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THE LATE GLACIAL AND PREBOREAL IN THE HINKELSMAAR POLLEN DIAGRAMS : FURTHER COMMENTS [1]

by

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(1 table)

ABSTRACT.- R.T. Slotboom (1982) has proposed a new interpretation of the pollen diagram Hinkelsmaar IV (B.Bastin, 1980) , the Piottino oscillation and the Younger Dryas of this diagram becoming respectively the Younger Dryas and a cold phase in the middle of the Allerød. The present article refutes this new interpretation.

RESUME.- R.T. Slotboom (1982) a proposé une nouvelle interprétation du diagramme pollinique Hinkelsmaar IV (B.Bastin, 1980), dans laquelle l'oscillation de Piottino et le Dryas récent de ce diagramme deviendraient respectivement le Dryas récent et une phase froide au sein de l'Allerød. Le présent article réfute cette nouvelle interprétation.

1.-INTRODUCTION

Since twenty years, the cold Piottino oscillation, which H. Zoller (1960) assumed to be of Preboreal age, is a matter of controversy. I hoped that my pollen diagram Hinkelsmaar IV (B.Bastin, 1980) would contribute to close this controversy. Indeed, thanks to ^{14}C datings, this diagram demonstrated the occurence of two distinct cold phases after the Allerød oscillation : the Younger Dryas at the end of the Late Glacial, and the Piottino oscillation in the beginning of the Preboreal.

Unfortunately, this pollen diagram was recently subject to a misinterpretation by R.T. Slotboom (1982), resulting from a too superficial knowledge of the concerned literature, and leading to erroneous citations. So, although I am not inclined to polemize, I must submit the Slotboom's comments on my diagram to a close criticism !

2.- COMPARISON BETWEEN THE POLLEN DIAGRAMS HINKELSMAAR I AND IV

According to Slotboom, the arguments for his new interpretation of my diagram Hinkelsmaar IV are based on a comparison between this diagram and the diagram Hinkelsmaar I published by H. Straka (1958, 1960, 1961, 1975). For this purpose, Slotboom has drawn a figure in wich the two pollen diagrams are brought together in a somewhat simplified form. Unfortunately, this figure and its comment by Slotboom are both factitious.

1. The two pollen diagrams were obtained from borings carried out at an interval of about 13 m (E.Juvigne, personal communication). In the two borings, a layer of sandy volcanic ash forms a key bed, between 449,5 and 456 cm in Hinkelsmaar IV, between 415 and 425 cm in Hinkelsmaar I. Above this key bed, the limits " Gyttja/Peat " (corresponding to the end of the Piottino oscillation : B.Bastin, 1980) and " Feindetritusgyttja/Grobdetritusgyttja " (corresponding to the limit Younger Dryas/Preboreal : H.Straka, 1958) lie respectively 38,5 cm and 42 cm higher. In his Figure 1, Slotboom should have taken into account this good lithostratigraphical correlation between the two borings, and would have drawn in column C the nine pollen spectra issued from the " Feindetritusgyttja " in the space corresponding to 449,5 - 411 cm in column

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A. Furthermore, the limit Younger Dryas/Preboreal (III/IV) was fixed by H.Straka (1958) at one level higher than indicated by Slotboom !.

Correctly drawn in the above-mentioned way, Slotboom's Figure 1 reveals, above the volcanic ash layer, a deep disagreement between the two diagrams. Thus the Slotboom's assertion that both diagrams are largely in agreement with each other results from a graphic artifice !

2. As mentioned above, the layer of sandy volcanic ash, intercalated in the gyttja deposits of the two borings, is a key bed. In the legend of his Figure 1, Slotboom indicates that this key bed is a Laacher See Tuff. Such an identification was made first by P.D. Jungerius *et al.* (1968), later by E.Juvigne (1980). H. Straka (1958, 1961, 1975) on the contrary has always attributed these sandy volcanic ashes (Tuffsand) to an eruption of the Meerfelder Maar. Furthermore, H. Erlenkeuser *et al.*(1972) have especially devoted one article to refute the views of P.D. Jungerius *et al.* (1968). Therefore, in column C of Slotboom's Figure 1, the presence of a Laacher See Tuff is certainly not "according to H. Straka"!
3. After Slotboom, column B of his Figure 1 represents the chronozones "after F.Firbas, 1949". For the chronozone II, this assertion is wrong, because from 1949 to his death, F. Firbas has always subdivided the Allerød into two phases only : IIa and IIb. In fact, the tripartition of the Allerød adopted here, with a colder phase IIb in the middle, was introduced by H. Usinger (1975).
4. Comparing two pollen diagrams published in 1958 and 1980 respectively is in itself a somewhat unsuitable process. This is particularly true for the parts of the diagrams which are issued from other sediments than peat. Indeed, great progresses were recently made in the field of pollen extraction from mineral sediments (B. Frenzel, 1964 ; B. Bastin, 1971 ; S. Björck *et al.*, 1978). Thanks to new methods, the slides now investigated under the microscope for pollen analysis are very clean, free of any mineral particles which obstruct or even make impossible the identification of relatively translucide pollen grains or spores, such as *Potamogeton* and *Isoetes.* Notheworthy are the facts that in the gyttja deposits :
   - *Potamogeton* reaches an average of 2 °/o in Hinkelsmaar IV (with a maximum of 38 °/o in the Younger Dryas), whereas it was noted with 0,5 °/o in only one level of Hinkelsmaar I.
   - *Isoetes echinospora* reaches an average of 9 °/o in Hinkelsmaar IV (with a maximum of 71 °/o in the Piottino oscillation), but was identified nowhere in Hinkelsmaar I. Moreover, in the diagram Hinkelsmaar E published later by H. Straka (1975), *Isoetes echinospora* reaches values up to 884 °/o A.P. in the uppermost gyttja deposits !

In my opinion, these two examples demonstrate the weakness of a comparison between modern and ancient pollen diagrams.

3.- THE CHRONOZONATION OF THE POLLEN DIAGRAM HINKELSMAAR IV

3.1. THE ^{14}C DATINGS

The two phases of climatic pejoration, registered in the volcanic ash layer and in the uppermost part of the gyttja deposits, were assigned to the Younger Dryas and the Piottino oscillation respectively. These correlations were both supported by the radiocarbon dating of a directly overlying sample of peat. Theoretical considerations lead Slotboom to postulate a rejuvenation of the two dated samples. Once more, in order to avoid polemics, a close criticism must be applied to the Soltboom's comments.

1. The ^{14}C dating Lv 1132 : 10540 ± 90 B.P. (and not 10440 as indicated by Slotboom) is in good agreement with the ^{14}C dating KI-306.01 : 10580 ± 170 B.P. of a 10 cm thick sample of gyttja, directly overlying the "Tuffsand" in the boring Hinkelsmaar I (H. Erlenkeuser & H. Willkomm, 1971).

   Nevertheless, because he considers that the gyttja overlying the sandy volcanic ash layer must be of Allerød age, Slotboom asserts that the ^{14}C dating Lv 1132 is too young.. According to him, the rejuvenation of the radiocarbon dated peat could result from the seepage water, carrying humic acids through the sandy volcanic ash layer. Personally, I do not understand how water seeping upwards through the volcanic tuff layer could rejuvenate the overlying peat !
2. The ^{14}C dating Lv 1131 : 9910 ± 70 B.P. corresponds exactly with the average value of the eight radiocarbon datings published till now from pollen analysed samples, referred either to the Piottino oscillation or to its Dutch equivalent : the Rammelbeek phase (details in B. Bastin, 1980 and in addition B. Van Geel *et al.*, 1981). Moreover, this dating is almost identical to the first dating of the Piottino oscillation in the Bedrina site : 9900 ± 190 B.P. (H.Zoller, 1960). Therefore, there is no reason to suspect a rejuvenation of the 8 cm thick sample of peat from wich the ^{14}C dating Lv 1131 was gained.

According to Slotboom, M. Küttel (1977) "observed that the very datings which fall in the periods of climatic deterioration are apparently too young". Hence, Slotboom asserts that the dating Lv 1131 is too young. One must remind that on the basis of new ^{14}C datings and new pollen analytical investigations, carried out in the Bedrina site, M. Küttel (1977) concluded that the Piottino oscillation should represent the Younger Dryas, at least for the most part. In fact, Küttel's conclusion is in contradiction with the ^{14}C datings published by himself.

In pollen diagram BE I, on the basis of four ^{14}C datings, the age of the Piottino oscillation is comprised between 10400 ± 170 and 9780 ± 140 B.P. In pollen diagram BE II, on the basis of eight ^{14}C datings, its age is comprised between 10270 ± 100 and 9450 ± 120 B.P. It is thus obvious that the radiocarbon datings are rather in favour of a Preboreal age for the Piottino oscillation. Nevertheless, Küttel's conclusion is that the greatest part of the Piottino oscillation, and possibly its totality, must be correlated with the Younger Dryas ! Based on theoretical considerations, this assertion is finally subjective and thus inverifiable.

3.2. THE ALLERØD AND THE YOUNGER DRYAS

Inferring from the Allerød age of the Laacher See Tuff, currently asserted in the literature, Slotboom puts the Allerød/Younger Dryas boundary between 428 and 423 cm in the pollen diagram Hinkelsmaar IV. This chronozonation calls two comments.

1. Having assumed that the two ^{14}C datings from Hinkelsmaar IV are too young, Slotboom should logically put the Allerød/Younger Dryas boundary between 415,5 and 413 cm, immediately below the strong increase of the non arboreal pollen. His illusory search for a strict agreement between the pollen diagrams Hinkelsmaar I and IV leads him to an inconsistent chronozonation, not devoid of contradictions.

   In Vallensgård Mose, the unique site where a Laacher See Tuff is interbedded in an Allerød subdivided into three phases, the Laacher See Tuff is situated inside the subzone IIc (H. Usinger, 1977). On the contrary in Hinkelsmaar IV, Slotboom's subzone IIc (448-428 cm) overlies the Laacher See Tuff, which constitutes Slotboom's subzone IIb.

   The 448-415,5 cm section of Hinkelsmaar IV is a very homogeneous phase, in which nothing can justify the Slotboom's chronozonal limit IIb/IIc between 428 and 423 cm. Doing so, he creates an artificial limit amidst eight homogeneous pollen spectra of whom the four lower have an average A.P. value of 42 °/o, and the four upper an average A.P. value of 42,5 °/o !

   Concerning this section, the Slotboom's assertion "Bastin puts the transition Younger Dryas into Preboreal at the base of the peat layer, because peat formation has to start in the Preboreal (p. 90)" is a typical example of factitious citation, denoting a polemic purpose.

2. About the Laacher See Tuff, several things must be reminded.
   The sandy volcanic ash layer, interbedded in the gyttja deposits of the boring Hinkelsmaar IV, was correlated by E. Juvigne (1980) with the "L.S.T. 5 final"(1), for which he had previously proposed an Allerød age between about 10950 and 10750 B.P. (E.Juvigne, 1977).

   When E.Juvigne (1977) introduced the vocable "L.S.T. 5 final", it seemed more or less easy to distinguish the different Laacher See Tuffs, on the basis of results published by J.Frechen (1971) summarized in the Table 1 hereunder.

Laacher See Tuffs	Ratio Hornblende/Augite	Sphene
"L.S.T. 5 final"	0,97	11,0%
L.S.T. 5	0,50	0,9%
L.S.T. 4	0,10	1,8%
L.S.T. 3	0,10	2,4%
L.S.T. 2	0,07	1,7%
L.S.T. 1	0,06	2,6%

Table 1.- Mineral composition of the Laacher See Tuffs (after J. Frechen, 1971 and E. Juvigne, 1977).

At that moment, it was largely accepted that all the eruptions of the Laacher See occured in a short period of about 500 years, between 11150 and 10680 B.P. (J.Frechen, 1959). Actually, both the identification of the "L.S.T. 5 final" and its age remain questionable for different reasons.

A) E.Juvigne (1977) extends the correlation with the "L.S.T. 5 final" to volcanic tuffs characterized by a ratio Hornblende/Augite of about 1,8 -2, or more. But some of them seem to be of post-Allerød age : Veigy (J.Martini & J.J. Duret, 1965) and Vance (G.Woillard, 1975), for example.

(1) L.S.T. : abbreviation for Laacher See Tuff.

B) According to more recent researchs of J. Frechen (1976), it seems no more possible to distinguish the five Laacher See Tuffs from each other.

C) As mentioned above, the late-Allerød age of the " L.S.T. 5 final" is challenged by the ^{14}C dating Lv-702 : 10230 ± 240 B.P. from a 4 cm thick sample of peat underlying the tuff of Vance (G. Woillard, 1975).

Since almost forty years, the presence of a Laacher See Tuff interbedded in sediments of Allerød age has been mentioned in numerous sites, first in Germany, later in Switzerland, in France, in Belgium and in Denmark. It is not the aim of this article to make an exhaustive review of the literature concerning those finds. It will be made in due form, in a general review concerning the Laacher See Tuffs, their identification and value as time-markers (E. Juvigne and B. Bastin, in preparation).

Discarding Belgium, where a revision of the problem is now in progress (E. Juvigne, personal communication), I would only comment on the sites in which modern pollen analysis was associated with a petrological investigation of a Laacher See Tuff. There is about a dozen of them, among which a L.S.T. 5 was found in only four : Luttersee and Wallensen in Germany (F. Firbas, 1950), Coinsins and Chirens in France (S. Wegmüller & M. Welten, 1973). In the other sites, taking into account the values given in Table I, the volcanic ash bed was a tuff older than the L.S.T. 5.

- In Wallensen, the L.S.T. 5 lies a little above the middle of the Allerød, which cannot be divided in subzones (F. Firbas, 1950).
- In Luttersee, the L.S.T. 5 lies at the transition between the IIa/IIb subzones of the Allerød (F. Firbas, 1950).
- In Coinsins and Chirens, the L.S.T. 5 lies inside the subzone IIb of the Allerød (S.Wegmüller & M. Welten, 1973).

Finally the Slotboom's assertion " that in a number of pollen diagrams where the Laacher See Tuff is interbedded a tripartition of the Allerød is a common phenomenon" is supported by the Vallensgård Mose site alone (H. Usinger, 1977). However in Vallensgård Mose, the Laacher See Tuff lies inside the subzone IIc of the Allerød, although according to H. Usinger (1977) it must be older than the L.S.T. 5 !

In conclusion, my assignment of the sandy volcanic tuff of the Hinkelsmaar, assumed to be the " L.S.T. 5 final", to the Younger Dryas is maybe questionable. On a tephrostratigraphical view-point, its assignment by Slotboom to the middle part of the Allerød is quite as much questionable. But on a climatological view-point, the Younger Dryas is a well-known cold oscillation, whereas a cold phase characterized by an increase of the non arboreal pollen till 79 °/o is strictly unknown in the middle of the Allerød ! So the Slotboom's assignment of the sandy volcanic tuff of the Hinkelsmaar to a cold subzone IIb in the middle of the Allerød may no longer be supported.

3.3. THE PREBOREAL AND THE PLEISTOCENE/ HOLOCENE BOUNDARY

In his comment concerning the 448-408 cm section of Hinkelsmaar IV, Slotboom makes a confusion between the Younger Dryas/Preboreal boundary and that of the Pleistocene/Holocene, when he asserts : " The boundary between the Younger Dryas and the Preboreal is fixed at about 10.000 B.P.". This is only true for northern Europe, where J. Mangerud *et al.* (1974) have recently proposed to fix the Younger Dryas/Preboreal boundary at 10.000 B.P. and to make coincide the Younger Dryas/Preboreal and the Pleistocene/Holocene boundaries.

In occidental Europe, one must take into consideration the radiocarbon date of about 10.250 B.P. assigned to the beginning of the Preboreal since a long time (H. Straka, 1961). One must also take into account the discovery of a cold phase interrupting the rise in temperature at the beginning of the Preboreal, whatever its denomination : Piottino oscillation (H. Zoller, 1960), Rammelbeek phase (T.A. Wijmstra & E. De Vin, 1971), Youngest Dryas (K.E.Behre, 1978). One is therefore induced to place the Pleistocene/Holocene boundary within the Preboreal, as it was proposed previously (H. Zoller *et al.*, 1972).

This is exactly what I have done, fixing the Pleistocene/Holocene boundary between 410,5 and 408 cm in the diagram Hinkelsmaar IV (B. Bastin, 1980, p. 93). Thus Slotboom is wrong when he claims that I have placed " the transition between Late Glacial and Holocene... at 448 cm".

4.-CONCLUSION

Since twenty years, the Piottino oscillation is a matter of controversy. Several articles were devoted to the question, based on theoretical considerations, but without the support of original results published by

their authors. The comment of R.T. Slotboom (1982) ranges in this category of contributions.

Personally, I committed myself to publish an original pollen diagram, supported by two radiocarbon datings. I am convinced that it is not by theoretical discussions, but by the publication of more pollen diagrams and more radiocarbon datings, that the Piottino controversy will definitively be closed.

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BIBLIOGRAPHY

BASTIN, B., 1971. Recherches sur l'évolution du peuplement végétal en Belgique durant la glaciation de Würm. Acta Geographica Lovaniensia, 9, 136 p.

BASTIN, B., 1980. Mise en évidence et datation ^{14}C de l'oscillation préboréale de Piottino dans un nouveau diagramme pollinique réalisé dans le Hinkelsmaar (Eifel occidental). Ann. Soc. Geol. Belg., 103 : 87-95.

BEHRE, K.E., 1978. Die Klimaschwankungen im europäischen Präboreal. Petermanns Geogr. Mitteil., 122 (2) : 97-102.

BJÖRCK, S., PERSSON, T. & KRISTERSSON, I., 1978. Comparison of two concentration methods for pollen in minerogenic sediments. Geol. Förening. Stockholm Förhandl., 100 : 107-111.

ERLENKEUSER, H. & WILLKOMM, H., 1971. University of Kiel Radiocarbon Measurements VI. Radiocarbon, 13 (2) : 325-339.

ERLENKEUSER, H., FRECHEN, J., STRAKA, H. & WILLKOMM, H., 1972. Das Alter einiger Eifelmaare nach neuen petrologischen, pollenanalytischen und Radiocarbon-Untersuchungen. Decheniana, 125 (1-2) : 113-129.

FIRBAS, F., 1949. Spät- und nacheiszeitliche Waldgeschichte Mitteleuropas nördlich der Alpen. I. Allgemeine Waldgeschichte. Gustav Fisher, Jena, 480 p.

FIRBAS, F., 1950. The Late-Glacial vegetation of Central Europe. The New Phytologist, 49 : 163-173.

FRECHEN, J., 1959. Die Tuffe des Laacher Vulkangebietes als quartärgeologische Leitgesteine und Zeitmarken. Fortschr. Geol. Rheinld. u. Westf., 4 : 363-370.

FRECHEN, J., 1971. Siebengebirge am Rhein -Laacher Vulkangebiet - Maargebiet der Westeifel. Sammlung geologischer Führer, 56, 2. Aufl., 195 p.

FRECHEN, J., 1976. Siebengebirge am Rhein - Laacher Vulkangebiet - Maargebiet der Westeifel. Sammlung geologischer Führer, 56, 3. Aufl., 209 p.

FRENZEL, B., 1964. Zur Pollenanalyse von Lössen. Untersuchungen der Lössprofile von Oberfellabrunn und Stillfried (Niederösterreich). Eiszeitalter und Gegenwart, 15 : 5-39.

JUNGERIUS, P.D., RIEZEBOS, P.A. & SLOTBOOM, R.T., 1968. The age of the Eifel Maars as shown by the presence of Laacher See Ash of Allerød age. Geologie en Mijnbouw, 47 (3) : 199-205.

JUVIGNE, E., 1977. La zone de dispersion des poussières émises par une des dernières éruptions du volcan du Laachersee (Eifel). Zeitschr. für Geomorph., 21 (3) : 323-342.

JUVIGNE, E., 1980. Révision de l'âge de volcans de l'Eifel occidental. Zeitschr. für Geomorph., 24 (3) : 345-355.

KÜTTEL, M., 1977. Pollenanalytische und geochronologische Untersuchungen zur Piottino-Schwankung (Jüngere Dryas). Boreas, 6 : 259-274.

MANGERUD, J., ANDERSEN, S.T., BERGLUND, B.E. & DONNER, J.J., 1974. Quaternary stratigraphy of Norden, a proposal for terminology and classification. Boreas, 3 : 109-126.

MARTINI, J. & DURET, J.J., 1965. Etude du niveau de cendres volcaniques des sédiments postglaciaires récents des environs de Genève. Arch. Sc., Soc. Phys. Hist. Nat. Genève, 18 (3) : 563-575.

SLOTBOOM, R.T., 1982. The Late Glacial and Preboreal in the Hinkelsmaar pollen diagrams : a comment. Ann. Soc. Geol. Belg., 105 (1) : 41-44.

STRAKA, H., 1958. Ein spätglaziales Pollendiagramm aus dem Hinkelsmaar bei Manderscheid (Vulkaneifel). Flora 146 : 412-424.

STRAKA, H., 1960. Zwei Pollendiagramme aus dem Hinkelsmaar bei Manderscheid (Vulkaneifel). Decheniana, 112 (2) : 219-241.

STRAKA, H., 1961. Relative und absolute Datierung quartärer Ablagerungen. Die Naturwissenschaften, 48 (9) : 324-332.

STRAKA, H., 1975. Die spätquartäre Vegetationsgeschichte der Vulkaneifel. Beiträge Landespflege Rhld.-Pfalz, 3 : 1-163.

USINGER, H., 1975. Pollenanalytische und stratigraphische Untersuchungen an zwei Spätglazial-Vorkommen in Schleswig-Holstein. Mitt. Arbeitgem. Geobot. Schl.-Holst. u. Hamburg, 25 : 1-183.

USINGER, H., 1977. Bölling-Interstadial und Laacher Bimstuff in einem neuen Spätglazial-Profil aus dem Vallensgård Mose/Bornholm. Mit pollen grössenstatistischer Trennung der Birken. Danm. Geol. Unders, Arbog 1977 : 5-29.

VAN GEEL, B., BOHNCKE, S.J. & DEE, H., 1981. A palaeoecological study of an upper Late Glacial and Holocene sequence from "De Borchert", The Netherlands. Rev. Palaeobot. Palynol., 31 : 367-448.

WEGMÜLLER, S. & WELTEN, M., 1973. Spätglaziale Bimstufflagen des Laacher Vulkanismus im Gebiet der

westlichen Schweiz und der Dauphiné (F). Eclogae Geol. Helv., 66 (3) : 533–541.

WIJMSTRA, T.A. & DE VIN, E., 1971. The New Dinkel Canal section. Meded. Rijks Geol. Dienst, 22 : 101–129.

WOILLARD, G., 1975. Recherches palynologiques sur le pléistocène dans l'est de la Belgique et dans les Vosges lorraines. Acta Geographica Lovaniensia, 14, 118 p., 8 tabl., 47 fig.

ZOLLER, H., 1960. Pollenanalytische Untersuchungen zur Vegetationsgeschichte der insubrischen Schweiz. Denk. Schweizer. Naturforsch. Gesell., 83 (2) : 45–156.

ZOLLER, H., MÜLLER, H.J. & KLEIBER, H., 1972. Zur Grenze Pleistozän/Holozän in den östlichen Schweizer Alpen. Ber. Deutsch. Bot. Ges., 85 : 59–67.