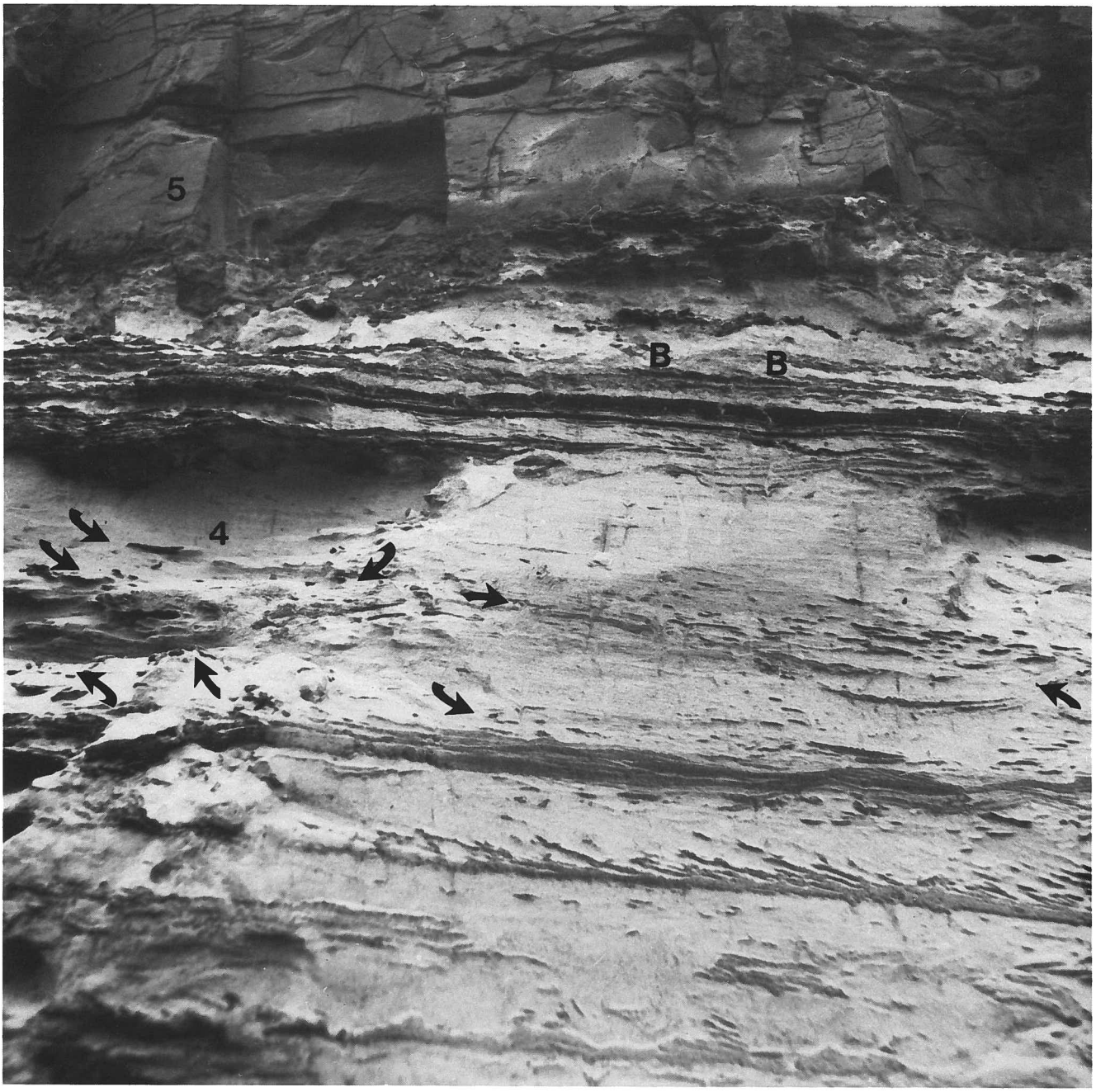
Atlas-Fig. 102. The dark green glauconitic clay of the Gram Formation with a weathered (bleached) cap, exposed in the western trench bordering the Søby-Fasterholt mining area, near the former coal stock of the Damgaard mine. E.K. Photo 1971.

Atlas-Fig. 103. The south front in the Klynholt mining area at Lavsbjerg point. The Gram Clay (GC) is exposed along the cleared front in the foreground. The two persons are located at the fossiliferous locality (Astarte reimersi-Goodallia esbjergensis zone) (to the left). In the background the eastern flank of an anticline is exposed. Starting below at the arrow the sequence consists of the "Upper Sands" of the Odderup Formation (white), Hodde Formation (H) (basal bedded clay, light grey; upper unit of black, homogeneous clay), Glauconitic Clay (dark grey) (G) and on top the Gram Clay (GC). E.K. Photo 1974.



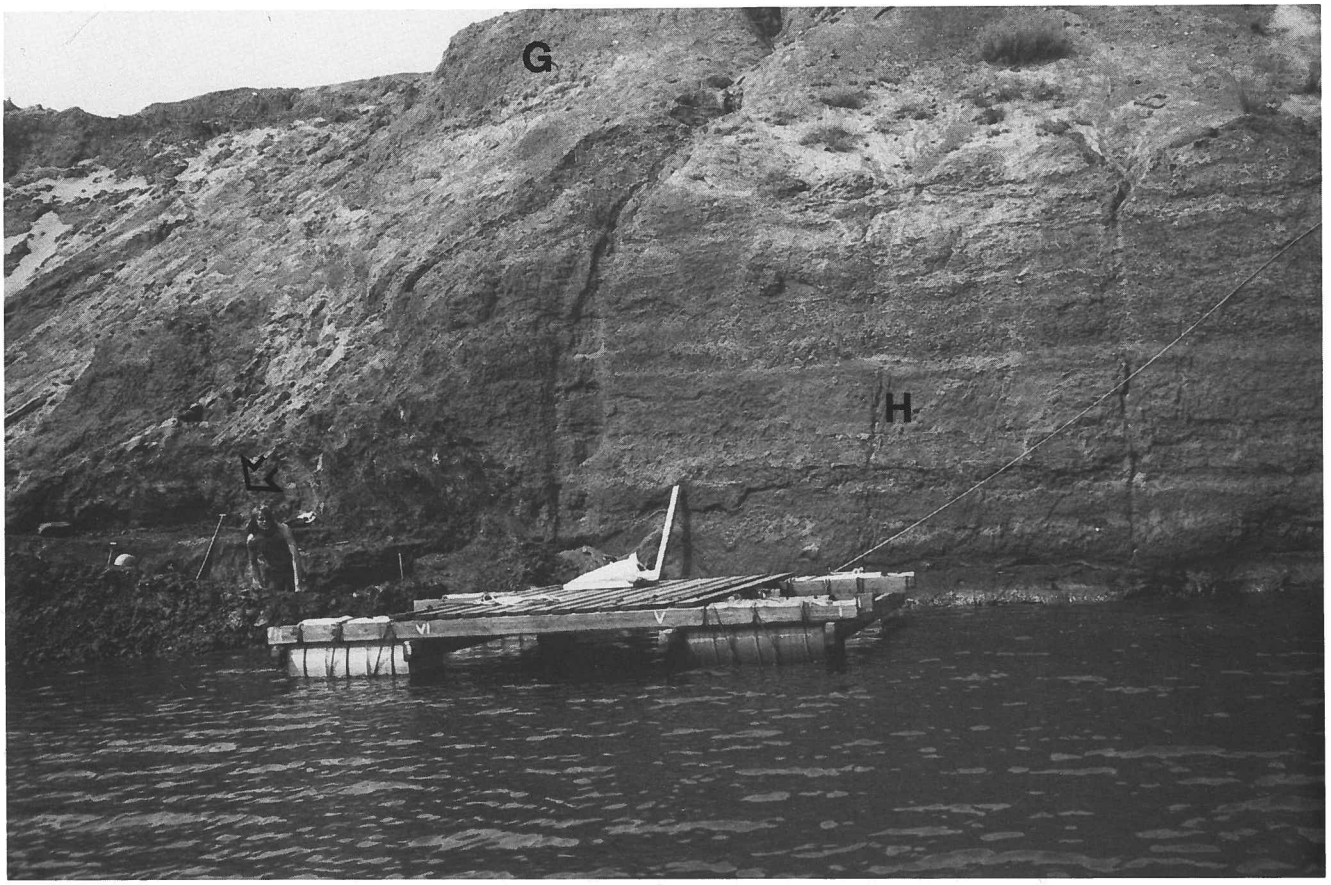
Atlas-Fig. 104. Positive (to the left) and negative (right) impressions of a Spatangoide sea urchin belonging to the Brissidae, Brisopsis? (det. S. Bo Andersen). Brisopsis is an extant genus living in muddy sea bottoms, burrowing, at depths of water between 5 - 100 metres. The specimen was found in the Lower Gram Clay of the Lavsbjerg outcrop (see Atlas-Fig. 103). Scale in mm. S.B.A. Photo

Atlas-Fig. 105. The fossiliferous locality of the Fasterholt-Flora where collecting of the fossil fruits, cones and seeds was done by wet sieving in the drainage ditch (star) in 1970. On the terrace which is left over from mining of the 3rd seam, the underclay (bed no. 5) could be removed near to the H-front giving acces to the fossiliferous sand (bed 3+4). The sand was placed ground-wet into the sieving boxes and immediately separated by sieving the sand in the drainage ditch (star). the transport to the laboratory was carried out in water in closed containers. In the clay pile (5), fossil leaqves etc. were collected from the underclay which had been removed from the terrace when uncovering the Fasterholt flora bed. Location: F-front, the Carl Nielsen Ltd. pit at Fasterholt. E. K. Photo 1970.

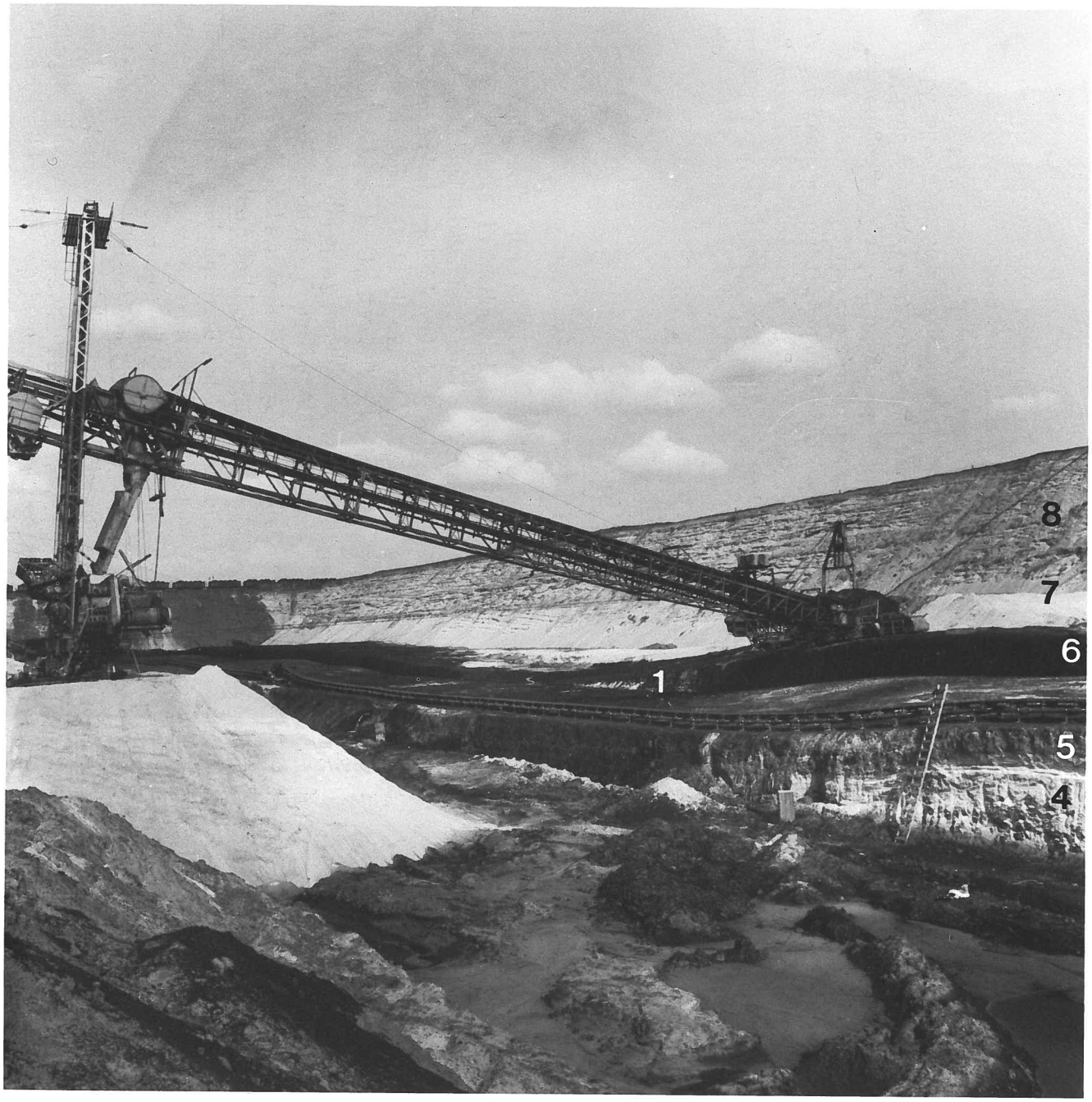


Atlas-Fig. 106. A closer look at the fossiliferous beds containing the Fasterholt diaspore Flora (fruits, seeds etc.) in the small sandy delta structure (bed no. 3+4), overlain by the silty clay bed no. 5 containing fossil leaves. The incoaled fossils (arrows) are concentrated over a 100 m distance in the mining fronts. The fossiliferous zone represents deposition within a certain energy level of the current water. Remains of twigs, branches and the bark (B) of larger specimens left as shells can be seen. Location: The E-front, the Carl Nielsen Ltd. browncoal pit at Fasterholt. W.F. Photo 1969.

Atlas-Fig. 107. Collecting of fossil leaves of the Fasterholt flora from piles of clay (asterisk) of bed no. 5 dumped after removal from the terrace during the mining procedure. In the center of the picture can be seen the western syncline. It is well-defined by the cleared (dark) surface of the 3rd browncoal seam (6) being the temporary surface on the upper terrace. Location: In the central part of the mining trench, the Carl Nielsen Ltd. pit at Fasterholt. View towards the west. E.K. Photo 1969.



Atlas-Fig. 108. The west end of the Damgaard Nord pit exposing the Søby Flora locality (marked by an arrow) during field work. To the right, separated from the fossiliferous locality by a small fault, are downfaulted overlying marine deposits: H: Hodde Clay. G: Glauconite clay of the Gram Formation. E.F.C. Photo 1974.



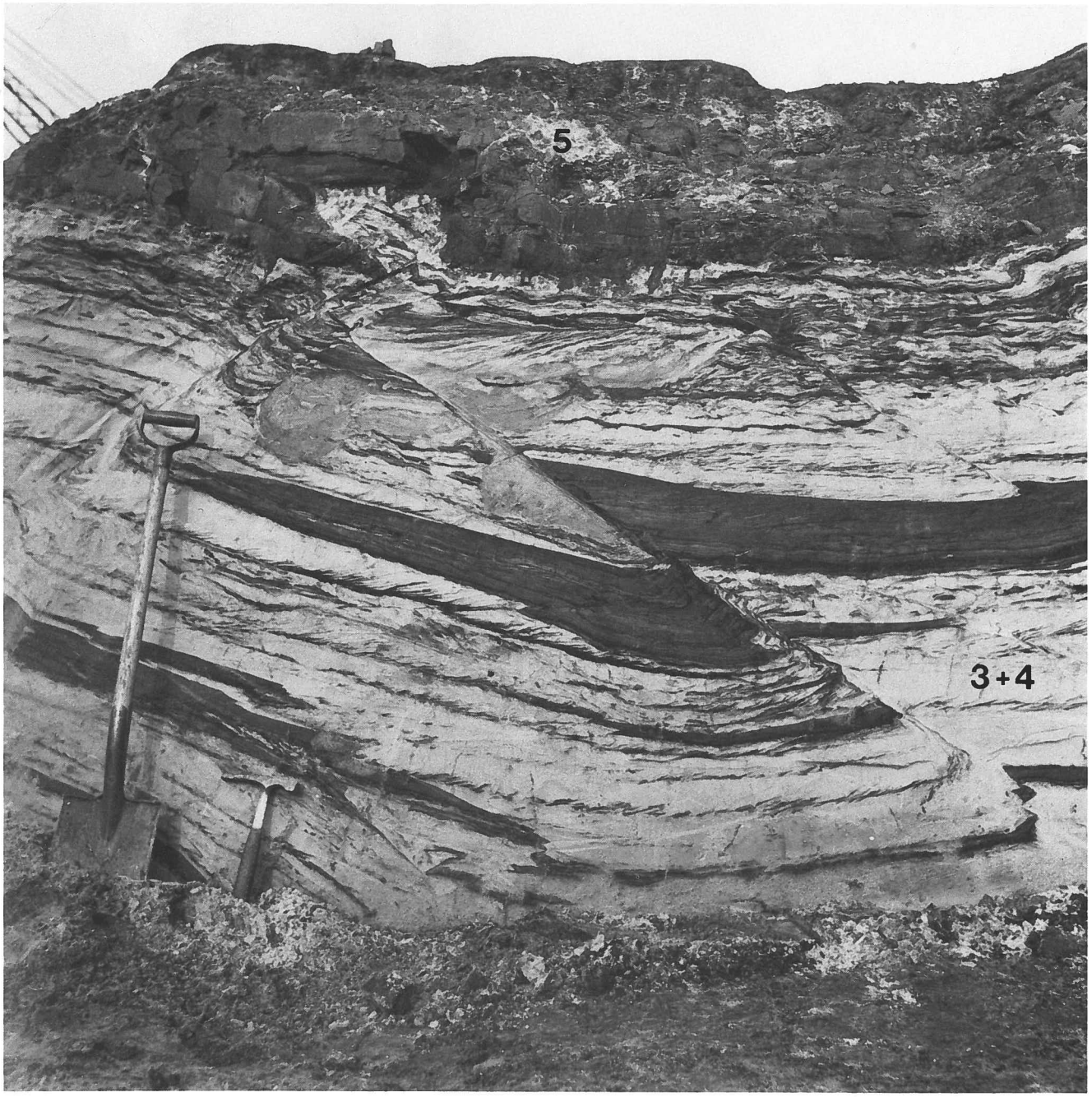
Atlas-Fig. 109. A syncline in the eastern end of the Carl Nielsen Ltd. browncoal pit at Fasterholt. In the foreground is the A-front (profile A 9 is by the ladder). The 3rd browncoal seam (6) is visible in the B-front. The browncoal bed clearly reveals the syncline as does the overlying "Upper Sands" (see bedding below the transporter bridge) filling the trough in the browncoal terrace. The numbers refer to the type-section. (Chapt. 4B.2.1.) E.K. Photo 1968.

Atlas-Fig. 110. South front of the Carl Nielsen Ltd. pit at Fasterholt displaying part of a syncline in the "Upper Sands" (T) truncated by Quaternary glaciofluviatile sands (Q). The flank of the fold is cut by a reverse fault. In the foreground the surface of the 3rd browncoal seam (B) is exposed. The mining front C late in 1968. W.F. Photo 1968.

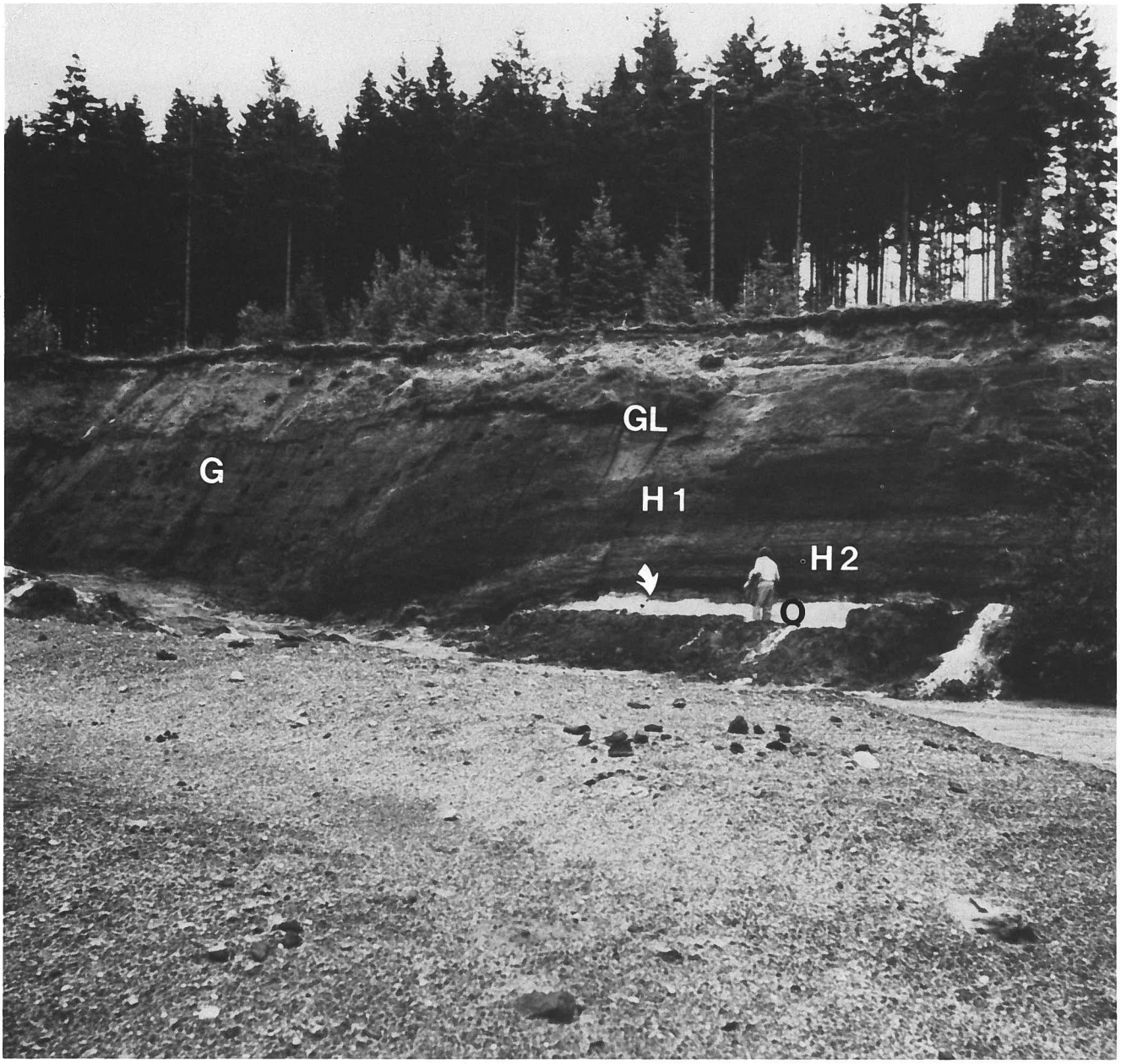
Atlas-Fig. 111. Detail of the western syncline in the south front of the Carl Nielsen Ltd. pit at Fasterholt. The syncline is developed in the Tertiary "Upper Sands" (T) which is unconformably overlain by Quaternary glacio-fluviatile sands (Q). The limit is marked by arrows. The picture shows the flank of a syncline with a small overturned secondary fold changing into a reverse fault lower in the outcrop (a similar outcrop of the same fold, seen in Atlas-Fig. 110, was visible 3 months earlier.) The C-front during winter 1968-69. W.F. Photo 1969.

Atlas-Fig. 112. The eastern half of the Carl Nielsen Ltd. pit at Fasterholt with the south front (K-). The Tertiary sequence, including the 2nd and 3rd browncoal seams, is folded into a syncline, with a small secondary syncline placed on the eastern flank. This undulation may be the initiation of an intervening syncline of the "en échelon" system. The folded structure is 3-dimensionally reproduced in the mine because the terrace reproduces the synchronous surface of the underclay (bed no. 5) of the 3rd seam. An exception is seen in the centre of the syncline (to the right in the picture) where the surface of the 3rd seam is covered by a thin sheet of the "Upper Sands" (UT) "in situ". Only the eastern half of the syncline is visible in the picture. The right side of the picture is in the axial plane at its intersection of the syncline with the mining front H (foreground). Legend: 2. 3.: browncoal seams by number. US : "Upper Sands" in the south front UT : "Upper Sands" on the mining terrace Q : Quaternary glacio-fluviatile sand. E.K. Photo 1970.

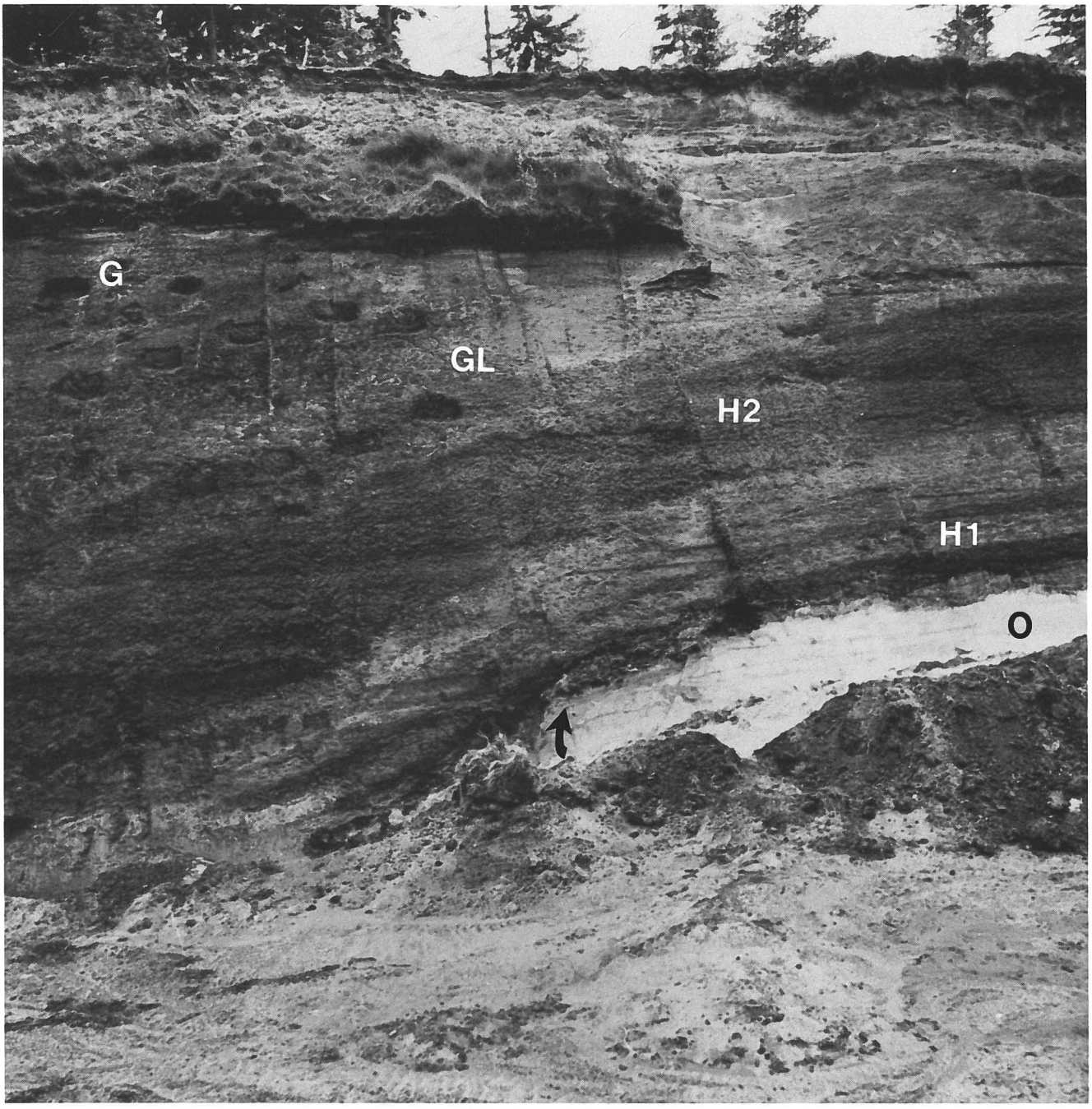
Atlas-Fig. 113. The western half of the Carl Nielsen Ltd. pit with the H-front in the foreground. In the background the I-front evolves, and the upper terrace represents the upper surface of the 3rd browncoal seam (3), and exposes 3-dimensionally a syncline which affects the Tertiary sequence. In the foreground are piles of the silty clay bed no. 5 containing fossil leaves. E.K. Photo 1970.



Atlas-Fig. 114. Fossiliferous sand (bed no. 3+4, Fasterholt-Flora bed) is exposed overlain by silty clay (bed no. 5). The sand is brown, humous coloured above the clay lamina and reveals the reverse fault on the flank of an "en échelon" syncline (see figs. 100-104). This exposure is in a N-S incision in the J-front (J 1 - J 2). Location: The Carl Nielsen Ltd. pit at Fasterholt. E.K. Photo 1970.



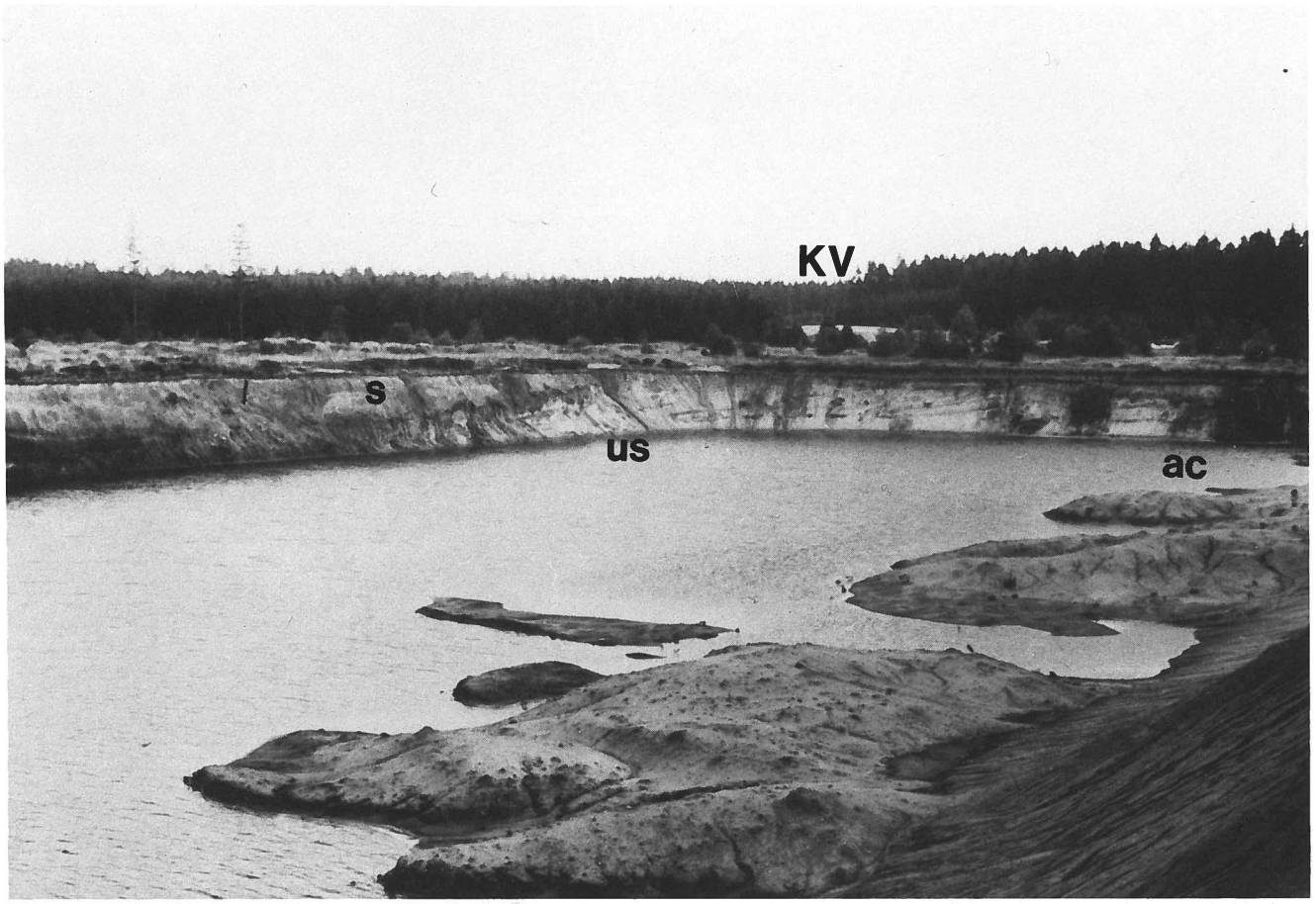
Atlas-Fig. 115. The south front in the abandoned Klynholt mining area at the Lavsbjerg point. The cleared outcrop demonstrates an anticlinal culmination (see chapt. 4C, Tectonics) with axial orientation SE-NW and passing between the Lavsbjerg point and the Fasterholtgaard mansion (see map of Text-Fig. 63). In the outcrop the following units are exposed: G: Gram Clay of the Gram Formation GL: Glauconite Clay of the Gram Formation H2: The homogeneous upper Hodde Clay of the Hodde Formation. H1: The distinctly bedded basal Hodde Clay of the Hodde Formation. Arrow: Basal transgressional bed of gravel, sand, and clay of the Hodde Formation. O: "Upper Sands" of the Odderup Formation. See also Atlas-Fig. 116. E.K. Photo 1974.



Atlas-Fig. 116. Detail of Atlas-Fig. 115. Cleared outcrop in the south front of the abandoned Klynholt mining area. Anticlinal culmination on the Tertiary sequence. For interpretation of the symbols, see Atlas-Fig. 115. E.K. Photo 1974.

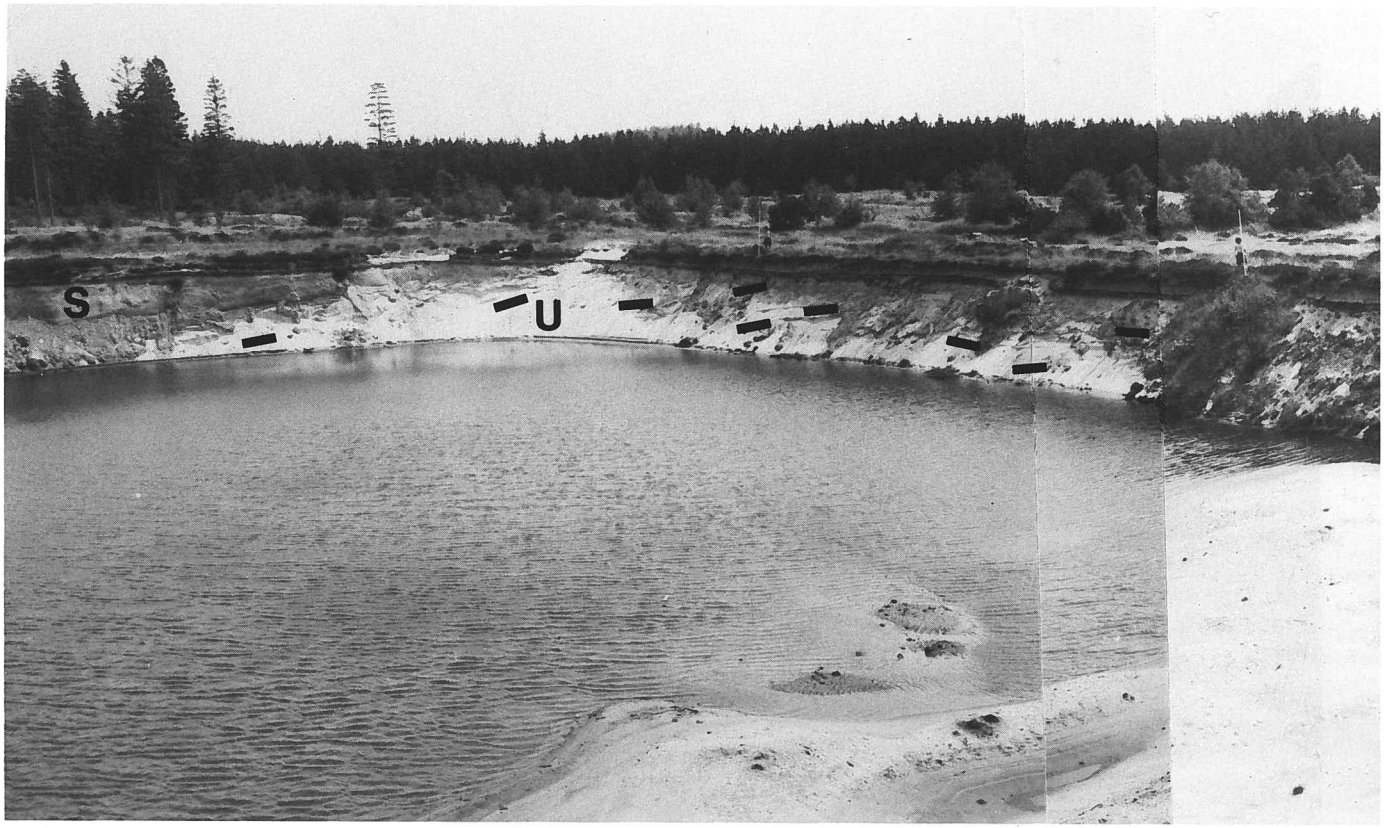
Atlas-Fig. 117. The North-front in the Klynholt mining area, exposing the "Upper Sands" (Odderup Formation) (O) and the Hodde Formation (H) (the distinctly bedded unit is the lower Hodde Clay, and overlain is the homogeneous, black Hodde Clay (at the letter H). The Hodde Clay reveals a wide shallow secondary syncline which is on the east flank of the anticlinorium in the south-western part of the Søby-Fasterholt mining area (see Text-figs. 62, 63). E.K. Photo 1978.

Atlas-Fig. 118. The Hoffmann & Sønner browncoal pit at Søbylund: The mining front of the western end of the mining trench. The Browncoal Bearing Sequence is exposed and shows a minor deformation that may be tectonic (compression). The mine is situated in the top of an anticline (anticlinorium) (ref. Text-fig. 62,63). The sequence and the signatures are the same as on Atlas-Figs. 89 and 91.. E.K. Photo 1968.



Atlas-Fig. 119. The southwestern corner in the Damgaard S mining area, seen from the north. To the left the southern part of the east front is seen, including the "Upper Sands" (us), the Hodde Clay (H) and a Quaternary solifluction sheet (s). To the right in the picture, behind the pond (submerged pit) the eastern half of the south front is seen with exposure of the "Upper Sands". Here, the bedding reveals the flank of a shallow anticline. ac indicates the approximate site of the anticlinal axis (the right side of the photo). KV indicates the site of the exposure of the "section "EM" in the Klynholt west front. E.K. Photo 1973.

Atlas-Fig. 120. The SE-corner of the Damgaard mining area, showing the junction of the south- and east fronts. View towards west along the south front. The beds of the Odderup Formation ("Upper Sands") (O) are exposed. The apparent dip of these beds is towards the east in the south front, where the dip becomes steeper towards the east and shallower towards the west. Apparent dip is indicated by black bars. S: Quaternary soil and aeolic sand. Location: The east flank of the Klynholt anticline (axis in direction NNW-SSE), the Damgaard S mine. E.K. Photo 1978.



Atlas-Fig. 121. View to the SE along the south front (right side) to the SE-corner (left side) of the former Damgaard S mining area. The northwesterly dip of the bedding of the "Upper Sands" (U) (see the corner) is affected by the anticlinal culmination of the Damgaard N - Lavsbjerg axis, which cuts across the south front of the Damgaard mining area (ref. map of Text-Figs. 62, 63 and Atlas-Figs. 103, 115, 120). The black bars indicate apparent dip. Symbols: S: Quaternary solifluction deposit. K: Tip of the former Klynholt mining area. The area between these former mining areas is unmined and the Tertiary sequence undisturbed (ref.chapt.4.B. 2.3 and Text-Figs. 39, 40). E.K. Photo 1978.


K

This Atlas contains 121 photographic pictures demonstrating exposures from the former Søby-Fasterholt browncoal mining area, Central Jutland, which is described in the text-volume. It is a collection of selected geological pictures describing all aspects of the geology of a Danish quadrangle and will be useful for geologists, teachers, students and even artists.

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