ARCHAEOLOGICAL BACKGROUND OF ANCIENT LAKE PÄIJÄNNE AND GEOLOGICAL DATING OF THE MESO-NEOLITHIC BOUNDARY IN FINLAND

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ABSTRACT

The elevation of the Ancient Lake Päijänne transgression maximum has been studied with the aid of 27 datable Stone Age shore-side dwelling places. The transition from the Mesolithic Stone Age to the Neolithic Stone Age and the change of the discharge channel of Ancient Päijänne from the Hinkua river to the Kymi river were almost simultaneous occurrences. The absolute age, expressed in $^{14}$C-years, is in the order of $5810 \pm 70$ years. The transgression niveau is supposed to be nearly linear.

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Tasks

Archaeology

The aim of this article is, by applying geological methods, to throw light on a question that has long occupied the minds of archaeologists, namely the age of the comb-ceramic culture, the phase limit $S/Ka^1$ or the boundary between the $^1$ $S=$ Suomusjärvi group, $Ka=$ comb-ceramic group. Mesolithic and Neolithic periods of the Stone Age. In absolute chronology it has traditionally been placed at about the year 3 000 B.C. (e.g. Kivikoski 1961 p. 9). However, in 1926, on the basis of the gradient of the shore line, Ramsay placed the end of the Ka I I-phase at around the year 3 450 B.C. (Ramsay 1926 p. 47). In 1955, Äyräpää suggested that the beginning of the
Ka-group, along with the Swedish Vrå-group should be shifted to the year 3500 B.C. (Äyräpää 1955 p. 46), while Luho went a step further and, although only incidentally, expressed the idea that the phase in question might lie on the L I-shore of Sauramo (cf. also Virkkala 1953 p. 70); that would shift the beginning of the phase to the year 4000 B.C. in the absolute chronology of Sauramo (Luho 1957 p. 159, cf. Sauramo 1955 p. 338). A fragment on an earthen vessel of the Ka I1-style was found in the Niinnikumpu bog in Kitee; on the basis of a pollen analysis the fragment was assigned by Luho to the vegetation historical zone boundary VI/VII (Luho 1957 p. 142); however, in the pollen diagrams, the zone boundaries VI/VII and VII/VIII cannot be determined with accuracy (Donner 1963 p. 8). Later, Luho placed the S/Ka boundary between the years 4000 and 3000 B.C. (Luho 1965 p. 54). The present author has suggested that the comb-ceramics appeared on the scene of material culture before 3500 B.C. but he also is unable to define an earlier time limit (Siiriäinen 1969 p. 68).

Geology

Since the dwelling places of the Stone Age fishing and hunting cultures were situated in the immediate proximity of the shoreline, they have proved to be suitable material for the study of shoreline displacement (cf. Siiriäinen 1969). Archaeologically, the dwelling places can be arranged in a relative order of age which enables the synchronous shorelines of the watercourses to be determined. In the case of Päijänne, this is of particular interest, because in the distance diagram of Risto Aario, the synchronous shoreline representing the highest position of Ancient Päijänne (= Päijänne before the breakthrough of the southern discharge channel) has been defined as a curved line the definition of which is in conflict with the findings of Tolvanen (Aario 1965 a, Tolvanen 1922). This matter can be tested archaeologically; in chapter III, the transgression of Ancient Päijänne is reviewed in the light of Stone Age dwelling places.

Fig. 1. Map showing the datable Stone Age dwelling places in the Ancient Päijänne basin and the direction of the base line used in the distance diagrams, Fig. 2 and 5 (according to Aario).

Transgression of ancient Päijänne and Stone Age dwelling places north of the present-day Päijänne

Observations at Pihtipudas and Viitasaari

The distance diagram, Fig. 2, shows the following Stone Age dwelling places in the northern part of the Päijänne lake complex in which key
objects of the S-group (cf. Äyräpää 1950 a) or ceramics have been found. In connection with archaeological surveys at Pihtipudas (Leena Roine, 1964) and Viitasaari (Siiriäinen, 1969) it was established that these sites of discovery had been dwelling places. Excavations have been carried out at only four sites. The elevations of the others have been determined from basic maps with a scale of 1 : 20 000 on the basis of the height curves closest to the dwelling places and running below them.

**Group S**

P 38

Pihtipudas Koivukangas,
basic map 2343 08, coord. \( x = 7 \, 052 \, 86, \)
\( y = 565 \, 76, \text{altitude 125 m.} \)
On a gently sloping SW-hillside; field.
Datable finds: two chisels with bifacial percussion, KM 10 422 : 1 and 3.

P 39

Pihtipudas Rimpisalo,
2343 10, \( x = 7 \, 049 \, 14, \)
\( y = 570 \, 16; \)
122.5 m.
On a gradual western slope of a long ridge in a northsouth direction; field
A club with a funnel-shaped hole, KM 14 901 : 2.

P 40

Pihtipudas Teini,
2343 10, \( x = 7 \, 048 \, 82, \)
\( y = 569 \, 98; \)
122.5 m.
On the top of a low hill; field.
A club with a funnel-shaped hole, KM 14 454.

P 41

Pihtipudas Auhtola,
2343 07, \( x = 7 \, 049 \, 22, \)
\( y = 569 \, 43; \)
122.5 m.
On the top of a low hill; field.
A club with a funnel-shaped hole, KM 14 456.

P 52 A

Pihtipudas Vuohtojärvi,
2343 07, \( x = 7 \, 049 \, 77, \)
\( y = 561 \, 63; \)
125 m.
On a southern slope south of an esker; field.
Excavations by J. Ailio in 1902 (area II).
Two fragments of leaf-shaped points of schist, KM 4 148 : 12.
Ailio 1909 p. 144, Meinander 1964 p. 36.

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Fig. 2. Distance diagram with the transgression maximum of the northern part of Ancient Päijänne and the dwelling places of the S- and ceramic groups.

**Viitasaari Lamminpää,**
3311 07, \( x = 6 \, 987 \, 75, \)
\( y = 442 \, 24; \)
112.5 m (A)
3311 07, \( x = 6 \, 987 \, 91, \)
\( y = 442 \, 32; \)
112.5 m. (B)
A: on the top of a low till covered hill,
on a gradual eastern slope; forest,
B: on the NE-slope of a low morainic ridge projecting southward; field.
A broken half of a club with a funnel-shaped hole, Ilmolahti elementary school.

**Viitasaari Ruuppo,**
3311 09, \( x = 7 \, 003 \, 90, \)
\( y = 444 \, 52; \)
115 m.
On a sandy plane at the NW-foot of a steep hill, above a distinct abrasion scarp (Ancient Päijänne) that has cut into the sand; forest.
An axe with bifacial percussion, KM 18 142

**Viitasaari Siirtola,**
3311 09, \( x = 7 \, 002 \, 32, \)
\( y = 446 \, 59; \)
115 m.
On a gradual sandy NW-slope of a low morainic hill, above a slightly steeper portion of the hillside; forest.
A leaf-shaped point of schist, KM 13 362.
Viitasaari Ottola,
3312, x = 7 015 58, y = 430 90; 120—125 m.
On the top and on the southern slope of a low esker projecting in a SE-direction; field.
A hollow chisel with a curved back, KM 2 029 : 86.

P 20

PR

Pyhäjärvi Rajahoikka,
2343 08, x = 7 054—55, y = 567, 122.5 m.
About 40 stone objects which indicate that the area was heavily populated (leaf-shaped points of schist KM 3 354 : 66, 8 922 : 11, 12, 16, 13 846 : 1—3; objects with bifacial percussion KM 5 928 : 1, 8 922 : 2, 7, 13 846 : 6, 7; a club with a funnel-shaped hole KM 8 922 : 22) have been found in the fields of Rajahoikka farm, east of Lake Iso Kotajärvi, situated on a W-slope at the neck of ancient Hinkua river, 122.5—125 m above sea level. In 1909 Europaeus (Åyräpää) discovered a dwelling place in the area.

P 27


P 50

Pihtipudas Madeneva,
3312, x = 7 031, y = 426; 115 m.
On the northern slope of the Madeharju esker and on the southern edge of the Madeneva bog, above a distinct abrasion scarp; forest.
Excavations by C. F. Meinander in 1950 and V. Luho in 1950 and 1956.

P 52 B

Ka II 1- and Ka I 2-ceramics, latter found at an elevation of 115—120 m above sea level, and asbestos-ceramics, KM 12 520, 12 589, 13 887, 16 422. Meinander 1964 p. 35.

Pihtipudas Ohtola,
3312 03, x = 7 030 87, y = 429 14; 115 m.
On the SE-slope of the Putaanvirta river, northern shore; field.
Excavations by V. Luho in 1968 did not lead to discovery of an area that had been inhabited.
Ka I 2- and Ka II 1-ceramics, KM 12 389, 12 591.

P 20

Pihtipudas Virtala,
3312 03, x = 7 032 07, y = 428 89; 116.5 m.
Excavations by Th. Schvindt in 1900 and J. Ailio in 1902 and 1911.
Ka II 1- and Ka II 2-ceramics, KM 3 938, 5 921.
Ailio 1909 p. 141, Meinander 1964 p. 34.

Pihtipudas Luomala,
3312 05, x = 7 028 09, y = 432 22; 111—115 m.
On the gradual western slope of the Kolimajärvi lake shore; yard.
A flint flake, KM 16 659 (flint does not occur in Finland until the Ka II 1-phase).

Pihtipudas Kokkomäki,
2334 09, x = 7 037 63, y = 568 92; 115.
On the SW-slope of a high esker; forest.
Asbestos ceramics, KM 16 993 : 2, 3, 8.

Pihtipudas Juntinniemi,
3312 03, x = 7 037 59, y = 429 95; 113.5—115 m.
On a SE-hillside gently sloping to Lake Saani; forest.
Ka II 1-ceramics, KM 15 459 : 1.
Meinander 1964 p. 33.

Pihtipudas Vuohtojärvi,
2343 07, x = 7 049, y = 562; 120 m.
On the southern slope of an esker; field.
Excavations by J. Ailio in 1902 (area III).
Ka II 1- and Ka II 2-ceramics, KM 3 938, 4 148.
Ailio 1909 p. 144, Meinander 1964 p. 36.
Archeological background of Ancient Lake Päijänne

3311 06 1 Viitasaari Jokela, 3311 06, x = 7 003 34, y = 437 33; 100—102.5 m. On a sloping eastern hillside at the upper end of the bay of Myllylahdi; field. Ka II 1- and Ka II 2-ceramics, KM 17 332.

3311 08 3 Viitasaari Mertainsaari, 3311 08, x = 6 997 78, y = 443 50; 100—105 m. On the SW-shore of a small (about 300 x 100 m) island; yard. Fragment of a Ka II 1-style earthen vessel, KM 11 653.

3311 09 1 Viitasaari Järvilinna, 3311 09, x = 7 001 32, y = 440 27; 100—102.5 m. On a sloping SW-hillside at the upper end of the Taimonlahti bay; field. Ka II 1-ceramics, KM 15 869, 17 333.

The diagram also indicates the highest position of Ancient Päijänne according to studies carried out by Tolvanen and Risto Aario, as well as the water levels of the present-day lakes Keitele, Kolima, Löytänä, Alva and Muuras. It can be seen that except for site P 48, all the dwelling places where S-group finds were made are located at the height of the transgression maximum of Ancient Päijänne whereas all the dwelling places of the ceramic group are situated below this level, 1—4 m above the present levels of the lakes.

The most ancient ceramics representative of the style phase Ka I 1 were found at dwelling place P 48; this site is the closest to the highest niveau of Ancient Päijänne which, according to Aario, is 119 m above sea level. In the small excavation area of site P 48, in addition to Ka I 1-ceramics, a fragment of an earthen vessel assignable to Ka Sär I-ceramics has been found. It has been held that this group of ceramics belongs to the Ka II 1-phase but this conception may change (cf. Siiriäinen 1969 p. 57). An unpolished axe with bifacial percussion and a leaf-shaped point of schist were also found. The fact that objects such as these which, without doubt, are of the S-group type, are represented in finds made in a dwelling place slightly below the maximum niveau of Ancient Päijänne, can be interpreted in two ways: (1) objects of the type involved were in use in central Finland as late as the early comb-ceramic period (cf. Äyräpää 1950 b p. 10, 12, Luho 1957 p. 153) or (2) the site was inhabited during the S-culture period. The latter interpretation would justify the dating of the objects at before or just after the culmination of Ancient Päijänne. The latter alternative would seem more appropriate because the objects as well as the ceramics were, according to Ailio’s report, found at the same level and no evidence of the transgression could be found in the cultural stratum.

What has been stated above implies the dominance of the Stone Age S-group during the niveau representing the culmination of the transgression, i.e. the drying out of the northern and the breakthrough of the southern discharge channel; the Ka-phase began, however, immediately after opening of the Vuolenkoski channel. The regression that followed the opening of the discharge channel of the Vuolenkoski rapids reached the Äänekoski threshold no later than during the archaeological Ka I 2-phase (dwelling places P 5 and P 18). In other words, Lake Keitele and the lakes to the north of it had by then been formed into independent lakes.

The northern outlet of Ancient Päijänne in archaeological chronology

The geochronology of Ancient Päijänne can be correlated with archaeological chronology also in another way. The distance diagram, Fig. 3, shows those dwelling places of S- and Ka I 1-groups where investigatory excavations have been carried out. The location of the sites concerned is in the Baltic Sea basin in southern and central Ostrobothnia (as regards the construction of the diagram, reference is made to Siiriäinen 1969 p. 47). The area is the shore of continuous regression and thus even during the eustatic
transgressions, the dwelling places are in order of age from the top down. The diagram also shows the lowermost delta sediments of the Hinkua river as the discharge channel of Ancient Päijänne, situated in the Kalajoki river valley in the commune of Haapajärvi, in Kortejärvi. These delta sediments indicate the water level of the Baltic Sea basin at the time when the Kymi river was replacing the Hinkua river as the discharge channel of Ancient Päijänne. The delta is situated at an elevation of 80—81 m above sea level (Aario 1965 a p. 78, 87) and consequently appears in the diagram in the transitional zone between groups S and Ka I 1. The gradient obtained for the tilt in the niveau of the marine stage at the period comprising the end of the Ka I 1-phase was ca. 14.5 cm/km (Siiriäinen 1969 p. 59). Being older, the gradient for the niveau corresponding to the end of the S-phase is slightly greater. If, in the diagram, dwelling place No. 7 (Kuortane Haavistonharju) is marked at a distance corresponding to the distance of the delta formation (85 km) at the elevation concerned, its position would be 1—2 m below the delta, i.e. at a height of about 79 m, provided the above-mentioned gradient value is applied. Thus, the youngest dwelling place of group S is slightly younger than the last delta sediments of the Hinkua river which formed before the river bed dried out.

**Dating of the Meso-Neolithic boundary**

Observational data pertaining to the northern parts of the Päijänne lake complex and to Ostrobothnia respectively led to the same result: it was the S-phase of the archaeological succession that prevailed when Ancient Päijänne, after becoming independent, attained its transgressive culmination which abruptly changed into regression as masses of water in the south transgressed the Vuolenkoski threshold. The Ka I 1-phase began immediately after this geological phenomenon had occurred. It is known that, in the Baltic Sea basin the Ka I 1-phase lies at the shore of the II transgression of the Litorina Sea (cf. Donner 1964 p. 36, Siiriäinen 1969 p. 67); thus, in geochronology the Meso-Neolithic phase limit S/Ka can be placed between the transgression maximum of Ancient Päijänne and the II transgression of the Litorina Sea. Furthermore, it seems that in terms of time the phase limit falls very close to the transgression maximum of Ancient Päijänne. The schematic diagram, Fig. 4, shows the shoreline displacements in the Baltic Sea basin, in Keitele and Päijänne. The diagram also indicates the $^{14}$C-datings for the aforementioned transgressions. The dating for L II was obtained in Sweden, indirectly from material pertaining to Vrå-group Stone Age dwelling places lying on the L II-shore (Florin 1963 p. 257); however, since it is indirect, the dating is not fully reliable. The dating for Ancient Päijänne, which in this connection is of greater interest because it determines the dating for the terminal phase of group S, originates from the neighbourhood of Heinola (Aario 1965 p. 78, 87).
Archeological background of Ancient Lake Päijänne

3860 B.C. (5810 ±70 B.P.)

Fig. 4. Schematic diagram showing the shoreline displacements in the Baltic Sea (A), Lake Keitele (B) and Lake Päijänne (C) basins and the C14 datings for the culmination stages of the Ancient Päijänne and L II-transgressions. Not to scale.

a p. 178). Since the transgression limit is synchronous in the whole of Ancient Päijänne — the lake changed its discharge channel only once — the dating (5810 B.P.) is also valid in the north (see also Aario 1965 b p. 218). Consequently, we may conclude that the S/Ka phase-limit falls between the years 3800 B.C. and 3500 B.C., probably in the immediate proximity of the year 3800 B.C. In her study on shoreline displacement along the Finnish sea coast, Okko (1967, p. 31) suggested the same approximate age of 5800 years for the beginning of the Neolithic Stone Age.

Ancient Päijänne and Stone Age dwelling places on the Päijänne basin

In the foregoing, it was established that in archaeological chronology the transgression maximum of Ancient Päijänne is confined within the S/Ka transition zone. On the basis of his stratigraphic investigations, Risto Aario placed the niveau concerned south of Jyväskylä, at a level considerably below the one indicated by the shore-morphological investigations carried out by Tolvanen (Tolvanen 1922). Furthermore, according to Aario, this synchronous niveau curves in such a way that its gradient becomes more gradual as the Vuolenkoski threshold is approached (cf. Aario 1965 c); the curving would be caused by uneven land uplift. The niveau determined by Tolvanen is linear and, as has been mentioned, is above Aario's niveau. The differences are considerable: in Jyväskylä, 3 m, in Jämsä, 7 m, in Kuhmoinen, 9 m and at the Vuolenkoski threshold, 6.5 m. The transgression niveaus given by these investigators merge north of Jyväskylä.

In order to clarify the synchronism of the niveau given by Aario for Ancient Päijänne, the following Stone Age dwelling places located on the shores of Päijänne and Kynsivesi were marked on the diagram, Fig. 5:

1. Asikkala Kotasaari,
   basic map 3112 03, coord. x = 6798 48, y = 425 63; altitude 81.5 m (asbestos ceramics) and 83 m (Ka II 2-ceramics)
   Above a rather steep slope on the SE-shore of an island about 400 x 250 m in size; field.
   Datable finds: Ka II 1- and Ka II 2-ceramics as well as asbestos and textile ceramics, KM 15 466, 15 789.

2. Luhanka Päivärinne,
   3122 02, x = 6846 08, y = 422 52; 94 m.
   On the eastern slope of a valley about 200 m wide in a north-south direction; yard.
   Ka I 1-ceramics, KM 17 130.

3. Korpilahti Lähdemäki,
   3211 04, x = 6865 08, y = 433 20; 90 m.
   On a gentle western slope about 100 m from the eastern shore of Virtasalmi; pasture-land.
   Ka II 1-ceramics, KM 16 358, 16 823.
4. Korpilahti Kortelahti,
3211 04, x = 6 868 00, y = 433 66; 89.5 m.
On a southern slope about 100 from Lake Ylisjärvi
northern slope; forest.
Ka II 2-ceramics, KM 16 357.

5. Muurame Muuramenkangas,
3212 04, x = 6 890 92, y = 430 36; 95—97 m.
On the eastern side of the Muuramenharju esker; at the
place of discovery the slope is very gentle; sports
field.
Excavations by J. Ailio in 1930.
Ka I 1- and Ka II 1-ceramics, KM 9 318.

6. Hankasalmi Salo,
3214 03, x = 6 950 00, y = 463 60; 90.5 m.
On the gently sloping eastern shore of a narrow cape
in a north-south direction, projecting into Lake
Kynsivesi; field.
Ka II 1-, Ka II 2- and asbestos ceramics, KM 3 006,
4 340, 5 427.

It can be seen from the diagram that all the
dwelling places fall below the highest stage of
Tolvanen’s Ancient Päijänne but, except for site
6, above the corresponding niveau given by
Aario. In the terrain, the position of the dwelling
places is similar to that of the waterside dwelling
places. Since the cultural stratum is in sand,
there is no reason for regarding them as not
being confined to the shore. It would also be im-
probable that the dwelling places along the
present-day Päijänne basin should be less
strictly confined to the shore than would those
farther north and along the Baltic Sea basin. The
dwelling places indicate that the transgression
of Päijänne extended beyond the niveau given
by Aario. Dwelling place 2 which, archaeolog-
ically, is the oldest of the group (Ka I 1), falls,
in its relation to Tolvanen’s niveau, in the same
position as dwelling place P 48 (Fig. 2), above,
in its relation to the common niveau of Tolvanen
and Aario.

Thus, according to archaeological observ-
ations, Aario’s niveau must be regarded as
metachronous. Since in the diagram, even the
dwelling places of Ka II-phase fall above the
niveau, it must be at least 1300 years older north
of Päijänne than in the south on the shore of the
present-day Päijänne. Dwelling place 2 in the
diagram, Fig. 5, indicates that the transgression
of Ancient Päijänne extended to the niveau sug-
gested by the morphological studies of Tolva-
nen, i.e. 9—10 m above the niveau given by
Aario. The above-mentioned change in level
will not invalidate the dating for the transgres-
sion maximum given on page 125.

The regression that followed the breakthrough
of the Vuolenkoski channel was very rapid. In
the northern part of Päijänne, during phase Ka I 1
the water level fell at least 4—5 m or \( \frac{1}{4} \) of its
entire drainage. There are still ceramics per-
taining to this phase in dwelling place 5 at Muu-
rame, i.e. at an altitude of 95—97 m.

Summary

The answer to the archaeological problem
posed at the beginning of this article is that the
transition from the Mesolithic Stone Age (group
S) to the Neolithic Stone Age as the result of the
intrusion of comb-ceramics, and the change of
the discharge channel of Ancient Päijänne from
the Hinkua river to the Kymi river were almost
simultaneous occurrences. The absolute age,
expressed in \( \text{C}^{14} \)-years, is in the order of 5 810 ±
70 years.

The Stone Age dwelling places of the Päi-
jänne shore appear to indicate that the trans-
gression of Ancient Päijänne extended beyond the
niveau defined by Aario; it is possible that the
transgression niveau defined earlier by Tolva-
nen is correct. The Stone Age dwelling places
in the Ancient Päijänne lake complex region are
still too few to establish this matter. They are
also too few in number for a final determination
as to whether the transgression niveau is curved
or linear. However, the material presented in
this article rather suggests it is linear.
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