Campanian Province, Tyrrhenian Sea and Human Settlement with Special Reference to the Palinuro Peninsula

The Quaternary period, *i.e.* the last 3 million years, are of interest to archaeological research. Man is late on Earth. Our oldest ancestors using implements are hitherto not found in the Mediterranean region, but not far away, in the northeastern part of Africa.

A slowly working deterioration of the climatic conditions at the end of the Tertiary period predicted repeated Quaternary glaciations. The oldest traces of glaciation should be searched for in high lying and cold areas, rich in precipitation. It is quite impossible to state directly when, for instance, the first glaciation commenced in the Alps. The accumulations originating from one glaciation can be obliterated or mostly reworked during next glaciation stage. The potential existence of unconformities and stratigraphic breaks means that glacial accumulation in a given place can only be stated to postdate underlying strata by an uncertain length of time.

Climatic changes are obviously correlated to geological phenomena as for instance topographical features, tectonic movements and volcanic activity. The changes of precipitation and temperature are, however, intimately connected with changes in the societies of fauna and flora and ultimately with the development of human culture.

In 1948, *Italy* was formally selected by the International Geological Congress in London as a *general type area for the definition of the Pliocene-Pleistocene boundary*. During forty years since then the transition from Tertiary to Quaternary time has been documented and in detail investigated in several regions of Italy.

The most undisturbed series is 3000 m of marine sediments of Pleistocene age, deposited on the Po plain, which began to be invaded by the sea in the end of the Tertiary.

The province of *Campania* is geographically especially interesting because it is *a transition zone* from glaciated to unglaciated areas. The latitude 40 N, which crosses southern Campania, seems to be a borderline for glaciations through the whole Quaternary period. Southward increasing humidity corresponds to the glaciation phases. Pronounced cool and damp climatic conditions are recorded in the changes of the fauna and flora societies corresponding to the three phases of the last glaciation in northern Italy. At the same time, seeping groundwater caused the formation of stalagmite horizons in many caves around the Mediterranean Sea.

The complex province of Campania has a fascinating geological history, in many ways linked to the story of the early man and human settlement. The province stretches from Golfo di Gaeta to Golfo di Policastro, including steep mountains and large river plains, bordering the Tyrrhenian Sea. The interior of the province comprises the southern part of the Italian mountain chain, the Apennines. The parent rock is often folded and sometimes subject to high grade metamorphosis, and originating from the sediments, once deposited in the Tethys Sea.

The oldest visible sediments are of Jurassic age (Lias), in many regions covered by younger Mesozoic and Tertiary deposits. The dominating direction of the marked faultlines is NW-SW, crossed by transverse fracture zones, together guiding the water of the river systems to the sea. The sediments visible in the bottom of the valleys are mostly of Pleistocene age. Since calcium carbonate is the most common mineral and rock, the running water has a considerable content of lime in solution. The loose rock material rapidly becomes cemented and animal bones and vegetation get covered with lime. Of archaeological interest are small lenses of chert or flint stone (selce) in some sediments of Mesozoic or Eocene age.

The most striking element, however, of the Campanian province — and the Tyrrhenian Sea — is the volcanic character, by all means the Napoli region and the archipelago. In particular Italian research has greatly clarified the Quaternary history of the northeastern part of the Tyrrhenian coastal region. Evident are the relations between the glaciations in the Alps and changes in the sea level, and the correspondence between the volcanic development and the Quaternary chronology.

In the Tertiary period the geography of the western Mediterranean was very different from the present one. The region consisted of a mountainous land. Remnants are the islands of Sardinia, Corsica, Elba and the Pontian Islands (Fig. 7). The collapse and subsidence of the western Mediterranean Sea seems to have been closely connected with the folding of the Apennines and the upheaval of the peninsular ranges. It started possibly already in Lower Miocene with the formation of local depressions.

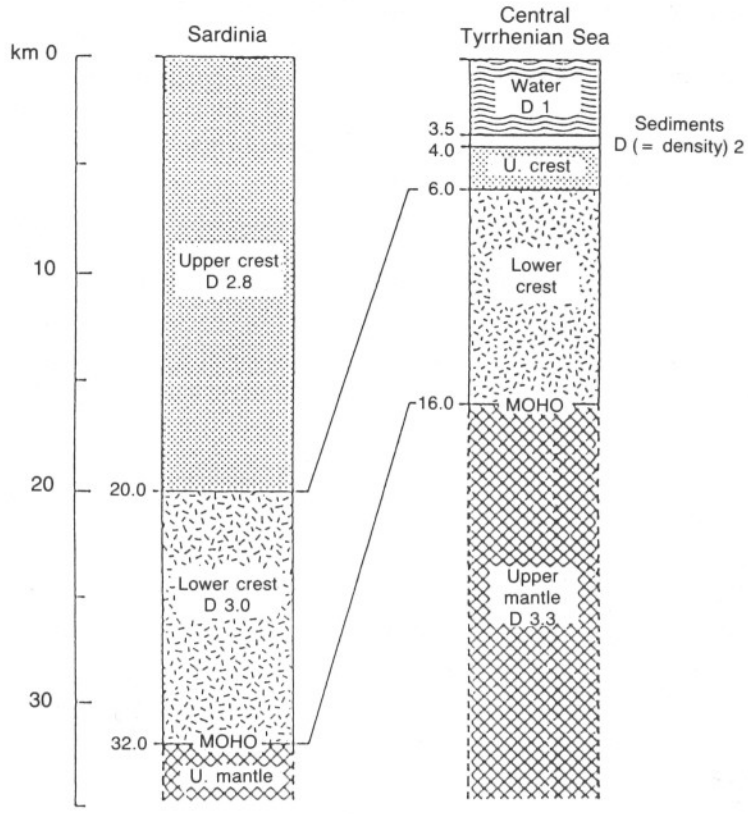


Fig. 7. Schematic crust-mantle profile of Sardinia and the central Tyrrhenian Sea, mainly gravimetric data. Sardinia has a stable continental character, the Tyrrhenian Sea an unstable, thin, almost oceanic crust. After Selli, 1974. From Pichler, 1981.

Fig. 8. Arctica (*Cyprina*) islandica. *From T. Nilsson, 1983.*

The earliest Quaternary marine formation, the Calabrian, (Quaternary stages, see the table Fig. 6) is characterized by *cold northern Atlantic forms*, such as the mollusc *Arctica islandica* (Fig. 8). In the same time thick formations of volcanic tuffs and tuffites build up the Monte Epomeo on Ischia and have also been found in deep borings in the Phlegrean Fields, the volcanic area not far away from Napoli.

During one of the following regressive stages — between the Sicilian and the Tyrrhenian, in earlier Quaternary — the sea level dropped some 200 m below the present. Large parts of the Adriatic Sea became dry land, and Sicilia expanded southwards to comprise Malta and westwards to Tunisia (Fig. 9). During the regression maximum the straits of Gibraltar became very narrow or even closed. The evaporation in the more shallow sea caused a considerable increase of the salinity of the sea water. That was the reason for that some marine forms, which had persisted since the Pliocene, now became extinct in this region.

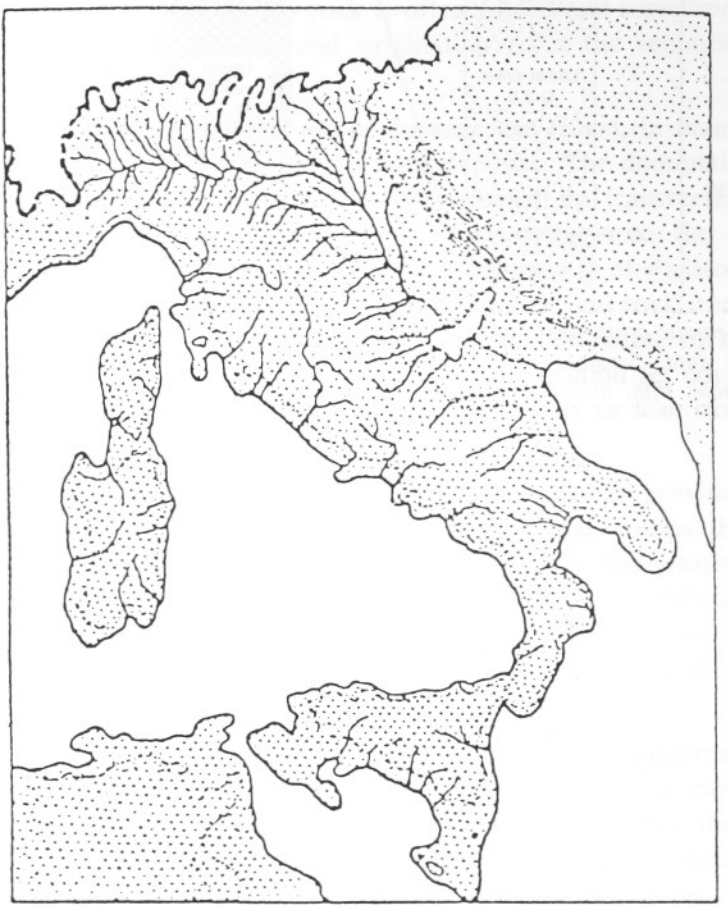


Fig. 9. Sketch-map of the central Mediterranean region during a Late-Pleistocene stage. After Blanc, 1942. From K.G. Eriksson, 1961.

On the broad shelves laid bare along the shores, the fluvial sediments were reworked by strong winds and extensive sand dune areas accumulated (Fig. 10).

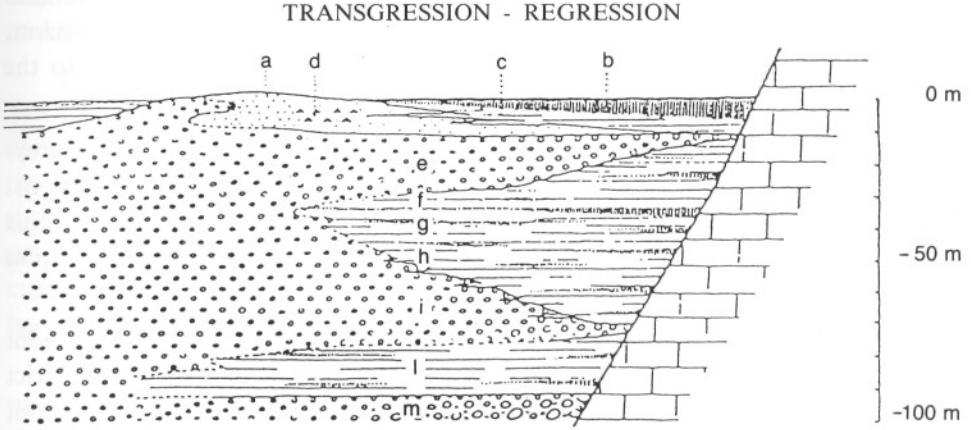


Fig. 10. Transgression - regression. Stratal succession of Lago di Massaciuccoli, Tuscany. a, windblown sand ; b-c, young peat ; d, Mousterian artefacts ; e, i, m, marine deposits ; f, g, h, l, continental deposits. After Blanc. From T. Nilsson, 1983.

The following Tyrrhenian transgression raised the sea level between 30 and 35 m above the present mark. The communication between the Mediterranean and the Atlantic was re-established. From the western coast of Africa *the warm gastropod species Strombus bubonius* (Fig. 11) invaded the Mediterranean basin and persisted there for a long time. On the island of Mallorca the Strombus-fauna is related to two sets of raised beaches, separated from each other by a major regression.

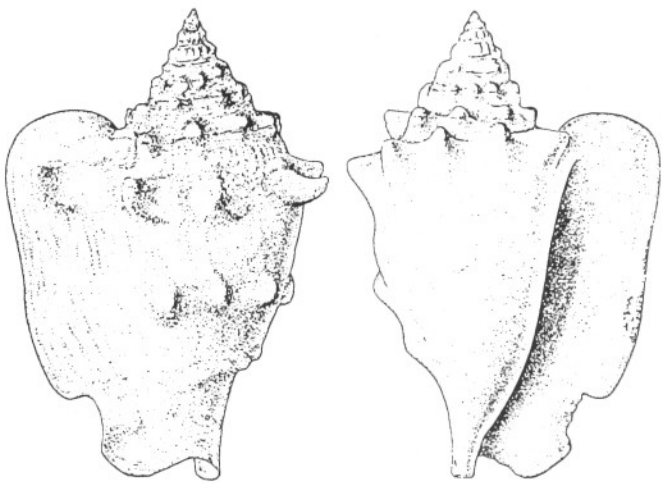


Fig. 11. Strombus bubonius. *From T. Nilsson, 1983.*

In the Pontine Marshes, southeast of Rome, the earliest phase of the Post-Tyrrhenian regression is represented by a succession of *peat beds* which show an evolution of the local vegetation from a *warm climate hardwood flora into plant assemblages indicating gradually cooler oceanic climatic conditions with a nearly pure* Abies alba *(fir) flora* in the youngest horizon, correlated to the first cold oscillation of the *Würm Glaciations* and to the peak of the Post-Tyrrhenian regression.

The peatbeds are covered by reddish crossbedded sand, overlaid by grey-green loess-like sand with layers and crusts of calcareous concretions, presumably formed during a period of cold continental climate. In this deposit *the woolly mammoth*, Elephas primigenius, and *the wild ass*, Equus hydruntinus, were collected together with typical *Mousterian implements.*

The volcanic centres south of Rome group themselves into two different districts, the Campanian and the Liparian. The Campanian volcanic district has an easterly trend, comprizing the Ponza group, Ischia, the Campi Phlegrei, the double volcano Somma-Vesuvio, and furthest to the east the Monte Volture. The southern volcanic district of the province, the Liparian, comprizes the Liparian islands, besides also Ustica and Etna. Each district is characterized by the predominance of a certain magma type. The volcanic ejecta of the Somma-Vesuvio, for instance, are composed of molten magma from the mantle of the earth mixed with the pre-existing rock around the magma chamber in a depth of 5-6 km. This is also ascertained by seismic measuring during accompanying earthquakes triggered by the eruptive activity.

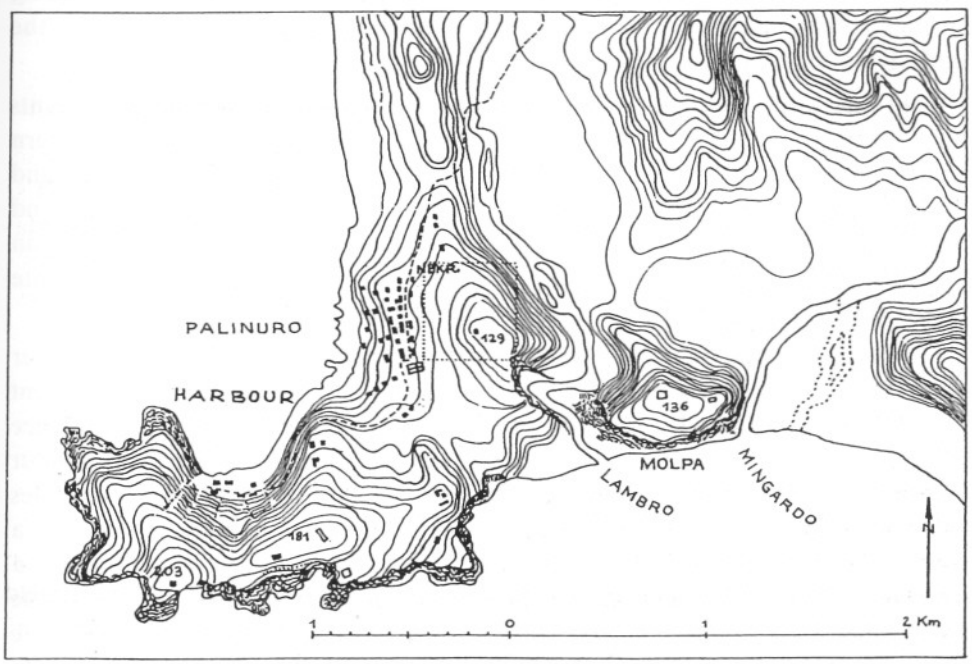
In this part of Italy the volcanism started in Early Quaternary time. Then the volcanic intensity increased and culminated during the Mindel-Riss Interglacial. On the island Ischia the oldest volcanic activity caused accumulation of huge masses of ejecta which give evidence of a period of tremendous volcanic explosions. The island got tapped in the interior by big eruptions. The covering Tertiary and Quaternary formations collapsed along fractures, the blocks subsiding with variable amount.

To elucidate the problems in areas of strong tectonic movements when correlating ancient sea levels in a restricted area the island of Lipari is a good example. In the western part a terrace of Pleistocene age is cut into the volcanic deposits. The altitude of these fossil terraces ranges between 18 and 35 m above the present sea level. On the northwestern coast of Lipari the same terrace system is locally situated about 70 m above the sea level. Field observations confirm that this latter terrace belongs to the same episode of high sea level, *i.e.* to the *Tyrrhenian I*, corresponding to the *Mindel-Riss Interglacial*, despite its different altitude. The irregular altitudes of the terrace are due to local volcano-tectonic movements occurring during the activity of the period I. Mostly the throws of these faults reach only a few meters.

The Lipari island also demonstrates other stratigraphical problems, for instance volcanic products more or less strongly reworked by rainwash and deflation, especially in steeper slopes. Lifting and removal of volcanic sand and dust are typical for the sleeping activity periods on all Aeolian islands and produce a fine-grained dark brown aeolian sediment called « Tufflöss ».

Heavy rains during the winter season sometimes cause cold mudflows. The spreading pattern of floating pumice may also be influenced by the common earth rotation forces. The pumice is moving with the sea currents to the east. When arriving to the western coast lines of Italy it is forced to turn to the north, in the same way as other dispersed particles in the water column, as for instance suspended estuary sand and silt. The coastal sea currents are constantly moving suspended matter in the same way and causes harbours to move repeatedly throughout historical time.

Interesting to archaeologists — as a type area of many geological phenomena mentioned above — is the region of *Palinuro* in southern Campania, situated at the latitude 40 N. The mountainous Cape Palinuro of 203 meters altitude, a peninsula between the gulf of Velia and gulf of Policastro, is the southern promontory of a Mesozoic island arc (see the map, Fig. 12). Encircled is a huge sediment complex of Tertiary rocks — *Cilento*



AFTER R. NAUMANN 1958.

Fig. 12. Palinuro region, a geographical map on the scale 1 : 25.000. Excavation area around point 129 (Cf. Romito, 1985).

— mostly flysch and sandstones but also conglomerates. Cape Palinuro is situated in the fracture zone of the Tyrrhenian trough or subsidence area.

Steep and vertical tilted blocks of limestone fringe the sea. Seeping groundwater and the breakers have cut hundreds of caves in the coastal rocks. In a length of 20 km to the east of Palinuro 62 caves have been investigated and a coastal platform has been indented in the dolomite about 11 m above the sea level, in the Pleistocene time. About ten caves contained Palaeolithic implements and some of them also remnants of a rich mammal fauna, even bones from a Palaeolithic man (Neanderthaloid).

Two rivers, *Lambro* and *Mingardo*, riding down the Cilento, discharge their water into the sea not far away from Palinuro, on the southern coast, breaking through the limestone barrier and very close to each other. The water divide is here a small rock — *Molpa* — just 136 m high. Some parts of the small rock are covered by a thin yellow-reddish conglomerate of the same type as the stone material in the bottom of the river valleys.

The landscape of the town Palinuro is characterized by a fossil yellow-reddish dune sand, which also covers the stony beach to the north of the Palinuro harbour and the westerly slopes (cf. the map, point 129, Fig. 12). In the center of the small town the eolian sand measures a thickness of 7-8 m. At an altitude of 60-70 m above sea level three rushing springs break through the sand cover. They probably come from the underlying Eocene rock.

In the surroundings of these springs a lot of Palaeolithic implements have been found. They concentrate close to a necropole on the northern slopes. Here a large *Neolithic* settlement was discovered in the loesslike sand dunes. Excavations started on a spot around 87 m above sea level, and during the summer 1983 a fire place was unearthed together with an abundant lithic industry, especially obsidian flakes. They probably originate from the Liparian islands. The excavations have continued in 1986.

It is a striking fact that in the Mediterranean region, just as in other parts of the globe, there is a decrease with age in the elevation of present raised beaches (Fig. 13). Certain scholars are presuming a slow subsidence of the ocean floor, and a concurrent uplift of continents, throughout Quaternary time. Others consider the general lowering of the shorelines eustatic, that means to be caused by reduced water volume owing to a continuous accumulation of water in the persisting Antartic and Greenland ice sheets. Very likely a moderate influence can be postulated. In the whole Tyrrhenian Sea, however, the earth crust is today very thin and the transition to the mantle not more than 13 km under the surface. In the same time as the sea bottom of the Mediterranean is sinking the Apennines are raising isostatically, causing sometimes strong earthquakes and volcanism.

The stratigraphy inside many caves along the coast lines and river terraces all around the Mediterranean area of today records human settlement since hundred thousands of years, but also human migration, caused by climate and sea level changes, river sedimentation and beach currents, and last but not least, due to volcanic disasters.

New volcanic ash first devastates the vegetation, but in the long run it is fertilizing, in the same way as the river inundations. The rich soils on the coastal plains have developed many human cultures from prehistoric times until present days. However, the increasing number of settlements also has led to an increasing plundering of natural resources. The erosional pattern includes man's wasting of luxuriant vegetational cover, and devastation of forests, starting already in late prehistoric time. Owing to deforestation and overgrazing enormous quantities of fertil soil has been removed from the mountains and transported by running water and the

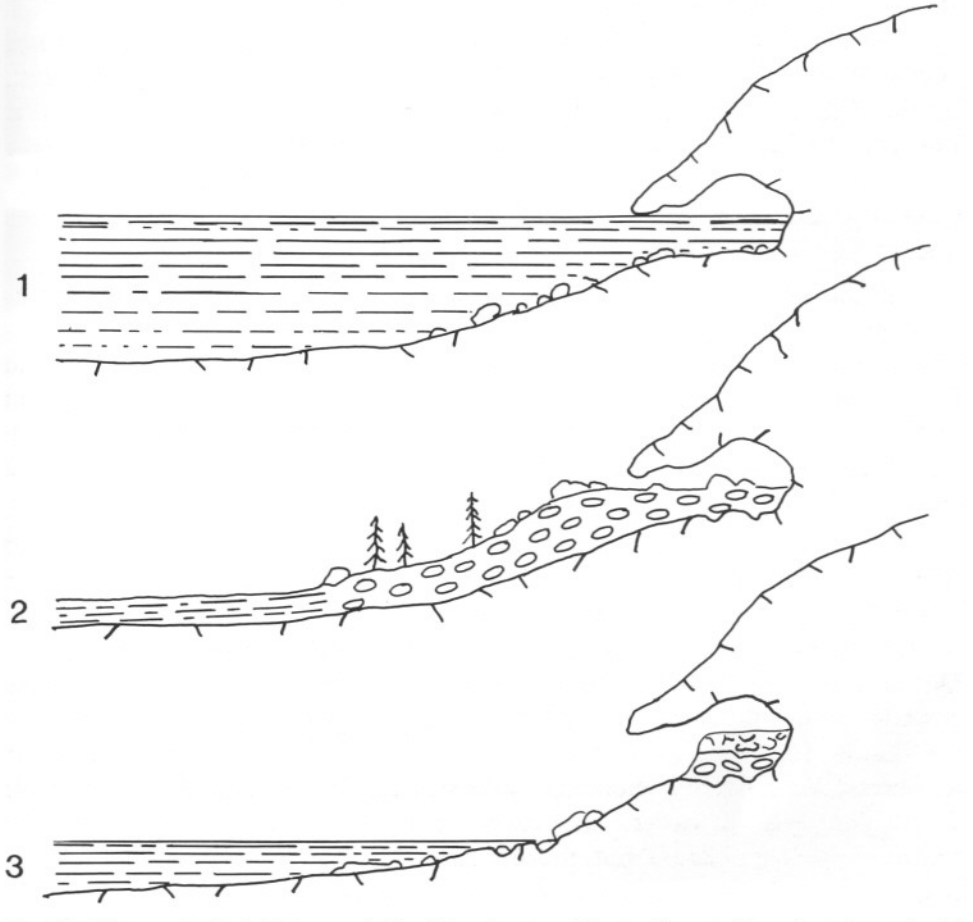


Fig. 13. The geological history of the littoral cave, Monte Circeo, from last Interglacial until today. From Blanc, 1942.

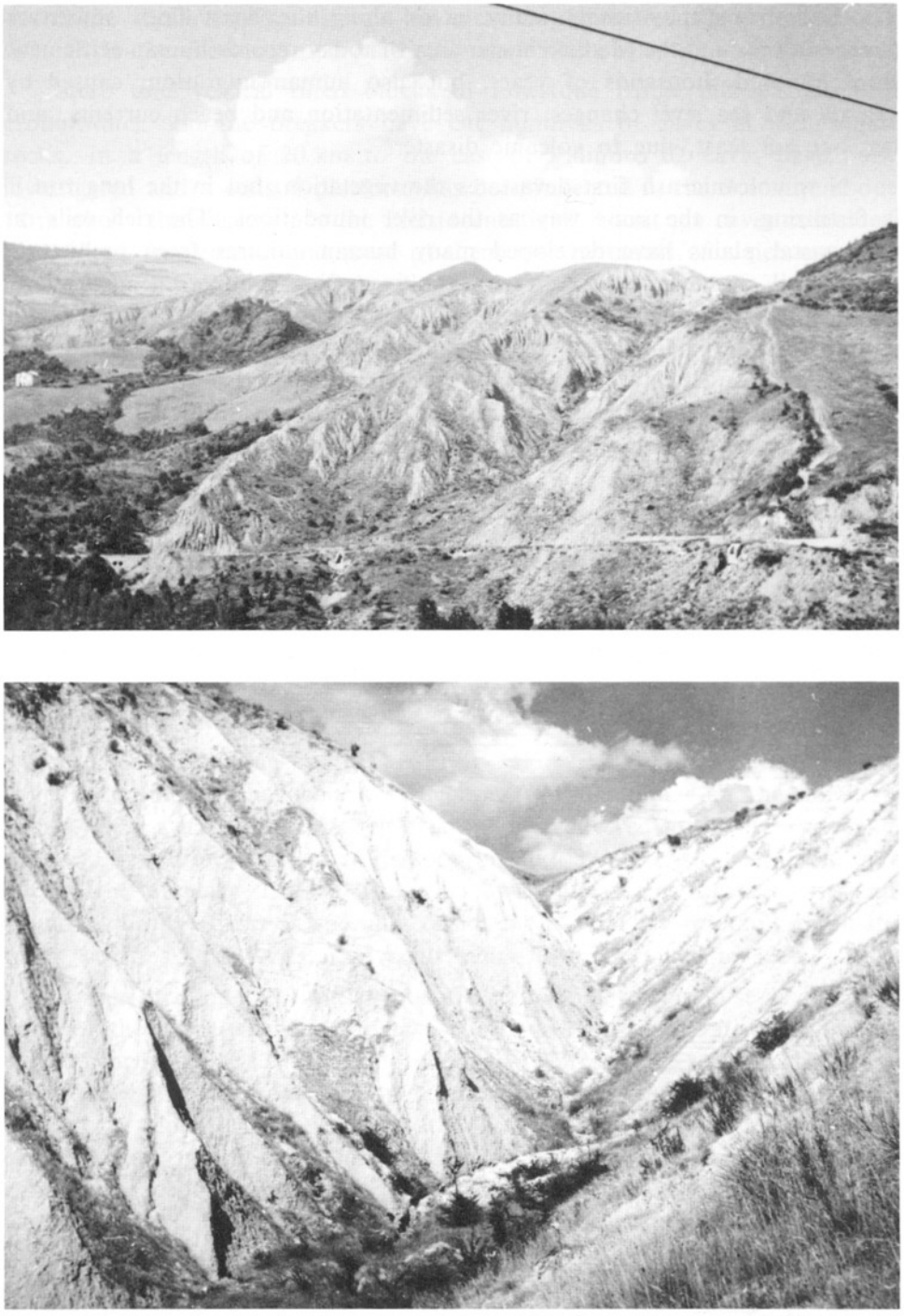


Fig. 14. Gradual destruction of the vegetational cover by soil erosion. Orvieto, Italy. Photo : J. Fries, 1949.

wind down to the coastal plains and out into the bottom of the sea (Fig. 14).

The Quaternary period throughout human settlements are bound to freshwater, for instance river terraces, delta plains, lakes or springs, and strikingly often to sites sheltered from strong winds or protected against bright sunshine or wild animals.

The water is the most important way of communication in the Mediterranean area. It has also been experienced in the archaeological research of the Campanian province, for instance apparent in the seashore colonization and in the trade of obsidian from Lipari to the Italian mainland.

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