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CHESTNUT (*CASTANEA SATIVA* MILL.) AS AN INDIGENOUS SPECIES IN NORTHERN ITALY

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ABSTRACT - *Chestnut (Castanea sativa Mill.) as an indigenous species in Northern Italy.* Il Quaternario, 4(1a), 1991, p. 99-106 - The native status of the sweet chestnut (*Castanea sativa* Mill.) in N-Italy has been a controversial issue so far. Most Authors believed that it had disappeared during the Würm glaciation and that afterwards it had been introduced by man. In the present paper pollen records with radiocarbon dating of sediments and woods from N-Italy are reported, which give evidence that chestnut certainly survived the last glacial period in refuge areas. Therefore, chestnut has to be considered as an indigenous species.

RIASSUNTO - *L'indigenato del castagno (*Castanea sativa *Mill.) nell'Italia settentrionale.* Il Quaternario, 4(1a), 1991, p .99-106 - Viene discusso il problema dell'indigenato del castagno nel Nord-Italia. Mentre era stata accertata palinologicamente e tramite filliti la presenza di due specie di castagno (*Castanea sativa* Mill. e *Castanea latifolia* Sord.) in questa regione geografica fino all'Interglaciale Riss-Würm, solo *Castanea sativa* ricomparirà nell'Olocene e precisamente nel Sub-Atlantico. Si pensò quindi che la glaciazione würmiana avesse estinto le due specie di castagno in Italia e che la presenza di *Castanea sativa* dal Neolitico in poi nel Nord-Italia fosse dovuta all'uomo che l'aveva importata da altre regioni. Le analisi polliniche, corredate da radiodatazioni, eseguite nel Veneto (Fig. 1) e precisamente presso la "Stazione di Villaga-Barbarano" nel Vicentino (Fig. 2), a "Carturo sul Brenta" nel Padovano (Fig. 3) ed a "Garda" nel Veronese (Fig. 4) hanno definitivamente chiarito il problema. *Castanea latifolia* non sopravvisse in Italia alla glaciazione würmiana, mentre *Castanea sativa* riuscì a sopravvivere in alcune stazioni di rifugio, anche nell'Italia settentrionale. Per il Veneto, queste furono le zone collinari dei Colli Euganei e dei Monti Berici e montuose delle Prealpi Venete, del Monte Baldo e delle Giudicarie; da queste zone poi tornò a ridiffondersi. L'uomo favorì solo la diffusione del castagno col diradamento della foresta e col taglio selettivo.

Key-words: Chestnut (*Castanea sativa* Mill.), native species, pollen analyses, radiocarbon dating, Upper Pleistocene and Holocene, N-Italy

Parole chiave: Indigenato del castagno (*Castanea sativa* Mill.), analisi polliniche, datazioni col radiocarbonio, Pleistocene superiore e Olocene, N-Italia

1. INTRODUCTION

Chestnut has been always reported as a component of the Italian Pleistocenic flora, obviously depending on suitable environmental conditions.

Pollen finds show that the species seems to have vanished from Northern Italy with the maximal extension of ice during the last glaciation of the Alps (Würm 3). Chestnut pollen does not occur until the Holocene, namely the Sub-Boreal (Neolithic - Bronze Age). Therefore, there was general agreement about chestnut disappearance from Northern Italy during the Würm glacial and its later reappearance as the result of introduction by men (Keller, 1931; Dalla Fior, 1932 and 1940; Paganelli, 1959; Beug, 1964). Authors disagreed only on the arrival time and way (Sordelli, 1896; Beug, 1962).

Phytogeographic evidence supported the hypothesis that chestnut might be an indigenous Italian species (Negri, 1931; Bertolani Marchetti, 1974; Fenaroli *et. al.*, 1976; De Dominicis *et al.*, 1979). Chestnut pollens were found in a number of Late-glacial and Post-glacial peat bogs from Central-Southern Italy (Tuscan Apennin: Chiarugi, 1936; Apennin of Abruzzo: Marchetti, 1936; Lucan Apennin: Chiarugi, 1937). Such finds supported the view of the native status of chestnut in Central-Southern Italy (Chiarugi, 1939).

The native status of chestnut in Northern Italy has been a controversial issue so far because it was supported only by a few pollen records from sediments formed in the interval between the Late-glacial and Sub-Atlantic periods.

In the present paper new evidence from pollen analyses and radiocarbon dating is given which shows beyond any doubt the presence of *Castanea sativa* Mill. in Northern-Italy even in the period from the Late-glacial to the Pre-Boreal.

2. ON THE HISTORY OF *CASTANEA* IN NORTHERN ITALY FROM THE UPPER PLEISTOCENE

The occurrence of *Castanea* in Northern Italy up to the end of the Riss-Würm Interglacial is well documented both by macrofossil (Sordelli, 1896; Principi, 1938; Bertolani Marchetti, 1955) and palynological (Paganelli, 1961a; Sorbini *et al.*, 1984) records.

During the Riss-Würm Interglacial two *Castanea* taxa were present, namely *Castanea sativa* Mill. and *Castanea latifolia* Sord. According to Sordelli (1896), *Castanea latifolia* is a species which would have derived from a Tertiary form (probably *Castanea kubinyi* Kov.)

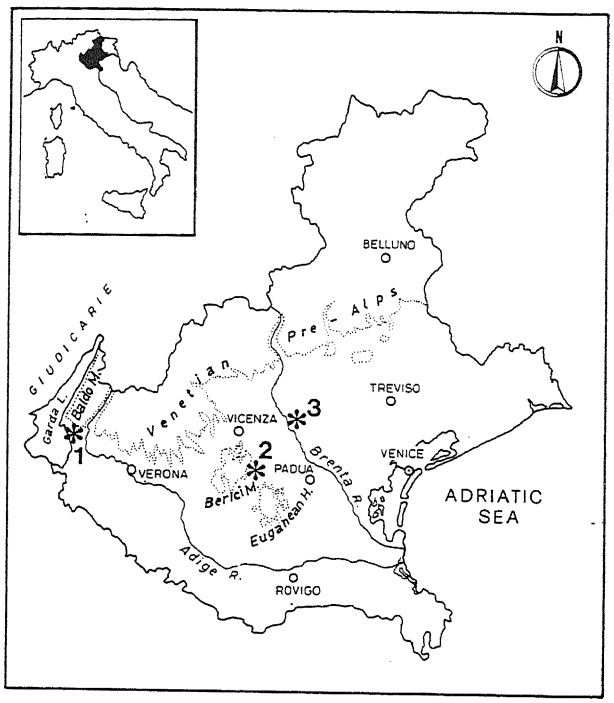

Fig. 1 - Location map of the investigated sites. 1) Garda; 2) Stazione di Villaga-Barbarano; 3) Carturo on the Brenta River.
Ubicazione dei luoghi studiati. 1) Garda; 2) Stazione di Villaga-Barbarano; 3) Carturo sul Brenta.

and then it would have become extinct without giving origin to the cultivated species.

Castanea latifolia and *Castanea sativa* were identified in many remains of phyllites from deposits of the Riss-Würm Interglacial in Lombardy, particularly at Re in Vigezzo Valley (Sordelli, 1896; Principi, 1938; Bertolani Marchetti, 1955). Two types of *Castanea* pollen grains with different sizes were found in sediments of the last interglacial from the Delta of the Po River (Paganelli, 1961a; 1961b): the smaller ones (12÷20 μm) were quite alike to the present pollen grains of *Castanea sativa*, the larger ones (22÷25 μm) should be, according to Lona (1950), the pollen grains of *Castanea latifolia*; other chestnut pollens (without differentiating the two *Castanea* species) were also recorded in the Verona area (Sorbini *et al.*, 1984).

During the Würm glacial low chestnut pollen percentages (0.4%) were recorded in one radiocarbon dated (24,000 ± 2,000 B.P.) peat deposit from Avesa (86 m a.s.l. at the North of Verona) and in other non radiocarbon dated sediments in the area at the SE of Verona (Sorbini *et al.*, 1984). On the contrary, during the Late-glacial period and the beginning of the Holocene, no chestnut pollen grains had been found in deposits from Northern Italy, which had led to believe that both *Castanea* species had vanished from this area during the last glacial. Pollen analyses of several peat-bogs on the Southern side of the Alps from Piedmont to Friuli (Keller, 1931) and in Trient region (Dalla Fior, 1932;1940; Paganelli, 1959; Beug, 1964) had given evidence for chestnut occurrence only in a period between the Neolithic and the Bronze Age, that is in the period of the appearance of the first forms of agriculture in Northern Italy.

Later on, a few pollen records showing the sporadic occurrence of the sweet chestnut in NE-Italy in sediments from the Early Holocene, *i.e.* before significant influence of man on the environment, became available. These reports are the following: 1) Euganean Hills (Arquà Petrarca, 56 m a.s.l.), during the warm arid Boreal period along with species of the *Quercetum mixtum* (Lona, 1957); 2) Po Plain at the South of the Garda Lake (Castellaro 100 m a.s.l.), in levels generically described as older than the Sub-Atlantic (Bertoldi, 1968); Southern Alps near Trient: 3) Cembra Valley (Vedes, 1496 m a.s.l.), in levels from the late Boreal (Paganelli *et al.*, 1981), and 4) Travignolo Valley (Pal dei Mugheri near Paneveggio, 1480 m a.s.l.) in levels attributed to the Boreal period (Braggio Morucchio *et al.*, 1986).

Moreover, chestnut pollen grains were found in sediments belonging to the Boreal period from the Northern Apennines (Lagdei, 1254 m a.s.l.) by Bertoldi (1980) and in sediments ascribed to the Pre-Boreal and Boreal periods from the Central Adriatic Sea (Bottema, 1974). In the later case, the chestnut pollen origin from Italy and namely from Northern Italy, cannot be established.

So far, therefore, the only available evidence for chestnut occurrence in Northern Italy after the Würm glacial, comes from a few pollen records from levels for which datation had been done only on a palynological basis.

In this paper evidence for chestnut pollen occurrence in radiocarbon dated Late-glacial levels from three sites of the Venetian area, is given. This confirms the suggested hypothesis of chestnut as a native tree in Northern Italy.

3. SITES AND METHODOLOGY

The three investigated sites are situated in the Venetian Po Plain (Fig. 1). The deposits formed from the maximal Würm glacial expansion (Würm 3) up to about the end of the Late-glacial.

The oldest deposit (Fig. 1, site 2), Stazione di Villaga-Barbarano (N 45°23'37", E 11°33'44", 19 m a.s.l.) is situated close to the Eastern Berici Mounts. The deposit (Fig. 2) consists mainly of sandy clays with intercalated sandy and peaty levels (Paganelli *et al.*, 1988). Pollen analyses were performed from the level of -250 cm, downwards. Two samples were collected for radiocarbon dating: a peaty-sandy clay (with low ^{14}C content) at the level from -295 to -310 cm, and a Phragmites peat at the level from -605 to -625 cm.

The second deposit (Fig. 1, site 3) is at Carturo on

the Brenta River (N 45°34'45", E 11°45'28", 20 m a.s.l.) at about 20 Km NW from Padua (Pellegrini *et al.*, 1984). In this site two samples were collected. The first one (125 cm of depth) from the pleistocenic clay bank outcropping from the bed of the Brenta River in the place were a stem of *Betula pubescens* Ehr. was found rooted in growing position. The second one was collected from the right river bank, 475 cm high in that site. The topographical survey showed that the deposit collected on the river bed (indicated as profile B in Fig. 3) had formed before the deposit collected on the right river bank (indicated as profile A in Fig. 3). In the younger deposit, alternate clay, sand and gravel layers were found, which gives evidence of different sedimentation phases. Pollen analyses were performed from -270 to -455 cm of depth. The deposit from Carturo consists mainly of clay layers; pollen analyses were performed from 0 to -125 cm of depth. The birch stem was radiocarbon dated (Castiglioni *et al.*, 1981).

The third investigated deposit (Fig. 1, site 1) is the most recent and is situated on the SE side of the Garda Lake, in locality Garda (N 45°34'39", E 10°42'48", 80 m a.s.l.) at the foot of Baldo Mount (Sauro *et al.*, 1983).

The stratigraphic column (Fig. 4) starts with a disturbed colluvial sediment (50 cm in thickness) on which no pollen analyses were performed,

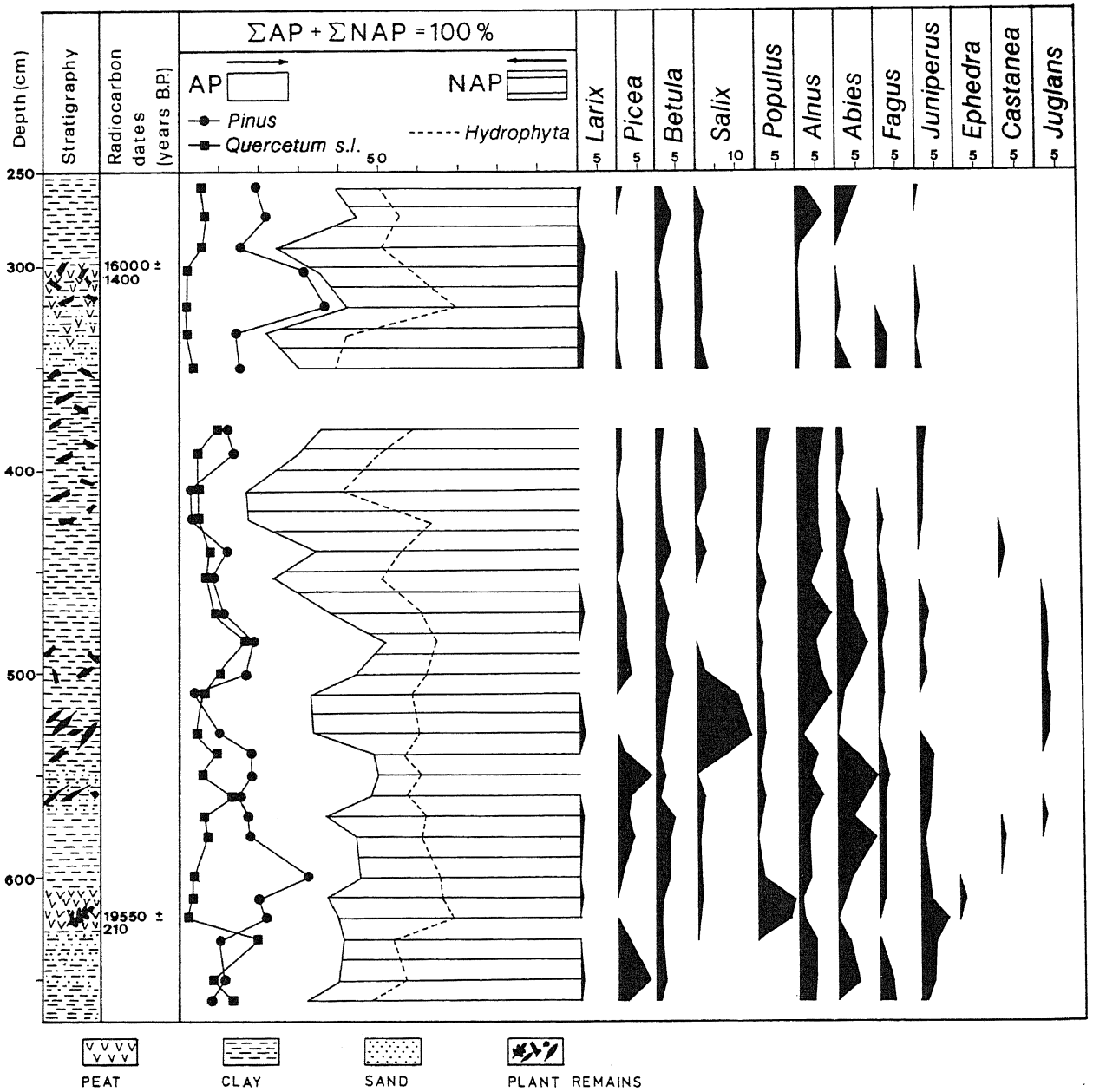

Fig. 2 - Pollen diagram of the Stazione di Villaga-Barbarano deposit.
Diagramma pollinico del deposito di Stazione di Villaga-Barbarano.

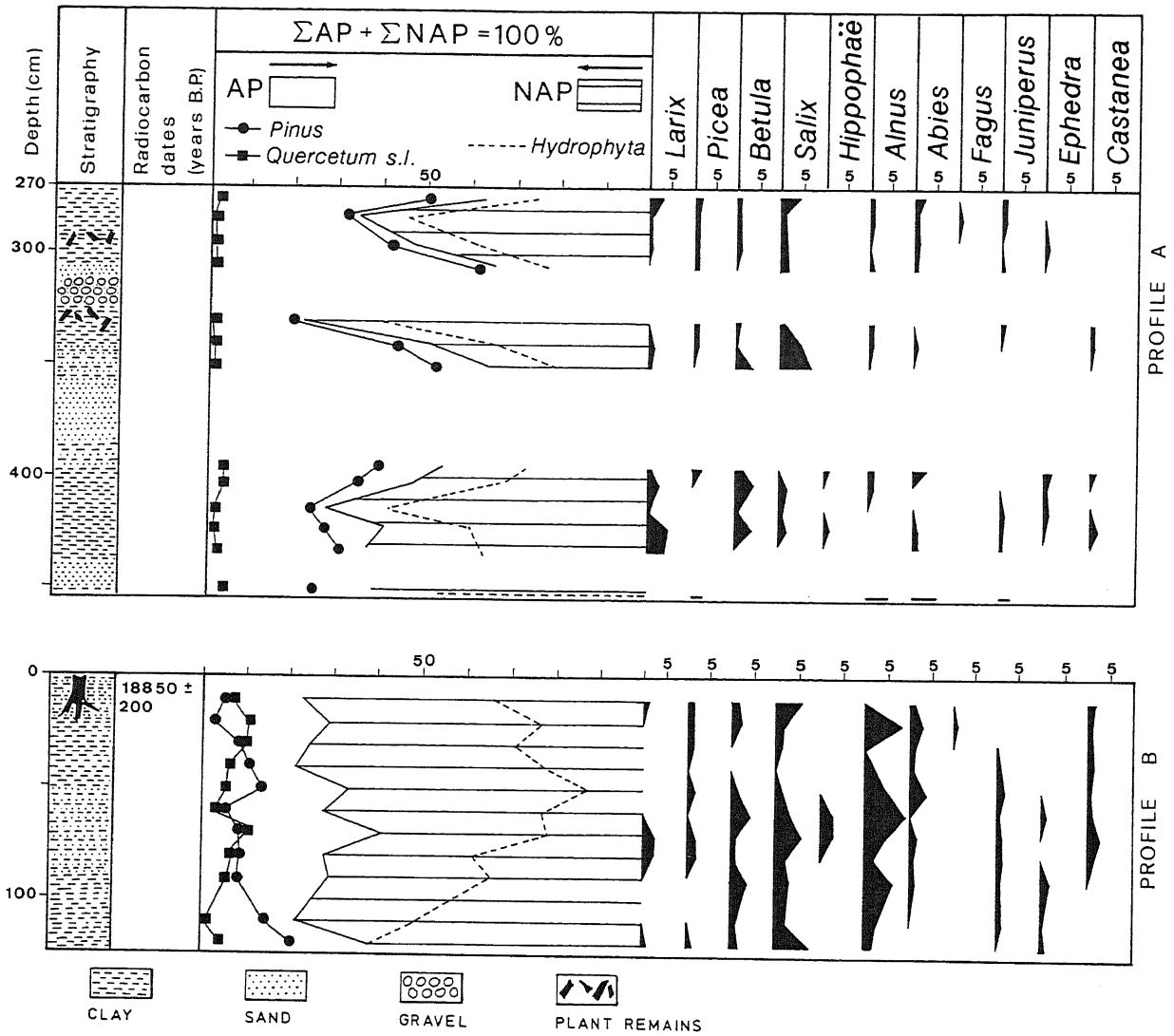

Fig. 3 - Pollen diagram of the Carturo on the Brenta River deposit.
Diagramma pollinico del deposito di Carturo sul Brenta.

followed by a sequence (250 cm in thickness) characterized by alternate sandy clay, silt and clay layers, all palynologically investigated. An erosion surface completely devoid of pollen, was found in the level from -120 to -130 cm. A rooted stem fragment collected at the level from -200 to -220 cm was used for radiocarbon dating.

The results of the pollen analyses are illustrated in three schematic diagrams (Figs. 2, 3, and 4) in which are reported: the stratigraphy, the AP (arboreal pollens) and NAP (non arboreal pollens) percentages, and the curves of *Pinus* (including *Pinus sylvestris* L., *Pinus mugo* Turra, and *Pinus cembra* L.), and of the *Quercetum* s.l. (*sensu lato*), including *Quercus* sp. pl., *Carpinus betulus* L. and *Carpinus orientalis* Miller, *Corylus*, *Acer*, *Rhamnus*, *Frangula*, *Sambucus*, *Ulmus*, *Tilia*, *Cornus*, *Fraxinus*. In the total NAP curve only that of the *Hydrophyta* (*Myriophyllum*, *Potamogeton*, *Nymphaea*, *Nuphar*, *Hottonia palustris* L., *Scheuchzeria palustris* L., *Typha* sp. pl., *Alismataceae*, *Cyperaceae*, *Juncaceae*) has been included (this group is inclusive of the hygrophytes too). In fact these plants can provide valuable information on changes of the edaphic and microclimatic conditions.

The curves for a number of important trees (among which *Castanea sativa*) are also given.

4. RESULTS

The results of the pollen analyses are given in Figs. 2, 3, and 4.

The pollen diagram of the deposit from the site Stazione di Villaga-Barbarano (Fig. 2) documents the climatic and vegetational history of a short time interval in the period during the maximal ice extension of the last glaciation (Würm 3), that took place in Italy between 20,000 and 18,000 B.P. (Orombelli, 1983).

In the level from -355 to -370 cm no pollen grains were found.

Pollen analyses reveal the occurrence of a type of vegetation resembling in some degree that of our mountain areas at the present day. In fact a forest composition characterized by larch, spruce, fir, pines (among which *Pinus mugo* along with *Pinus sylvestris)*, beech, birches (*Betula nana* L. included), willows and dwarf willows, was found. The thermophilous species, included in the curve of the *Quercetum* s.l. (among which *Corylus*), are poorly represented throughout the profile. Most probably they were established in limited areas with favourable microclimatic conditions (refuge areas).

The presence of marsh habitats is well documented by pollen records of arboreous willows, alders, and by the curve of the marsh and aquatic plants (*Hydrophyta*) such as Carices, *Juncus*, *Typha*, *Phragmites*, *Potamogeton*, *Myriophyllum*, and so on.

Chestnut pollen was recorded only from two levels of the profile, namely in the level from -430 to -445 cm (pollen percentage: 0.7%) and in the level from -575 to -585 cm (0.3%). The sporadic occurrence of chestnut pollen grains in the sediments suggests that this species had survived in refuge areas on the Euganean Hills and Berici Mounts (ESE and WNW of the investigated site, respectively), where only a relict population of chestnut was present which, most probably, flowered with difficulty.

The occurrence of walnut *(Juglans)* pollen in five levels from the profile is outstanding. In Paganelli's opinion, walnut has survived the last glacial period in refuge areas and therefore should be regarded, like chestnut, as a native tree. Research is in progress to confirm this hypothesis.

The radiocarbon dating gave 16,000 ± 1,400 B.P. for the level from -295 to -310 cm (sandy-peaty clay with low ^{14}C content), and 19,550 ± 210 B.P. for the deeper peat level (from -605 to -625 cm).

According to the radiocarbon dating the deposit would have formed during the maximum expansion of the last glacial (Würm 3) until the period between the warmth oscillation of Lascaux and the Lower Dryas.

On the contrary, the surface and the deep layers, according to the palynoligical records, indicate no substantial variations of the pollen curve patterns.

Therefore, the radiocarbon dating of the level from -295 to -310 cm is unreliable.

The pollen diagrams of the deposit of Carturo on the Brenta River (Fig. 3) show a cold vegetation type resembling that of present mountain areas with larch, spruce, fir, tree birches and Betula nana, willows and dwarf willows, and pines (the Scots pine dominant, *Pinus mugo* and *Pinus cembra*). Most probably, in this period the tree vegetation had started colonization of the tundra areas, giving origin to a park tundra.

Considerable pollen percentages of aquatic and marsh plants were recorded, which suggests the presence of a marshy habitat, perhaps a ox-bow lake along the course of the Brenta River.

In the pollen diagrams a number of deciduous forest trees was found, namely oaks, hornbeam, hazel, and chestnut.

Chestnut pollen was recorded almost uninterruptedly throughout the profiles, especially in the more ancient one (profile B), although pollen percentages are low (maximum 1.6%).

The radiocarbon dating gave an age of 18,850 ± 200 B.P. for the layer 0÷15 cm of the profile B, which corresponds again to the terminal phase of Würm 3.

The occurrence of chestnut pollen in the radiocarbon dated level as well as in the layers above and below is noteworthy.

The total pollen curve of the arboreal species (AP) from the deposit of Garda (Fig. 4) shows two warm periods intercalated by a cold climatic oscillation.

The oldest part of the deposit gives evidence of climatic conditions suitable for forest expansion: the AP percentage is about 80÷90%, where the species of the *Quercetum* s.l. are well represented.

A subsequent climatic deterioration is shown by the diminishing frequency of trees (the AP percentages are about 50%), particularly of the species of the *Quercetum* s.l., followed by a phase of initial climate improvement.

Noteworthy is the fact that the AP curve includes the pines (*Pinus sylvestris*, *Pinus mugo*, and *Pinus cembra*), larch, spruce, fir, beech, birches (the dwarf species is also present), willows and dwarf willows, which gives evidence of a forest composition of mountain type.

An erosion surface was found at the level from -120 to -130 cm. Above the erosion surface, pollen results show a very recent vegetational history and provide evidence of a highly developed agriculture (pollen grains of *Secale*, *Avena*, *Vitis*, *Olea*, with walnut and chestnut).

Therefore, the erosion process caused a large hiatus with most of the Holocene sediments removed.

The radiocarbon dating of the wood from the level at 200÷220 cm of depth, gave an age of 10,570 ± 200 B.P., corresponding to the Upper Dryas period.

Therefore, the vegetational history of the deposit goes from the warm Allerd oscillation through the cold Upper Dryas up to the beginning of the phase of climatic improvement which took place in the Pre-Boreal period.

Chestnut pollen was recorded (maximum percentage 2.4%) from the oldest level up to -180 cm, and therefore also in the radiocarbon dated level.

The pollen analyses of the Garda deposit confirm once again the hypothesis that chestnut is an indigenous species, the expansion of which has been subsequently favoured by man along with other cultivated species.

5. DISCUSSION AND CONCLUSIONS

The macroscopic remains and pollen records give enough evidence to delineate the history of the genus *Castanea* from the Riss-Würm Interglacial up to the present times.

Pollen records show that the last glacial caused a qualitative reduction at the species level, namely the extinction of *Castanea latifolia* Sord. Only the sweet chestnut, *Castanea sativa* Mill., survived through the last glaciation in Italy.

The native status of chestnut in Northern Italy, so far doubtful, is positively proved by chestnut pollen records in radiocarbon dated layers deposited during and just after the maximum Würm glacial expansion (Würm 3) and by their occurrence both below and above the radiodated levels. The sweet chestnut has survived the last glaciation in refuge areas where the microclimatic and edaphic conditions were favourable.

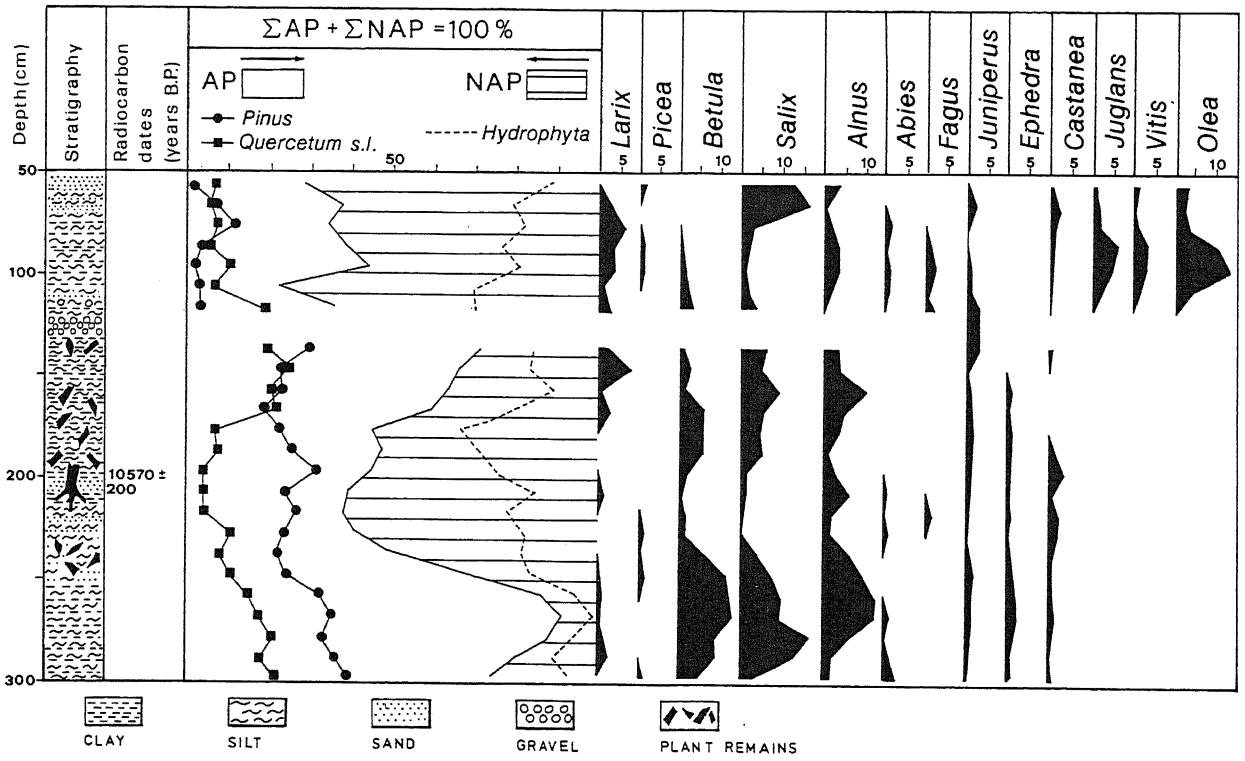

Fig. 4 - Pollen diagram of Garda deposit.
Diagramma pollinico del deposito di Garda.

The same happened for a number of even more thermophilous plants, such as *Quercus ilex* L., *Pistacia*, *Phillyrea*, the pollen of which were recorded from Late-glacial sediments of Castellaro (South of Garda Lake, Bertoldi, 1968) and of Garda (Paganelli, unpublished data). On the other hand, today around the Garda Lake and on the Euganean Hills a vegetation of mediterranean type with thermophilous species, is present.

The sweet chestnut could not grow in the Venetain Po Plain, where the soils are poorly drained and there is a superficial water-bearing stratum. It is most likely that *Castanea sativa* lived on the surrounding mountain areas, where suitable microclimatic and edaphic conditions were present; in fact chestnut is generally calcifuge and favours well-drained soils.

The chestnut pollen grains recorded in the deposit of Stazione di Villaga-Barbarano might come from the near Euganean Hills and Berici Mounts; the chestnut pollen grains of the deposit of Carturo on the Brenta River might come from the North, namely from the mountain areas of the Venetian Pre-Alps as well as from the South, namely from the Euganean Hills, and the Berici Mounts; those of the deposit of Garda from the mountain areas of Baldo Mount and Giudicarie (Fig. 1). Lona's findings of chestnut pollen (Lona, 1957) in Boreal layers from Arqu Petrarca on the Euganean Hills supports the view that they might have been a refuge area.

According to Huntley *et al.* (1983) pollen diagrams with a chestnut "pollen value of >5% almost certainly indicate the widespread occurrence of *Castanea* wood-

lands near the site". The low chestnut pollen percentage found in the investigated deposits suggests that the species might not grow in the close neighbourhood.

On the other hand, the transport distance of the air dispersed chestnut pollen grains can reach about 30 Km (Peeters *et al.*, 1988). Even the site farthest away from the mountain areas (Carturo on the Brenta River) is within this range.

The sporadic occurrence and the low chestnut pollen percentages recorded in the deposit of Stazione di Villaga-Barbarano, suggest that chestnut trees surviving in refuge areas lived under severe climatic conditions, which might have prevented or reduced pollen production. It is noteworth remembering that, for optimum growth, the sweet chestnut requires average annual temperature between +8°C and +15°C, with average monthly temperatures higher than +10°C for at least six months.

The Beug's (1962) view that "at the southern border of the Alps, the Dalmatian coast and northwestern Spain, there are no pollen grains of *Castanea* earlier than in Roman or Greek times" and that in these northern parts of the mediterranean region chestnut was introduced by men, should be revised in the light of our findings. The same is true for the Huntley's statement (Huntley *et al.*, 1983) that only "at 5500 B.P. the pollen of *Castanea* appears for the first time in Central and Southern Italy".

No doubt that man may actually have favoured chestnut spreading to the detriment of oak.

Pollen records from the eastern Alps (Paganelli *et al.*, 1981) showed a pronunced chestnut frequency increase from the low values observed in the Boreal period, at the same time of the appearance of *Cerealia* pollens and of the tree-pollen curve decline.

In this connection it is worth noting the fact that coppicing a mixed oak-forest with *Castanea*, favours chestnut spreading (Couteaux, 1981). This might be the reason for the fact that in many pollen diagrams from Northern Italy (Keller, 1931; Dalla Fior, 1932; 1940), chestnut pollen could not be found until man begun forest exploitation. Huntley *et al.* (1983) exclude that Neolithic people, with a nomadic culture, may have cultivated the sweet chestnut, plant which requires 20 years to reach maturity. According to the above mentioned Authors, the chestnut increase since "the post-5000 B.P. Neolithic period" is mainly due to selective felling of forest to leave chestnut or to chestnut expansion after forest clearance (Filipovitch, 1977).

In conclusion, our pollen records of sweet chestnut in radiocarbon dated deposits that had formed in the interval between the end of Würm 3 and the Pre-Boreal (and therefore before significant influence of man on the natural vegetation), remove any doubt about the native status of *Castanea sativa*.

Therefore, chestnut must be considered a Tertiary relict restricted to Southern Europe, N-Italy included, by successive Pleistocene glaciations.

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