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stärkt. Die völlige Entwaldung Äthiopiens ist eine Frage von Jahrzehnten. Für die äthiopische Nation sind die Folgen katastrophal. Ungünstige Veränderungen der grossklimatischen Verhältnisse sind überdies zu vermuten.

Literatur vom Verfasser:

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COMMENT ON CHENOPODIUM ALBUM AS A FOOD PLANT IN PREHISTORY

By Hans HELBAEK, National Museum, Copenhagen

In the Annual Report for 1958 (1959) of Geobotanisches Forschungsinstitut Rübel in Zürich, Paul MÜLLER-SCHNEIDER raises the question whether it is reasonable to interpret the frequent occurrence of seeds of *Chenopodium album* L. in prehistoric cultural deposits in Switzerland as evidence of the exploitation of the seeds of this weed for human food. The communication takes its departure in a remark by M. VILLARET-V. ROCHOW (1958) who, following NEUWEILER (1905), expresses the opinion that most probably this was the case in the Bronze Age site of Valeggio in northern Italy; the figures of her plant list certainly support her appreciation.

As an argument against this view the author points out that *Chenopodium* is of so frequent occurrence in field and fallow that the seeds must be expected to turn up even without human interference wherever prehistoric man and his domesticated animals left their droppings and other traces. He considers NEUWEILER's discussion invalid because many of the examples concerning the use of seeds upon which it is based are drawn from outside Switzerland, e.g. Russia, Greece, and South America.

If the author's view is to be maintained, that evidence from beyond central Europe can have no relevance to the situation in Switzerland, discussion is of course not possible. But in my opinion, this view is highly questionable. Admitting that NEUWEILER's reference to *Chenopodium quinoa* Willd. may seem farfetched in several respects, I believe that people and their needs were much the same in Switzerland, Greece, Russia, and Denmark, in prehistoric times. Also, that the fundamental principle for agricultural economy was then the same all over Europe, as indeed it is to-day, namely to obtain the biggest output in vegetable food for the smallest endeavour. In our day it would not be a paying proposition to obtain starch and protein from uncultivated plants, but in prehistory the

direct output of plant husbandry was in many periods and in many areas obviously supplemented by the gathering of seeds of weeds, preferably from the fallows. This practice is evinced by numerous finds in Denmark (HELBAEK 1954) and, as demonstrated by NEUWEILER in a long series of reports, in Switzerland also. The percentage of weed seeds found in many Danish Iron Age deposits of grain is out of all proportion to the natural frequency of these species in cultivated fields.

To the question generally, the bog-found corpses from Iron Age Jutland are highly revealing. I have examined the stomach contents of two such corpses, and what was found in the perfectly sealed intestinal canals must inevitably have been eaten by these men. There is a striking agreement between the species here encountered and those most commonly found mixed with the carbonized grain which is frequently excavated in Danish Iron Age houses, an agreement that does not stand up in comparison with the normal composition of field weed communities.

The man from Tollund (HELBAEK 1950) had eaten 21 species of seeds and fruits: Naked and Hulled six-row barley, seeds of *Linum*, *Polygonum* spp., *Camelina*, *Chenopodium*, *Spergula*, and *Viola*—as far as it is possible to judge from these millions of fragments—in that order of frequency. The last meal of Grauballe Man (HELBAEK 1958) consisted of 64 species: Naked and Hulled six-row barley, *Polygonum* spp., *Bromus*, Emmer and Spelt, *Avena* sp., *Rumex acetosella*, and, in minor quantities, *Chenopodium*, *Spergula*, and *Plantago* spp. Particularly the achenes of *Polygonum lapathifolium* abound to such an extent as to exclude their being considered as a natural proportional component in a corn field.

As regards *Chenopodium album* specifically, a find was made in Jutland some years ago which must be considered as absolutely irrefutable proof of the intentional gathering of these seeds for human consumption.

In a burnt-down village of the first century A.D. (Fjand, HATT 1957), consisting of a large number of houses, was found a small hut evidently employed as a granary. Charred wooden structures indicated the arrangement of compartments or storage bins for grain. Three separate heaps of charred plant remains were preserved, consisting of: 3750 ccm of barley, 12800 ccm of Oats, and 1670 ccm of seeds of *Chenopodium album*. In their shrunken state the seeds do not look impressive, but according to the tested 1000-weight there are just over 2400000 seeds preserved, and how many were converted into ash in the fire we cannot judge. The *Chenopodium* deposit contained only 252 seeds of other species all of which are edible, viz., *Polygonum* (four species), *Linum*, *Spergula*, *Camelina*, *Brassica*, *Sinapis*, and *Bromus*.

It is clear that the seeds were not sifted from the grain; undoubtedly the Iron Age farmers went over the fallow land and collected the entire plants for subsequent drying and threshing. In the process they took along such other fortuitously available species as they appreciated, but obviously *Chenopodium* was their principal goal in this case.

Another instance is even more intimate. A small pot, found in a burnt house of the pre-Roman Iron Age in Jutland (Görding, HELBAEK 1951), contained the charred remains of a vegetable soup or gruel amounting to some 90 ccm. Apart from 56 seeds of 17 species, this deposit consisted of: 65 ccm of barley, 8 ccm of *Polygonum* spp., 18 ccm of *Chenopodium*, and 2 ccm of *Spergula*. These 20 per cent of *Chenopodium* are much too much for any field, however, one looks upon it, and it is significant that no percentage anything like it is found in larger deposits of prehistoric grain—which in Denmark are fairly common. Thus, for instance, 1050 ccm of barley from Iron Age Bornholm contained only 33 seeds of weeds, 17 of which were *Chenopodium* (HELBAEK 1957).

Numerous examples might be added; a small vessel containing almost 1000 ccm of pure *Polygonum lapathifolium* seeds was found beside the fireplace in a house of the first century AD. (Alrum, HATT 1943), and Knud JESSEN (1933) reports on a heap of *Spergula* amounting to 5600 ccm from the ruins of another Iron Age house in Jutland (Ginderup).

I do believe that NEUWEILER's (1924) concept of special attention given such plants was slightly distorted. When he says: *Andere heutige Unkräuter erfreuten sich wohl auch als Nutzpflanzen guter Pflege . . .*, then he presumably disregarded the fact that in prehistoric times fallowing on a big scale was necessary, and that fallowing, with regard to annual weeds, eo ipso is a kind of "Pflege" without intention. The crops of unsown annuals which always will spring up on a recently deserted field was most certainly something which primitive farmers could not afford to waste. Those people were completely self-dependent and subject to the hazards of nature to a much greater extent than are the farmers belonging to modern society of a highly complex economical structure, and they had to take every possible source of food into account.

The purpose with this brief comment is primarily to supplement the concept based upon sound knowledge of contemporary plant ecology and distribution of weed species in cultivated and uncultivated soil, with the views based on the study of the same plants met with in prehistoric cultural context. To the understanding of prehistoric economy this aspect is vitally important. Secondly, it is to remind the present generation of the fact that the late Swiss morphologist, E. NEUWEILER, was one of the most

distinguished scholars who ever worked this particular field. He was a man of such wide experience that his expressed opinions cannot be opposed except on the basis of incontrovertible facts. Admittedly his published representations suffer from lack of statistics, and the present problem can only be adequately illuminated by this means, but even so, his experience enabled him to assess the significance of the occurrence of the various species pretty accurately. Therefore, without in any way underestimating the usefulness of the contribution made by Paul MÜLLER-SCHNEIDER, I feel it proper to suggest: *Audiat et altera pars*.

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BODENVEGETATION UND NATURVERJÜNGUNG VON TANNE UND FICHTE IN EINEM ALLGÄUER PLENTERBESTAND

Von Hannes MAYER, München

Gegenüber den waldbaulichen Diskussionen über die beste Verjüngungsmethode wurden ökologische Fragen der Naturverjüngung lange weniger beachtet. Erst ŠIMÁK (1951) beschäftigte sich eingehend mit den Ansamlungsbedingungen von Tanne (*Abies alba*) und Fichte (*Picea abies*), insbesondere