THE SALTEN VALLEY

A geomorphological analysis

KAJ HANSEN

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The Salten Valley is one of the tunnel valleys which Ussing believed were eroded by subglacial rivers. A more detailed investigation has shown that the valley is older than the last glaciation. A glacier tongue from the last glaciation has filled the valley, however, and two successive stages in the retreat of this glacier can be demonstrated. An analysis of the areas to the north and south of the Salten Valley has shown that the utmost limit of the last glaciation must have been much farther to the east than was hitherto supposed. It is confirmed that there are two sandurs west of the valley, an older one sloping to the south and a younger one eroded into the first one. This later sandur was produced by the outflow from the glacier tongue in the Salten Valley.

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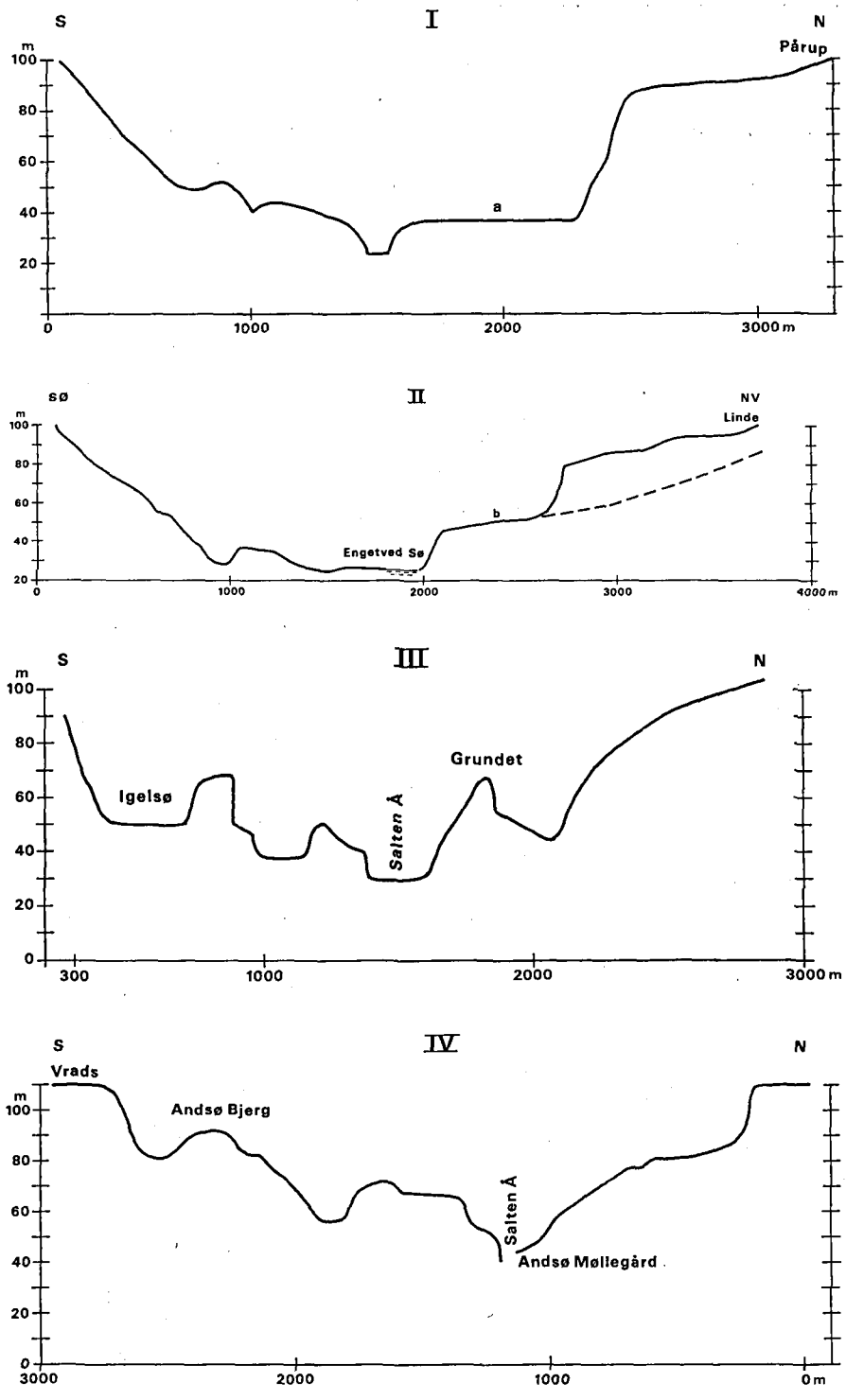
The Salten Valley is one of the most impressive valleys in central Jylland. It is the continuation of a wide and irregular depression which contains the lakes Mossø and Skanderborg Sø to the east. In a restricted sense the Salten Valley stretches from the lake Salten Langsø in the east to the sandurs at Sepstrup Sande and Christianshede to the west. The section is 10 km long; the width of it varies from place to place.

The valley is eroded in Tertiary deposits which are exposed at several places in the sides and bottom. With regard to morphology the valley may be divided into three sections, each with its special characteristics.

As shown on the map (plate 3) and in the profiles, fig. 1, there is an essential difference between the surroundings to the north and to the south. To the north a 90–110 m plateau stretches as a gently undulating surface to the next large valley, containing the lakes Julsø, Borresø, and Thorsø. Only to the extreme west does still higher ground border the valley north of Andsø.

To the south of the Salten Valley, the top of the slope is difficult to locate. It is almost completely covered with forest westwards as far as Vrads. The eastern part borders the high ridge to the north of Vinding. The boundary between the more horizontal part and the steep slope lies at 130 m above sea-level. Farther to the west the top of the slope lies only 100–110 m a. s. l.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The eastern section

The eastern section runs from the western end of the lake Salten Langsø to the main road from Silkeborg to Bryrup. The section is 4.5 km long. The width of the valley is about 2 km at the top of the slopes, but only 100 to 600 m at the present bottom. At the western end of Salten Langsø the bottom lies at 22 m above sea level and at the main road at 26 m.

The northern slope

At the valley bottom there are several terrace fragments, (a) profile I, with their surfaces at about 36 m. The most extensive fragment can be followed almost continuously from Salten Langsø to a little west of the farm Tolstruplund. Another terrace fragment is situated in front of the lake Engetved Sø, and farthest to the west, two small hills lie near the main road. The surface of all these terrace fragments lie at about 36 m (profile I).

A very conspicuous feature of the northern slope in this section is the group of dry valleys which run into the Salten Valley from the vicinity of the road between Lindgaarde and Tømmerby. They are typical V-shaped valleys eroded by running water, steep and narrow at the head, wider and with decreasing inclination in the lower part (fig. 2). They are hanging at 54 m (fig. 3), and none of them reaches the bottom of the Salten Valley. In front of them lies a terrace with the surface gently sloping down to 44 m and with a steep cliff against the southern part of Lake Engetved Sø (fig. 4 and profile II in fig. 1).

Farther to the west, near the farm Klarfald, another dry valley hangs at 54 m, terminating at the top of a cliff with its foot at 32 m. This cliff has been formed by several recent landslips. The last one took place February 23, 1952, and another slip is known to have occurred seventy-five years earlier (Hansen, 1959).

The long valley, through which the main road from Rodelund to Addit runs, also seems to have originally been hanging at 54 m; road construction, however, has disturbed it very much.

Immediately east of the large dry hanging valleys we find the Salten profile

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Fig. 1. Four cross sections through the Salten Valley as shown on the map, plate 3. Section I shows the low terraces 36 m above sea level. Section II is placed through the nose between the two dry valleys and shows the terrace in front of the dry valleys. The dotted line is the longitudinal profile of one of these dry valleys. Section III is placed through the Igelsø terrace and shows the many irregular hills which fill up the valley at that place. Section IV shows three of the terraces on Vrads Sande with the dunes.

Fig. 2. The head of the dry valleys in the eastern section of the Salten Valley.

(fig. 5), a steep cliff also caused by a landslip (Hansen, 1959). It was first observed by A. Jessen in 1898, probably shortly after being formed. According to Hartz (1909) the sedimentary complex is topped by 1.6 m glacial sand and gravel. Below this lies Miocene micaceous sand and lignitic clay. The Tertiary strata reach an altitude of as much as 60 m. The profile is formed by a landslip owing to seepage water coming out at the clay-sand interface and soaking the clay.

The dry hanging valleys and the terrace in front of them indicate that the Salten Valley must have been occupied by ice up to the level of the terrace, and that the terrace itself has been built up by erosion material from the valleys. In other instances, where there is no terrace in front of the hanging valleys, the longitudinal profile of the continuation of these valleys shows several steps in the lowering of the base level of erosion.

Apart from the terraces in front of the dry valleys there are also some solifluction terraces at the northern slope of the Salten Valley south of the farm Engetved with the surface at 45 m and another near the farm Overengetved with the surface sloping down from 89 m to 86 above sea level.

Fig. 3. The distal end of the dry valleys on the terrace 32 m above the valley bottom.

The southern slope

The southern slope of the Salten Valley in this section has a quite different morphology. There are no landslips and only a few terraces, possibly caused by solifluction. One terrace is situated at both sides of the main road from Silkeborg to Horsens. The inner edge lies at 50 m and slopes gently down to 30 m to end in a 6 m high cliff to the bottom of the Salten Valley.

Fig. 4. The eastern section of he Salten Valley with the lake Engetved Sø and the 36 m terraces.

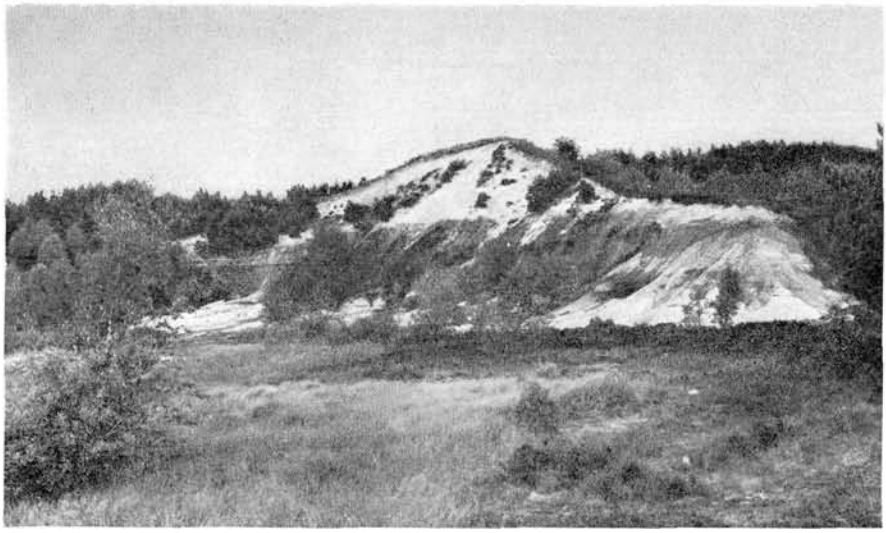

Fig. 5. The Salten profile formed by a landslip ca. 1898.

Water-eroded channels and dry valleys are also seen on the southern slope. Two of the dry valleys have their heads near Addit Hede. The valley through which the main road runs is probably also a dry valley of this type.

The valley Vinding Tved is most likely the oldest, its head lying at 98 m. A longitudinal profile (fig. 6) through it shows at least two rejuvenations of erosion due to lowering of the base level. The oldest stage stretches from the head of the valley down to 68 m with a gradient of 30 m in 2500 m, i. e. 1:83. The next stage runs from 68 m to 50 m a. s. l. with a gradient of 18 m in 410 m, i. e. 1:23. The last stretch down to the bottom of the Salten Valley has a gradient of 18 m in 280 m, i. e. 1:16.

Supposing that the younger cycles of water erosion has removed the lower part of the previous stages, then the upper part of the Vinding Tved originally

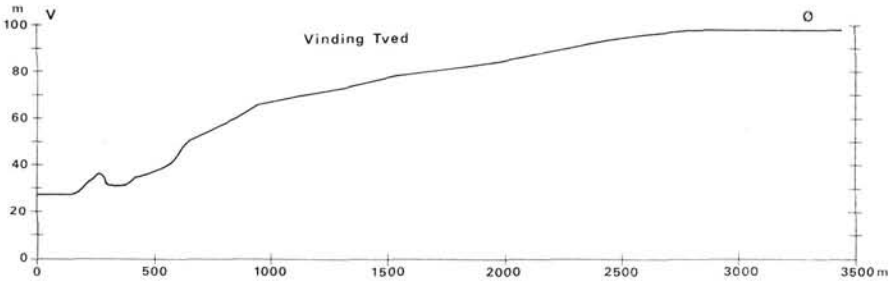

Fig. 6. Longitudinal profile through the valley Vinding Tved. The profile shows at least three rejuvenations of the erosion.

had its lower end at the same level as the terraces in front of the dry valleys on the northern slope of the Salten Valley.

To the north Vinding Tved is bordered by fragments of a plateau with its surface from 90–100 m a. s. l., that is at about the same level as the plain north of the Salten Valley.

To the south the Vinding Tved is bordered by the considerably higher ridge north of Vinding. However, the entire slope between the top of this ridge and the bottom of the Salten Valley is so furrowed by channels that it is split into a labyrinth of narrow ridges. A more detailed study of the contour-lines on the map shows that these furrows have been eroded during several lowerings of the base level of erosion. The forest nursery Vinding Tved is situated upon a small delta cone which has been eroded by a brook, and the eroded material is now lying as another delta cone 60–65 m above sea level. Landslips seem to have been active at this place, too. However, the entire slope in this section is covered by forest which makes field studies very difficult.

The central part of the Salten Valley

The next section runs from the Silkeborg-Bryrup main road about 2 km to the west. The direction of the valley now changes to east-west, and the valley has a considerably more complex appearance than in the eastern section. Several hills and terraces stretch from the slopes out into the valley, and also some single hills are situated in the middle of the valley, each with its summit at a different altitude.

Profile III in fig. 1 and plate 1 show how two hills, Grundet immediately west of the main road and Knolden west of the farm Fogstruplund, have their summits at 67 and 63 m respectively.

The now abandoned Katrinedal brickworks exploited several clay pits in the hills, and one in the esker-like ridge near the house "Tilfredshed" in the middle of the valley. Its surface lies at 52 m. In 1950, clay was dug at the western end of the ridge. In the pitface, stone-free clay with lenses and balls of sand was exposed (fig. 7). The clay digging stopped here in 1960 and then only sand was visible in the face.

From the northern slope of the valley another esker-like ridge stretches south-eastwards from the farm Fogstruplund. Its highest point is situated at 55 m, and from here it slopes down step by step through 48–46–42 to 40 m a. s. l.

About 800 m to the east of Vorret another hill stretches out into the valley in a south-easterly direction between the farms Svejshøj and Skovballe. The northwestern part of this hill is situated 79 m above sea level and slopes down from here to 69 m. At Skovballe it ends in a steep cliff against a depression which on the opposite side is bordered by the hill "Grundet". Just south of

Fig. 7. The clay pit in the esker-like ridge at Katrinedal brickworks. In the middle of the sequence a large ball of sand in the clay is seen.

Vorret another plane surface slopes down from 90 to 84 m, and in which there is an abandoned lignite pit.

The southern side of the Salten Valley in this central section has a more regular shape. The edge of the plateau is situated at 120 m and the slope is furrowed by numerous water-eroded gullies. Immediately west of the Silkeborg-Bryrup main road there is a terrace 500 m wide around the lake Igelsø and with a sand-ridge along its outer edge (b on the map, plate 3). At the northeastern corner of that terrace there is a clay pit with Tertiary clay overlain by Tertiary and diluvial sand (plate 1, fig. B). As late in 1968, clay was dug in the pit, but it is now abandoned.

It is difficult to interpret the Igelsø terrace. It stretches 1 km to the west from the main road and continues together with the lake Igelsø westwards to the now totally overgrown swamp Langkær. The sand-ridge along the edge of the terrace is in fact composed of three separate hills. Farthest to the east there is a pear-shaped hill, 400 m long, with its point to the west. The eastern end reaches an altitude of 69 m. To the west of it another, smaller, triangular hill has its top at 74 m, and the most westerly of the hills Langbjerg, has its top 79 m.

This part of the Salten Valley with its many sand-ridges seems to have been formed in the valley by the distal part of a glacier which shrank progressively downwards during the melting period. Simultaneously the glacier was reduced

in width causing solifluction and landslips, especially on the northern side of the valley.

The western section

The development of this section is still more difficult to explain, partly because the surrounding country is covered with forest obscuring the view, and partly because drift sand covers the original surface with dunes and sand ridges.

The first part, as far as to the point where the embankment of the abandoned railway crossed the valley, is 400–600 m wide at the bottom and displays fairly normal valley slopes, but several domed solifluction ridges slope down from both sides. At the southern side of the Salten Valley, the Bryrup Valley debouches into it as two narrower valleys.

From the railway embankment westwards to a little past the road crossing the valley at Andsø Møllegård the valley is again almost filled with domed hills (plate 2, fig. A). The northern side, which along the preceding stretch is bordered by a plateau about 100 m above sea level, is here bordered by the much higher ground between Tem and Sebstrup, where Tertiary sand is found a few metres below the surface.

The side towards the Salten Valley is very steep, and the direction of the valley has now changed to a more NW-SE course. Later again, it seems more E-W and cuts into the sandur west of Sebstrup.

In front of the steep slope a 400 m wide terrace is situated with its upper edge at 85 m sloping gently down to 70 m. On the outer edge there is a small hill, Tornbjerg (plate 2).

The southern side of the Salten Valley has in this section quite another appearance than farther eastward. From the mouth of the Bryrup valley, the Salten valley is bordered by a 110 m plateau. About 2 km west of Vrads the edge of this plateau turns at first to the west and later to the south and here constitutes the eastern side of the valley which contains the lakes Rævsø and Grane Langsø. At the point where the plateau turns west the real southern side of the Salten Valley ends. However, there are several terraces on the southern slope of the Salten Valley and the uppermost of these at 90 m now continues as a 300 m wide ridge between the Salten Valley and the other valley to the southwest, fig. 8. This terrace continues until about 600 m north of St. Hjøllund where it ends at the Christianshede sandur.

Two additional terraces may be distinguished on the southern side of the Salten Valley (profile IV in fig. 1). One of these has its outer edge at 82 m and ends in a steep 4 m high cliff against the lower terrace, the outer end of which lies at 60 m. The bottom of the valley is at Andsø at a height of 44 m.

The upper one of these two terraces is clearest developed at Vrads Sande

plate 2, Fig. B). It has several dunes and sand hills upon its furface such as Kukmandsbjerg, Svinballebjerg, Drejsbjeroland, and Andsø Bjerg. Between Daneborg and Vrods, the 82 m terrace is about 300 m wide but, like the other terraces, it becomes narrower to the east and at the railway embankment they have all totally disappeared.

To the north of Tvillingmose sand drift hides the topography and the ground is here sloping gently down from 90 to 60 m. The Salten Valley ends west of Andsø.

Earlier theories about the formation of the Salten Valley

The Salten Valley belongs to the group of valleys in Jylland that was called "fjord valleys" by Ussing (1904, 1907). According to Ussing they were older than the river valleys formed by the meltwater rivers outside the inland ice. They existed, although not with their present appearance, already before the inland ice melted away.

Whether the fjord valleys were eroded underneath the inland ice by the ice only, or in combination with erosion by the rivers which built up the sandurs is knot known. After the retreat of the ice these fjord valleys were exposed to considerable changes caused partly by the meltwater rivers in front of the ice margin, and partly by the considerable amount of moraine material which was deposited across them. In this way, the chains of lakes, which are seen in many of these valleys, were created, while others were incorporated into the younger river valleys.

During the melting period several of the fjord valleys contained lakes much larger than now, because the ice barred the outlets. Such ice-dammed lakes left terraces on the valley slopes.

Madsen (1921) changed the name fjord valley to tunnel valley and wrote that they were eroded by meltwater rivers running in subglacial tunnels and with their outwash plains (sandurs) or delta cones situated in front of them. Further Madsen stated that during the last glaciation the inland ice did not reach farther to the west than tunnel valleys are found.

Milthers (1948) referred to the Salten Valley as the southern branch of a tunnel valley with its western end at Vrads, and which from here eastwards contains the lakes Salten Langsø, Mossø, and Skanderborg Sø. The northern branch of this valley system runs from Ry, passes Alken and follows the river Hillerup Aa valley towards the lake Stilling-Solbjerg Sø.

Concerning the tunnel valleys Milthers (1948) wrote that they were developed as tunnels underneath the ice cover and indicate the routes of the subglacial rivers. He further believed that the irregularity of the valley bottom where lakes alternate with dry valley bottom was caused by subglacial rivers under pressure eroding the channel.

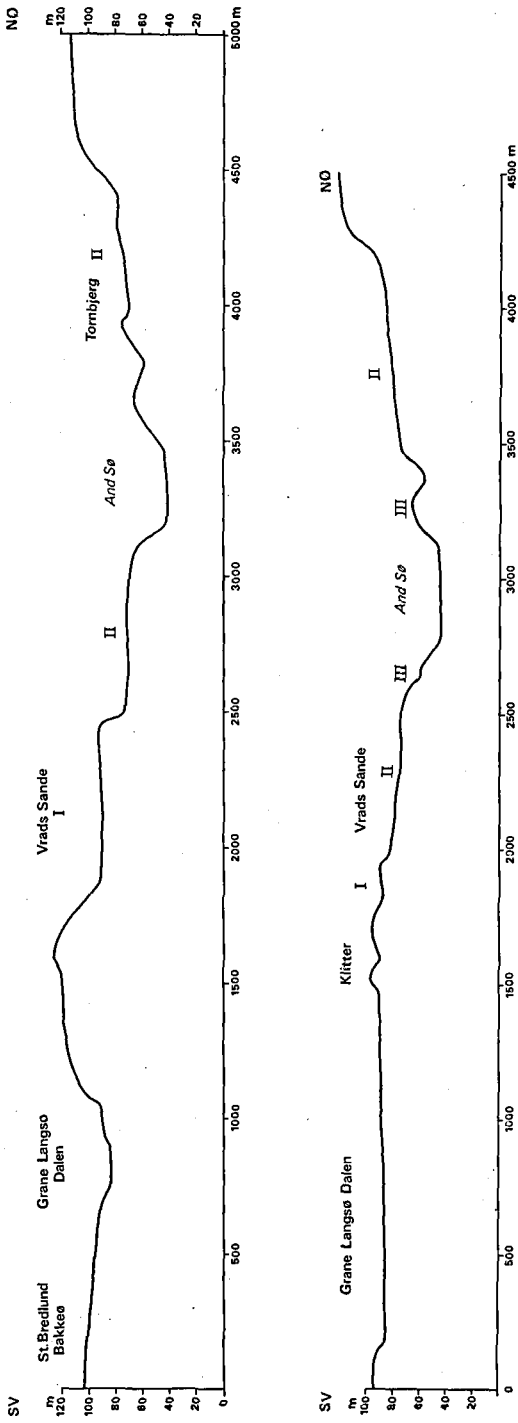

Fig. 8. Two cross sections through the Salten Valley and the Grane Langsø valley, showing the transition from the upper terrace in the Salten Valley to the sandur. The terraces I, II, and III correspond to the terraces c, d, and e on the map, plate 3.

It has been shown (Hansen, 1971) that Ussing's theory about the formation of these valleys must be wrong. The special form in which Madsen and Milthers gave their theory concerning the development of the tunnel valleys must in every case be abandoned.

It is quite clear that the present appearance of the Salten Valley is the result of an interaction between many different glacial, as well as periglacial forces. It is evident that during the last glaciation the Salten Valley was filled up by a glacier tongue. However, it is not known whether the valley was eroded by this glacier, or whether the glacier followed an older valley. However, in the author's opinion various facts concerning the landscape, especially to the south of the valley, indicate that the last theory is the most probable.

The outher limit of the last glaciation

From Dollerup southwards to Engesvang and Funder the outer limit of the last glaciation may be drawn with considerable precision, because the configuration of the terrain is manifestly different on the two sides of the boundary, with the wide, very gently sloping sandurs to the west and the more irregular hilly country to the east. Further to the south the interpretation becomes more difficult.

Ussing (1907) wrote that southwards from Sebstrup the configuration of the terrain is very difficult to unravel. It is evident that the front of the inland ice has turned to the southwest and later to the south, because in the area south of Sebstrup the sandurs are bordered by depressions and lakes which cannot have originated from later erosion. They must, therefore, be supposed to have been covered by sand at the time when the large meltwater rivers were spreading out over the sandurs.

Apparently there are no conspicuous terminal moraines along the entire stretch down to the Danish/German border (which in 1907 followed the river Kongeaa). Neither is there along this stretch so distinct a difference in the landscape to indicate the limit as is found in the stretch north of Funder. The stagnation line drawn on the map should therefore here only be considered the approximate limit between the hilly older diluvium and the sandurs on one side and the more irregularly developed terrain on the other.

Milthers (1939) wrote that an indicator for the outer limit of the ice to the north of Tyregod and farther to the northeast in the region between Nørre Snede and Bryrup may be the lakes and chains of lakes, because all these lakes were formed inside or underneath the ice. According to Milthers the lake Eistrup Sø should also have been lying behind the ice front.

Further, Milthers wrote that in order to get some understanding of the extension of the ice in this area, it is necessary to reflect on the conditions under which the sandurs to the south of Christianshede were built up, and

this he described as follows: The top of the sandur is situated a little north of Sebstrup at 105–110 m above sea level. At that level the narrowing end of the sandur disappears gradually into the glacial country sloping westwards. Indicator boulders from the surface near Sebstrup and on the neighbouring part of the sandur, together with the configuration of the terrain north and south of the sandur, show that the ice, whose meltwater streams built up the sandur, may have been situated at the southeastern side of the sandur, whereas the meltwater streams to the north eroded steep cliffs into the side of the higher-lying country.

Farther away from the river Storaa, the streams have eroded cliffs into the hill "Isen". If the valley between Ikast and Bording was formed in the late-glacial period and not in the melting period of the previous glaciation this would only have been possible if the ice cover had transgressed so far to the west as to Christianshede and Guldforlund.

Furthermore, Milthers wrote that the sandur south of Guldforland and Christianshede church mostly consists of coarse gravel; in some places also very large angular boulders, mostly of Norwegian origin, are seen. According to Milthers, the sandur west of Guldforhoved was built up by meltwater from the Salten Valley and the Bryrup Valley. He added, however, that if the formation of the sandur took place entirely during the late-glacial period, the Baltic ice cover must have extended as far west as Guldforhoved, but Milthers finally stated that this interpretation pre-assumes the date of formation of the sandur and adjoining erosional limits as the melting period of the last glaciation and not during previous glaciations, the valley rivers of which were followed by younger rivers.

Ussing's and Milthers' conclusions are so strongly dominated by the former that the sandur, which Ussing called the Sebstrup cone, should be a single element, built up by a meltwater stream with its head to the north of Sebstrup. They have seen that this sandur consists of two plains: an older one sloping to the southwest, the Brande-Pårup sandur, according to Ussing with its top north of Sebstrup, and a younger one sloping westwards, and eroded into the first by water coming from the Salten Valley glacier.

In both cases the gradient is so small that the difference between them cannot be discerned in the field. However, a closer study of the contour curves on the maps shows that in a narrow belt about 1 km south of Guldforhoved, the distance between the contour curved is considerably smaller than above and below this belt.

The belt represents the outer edge of the upper part of the Sebstrup cone. The cone continues in the gap between the hills Lunerbakke, Overisen, and the Ikast hill. This is in full agreement with Milthers who placed the outermost limit for the ice advancing from north or northwest along the northern edge of the Sebstrup cone, but it is not evident whether this ice limit dates from the last glaciation or from the previous one.

Farther to the south, the upper part of the Brande-Pårup sandur is bordered by the Store Hjøllund and the Store Bredlund hills, but the morphological features here are obscured, partly by dense forest vegetation and partly by a considerable thickness of drift sand deposited in late- and post-glacial time. However, the entire terrain between the Salten Valley and the upper end of the rivers Gudenaa and Skernaa shows many traces of being older than the last glaciation.

This is also true about the area east of Sebstrup. It borders the Salten Valley with a steep 20 m high cliff which continues past Fogstrup and then turns more to the northeast, descending and more gently sloping. At Salten it is only 10 m high, and here the slope is so gentle that the feature is hardly noticeable. From Salten, the ascending border of the high ground between Sebstrup and Tem runs to the north, and at Rodelund it is again 20 m above the plain which borders the eastern part of the Salten valley to the north. This eastern slope is distinguished by a lot of niches, caused by solifluction and landslips.

Wells and sandpits in the high-lying area between Sebstrup and Tem show that Tertiary sand is found everywhere a little below the surface. The area is gently undulating and contains two distinct valleys. One of them is a rather deep valley coming from north-east and reaching the lake Hummel Sø west of Tem. The second one is a wide dry valley meandering through the area and with its head just above the first valley.

About the dry valley Milthers (1948) wrote that a 10 km long and 300–400 m wide late-glacial valley runs from the vicinity of Tem to the likewise late-glacial Karup valley south of Funder and with its outlet at 72 m altitude. The head of this valley lies at 97 m.

The late-glacial terrace at the head of the Karup Valley lies at 82 m at Løvagergaard. Milthers believed that a corresponding terrace is to be found in the Salten Valley. However, this "terrace" is in fact the western end of the plateau bordering the Salten Valley to the north along the above-mentioned cliff at the southern side of the high area west of Tem, but this plateau is not a river terrace.

Milthers' description of the area between Tem and Sebstrup is insufficient. Milthers did not understand that the surface of this high-lying region was not formed during the last glaciation, but during the previous one. The mentioned dry valley is not late-glacial, but an old river valley with its head immediaely west of the lake Hummel Sø, where it is hardly recognizable as a valley (fig. 9). The valley has an almost constant width throughout, but after having passed the road from Tem to Gedsø it becomes deeper and more distinct (fig. 10). A longitudinal profile through it (fig. 11) shows that several erosional cycles are discernible.The uppermost part has a gradient of 1:300. Farther down it is 1:170. This profile differs markedly from the normal profile of a rather young, eroded valley, and it would appear evident that the part of the valley running northwards with a gradient of 1:80 must be the lower

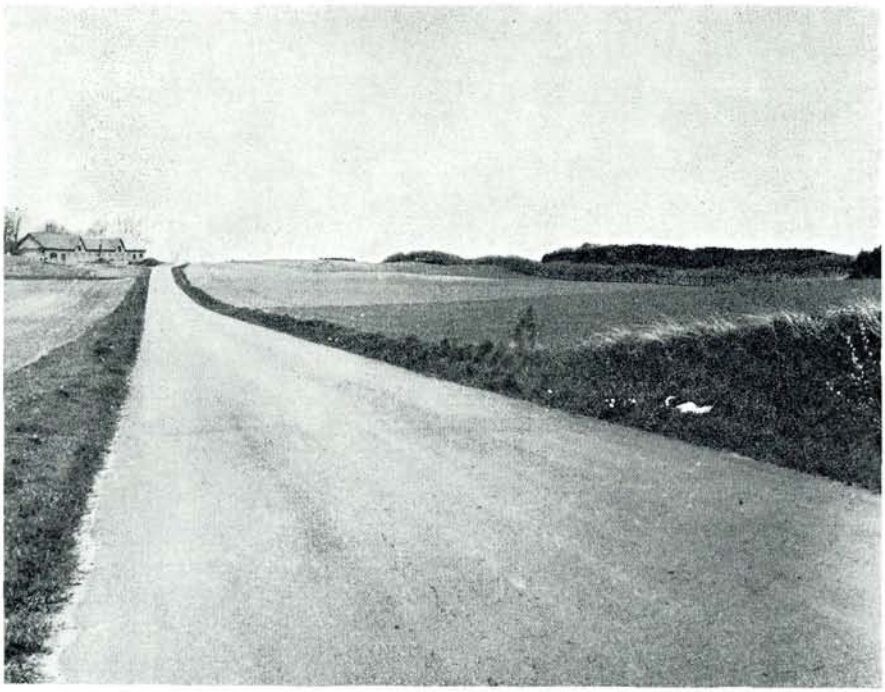

Fig. 9. The large dry valley in the older diluvial landscape west of Tem; the upper part is crossing the road from right to left.

part of an erosion channel which had its head on the sandur to the south, and which is probably late-glacial.

The long, dry valley must therefore be a very old valley, older than the last glaciation and was cut during the late-glacial period by a gully from the south to the terrace in the Karup valley. This means that the dry valley must originally have continued into the sandur west of Sebstrup and that its lower end has been disturbed or covered by deposits from the last glaciation. It would be in accordance with Milthers' theories that the ridge between Pårup and Christianshede represents the outer limit of an ice advancing from the north or northeast. However, its eastern continuation has not crossed the Salten Valley here, but must have run eastwards along the southern side of the valley which contains the lakes Torsø, Borresø and Julsø as far to the east as to the hill Himmelbjerget.

From Himmelbjerget, the ice front probably turned to the south to the Salten Valley and filled it with a glacier tongue. South of the valley the ice front went from Addit and continued along the western side of the river Gudenaaen.

In support of the above theory it may be stated that in the forest "Ry Sønderskov" there is a north-south trending hilly ridge reaching 158–162 m, its

Fig. 10. A lower part of the dry valley seen in fig. 9.

western side furrowed by several gently sloping dry valleys. An almost similar area lies to the south of Himmelbjerget, at 151–157 m. These two ridges constitute the most westerly, confirmed boundary of the last glaciation in this part of Jylland. The areas south of the Salten Valley is also at a very high level more than 100 m. Milthers wrote that the surface here is just as flat as the surface of the areas with older diluvium in western Jylland. A more detailed description of this area is under preparation and will show that it must have been lying outside the last glaciation.

As mentioned above, Milthers (1948) stated that the region west of the line from Himmelbjerget to Salten Valley in its western part is the upper terrace of the Salten Valley, because he was of the opinion that the cliff west of Fogstrup is the result of river erosion. However, the surface at the foot of this cliff is not a terrace or a river plain, and most of the meltwater from the ice front has probably disappeared into the ice of the Salten Valley.

Reverting to the Salten Valley and its terraces, it is evident from this analysis that the valley has no throughgoing terrace. The small terraces near the bottom in the eastern section at 36 m were formed during the last phase in the development of the valley and have their continuation in the terraces of the river Gudenaa to the east.

The terraces at Vrads Sande belong to the older phase of the development. The uppermost one, at 90–100 m, corresponds to the oldest of the two sandurs. However, it is striking that its northern part is a ridge between the

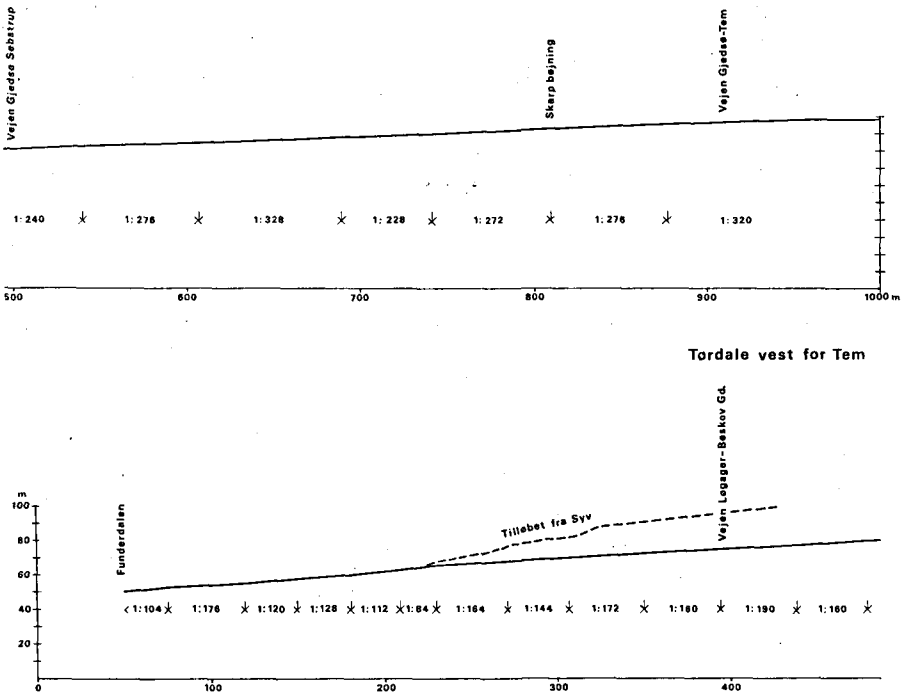

Fig. 11. Longitudinal profile through the large dry valley in the older diluvial landscape west of Tem. The dotted line shows the profile of the creek, which cuts off the dry valley from the south. The figures below the profile show the gradient of the valley bottom. Here several erosion cycles may be seen.

Salten Valley and the valley to the southwest, and which is the upper end of the same sandur, though at a lower level.

The next terrace on Vrads Sande at 82 m probably corresponds to the younger sandur and has outlet to the west. The division here is now lying at 85 m, but deposition of drift sand during the late- and post-glacial periods may have taken place.

The 60 m terrace is lying at so low a level that maybe there has been no outlet to the west.

Immediately east of the road from Vrads through Andsø Mølle to Fogstrup and farther eastward, at Katrinedal, the valley is blocked by hills of which some may be due to solifluction, whereas others must have been deposited at the front of the glacier tongue. This means that during the retreat of the glacier tongue, the western part of the valley must have been an ice-dammed lake, and the younger sandur has not been built up by deposits from the Salten Valley, but was eroded into the older sandur by the outlet from the glacier into the valley.

This detailed examination of the morphology of the Salten Valley and the

area north and south of it clearly shows that the explanation of the origin of these large valleys is not as simple as was believed by Ussing and Milthers. The theory that these valleys were only the result of erosion from subglacial valleys is not true.

They are all the result of a very complicated interaction between several glacial and periglacial processes some of which must be older than the last glaciation.

Dansk sammendrag

Saltendalen er en af de store midtjyske dale, som Ussing (1904, 1907), Madsen (1921) og Milthers (1939, 1948) kaldte »fjorddale« eller »tunneldale«, idet de mente, at de var udgravet af floder, der i tuneller under isen havde løbet under tryk og derfor havde kunnet udgrave disse dale. Derved blev ydergrænsen for sidste nedisning gennem Jylland trukket vest om disse dale.

Det er tidligere (Hansen, 1971) vist, at Ussing's anskuelse ikke er holdbar, og på flere punkter endog er i uoverensstemmelse med de faktiske forhold. En nøjere gennemgang af hver enkelt af disse store dale er derfor nødvendig. Saltendalen strækker sig fra vestenden af Salten Langsø til hedesletterne vest for Vrads. Morfologisk falder Saltendalen i tre afsnit, hvoraf det østlige strækker sig fra vestenden af Salten Langsø til landevejen fra Silkeborg til Bryrup. På dette stykke er dalbunden flad og har en bredde af 100–600 m, men afstanden mellem dalsidernes overkant er ca. 2 km. Nordsiden kan karakteriseres ved flere tørdale, der er hængende i en højde af ca. 22 m over dalbunden. Foran de to største ligger en bred terrasse, der igen står med en stejl skrænt ud mod Engetved Sø, og dalsiden viser iøvrigt mange spor af flydejord og skred (Figurerne 2–5 og profilerne I og II i fig. 1).

Sydsiden af Saltendalen viser i dette afsnit et virvar af erosionsrender, i hvilke der kan erkendes spor af flere erosionscykler som følge af en trinvis sænkning af erosionsbasis (Vinding Tved, fig. 6).

Dette viser, at Saltendalen under den sidste nedisning har været fyldt af en gletschertunge.

Det næste afsnit strækker sig fra Silkeborg–Bryrup landevej til noget sydøst for Vorret. Lige vest for landevejen er dalen fyldt af flere fritliggende kuplede eller åslignende bakker, og fra siderne skyder hældende bakkerygge sig ud i dalen (fig. 7 og plate 1). I nogle af disse har det nu nedlagte Katrinedal Teglværk tidligere gravet ler. Mærkeligst er en åslignende bakke, hvor der i 1950'erne endnu fandtes ler med store linser af sand, men i 1960 fandtes kun sand.

I det vestligste afsnit af Saltendalen findes der igen øst for Andsø talrige kuplede bakker og flydejordsrygge ude i dalen (tavle 2, fig. A). Disse forhold viser, at både her og senere ved Katrinedal Teglværk har gletchertungen haft en stilstandslinje under afsmeltningen.

Vest for den sidste af disse linier findes der på Vrads Sande flere terrasser, men forholdene tilsløres stærekt af flyvesand, der danner store klitter, og af de mange plantager på begge sider af denne del af dalen (fig. 8).

Det må heraf fremgå, at Saltendalen ikke er udgravet af subglaciale floder, men at mange forskellige såvel glaciale som periglaciale processer har været medvirkende til dens nuværende udformning.

Ussing og Milthers mente, at smeltevandet fra isen samledes i store subglaciale

vandløb, der foran deres udstrømningssted aflejrede hedesletterne som flade kegleflader med toppunkt ved gletscherporten. En sådan kegleflade skulle have haft sit toppunkt ved Sebstrup; smeltevandet skulle herfra dels være løbet mod sydvest og have aflejret den store Brande–Pårup hedeslette, dels være løbet mod vestnordvest til Storåen og på sin vej have frembragt de stejle erosionsskrænter på nordsiden af Overisen, Lundebakke og Ikast bakkeøerne. Der findes her to hedesletter, en ældre, den egentlige Brande-Pårup flade, der har sin overkant gående fra Sebstrup mod vestnordvest over Christianshede og Guldforlund, langs bakkeøen nordfor, med fald mod sydvest og uden noget kegletoppunkt, og en yngre, der af afløbet fra Saltendalen er gravet ned i den ældre hedeslette med flodrende mod vestnordvest og afløb til Storåen.

Landet mellem Sebstrup og Tem ligger meget højt og begrænses mod øst og syd af en skrænt, der fra det nordøstlige hjørne ved Rodelund, hvor højden er 20 m, strækker sig først mod syd til Salten og derfra mod sydøst til Saltendalen. På strækningen mellem Salten og Fogstrup er såvel højden som stejlheden aftaget så meget, at man knap lægger mærke til skrænten, men fra Fogstrup og ud til Saltendalen stiger begge dele igen i højde til 20 m.

Overfladen på dette højtliggende parti er lige så flad og svagt bølget som overfladen af de vestligere bakkeøer; men den rummer to meget karakteristiske træk. Fra nordøsthjørnet strækker en lavning sig ind mod Tem, og vest for den gennemskæres området af en bred tørdal, der i sin vestlige ende afskæres af en fra syd kommende erosionsrende, ned til Funderdalen. Milthers angiver, at denne tørdal er senglacial, men både dens bugtede forløb og dens længdeprofil viser, at det er en meget gammel dal, ældre end sidste nedisning og hele områdets overflade tyder i samme retning.

Ydergrænsen for sidste nedisning må derfor fra ombøjningen vest for Hald Sø have fulgt Ussing's hovedopholdslinie mod syd til Engesvang. Herfra er den imidlertid bøjet mod øst langs sydsiden af Torup Sø – Borresø – Julsø dalen indtil Himmelbjerget. Herfra er den gået mod syd gennem Ry Sønderskov til Saltendalen og har skudt en gletchertunge ind gennem denne. Videre er isens ydergrænse gået fra Addit og sydpå langs Gudenås vestside.

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Plate 1

Fig. A. View of the central section of the Salten Valley, seen from the esker-like hill at Katrinedal brickworks westwards. To the right the valley is filled by many hills.

Fig. B. The clay pit in the Igelsø terrace, with Tertiary clay covered by Tertiary and diluvial sand.

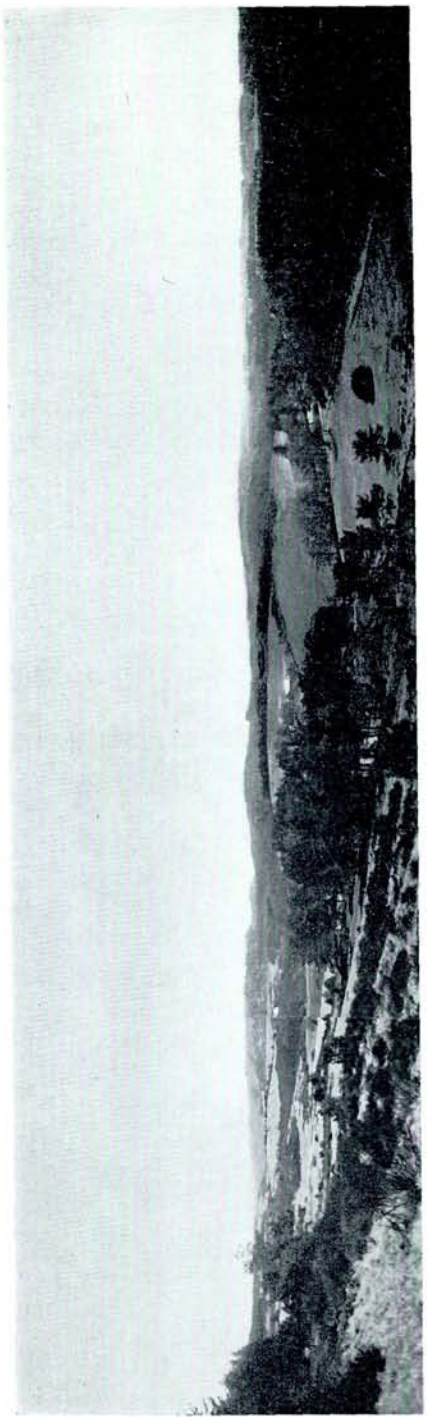
A

B

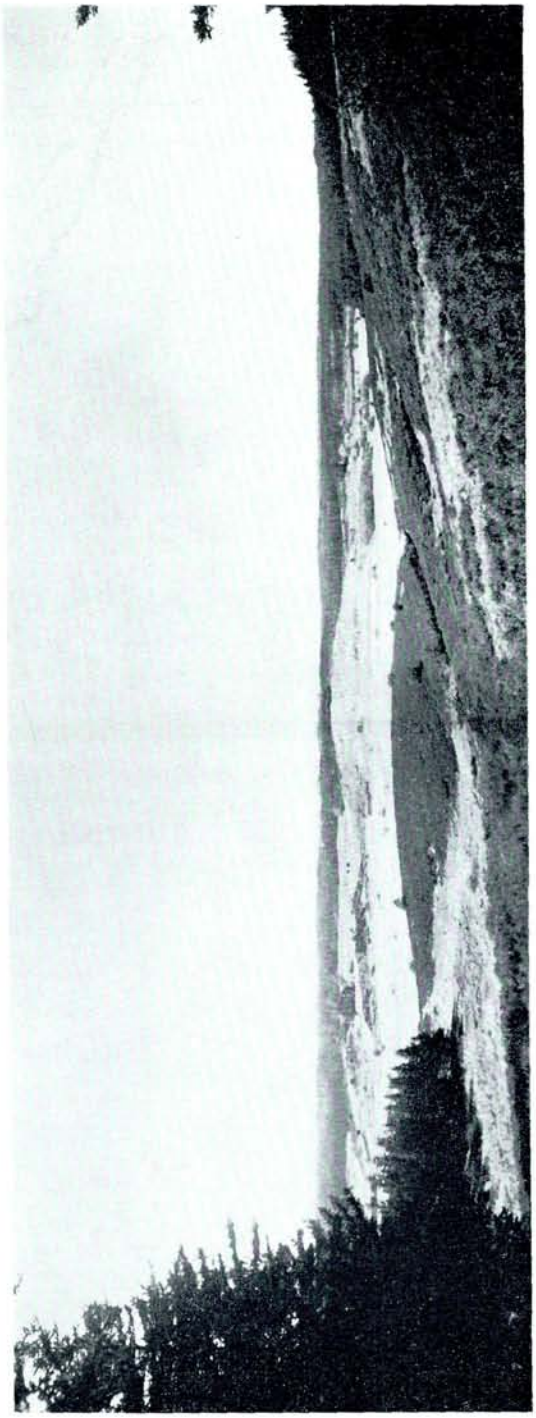
Plate 2

Fig. A. The Salten Valley at Andsø Møllegård sen from the northern slope at Torbjerg. In the background to the right the village Vrads. The valley is filled with isolated hills.

Fig. B. Vrads Sande.The uppermost terrace on the southern side of the western section of the Salten Valley. Drift sand and several large dunes cover the terrace.



A



B

Plate 3

Map of the Salten Valley and the surrounding country.

Legend:

1. Contour curves on the sandurs.
2. Terminal moraines from the Weichsel galciation.
3. Hilly areas older than the Weichsel glaciation.
4. The present bottom of the Salten Valley.

a-e. Terraces in the Salten Valley, mentioned in the text.
I–IV. Position of the cross sections shown in text-fig. 1.