MANTEN, A. A.: Pollen-grain size and its value in Palynology

In prequaternary palynology identification of the pollen-grains with natural genera and species often proves to be impossible or very difficult. Therefore organ genera and species had to be created. The organ species, however, are not rarely large and sometimes ill-defined, viz. when they show transitions from one to another. Moreover, for stratigraphical use a subdivision may be desirable. Then, in the absence of good diagnostic characters of a qualitative nature often the dimensions of the pollen grains are called to aid. Examples are not difficult to find. Here some will be mentioned taken from the pollen atlas of THOMSON and PFLUG (1953):

Pityosporites microalatus (R. Pot) Pf. et Th. — the *Pinus haploxylon* type — is divided into two forms: *major* (70–110 μ) and *minor* (45–70 μ).

Tricolporopollenites kruschi (R. Pot.) Pf. et Th. (Nyssa?) is divided into five subspecies, three of which differ according to the diagnosis only in their dimensions.

The *Ilex*-like pollen grains are classified in two organ species: *Tricolporopollenites iliacus* (R. Pot.) Pf. et Th. and *Tricolporopollenites microiliacus* Pf. et Th. For the latter diagnostic characteristics are given that are found in *Tricolporopollenites iliacus* too. Only the dimensions are different (*T. microiliacus* 15–25 μ; *T. iliacus* 25–50 μ). *T. iliacus* is subdivided into two forms: *major* (more than 45 μ) and *medius* (25–45 μ).

The organ species *Triatriopollenites coryphaeus* (R. Pot.) Pf. et Th., from the group *Myricaceae/Betulaceae*, is subdivided into two subspecies: *punctatus* (R. Pot.) Pf. et Th. and *microcoryphaeus* (R. Pot.) Pf. et Th. Pollen grains from the subspecies *Triatr. coryph. microcoryphaeus* are often identified with Engelhardtioid pollenforms. There are, however, all possible transitions to the *Myricaceae* and *Betulaceae*. Therefore, a border line is taken at 18 μ. All pollen grains of this type that are smaller than this measure are referred to the subspecies *microcoryphaeus*. When THOMSON in his diagram of the quarry "Fortuna" represents the percentage of Engelhardtioid pollen-forms, he only means the percentage *Triatr. coryphaeus microcoryphaeus*. In this diagram (THOMSON 1950) can be seen that there is some relation between the curves for Engelhardtioid pollen-forms and that for *Myricaceae/Betulaceae*. This also is likely, for, when in this case all dimensions are present, it is a strange supposition that *Engelhardtia* should only have provided pollen-grains up to 17,9 μ and the *Myricaceae* and *Betulaceae* only of 18.1 μ and larger. TRAVERSE (1955, p. 45) even mentions as size of *Engelhardtia* pollen-grains an average of ca. 28 μ, with maximum dimensions up to 32 μ.

It has been found that the so-called Engelhardtioid pollen-forms are most numerous in the older tertiary, in younger deposits their percentage decreases. Even in the diagram of the Rhenish browncoal formation can be seen that these

smaller pollen types are more common at the bottom than at the top. It is not quite clear, however, what botanical conclusion may be drawn from this.

TABLE I

The rank correlation test of KENDALL applied to data from a palynological study of the miocene browncoal in the quarry "Anna" (SE. Netherlands).

Column I: Percentages of pollen grains from the bog vegetation *(Myricaceae/Betulaceae + Cyrillaceae + Ericales)* in 32 samples.

Column II: Percentages of pollen grains from the vegetation round the bog *(Pinaceae + Salicaceae/Platanaceae + Fagaceae)*.

Column III: Quotient bog vegetation/surrounding vegetation.

Column IV: Percentages of *Triatriopollenites coryphaeus micro-coryphaeus*.

I	II	III	IV
38,0	37,2	1,02	2,8
39,2	40,0	0,98	2,8
40,0	46,4	0,86	0,4
42,0	38,8	1,082	4,4
40,4	43,6	0,93	2,4
46,4	34,4	1,35	2,4
43,2	40,0	1,080	3,2
47,2	36,8	1,28	2,0
38,0	40,4	0,94	2,0
42,0	41,6	1,01	3,6
34,4	36,4	0,95	5,6
44,0	46,0	0,96	2,4
38,8	43,2	0,90	3,2
33,6	39,6	0,85	6,0
44,8	30,8	1,45	6,0
42,4	31,6	1,34	4,8
40,4	30,4	1,33	9,2
54,4	21,2	2,57	12,4
47,6	29,2	1,63	4,0
38,8	42,8	0,91	0,8
36,8	42,4	0,87	1,6
35,6	46,8	0,76	4,4
36,4	50,0	0,73	4,4
48,4	32,4	1,49	2,8
30,4	55,2	0,55	4,0
33,2	46,0	0,72	2,0
69,2	19,6	3,53	4,0
60,4	28,0	2,16	4,0
39,2	33,2	1,18	4,0
40,4	43,2	0,94	6,8
37,2	36,0	1,03	8,0
36,4	28,0	1,30	5,6

Engelhardtia is a tall tree and, as TRAVERSE (1955, p. 25) in his study of the Brandon lignite of Vermont (U.S.A.) rightly remarks, "presumably grew near, not in the swamps of the basin of deposition." Thus, when *Triatriopoll. coryphaeus microcoryphaeus* may be identified with *Engelhardtia* pollen, a definite connection may be expected in a pollen diagram, between the percentages found for the *microcoryphaeus* pollen-grains and those of the pollen-grains from the vegetation surrounding the bog. As an example data were taken from a palynological study of the browncoal in the quarry "Anna", Dutch Limburg (MANTEN, 1958), see table. The author checked

whether there exists a correlation between the quotient of the percentages of pollen-grains from the bog vegetation and those of the pollen-grains from the surrounding vegetation (magnitude A, table, column III) and the frequencies of *microcoryphaeus* pollen-grains (magnitude B, table, column IV). For this it has been examined whether at increasing A, magnitude B also increases (positive correlation), or just decreases (negative correlation), or shows no distinct course (no correlation). According as the correlation is positive or negative it may be concluded that the *microcoryphaeus* pollen-grains have come mainly from the bog vegetation, respectively from the forests round the bog.

Correlation was tested by means of Kendall's rank correlation test (KENDALL 1948). For this the figures from column III were arranged in an ascending series; the percentages from column IV, belonging each to a special figure from column III, were rearranged accordingly. Each of these samples then was compared with every other sample, and for each pair a value $+1$, -1 or 0 was scored according as the two samples agreed or disagreed in their rankings or were tied. The 32 samples yielded 496 comparisons with 293 scores $+1$, 178 scores -1 and 25 scores 0, resulting in a value $+115$ for KENDALL's statistic S. The significance of the deviation of this value from the value 0, expected under the hypothesis that no correlation exists, can be judged by the probability $P] \mid S \mid \leqslant 115]$, which is found to be 0,062 if the distribution of S is approximated by a normal distribution with the same mean and variance. This probability is sufficiently low to justify the conclusion that there exists a positive correlation between the two characteristics.

This implies that the greater part of the pollen-grains in the subspecies *Triatriopoll. coryphaeus microcoryphaeus* must have come from plants living in the browncoal. Because *Engelhardtia*, as mentioned above, is a tall tree, not growing in the bog, this is a very strong indication that the *microcoryphaeus* pollen-grains have not originated from *Engelhardtia*. Presumably they came from *Myricaceae/Betulaceae*, as is the case with the other *Triatriopollenites* forms. The border line of 18 μ without other characteristics thus *does not have any diagnostic value.*

SUMMARY

A subdivision of pollen types based only on different dimensions is very dubious. An example is given, taken from the miocene browncoal in the Lower-Rhine area of Germany and the Netherlands.

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