Neolithic Period in Switzerland and Denmark

J. Troels-Smith

The first problem taken up by the Radiocarbon Dating Laboratory in Denmark dealt with the Alleröd climatic oscillation (*1*). The second has been the dating of the oldest Neolithic period in Europe.

Two dwelling places were chosen as especially well suited: Egolzwil 3, Wauwilermoos, Lucerne, Switzerland, and Mul. I, Aamosen, Zealand, Denmark. In both places, the culture layers are imbedded in Quaternary sediments, which makes palynologic pollen analytic dating of the layers possible. It is a further advantage that not only charcoal but also other organic material such as wood, bark, hazelnut shells, gyttja, swamp peat, and so forth, are preserved and can be used for radiocarbon dating.

H. Tauber has given the age determinations on these samples (*2*). Some comments are presented in the following paragraphs, on archeologic, geologic, and botanical aspects in connection with a discussion of both dwelling places (*3*).

Switzerland

The dwelling place Egolzwil 3 is situated about 30 kilometers northwest of Lucerne, Switzerland, in the northern part of the former Lake Wauwilersee, which is now dried out. The archeological investigation of the culture layers was performed by Emil Vogt of the Landesmuseum in Zurich (*4, 5*). The artifacts found in the culture layer originate in the Older Cortaillod culture which, culturally, belongs to the Western European neolithic culture group. The Cortaillod culture represents the oldest agriculture that has been found to date in Middle Switzerland. In the culture layer was found a beautifully ornamented earthen vessel of Rössen type, which indicates that the Older Cortaillod culture must be contemporary with the Rössen culture.

The culture layer is imbedded in a layer of calcareous lake mud. Toward the land, the latter is approximately 0.60 meter thick, and toward the former lake it is 2 meters thick above the culture layer. Underneath the culture layer, the calcareous mud extends to a depth of at least 1 meter. Geologic investigations and pollen analyses, carried out in connection with the archeological excavation, indicate that, at the time of the settlement, there was a more or less dry pasture; this is in agreement with Vogt's viewpoint, which is based on archeological studies (*4–6*).

Through pollen analyses, the dwelling place can be dated to the time immediately after the first strong decline of the beech curve. It should be noted, however, that the fall of the beech curve is most probably the result of the fact that the first peasants on the place cleared the beech forest in order to gain space for arable land and to promote growth of trees that provided useful leaf fodder. This means that the fall of the beech curve is not due to climate and, consequently, it cannot directly be applied as a synchronous level. On the other hand, it is reasonable to assume that the oldest neolithic agriculture in Switzerland was so extensive that the beech fall occurred almost simultaneously at locations within the Swiss lowland between the mountains of Jura and the Alps. Furthermore, it should be mentioned that the lake marl at the bottom of the culture layer and 0.10 meter down contains pollen of plants favored by culture—that is, broad-leaved plantain and cereal—so that we have reason to assume that the culture layer does not represent the very oldest agriculture in this region, although the difference in time can only be insignificant (Fig. 1) (*6*).

While the material for the carbon-14 measurements was being collected, the following viewpoints were considered important. (i) The samples must with certainty be synchronous with the culture layer. (ii) It is desirable, whenever possible, to obtain samples of different organic material.

Samples of vertical piles were therefore deliberately rejected as dating material, since it is difficult to ascertain their simultaneity with a given culture layer. Samples K-115 and K-116 were taken from wood that was imbedded horizontally in the culture layer proper; their dates are 2550 ± 150 B.C. and 3130 ± 280 B.C., respectively. Sample K-118 consisted of lime bark that was found directly below the culture layer. Vogt assumes that the dwellers used bark to protect themselves from the moisture of the ground. The result of three determinations gives a date of 2830 ± 140 B.C. Further, charcoal (sample K-121) was dated to 2770 ± 130 B.C. Consequently, the mean date of the culture layer is found to be 2740 ± 90 B.C. (7–9).

From a geologic point of view, it will be difficult at the present to gain more than a rough estimate of the age of the dwelling place; from an archeological viewpoint, one might set the date closer to 2000 B.C. than to 3000 B.C. because the Older Cortaillod culture is contemporaneous with the Rössen culture, which, in turn, must be younger than the Older and the Younger Danubian culture. On the other hand, if the carbon-14 determinations performed on material from Older Danubian culture dwellings (charred wheat, Westeregeln, Magdeburg, 4250 ± 200 B.C.; and charcoal, Wittislingen a.d. Donau, Dillingen, 4080 ± 110 B.C.) (*10*) are correct, this culture is so much older than has hitherto been assumed that the dating result of 2700 B.C. for both the Cortaillod culture and the Rössen culture appears to be reasonable.

While the Cortaillod culture apparently advanced from the west or southwest into Switzerland, the Michelsberg culture belongs to the northern and eastern parts of Switzerland. The finds that indicate a certain contact between these two cultures should be dated to the Younger Cortaillod culture. Recently, wood from the Michelsberg dwelling place, Weiher, near Thayngen in northeastern Switzerland, has been dated in Groningen; the result is 2780 ± 130 B.C. (*10*). This result means that the wood is contemporary with the Older Cortaillod culture of Egolzwil 3. Consequently, the Michelsberg culture becomes older than has been assumed so far. Near Weiher, three cultural horizons have been observed, and it would be important to know from which of these horizons the dated wood originated.

Denmark

The dwelling place Mul. I (Sandlyng complex, Aamosen, Zealand, Denmark) has been excavated in the course of the last 5 years under my direction. The artifacts that have been found belong to the late Ertebølle culture and are characterized by typical flat-trimmed flake axes, blade implements, and transverse arrow heads; numerous small bore points are typical of the dwelling place, together with oblong flake scrapers and

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round discoid scrapers, and a flake of a polished, pointed-botted, flint axe. Also ceramics, both thick-walled and coarsely built of strips, and thin-walled and of laminated structure, were found. The first shards correspond to the typical, pointed base Ertebølle vessels, while the latter, with respect to both material and to ornamentation, point to the A-ceramic that was suggested by Becker (*11*). The bones found originate from game: red deer, roedeer, boar, beaver, and so forth. However, a few finds indicate knowledge of agriculture—for example, an impression of a wheat grain in a shard belonging to an A-vessel, and some bones of tamed cow, sheep, or goat.

The excavation was carried through by means of a minute technique which, together with stratigraphic investigations, shows that all artifacts must have been left behind on the place within a very short period of time (*12*). The culture layer is covered by alder-wood peat to a thickness of 1 meter and rests on a layer of swamp peat 0.40 meter thick. The layer of swamp peat is separated from the underlying calcareous lake mud by a layer of drift mud varying in thickness from 0.10 to 0.30 meter. In the drift mud, artifacts occur which are identical with those imbedded in the culture layer that is situated about 0.40 meter higher. It can, for example, be mentioned that potsherds found in the drift mud fit together with potsherds from the culture layer.

Although it is most reasonable to assume that the drift mud was deposited simultaneously with the layer of the dwelling place, the theoretical possibility cannot be excluded that the drift mud and the artifacts found in it could have been deposited at a later period. The palynologic dating of the place shows that the drift mud was deposited at a time after the decline of the *Ulmus* curve and before lanceolate plantain started to spread in larger quantities in this region. The dating of the dwelling-place layer—which presupposes that the deposition of the culture layer and the drift mud occurred at the same time—is in agreement with the fact that four palynologic datings of singly found earthen vessels of Becker's type A should belong to exactly the same period in the pollen diagrams. This finding indicates that the drift mud was deposited simultaneously with, or at least but slightly later than, the culture layer (Fig. 2).

The material used for the carbon-14 dating of the dwelling place originated partly from the culture layer proper—for example, bark (samples K-124, K-125, and K-126), hazelnuts (samples K-128 and K-129), and charcoal (samples K-131 and K-132). Other material consisted of alder-wood peat from directly above the culture layer (sample K-127), swamp peat from immediately below the culture layer (sample K-123), swamp peat mixed with mud from directly above the drift mud (sample K-148), and calcareous lake mud from directly below the drift mud (sample K-149). From the drift mud proper, four samples have been dated, two single samples from the center of the layer (K-122 and K-156) and two samples from the same place as K-148 and K-149—that is, sample K-137, which was taken in the upper part of the drift mud, and sample K-136, which was

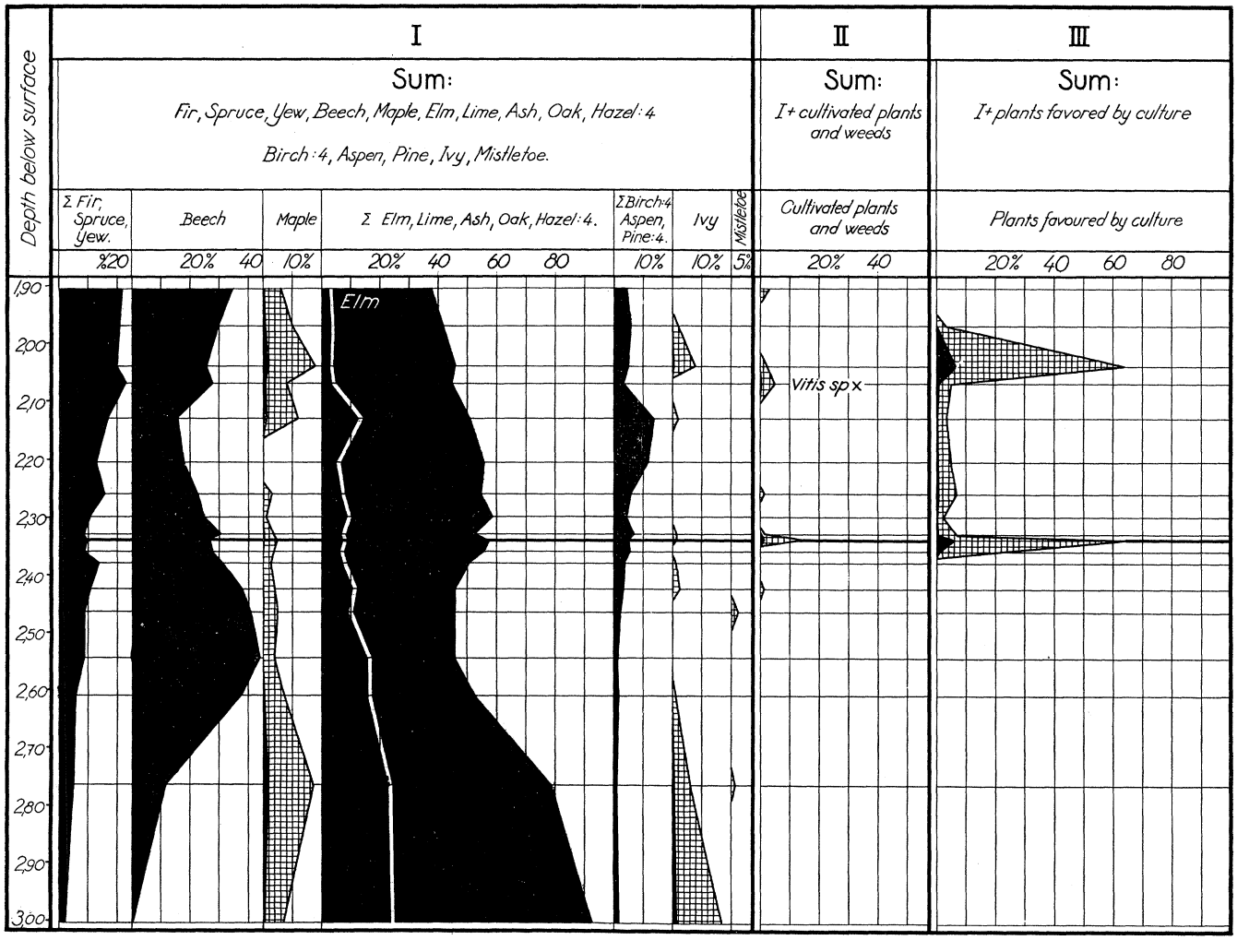

Fig. 1. Pollen diagram of locality about 5 meters south of the dwelliing place Egolzwil 3 toward the former lake. The black silhouettes give the percentages, and the shaded curves give percentage × 10. The heavy line between 2.30 and 2.40 meters below the surface indicates the location of the dwelling place in the diagram (*13*).

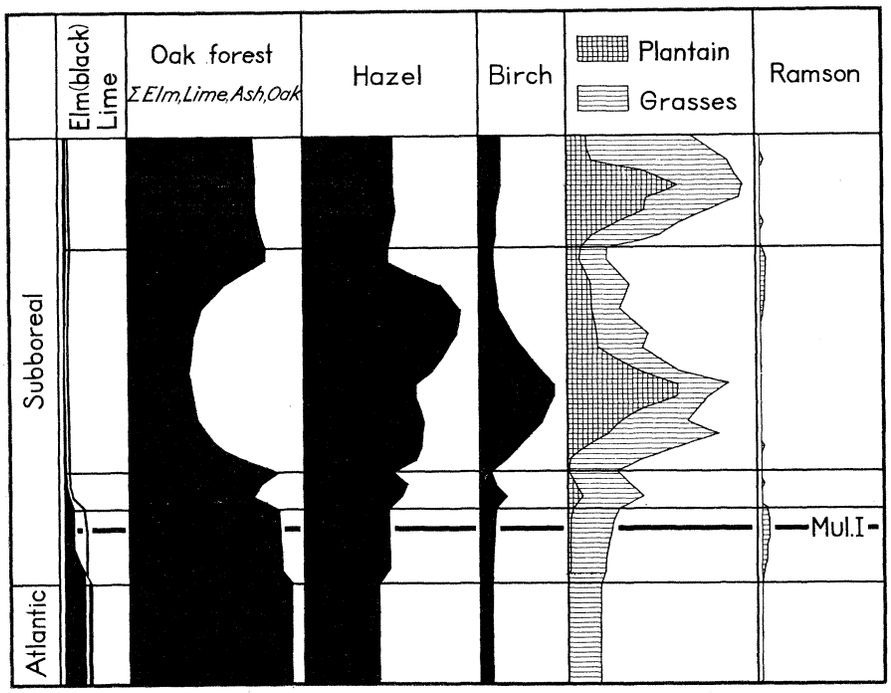

Fig. 2. Schematic pollen diagram showing the occurrence of some important trees and herbs in late Atlantic and early Subboreal time. The full-drawn curves indicate percentages, the shaded ones give percentage × 10. The heavy line indicates the pollen-diagrammatic age of the dwelling place Mul. I (*14*).

taken from the lower part (see the schematic profile, Fig. 3).

The carbon-14 date of the bark, hazelnuts, and charcoal from the culture layer is 2630 ± 80 B.C. The dates of alder-wood peat from above the culture layer and of swamp peat from below the culture layer, respectively, are 2700 ± 120 B.C. and 2530 ± 120 B.C. Strangely enough, the younger peat layer turned out to be older, and vice versa. This is within the statistical error of the measurements, but still, the carbon-14 dating seems to indicate that the building period of the dwelling place was very short; in other words, the dwelling place was built on the swamp peat that was deposited during the immediately preceding period, and the culture layer was covered by alder-wood peat immediately after the settlement was abandoned. The mean of the two figures gives an age very close to that of the artifacts.

The dating results of the samples of drift mud call for more detailed comments. Samples K-137, K-136, and K-156 are obviously older than the culture layer—that is, they date 3200 ± 160 B.C., 2970 ± 180 B.C., and 2850 ± 160 B.C., respectively, while the fourth sample (K-122) is clearly younger than the culture layer. To clarify this finding, another sample (K-148) consisting of swamp peat mixed with noncalcareous mud was taken from the lower edge of the former floating island of swamp peat; its date was determined to be 3530 ± 170 B.C.; thus it is markedly older than the underlying drift mud. Furthermore, a sample (K-149) was taken from directly under the drift mud where samples K-137 and K-136 were taken; it was composed of calcareous lake mud. The organic fraction of the sample was dated to 3660 ± 180 B.C. It is possible that this sample contained aquatic plants which can have utilized prequaternary carbon and, consequently, the date may turn out to be somewhat too old. However, the result is in reasonable agreement with the geologically somewhat younger sample K-148 from the lower edge of the floating island of swamp peat.

As a consequence of the afore-mentioned datings, it is reasonable to assume

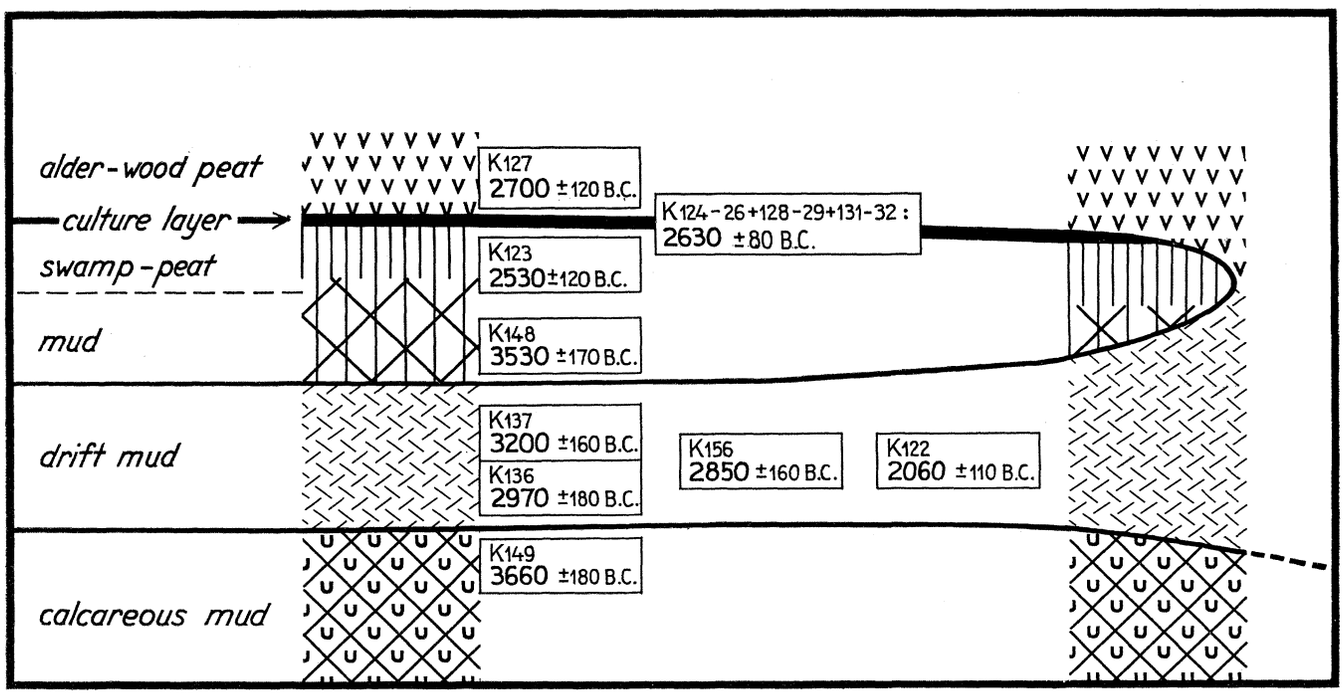

Fig. 3. Schematic section through the dwelling place Mul. I. The dwelling place rests on humified swamp peat and is covered by alder-wood peat. Under the floating island of swamp peat and mud, in the drift mud, artifacts similar to those in the culture layer have been found.

that the drift mud that was interposed between these two layers at a later period has taken up material from the surrounding older layers. This explanation also applies to the sample of drift mud, K-156. With regard to the drift-mud sample K-122, this dating result is difficult to understand. If one does not anticipate contamination of this sample, the possibility exists of a renewed elevation of the island of swamp peat at a later time than the elevation which caused the deposit of drift mud of samples K-137, K-136, and K-156. There is at present no stratigraphic or geologic evidence that this happened. However, the investigations are not yet concluded, and the comments offered here are an attempt at a preliminary interpretation of the results obtained to date.

Conclusion

The main result of the age determinations is that the oldest agricultures in Switzerland (Older Cortaillod culture) and in Denmark (Younger Ertebølle culture and A-earthen vessel) started almost simultaneously, about 2740 ± 90 B.C. and 2620 ± 80 B.C., respectively. Furthermore, the first marked fall of the beech curve in Switzerland is essentially synchronous with the decline of the elm curve in the Danish diagrams.

References and Notes

1. E. C. Anderson, H. Levi, H. Tauber, *Science* 118, 6 (1953); J. Iversen, *Science* 118, 9 (1953).
2. H. Tauber, *Science*, this issue.
3. I wish to express my gratitude to the Carlsberg Foundation for a travel grant that enabled S. Jørgensen and me to go to Switzerland in 1952. The permission of the Heimatsvereinigung Wiggertal and of Emil Vogt, Landesmuseum, Zurich, to take samples for radiocarbon dating from the dwelling place Egolzwil 3 is highly appreciated.
4. E. Vogt, *Z. schweiz. Archaeol. u. Kunstgeschichte* 12, No. 4 (1951).
5. ———, in W. U. Guyan, Ed., *Das Pfahlbauproblem*. Monographien zur Ur- und Frühgeschichte der Schweiz, vol. 11 (Birkhäuser, Basel, 1955).
6. J. Troels-Smith, *ibid.*
7. H. Levi and H. Tauber, *ibid.*
8. Recently, Zeuner (*9*) published two datings from Egolzwil 3. The material was collected by W. Lüdi, Forschungsinstitut Rübel, Zurich, during the excavation in 1952. The expected date of the culture layer, according to Lüdi, is about 1900 B.C. ("The expected age is based on pollen analytical correlation, the absolute age being ultimately dependent on the Swedish varve scale.") The result of the dating is "G1.17, oak, 4000 ± 110 : c. 2050 B.C.; G1.18, ash, 4650 ± 110 : c. 2700 B.C." It would be of interest to know whether the material was taken from vertical piles or from piles imbedded horizontally in the culture layer. In the latter case, the settlement in this place would have lasted for at least approximately 500 years. However, the results of the pollen analyses are in favor of a very short-lasting settlement. A comparison of Zeuner's dating with those made in Copenhagen makes it reasonable to assume that the date of the culture layer is very close to 2700 B.C. (in agreement with Zeuner's sample G1.18) and that the settlement existed for a very short period. Zeuner's sample G1.17 is beyond the age of the culture layer; this can be explained if a vertical pile, which easily may have been driven in at a later period, has been dated.
9. F. E. Zeuner, *Eleventh Annual Report of the Institute of Archaeology, University of London* (1955).
10. H. De Vries and G. W. Barendsen, *Nature* 174, 1138 (1954).
11. C. J. Becker, *Aarbøger for Nordisk Oldkyndighed og Historie* (1947).
12. J. Troels-Smith, *ibid.* (1953).
13. Analyzed by Svend Jørgensen.
14. Drawn on the basis of analyses carried out by Svend Jørgensen and me.

Copenhagen Natural Radiocarbon Measurements II

Henrik Tauber

Archeological samples (*1*) from the earliest phases of the Neolithic period in Switzerland and Denmark were measured in the carbon-14 dating laboratory at Copenhagen during the period from February 1953 to May 1955 (*2*). All samples (Table 1) were excavated and submitted by J. Troels-Smith (*3*).

The Swiss samples originated from the neolithic lake dwelling Egolzwil 3, Wauwilermoos, Lucerne Canton. The settlement is of Older Cortaillod culture, and the samples were taken from a culture layer only a few inches thick and completely imbedded in sterile lake marl. The material used for the dating was wood, bark, and charcoal, which was very well preserved. The wood samples consisted of pieces of thin piles without bark; only the ten outer year-rings were used in the measurements (*4*). The settlement has been dated to the time immediately after the first strong beech fall in the Swiss pollen diagrams (*5*).

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The Danish samples were taken from a neolithic dwelling place Mul. I, in the bog Aamosen, West Zealand, and represent the earliest (phase A, predolmen) Neolithic period in Denmark (*6*). The cultural remains, which are of late Ertebølle culture, were deposited in a thin layer on a floating island of swamp peat. Between this former floating island and the gyttja layer of the bottom of the former lake was found a layer of washed-in drift mud 10 to 40 centimeters thick. The mud contained cultural remains, which are contemporaneous with the cultural deposits from the dwelling place. The samples consisted of well preserved bark, hazelnut shells, and charcoal, as well as swamp peat and drift mud. The time of the settlement coincides with the elm fall in the Danish pollen diagrams.

The samples were measured by using Libby's solid-carbon method as described previously by Anderson, Levi, and Tauber (*7*). Twice during the period of measurements the laboratory was contaminated by fallout from nuclear detonations (October and November 1954 and April and May 1955). All measurements made during these periods have been discarded.

The calculation of the dates is based on a half-life for carbon-14 of 5568 ± 30 years (*8*). The ages are given in the fixed time scale (B.C. and A.D.), and each figure represents a separate run. The errors assigned to the dates include the statistical error in the net count of the unknown sample (e_s), the statistical error in the measurement of the activity of modern wood (e_r) which is used as a reference, and the error in the half life of carbon-14 (e_h). The possible effect of industrial combustion on the activity of modern wood has not been taken into account; such an effect, if present in the area of

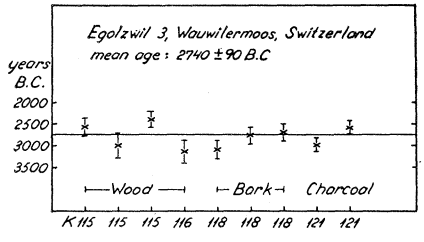

Fig. 1. Dating results from Switzerland.

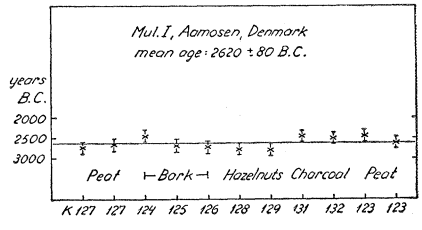

Fig. 2. Dating results from Denmark.