Excursion to the valley of the Torrente Tiepido

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EXCURSION TO THE VALLEY OF THE TORRENTE TIEPIDO

Istituto di Geologia, Università degli Studi, Modena (Italy)

1979

EXCURSION TO THE VALLEY OF THE TORRENTE TIEPIDO

by

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The afternoon of 9 September 1979

Departure: from Torre Maina

Itinerary: Torre Maina - Madonna di Puianello - Torrente Tiepido - Modena.

Geological setting (1)

Along the margin of the Apennines between the rivers Panaro and Secchia, silty, blue-grey, marine, Neoautochthonous clays of the Lower Pleistocene age, outcrop almost continuously in a belt about twenty kilometres long and less than ten km wide, (ANNOVI et alii, 1969). Towards South these clays are normally in transgressive contact with the Ligurian Complex formations, whilst to the North, towards the plain, they are covered by alluvial deposits.

The base part of the Pleistocene clays belongs to the Globigerina pachiderma coenozone (Santernian) and the rest to the Hyalinea balthica coenozone (Emilian). There are also levels of Arctica islandica whose appearance precedes Hyalinea balthica.

The thickness of this formation is about 700 m. The environmental in which it was deposited is neritic infralittoral.

Towards the top the clays give way to yellow beach sands and after a gap due to erosion, they become gravels, conglomerates, clays and sands, from a continental environment, marshy, lacustrine and fluvial deposits. In this sequence there is an intercalated paleosoil related to an important Interglacial phase (GÜnz - Mindel ?). Above this succession there are fluvial deposits: these are discordant with the above-described sequence and seem to be weathered into a second paleosoil. This paleosoil is widespread in the high Modena plain and can be attributed to the Mindel-Riss Interglacial period.

The tectonic order of these formations is complex. Between the River Secchia and the Torrente Tiepido they are in the attitude of a monocline dipping towards NNE, which is transformed into an overfold thrusted towards NNE on the border of the plain. Between the Torrente Tiepido and the River Panaro, the Pleistocene formations are still in a monocline dipping towards NNE and the strata are upturned in contact with the formations of the Ligurian Complex. Various faults in a more or less Apennine or anti-Apennine direction displace these Pleistocene formations (fig. 1,2).

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(1) by G. Gasperi.

Fig. 1 - Geological sketch map of the margin of the Apennines between the rivers Panaro and Secchia. 1)Alluvium; 2)Marine-continental Pleistocene formations; 3)Upper Pliocene formation ; 4)Early Pliocene formation; 5)Pre-Pliocen formations; 6)Faults; 7) Flexure; 8)Geological cross-sections line.

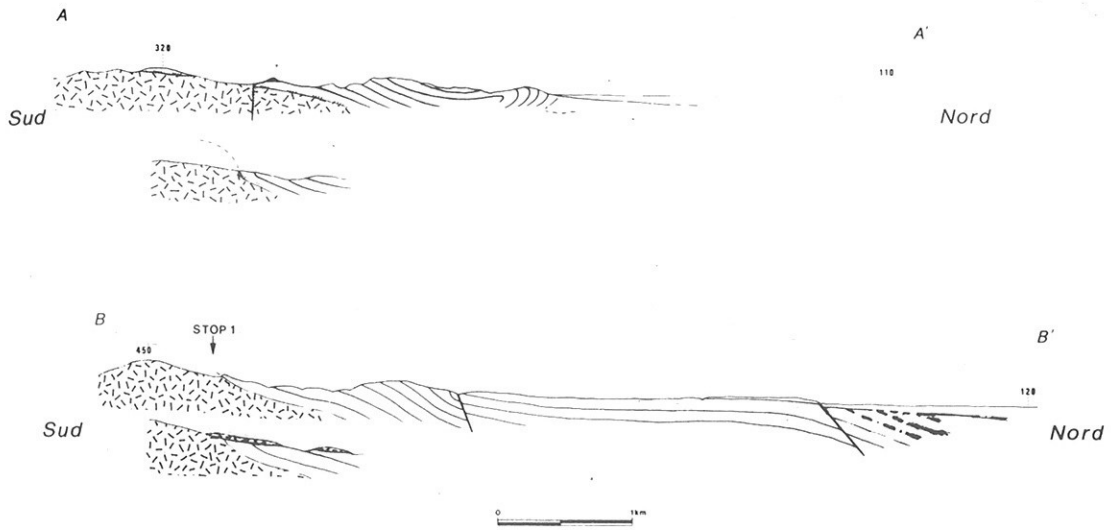

Fig.2 - Geological cross-sections.

Fig. 3 – Panorama northwards from STOP 1 : the Apenninic margin and the alluvial plane of the Po valley.

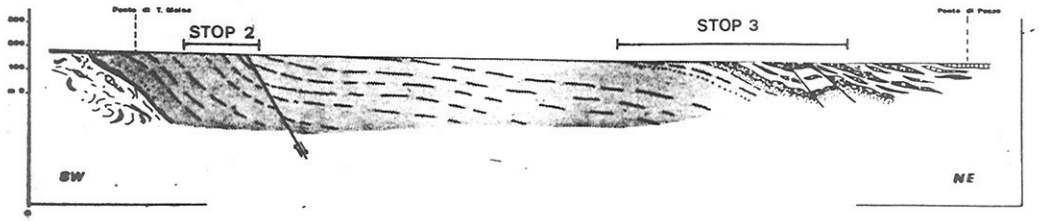

Fig. 4 – Geological cross-section corresponding to the long profil of the T. Tiepido.

Geomorphological features (1)

The limit between the Apennine chain and the Po Valley is here characterized by a series of terraces (at least four) of the Mid-Upper Pleistocene age. They are greatly developed between the Tiepido and the Panaro whilst they tend to disappear between the Tiepido and the Secchia.

The watercourses outlet into the plain gives origin to a series of gravelly alluvial fans: the rivers Secchia and Panaro at present flow on the western edge of the respective alluvial fans.

Erosion is particularly active in all this belt, with the development of landslides and gullies in correspondence with both the Pleistocene argillites and the clayey formations of the Ligurian Complexes ("Argille Scagliose").

STOP n° 1 = MADONNA DI PUIANELLO.

Panorama of the margin of the Apennines (1) : fig.3

Here we are near the contact between the Ligurid Units ("Argille Scagliose") and the Neoautochthonous ones. In fact, all around the A.S. can be seen in their most typical facies: a heterogeneous and chaotic mass of black, red, greenish and grey clays containing blocks of various dimensions (from a few centimetres to over a metre) of marly limestone, sandstone, calcarenites and ophiliotic breccias, prevalently Cretaceous in age. More to the North outcrops the Pleistocene marine sequence of the Apennine margin in a silty- clayey facies. The stratigraphic contact between the silty-clayey strata of the Pleistocene base and the "Argilla Scagliose" may be very clearly seen. Their attitude is about 30° towards NNE. More to the North of the geological limit of the stratigraphic contact, covers of A.S. on the ridges of Pleistocene deposits may also be observed extending about 1 km^2. This A.S. cover is interpreted as a paleo-landslide occurring before the division of the Pleistocene deposits into ridges: in this way it now appears terraced on the valley bottoms.

More to the North we can notice the different Mid-or Late Pleistocene terraces which are typical of this tract of the Apennines? In the distance there is the Modena plain.

In this area landslides, gullies and badlands are very widespread, owing to the intense degradation of the area and to various other causes: especially neotectonics and deforestation.

STOP n° 2 = THE BED OF THE TORRENTE TIEPIDO (FIG. 4 and 5).

The Pleistocene succession (1)

In this strect of the Torrente Tiepido outcrops the lower part of the

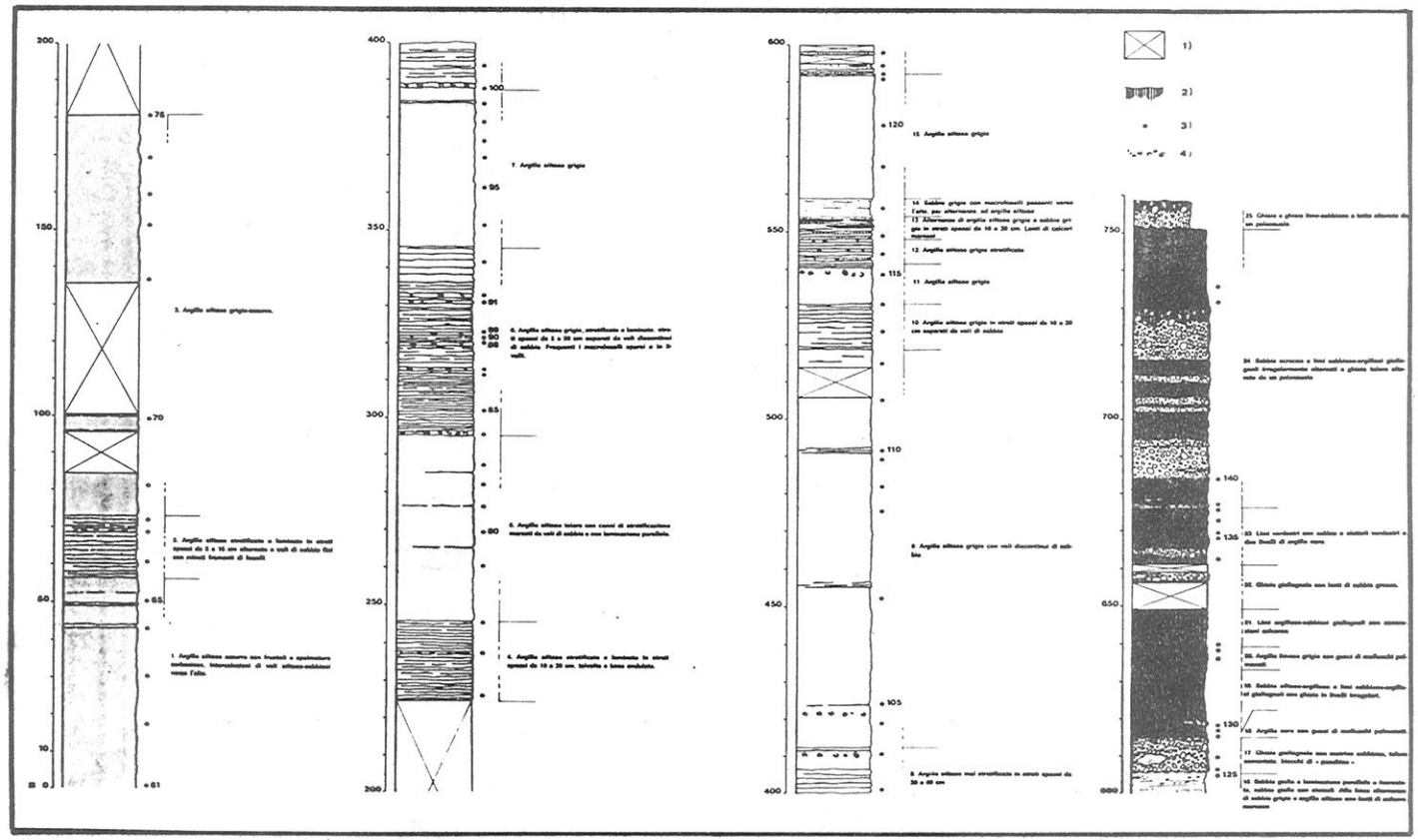

Fig. 5 - Stratigraphic column of marine-continental Pleistocene formations outcropping in the bed of the T. Tiepido (by ANNOVI et alii, 1979).

Lower Pleistocene clayey marine succession (the stop corresponds to the interval between 225 m and 370 m, approximately, in the stratigraphic column in: ANNOVI & Al., 1979). The clays present some tracts without stratification and others closely stratified: the clayey strata are separated by discontinuous veils of sand. The macro-fossils are numerous.

Upstream of the first dam there is the first appearance of Arctica islandica, slightly upstream of the second dam there is the first appearance of Hyalinea balthica. A direct fault displaces the succession in this area: it is one of the margin faults of the Apennines in a WNW - ESE direction, and is very evident also from a geomorphological viewpoint.

The strata of the Pleistocene clays uphill of the faults dip towards NE with an angle of 60°, downhill of the faults they are inclined at an angle of only 10°.

The Torrente Tiepido is affected by intense regressive erosion owing to anthropic causes (see forward). The intensity of the erosion may be appreciated if we note that the second dam was built at the end of 1978. The extraction of the gravel (PELLEGRINI & ZAROTTI, 1975) which lines the river bed causes the recurrence of erosion with consequent incision into the clayey substratum no longer protected by its "pavage".

STOP n° 3 = THE BED OF THE TORRENT TIEPIDO

The continental Sequence (2) : fig. 4,5

The upper part of the stratigraphic sequence outcropping along the Torrente Tiepido is composed of Continental deposits. They begin with a bank of gravels laid on the erosion surface which limits at their top the yellow sands with a littoral facies which represent the closure of the marine cycle.

Above, there follows an alternation of clearly fluvial levels (gravels ans sands) and others with a fluvio-lacustrine facies (clays, silts and fine sands) containing peaty levels, continental gasteropods and fragments of wood. This succession is analogous to the one found in the nearby rivers of western Emilia: Lodola, Crostolo, Modolena, Enza and Stirone (AMBROSETTI & CREMASCHI, 1976; CREMASCHI & PERETTO, 1977).

The strata dip at the end of the sequence with an angle of about 30° downhill whilst towards the top the inclination gets progressively milder.

The bank of gravels between 715 and 750 m is weathered by a fersiallitic paleosoil of which only the argillitic and B/C levels remain. Its pedological characteristics permit its attribution to an important interglacial period in which the climate of the Po Valley area was much more Mediterranean than nowadays (GUNZ+MINDEL?).

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(2) BY M. Cremaschi

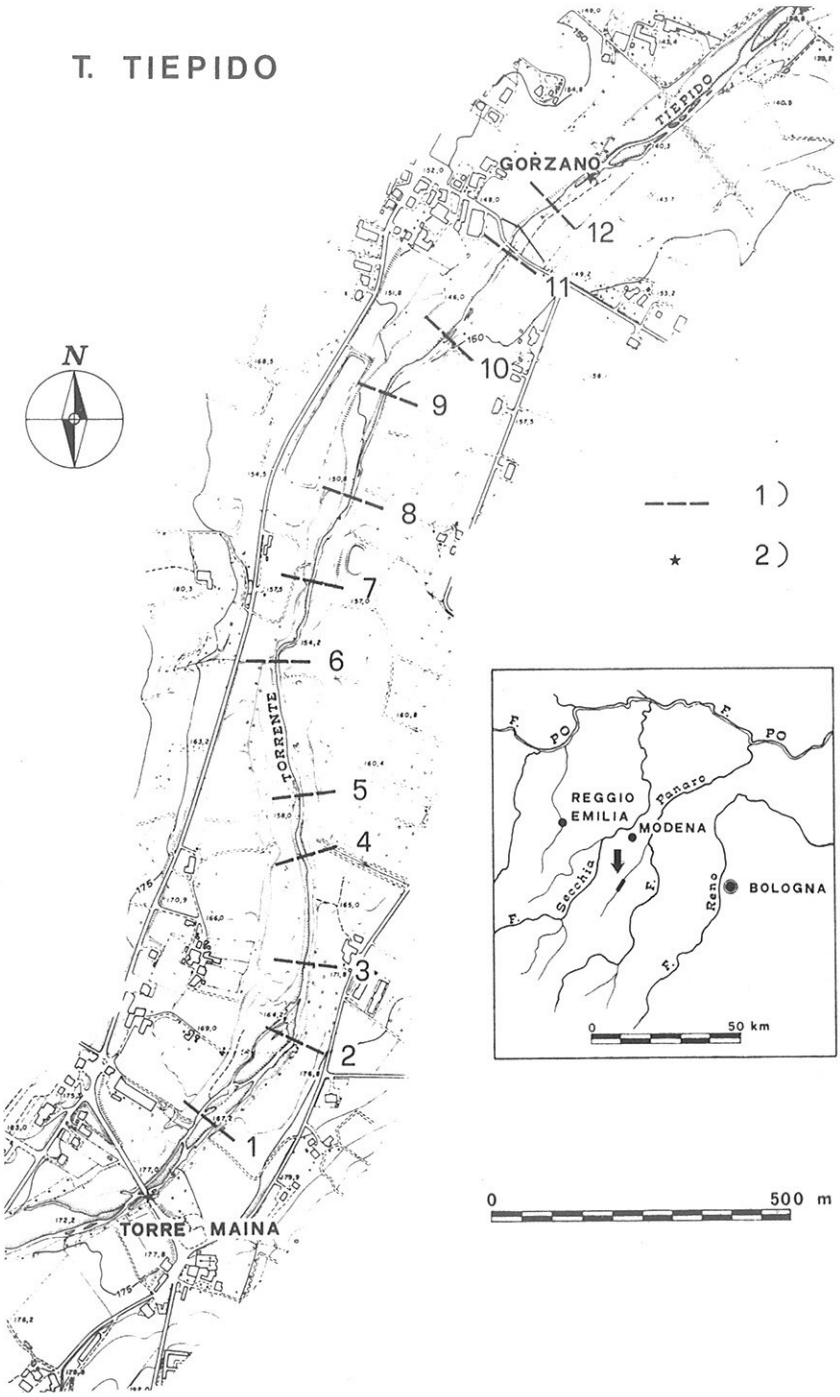

Fig. 6 - Index map and topography of the valley of the Torrente Tiepido in the stretch affected by the erosive phenomenon studied up to 1975.

1) outline of the cross-sections illustrated in Fig. 2;

2) extremities of the long profile traced out in 1975.

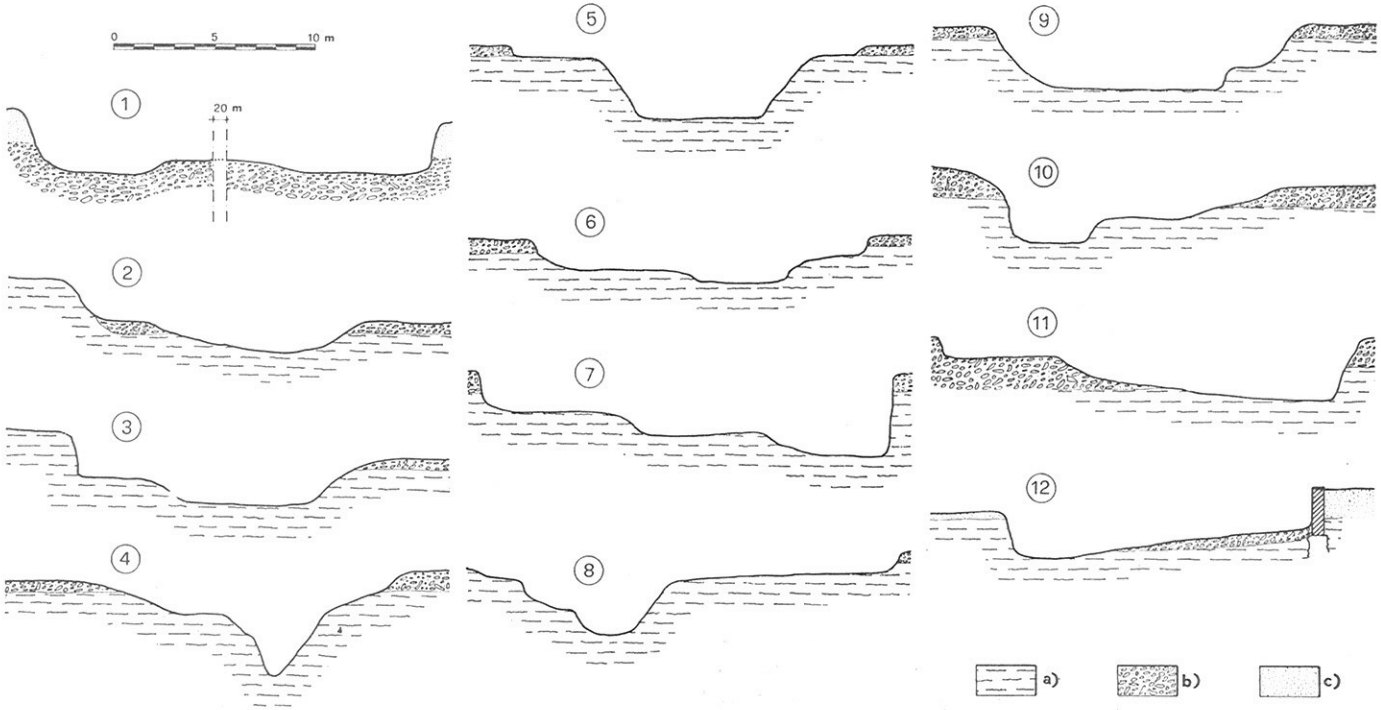

Fig. 7 - Cross-sections of the river-bed of the T. Tiepido between Torre Maina and Gerzano (July 1975); the numeration refers to the outline shown in Fig. 1.
a) grey-blue fossiliferous argillites of early Pleistocene age;
b) mainly gravelly alluvial deposits;
c) silty-sandy alluvial deposits.

The fersiallitic paleosoil is now divided by a series of small reverse faults with slight offsets which displace indifferent points the same level along the river bed.

The top of the continental sequence of the Torrente Tiepido is composed of another pack of fluvial sediments on top of which another fersiallitic paleosoil has evolved.

This is widespread all along the feet of the Emilian Apennines and is attributed to the Mindel-Riss interglacial period.

ACCELERATED EROSION PROCESSES (3) (Fig. 8 - 10).

Within the finalized CNR (4) project "Soil Conservation" sub-project Fluvial Dynamics, the Operative Unit of the Institute of Geology of University of Modena is at present studying the phenomenon of concentrated erosion in a stretch of the Torrente Tiepido, a tributary of the River Panaro (Province of Modena).

As observations and measurements made at various times since 1964 were available, it has been possible to follow the evolution of the phenomenon, practically from its beginning, and to individuate with certainty its causes, represented especially by some occasional excavations of inert material from the river-bed: in fact, the extraction of gravel gives rise to an erosive process in the clayey substratum. The quantity of argillite removed spontaneously by the watercourse is greater than that of the gravel excavated artificially. Therefore, we have been able to follow on a small scale a process which has been taking place for some years in all the main watercourses of the Po Valley side of the Apennines. Very often, it is difficult to define the causes of this process, which have provoked an apparent rejuvenation in the long profiles in relation to both the extension of the stretches subject to excavation and erosion and the impossibility to quantify the amount of inert materials removed.

In 1975-1978 some dams were built in order to stabilize the long profile and guarantee the stability of a bridge near the village of Torre Maina. The lithological situation of the river bed, whose alluvial matress has been completely removed, and the excessive height of the dams, though stopping the erosion process upstream, have determined a new intense lowering of the long profile for a distance of about 1.5 km downstream. The cause of this new erosive process may be found in the dams which for some years have been keeping back all the small quantity of material transported by the flow: downstream of the dams the energy of the current is expended only for erosive processes instead of transport and sedimentation.

Because of the removal of the gravel alluvial mattres and of the presence of a clayey substratum, an optimal solution would have lain in the building

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(3) BY S. Losacco, G. Tosatti and L. Zarotti.

(4) Consiglio Nazionale delle Ricerche (National Council of Researches).

of simple stabilization sills instead of high dams.

The attached diagram (Fig.11) illustrates the variations in the long profile in 1964, 1975 and 1979, respectively.

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Fig. 8 - The river-bed in March 1967 near cross-section n° 7.

Fig. 9 - The same cross-section of the previous figure in July 1975: the framing and the perspective of the photograph are not quite identical since the levels of the shot point are changed. On the background a gravel heap taken out of the river-bed is visible.

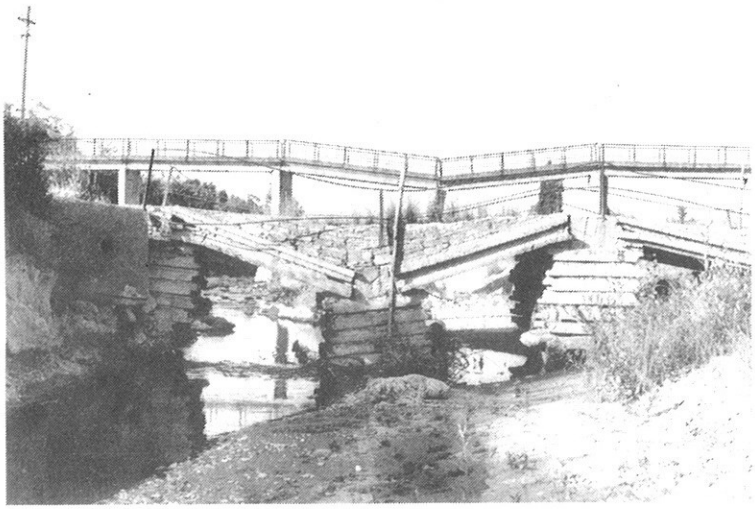

Fig. 10 - Effects of the river-bed erosion: the bridges near Gorzano in July 1975.

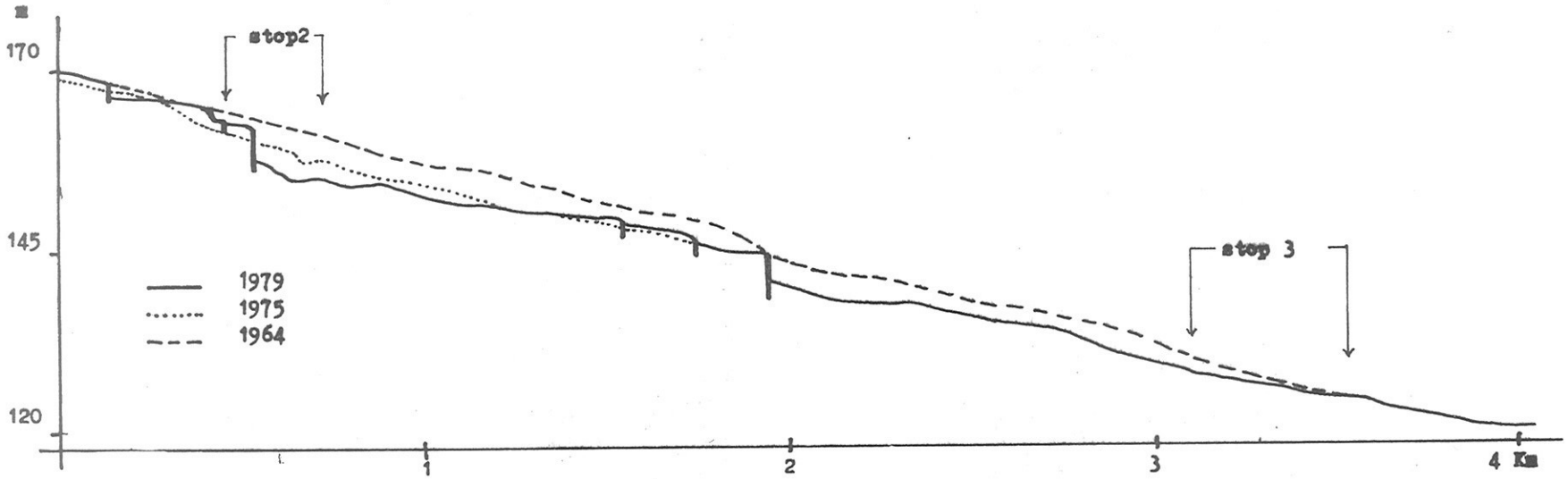

Fig. 11 - Evolution of the long profile of the T. Tiepido from 1964 to 1979.