POST-PREHISTORIC CHANGES IN THE TAVOLIERE COASTLANDS

(Apulia, Italy)

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ABSTRACT.

This thesis is concerned with related aspects of physical and settlement changes in the coastal portion of the largest lowland in peninsular Italy, the Tavoliere of Foggia (Apulia). It is an empirical study, summarising the state of archaeological and geographical information, offering new archaeological and sedimentary evidence, and reassessing many interpretations concerning settlement, economic activity and the environment from the mid-Holocene and Early Neolithic times to the present.

Formerly there were a number of lagoons in the coastlands, wide open to the Adriatic or almost wholly closed by the barrier island. Today much of this is cultivated land. Before the implications of such a physical change on past settlement and economy can be assessed, the ancient settlement patterns have to be discovered; the buried topography revealed; and the nature and phasing of the sedimentation that has all but obliterated the lagoons outlined. These are the main objectives in the present study. A perhaps wider range of source material than is orthodox in historical geography is investigated to these ends. The study of written and cartographic sources, from the Roman period onward, is intimately combined with the study of field evidence both archaeological and sedimentary. In this way, much of the evidence falls in to place as a better understanding of the former physical environment is achieved. For instance, cognizance of the openness of one lagoon leads to a more accurate interpretation of the route directions of the Roman itineraria and a better coincidence of archaeological and written evidences for lost settlements. But, bearing in mind that the thesis is essentially an interim statement on an active and long-term research programme, no conclusions are attempted although the study has implications reaching beyond the local area. Instead, the three important factors of change - climatic change, changes in sea level, and the anthropogenic factor - are introduced as the basis of the next stage in the research programme.

Figure I

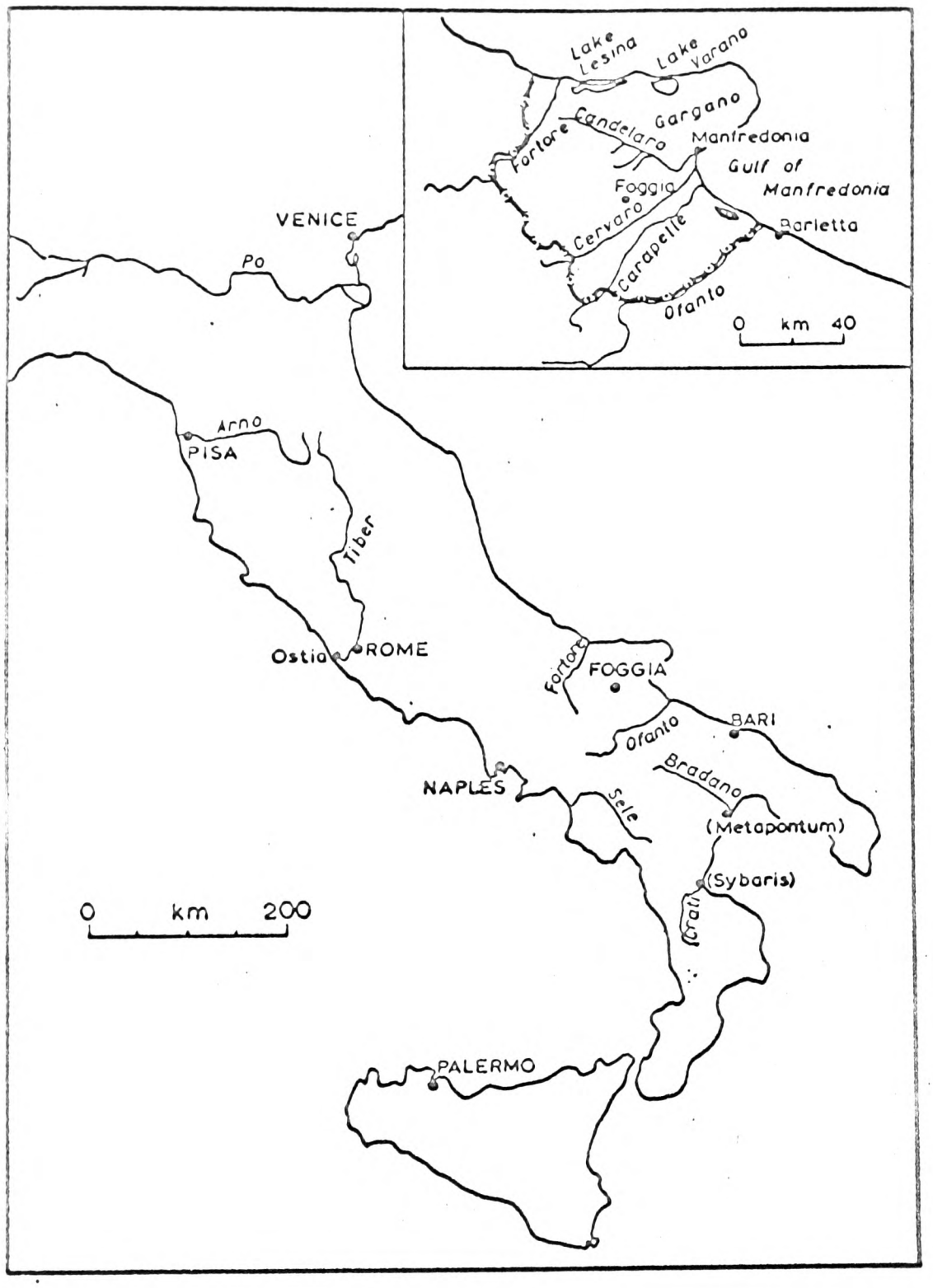


Figure I The Italian Peninsula.

PREFACE AND ACKNOWLEDGEMENTS

The province of Foggia, in Apulia, south-eastern Italy, today has a clear-cut administrative identity (figure 1). It includes 62 communes (some the largest in all Italy), covers an area of well over 7,000 square kilometres and accounts for a resident population (1971) of just over 655,000 persons. Its terrain is succinctly classed in three categories: 4 percent is mountain, 42 percent is hill, so by far the major part is plain. This plain is the Tavoliere.

My association with the Tavoliere began in 1963, while I was at the University of Oxford. I was already engaged in research in southern France (on the Late Neolithic and the Gallo-Roman landscapes of the Garrignes of Montpellier) when the late Professor Sir Ian Richmond introduced me to southern Italy and to the Tavoliere of John Bradford. I was to associate, as a geographer, with those archaeologists who had undertaken to continue Bradford's project by completing three research volumes, on the Neolithic, Roman, and Medieval landscapes of the Tavoliere. By that time Bradford's work was under the auspices of the London Society of Antiquaries, administered by the Apulia Sub-Committee of which Sir Mortimer Wheeler was chairman and Sir Ian Richmond was treasurer. Misfortunes have beset the Apulia Research Project and there have been delays in producing the volumes, two of which are almost ready for publication. My own contributions were initially written by early 1967 and by 1969. Inevitably I have drawn a good deal on them as background for the present study. But wherever possible I have given the original reference to avoid quoting from unpublished writings.

About 1970 I turned my attention deliberately to the coastal region of the Tavoliere. I wanted to attempt to identify the key factor in the changes in life and landscape on the Tavoliere during the tangible past.

I argued that, if this contained a physical element, it would be found in the areas most susceptible to change and in which the changes would be the most observable and measureable. These would be the coastlands in the first place, and the valley bottoms secondly. Once the post-prehistoric sedimentary and ecological changes of the Tavoliere were accounted for, interpretation of the archaeological and documentary records of human settlement and economic activity could follow.

Because of the size of the Tavoliere, and of even the coastal area alone (nearly 300 square kilometres); because of the archaeological and documentary record, unusually rich in some respects, unusually poor in others; and because of the very long timespan involved, some seven or eight millennia - it is appreciated that, as a lone researcher on the non-archaeological side, to hope to achieve even a sketchy outline may be a vain and presumptuous ambition. The work is scarcely begun and the present study can be little more than an interim statement. But it is hoped that it may be of interest, and possibly of use, to some of my Italian colleagues, without whose kind tolerance of a stranger's somewhat idiosyncratic curiosity in their homeland even this could not have been achieved. To them, I should like to express my thanks and assure them that I have actually enjoyed every minute of it - even the Foggiana in the most sultry of mid-summers!

Naturally, over the years my association with the Tavoliere has brought me into contact with many people both in England and in Italy. It would be impossible and profitless to attempt to name all individually, and in this list are included only those directly, or very closely, involved in the preparation of the present study, exception made only for fieldwork helpers and for sources of financial support:-

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C.D.S.

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to V.S. and H.V.S.

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NOTE: An attempt has been made to be consistent in the spelling of Siponto. The modern settlement is known as SIPONTO and all matters pertaining to the area south of Manfredonia, or that post-date the abandonment of the ancient city, are so named. This includes the sedimentary studies, although they sometimes refer to earlier times. The ancient city was known as SIPONTUM and for all contemporary features (such as the villa) the classical form is retained. The modern form of Salpi (rather than the older Salapia) is used throughout.

Introduction

The underlying theme in this study of the Tavoliere coastlands is change. Changes in the physical environment in the first place and changes in the patterns of human settlement and economic activity in the second place. My concern, as an historical geographer, with the physical aspects of the coastlands resulted from a quite specific if apparently simple problem, that of accounting for the changes in prehistoric and historic settlement patterns on the Tavoliere as a whole (Delano Smith (a) and (b)). It became apparent that while by no means all the changes on the Tavoliere in general could be explained by physical factors, these could be assumed to have considerable relevance in the coastlands in particular. Thus accounting for the disappearance of both former lagoons and former habitations in the coastal area led to the investigations into the sedimentary history of the coastlands that are described later in this study.

But, as Marc Bloch stated, "It happens that men are such that they fail to notice (the environment) except when there are changes and, especially, abrupt changes". (Bloch, 1931, preface). The changes on the Tavoliere or in the coastlands have not usually been abrupt and centuries, perhaps millennia, of the most fundamental of the many transformations that have been wrought on the face of the Tavoliere passed unnoticed or at least unrecorded. It was only in the latter half of the eighteenth century A.D. that attention began to be directed to that part of the Tavoliere that alone has shown significant physical change, the coastlands. That there have been some quite remarkable settlement changes on the Tavoliere is not difficult to appreciate. It has been hailed as having one of the densest and most remarkable prehistoric settlement patterns of all Europe (Bradford, 1957). Less well documented are the former cities of the Daunian (early Classical) period; there were at least nine of these

on the Tavoliere, most of them today no more than earthworks of considerable extent. There are, too, no less than thirty deserted Medieval villages (sensu stricto) on the lowland (Delano Smith, 1973 B).

In addition to the changes in settlement pattern there have been great economic transformations. The Tavoliere saw some of the most intensive and orderly cultivation of Roman times, that associated with the centuriation systems (Bradford, 1957; Delano Smith, 1967). It was vaunted as one of the most valuable grain-exporting regions of the Mediterranean world during and after the Middle Ages (Braudel, 1972). Yet Apulian wool was esteemed amongst the finest to reach northern Europe in the post-Medieval period (Romano, 1951) and the reputation of the Tavoliere as a pastoral region takes second place only to the Mesta of Spain (Bautier, 1971). Much of course depends on the scale of these different types of farming but on a commercial scale not all of these activities would have been compatible and the processes of change and adjustment involved is one of the most intriguing questions to emerge.

What is clear, on reviewing the evidence for past settlement and economic activities on the Tavoliere, is that there is no commond thread to the changes. Contrary to what some (geographers) would have us believe, there is no determinism in the physical environment of the Tavoliere; no vocation agricole or vocation pastorale as the French expressed it. That there have been physical changes is revealed in this study. The lagoons that contributed to the coastland landscape in prehistoric, classical and medieval times have now quite vanished. Even so, whatever the consequences of lagoon sedimentation on aggredation not only in the coastlands, but in the valleys further inland, it cannot be admitted that the physical attributes of the region had, in the final analysis, much of a role in the shaping of the economic and social history or of the lives of past inhabitants of the Tavoliere.

A second point is also clear. That whatever the physical attributes of

the region may be today, or have been in the past, they have not always been accurately represented outside the region. The contrast between the 'mental image' of the Tavoliere or the 'country of the mind' (Wreford Watson, 1967) and the basic facts, has been of little consequence within the region, as far as one can tell. At most it could have served as political ammunition as, for example, in the struggles of the late 18th/early 19th century for the enfranchisement of the Tavoliere grazing lands. But that it may have been of vital importance in extra-regional relationships is reflected in the poignant division of the modern nation; for across the 'frontier' between northern and southern Italy, attitudes are commoner currency than straight 'geographical' fact.

For this reason, both the 'real' Tavoliere and the 'country of the mind' are sketched out in this introductory chapter, the latter first. And in this chapter it is the Tavoliere as a whole that is described, for a proper appreciation of changes in the coastlands, it is felt, can emerge only from an understanding of at least the salient features, characteristics, and historical events of the great plain itself. The focus is narrowed in the following chapters (section II) where documentary (and cartographic) evidence for changes in the coastlands is examined, the lost settlements identified, the sedimentary analyses described and, finally, some of the physical changes elucidated. In the third section a return to the broader view is necessary in order to comment on aspects of prehistoric (Neolithic and Bronze Age) settlement pattern and economic activities, though the section is concluded with an account of the topographical developments of the two major coastland settlements, the former cities of Salpi and Sipontum. Remarks in the concluding chapter are confined to brief comments on three of the major factors that may have been involved in the physical changes. No attempt is made, in view of the relatively early stage of research on the Tavoliere, to elaborate on the implications of our findings or to generalise from them. This thesis, it is hoped, marks only the

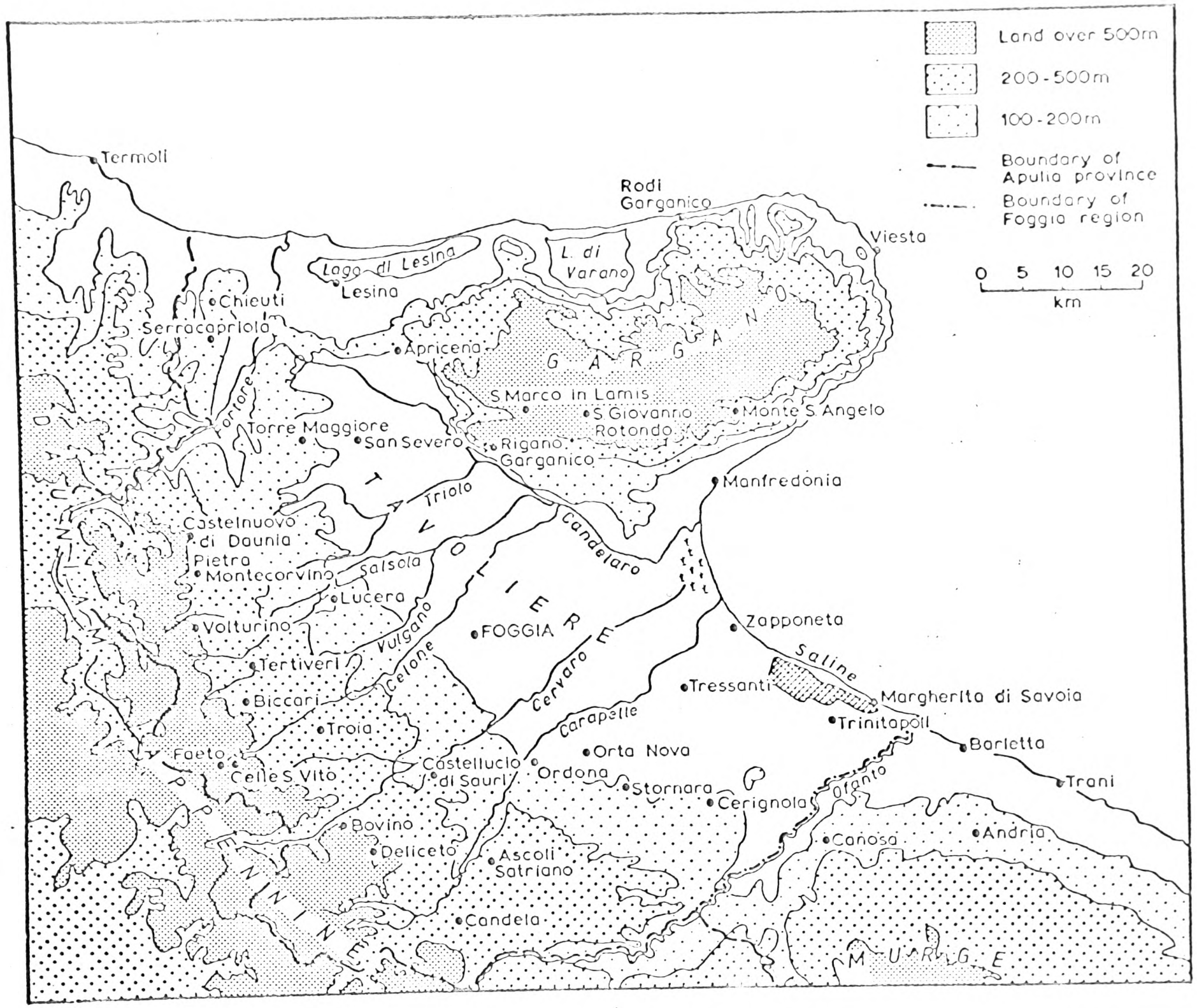
beginning of integrated and international research into the human past of the greatest plain in southern Italy, based on a sound empirical approach.

I

PORTRAIT OF THE TAVOLIERE

Figure 2

Figure 2. The Tavoliere.



1. Puglia Piana

In southern Italy, Apulia (Puglia) lies between the eastern flanks of the Apennines and the Adriatic. It is a long and narrow regione, stretching over 360 kilometres north-west to south-east, from the spur of the Gargano peninsula to the heel of the Sallentine peninsula. The Gargano, besides being the only major promonotory anywhere on the Italian side of the Adriatic, is also remarkable for its abrupt vertical elevation. The contrast, therefore, between the 1000 metre high limestone massif and the plain at its foot, on the southern side, is all the more striking. (plate 1).

This lowland at the foot of the Gargano is the plain of Foggia (figure 2). From the impression gained when traversing it - of monotonous flatness - has come, (according to one school of thought), its second name: The Tavoliere (the Tableland). Today by express train, it takes well over an hour to traverse its length (nearly 100 kilometres, from Fortore to Ofanto). In the 18th century, Henry Swinburne "... passed the whole day in crossing the plains of Puglia to the bridge of Bovino". (1783, p.333 vol. II). He was travelling from Lavello, a straight-line distance of 45 kilometres and rather less than the width of the plain (from coast to Apennines, 60 kilometres).

Sometime in the first half of the 16th century Leandro Alberti also travelled the Tavoliere. He traversed the coastlands from south (and ancient Salpi) to north (and ancient Sipontum) before turning inland. He subdivided his account of northern Apulia into two and described the hilly Daunian Apulia separately from Lowland or Flat Apulia (Puglia Piana) (Alberti, 1550). The latter phrase stuck and in 1830, for instance, the topographer G. del Re used it to head his description of the ancient province of Foggia, Capitanata (Re, 1830).

There is hardly a writer, ancient or modern, literary or academic, who has failed to comment on the flatness of the plain and on its great size. Galanti commented graphically, if unscientifically, that "Capitanata is

almost perfectly flat". (Galanti, 1833, p.291). The English poet Edward Lear described it with a painter's eye:

> "None of your half and half undulations but real flat Apulian plains - pale and pink, and level as a calm lake." (Lear, 1852, p.239).

Another Englishman, the aforementioned Henry Swinburne, was attentive, but disliked the

> "... extensive plains of Puglia ... (which) ... afford a prospect curious from its novelty, but disagreeable after the survey of a few minutes." (Swinburne, 1783, Vol.I, p.213).

Ciasca viewed the Tavoliere, "with its grazing lands lost to view", as"a piece of Tartary". (Ciasca, 1928, p.67).

There is good substance to these descriptions. The plain <u>is</u> big, by Italian standards especially. With 4,300 square kilometres, most of which lies below 200 metres in altitude, it is the largest lowland unit of the entire peninsula. Within national frontiers it is second only to the North Italian Plain. It is true, too, that an overwhelming sensation is of vastness and featurelessness. The Apennine and Gargano mountain horizons are substantial enough but too distant to be seen to encompass the plain. The seemingly endless vistas are given but little variety by the slight undulations of valleys cutting into the gently sloping, imperceptibly stepped, surface of the plain. Even inland, where relief is more broken, the interfluves are still level. In the hazy distance land, sky and coast are one. In such an elusive setting, the works of man are small. Villages and towns become invisible despite their distinctive and often stark sites.

But other epithets have been handed down; assessments that are more subjective and less favourable. Take the historian Kantorowicz, who was interested in the Tavoliere only as one of the Emperor Frederick II's favourite places of sojourn. His careful biographical documentation is interspersed with ejaculations such as these:

"This god-forsaken Tavoliere"

"This sterile region"

"Todays stoney desert"

"The very barrenness of the region" (Kantorowicz, 1931).

Even the geographer J.M. Houston could not refrain from writing of "a kingdom of drought and stone". (Houston, 1964, p.529). Galanti continued that "La Puglia is truly a desert, almost without produce and without inhabitants." Finally, let us quote from an Italian's view of the Tavoliere, which was described as

> "the immense and sad plain of the province of Capitanata, deserted, in salubrious, almost treeless, with little cultivation ...." (Le Normant, 1917, p.9).

Significant, though perhaps unintentionally so, are Le Normant's adjectives and adverbs (sad, and a little further on, tragically). For this inheritance is man-wrought and not the product of some sort of geomorphological or ecological <u>deus ex machina</u>. The sadness of <u>le triste pianura</u> derives from man's failure, here on the Tavoliere, to manipulate economic activity successfully in a region that is not really a region of difficulty let alone one of hardship.

The emptiness of the plain seems to have been something to be afraid of. It is as if the scarcity of other men, of their settlements and signs of cultivation, reflect human insecurity. How much more threatening to the illusion of human achievement would these writers have found the Tavoliere had they known it as the palimpsest that it has been recently discovered to be. An archaeological wealth (a trifle fragmented, it is true) is bursting from the seams as potsherds erupt into the ploughsoil, and it has been recorded on the air photographs too. This is evidence of long, long, millennia of prehistoric occupation (Neolithic and Bronze Age); of past inhabitants who called themselves Daunians; of Romans; of Hellenic Greeks first, and then Byzantine; of Lombards and of Normans; of Apulians ruled by Swabians, by Angevines, by the Houses of Aragon and of Bourbon,

by Napoleonic agents of the French revolution; and, finally of southerners ruled by northerners in so-called united Italy.

Most travellers to the Mezzogiorno today hurry across the Tavoliere. Few stay even in Foggia. They are tired and bored by the journey across a 'flat', hot, landscape; they despise the brashness of a city that has arisen from the devastation of World War II much as it must have done from the devastation of the earthquake of 1731; they miss the tradition and the folksiness of hill and mountain communities.

But for these that stoop to the soil of the Tavoliere, there is a gripping mystique. It is borne, precisely, of the vastness and of the desolation of distance and dryness. But it is from below ground level that the disturbing pulse of history is discerned; so many people have lived their lives out on this spot, contributing to so long a history, but there is so little to show for it. Compared with "ever-pregnant Sicily" for instance, the past of the Tavoliere is dissimulated and writers of archaeological guide-books are hard put to it to balance their pages. Perhaps it is in this subtlety that the essence of the Tavoliere's attraction lies.

2. 'le triste pianura'

The unfamiliarity of some aspects of the Tavoliere's history may explain some of the misconceptions regarding the physical environment. Sad to relate, foremost amongst those misinformed have been English-language geographers. The triste pianura portrayed in the text-books is a perceived country, a country of the mind.

History has not been kind to the Tavoliere. The first hint of this to the modern observer is in the abnormally low population density of the plain. But late in the 18th century the subject of the environmental potential of the Tavoliere was also of concern. Abbot Longano wistfully asserted that "Capitanata could be one of the most prosperous provinces of the (Neapolitan) kingdom". (Longano, 1790). He was right, and in recent years Apulia has become the sixth most prosperous agricultural region in all Italy, following only those of the northern plain. Earlier still, Porzio said, first, very much the same thing and then went on to point out that, despite drought, disease, treelessness and lack of timber resources, low population density, the Tavoliere still managed to produce grain, barley, oats etc.

> "... in such quantity that truly it can be called the granary not only of Naples and of the kingdom but of many cities in Italy."

and that

> "in winter it feeds the greater part of the Kingdom's livestock which came from cold and mountainous places ... (and are) ... so numerous as to count over a million at times". (Porzio, 1575-7, p.361).

One of the most influential of the early modern commentators would have been Afan de Rivera, the engineer involved with the reclamation of Lago Salpi. In 1832 he commented on the fertility of the soil and on the climatic advantages of the Tavoliere, elaborated on the need for, and the ease of irrigation, and then concluded:

> "In sum, regarding the plain of Capitanata, nature has been highly generous in the giving of its gifts." (Afan de Rivera, 1832, p.185).

He stressed the importance of political and economic factors in ensuring the best use of what he insisted were basic advantages in the physical

environment. But even Afan de Rivera could not escape the spell of "the silent desert of the plain of Capitanata" and of its huge and arid pastures (Ibed, p.188).

Thus 19th century commentators kept closer to an objective assessment of the Tavoliere's potential than many have done recently. A personal reaction to an idiosyncratic landscape is understandable. It is easy for us, northerners, to sympathise with the Florentine geographer, A. Sestini, for his view that "in full summer (the Tavoliere) appears squalid and repulsive" (T.C.I., 1963). Or to bear with the brusqueness of travellers "... almost suffocated with dust and parched up with heat" (Swinburne, 1783, vol.I, p.333). Swinburne, like Sestini, nevertheless retained an impartiality in his observations. It is distinctly discomforting, however, to encounter the long trail of an over-hasty assessment or a simple error from a standard geographical text, woven into the writings of others who turn to geographers for the basic facts. A few examples are cited below.

Thus Ellen Semple's inaccurate and misleading description of the Tavoliere was liable to be read and accepted by scholars from several disciplines. Evidently she wrote without first hand acquaintance with the region for she stated that:

> "The depressed region of northern Apulia, located between the Appenines (sic) and Monte Gargano was a lakestrewn lowland of immature drainage underlain by hard limestone which was impenetrable to the roots of trees. Useless for orchards and vineyards ... it served well for pasture land." (Semple, 1932, p.326).

The lakes referred to can only be the coastal lagoons which cover less than six percent of the total area of the lowland. The 'hard limestone' is the calcrete substratum, shortly to be described. This does usually have a hard carapace but of only a couple of centimetres thickness. The deposit below becomes increasingly friable and soft with depth, a fact appreciated by local farmers since Roman times at least. For, contrary to Miss Semple's indications, vines and olives, and all manner of tree crops, have been

grown on the Tavoliere from classical times to the present day, the young stock planted in specially prepared trenches or pits. Although the archaeological details of Roman centuriation farming on the Tavoliere would not have been available to Miss Semple at the time of writing, the practice of trenching for arboriculture became obsolete only in the last fifteen years by the use of mechanised deep-ploughing to break up the hard carapace. As John Bradford noted, it is a warning against "building arguments upon scrappy written evidence and inference" (Bradford, 1949, p.70). True, the Tavoliere was for a time used predominantly as pasture, but this reflected deliberate policy and the plain's reputation as a grainland certainly dates back to the Roman period (Columella, On Agriculture II vii 4)

From another widely circulating text, The Geographical Background to Greek and Roman History, non-geographical researchers might accept that:

> "South East Italy has the lowest rainfall of the peninsula and (that there is here) a dry top layer of limestone. Consequently, in spite of its moderate elevation and low relief the inland does not lend itself to intensive tillage and is suitable for little else besides sheep grazing."
> (Cary, 1949, p.140)

Almost word for word, in a recent book on Virgil's Italy, we read that:

> "Southeastern Italy has the lowest rainfall of the entire peninsula, and the soil is burdened by a dry top layer of limestone. Consequently, the terrain could not be adapted to extensive (a mistake for intensive presumably) agriculture and land-owners had to use their holdings as grazing lands for sheep and horses..."
> (McKay, 1970, p.250).

While there are grains of truth in such statements, it is the suggestion of direct causality that over-simplifies and masks reality. Few geographers writing major texts on the Mediterranean lands have taken pains to stress just how wide physical parameters can be made by human ingenuity and adaptability, (but see Houston, 1964). Crop selection and cropping patterns are but two of the traditional responses to the exigencies of a Mediterranean climate. The trilogy of grain, olive and vine that has been the basis of peasant farming in all Mediterranean lands, for two if not

three or more millennia, was hallowed in a special plot in the Forum at Rome.

But too many geographers have themselves underlined the wrong relationships. Another example is taken from one of the most durable of the standard textbooks on the regional geography of Europe. With regard to the Tavoliere we read:

> "These late Tertiary and marine sediments spread out widely into a broad plain. On the whole they give rise to rather useless country apt to dry out in summer and to become water-logged in winter; it was <u>therefore</u> devoted mainly to winter pasture for sheep ..."
> (Shackleton, 1958, 6th edition, p.78; my italics

In fairness to the author it should be pointed out that he did mention the role of deforestation in such aridity. But it is small wonder that similar misrepresentations appear in the archaeological literature. In one of the very few texts to deal with the Tavoliere we have to bear with:

> "It is now the driest corner of Italy and through the summer months completely arid. Water is brought down by aqueducts from the mountains to make life possible..."
> (Trump, 1966, p.56).

The aqueduct (without which, it is implied, there can be no settlement or, at the very least, no summer occupation on the Tavoliere) reached Apulia only in 1939. Yet, as a prehistorian, few appreciate better than Dr. Trump himself that there has been a good deal of permanent settlement and life on the plain for something approaching five millennia.

It would seem, therefore, that writers have tended to be poorly informed or that the Tavoliere has been badly represented in other parts of Italy and more distantly. In either case, many of the supposed (as well as the real) difficulties of life on the Tavoliere can be traced to a single factor, one of marginality. This is not intended in a physical sense, although it is true that the regional climate is close to the margin between sub-arid and arid (page 285), but in the ordering of regional economic and social affairs; the political aspects, in other words. Whether in intra-regional matters, in the relationship between the local

area and the locus of the highest administrative echelon; or in inter-regional relationships, the Tavoliere seems always to have been excentric or frontier in location. This is fundamental to the understanding of the region's history and of its changes although only a limited number of points are given here to illustrate the theme.

In the first place, the Tavoliere has been separated from the various political centres responsible for it. Not to mention the relationship between Byzantium and the Tavoliere, as far as the Italian capitals only were concerned great distances or difficult journeys over the Apennines separated the Apulian lowland from Rome, Palermo and Naples. The chief link was the long sea route south around the heel and toe of the peninsula. Not surprisingly, the Tavoliere has tended to have the fate of a backwoods area. Three instances, drawn from different historic periods, suffice to bear this out. As a consequence of the Punic War in Republican Roman times, the plain acquired attributes more usually associated with the colonies of a frontier zone, notably the centuriation system (Toynbee, 1966). Secondly, we have been shown how the policing of the Neapolitain kingdom in the 16th century decreased in efficiency with increased distance from the capital (Aymard, 1970). Few of the convicts, in the crews of Italian galleys came from east of the Apennines, for convictions in the relatively isolated provinces were rare compared with those taken from the west coast and the Terra di Lavoro (a quarter of those recorded came from Naples itself and the bay area). Finally, let it not be overlooked that Aragonese exploitation of the Tavoliere, through the Dogana of Foggia, as ranchland was nothing less than a form of pastoral capitalism.

The Dogana delle Mene delle Pecore was established by the Spanish ruler of southern Italy, Alfonso I of Aragon, in 1447. (Dominicis, 1781). That there had been antecedents of some sort is undeniable; there are a number of Constitutions dating from Frederick II's rule and enough evidence from the Roman period to indicate that organisation of large-scale grazing

is traditional in this part of the peninsula. But the Dogana involved more than the normal regularisation of Mediterranean pastoral activities, for it was established as one of the most powerful economic bodies in Italy and it lost nothing of that role until abolition in the nineteenth century. Like its ancestor, the Spanish Mesta, it comprised a judicial as well as an administrative body. Its officers collected rent for grazing rights, taxes per hundred head of sheep or goats and dues for the (compulsory) usage of the drove roads (tratturi) that linked the summer pastures of the Gran Sasso and the Abruzzi to the winter ranches on the Tavoliere. They were also empowered to decide on the laws by which not only grazing but all land use was directly or indirectly governed. Thus, since the Dogana was anxious to increase the area of grazing under its control, village lands were taken over at the slightest opportunity (see page 269 for the fate of arable land at Salpi for instance). The extent of arable and even of grazing for plough teams was severely limited. Trees were expressly forbidden in the grazing area (locatione) on the grounds that their roots dried the ground, thus impairing the grass cover. That the Dogana, or its protected royal or baronial graziers, were agents in the felling of trees and clearance of woodland was surely the message conveyed by A. di Michele di Rovere through his maps of the grazing locatione. (Dogana, 1687, see page 40). It was to the unnatural duration of this formalised, and self-perpetrating, economy that much of the 'backwardness' of this part of the Mezzogiorno may be attributed. (Delano Smith, 1970). Also, according to a second school of thought (see page 5), it was from the Tabula censurial, the rules governing the use of the pasture until 1865, that the Tavoliere gained its name (Almagia, 1959).

To return to the question of marginality however. In the second place, the Tavoliere has been, for nearly all of its recorded history, at or near a frontier. While much frontier conflict remains abstract, fought by nothing more harmful than diplomatic notes or sharp ambassadorial exchanges,

there are occasions when at local level the struggle becomes not only real but detrimental. The Tavoliere, as part of the province of Capitanata, (the fore-runner of Foggia province) has seen conflict between Rome and Samnium; Rome and Italiote-backed Hannibal; between Lombards and Byzantine Greeks; between Normans and Lombards and Greeks; between the Pope and the Norman or Swabian rulers of the southern Kingdom; and between the usurping Angevines and the last of the Hohenstaufen. For the local population all of these conflicts involved a certain number of pitched battles but more significant to them would have been the tremendous and far-reaching harrying that accompanied each conflict and that continued on and off during many centuries. This would have meant the requisitioning of stores, seed and corn, even standing grain (when this had not been burnt); of livestock for meat or as beasts of burden. It would have involved the pressing of men into military service and the destruction of buildings. Attrition derived from such frontier conflicts, let alone local vendettas, may be a factor in the unusually low population density that appears to have been a characteristic of the Tavoliere throughout the last millennium. Today, the Tavoliere is at peace and at rather greater distance from the official frontier than ever previously. On the other hand, now more than ever perhaps, it lies in a different world from that of its political and economic rulers.

Finally, there is no denying that the Tavoliere would have <u>appeared</u> to almost any non-Apulian visitor a strangely empty area. Even to a Neapolitan today, it is climatically and scenically alien. It has a dry continental climate, Saharan in summer and relatively 'Siberian' in winter. Above all, it lacks trees and it lacks people, both hallmarks of not only northern landscapes but of the Campanian one too, just the other side of the Apennines.

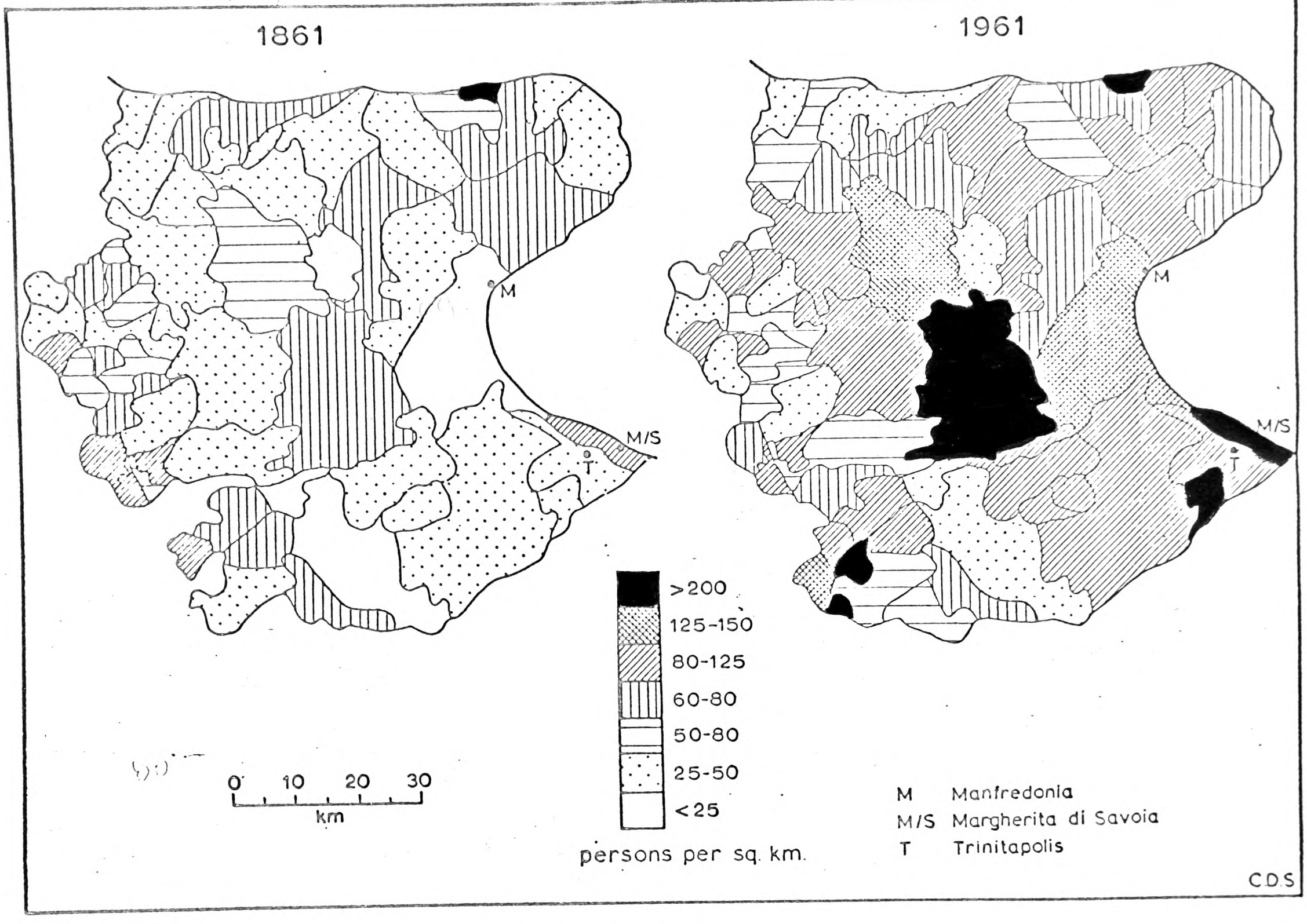
The absence of trees in the Tavoliere landscape has been remarked on by almost every writer in the last two or three centuries. This is a signif-

icant point, for trees have a special significance to the European mentality. (Wreford Watson, 1967). Where trees grow so, the assumption is, will bread corn; for where there are no trees, the soil is barren and barren means not simply treeless but soil incapable of supporting them, infertile or sterile land. Yet it is easy to account for the disappearance of trees from the Tavoliere. Moreover, the onus of the blame should be attributed to the activities of the Dogana for there is evidence that a good deal of the "broad oak forests" of ancient Daunia (Horace Odes I. 22. 13–14) were surviving earlier in the Middle Ages.

While there is no direct evidence for the 'original' or prehistoric vegetation cover of the Tavoliere (in the absence of pollen analyses) there are no grounds for refuting the botanical argument for a climax woodland on the valley bottoms and for an open, Ilex-dominated Mediterranean forest on the interfluves. Man as a farmer can hardly avoid cutting trees. He needs to remove at least the crowns to have open space for arable land; he needs timber for fencing and building, fuel for domestic and other purposes. But these demands need not destitute an entire region of its forest cover; on the contrary, the peasant farmer has considerable need of, and uses for, the perimeter woods. But what direct clearance may fail to do, degradation can achieve irrevocably. On the scarcely perceptible gradients of the Tavoliere erosion is of little consequence. But removal of the forest crowns, or clearance of the shade-giving shrub horizons, destroys the micro-climate upon which the saplings of the dominant tree species are dependent for their regeneration. In this way the ecological trend is downwards, or regressive: from scrub, the vegetation cover passes to heath (with asphodel or, in Apulia, the giant-fennel) and thence to grassland or even a bare soil and rock. Human and human-induced activity (livestock grazing, food gathering) merely reinforces the regressive trend. The role, in this respect, of the Dogana and Dogana-protected activities and of the grazing (in the eighteenth century) of some five

Figure 3

Figure 3. Population density 1861 and 1961, by commune.



and a half million animals on the Tavoliere needs no further emphasis.

There is too the question of the lack of people on the Tavoliere. No doubt the restrictions imposed by the Dogana on arable land, and the pressures brought on settlements already declining, with a view to the expropriation of their lands were contributory factors. But whatever the details of the demographic profile, and despite the lack of adequate data, especially for pre-Medieval times, the impression gained is that the low-land has never been densely inhabited as might be expected, except for one historic period. When archaeologists have studied more closely and completely the great 'city' sites of the Daunian period, they may be able to substantiate the suggestion that the Tavoliere has never recovered from the devastations of the Hannibalic (Second Punic) war. (Afan de Rivera, 1832; Marin, 1970; Toynbee, 1966). But however sparsely inhabited, the plain has not always been so despised as in recent times. The Emperor Frederick II, for example, whose spirit pervades the Tavoliere still through so many of the Medieval sites, was proud of his Apulian associations:

> "We have chosen our domain of Sicily for our own amongst all other land ... and yet feel it is no ignoble thing to be called 'a man of Apulia'."
> (Kantorowicz, 1931, p.221).

One of the most striking aspects of the Tavoliere is that there never have been many 'men of Apulia'. In 1961 the average population density of the whole Foggia province, was 93 persons per square kilometre (figure 3). (In comparison, note that on the north Italian plain the average density rises to 300 or 400 persons per square kilometre, or more.) In the 19th century the emptiness of the Tavoliere would have been ever starker: in 1861 there were not many more than 300,000 inhabitants in the province and the average density was just over 40 persons per square kilometre. Against that figure should be set the observation that since only 46% of the population was living on the Tavoliere itself (compared with 66% in 1961) as opposed to the hill communes, the real density of the plain was still lower.

Figure 4

Figure 4. Medieval settlement pattern in Capitanata as indicated by agglomerations taxed in 1300.

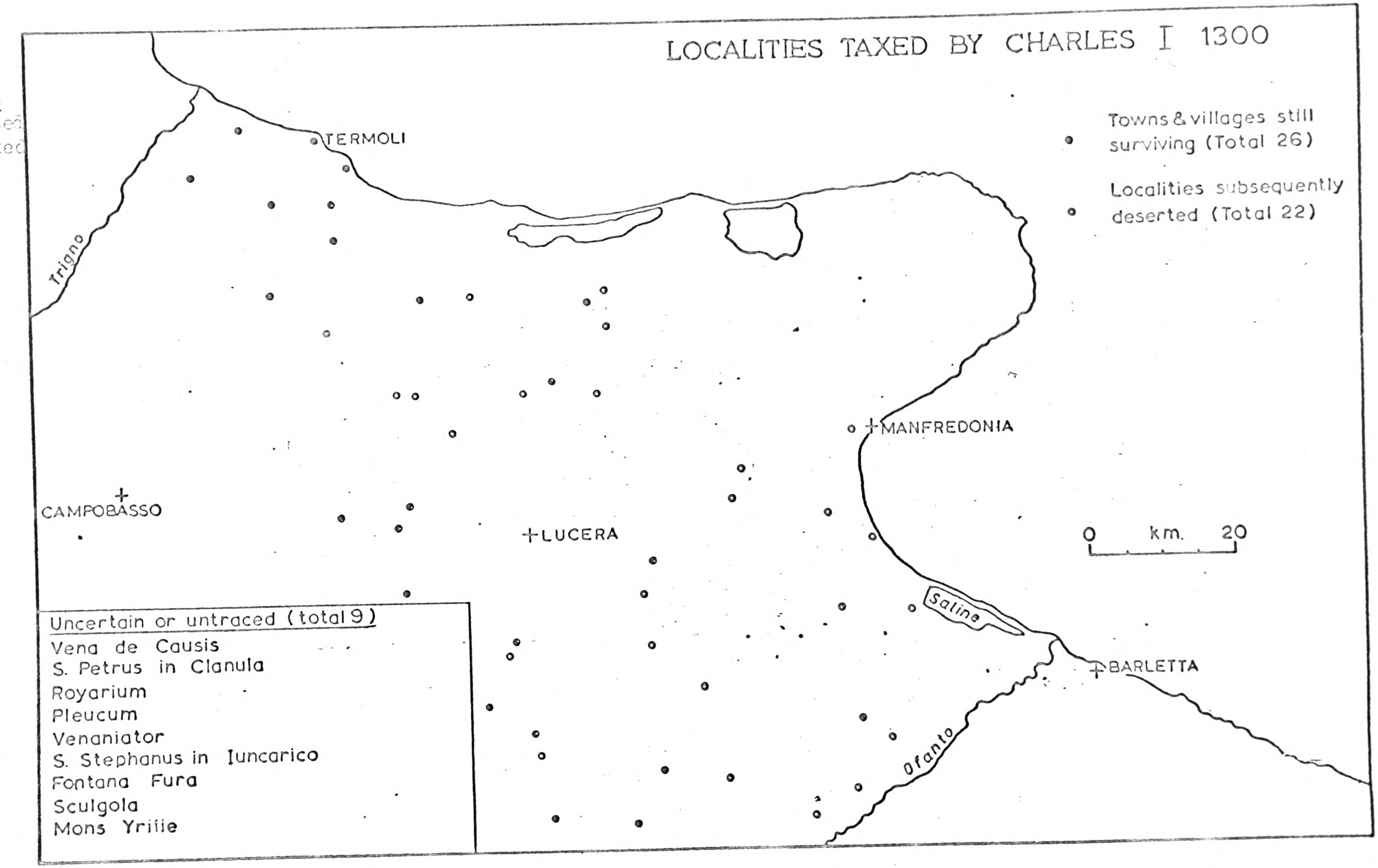
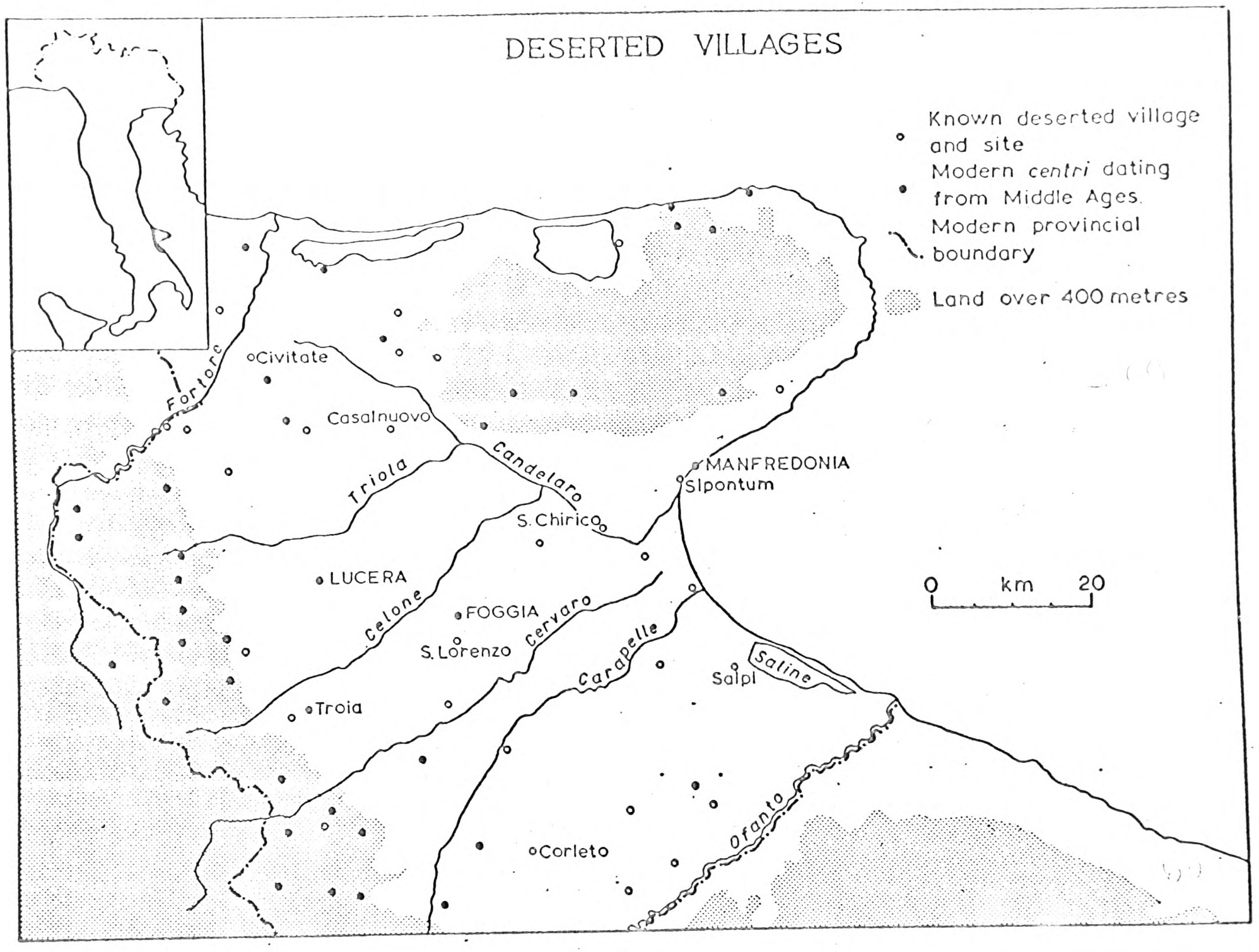


Figure 5

Figure 5. Deserted medieval villages.



Without venturing to assign the blame or to discuss the factors, it is sufficient to observe that the desertion of the lowland appears to have been a relatively recent phenomenon. About two thirds of the localities inhabited during the 13th century were found on the Tavoliere. (figure 4). By far the greatest number of village desertions however occurred on the lowland and it is through such processes that the Tavoliere became depopulated. (figure 5).

Accurate or reliable data for historical demography are hard to come by and susceptible to misinterpretation. However, in order to give some idea, the following figures have been collated from various (second-hand) sources. They are cited at their face value only and no attempt is made here to discuss them further:

Table 1. Total population for Capitanata, 13th to 20th century

1294-99	250,763	persons in Capitanata
1322-23	275,327	" " "
1442-44	277,359	" " "
1788	266,225	" " "
1861	352,010	" " Foggia (province)
1961	665,286	" " " "

(Edigi, 1920; Beloch, 1934; Baldacci, 1962; Censimento, 1861; Censimento, 1961). It is seen that at the end of the eighteenth century there were scarcely more people in Capitanata than in the Middle Ages, an unusual situation in Europe.

Another factor contributing to the aspect of emptiness on the Tavoliere is the settlement form. The Tavoliere has been an area of almost exclusively rural settlement, given that even the bigger centres (e.g. Troia, 9,764 inhabitants) are defined as 'agro-towns', rural in function if not in form. In modern times (1961) only 6% of the total provincial population live in isolated houses (case sparse) or hamlets (nuclei). The majority are clustered together in the 69 agglomeration (centri) of the province.

In the 19th century (1861) this grouping was even more pronounced and more than 95% of the inhabitants lived in the centri.

The reasons for an agglomerated rural settlement pattern in Mediterranean lands are well known (Houston, 1964; Chisholm, 1962) though not always very logically presented (as pointed out by Delano Smith, 1972). In this way, economy of built-up area is ensured, community spirit is fostered, advantage is taken of well-ventilated knoll-top sites, of the shadiness of narrow alleys, and of a more or less central location in relation to the village lands. However, the critical factor for the great distances between settlements on the Tavoliere lay in the feudal system.

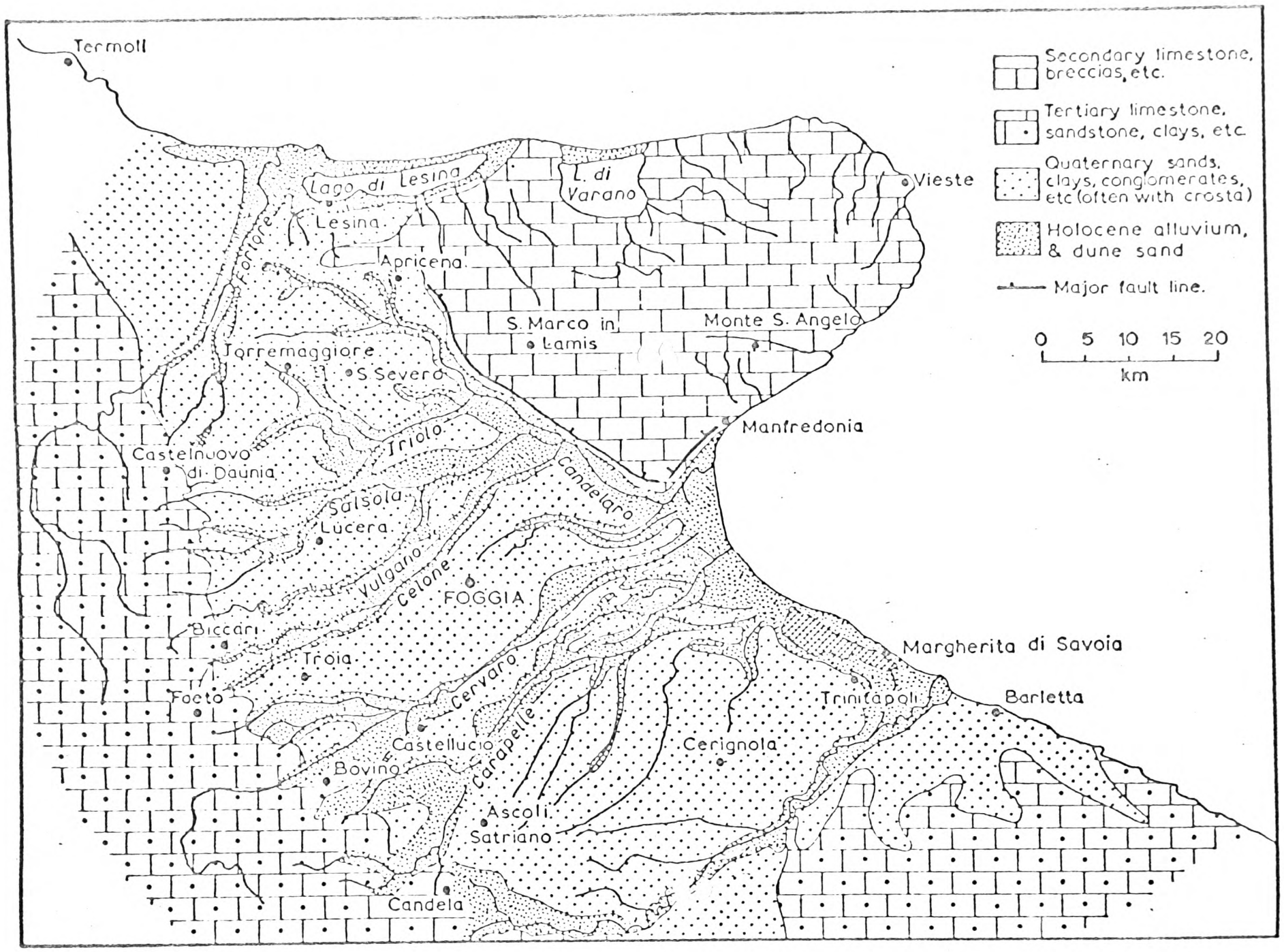
Feudalism in southern Italy, and Sicily, remained official until 1812 and effective long after (Mack Smith, 1969). So with a static tenurial and social system as well as the inflexible Dogana there were on the Tavoliere none of the transformations that characterised the English rural settlement pattern in the post-Medieval period. In very general terms, free and tenant farmers lived in the centri (the citta of early documents), the villages so to speak. The former would have been the owners of the regular, squarish, enclosed plots that lay in a zone immediately outside the walls of the settlement and that are recorded so dramatically on the air photographs. Descriptions and measurements of these plots comprise much of the records in the Cartulary of San Leonardo (Camobreco, 1913). The landless were labourers, many of whom would have lived in the masseria, working the land of an absent landlord under the direction of a bailiff. The masseria were the centres of the baronial or royal estates and lay isolated in the countryside. A single masseria could comprise a vast complex of buildings and a substantial population nucleus (and are classed in the modern census as hamlets or nuclei). One was described as ... "a farmhouse as big as a village, with storebarns that looked like churches and ... a big well". (Verga, 1883, in Property). But, like the true villages, the masseria were compact features. The fact that the arable fields were open

and unhedged added to the sense of space and emptiness in the Tavoliere countryside. Because of climatic exigencies dry farming was the normal, indeed the only, farming system. But the need for half the arable land to lie fallow for a year meant that each estate had to hold a double acreage of nominal arable. In summer months, when stubble and fallow are virtually indistinguishable, the distances between masseria and villages are even more exaggerated and the treeless, hedgeless, houseless spaces between can be indeed lonely immensities.

Small wonder, then, that some of the less discerning travellers have been overwhelmed by the aspect of the Tavoliere to the point of misunderstanding the realities. Even today, the isolation and openness of the plain have contributed to the desertion of many of the reform steadings established both since and before the last war. In the next chapter the salient features of structure and relief and of climate are outlined, the basic facts behind the perceived country.

Figure 6

Figure 6. Geology of the Tavoliere and the hydrological network.



3. The physiognomy of the Tavoliere

The Tavoliere is the surface of a most impressive accumulation of unconsolidated Pliocene and Pleistocene deposits in a major structural depression. (figure 6). Geological dislocations on a continental scale have resulted in the downfaulting of portions of the Secondary limestones, leaving trenches that became filled by sediments (the Bradano trough, the Tavoliere) or by the Adriatic sea. So the limestone floor of the Tavoliere lies at considerable depth; it is reached about 250 metres down in the vicinity of Foggia but not till nearly 500 metres below sea level in the bay of Manfredonia, (Reina, 1957). To the north, however, the upstanding limestone horst of the Gargano towers over the Tavoliere, while south of the Ofanto river are the limestones of the Murge. Inland, the secondary core of the Apennines is usually masked by more recent, more heterogeneous, and less stable deposits. These are most commonly sandstones, thinly bedded limestones, flysch and molassic deposits. The Secondary limestones of the Gargano are massive and resistant. Alternate phases of erosion and tectonic (continental) dislocation have given the Gargano a stepped profile with sometimes extensive levels of plateaux at various altitudes (most notably at 500-600 metres, at 800 metres and, less continuous, at about 1000 metres above sea level).

By far the greater part of the infilling that comprises the Tavoliere is of marine origin. Inland some of the softer strata of the Apennines have been heavily eroded and material of continental origin has accumulated at the foot of the hills. At the foot of the Gargano there is a zone of breccia, cemented fault and other detritius. But in the main there are two series of infilling sediments: fine blue Pliocene clay and, over this, yellow Pleistocene clay. The superficial deposits (late Pleistocene) are unconsolidated sands, gravels, clays, and some conglomerates. Over a good deal of the plain there is a sometimes substantial stratum of calcrete, a calcareous precipitate.

It might be expected that the juxtaposition of Tavoliere clays and Gargano limestones, effected by deep-seated faulting, would have given rise to a major line of springs and resurgences at the foot of the Gargano. On the contrary, the spring line is noticeable for its absence. This absence of resurgence is supposedly due to the deep-seated nature of the faulting; rainfall that has seeped to considerable depths in the limestones is drawn through subterranean fissures into the acquifer (Zorzi and Reina, 1962). But there are in fact minor seepages, not indicated on either geological or hydrological maps. Three at least are known in the Siponto area and one in the vicinity of Salpi. Without doubt these have been of importance locally, both as a source of water supply for neighbouring settlements and in the local pattern of sedimentation.

The hydrological network on the Tavoliere is drawn from the Apennine foothills. No streams rise at an altitude higher than 1000 metres above sea level and by Italian standards they are small, with relatively small discharge and, most relevant to this study, little load. The valleys, in contrast, are huge. (plate 2). From middle reaches to the coastlands, where flood-plain is scarcely distinguishable from coastal flat, the valleys are flat-bottomed, broad and sharply defined (at least on one side) by steep and high bluffs. At the bottom of these great alluvium-filled valleys today's streams are 'misfits', despite their braided courses. A maze of abandoned meanders, channels and relict courses is quite dramatically revealed by air photographs; the valleys have been shaped during periods of great surface flow, the Pleistocene. Just how much they had shrunk by the first Neolithic settlement on the Tavoliere is not clear. Possibly by the mid-Holocene, say 5500 B.C., stream regimes were not very different from those today. Certainly to assume that the simple presence in the landscape of relict channels necessarily ... "implies still flowing streams" during the Middle Neolithic is quite erroneous. (Tramp, 1966, p.56).

Figure 7

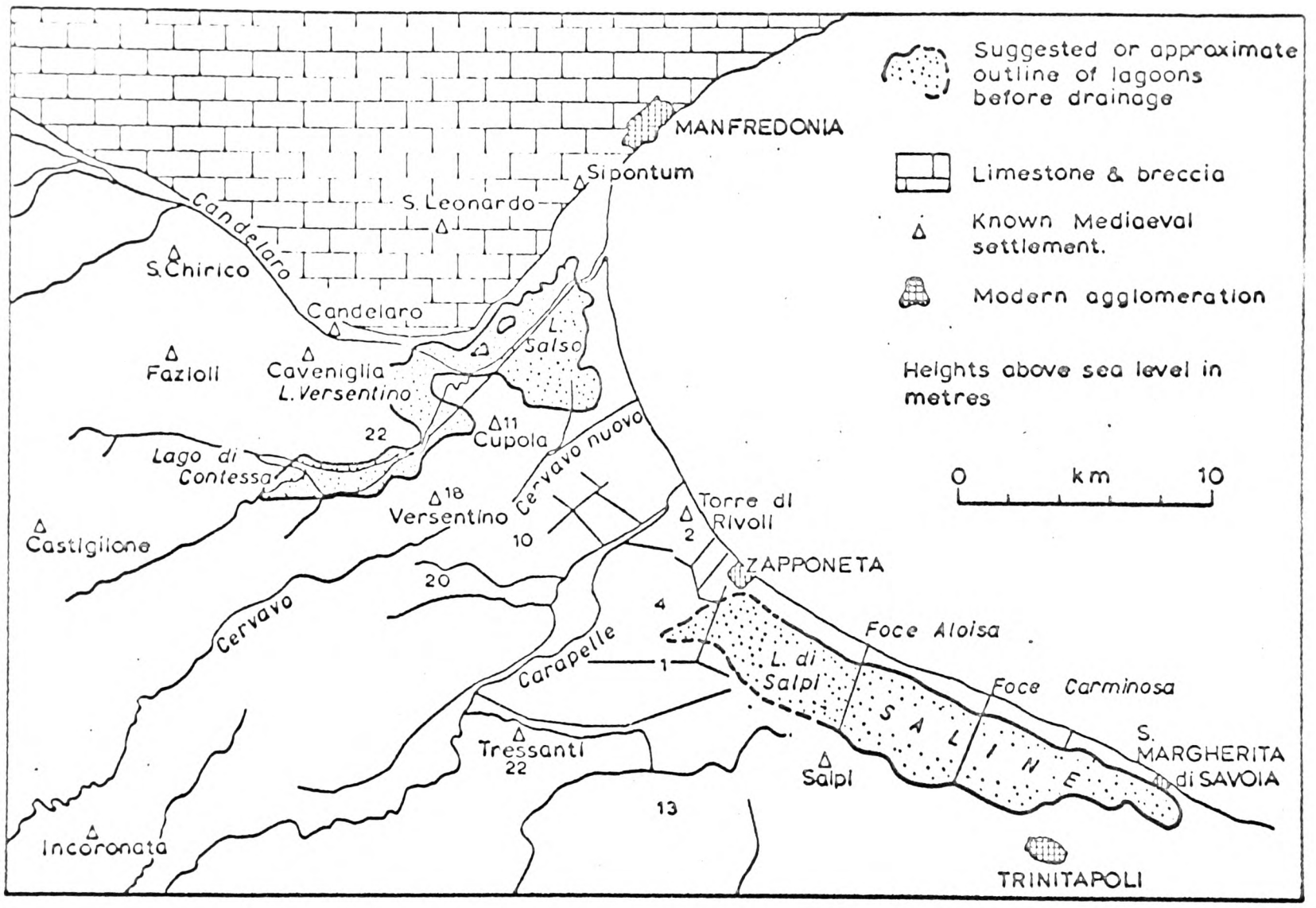


Figure 7. Former lagoons in the Tavoliere coastlands.

The two largest river systems of northern Apulia, the Fortore and the Ofanto, have had little to do with either the formation or the drainage of the Tavoliere. They merely flank the plain, serving as convenient (but not, in the case of the Fortore, strictly accurate) geomorphological boundaries to the lowland. Both seem to be contained in discordant, or antedecent, alignments. Of the Tavoliere rivers, the largest is the Candelaro. Its tributaries include the Triolo, Salsola, Vulgano and Celone, which gives it a fan-shaped basin and catchment area. The Cervaro and Carapelle both have simple courses and linear basins, with few tributaries except in their upper reaches.

Towards the coast and the Bay of Manfredonia, the lowest reaches of all the Tavoliere rivers become lost in a confusion of distributaries, both natural and artificial, marsh, relict courses, and artificial outlets. This is the zone of the former lagoons. (figure 7). Formerly there was Lago Salso, together with Lago Versentino and Lago Contessa, at the mouth of the Candelaro. The Cervaro has been deflected north into the former Lago Salso. Further south, there was Lago Salpi also with ancillary marshes (Marana di Lupara) but only insignificant streams flowing in (Pila, Castello, for example, at Salpi). In the extreme north of the coastland, hard up against the Gargano limestone, was the Sipontinian marsh, the former lagoon of Siponto.

Except to the trained observer, the surface of the Tavoliere appears 'perfectly flat'. Apart from the valleys, a series of marine terraces, each marking former sea stands, can be identified, chiefly on altrimetric evidence. They are correlated with the general Mediterranean levels (using Butzer's nomenclature) only very tentatively, for their verification has not entered into the scope of this study. (Butzer, 1964). The highest, and oldest, of the terraces (the Calabrian), is very much fragmented by valleys and dissected by erosion. It is noticeable in the landscape through the regularity of skylines of ridges and knolls at about 400

metres above present sea level. Many of the ridges have been the site of sometimes dramatically perched settlements (Troia and Lucera, for instance). Less dissected, and more restricted in distribution, are the remnants of a surface between 200 and 150 metres. This would seem to be the Sicilian level. There are some continental facies as well as marine deposits associated with this terrace, which is found south of San Severo; east of Lucera as far as Seggio Curati (where a sharp break of slope marks the former coastline); on the Troia ridge to the east of the town; and around Cerignola. The third main level slopes between 70 and 50 metres. It is tempting to identify this with Butzer's Milazzian sea stand. It is found in the central parts of the Tavoliere and being by far the most extensive and one of the most featureless, it can be said to dominate the landscape of the plain. It passes, however, into another level, at about 35 to 30 metres, the Tyrrhenian terrace. This is less extensive but well marked. It forms the background, as it were, to the coastlands. It accounts for the Amendola terrace (between the Candelaro, Celone and Faranelle streams) for example, and for the area behind Trinitapoli.

The closer one approaches present sea level, the more difficult it is to distinguish the marine surfaces. In terms of former settlement, however, the most recent terraces had considerable significance in prehistoric times as terra firma around the lagoons. The Cupola interfluve, for instance, lies about 15 to 12 metres above sea level and forms a promontory between ex-Lago Versentino, Lago Salso and the Cervaro and Carapelle rivers. It carries the site of a major Daunian settlement. The terrace is indicated by the geologists as of late Pleistocene date and may accord altimetrically with the Monasterian terrace of the Mediterranean at large. But much of the lowest marine surface has gone unremarked by the geologists, as at Marandrea, for instance. This level (the Nizzan or Versentian) lies between 5 and 3 metres above present sea level and is most readily identified by a characteristic substream of calcrete, into which the enclosure ditches of Neolithic

settlements were excavated. The surface therefore must be of Early Holocene date and can be supposed to have formed the shores of the pre-Neolithic lagoons.

In view of such geological homogeneity and such muted relief, it is hardly surprising that the soils of the Tavoliere are fairly uniform too. In general terms, they are the dark, dull coloured soils of a Mediterranean steppe (Kubiena, 1953). This means they are complex but of relatively recent origin, having developed from the reworked parent material, the Quaternary sands and clays of the Tavoliere. Like most soils under relatively arid conditions, they show little pedological evolution although a horizon of calcium accumulation is characteristic. Most of the soils have been classed, by agriculturalists, as loams; most tend to be calcareous though there are some sand or even silicious soils; and all have good to high pH values (pH7 to 8) (Consortzio). Only on the alluvial bottomlands are soils heavy; more generally, on the interfluves and over the levels of the marine surfaces, they are light and relatively easily worked. They tend to be dry too, for rarely is the total soil cover as much as one metre deep and below this is the calcrete sub-stratum that is so characteristic of the Tavoliere.

No good description, let alone study, of the Tavoliere calcretes (crosta) is known. Some analyses have been carried out on samples from the Tavoliere on the writer's behalf by Dr. A. Goudie (University of Oxford) to whom she is indebted for this kindness. A detailed study of this feature is clearly merited, however, for there is no doubt that it has considerable relevance to not only the Neolithic but to previous periods, the Mesolithic and above all, the Palaeolithic. No doubt it will be found eventually that there was more than one phase during which calcium was precipitated in such quantities that a stratum several metres thick accumulated. But in general the calcrete is associated with the Quaternary and, at the latest, the Early Holocene. However, it seems certain that

some thin accumulations have appeared since the Roman times. Conditions of formation, too, were probably very variable. Some conditions may have been general (e.g. climatic) while some are undoubtedly very local (e.g. soil drainage). Not only natural but also human or human-induced activities, such as ploughing and deforestation, may contribute to the behaviour of carbonates or of soil moisture. (Goudie, 1971).

Several forms of calcrete have been observed on the Tavoliere. Most interesting, perhaps, is a peculiarly hard, almost crystalline form. It is very thin, and has been noted at Salpi (in post-Roman occupation layers) where it is no more than half a centimetre thick, and at Casa Scoppa (San Severo) where it covered a vine-trench associated with a Roman centuriation system (plate 3). Here it measured 1 to 1.50 centimetres thick. At the other end of the hardness scale, is a very soft floury deposit of almost pure calcium carbonate. This was noted outcropping on the surface of the ground in the vicinity of the Amendola airfield but nowhere was it possible to estimate its total depth. Much more common, however, is a stratum two, four, or more, metres thick. This is widely distributed over the Tavoliere and has been noted at all altitudes, from the highest terraces (400 metres) to the lowest (3 metres above sea level) as at Marandrea. In some places it may be even thicker; Tramonte records calcrete 8 metres thick. (Tramonte, 1955).

In these thick strata, the calcrete usually has three horizons. The surface may be very hard indeed but it is thin and so similar to the post-Roman formations at Casa Scoppa that it would be reasonable to assume that it is the same feature. If this were to be the case, there would be little problem in accounting for the construction of the enclosure ditches of Neolithic settlements. For the underlying horizons, into which the carapace merges, are much softer and are quite easily excavated. Below the carapace a second horizon, 30 to 40 centimetres thick, may be present. It comprises a compact, almost blocky, formation. In some areas this horizon, together

with the carapace, seems to be in process of decomposition; Passo di Corvo and Candelaro (south side) would be cases in point. After deep-ploughing, the fields are littered with blocks of calcrete. These are piled into field walls, or heaped into a corner. Traditionally, calcrete has been used too, for the inner walls of buildings, houses as well as barns or stables. The lowest horizon tends to be softer still and merges into the sands or clays below.

The presence of calcrete under the soil on the Tavoliere has no direct effect on the growing or herbaceous and other shallow-rooting crops. Nor does it directly preclude woodland or tree crops, for provided the roots of the trees have penetrated beyond the carapace, the lower horizons are sufficiently friable to allow root development. There is no real problem even when trees, or shrubs such as vines are grown. Columella suggests that light soils over a calcareous subsoil are 'excellent' for vines (On Trees III 6). In this case the young plants are placed in specially prepared trenches (for vines) or pits (for olives). The practise of trenching for tree crops was standard in Roman times and is described in detail in the agricultural treatises (Columella; Cato). In these texts no specific reference is made to Tavoliere calcretes and it is clear that the practise concerned all types of soils and had nothing to do with the particular problem facing Tavoliere farmers. In their case, however, trenching for tree crops would have been not only advisable but essential. Air photographs have revealed in most astonishing detail, and with great precision, that trenching was in fact carried out extensively on the Tavoliere. Vine trenches and olive pits are associated with Roman centuriation (Bradford, 1957; Delano Smith, 1967). The practise was carried on through the Middle Ages (figure 47) and became obsolete only very recently with the advent of mechanised deep ploughs which are used to break up the entire surface of the calcrete instead of excavating more selectively.

Figure 8

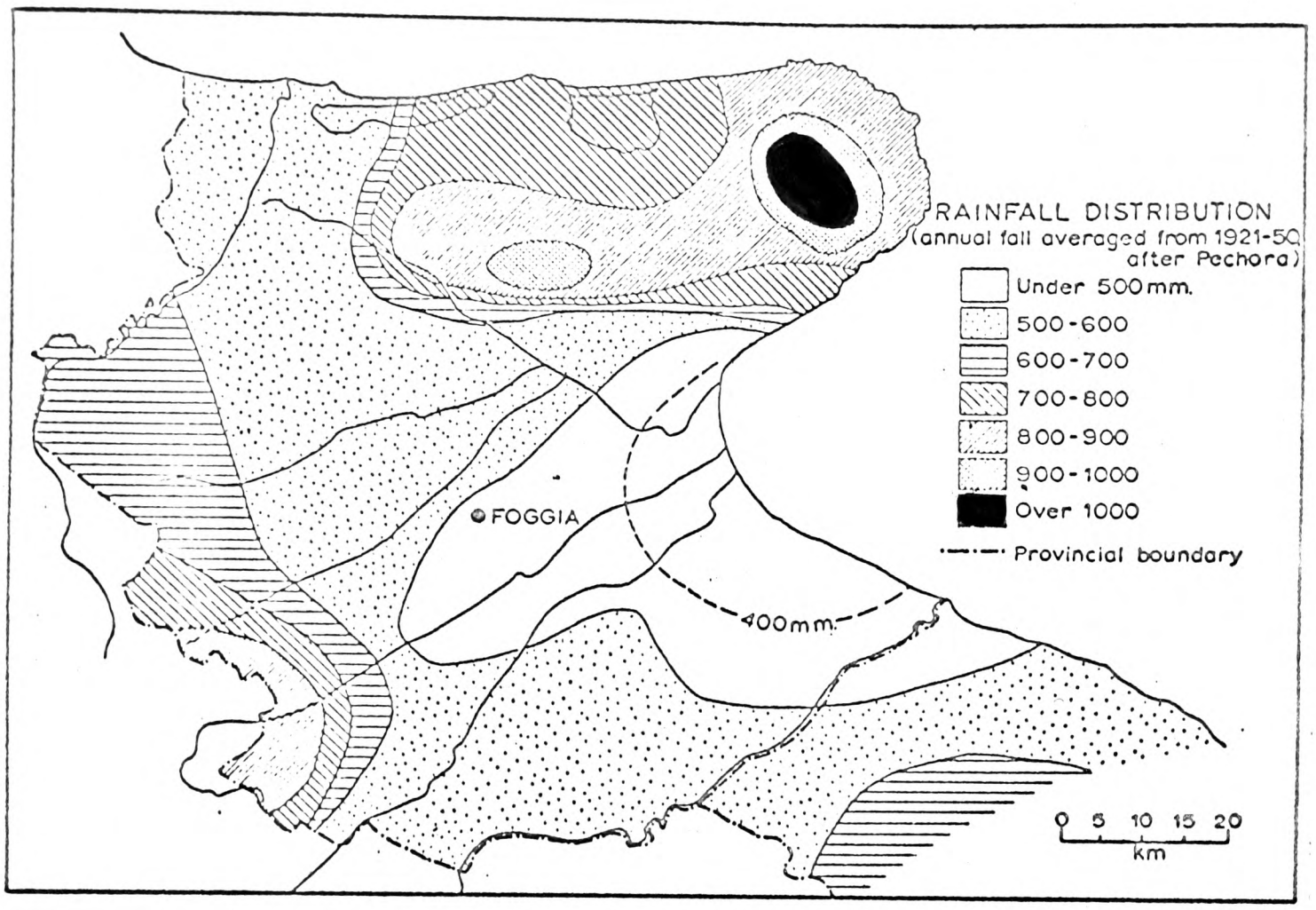


Figure 8. Rainfall distribution in the province of Foggia.

No introduction of the Tavoliere would be complete without at least a brief description of the regional climate. (Vegetation is described in the context of Neolithic land use). It is the heat and drought of the Tavoliere summer, rather than the unusually chilling winter, that has entered the literature. The Apulia-born poet, Horace, for instance, drew on Apulia for a simile, complaining that "Apulia in the dog-day never burnt like this" (an indigestible garlic!) (Carmen III, 15-16). Since the Italian peninsula as a whole lies well within the warm temperate climate zone, the Tavoliere could be described as enjoying a Mediterranean climate with typically hot summers, a markedly dry summer of variable length, and cool humid winters. These generalities, however, bear little relation to annual average conditions actually observed on the Tavoliere.

At Foggia the total annual precipitation of 450 millimetres is not high even by Mediterranean standards and it is true that this is one of the driest parts of the Italian peninsula (figures 8 and 51). Similarly, the average annual temperature is slightly lower than that of the Mediterranean in general: 15.5/at Foggia, 17.7°C for the Mediterranean as a whole. A high thermal range, however, masks the fact that there are sometimes excessively low winter temperatures. The average temperature for the coldest month (January) is 6.3°C. In contrast, summer months are not outstandingly hot: the average for the hottest month (July) is 25.0°C. Summer extreme temperatures may be over 46 C. but it is the sometimes frankly cold winter extremes that are more/usual for the latitude: extremes of minus 7.5°C for instance was recorded in February 1961. These figures indicate/a distinctly continental nuance affects the Tavoliere regional climate. This characteristic is summarised in the Koppen formula BHks, which describes "a humid, cold variant of a hot climate with a marked dry season".

Several factors combine to account for this somewhat anomalous regional variation of the Mediterranean climate and for local variations. In the

first place is the situation of the Tavoliere and particularly its relation to the Adriatic which, though deep, is a narrow body of water almost surrounded by land masses. This means that any moderating effect the sea might normally have is here considerably reduced. Secondly, the arrangement of the upland masses of northern Apulia perhaps does most to account for the region's climatic continentality. The Apennines shelter the Tavoliere from rain-bearing westerly winds and from the passage of air masses of Atlantic origin. The Gargano and, to a lesser extent the Murge, effectively enclose the lowland, so that it becomes a land-locked basin, open to muted maritime influences only from the Adriatic. Thus the Tavoliere lies in the rain shadow of the Apennines and annual precipitation is much lower here than that at comparable latitudes on the west coast of the peninsula (400 millimetres in the coastlands but at Naples, 865 millimetres). This is an important contrast when considering factors of post-Neolithic erosion and valley infill. Moreover, temperatures can soar excessively high in this quazi-landlocked basin in summer.

On the Tavoliere the overall climatic rhythm of sometimes bitterly cold winters and hot summers which are dry except for torrential downpours is by no means uniform in its detail. On the higher terraces, particularly in the Apricena - S. Severo area, the effect of exposure to winds from the northern sector is reflected in, for example, a slight increase in number of snow days; in 1953 when Foggia had only one day of snow, S. Severo had three. On the other hand, it is here that some of the highest temperatures have been recorded; 46.6°C in 1945 for example. The lower terraces all fall within the area delimited by the 500 millimetre isohyet (figure 8) Towards the coast, however, rainfall averages tend to fall off to figures of less than 400 millimetres despite the proximity of the sea. This reflects the fact that the coastal zone lies in a double rainshadow, being in the lee of the Gargano (with respect to north-east rain-bearing winds) as well as in the Apennine rainshadow.

Thus, the physiognomy of the Tavoliere is of a compact, extensive, rather featureless, plain almost enclosed by mountains or hills, but open to the Adriatic sea on the east. Climatically, and in part geologically, it is dry, even exceptionally dry in comparison with other parts of the southern peninsula. In terms of water supply, however, there has not been a significant problem, for the level of the water table is nearly everywhere fairly close to the surface and wells are a prominent element of the human landscape. Even in Neolithic times, it seems, each domestic compound had its own well. However, it is to the emptiest, driest, hottest, most lowlying and featureless part of the Tavoliere that attention is now directed; that is, to the coastlands of the Tavoliere.



Plate I. The Tavoliere coastlands viewed from the Gargano. On clear days the entire curve of the coast, together with Zapponeta and Margherita di Savoia, is seen.

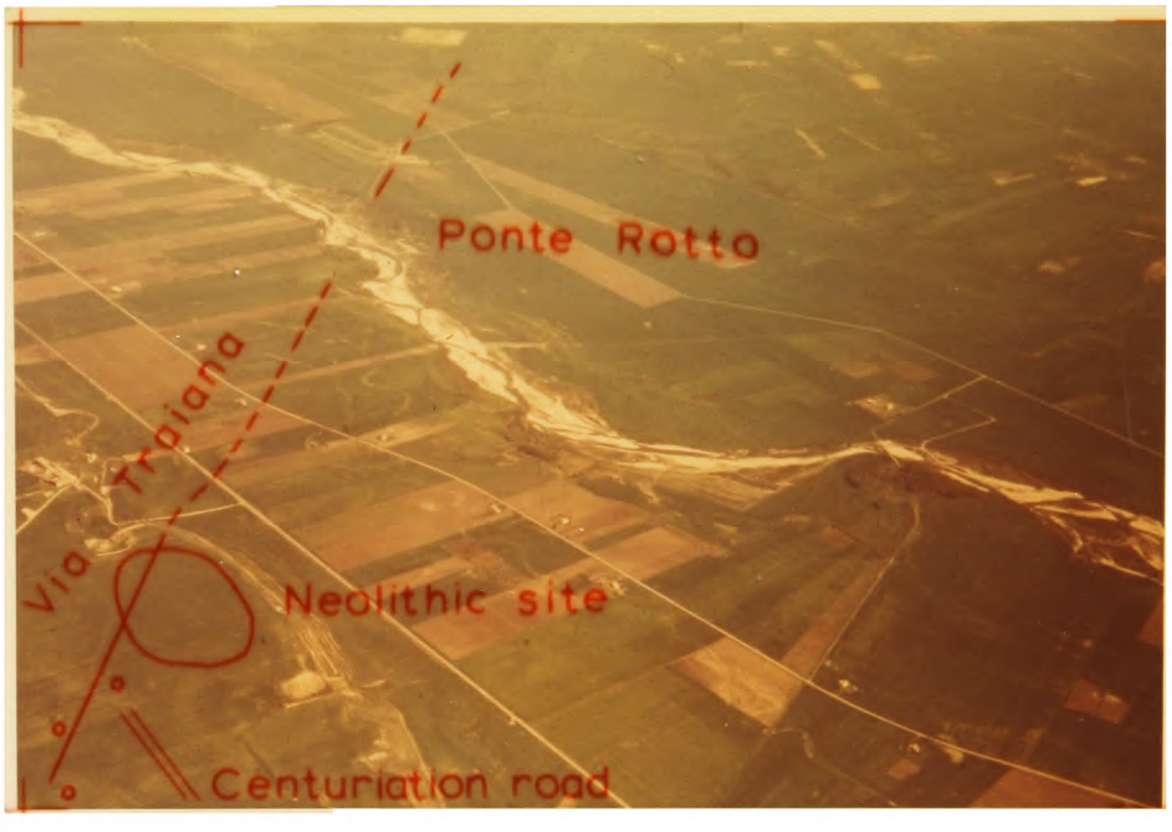


Plate 2. The Cervaro valley at Ponte Albanito; the Via Traiana and a Neolithic site are discernible as cropmarks.

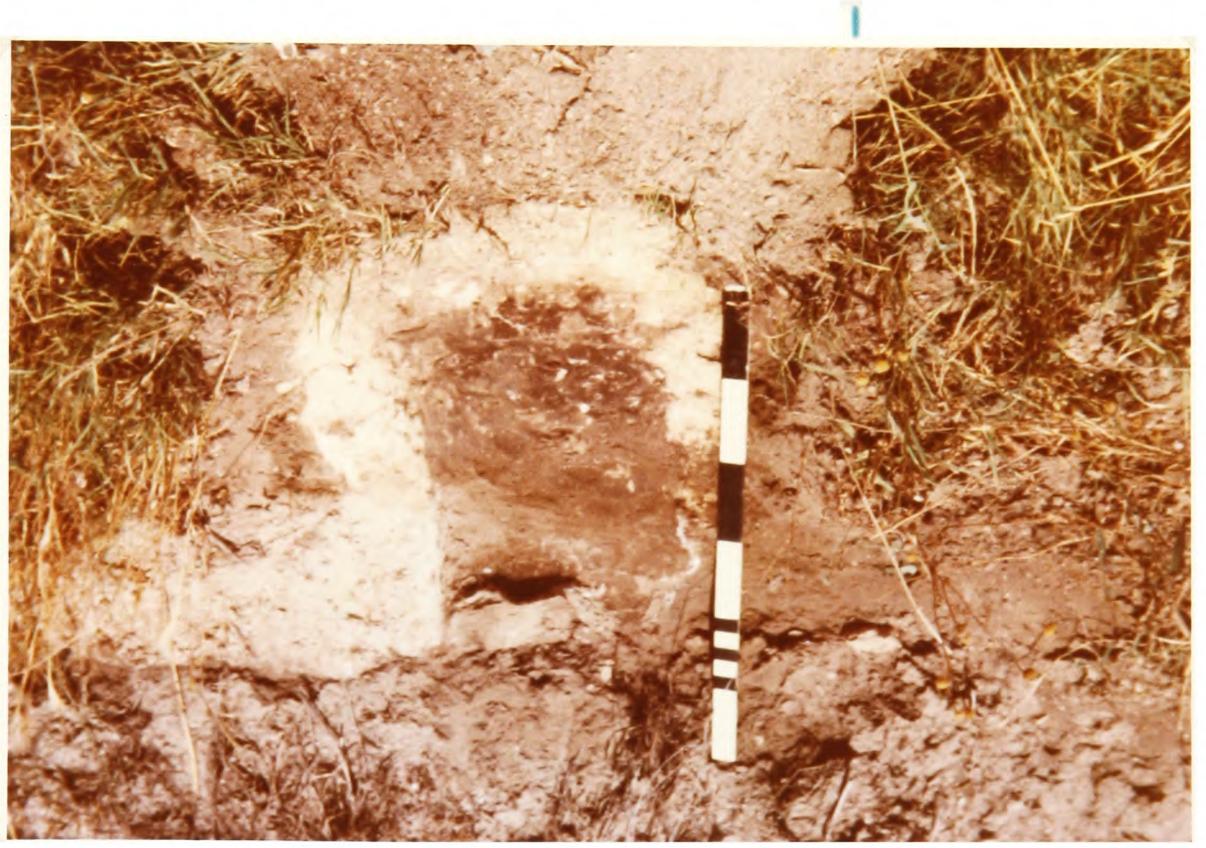


Plate 3. Roman vine-trench at Casa Scoppa (near San Severo), partly sealed by calcrete.

II

CHANGES IN THE COASTLANDS

A. Evidence for changes.

IIA: EVIDENCE FOR CHANGES IN THE COASTLANDS

§ I Sources

The problem of sources of information for post-prehistoric changes in the Tavoliere coastlands is a fundamental one. On the one hand are the normal problems associated with the use of early documentary and cartographic material. On the other hand are the peculiarities of the local situation as regards the availability, or even the existence, of appropriate records. Thirdly, there is the obvious consideration of the total absence of documentation for the prehistoric period and the need for an alternative approach.

The English researcher in Italy may take the first problem as a matter of course. Full cognizance however, of the second, the availability of pertinent local documentation, is much less easily achieved especially for a foreigner. However, it is only partly consequent on the limitations of the traditionally historical evidence that the present broad-fronted approach was adopted. Rather, it is held that the Holocene history of an aggrading coastland can emerge only from as comprehensive a search for the basic facts as possible. Hence this study is based on both documents and sediments as sources of information for post-prehistoric changes in the human geography of the Tavoliere coastland.

Any historical researcher is best by these two familiar questions of availability of information and, especially in the case of documentary sources, its reliability. Source material may increase in quantity and in range after the sixteenth century but this is not necessarily concomitant with an increase in quality. On the other hand, bearing in mind some of the misleading statements concerning the nature of the Tavoliere emanating from modern geographers, the dilemma as to how far one may trust an isolated piece of information, salvaged from the classical period, can be anguishing. That the value of an historical document is not intrinsic is an elementary

lesson. Strictly speaking, each document should be used for the purpose for, or in the context of, which it was originally compiled. The greater the discrepancy between original and present use, the greater the uncertainty as to the trustworthiness of what, after all, were originally merely background details. The historical document is subjective on at least two counts. First, it reflects, to a greater or lesser degree, the personal character and circumstances of the compiler. And, likewise, second, its "accuracy" may be little more than a compound of the character and circumstances of the researcher who is desperate for information. But these are general and familiar problems and are not enlarged on further here.

The Tavoliere seems never to have been a favourite region in Italy for documentors or cartographers. This has two implications. Even today, very few studies have been made of the area or of any of its human or physical attributes. Virtually nothing exists by way of the sort of foundation studies that, in Britain or France say, are usually taken for granted. There are no regional monographs, no toponymic studies, no true 'county' histories, or any of the official surveys, such as the Agricultural Survey of late eighteenth century that in England can provide a sound and highly detailed introduction to a local area. By far the biggest single problem on the documentary side has been in finding out the range of archive resources. This problem derives in part from the general lack of indexing and editing that turns a potential supporting reference into a full-time research topic. But it must be admitted that whole-hearted confrontation with the wealth of archive material that certainly waits to be tapped has so far been deliberately avoided. It demands a degree of single-minded attention (and time) that has been neither available nor commensurate with the sort of preliminary studies undertaken to date. However, with the recent creation of the Research Centre at Foggia, it may be hoped that local efforts will henceforth embrace some of the background studies, such as the collation of a regional bibliography.

For the present study, therefore, we have had to be content with (mostly) published material. It is not intended to account in detail for all documentary sources drawn on but some comment is called for concerning the major documents and maps used in this study as a justification for the interpretations made from them. In the view of many it would be unnatural for a geographer not to turn at some stage to consider ANCIENT MAPS as a source of information for a regional study. So to maintain the traditional association of the geographer with maps, these are described first!

Two major corpus' of ancient Italian maps are available, both edited by the geographer Roberto Almagia. Unless otherwise acknowledged, details and comments on the national and regional maps are drawn from one or other of the two collections. The first to be published was the Monumenta Italiae Cartographica, brought out in 1929 under the auspices of the Instituto Geografico Militare (Almagia, 1929). This was followed, after the war, by the Monumenta Cartographica Vaticana (Almagia, 1944). This is in four volumes. The first volume is devoted to portolan and nautical charts; the second concerns some of the rare maps in the Vatican collection; the third volume alone was pertinent to this study, as it is devoted to the mural maps executed by Egnazi Danti in the Vatican Gallery. The fourth volume contains map murals from other parts of the Vatican. In the Monumenta Italiae Cartographica there are about 155 maps in total but only a single one can be classed as regional (a manuscript map of Capitanata). Only nine show the Neapolitan kingdom (as opposed to the entire peninsula) on a single sheet and the remainder are all maps on a national scale. This means that, frequently, regional detail is lost because of the smallness of scale and the same limitation was found to apply to the portolan charts. Thus in terms of quantity, in the first place, the total cull of potential cartographic sources for the Tavoliere coastlands was found to be very limited.

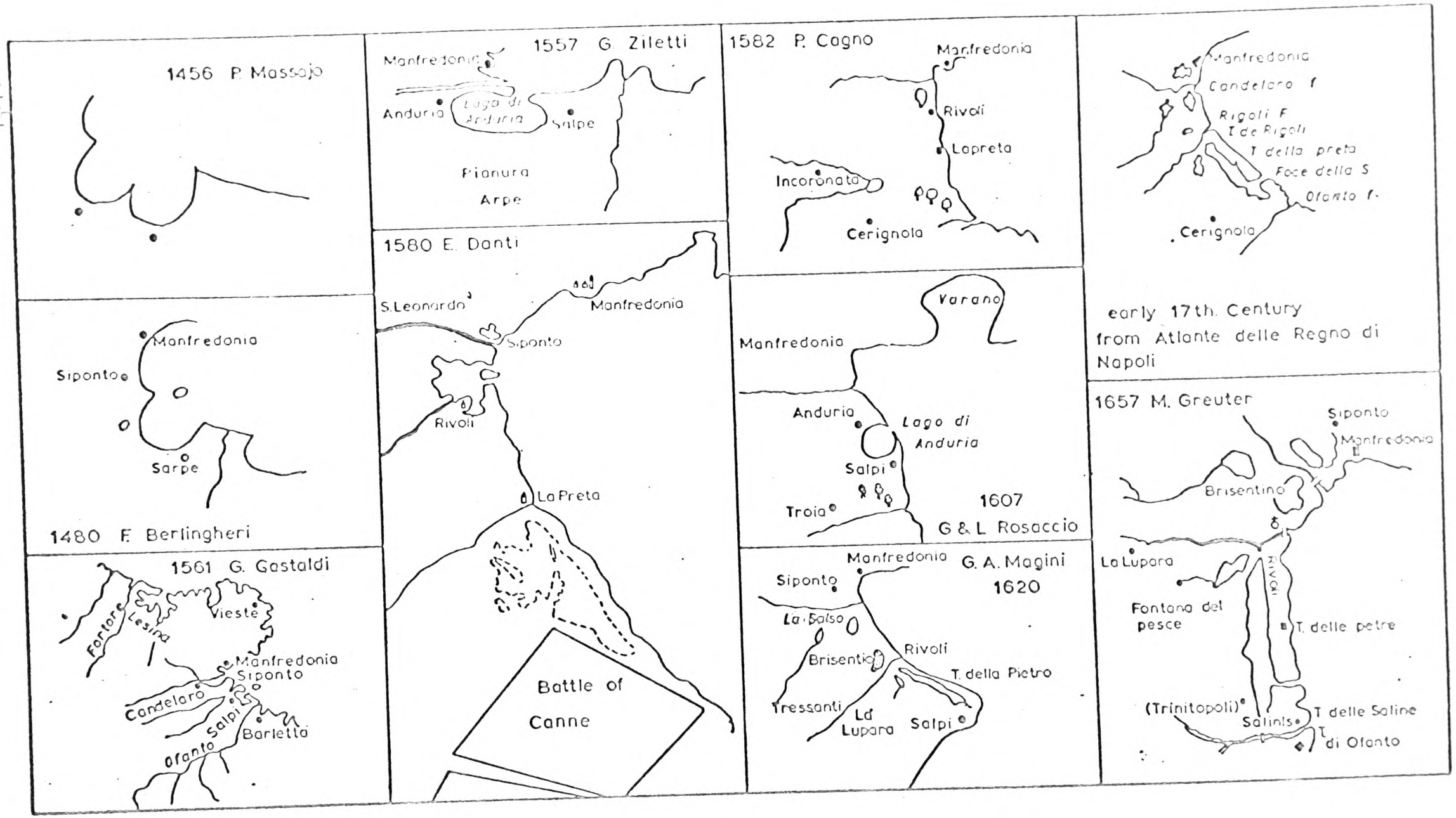
In terms of quality, too, the dozen or so that were eventually selected as meriting closer study proved to be of very varied usefulness. For

instance, the earliest map of Apulia (dated 1449) is a manuscript map now lodged in the Museo Civico at Venice (Almagia, 1929). But so generalised are the coastal outlines and so idiosyncratic the place-name spelling that it is quite unreliable as a source of information on early settlement or hydrographic patterns in the Tavoliere coastlands. In the other maps there is doubt as to the accuracy of the compiler's own sources or as to the basis of his selection of settlements and features to be portrayed. For example, Sipontum continues to be shown, usually together with Manfredonia, long after it had been deserted and had been both officially and effectively replaced by Manfredonia. Furthermore, the inclusion on a particular map of a certain settlement, a river or a lake, is in itself no reliable guide that others were not also present at that time. Nor is there, usually, any way of discerning the meaning of the different rankings of settlements; Matteo Greuter, for instance (1657) did use different symbols but failed to include a key. Finally, in some cases the drawing of the coastal outline is so formalised that it seems clear that a conventional outline was intended and not an accurate portrayal. For this reason Mercator's map (1554), for example, is devalued for our purposes although it was praised by Almagia as basically accurate despite some transcription and siting errors. For this reason too the map produced by Berlinghieri (1480) to illustrate an edition of Ptolemy's Geografia has been of little use to us.

In the end, four maps were selected as essentially reliable and useful although reference is made to others too. The four appear to have had more or less independent origins, to have an overall accuracy and to be of comparable detail so far as the coastland settlements and hydrographic features are concerned. They represent, moreover, the critical period between the middle of the 16th and the middle of the 17th centuries, a period for which there is not an abundance of documentary evidence on the coastlands yet one which seems to be the key one as regards both sedimentary and settlement changes in the Tavoliere coastlands.

Figure 9

igure 9. Early cartographic representations of the Tavoliere coastland.



In figure 9, a selection of the ancient maps referred to for the post-Medieval history of the Tavoliere coastlands are presented as sketches. The earliest two maps were produced for different editions of the Geografia. The first was compiled by Pietro del Massajo in Florence in 1456 and shows two gulfs in the Tavoliere coast. (Almagia, 1929, plate 8). The second is a little clearer but essentially similar. This, from a metal engraving, was drawn by F. Berlinghieri in 1480 and is entitled the 'Novella Italia' (Almagia, 1929, plate 9). Siponto is shown together with Manfredonia although it had by them been officially replaced by the new town and port. Salpi is marked and, interestingly, another settlement between Salpi and Siponto is shown but unfortunately not named. The second interesting feature on the Berlinghieri map is the little island near the opening of the embayment.

The earliest really clear and basically sound presentation of the Tavoliere is Giacomo Gastaldi's map of 1561. (Almagia, 1929, plate 28). Almagia commented (p.26) that this marked a major step forward in Italian cartography in the 16th century and that Gastaldi's Description of Italy was much richer in content than Mercator's. Hydrological features, relief and inhabited centres are shown. To what extent Gastaldi used new surveys, or information, or to what extent his map was based on pre-existing maps is not known, but it gave rise to a long trail of derivatives and the twelfth version was reprinted, or copied, as late as 1638. Much extolled is Gastaldi's map of Puglia but as it extends no further north than Bari it is of no use in the Tavoliere Coastland study.

In 1580 Egnatzi Danti was called to oversee the execution of forty wall maps in the newly built Gallery in the Vatican. Apparently, Danti was a mathematician, a cosmographer and an architect, he was born in Perugia in 1536, became a Dominican monk at Bologna in 1555 and was made archbishop of Alati in 1583, just three years before his death. He worked for the Medici Grandduke Cosimo before being appointed by Pope Gregory XIII

as pontifical cosmographer. The whole of Italy is shown on the walls of the Gallery, eight sections of the total 40 accounting for the Neapolitan kingdom. Such rapid progress was made in their execution (the Gallery murals being completed by the end of 1581) it is evident that not only did Danti have helpers (the names of three are known) but that he could command widely and authoratively in his search for his sources. For instance, in three cases it is known that the basic surveys were executed in the provinces and then sent on to Rome: one for the city of Aquila arrived in June 1581. Nevertheless, some contemporary opinions were not highly favourable. There were suggestions of errors and comments on the inconsistency of scale. It remains doubtful to what extent these most attractively located and presented maps can be relied on in the matter of accuracy and up-to-date-ness of information.

These doubts are particularly applicable to the map of Puglia (Almagia, 1952, plate 27). Almagia suggests that at least six of the provincial maps had been derived from one pre-existing survey, for they are essentially similar in content, presentation, style etc., and he includes the Apulian map in this group. (The Sallentinian peninsular map, in contrast, is thought to have all characteristics consistent with an origin in a portolan chart.) Apparently it is known that the Neapolitan government had been intending to carry out a national survey during the 1570's and although this does not appear to have been effected until 1591, when the Cartaro atlas was produced, it must be accepted that there were new regional sources available to Danti in 1580.

However, the map of Puglia does not convince that Danti had received as much information about the Tavoliere coastlands as we might wish. Instead of the then well-known Lago Salpi there is a rather unnecessary cartouche of the battle of Canne. The omission of Lago Salpi evidently was an embarrassment to later cartographers poaching from the Vatican Gallery maps because they too had to omit Lago Salpi! Paolo Cagno's map

of 1582, for instance, has many similarities with Danti's as regards, above all, the selection and names of coastal settlements. But he could contribute only a row of trees to cover the omission of Lago Salpi.

One of the few visitors to the Vatican Gallery after the maps were completed was G. Antonio Magini, successor to Danti in the studio at Bologna. Magini was to become one of the most outstanding 16th century Italian cartographers. His criticism of the Gallery maps was the most severe of all to be recorded, so it is as well for his own reputation that his Atlante dell'Italia (1620) is considered to be far superior to Danti's work. From it comes the map of Italia Nuovo which seems to have been as scrupulously researched and executed as possible.

Another of the outstanding early cartographers was Matteo Greuter. Greuter and Magini's maps remained, together with Sansoni's, the basis of Italian 17th century cartography and no truly new maps were in circulation. But even Greuter based his relatively large scale (1:540,000) map of Italy on Magini, or so Almagia suggests, except in the case of Puglia and Calabria where some modifications were introduced. Almagia goes on to venture that Greuter must have based these modifications on revisions of the Neapolitan map drawn up by Stigliola and Cartaro in 1597. If this is the case, then Greuter's coastal outlines are of particular interest to us. For like Magini, Greuter shows all the Tavoliere lagoons as closed. Evidently he had taken pains to depict the various lagoons and rivers carefully and, one would like to assume, accurately.

One group of maps from this period should be mentioned. There are four maps in the Monumenta Italiae Cartographica that show a lake and a settlement in the Tavoliere coastlands both named Andoria or Anduria. The earliest of these was drawn in Venice by Ziletti in 1557; it was evidently copied by Prospero Parisii in 1591 and presumably both Mercator's map (1589) and the Rosaccio's (1607) were derived directly from it or from a common source. As far as coastal outlines go the maps are not good, the single

Figure 10a.

The lagoons and the coastlands at the beginning of the 19th century: from the atlas by Rizzi-Zannoni (1808)

Salpi.

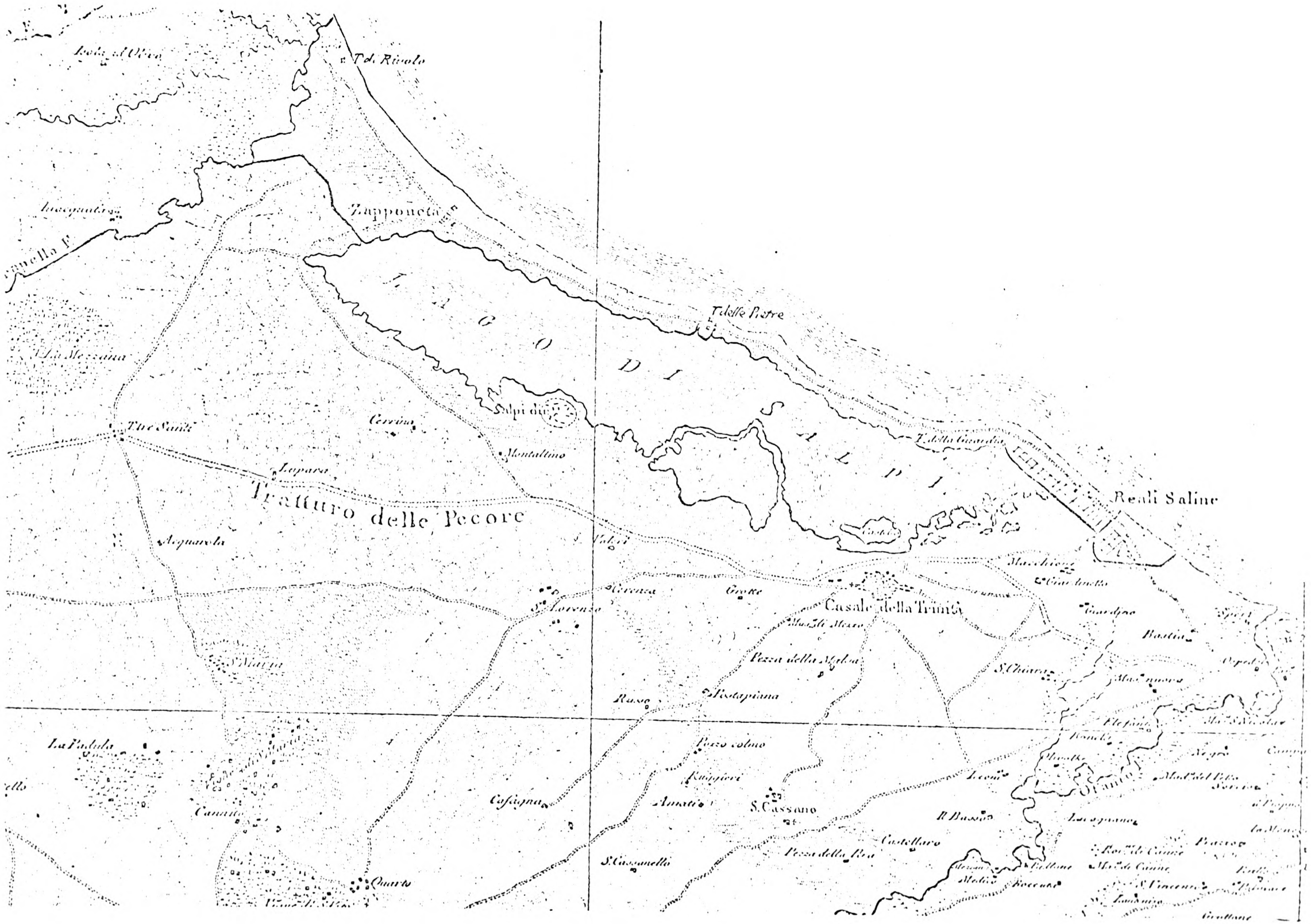
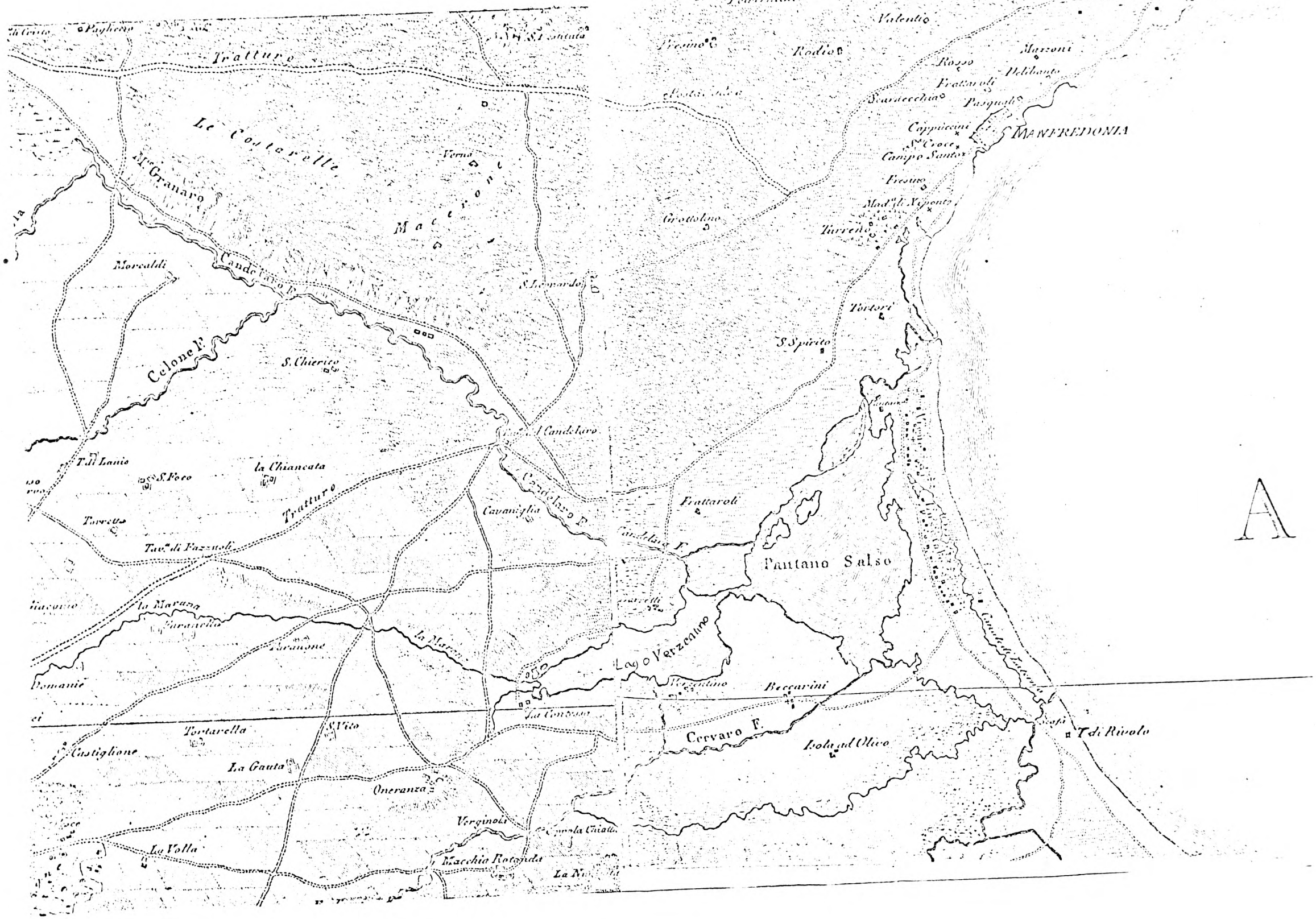


Figure 10b.

The lagoons and the coastland at the beginning of the 19th century: from the atlas by Rizzi-Zannoni (1808)

Salso and Siponto.



embayment (Lago Andoria) being obviously conventional as an outline. Settlement locations and transcriptions of place-names in Ziletti's map are quite awful but the outstanding oddity is the name Andoria. This was a locality existing in classical times, much further south, in the Sallentine peninsula (see page 76). It would be interesting to discover the source Ziletti was drawing from.

For a cartographic portrayal of the Tavoliere coastlands early in the nineteenth century, reference has been made to an apparently recent and accurate survey published in 1808. This is contained in the Atlante Geografico del Regno di Napoli by G. Antonio Rizzi-Zannoni (figure 10).

Only three ancient maps are known of Capitanata itself, the former province of Foggia. Two exist only in manuscript form but all three have been published variously. All three are fundamentally so similar that a common source must be assumed yet none is quite identical and the later copiers seemed to have made no attempt to create a facsimile. Which was the original is by no means clear. The most convincing, so far as accuracy is concerned, is that reproduced in Baldacci's Puglia (Baldacci, 1962, p.3). The rubric states that the map is located today in the Biblioteca Nazionale di Bari and that it dates from the first decades of the 17th century. Another version is included in the Monumenta Italiae Cartografica as part of an atlas of the Regno di Napoli attributed to M. Catario, dated 1613 (Almagia, 1929, plate 54). But this is supposed to be a copy date. It is true that, compared with the Bari version, the coastal outline, the rivers and the provincial boundary are so crudely drawn, and with so coarse a brush, that all detail is obliterated (figure 11a). Interestingly, there are numbers scattered over the map, evidently added later but suggesting that somebody had used the map in conjunction with a settlement register. The third version available is that published in a small text on recent drainage efforts in the Tavoliere (Colaccico, 1955, plate 1). The author has made no acknowledgement of the source or locus of the map, which is

Figure 11a.

Capitanata at the beginning of the 17th century: as one of the provinces of the Regno di Napoli in the manuscript atlas by M. Cataro (reproduced from Almagio 1929).

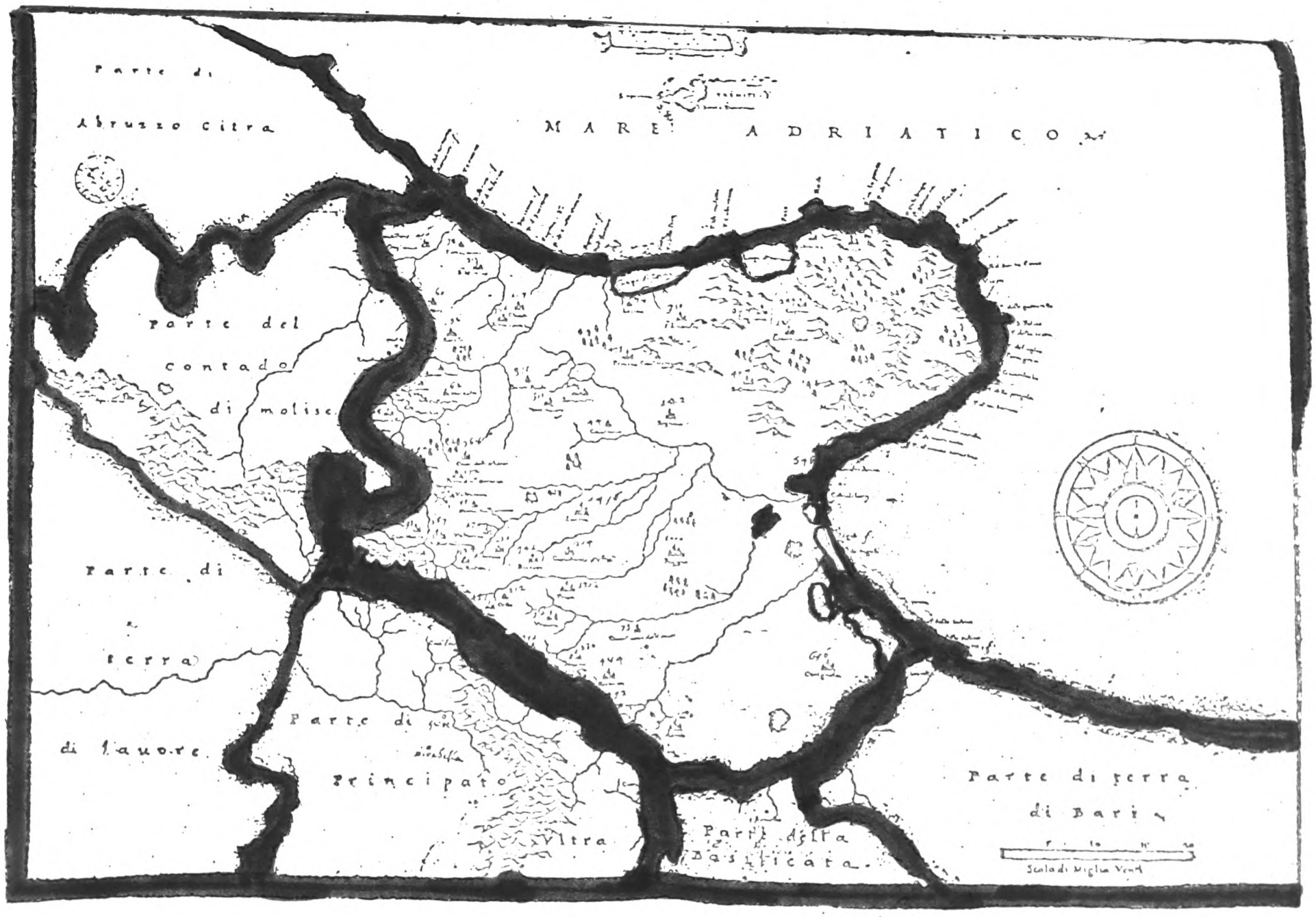
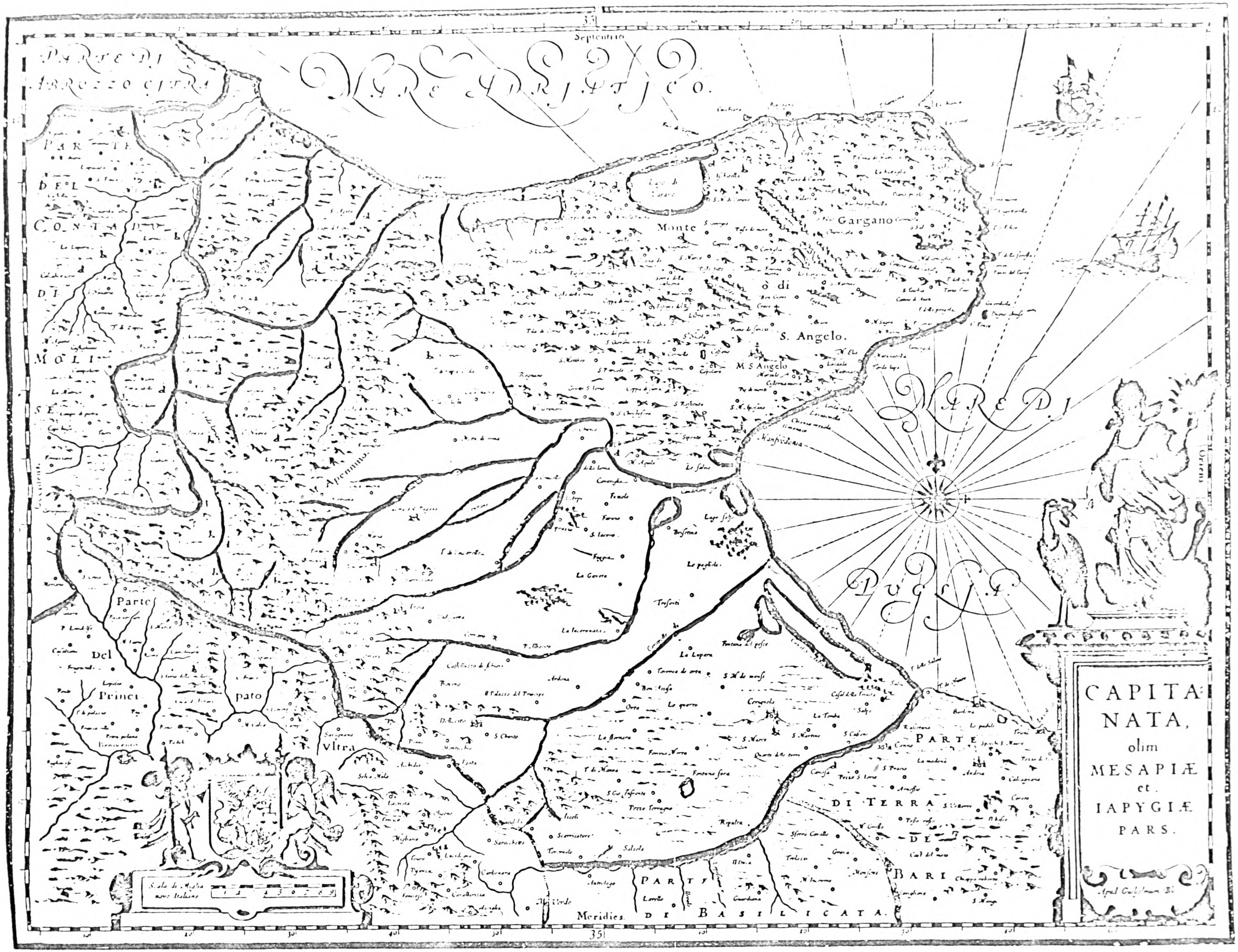


Figure IIa

Figure IIb

Figure 11b.

Capitanata at the beginning of the 17th century: the map derived from Wm. Blaue.



entitled "Capitanata olim Messapie et Iapygiae pars". In the vignette are the words "apud Guiljelmum Blaeu". This engraved version is very much more detailed with regard to settlements but is also crudely drawn with regard to rivers and to coastal outline. There can be little doubt, however, that it is basically the same map and that Blaeu had access to one of the manuscript versions. No date is given but since the text (title, scale) is in Italian it would seem that it comes from an Italianised version of the 1640 French edition of Blaeu.

There are, apparently, adequate indications that a much larger number of maps originally existed for the Kingdom of Naples in the 15th and 16th centuries. But so very little has survived that Almagia concludes that the Southern kingdom has to be regarded as having been cartographically backwards at that time. This is particularly dismaying for the present study as few maps of local scale, prior to the modern topographic surveys, have come to light. Since any that do exist are almost bound to be in manuscript, an archive search is involved. Three folios of manuscript maps pertaining to the Tavoliere, however, have been found in the Foggia archives. All three form part of the Dogana collections and are concerned with aspects of the grazing economy administered by the Dogana. In this respect the local maps are in no way 'topographical' surveys. One volume contains a set of sheets depicting the main tratturi (drove roads) between Puglia and the Abbruzzi and bears no relationship to the coastlands. The other two volumes contain individual plans of all the grazing units (locatione) into which the Tavoliere had been subdivided by the Dogana for administrative purposes. Some of the locatione (Salpi, Tressanti and Versentino) were in the coastlands and these plans are particularly interesting in the context of the present study.

The history of the surveys can be outlined briefly. In October 1548 a survey was carried out of the ordinary (i.e. the baronial, not the royal) locatione. This involved 77 separate units which together totalled 15½

Figure I2

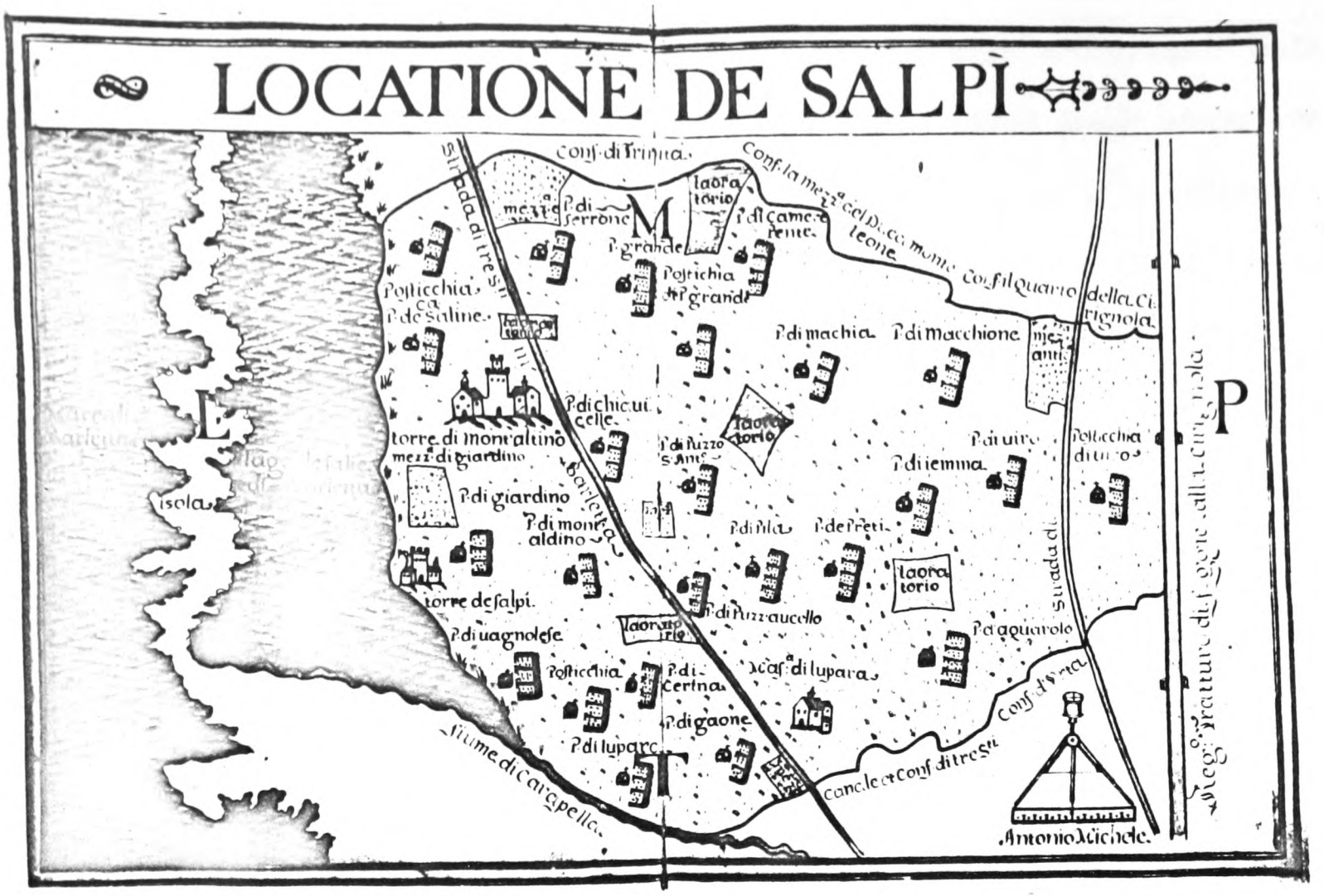


Figure 12. The Locatione of Salpi and of Tressanti, 1635 (reproduced by kind permission from the Archivio di Foggia and Mrs. P. Bradford).

thousand carra or about 6,275 square kilometres and the best "pittore, designatore e compassatore" that could be found in Apulia was called in (Dominicis, 1781). But of this survey none of the plans seem to have survived. A similar operation, however, a century later resulted in the collection held in the Foggia archives. This is dated 1687 (Dogana, 1687). The cartographer was usually one Antonio Michele di Rovere but a small number of the plans were executed, less attratively, by Nuncio Michele di Rovere. A third survey was carried out in the 18th century by A. della Croce (Dogana, 1735-1760) and the plans from this survey survive in the Foggia archives too. It is the earlier of the two extant surveys, however, that has the greatest interest for the study of the Tavoliere coastlands. There are 27 separate maps, all of which were photographed in 1963 for Mrs. Patience Bradford, and it is from those negatives that the illustrations included in this study have been reproduced (figure 12). The photography was carried out in black and white but the original plans are in colour wash.

The brief for the surveyors in the 17th century would have been to measure and portray the land use pattern within each locatione. The measurements were entered into a separate register. The maps contain a variety of features. Masseria, the big estate farms, and posta, the small steadings established for the supervision and tending of the livestock, are shown. Prominence is given too to the tratturi or drove roads. Rivers, with bridges where these existed, were sketched in and parts of the coast and of some of the lagoons were outlined. Relief is hardly a prominent feature on the Tavoliere but where it was noticeable an attempt was made to show it in sugar-loaf form. Other details were less relevant to the brief but since they reflect the status quo they have considerable interest for studies of post-medieval settlement history. For instance, the towers (torre) of deserted villages are depicted in the act of tumbling down, stone by stone (San Lorenzo and Fiorentino, for example). In woodland

areas, trees are shown as having been but recently felled, the canopies still littering the ground.

In other words, it is impossible to escape the conclusion that the cartographers were not merely executing their brief but discreetly adding a comment on the most urgent concerns of the day, the ills associated with the Dogana regime. These would have centred on just those topics, the pressures brought to bear on declining settlements, the measures taken to restrict woodland and arable. The perpetrators of these evils, too, are identified; rather too-well dressed 'shepherds' watch over flocks of sheep and herds of horses, and the 'wood cutters' are quite aristocratic in tenue too.

In addition to ancient maps, written sources have been drawn upon for information on the Tavoliere coastlands. These are, first, the Descrizione or descriptions that approximate to some of the English antiquarian surveys or county histories except that they nearly always concerned the whole of the Neapolitan kingdom. They are of unequal usefulness but taken with the cartographic evidence contribute usefully and interestingly to the background of the Tavoliere coastlands for the period between the sixteenth and the end of the nineteenth centuries.

The term 'description' is used to cover a variety of publications. There are the true descrizione where the writer has set out to describe or portray the Neapolitan kingdom, its physical environment and human features such as settlements and perhaps the economy. Not all the writers in fact visited the areas they describe. Leando Alberti stands out not only as one of the earliest in this tradition but as a genuine traveller. His account of Italy, first published in 1550 (in particularly beautiful print) not only rings true but reflects an unusually restrained and balanced view. Like all writers of descriptions, he was particularly interested in the classical antecedents of the area he was visiting but manages to quote only sufficient from the latin texts to support his comments and interpre-

tations. Another traveller was Galanti. His 'new description' of the two Sicilies (1786) was therefore fruit of both first hand observation and compilation. But by the time Galanti was travelling, the interest had shifted from the classical past to the economic present and this is reflected in his work.

Amongst those who did not travel was Romanelli. He set out with most laudable aims; to provide an antiquarian's reconstruction of the classical settlement pattern on the Tavoliere. His work, however, published between 1815-1819, is as verbose and studded with quotations as Alberti's was admirably terse and measured but it is useful for Romanelli quotes from other, often local, antiquarians whose writings would otherwise pass unnoticed, especially from outside Italy (e.g. Forges, see page 70).

Other descriptions were compiled with different interests at heart. Pacichelli (1703) was interested only in the nobility of each locality he describes. Economic aspects receive scant mention and coastal descriptions were not attempted. His book is outstanding, however, for its abundance of town plans (figure 48). But the abbot Longano (a traveller too) seems to have set out with the intention of commenting on socio-economic problems of the grazing economy and of economic mismanagement on the Tavoliere by the landowning classes (Longano, 1790).

The distinction between the Descrizione and purely travel accounts is a fine one, since the best of the former are also based on first-hand observation. There have been at least a few Italians who travelled for pleasure in Italy in the 18th century, as well as the many foreigners who did so. An intrepid voyager was Mathilde Perrino of Naples who published her letters describing the salient points of her sojourn in Apulia (1787). Her comments on the state of affairs in Capitanata and in Terra di Bari, around which her travels took her, are heartfelt and not unperspicaceous. But for purely topographical observations she showed less interest except in the case of Barletta, over which she enthused.

A third type of description are the official reports. Only the 'statistica' of 1810 can be found to fit this heading, for the excellently illustrated report on the effects of the 1783 earthquake (sponsored by the Royal Society of Naples) concerned only areas west of Benevento. The Neapolitan government, under the Bourbons, had several times mooted an official survey in the late 18th century but it was left to the occupying French, under Murat, to achieve this. The layout of the survey was similar to that of other accounts made in territories acquired by Napoleon and in France (Riccione, 1942). As the name implies, it is a bald economic statement. Of particular interest to us are the tables published as an appendix to Riccione's analysis: these list the acreage of uncultivated land, and lake, marsh and swamp in each commune.

The final category of written sources that has been grouped for convenience under the general heading of 'descriptions' is the gazeteer. The most readily available, and comprehensive was published in 1797 by Giustiniani, in twelve volumes as the Dizionario Geografico-Ragionata del Regno di Napoli. The localities described are arranged alphabetically but rivers and lakes are in a separate section. The classical antecedents of the older settlements are given prominence but some of the points made regarding the more recent state of affairs have not been encountered elsewhere and it seems a well-founded and researched topography.

Only one text was found to deal exclusively with Capitanata. This is Manicone's physical geography of Apulia. In fact it is limited to the Gargano and the Tavoliere. It was published in 1806, in five volumes, and a perusal of the index might suggest an impressively comprehensive study. But there is a good deal of ill-founded 'geographical' interpretation and verbose discussion and the many sections are in fact very short. There are some intriguing or informative details however, such as water depths in the Manfredonian anchorage. Most interestingly a discussion on the possibility of draining the Siponto palude concludes with these curiously prophetic

remarks (page 99):

> "Manfredonians; who knows! Perhaps one of the Sipontinian marshes, although now seen as a rabble of injurous swamp plants, will become a delicious country holiday place, where even the air is healthy to breath."

Some general points may be made concerning the relevance of these written sources to our studies. In the first place the range of topics mentioned is remarkably restricted. Information, in other words, is available for what is already largely known (often, as it happens, now more accurately). Partly this reflects a good deal of plagiarisation. For example even Galanti's account of the Dogana appears to follow just too closely Dominicis' detailed study to be mere coincidence. But it reflects, too, a self-imposed limitation of following only traditional or obvious interests. It is true that fieldwork had not yet been conceived but there is a disappointing lack of initiative. Of all the early writers, the most refreshing is Alberti, precisely because of some unusual details that he elected to describe; the fountain at Sipontum for example (which perhaps he found as unexpectedly pleasant and refreshing an oasis as the present writer did more than four hundred years later); and sculptures on steps in the Manfredonia quay.

Another, more serious, point is that there is a chronic confusion over certain aspects. For instance, no weight should be placed on the selection of words such as palude, stagna and lago. Only where all three are used in a statistical context (Riccione, 1812) may one be sure that the three words are intended to designate recognisably distinct conditions: the lake proper; land more or less permanently submerged (stagna); and marsh (palude) which is only seasonally inundated. Otherwise where found in juxtaposition one cannot be sure that the writer was not merely avoiding repetition.

Another chronic confusion concerns the rivers. Both names and courses have been mixed up. Romanelli, for example, insisted on identifying the

present Candelaro with Pliny's Cerbalus but achieves this only by leaving the modern Cervaro conveniently unnamed. It is small wonder that early writers did find it difficult to describe the coastland river courses for there have been some quite major changes since the Middle Ages. But the more the writers were aware of changes, the greater their confusion. Longano alone made an honest confession: after attempting to identify the three lakes of Capitanata as those of Lesina, Vieste and Salpi, and trying to account for three "new" lakes, that of the alveoli of S. Giovanni Rotondo (Gargano) and "two near the Candelaro mouth" he apparently gave up and commented only that there were also "other lakes and lagoons"! (Longano, 1890, p.37).

Compared with documentary evidence from the post-medieval period, that available for earlier centuries is not only quantitatively less but relatively straightforward. From the early Middle Ages only two major sources have been found describing the Tavoliere coast. The earliest is the Libro del Re Ruggero (King Roger's [of Sicily] Book) that was compiled between 1139 and 1154 by the Arab geographer Idrisi (Edrisi). The survey covered Italy in a series of 'compartments', subdivisions of larger climatic regions. Thus the Tavoliere coast, described from south to north, fell into the Third Compartment of the Fifth Climatic Region. The disadvantage of the description is that it is unequal. Canne, for instance, which today is nearly ten kilometres inland up the Ofanto river, is described in some detail but Salpi, still an active port just across the lagoon, is just named:

> "From [the convent of] S. Maria to S. Nicola di Pietra ... ... 12 miles. S. Nicola is sited by the sea on a promontory and opposite, on the landward side, stands the city of Salpi at a distance of six miles from the sea. From S. Nicola to Wadi Rivoli ..... 12 miles. The proper name of this river is nahr quanalas. From the Rivoli river to Wadi Katah 11 miles. From this to the city of Siponto 2 miles. Siponto is near the sea. From this to Mattinata also near the sea 12 miles .....
>
> (N.B. 1 arab mile is usually believed to equal 1 Roman mile (viz. 1481 metres) or 1 Sicilian mile (1487 metres) Amari and Schiaparelli, 1883).

There is ample confirmation that the name Rivoli was given to the combined lower courses of the Cervaro and Carapelle in later writings (for example,

in Longano, 1790, p.36 and Romanelli, 1815, p.205). But Idrisi was not interested in the lagoons that lay immediately behind the coastal dunes; even Lago Salpi is not mentioned.

The second early medieval account of the Tavoliere coast is even more succinct except for a valuable description of the anchorage at and access to the port of Sipontum. It is the sailing book known as the Compasso di Navigare, dated to about 1250-1265 (Motzo, 1947). The translation is fairly free:

> "From Barletta to Sipontum is 30 miles in a northwest direction. Sipontum is a good port and from it to the open sea is also 30 miles, where bottom is touched at 30 paces (54 metres); from there the approach to the city is gentle and easy, and the depth decreases one pace (1.9 metres) for each mile."

It seems clear that, although shipping could have ridden at anchor fairly far out, small boats would have been able to come right up to the city. The problem is to decide whether the New Sipontum (Manfredonia) was meant rather than ancient Siponto, for the editors suggest the Compasso was compiled about or soon after the date of Manfredonia's foundation. The scale is again in miles but in this case the mile is more likely, according to editors, to have been the geometric one (1230 metres) that was commonly used in the Mediterranean at that time.

Going still further back in time, in the search for written sources of information about the Tavoliere coastlands, one comes to the ITINERARIES of the Roman period. Of the three, the oldest and certainly the most familiar is the Peutinger Table. This would have been an itinerarium scriptum, later drawn out as a strip map in 12 sections (Miller, 1962). It is thought to have been compiled during the 3rd century A.D., or anyway no later than the 4th century, but the only extant version is a manuscript copy made by a monk in Colmar in 1265. This manuscript was later acquired by Konrad Peutinger, whence the itinerary has taken its modern name. It is thought that it may have originated as a private document, in contrast to the Antonine itinerary, and that the so-called Ravenna itinerary was

derived from it. The Antonine itinerary is also dated to the 3rd century A.D. but the extant copy comes from the time of Diocletian.

Interpretation of all the Itineraries presents similar problems to those highlighted by Chevallier for the Peutinger Table (Chevallier, 1965). There are, of course, straightforward errors of transcription, such as the writing of V for II and vice versa. Most misleading, however, has been the general tendency of students to regard the Itineraria as road maps when they were designed to describe a route, which is by no means necessarily the same thing. For instance, as Chevallier points out, the scale on which the Peutinger Table is usually published (1:500,000 or 1:1000,000) is too small to correct another fundamental misapprehension concerning roads in the Roman Empire. Contrary to popular belief, few roads in Roman times ran really straight, except perhaps in the plains, but on the published scale of the Peutinger sinuosities tend to be obliterated. It is useful to reiterate that the Table has

> "no intention of showing how to get from one place to another but makes a choice between the innumerable sections of roads in order, given the particular aims and particular period, to cross the particular area"
> (Chevallier, 1965, quoting Col. J. Baradez)

Nor should it be assumed that places named in the Itineraries necessarily lay on the route. In many cases, Chevallier points out, a road junction might be named where hesitation at a cross-roads would inconvenience the traveller. Mention of a settlement in an Itinerary does not necessarily indicate its status, for in a scantily populated area quite small localities might have to be mentioned in default of a bigger alternative. The relevant sections of the three Itineraries are set out below, but the implications are discussed later:

Table 1. The Roman Itineraries in the Tavoliere coastlands.

Peutinger	Ravenna	Antonine
Soponto	Sepontos	Siponto
VIIII (flumen)		
Anxano	Anxanum	XV
XII (lacus)		
Salinis	Salini	Salinis
XII		
Aufinum	Aufidum	Aufidena

The remaining documentary sources searched for information on the Tavoliere coastlands in the Roman period include the CLASSICAL TEXTS. Of the many Latin (or Greek) writers who cite the Tavoliere, two alone set out to provide a description. Pliny, writing his Natural History during the 1st century A.D., was presumably describing features of about that time. His description is less informative that it might have been, for the order of settlements around the Gargano is obviously irregular:

> "Here begins Apulia, called Apulia of the Daunii, who were named after their chief, the father-in-law of Diomede; in Apulia is the town of Salpi, famous as the scene of Hannibal's amour with a courtezan, Sipontum, Uria, the river Cervaro [Cerbalus] marking the boundary of the Daunii, the harbour of Porto Grecco, the promontory of Monte Gargano ... the port of Varano, the lake of Lesina, the river Frento [Fortore] which forms a harbour ...
> (Nat. Hist. III 103 Loeb Edition translated by R. Rackham.)

But Pliny's description would have been anteceded by Strabo. Strabo's often-quoted passage is thus the earliest known description of the Tavoliere coastlands, lagoons and settlements, for he wrote sometime during the first century B.C.. That Strabo's accounts can be taken as normally reliable and as accurate as such generalised remarks allow has been demonstrated in other contexts (see Schmeidt, 1964 for the Arno). He wrote much more fully on the Tavoliere than did Pliny, and after relating the tradition of the

foundation of Arpi (Argyrippinum) and mentioning Lucera, turns to the coast with these words:

> " ... Sipus (Sipontum) ... is about 140 stadia distant from Salapia; ... Between Salapia and Sipus is a navigable river, and also a large lake that opens into the sea; and the merchandise from Sipus, particularly grain, is brought down on both."
> (Geography 6.3.9. Loeb Edition translated H.L. Jones.)

Salapia(Salpi) had been described earlier as "the seaport of the Argyrippini". The description, however, is not entirely unambiguous, for the navigable river did not run from Salpi to Sipontum, or vice versa, but debouched into the sea (or into the large lake) between those two cities. To infer a continuous navigable waterway behind the coastal barrier might be possible from the text but improbable, we find, from the facts.

In addition to these major sources of information there are two other headings under which information may be compiled. The first covers further written sources of information that do not fit the sources already listed, the second concerns archaeological sources (fieldwork). Perhaps most notable amongst the MISCELLANEOUS written sources is the tax list of 1300 (Edigi, 1917, document 200). Fortunately published prior to the destruction during the war of the Angevine Registers, the list is given in a letter from Charles I of Anjou to the Justiciar of Capitanata concerning a levy demanded from 'territories and places' for the relief of the territory and city of Lucera (devastated in the course of Charles' struggles with the Swabian Sarrasins of Lucera). The use of this list in the context of the study of medieval settlement has been discussed elsewhere (Delano Smith, 1973(b)). The relevant point is that two of the then apparently prosperous localities of the coastlands, Rivoli and Cupola, are no longer traceable.

Amongst other documents referred to was the cartulary of San Leonardo di Siponto (Camobreco, 1913). The beautiful church of the Knights Templars' monastery still stands (plate 4), though all other buildings except the

refectory were accidentally devastated at the end of the war.
The cartulary contains documents from the 12th to the 18th century, concerning grants to, or purchases of land and property by, the monastery. Much of the land in question came from the northern part of the Tavoliere, between San Severo and the deserted village of Casalnuovo and Siponto in the coastlands.

For the precise location, and measurement, of settlements identified from or described in the written and cartographic sources, fieldwork is a basic complement. For the pre-documentary period, however, the search for ARCHAEOLOGICAL EVIDENCE (in the field and on air photographs) is the only means of discovering prehistoric sites and finding out about early occupation patterns on the Tavoliere. Not very much work has been done on the Tavoliere, in relation to the wealth of archaeological information available, and still less in the coastlands, and an integral element of the present study of the Tavoliere coastlands has been to search for unknown prehistoric sites in order to establish the outlines of the earliest settlement patterns.

Some published accounts of the archaeological evidence exist. But so far, owing to delays in the publication of the Society of Antiquaries Research Reports, only John Bradford's own writings are available (Bradford, 1943, 1945, 1947, 1957) of those based on his material. That Bradford was as concerned with the prehistoric, the Roman, and the medieval aspects of Tavoliere archaeology is measure of his unusually comprehensive view. That he aimed, too, at re-creating contemporary landscapes and at accounting for the physical and economic context of the archaeological features is measure of his intellectual far-sightedness. Since Bradford's time further excavation has been carried out both by British and Italian archaeologists, mostly on prehistoric and classical sites; and some brief reports have been published. But much of the information concerning the coastlands is derived from current (and incompleted) fieldwork; for instance, from Signora Tinè's

excavations at Daunian Salpi, at Cupola, and at Sipontum, and from the writer's own field surveys.

The Royal Air Force photographic cover is of particular value today as it has become an historical document in itself. For it antedates the deep-ploughing which has such an instant and disastrous effect on the archeological record; a great deal of the crop marks recorded on the war-time photographs will never reappear. The modern Italian air photograph cover has the advantages of being of very high quality and of being complete. Thus, despite losses through deep-ploughing, the close scrutiny of the photographs for archaeological evidence that has really only just been embarked on, has already revealed a quite startling density of early settlement evidence (see page 231). The fact that the air photographs record more detail in the case of the Tavoliere than in most other regions is due to the prevalence of the sub-soil calcrete. Ditches and pits dug from the calcareous stratum were preserved until the coming of the deep plough, and such buried features emerge on the air photographs and in the landscape as soil, weed or cropmarks (plates 7, 9, 10, 11).

In the coastlands, however, the nature of the terrain minimises the archaeological usefulness of the air photographs. The water table is generally high and the soil tends to be permanently saturated. Only on promontories or outliers of calcreted terrain may the circular enclosures of neolithic settlement or the parallel ditches of Roman roads and medieval vineyards be discerned. The prehistoric site of Marandrea, for instance, the trackways of Romano-Medieval Salpi and the vineyards of Giardino are good but rare examples of air photograph detail in the coastlands. Elsewhere the complexities of stream sedimentation may not only mask archaeological features but create confusing patterns, as at Carapellotto-Regina (page 203). In the coastlands, therefore, a field check is the vital preliminary step and air photograph information merely corroberative or suggestive. There are other hazards of interpretation too. For instance, parallel lines of rela-

tively moist soil (showing black in the air photograph) may arise in two ways. Normally, in the proven archaeological context, widely spaced, parallel dark lines coincide with ditches bounding a dry roadway but a similar pattern could result from poor drainage on either side of a buried drainage dyke (plate 19).

In summary, all that need be said at this point is that it would seem clear from the foregoing chapter that however uninhibited and however unconventional the search for documentary sources of information, the archive or library approach cannot be divorced from fieldwork. In later chapters it should become as clear that even the most successful excavation and archaeological fieldwork becomes victim to its own limitations without supporting or illuminating documentation. These two approaches however are familiar ones. One of the fundamental theses of the present study is to convince readers that a third approach, and a third class of source material (the sediments), may be as necessary as the other two for a proper understanding of the history of past settlement in the Tavoliere coastlands. Archaeologists and historians may have, by now, accepted the commonness of certain of their areas of interest; to their dialogue, a relative newcomer should be invited and welcomed, the geomorphologist. But before any good can be expected from such contacts, the common area of interest has to be redefined. And so another underlying concern in the present study is to attempt to at least indicate the outlines of an appropriate methodology.



Plate 4. San Leonardo, west door.



Plate 5. San Leonardo: the first lines of the inscription, recording reconstruction in 1745, read "The previous building having been destroyed as a result of an earthquake shock ..."



Plate 6. San Leonardo: bas-relief.



Plate 7. Weed marks in stubble.



Plate 8. Deep-ploughing at Salpi.



Plate 9. Soilmarks at Carapellotto-Regina reveal the Bronze Age occupation areas (pale patches)



Plate 10. Soilmarks at Giardino (Salpi): the pale soil in the foreground marks a former levée, that behind is rising Early Holocene terrain.



Plate 11. Soilmarks at Candelaro showing the outline of the recently bulldozed medieval sound.

§ 2 Lost Settlements in the Coastlands

The Tavoliere coastlands have a reputation for being deserted, devoid of settlements and of inhabitants. The present landscape, notwithstanding four decades of agrarian reform and resettlement, does little to deny this tradition. Census information showing the distribution of population in the coastlands plainly reinforces this view, since the inhabitants largely confined themselves to the agglomerations while vast stretches of coutryside between these remained empty and, it was believed, unhealthy.

To judge from some of the classical writers' comments it would be easy to assume this desolation had been chronic. Cicero spoke of Apulia in general as inanimissima pars Italiae - the least populated district in Italy. (Cicero, ad Atticus VIII 3.4). Seneca thought of Apulia as a desert (Seneca: Epistulae Morales lxxxvi 77). The coastlands were thought of as 'marsh and sand' (arena et paludes) where disease reigned (in Salpinorum pesti lentiae finibus) (Cicero: de Lege Agraria II 27.71). But a closer inspection of both documentary and archaeological evidence fails to substantiate that the coastlands were uninhabited in earlier times. There is no doubt, on the contrary, that up to a certain point in the post-medieval period the Tavoliere coastlands were at least as densely settled as the interior. The desertion of the coastal area, its lack of agglomerated settlement or even of isolated dwellings, is but a relatively recent phenomenon.

It is easy to sympathise with the modern concept of the coastlands as deserted, and hence inherently uninhabitable, when confronted with data showing population distribution in the mid-19th century. Then, as today, there were three agglomerations on the coast itself, in the fifty kilometres between the Gargano and the Ofanto. There were none at all in the immediate interior except for Trinitapoli, which lay on high ground to the west of Lago Salpi and the salt-pans. The three nineteenth century agglomerations of the coast are those of today. In the north, on a rocky shelf

at the foot of the Gargano, is the city of Manfredonia. In the extreme south, cramped into a restricted space between the saltpans and the sea, close to the mouth of the Ofanto, is Margherita di Savoia. Approximately mid-way between these two lies the rural settlement (borghate) of Zapponeta (actually in the commune of Manfredonia).

In the 19th century about 2.3% of the total population in the two coastal communes (Manfredonia and Margherita di Savoia) and in the lake-side commune of Trinitapoli lived outside the four agglomerations (censimento, 1861). The first national census revealed that only 114 people (1.5%) lived in isolated dwellings in Manfredonia's vast territory; that meant an average rural density of less than 3.5 inhabitants per square kilometre. Apart from some 300 persons who lived in Zapponeta the remainder were crowded into the city of Manfredonia (about 4,500 in 1861). Further south a very similar pattern obtained. A slightly higher proportion (6%) of the inhabitants of Margherita di Savoia lived outside the town (in case sparse) but only a hundred lived outside Trinitapoli despite the prosperous and inviting aspect of its unusually tree-studded fields.

The antecedents of Manfredonia and Margherita di Savoia go back at least to Roman times but Zapponeta was still a relatively new location in the middle of the 19th century. It emerged from the spate of reform colonies established in or after the 1770's under the Bourbons. King Ferdinand IV (of Naples) had earlier confiscated the Jesuits' vast and mismanaged estates in the Orta-Ordona area and some of this land was used for the resettlement of about 4,000 colons in five agricultural villages: Orta, Ordona, Stornara, Stornarella and, in a most-unpropicious flood-plain site, Carapelle. (Ciasca, 1928). Other colonies, also on demesne (Crown) land followed; San Ferdinando, Poggio Imperiale. Zapponeta was the result of the initiative of a private landowner, probably one Principe Bisignano (Afan de Rivera, 1838).

The choice of site for the new Zapponeta invites questioning, as it

must have seemed then even more an unlikely and insalubrious environment than it does today. The neat, low, whitewashed houses are regularly set out but they are scarcely 200 metres from the waves on the one side and 500 metres from the marshes on the other side. It must have been, throughout the 19th century, a poignantly isolated spot; there are 18 kilometres of coast road to travel before Margharetа di Savoia is reached, or, in the other direction, 25 kilometres to Manfredonia. It was never a fishing colony as it is virtually impossible to beach craft on the sands in anything but the calmest weather and the inhabitants were, and are still, dependent on agriculture.

With these disadvantages in mind, it is pertinent to ask why, precisely, the site of Zapponeta was selected. The very unlikeliness of the environment would suggest that tenurial advantages, or a pre-existing settlement, weighed the decision. There were precedents for this, Ferdinand IV himself had placed the new colony of Ordona on a hill next to the ancient (deserted) city of Ordona, but nothing conclusive can be ventured about Zapponeta. The only early description comes from Giustiniani (1786 Vol.X, p.106) who described it as a fief, held by the baronial Zezza family, bounded by the Carapelle and "the famous ancient saltpans of Barletta". It was supposedly, according to Giustiniani, ancient Uria but despite Pliny's erratic ordering of coastal settlements there seems to be general agreement today that classical Uria lay on, or near to, Lago Varano, on the northern side of the Gargano. More interesting are the two other points contributed by Giustiniani, that mosaics had been found 'not far from the sea', and that the settlement then comprised two centres of habitation. There was Orno, housing about 600 people, on the southern side, and Cittadella which, though smaller (500 souls), contained the parish church, the baronial palace and an obelisk. This duality may be significant for such duality in settlement form commonly betokens two stages of development. The locality of Zapponeta, and the precise circumstances of its 18th century layout,

deserve further investigation both in the field and in the archives.

This hint, elusive though it may prove to be, that even Zapponeta may have had much older antecedents than is recorded, sharpens the question of the secularity of the emptiness of the Tavoliere coastlands.

If Zapponeta, relative upstart in the Tavoliere coastlands, may have had much more respectable antecedents than is generally recorded, what of the other centres? To what extent have the coastlands been deserted and empty throughout history and prehistory? Alberti, travelling in the mid-16th century, commented on the emptiness of the countryside between the Candelaro and the ancient city of Siponto. (Alberti, 1550). Yet maps from the same century contain a number of place-names in the immediate coastal hinterland. In addition to the ancient cities of Salpi and Sipontum, six other place-names are indicated on various maps, excluding all the torre, for example— Torre di Rivoli and Torre Pietra. From other documentary sources another eight names have come to light. The archaeological record, however, is poorer. Only four ancient settlements can be described: the two cities of Salpi; Sipontum; and an extensive area of classical occupation in the vicinity of Masseria Cupola.

The cartographic evidence for lost coastal settlements presents some interesting if not entirely convincing points. Eighteen maps, published or drawn during the one and a half centuries between the mid-15th and the first decade of the 17th century have been studied. One of the first points to emerge was that a much greater degree of variation and contradiction amongst the compilers or editors of these maps was characteristic of the settlements and lakes of the Tavoliere coastlands than of those around the Gargano. It may be suggested that this inconsistency in the cartographic evidence stems from the fact that there had been real changes in the Tavoliere coastlands about the time the maps were drawn or, at least, sufficiently recently for the news to be slow in filtering through to cartographic circles in, say, Venice throughout the 16th century.

After all, it would have been quite difficult to judge that a settlement, once well-known in all the peninsula, (such as Sipontum, a pilgrim or crusader port) had dwindled in size to such an extent that it no longer existed and was not worthy of inclusion on a map of national scale. Sipontum (Siponto) continued to be shown, together with Manfredonia (which had officially replaced it in the 1250's) into the late 17th century. Salpi, likewise, continued to be added to maps as late as 1607, even though the bishopric had been amalgamated with that of Trani in 1547. Small wonder, too, if news that a long-threatening sandbar had finally effectively closed the mouth of a coastal lake, in some distant part of the peninsula, and turned a former gulf into a lagoon took a century or more to be admitted by cartographers. The indecisiveness of 16th century cartographers with regard to the Tavoliere coastlands may be in itself a measure of the recentness of these changes.

A cull of all place-names from the coastlands, derived from the full range of documentary and archaeological sources, is given below (table 2). One obvious problem is to match place-name with a possible site on the ground or with known archaeological evidence. But the first task is to weed out a number of false 'lost' settlements, names associated with the Tavoliere coastlands through error (Anduria) or poetic licence (Dardano). Therefore, in this chapter the well-known sites such as Salpi and Sipontum are but briefly introduced and attention is given to the more problematical identities.

The road from Foggia to Manfredonia cuts through the walled site of ancient SIPONTUM, following almost exactly the original route into the city. Despite the variety of spelling (Sipus, Sipontum or Sipuntum, Sipontos even Sepius, the cuttle-fish from which the name is held to have been derived (Strabo 6.3.9)), there has never been any problem in the identity of the prominent mound with the place-name. It is known that the Romans created a coast-guard colony here first in 194 B.C. and then

Table 2. Selected Place-Name Evidence for Lost Settlements in the Tavoliere Coastlands.

NAME	SOURCE			
	MAP	ITINERARY	CLASSICAL TEXT	Other document
Sipontum	from 1449-late 16th	Peut;Ant.	Strabo;Pliny	
Salpi I				
Salpi II	1480-1607		Strabo;Pliny	
Elpiae			Strabo	
Dardarno			Lycophron	
Salinis (Casale S.Maria di)		Peut;Ant.		1015 doc.
Salinis (di Barletta)	1570;and 16th c. 1606			
Cupola				1300 tax list
Anduria	1587;1607		Pliny	
Anxanum		Peut.		
Rivoli	1554,1570, 1580,1582, 1613			1300 tax list 1132;Barons' Cat.
Versentino	1554,1657			Dogana (1687)
(La Preta	1580,1582			
(Torre di Pietra	1554,1613			
"S. Pelagina"				
La Lupara				
(Aufidena		Peut;Ant.	not searched	)

again in 185 B.C. (Livy, XXXIX) but Strabo commented that the city, together with Arpi, was founded by Diomedes. Otherwise there is little evidence for the city being in existence prior to the 2nd century B.C.. Despite the abortiveness of the first attempt, attributable to a number of socio-economic factors rather than to natural conditions, the city apparently prospered. In the 8th century A.D. Paul the Deacon described it as satis opulenta; in the early Middle Ages pilgrims bound for the Sanctuary of Monte S. Angelo, one of the most famous in all Europe, embarked or disembarked at Siponto, as did many Crusaders. The Compasso di Navigare, compiled about the middle of the 13th century, even commented that Sipontum had 'a good port'.

Yet it was precisely at this time that the decision was taken to found an entirely new city immediately to the north of Siponto. The inhabitants of ancient Sipontum were enticed from a city that had been devastated by earthquakes by promises of tax concessions. It was also about this time too, we are often informed (for example, by Marin in Biancofiore et al 1970; and Palumbo, 1955) that the port of Sipontum fell into disrepute because of siltation. For this statement, however, no original documentary evidence has (to my knowledge) been produced. Our own sedimentary studies on this question lead us to doubt that siltation would yet have been a serious problem in the lagoon. However, there is no doubt that Sipontum certainly declined while Manfredonia, carefully fostered after its foundation in 1250, developed. It is not known by what date the ancient site of Sipontum was deserted. When Alberti visited the site, just before 1550, it was a deserted one though sufficient of the former architecture remained to impress the traveller that it had once been a "noble and magnificent city" (Alberti, 1550, p.221) (plate 39).

The history of ancient Sipontum is relatively straightforward. The identity of Salpi, however, has promoted a good deal of discussion not only recently (Marin, 1965; Biancofiore et al 1970) but during the last

centuries (Romanelli, 1815 and op.cit. therein; Giustiniani, 1797). This is because there were two Salpis (figure 37). The move from the Iron-Age and Daunian city (Old Salpi, Salpi Vetus or, in our terminology, Salpi I) is quite explicitly recorded by Vitruvius (de Arch. 1.4.12):

> "... the inhabitants ... came to M. Hostilius and, making a public request, obtained from him that he should seek out and choose a fit site for transferring their walls. Then he delayed not ... bought a site in a healthy place, and obtained permission from the senate and Roman people to remove the town. He established the walls and divided the sites ... When this was done he opened the lake into the sea and made a harbour out of the lake for the municipality. And so the people of Salapia now dwell on a healthy site at a distance of four miles from the old town."
>
> (Loeb Edition; translated by F. Granger)

The move took place about 200 B.C. but the new Salpi (Salpi II) continued to exist until after the Middle Ages. It declined very slowly after the 14th century, being finally abandoned only by the middle of the 17th century. It is this Romano-Medieval site of Salpi that was known throughout history. It is still, like Sipontum, a prominent mound but it has earthern ramparts, some 6 or 7 metres high, that even today present a quite forbidding aspect. These ramparts enclosed the Medieval city. Imperial (Roman) Salpi extended over a much greater area, as can be seen from both the air photographs and field evidence. (Schmiedt, 1964, figure 46). It was certainly to this city that Pliny referred, since he was writing during the 1st century A.D.. It was probably this site that Strabo had in mind, since he was writing a century after the move. Although his interests centred on the historical aspects of the regions he was describing, he made no reference to the older site of Salpi, a slightly puzzling fact.

The abandoned site lies just under four (Roman) miles away from Romano-Medieval Salpi, to the west at Lupara. The reasons for the move will be discussed elsewhere (page 264) but archaeological evidence supports the identification of the Lupara site as Salpi I. There is here a huge area of occupation debris partly defined by an agger, or ramparts, similar

to those found at other Daunian sites on the Tavoliere (most notably at Arpi and Ordona). There was also, it seems, extensive extra-mural occupation. Signora Tinè has excavated a very small area of this and uncovered three huts, the occupation of which dated back to the 8th or even 9th century B.C. but did not continue after the 3rd century B.C.. It is likely that this Salpi would also have had port activities; the now marshy Marana di Lupara that surrounds the site on the north and the east, has been shown to have been formerly a well-watered lake associated with the main body of Lago Salpi, not three kilometres distant (page 196).

The description of the supposed town of DARDANO given by the poet Lycophron (Alexandra, verse 1126) in the 3rd century B.C. is particularly apposite to the ancient topography of Daunian Salpi: "Incola, palustribus aquis affines" (an island fringed by marsh and water). The verse is cited by both Giustiniani (1797) and Romanelli (1815) but the place-name appears in no documents and can be dismissed as a fanciful displacement of the better-known Dodona from Epirus (Greece). Lycophron was in fact referring to the building of a temple near the shores of Lago Salpi.

There is, however, another, more genuine name associated with Salpi. This is the Rhodian colony of ELPIAE which would have been founded during the 6th century B.C. (Dunbabin, 1948). Not very much is known about Elpiae except that it was said to be on the coast (Strabo: XIV 654). While Marin is content to accept Elpiae as forerunner of Salpi I, there are those who pretend to have located the Greek site off the coast and under water. The description given me was of "numerous underwater buildings", pottery dating from the 4th century B.C., loom weights and spindle whorls, from an area about 4 kilometres out from Margherita di Savoia. The depth of water was not stated but according to the Admiralty Chart it is likely to be 4 or 5 fathoms deep. However, until this supposed 'archaeological' evidence is followed up, it is regarded with reserve, for exactly similar reasons as in the case of S. Pelagina (page 74).

One of the interesting points about the Itineraries is that not one of them mentions Salpi, although the route described (Siponto to Barletta) must have passed close by. Instead, the place-name SALINIS is given. In the 19th century, and previously, Margherita di Savoia was known as Salinis di Barletta. A suggestion has been made, however, that this would not have been exactly the same Salinis as the one frequently cited in documents after the 11th century, for there is a marked silence in the texts from the 13th to the 15th centuries (Candida, 1955). The later mention would refer to a new settlement, or to a resettlement, possibly to one on a site different from that occupied by the medieval Salinis, known as S. Maria di Salinis. S. Maria di Salinis is known to have had (in 1015) territory lying between the river Ofanto and Torre Pietra (ibed). The suggestion that there have been two Salinis sites since the early Middle Ages deserves further consideration, for it is our view that there may have been yet an earlier Salinis (the Roman) or still another site.

The site of Salinis di Barletta would have been particularly unattractive by the late 18th and especially during the early 19th century. Like Zapponeta, the houses are on the dunes of the barrier island with the sea to the east and saltpans to the west. Behind the saltpans stretched 18 square miles of Lago Salso. To the south was the Ofanto river; further north, emptying its waters into Lago Salpi, was the Carapelle river. Both these rivers were, by the turn of the century, liable to heavy and sudden flooding. That the inhabitants of Salinis di Barletta lived then in constant fear of flood such as the one that threatened their lives in 1813 is made amply clear by Afan de Rivera (Afan de Rivera, 1838). The increasing shallowness of the lake during the latter part of the eighteenth century meant that bigger waves battered the low wall that had protected the settlement since 1635. In addition, increasing salinity in the lake had led to the death of fish and to a putrefying stench of floral and faunal decay that tainted the countryside. Not least there was malaria

too.

Most of these ills were not inherent in the local environment but were fairly recent developments. Even so, in the choice of site for Salinis di Barletta it is clear that industrial attractions outweighed 'normal' rural settlement factors. That is to say, so long as Lago Salpi was appreciated for its salt production, so there would have had to be a settlement for saltpan workers. Today, 58% of the labour force of Margherita di Savoia is employed in the industrial sector. This is a staggeringly high proportion for almost any small town in Apulia. In the past, income from the saltpans (legal or contraband) must have accounted for a good deal of the livelihood of the local population. In 1860, for instance, only 52% of the commune's 2,630 hectares was available for cultivation. With a population of over 12 thousand, this meant a density of 929 inhabitants per square kilometre of arable land (Candida, 1955).

Any settlement in this area, called Salinis, might reasonably be expected to have had a similar industrial basis. The inhabitants would have been torn between the attraction of a livelihood from salt and the fearful inconveniences of location. Such a settlement is hardly likely to have had the relative durability of a wholly agricultural community. Moreover, saltpans can be easily constructed. They can be profitably built almost anywhere along the seaward fringe of Lago Salpi. Thus there have been, in short, few factors in this part of the Tavoliere coastlands to anchor the inhabitants of a 'Salinis' to any particular point on the barrier islands. Even housing, in the early 19th century, was largely a temporary affair for many; Afan de Rivera noted that 2,500 people at Salinis (di Barletta) were living in the little timber-framed and straw-thatched capanne that until recently were commonly used for the summer season only (Afan de Rivera, 1838).

That there may have been three different Salinis since Roman times is therefore not surprising. One would expect each settlement to have been



Plate 12. Torre Pietra today, with the chapel on the right.

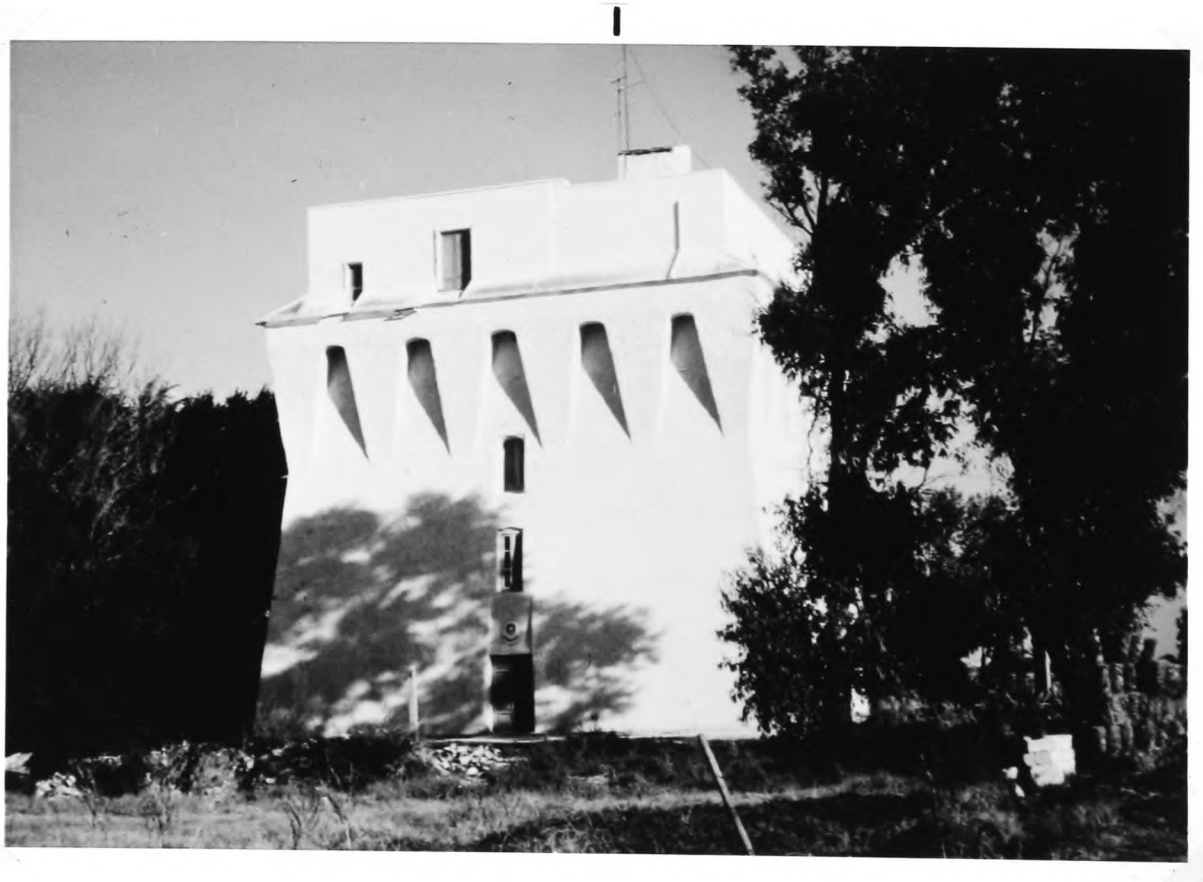


Plate 13. Torre di Rivoli.

established within an acknowledged territory, that is, somewhere on the dunes west of Lago Salpi. Since the 11th century this territory extended no further north than Torre Pietra, though it may have done so earlier.

There are grounds for suggesting that the Salinis of the Itineraries was an industrial settlement and that the location of Roman Salinis was, like its successors, on the dune belt. There are also grounds for narrowing the possible site of Roman Salinis to the vicinity of Torre Pietra or immediately south of it. For, in the first place, whatever misgivings are retained about the accuracy of distances quoted in the Peutinger Table, it must be admitted that the figures given for the settlements between Sipontum and the Ofanto make good sense as they stand (see page 69). For instance, the quoted distance of 9 (Roman) miles from Aufidena (by the Ofanto) to Salinis would have brought the traveller close to Torre Pietra, while from the Ofanto to Margherita di Savoia is only 3.5 (Roman) miles. However much the Ofanto may have shifted its course, it is difficult to accommodate such a differential by referring simply to physical changes.

Secondly, it is known that in Roman times an outlet (foce) was cut across the dunes to open a waterway between Lago Salpi and the open sea (Vitruvius). It is arguable that the cut would not have been made very much further south, or very much further north, of the new city if possible. The modern foce at Torre Pietra has been cut and recut throughout the late 18th and early 19th century in the course of the desperate efforts to improve conditions in Lago Salpi. It is true that such cuts are obliterated as easily as they are made and may disappear in little over a century. Afan de Rivera reported that he could only just discern a cut silted up in 1764. (Afan de Rivera, 1838). But Torre Pietra, and its foce, stands almost opposite the new Salpi.

Thirdly, there are reports of a paved causeway running out from Torre Pietra in the direction of Salpi. (Biancofiore et al 1970). This has been submerged since the early 19th century at least. The date of construction

is not given. It is not clear either how such a causeway across the lagoon affected shipping but there is no reference to such an impediment to fishing activities that were important until 1764. The existence of such a causeway, if that is what it was, might imply a fairly important pedestrian or cart traffic between Salpi and the Torre Pietra area.

It may also be mentioned, fourthly, that in Idrisi's account of the coast between Barletta and Siponto a locality north of the Convent of S. Maria (di Salinis, presumably) is named as "S. Nicola bbtra". This improbable word has been transliterated by the editors as Pietra (Amari and Schiaparelli, 1883). Idrisi was not simply listing the coastal towers, if these already existed, for he makes no reference to Torre di Rivoli, so it may be inferred that a hamlet, or some sort of settlement, existed to be served by the chapel or church of S. Nicola. This is admittedly a weak argument, for such a chapel might have been established solely for the convenience of fishermen and sailors.

But, finally, there is question of the place-name La Preta. This appears on Danti's map in the Vatican Gallery (1580/1) as a settlement located south of Rivoli and right on the coast. It is shown on Cagno's map published the following year (1582), though the name is scarcely legible. On Magini's map (1554) and many subsequent maps (e.g. the Atlantino di Napoli c. 1613; Blaeu, 1640) the name is presented as Torre di Petra. The cartographic evidence therefore lends substance to the idea that there was once a nucleated settlement of this name somewhere along this southern section of the Tavoliere coast. It was probably only a hamlet (casale) rather than a village (centre) for it is not recorded as taxed in 1300 as were both Cupola and Rivoli further north. The constant need for a coastal watch-tower and a landmark ensured that the name of the lost hamlet survives to the present as Torre di Pietra. Very much the same history may underlie the lost village of Rivoli and the modern Torre di Rivoli.

If a plausible case has been made for Roman Salinis somewhere on the southern side of Torre Pietra, it remains for fieldworkers to prove (or

disprove) the case. Torre Pietra is today a trim white land-mark (plate 12) but in the 1830's the upper storey was in ruins. Afan de Rivera had it restored and furnished as offices for the engineers working on the Lago Salpi improvements (Afan de Rivera, 1838). The chapel and tavern, once used by fishermen, were also restored for the benefit of the workforce employed in the drainage scheme. It would be nice to know if the chapel was indeed dedicated to S. Nicola - incidentally, the patron saint of sailors!

In addition to Sipontum and the two Salpi sites, there is one other major archaeological site in the coastlands. This takes its name from Masseria CUPOLA (once the property of Benedetto Croce). Close to the masseria, Signora Tinè carried out excavations in 1967/8 which revealed that the site had been occupied from about the 10th to the 3rd century B.C. (Tinè, 1969). But very little of the topography of this Iron Age and Daunian settlement is known. From the pottery scatter, a large city may be indicated but there is no trace of the agger characteristic of the other Daunian cities on the Tavoliere and even the outline of the settlement remains uncharted.

Masseria Cupola lies towards the northern end of a broad promonotory of Early Holocene terrain that until recently was surrounded by the marshes and lagoons of Salso (to east and north) and of Versentino (to the west). Two other localities share this promonotory with Masseria Cupola. Two kilometres further south, overlooking the 'new' canalized Cervaro from a low bluff, is the modern hamlet of Beccarini. This name has not been encountered in the documents but recently a Daunian burial was found there and it is possible that the site has had a longer history than has hitherto been suspected. Forming the third apex of the triangle with Cupola and Beccarini is Versentino. This also lies to the north of the Cervaro but the bluff on which the old, half-ruined, masseria stands rises very steeply from the flood plain and above the ex-lagoons of Versentino and Salso.

There may be a considerable depth of ancient occupation debris, for the plough soil is thickly littered with building debris (medieval or later, most probably) and pottery (a little medieval, no Roman or Daunian, a great deal of early Neolithic). Slightly to the east of the old farmstead, on flatter ground, a modern agricultural azienda has been established.

There are a number of references to Versentino in the documents and all make it clear that at no time since the early Middle Ages would there have been a major settlement (village or centri) here. One of the earliest mentions comes from the Barons' Catalogue (a list, by fiefs, of military service owing to the Crown) which was compiled in the mid-12th century and subsequently revised (Jamison, 1972). Here Versentino is described as the fief Bersentinum, a name that frequently appears in the Cartulary of San Leonardo and on many of the ancient maps. In the Cartulary, an earlier document refers to the casalis (hamlet) Versenteri and its territory (Camobreco, 1913, document 6, dated 1132). Other references (1219, 1302, for instance) make it clear that the territory of Versentino adjoined that of Candelaro, later itself a deserted settlement. Much later, under the Dogana, the fief was run as a grazing locatione. By this time there can have been few inhabitants though the masseria survived, possibly in ecclesiastical hands (to accept local tradition).

The Cupola-Beccarini-Versentino triangle merits further attention. The area concerned covers at least three square kilometres. It may have been formerly more conspicuous as a promontory, surrounded by lakes and rivers, for not only is Versentino today 18 metres above sea level but the very name Cupola may have topographical significance (cupola, a dome, convexity). Its location certainly has been a significant one. It forms the only extensive elevation between the former lagoons of Salpi, Salso and Versentino. It was traversed by one of the main routes in the eastern Tavoliere, that running from the Gargano south towards Barletta, a road still unmetalled in 1973. After crossing the Candelaro the traveller would

have passed close to Masseria Cupola and then by Beccarini before continuing to Salpi and the Ofanto.

None of the remaining lost settlements in the Tavoliere coastlands have archaeological evidence. They are known only from the documents. The oldest is ANXANUM, for this is shown in the Peutinger Itinerary to have been somewhere between Sipontum and Salinis. It may have been a relatively un/important place that just happened to lie on, or near, the route described in the Itinerary. Although no other references to such a settlement have been encountered, there can be little doubt that not only did a locality of that name exist but that a good case can be made for its having been sited within the Cupola-Beccarini-Versentino triangle.

The only original reference to Anxanum is the Peutinger Table (and its copy, the Ravenna Itinerary). From this it seems that Anxanum lay 9 (Roman) miles south from Sipontum and 12 (Roman) miles north of Salinis. All too often there are problems with the figures given in the Itineraries. Usually these can be ascribed to errors of transcription. It has happened, with regard to the Sipontum-Barletta section, that scholars in the past anticipated such errors of transcription and altered the figures so that they better fitted whatever argument was in hand. So Romanelli, as others before him, adjusted some of the distances:

Sipontum to Anxano	:	IX (instead of VIIII)
Anxano to Salinis	:	for XII read XVI
Salinis to Aufidena	:	for XII read IV

(Romanelli, 1815, p.204)

Apart from the first, which effects no actual change, neither of the corrections is convincing if all that was intended was to make good possible errors of transcription. The Anxano-Salinis figure would have been better altered to XV if that were the case, as for the Salinis-Aufidena distance. One cannot but suspect Romanelli of doctoring the figures to suit his argument that Anxanum lay right on the coast, in the vicinity of

Torre di Rivoli.

As it happens, there is simply no need to make any alterations (figure 15). From Sipontum a radius of 9 (Roman) miles, as indicated in the Peutinger Table, would cut the coast near Torre de Rivoli. But from both cartographic and documentary evidence it can be accepted as reasonably certain that in Roman times (or even in the Middle Ages) it would not have been possible to travel straight along the coast from Sipontum to Torre di Rivoli as one can today. To reach Torre di Rivoli, having circumvented Lago Salso by the road at the foot of the Gargano, crossing the Candelaro at Fonterosa, passing Cupola and Beccarini, would involve a journey of not less than 14 Roman miles. However, the radius of 9 miles from Sipontum also arrives at Beccarini. The real distance of 9 miles from Sipontum along the Gargano road, reaches Cupola!

To confirm this indication that the Cupola-Beccarini-Versentino triangle may contain the lost Anxanum, the unaltered Peutinger distances from Aufidena and Salinis to Anxanum also fit almost perfectly; providing, that is, the Torre di Pietra site is accepted for Roman Salinis. The straight-line distance from Torre di Pietra (12 Roman miles) arrives at Beccarini.

It is hardly sufficient to insist on identifying the Cupola-Beccarini site with the lost Anxanum on the basis of the Peutinger figures alone. But it does give a point, if not an urgency, to the archaeological study of that area. There is a further, possibly significant, fact. The Antonine Itinerary, although apparently compiled at about the same time as the Peutinger Table, omits all mention of Anxanum. The route described passed directly from Sipontum to Salinis (with a given distance of XV miles, which would read better as XXV miles ....). Of course this omission could be sheer accident. On the other hand, bearing in mind that the Antonine Itinerary is thought to have been an official document (while Peutinger was not) it is not inconceivable that the official who compiled

it was better informed than the author of the Peutinger Table, and that he knew that Anxanum no longer existed. The archaeological evidence from Signora Tinè's excavations, it may be recalled, indicated occupation only up to the 3rd century B.C. at Cupola.

Although the identity of the lost Roman settlement of Anxanum with the Cupola-Beccarini-Versentino area would fit nicely with the other more or less contemporary evidence (Peutinger and Strabo) and with what is known of the coastal outlines for this period, not all would accept the identification. Signora Tinè herself would like to see the Cupola site as an antecedent of Sipontum and others follow this argument (Tinè, 1969 and Marin, in Biancofiore et al 1972). However, the chief basis of their argument, as I see it - that the progressive move north of 'Sipontum' was associated with siltation factors - is probably untenable on physical grounds.

Past scholars have placed Anxanum right on the coast. Romanelli's doctoring of the Peutinger distances was to make it fit such a thesis. To be fairer to him, it should be pointed out that he was concurring with the views of a previous writer, the ecclesiastic Forges, who travelled in this area in 1790 (Romanelli, 1815). Forges apparently gave three reasons for postulating this locality for ancient Anxanum: first, that the distances in the Peutinger Table are correct; second, that the remains of ancient structures had been seen at the bottom of the sea just off-shore; and third, that a good deal of money etc. had been recovered from the Rivoli area: In short, he was implying that the site of Anxanum now lies off the coast and has been submerged (figure 13).

Whether Forges was the originator of what is now referred to as the SANTA PELAGINA site is not clear since, at the time of writing, his work remains untraced. It may be that he was merely perpetrator of a local tradition. What is certain is that the idea was kept alive through the 19th century and enthusiastically embraced by some in the present century. Local fishermen are familiar with the concept of a submerged city, either

complaining that the ruins foul their nets or displaying Roman amphorae dragged up in the same nets as proof of the settlement's existence. In the event, one suspects that it was primarily to such piscatorial activities that the tradition of a sunken settlement arose in the first place.

In 1838 Afan de Rivera wrote that

> " ... in that place called by fishermen S. Placida, in the neighbourhood of the present Torre di Rivoli towards the east and, due to the changes to which the Adriatic coast has been always subject, today entirely under water, can be seen in calm weather and with clear water the ruins of numerous buildings, intersected by the empty spaces of streets ..."
> (Quoted by Marin, 1964, p.169 footnote 1)

Santa Placida is an alternative name for Santa Pelagina.

In 1942 A. Riontino took up the tale and describes in slightly confusing detail the submerged site:

> "Its length from Torre di Rivoli on the west towards Torre di Pietra on the east, cannot be over 800 metres; its width, along both western and eastern sides, cannot be over 200 metres and 250 metres, and halfway along the side that looks towards the beach, for over 400 metres, must be the ancient wall, pushed out on this southern, terrestial side for the defence of the area. Along its western side I have discerned six streets, since scarcely had the walls of the first group of buildings come to an end when the anchor dropped into a culvert for another three metres and rejoined street level; a little further, beyond the street, the anchor soundings again touched the walls of the buildings, and so on, going from south to north, that is to say on the side facing the open sea, there must be six streets. The first street is at 8 metres below sea level, the sixth street at 9 metres. On the western side, the first group of buildings is about 500 metres distant from the beach, on the eastern side it is about 1 kilometre distant, the projecting section - the wall - halfway along the coast [is] no further than 450 metres."
> (A. Riontino, 1942, pp.209-210 cited by Marin, 1964, p.24 footnote 54. N.B. The translation is literal but the punctuation almost wholly as in the original.)

Marin's own comment on this passage is limited to the sage observation that only a submarine investigation will indicate the extent to which this description coincides with reality.

Most recently, and informally, Brigadier General G. Schmiedt made certain relevant comments on the large-scale air photographs he so kindly made available for inspection. In his view, a number of trackways can be detected in the coastal hinterland of Torre di Rivoli, tracks which converge towards the off-shore S. Pelagina.

Two submarine searches have in fact been made since Riontino described the sunken settlement solely from anchor soundings. In 1967 Gerhard Käpitan, a noted diver, spent two weeks searching the S. Pelagina area. Then as part of the 1973 fieldwork programme, a team of experienced amateur divers also devoted several days to an investigation of the supposed site. Led by Dr. I.A. Morrison (University of Edinburgh) the team included: Donald, Peter and Paul Smith and Martin Dean, all of the Slough Sub-Aquatic Club. They were guided to the correct area by the same fisherman, Pasquale, who had so directed Gerhard Käpitan a few years previously. Despite unfavourable conditions and extremely poor visibility, the reconnaissance was sufficiently successful to confirm any doubts that might have arisen from a prior consideration of the evidence for S. Pelagina just presented.

The evidence concerns four basic items: the Peutinger Table distances for Anxanum; structures seen or detected by sounding (in 8-9 metres of water); finds of money, pottery, etc.; and a convergent road network discerned from air photographs. The first point has already been considered and shown to be invalid (so far as the direct coastal route from Siponto to Torre di Rivoli is concerned) and unnecessary (in that the undoctored distances fit the Cupola-Beccarini site more conveniently). The third point can be speedily dispensed with. None of the finds reported would constitute prima facie evidence of a settlement even onshore. The range appears to be limited. Money is a portable commodity and its finding indicates no more than that somebody, at some time after the minting of the coin, passed that way, or buried a hoard, as the case may be. The most common find from S. Pelagina seems to have been Roman amphorae; the

Figure I3

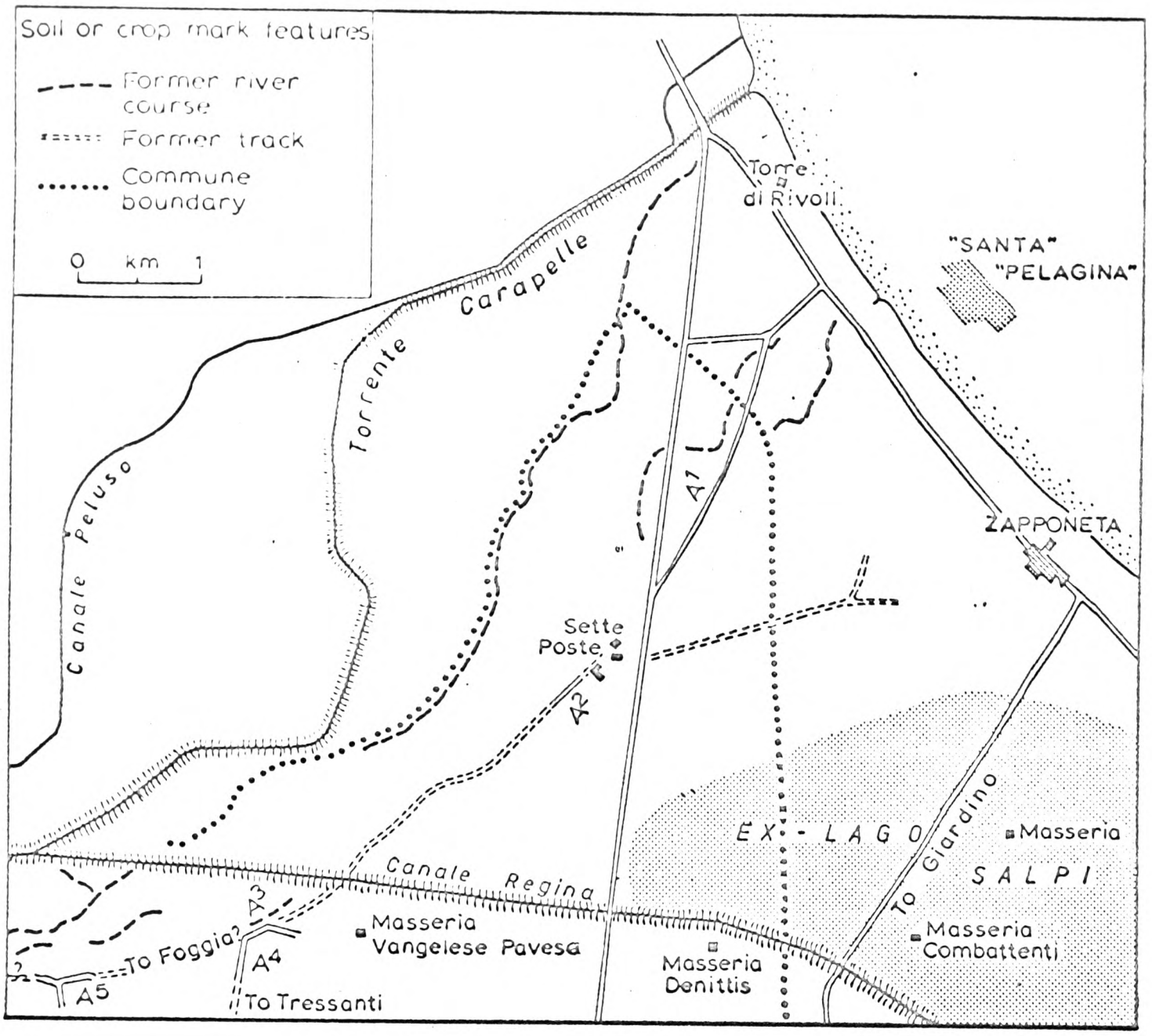


Figure 13. Lost settlements: the case for a 'Santa Pelagina'.

upper part of one, possibly dating from a "fairly early time in the Roman period" was recovered during our own searches but so was a plastic bottle. That is to say, that it is well-known that ship-loads of amphorae, containing wine or oil, were common merchandise throughout classical times and throughout the Mediterranean. The amphorae from S. Pelagina may have come from a shipwreck.

That being the case it is interesting, (if not strictly relevant to the problem of S. Pelagina) to speculate whether the ship might not have been attempting to enter (or to leave) the Rivoli river, (possibly, even, to sail further upstream to the vicinity of Anxanum (the Cupola-Beccarini area anyway). A ship wrecked anywhere close in to Torre di Rivoli would have been unusually close to shore unless it had been on a very local voyage - between Salpi and Siponto for instance. The other isolated finds, sculpture, the bronze tablet reported by Forges etc. are likewise easily transported.

At first sight, the air photograph evidence of former tracks or roads apparently converging on the coast at a point just opposite the supposed S. Pelagina, seemed impressive. However, disregarding some highly sinuous marks that obviously relate to former water courses, two such tracks are discernible south of the present Carapelle course (figure 13). Comparison with Zanoni's map (1808), rather than with the modern topographical sheets that show a much altered communications network, reveals the origin of the air photograph marks. Early in the 19th century a road, or track, ran northeast from Tressanti joining the coast-road just south of Torre di Rivoli and the Carapelle ferry. A branch, to the east, led to Zapponeta, just north of the head of Lago Salpi. These are the tracks picked out by Brigadier General Schmiedt as soil marks on the air photographs.

Today these routeways do not exist. The old edition of the 1:100,000 topographical map (sheet 164), which was not replaced by a new edition until the mid-1960's, did actually show the northern section of the Tressanti road. This was marked as an unfenced, unmetalled road leaving

the modern Cerignola-Rivoli road opposite Sette Poste. Other small sections survive as field or local tracks and are shown on the 1:25,000 sheets (164 II NE). But in the main, only dark lines on the air photograph (parallel lines near Masseria Vangalese Pavese) testify to this ancient line of communication.

But these routes do not necessarily form a network converging on a lost settlement. Viewed in the wider context of the communication pattern in the eastern part of the Tavoliere, the Tressanti track was part of the routeway between Cerignola and Manfredonia. The branch to Zapponeta was the only means of reaching this settlement from the interior, other than the coast road. It was replaced by the modern track - still (1973) unfenced and unmetalled - constructed in the 1840's by Afan de River. It is interesting that the older / track is scarcely visible on the air photographs and its near obliteration within the last 150 years suggests a relatively rapid process of marsh development and reclamation in this area.

The most telling objections to the S. Pelagina site, however, concern the supposed submerged structures. These, Riontino stated, were found at 8 or 9 metres below present sea level, an untenable depth for classical or post-classical features. There is no evidence of, nor justification for supposing, such a degree of relative land-sea level changes. From the sedimentary investigations at Siponto and at Salpi the parameters for land/sea level variations in the last two millennium are probably at most 0.8 metres. However important a role tectonic (structural) dislocations may have had in local changes there is, again, no reason to envisage the central portion of the coast as having just dropped a convenient 8 or 9 metres.

Finally, our own submarine observations indicate beyond doubt that it is not ruined buildings which catch fishermen's nets in an otherwise muddy bottom, but coral.

Despite poor visibility there is no doubt that the diving team were

searching part of a reef of coral in precisely the locality of the supposed S. Pelagina and precisely at a depth of 8 and 9 metres. The admiralty chart does indicate other coral formations in the Manfredonia bay, usually further out and at still greater depth (7 fathoms). But it would be coral, too, that is responsible for similar reports of sunken buildings offshore from Margherita di Savoia. These reefs are typically irregular and it is easy to see how, by soundings only, a searcher with the idea of a sunken settlement already in his mind might be misled into visualising the entire layout of a village beneath the keel of his boat. These conclusions were reached independently of Gehard Kapitan's results. After two weeks intensive searching in the same locality, and in similarly poor conditions, he arrived at the same conclusion, that coral formations have been mistaken for artificial structures (Personal Communication).

Nevertheless, there is good substance to the tradition of an ancient settlement in this central portion of the coastlands. The medieval village of RIVOLI, for instance, ranked high in the tax list of 1300 as one of the 57 "territories and places" in Capitanata considered of sufficient size or prosperity to contribute to the relief of Lucera and its territory (devastated as a consequence of the Sarrasin rebellion and the Angevine siege) (Egidi, 1917, doc. 200). In the tax list it was entered as Torre di Rivoli but on the maps it was more usual to put simply Rivoli, possibly for reasons of cartographic economy.

Rivoli is shown on many maps from the 15th to the 17th century. In the map of 1449, a 'Turris de Paludibus' is indicated, which may be taken for Torre di Rivoli (Colamonica, 1921). On the whole, the ancient cartographers were remarkably consistent in placing this now lost settlement just north of the Carapelle river; towards but not (usually) on the coast; and south of Lago Salpi. It is unlikely, therefore, that the present Torre di Rivoli marks the exact site of the earlier village. The stretch of marshy land immediately behind Torre di Rivoli, however, (now south of

the Carapelle) is known as Piano (plain) di Rivoli (I.G.M.: 1:25,000 sheet 164 II NE). There is no archaeological evidence yet for Rivoli and it is possible that there may never be. For much of the land immediately north of the Carapelle is today under water as one of the newly created wild-life reserves.

A similar problem concerns the lost settlement of CUPOLA. Cupola was also mentioned in the tax list of 1300 and also ranked sufficiently high to indicate that this, too, was no mean hamlet. Cupola contributed, or was assessed at, 18 ounces of gold. This was a little less than Rivoli (19 ounces) but it was more than Bovino raised (17 ounces). Bovino has survived to the present day (1961 population 7,200) but many of the lowest ranking settlements in the tax list, who paid in 1300 only 2 ounces each, were subsequently deserted (for example, Fazioli, Fiorentino, Ordona). In the 18th century, Cupola was described as a posta (a small farmstead set up by the Dogana) (Dogana, 1736). But as in the case of Rivoli, the site of the lost settlement of Cupola is not yet known. There was no evidence of medieval occupation in the excavations at Masseria Cupola and it is unlikely that it has been confused with Versentino, for even there insufficient pottery has been found, so far, to support the idea of a sizable medieval settlement.

Another name remains to be considered. This is ANDURIA or Andoria. On two early maps, of close date, the name is given to a wide open embayment or lagoon and, by implication, to a settlement marked halfway around the gulf. The earliest of the two maps was produced by Ziletti from Venice in 1557 (Almagia, 1929). Half a century later, on a map dated 1607, the Tavoliere coastline, the settlement pattern, and the names are so nearly identical that plagiarisation may be suspected. The conclusion reached is that the name refers to one of the more soundly established lost settlements (Rivoli or Cupola) and is not one in its own right. In both maps, the supposed settlement of Anduria is shown as south of the

Candelaro, north of the lagoon or gulf, and a little way inland. No original references have come to hand to support such a place-name. Alberti, however, appears to accept both the name and the tradition of a former settlement. He referred to Boccaccio concerning the site of an ancient castle on the margins of the lake of Anduria (Alberti, 1550). But he gives Pliny as the original source for the name of the settlement and lake. Pliny's reference however is to a town and a well-watered lake in the Sallentine peninsula:

> "In Sallentino, iuxta oppidum Mandoriam lacus, ad margines plenus, neque exhaustis aquis minuitur neque infusis augetur."
>
> (Pliny, Nat. Hist. II § 106)

Quite why this perfectly explicit location should suddenly be confused with the Tavoliere lagoon of Lago Salso is by no means clear. Possibly Alberti himself is to be held responsible for the initial mistake for his book was published just before Ziletti's map, but it would seem out of character. The name is certainly wrong but Lago Salso was formerly an open gulf as depicted, crudely, in the two maps. Very likely, the settlement Ziletti wished to indicate was one of those already considered and in that respect his map was not so fanciful as appears at first glance.

Reviewing the archaeological, documentary and cartographic evidence for former settlements in the Tavoliere coastlands, some place-names can be discarded: Dardana, Anduria. One or two 'archaeological' sites can also be dispensed with: Santa Pelagina, and an off-shore Elpie. The remainder of the names listed in table 2 are now seem to apply to a much smaller number of lost settlements than might have been apparent from that list. Moreover, it is possible to suggest, however tentatively, locations if not actual sites for most of these not already well-known. The matching of place-names and possible site or location is summarised in table 3 below:

Table 3. Lost settlements in the Tavoliere coastlands

Lost settlement	PERIOD OF OCCUPATION				
	Daunian	Early Classical	Late Classical	Medieval	
Known site					
Salpi I	x				ARCHAEO-LOGICAL evidence
Salpi II		x	x	x	
Sipontum		x	x	x	
Unknown site					
Salinis I			x		DOCU-MENTARY evidence
Anxanum			x		
Rivoli				x	
Cupola				x	

Discounting Aufidena (by the Ofanto and in an area not studied at all) there are/all seven lost settlements worthy of that designation. On the other hand, only three have been identified beyond dispute: the two Salpis and Sipontum. Two other locations, or areas of search, can be indicated: Torre Pietra (for Salinis I) and the Cupola-Beccarini-Versentino triangle. In the latter area we might expect to find Anxanum and medieval Cupola. What of medieval Rivoli? Has it, like ancient Sybaris, been washed over by a river changing course? Should we look in the Piano di Rivoli, south of the present lower course of the Candelaro, rather than to the north of that river, in an area now deliberately immersed as a wildfowl reserve? One point does seem to have been established, that the search for the lost settlements of the Tavoliere coastlands involves fieldwork and sedimentary studies, not diving techniques and off-shore work.

No mention has been made so far to the prehistoric settlement pattern in the coastlands. It is as fundamental to our thesis as are the classical and medieval sites, for the presence of a Bronze Age or Neolithic occupation area in the coastlands is testimony to the extent and outline of former

terra firma. There are, however, considerable differences in the study of the prehistoric and the historic patterns and in the patterns themselves. The most obvious difference is the lack of documentation for the prehistoric period and the search for the early settlement pattern has to be wholly archaeological, or field, survey and only half the approach is involved.

The second difference concerns selectivity. For the classical and medieval (i.e. the historical and proto-historical) periods no attempt has been made to look for, or to discuss, anything except nucleated settlements. Isolated dwellings have been excluded. These have proliferated in the coastlands, at certain times at least. Some have been found in the course of fieldwork. For instance, the site of what was probably an early (Republican) Roman farmstead, identified by sherding, lies close to Masseria Giardino at Salpi. There are a number of unexplained soil and vegetation marks on the air photographs that may have something to do, some of them at least, with the route stations or guard houses, may have been associated with routes such as that advocated in the itineraries. There must be, too, any number of farm sites; there are places such as Lupara, Lo Squarto, La Pagliete, Inaquata, Tressanti and, further inland still, Bonassissa, that are known to date from the 17th century (Dogana, 1687). But there is a limit to what can be usefully attempted in the study of the ancient settlement of the Tavoliere coastlands and it must be accepted that such features lie well beyond that limit. But apart from convenience and academic logistics, such selectivity does imply a recognisable point of reference for interpretation of the evidence. This is something lacking from the study of prehistoric settlement patterns. Not only is the total cull of prehistoric settlements a very much smaller proportion of the former pattern but there is little from which to judge the past status of the evidence uncovered. One has, for instance, no means of knowing whether one is facing the unique or an example of the general.

In fieldwork is the key to the reconstruction of the prehistoric settlement pattern. There are two approaches. One is to scrutinise the aerial photographs for anomolies and to check these on the ground. The other is to check the ground first, methodically (e.g. on a gridded plan) and painstakingly. The second is the most desirable but to hope to cover even a relatively narrow strip of the 30 kilometres of coastlands between Salpi and Sipontum would involve a good deal of time and a number of trained fieldworkers. Hence the first approach, born of expediency, has usually been the starting point of the archaeological programme during the two fieldwork sessions in the Tavoliere coastlands.

A number of factors affect fieldwork and there is no guarantee that all occupation areas would be detected during only one year's fieldwalking, however intensive this might be. For instance, as is well known, successful sherding of a site can be affected by so many things, such as: depth of ploughing; the time interval since ploughing; whether it rained between ploughing and the field survey; the quality and angle of light and so on. These factors operate in the coastlands in a particular manner. In the first place, much of the land that is today ploughed has come under the plough only very recently, perhaps within the last five years. In some cases one may be searching a field that was first ploughed only one or two years previously. This does not mean that the quality of the potsherds tends to be good (at least as regards size) and it must have considerable bearing on the amount of material brought to the surface. On the whole, the impression gained is that modern deep-ploughing does more good in the coastlands than harm, for where a layer of colmate alluvium masks older soils and occupation horizons, the pottery reaches the surface only as a consequence of deep-ploughing. For example, if ploughing at Carapellotto-Regina had cut less than 50 to 75 centimetres deep, it is probable that none of the Bronze Age sherds would have been brought to the surface and this significant site might have remained undetected for years. A good

deal of the coastlands, however, has not been ploughed. Sherding over land masked by a close cover of hare's tail grass, for instance, is almost useless.

However, pottery scatter is not the sole indicator of a former settlement site, although it is important in providing a date for part of the occupation period at least. The flatness of the coastal landscape is not absolute, and micro-relief is a second element in site detection. The highest mound at Carapellotto-Regina seemed an outstanding feature when first seen, at dusk, but it rises only 70 centimetres above the surrounding field (plate 9). In the Marana di Lupara, the knoll on which are located the Iron Age huts excavated by Signora Tinè 'towers' above the marshes and lowlying arable by 150 centimetres but even this would be easily by-passed. At many prehistoric sites there is no relief feature at all (Marandrea, for instance). Usually what draws attention to a possible site is not so much the elevation (especially in the glare of a high morning sun) as the concordant soil colour change. Both at Carapelle-Regina and in the Marana di Lupara this was demonstrated particularly well (plates 9 and 26). Where the soil is not exposed, recourse has to be made to looking for variations in vegetation (height, density, species) but these may result from so many factors (salinity for one) that vegetation is less useful an indicator in the coastlands than inland on the Tavoliere. Using these three elements of site detection together with air photographs, several new prehistoric sites have already been discovered (page 231). Even so, the prehistoric distribution pattern remains incomplete, for searching has not been intensive enough due to lack of time (and finance). However, sufficient evidence has emerged for it to be now quite clear that there is a prehistoric foundation to the changing settlement patterns of the Tavoliere coastlands.

In this chapter, something of the outlines of post-prehistoric settlement changes in the Tavoliere coastlands have been sketched. That there

have been some quite drastic physical changes since the mid-Holocene is clearly implied, whatever the factors of settlement desertion may have been at different times. The outstanding period of change would seem to have been after the Middle Ages, for it is since the disappearance of villages such as Salpi, Rivoli and Cupola that the coastlands took on the aspect of emptiness for which they became known. A suggestion may be hazarded that the change occurred after the 15th century; by the time the Dogana maps were drawn (1787) it had been completed. But it is difficult to tell, for the very uneven availability of documentary information may give an impression of phases of maximum decline coinciding with periods for which there is least information.

There are signs of other periods of desertion. Roman Salinis is unlikely, it has been suggested, to have been on precisely the same spot as its medieval successor. Anxanum seems to have been a Daunian 'city' deserted during the Roman period. Was it replaced, as Daunian Salpi was, by another site, an untraced Roman Rivoli or Versentino, for instance? What lies behind the selection of site for Zapponeta; more practically, what lies below the dune sands? To what extent was there continuity of settlement in the coastlands from prehistoric times onwards? One point has been demonstrated in the last few months, that the "empty millennium" of the Bronze Age is a myth, at least in the coastlands of the Tavoliere.

Perusal of the study of lost settlements and past settlement patterns in the Tavoliere coastlands is bound to be rewarding. Not just so that the distribution maps may be completed, but to bring a little nearer the time (if it shall ever be!) when the quality of living in the coastlands at past times can be understood. To this end we turn next to consider the outlines of the former lagoons and the changes that have been effected in the physical environment along the Tavoliere coast.

§ 3 Historic Changes in the Lagoons and in the Coastal Outline

If, scenically, little remains today of the lakes and lagoons in the coastlands the memory of them is much more alive. Local farmers appreciate that much of their land has come from some vast watery horizon. That the reality of the transformation is so generally acknowledged is itself a measure of the recentness of the changes. Effective reclamation (bonifica), infilling (colmate), and drainage has been achieved only during the last four or five decades. The history of drainage in the Tavoliere coastlands is not an old one, and dates in the main from the early 19th century.

It might be thought, since the demise of the lagoons is a relatively recent event, that to trace the former outline of each lagoon would be a relatively simple task. Far from it. Almost as much confusion reigns in the cartographic evidence concerning the former configuration of the coastlands as over the lost settlements, while written accounts tend to be much less informative. This may be because a hamlet or village, however remote, had a palpable identity for the early topographers, a site and a name. The transient outlines of water-bodies in a lowlying and otherwise featureless coast are difficult to recognise from ground level and to describe in the abstract. Moreover, there were seasonal changes; Afan de Rivera spoke of a winter and a summer area for Lago Salpi (Afan de Rivera, 1832). It would have baffled even local cartographers to keep an accurate and up-to-date account of the vagaries of coastland rivers, the Cervaro and the Carapelle notably, let alone those in distant Venice or Rome.

Small wonder then that a document-based investigation is inadequate where a detailed study of the outlines of the former lagoons of the Tavoliere coastlands is demanded. There is a double scale problem. In the first place, measurements in hundreds of metres are required, even though the total area in question may amount to over one or even two hundred square kilometres. In the second place, on the chronological scale, the history of the lagoon changes is required in, say, hundred-year periods, to match

Figure I4

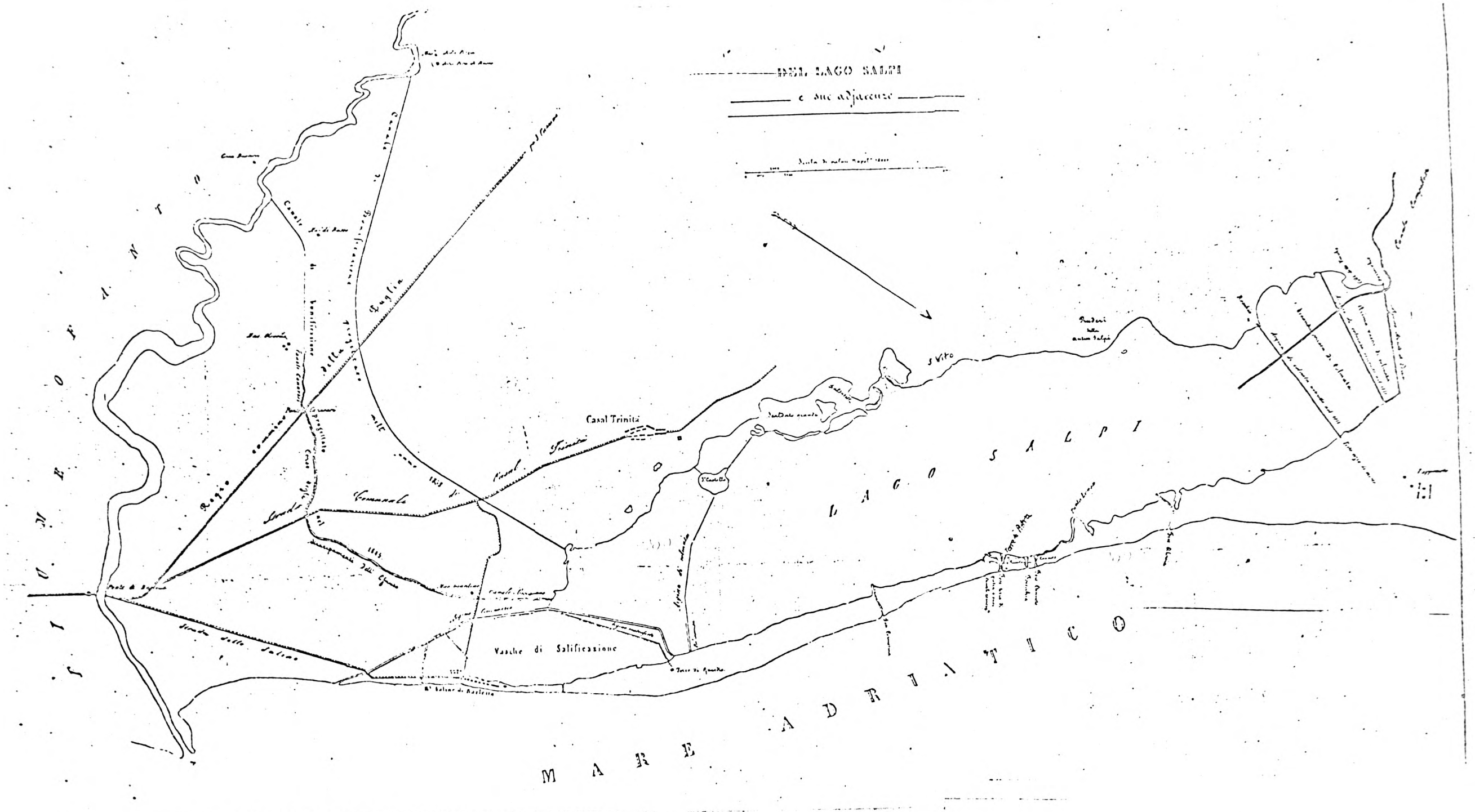


Figure 14. Lago Salpi about 1845, according to Afan de Rivera.

with events in human history, but the total time-span under scrutiny amounts to seven or eight millennia. The only faithful record of changes is that contained in the sediments themselves, a fact which puts the onus onto fieldwork aspects of the study. However, the broad outlines and salient features of the process and progress of lagoon change can be derived from the documentary evidence, and indeed should be sought there first, prior to intensive (and costly) field investigations. It is also probably easier, if not more logical, to attempt to work retrogressively, starting with the pre-reform coastlands; that is, with the lagoon landscape at the beginning of the 19th century.

At this time, LAGO SALPI extended as far north as Zapponeta. With reference to Afan de Rivera's sketch (Afan de Rivera, 1845) the former north-west corner is located as somewhere between Masseria S. Christina and Masseria Denitis (north of the Regina canal, east of the modern Cerignola - Rivoli road). The northern shore should have been just south of the old track to Zapponeta. Zanonni's map (1808) indicates that a branch of the Carapelle entered Lago Salpi mid-way along this shore. It is true that a zone of marsh does accord with such a tributary (according to air photographs) but Afan de Rivera's sketch makes it clear that one of the main Carapellotto distributaries entered the lagoon at the north-western corner, much as at present. Although the lower section had just been canalized (c. 1816 ?), the sinuosity of the upper course betrays the essentially natural alignment of Canale Carapellotto. This would have been the section that was reported as having been straightened by 1848 (Afan de Rivers, 1848). Interestingly, the Dogana plan of the locatione of Salpi (1687) also makes it clear that a Carapelle stream entered the lagoon at this point (plate 12a). So, there may have been a small channel running into Lago Salpi from the north, as shown in Zanonni's map, but it certainly was not one of the two major distributaries of the Carapelle that exist today. One point of interest is the date at which the northern distributary developed or was

created; in the Dogana plan of locatione Tressanti (plate 12b) it is not only shown but described plainly as the 'new' Carapelle (Carapella nuova), yet it served as the boundary between Salpi and Manfredonian territory; these boundaries were later altered, perhaps to accommodate the new settlement of Zapponeta.

From this northerly point Lago Salpi extended to the Ofanto, forming an oblong body of water at least 18 square miles in area early in the 19th century. This outline appears to have been unusually consistent throughout history, for in the ancient maps a similar form is almost without exception portrayed. The eastern shore was formed by the narrow, sandy barrier beach and was rather featureless, interrupted only by the inlets (foce) that gave the lagoon communication with the open sea. The western shore, however, was very much more irregular in outline. There were headlands: Afan de Rivera's sketch (figure 14) indicates, for instance, Colle delle Vacche (possibly the area of the Bronze Age site of Carapellotto-Regina) and Rocchio (another prehistoric site, Alma Dannata). There were embayments too, such as that immediately to the north of Monte di Salpi (Salpi II). Further south, still on the western side, Zanonni showed a bar and an island which sheltered the exceptionally saline waters of shallows known locally as Castello and San Vito. It was to prevent this water from polluting the rest of the lagoon that Afan de Rivera suggested a dyke closing them off. On the other side of the lagoon, close to Salinis di Barletta (Margherita di Savoia) were the saltpans, about 200 hectares, long previously dyked off from the main body of Lago Salpi.

The 19th century history of Lago Salpi is the best documented of all the Tavoliere lagoons. This is a consequence of two, associated, factors. In the first place, it was openly acknowledged by the late 18th century that Lago Salpi was a major problem. It was not simply a question of a changed environment but one in which the changes were obviously and oppressively for the worse. For instance by 1764 all fishing had ceased, for it

was reported all the fish were dead. The lake had become so shallow, and consequently so saline, that not only fish but plants could no longer survive and the stench of decay was pernicious. Another problem was, of course, malaria; Afan de Rivera complained that the number of guardians was severely decimated by the disease; although it is true that this concerned Lago Salso and the Candelaro marshes there were also complaints about the 'infections' of Lago Salpi. There were other problems too. The increasing shallowness of the lake meant that winds whipped up larger waves than before and the orientation of Lago Salpi was such that its longest axis coincided with the commonest and stormiest wind so that these had the maximum fetch along the lake. Salinis had been successfully protected since 1635 from lagoon waves by a wall of limestone blocks that reached 5 palmi (150 centimetres) above sea level but after a particularly bad Ofanto flood (1813) the "panic-stricken" inhabitants insisted on a new wall (Afan de Rivera, 1838). In fact there was perennial danger from flooding but this came mainly from the rivers. Salinis was uncomfortably located between the tumultuous Ofanto, the lake and the sea. It was a convenient answer to many problems to attempt to direct flood water from the Ofanto, by means of a diversionary channel, into the south-western part of the lake, but of small comfort to the inhabitants of Salinis.

Another problem in the new conditions at Lago Salpi however was of no local concern. On the contrary, the greater salinity of the water meant ample opportunities for the local population to enjoy a highly profitable, and highly illegal, contraband in salt. All that any inhabitant had to do was to go out to the marshes fringing the lake, in high summer, and scrape the salt from the ground (plate 15). But the authorities were dismayed. Salt-production and trade had, after all, been a Royal or a State monopoly since Swabian and Angevine times. Yet the salt smugglers of Salpi included the inhabitants not only of Salinis itself and neighbouring Trinitapoli but, with some irony, people from colonies set up by King

Ferdinand himself (San Ferdinando) or under his inspiration (Zapponeta). It was estimated by Afan de Rivera that the government was deprived of 100,000 ducats each year through smuggling.

It was easy enough to identify the problems associated with the changed physical condition of Lago Salpi. The remedy, too, seemed simple enough at first. Fresh water inflow was to be encouraged so that fishing could be restored; by diverting river outlets, flood danger further upstream would be lessened and a third benefit would be gained; river load would be deposited in areas designated for reclamation. In the event, the achievement of these aims took more than forty years. The advantage of the long delays and many problems encountered was that we have Afan de Rivera's accounts of the trials, errors and the wrangles between the Director of the saltpans and the Director of the ministerial department of Ponte e Strade. (Afan de Rivera, 1832; 1838; 1845).

The story of the 'improvement' of Lago Salpi opened when the fishing problem became acute in the latter half of the 18th century. Then, most of the land around the southern end of Lago Salpi was wholly the landowner's responsibility (in piena proprieta) and not subject to the Dogana (Galanti, 1786). Thus the unfortunate but well-intentioned Principe di Bisignano found himself facing what was to emerge as one of the most daunting tasks in the Tavoliere coastlands. But, as Afan de Rivera observed sympathetically, to improve or to reclaim 18 square miles of water-body is beyond the resources of any individual. In 1814 the Government, spurred on by a determination to check the contraband in salt, agreed to purchase the lake.

At first the aim was to improve the lake for fishing. An inflow of fresh water would automatically bring about a reduction in the 'natural' production of salt that we benefiting far too many of the local inhabitants. The government proposed a 6-mile long canal (Carapellotto) to encourage the inflow and to raise the level of the lake so that there

would be a strong outgoing current (at low tide) from lake to sea, a condition favourable to fishing. Accordingly four outlets (foce) were also to be opened: Torre Pietra, Canneto, Focecchia and Torre Carminosa. Fishermen would once again use the chapel and the taverna at Torre Pietra, as they did before 1764.

To understand something of the importance of earlier fishing in Lago Salpi one can turn to recent times and to Lago Lesina on the Gargano side of Capitanata. That a fishing industry survives still at Lesina is despite a protracted and bitter struggle between local authorities and the fisherman's syndicate. Apparently, in 1923, a project was drawn up whereby fishing in Lago Lesina was to be subordinated to extensive reclamation for agriculture (Colaccico, 1955). This proposition met, not surprisingly, with stubborn resistance from the Lesina fishermen's condominium, a body that had been granted fishing rights in the lake and in 12,000 hectares of marsh by the new Italian government in 1868. In the end, thanks to Anglo-American intervention during the occupation, the fishermen maintained their rights and Lesina today has not only an intriguing and lively quayside scene but remains as a reminder of what Salpi once would have looked like from the lagoon (plate 37).

The government's attempts at dyking the Carapellotto proved disastrous. No provision had been made at the intake end for controlling flow into the canal. Siltation in the canal was rapid and it was not long (1816) before heavy floods burst over and through the new dykes, spreading coarse sands and gravels over (Crown) farmland at Tressanti and at Giardino. (Afan de Rivera, 1838). No more successful were the engineers in creating new outlets across the barrier dunes. Almost as soon as these were cut, so they were closed again by longshore drift. The situation, comments Colaccico, began to be ridiculous (Colaccico, 1955). New engineers were appointed (1816), the problems remained, and the inhabitants, still terrified of another flooding, consoled themselves no less than previously with salt

smuggling.

It was not until 1839 that Afan de Rivera, Director General of the Royal Corps of Roads and Bridges, was at last detailed to execute the scheme he had drawn up for Lago Salpi some years before. Afan de Rivera took a hard look at the basic fact: that the lake was becoming progressively shallower. He gave these figures for the depth of the lake (1838, p.40):

1765	7	palmi
1803	5	palmi
1808	3.16	palmi
1819	2.16	palmi.

The implication was plain. Against such a natural tendency, it would have been futile to attempt to save the lake and to reconstitute a fishing industry. The point had been taken earlier; in 1928 for instance, the government, faced with a pig-in-a-poke, announced its intention of reclaiming the entire lagoon. Afan de Rivera now prophesied that it would need only 61 years before the lake was completely dry but that long before that, indeed in 10 years' time, much of the coastland would be "teeming with good agriculture" and from Manfredonia to the Ofanto, there would be prosperity. (Afan de Rivera, 1838, p.134 and p.135).

Despite Afan de Rivera's undoubted successes, that was not quite what happened to Lago Salpi (or to Lago Salso). By 1845 the work had been completed, handed over to the local authority for maintenance, and there had been several procés-verbaux at which commissioners reported on his achievements. But Lago Salpi remained, at least in part. Afan de Rivera's own sketch plan summarises his achievements at the Salpi end of the lagoon and it is seen that these were threefold. Despite opposition from farmers in the Tressanti and Giardino area, fearful that another new canal would merely ruin yet more land as in 1816, the Carapellotto canal had been realigned and straightened over a six mile section. There is no mention anywhere that a second canal, Canale Regina, was constructed at this time, as

Colaccico suggests (Colaccico, 1955). This was built much later, probably in 1870 (Candida, 1955). But three entirely new dykes ran across the northern end of the lake, enclosing two vasce di colmate, the most northerly carrying the track to Zapponeta.

In other words, the first part of Afan de Rivera's achievements was to appropriate the northern section of Lago Salpi, the shallowest and most marshy, for reclamation. After a good deal of further dyking, ditching and canal cutting, mostly in this century, part of the former lagoon is not only cultivated but has even been built on. Two, now rather forlorn, Masseria Combattanti were built during the inter-war period. One is sited right on a relict levée.

Right at the southern end of Lago Salpi there were further changes. The Ofanto deviation canal had been cut and dyked, and Afan de Rivera had started the closing off of the whole of the southern extremity with another cross-dyke. Evidently this was to be a second zone of infilling (colmate) and eventual reclamation. But between the two reclamation areas, the central portion of Lago Salpi remained relatively untouched until this century. Under Afan de Rivera the foce were recut and inspected daily for encroaching marine sands. A column was erected at Torre Pietra against which tides were to be measured. Torre Pietra itself had been restored, as had been the chapel and the taverna. But there was no further talk of fishing in this third part. Although in 1842 it was noted with approval that the bottom of the Lago Salpi was not only deeper but once again green with healthy and luxuriant vegetation, it would seem that the engineers had accepted that there were odds against their manipulation of the physical factors to this extent.

In the event, the remainder of Lago Salpi was destined for a different fate. While persistent sedimentation gradually blocked the new canals (despite the investigating Commissioners' appreciation of Afan de Rivera's warning that in maintenance would lie the success of his measures at Salpi)

so that Canale Carapellotto was permanently dry by early this century, the central part of the ex-lagoon remained a water body but in the guise of saltpans.

By a series of encroachments almost all the remaining waterbody had been converted into saltpans by 1927. There had been developments early in the 19th century but only on a very small scale. Not until 1907-8 was an entirely new sector of the lake taken over. This provided a further 20 evaporating basins, supplied by a feeder canal 700 metres long. A hangar with a storage capacity of 70 thousand quintaux of salt was also built. (Candida, 1955). In 1910 a further 800 hectares of lake were taken over and by 1927 all the remaining part of Lago Salpi that was one metre below sea level was handed over to the saltpan administration for conversion; a tacit admission perhaps that the lake could never be entirely dried out, contrary to Afan de Rivera's prognostication.

It is difficult to match the history of drainage and reclamation in the Salpi area dyke by dyke with field evidence. Both the air photographs and the pattern of soil colour changes in the field reveal a highly confusing palimpsest of channels, cuts, former levées etc.. Even of Afan de Rivera's colmate dykes there is not more than a scarcely discernible trace. They were not, in the first place, very big features; assuming the Neapolitan palmi to have been equivalent to about 30 centimetres (War Office, 1882), each dyke was not much more than 1.20 metres wide and 1.50 metres high when it was first built, and much of the drainage channel network would have been undyked. One relict levée (on which Masseria Combatanti stands) has already been mentioned; another shows clearly as a soil colour change and in micro-relief. It runs a short distance towards Giardino from the Canale Carapellotto (plate 10). Not until the archives of the various authorities involved in dyking and draining in the coastlands have been located and inspected, can this sort of fieldwork be achieved.

North of Lago Salpi, in the 19th century, was a broad zone of low-

lying, river-crossed land that stretched to the southern end of Lago Salso. Two rivers flow across this 'mesopotamia' to reach the sea, the Carapelle and the Cervaro, but so complex has been their hydrological history that the zone is marked by a maze of former channels and relict alignments, some marshy, some merely depressions revealed best on the air photographs. The two rivers mouths are today north of Torre di Rivoli and both are called new. Their newness however must come from rather different periods, for the Carapelle has had two courses labelled as 'new' since the 17th century, if not earlier. On the Dogana plan of the locatione of Tressanti (1687) both the Carapelle and the Cervaro are shown as debouching into the Gulf of Manfredonia independently, one to either side of Torre di Rivoli (the Cervaro to the north, the 'new' Carapelle to the south). The air photographs confirm this course and from the topographical map (164 II NE) it is seen that it is followed by the commune boundary between Manfredonia and Cerignola. It seems that the shift north to the present course took place, or was induced, sometime after the early 19th century. It is not known when the Carapelle would have taken the alignment recorded on the Dogana plan as 'new' but the implication is that the oldest course was that already described, the one past Tressanti into the north-western corner of Lago Salpi. Thus the Carapelle has shifted north since the Middle Ages, leaving at each major move a relict course contributing to the marshiness of the inter-lake zone. Galanti, for instance, noted that the streams (sic) of the Carapelle inundated and swept over the whole of the area at the north end of Lago Salpi (Galanti, 1786).

But the story is not so simple. At the beginning of the 19th century the Cervaro emptied most of its waters into Lago Salso having made an abrupt turn north to do so. Another branch, likewise deflected north, took some water into Lago Versentino (Zanonni, 1808). From the south-eastern corner of Lago Salso a small stream led to what one would take to be a relict Cervaro that reached the sea north of Torre di Rivoli. This

is what Romanelli would have been referring to when he described the Cervaro as flowing into Lago Salpi and then out again (Romanelli, 1815). But several writers have made it clear that a united branch of the Cervaro and the Carapelle ran to the sea as the river Rivoli "between the marshes of Salpi and Candelaro" (Longano, 1790, p.36). Unfortunately no indication is given, either here or in the early Medieval source, as to whether this combined section went past Torre di Rivoli on the northern or on the southern side, and whether it should be identified with the 'new' Carapelle course shown in the Dogana plan or with a lower reach of the Cervaro.

From the 12th century comes Idrisi's account of the 'Wadi Rivoli', alias '<u>nahr quanalar</u>' (Amari and Schiaparelli, 1883). This is disturbing, for the Rivoli stream can be only either the Carapelle or Cervaro distributaries although the sound of '<u>quanalar</u>' is closer to 'Candelaro'. Another confusion is introduced by the only explicit reference to a river in the Tavoliere coastlands in the classical litterature: Pliny describes the <u>Cerbalus</u> as the boundary of Daunian territory (Natural History III xi 103). Which of the three rivers (Carapelle, Cervaro or Candelaro) would have been selected as a territorial boundary? In short, one cannot escape the suspicion that there have been at least two branches of the Carapelle throughout the historical period; one flowing directly into Lago Salpi and one reaching the sea somewhere south of Torre di Rivoli. The tradition to regard the Carapelle as the main coastland river, possibly navigable, and probably Pliny's <u>Cerbalus</u>, is a strong one. If this is the case, the 'newness' of the 17th century Carapelle of the Dogana plan reflected only a minor course shift or an improved course. The second conclusion arrived at is that this river-girt zone between the two lagoons is in effect nothing other than a delta, formed early in the Holocene or late in the Quaternary.

To the north of "mesopotamia" lay LAGO SALSO. The very name is significant: Salt Lake. At its southern end Lago Salso was flanked by the long low promontory on which stood the Masseria of Cupola and the localities of

Beccarini and Versentino. At its northern end things were more complex. The Candelaro meandered through the lakes and marshes of Lago Salso to reach the sea only very far to the north and almost at Siponto. There were islands in the marshes. These formed a string of elongated rises parallel to the Gargano from Coppa Nevigata to the breccia terrace that separated the Candelaro marshes from those of Siponto.

The reclamation of Lago Salso started officially under the French government in 1813 with the dyking of the Candelaro and Cervaro rivers in order to direct their load to promote the infilling of Salso. (Colaccico, 1955). But Giustiniani mentions that a palisade around Lago Salso was broken through in times of flood, suggesting that there had been previous attempts to contain the lake. (Giustiniani, 1797). He also names two canals, the Puzzolato and the Staino, but these could have been the work of private individuals who, as Colaccico puts it, attempted to 'nibble' at the fringes of the lagoon. As at Lago Salpi, the problem of reclamation was formidable. Lago Salso doubled in winter from a breadth of 5 miles to 10 miles. Nevertheless evidently there was confidence in the eventual success of the reclamation efforts. This is reflected in the 'Statistica' of 1810. After the areas of lake and marsh in the commune of Manfredonia are listed, there is a footnote to the effect that, with dewatering, the marshes could be used for orchards and even grain (Riccione, 1810, p.309). It seems however a little unwise to take the Statistica figures too uncritically. The Intendente of Capitanata was either anticipating the success of the bonifica schemes on the Tavoliere or wished to impress the alien government that the province's reputation for coastal marshes was exaggerated, for in the same publication Lago Salpi was deemed to no longer exist and the appropriate note reads "there was a marsh"!

In the end (i.e. in the 1930's) Lago Salso was divided into seven major vasce and an improved cut near Siponto assured the waters of the Candelaro and of the Cervaro an unimpeded outlet to the sea (plate 20).

Today, about 1500 hectares of marsh and lagoon remain, with two of the vasce officially in the process of infilling (colmate). But the marsh is greatly treasured by passionate wild-fowlers and hunters and it is only in these relicts that an appreciation of the former wetlands, once almost continuous from Manfredonia to the Ofanto, can be gained today (plate 28). It is a beautiful and wild landscape, disturbed only by grazing water buffaloe, by crying birds, and by vociferous frogs.

To the west of the Cupola-Versentino promontory lay LAGO VERSENTINO. This was small, 3 or 4 kilometres by almost 2 kilometres. It was supplied by water from the Faraniello streams and from Lago Contessa further up-stream. It was already partly reclaimed by the first World War but neglect of the drainage works led to its reversion to a lake once more. Only in the 1950's, with finance from the Cassa per il Mezzogiorno, was reclamation completed but today the new, regular, fields are under the plough.

For a 19th century outline of the SIPONTO lagoon very little information is to hand. From all accounts it was already a marsh (palude) rather than a lagoon. Zanonni's map shows isolated pools (stagna), interconnected by streams and channels. The pools would have been maintained by the several springs that emerge from the limestones. In the litterature it was referred to as 'an infamous marsh', presumably because of the infections. It is true that even today, although malaria has been eradicated by D.D.T., the mosquitoes are again very much alive and active. But in the 18th and 19th century the chief source of infection was recognised to be the Candelaro marshes of Lago Salso, just to the south (Longano, 1790).

It was also thought that the Siponto patano (marsh) was formed by siltation from the Candelaro. Our own sedimentary studies have shown that this was not the case, for the deposits that closed the lagoon from the sea are all of marine origine. In the process of reclamation, however, Candelaro silts were introduced into the Siponto patano to hasten infilling (colmate). During the 19th century very little was done at Siponto other than the

attempted reclamation of about 400 hectares between the sea and the Manfredonia-Cerignola road. Effective drainage started in 1900 when the Genie Civile excavated a network of drainage canals and installed a coal-fired pumping station (Colaccico, 1955). But the money for coal ran out and it was not until 1937 that the Consorzio Generale made an outright purchase of the Patano from the commune of Manfredonia in order to have a free hand. A new electric pump was installed, canals were deepened and the network intensified. Access roads were built. As the soil dried out so it was ploughed and huge bonfies made of the "colossal" reed stocks that came to the surface. Finally 30 podere were created for colonists; a house, and land of acreages varying from 3 to 12 hectares according to quality (plate 23). The larger podere would be those with land mainly on the dune sands rather than on the colmate alluvium. A service centre was established on the limestone slope to the north in a locality known as Scoppa, supplied with drinking water from the new Aquedotto Pugliese. By 1940 the families had moved in and modern Siponto was born, scarce a stone's throw from the walls of the ancient and once splendid city of Sipontum. In the last two decades, the agricultural borgo has become a beach-orientated tourist centre; numerous neat villas, set in flourishing gardens, now line tree-shaded roads.

Just how familiar would the 19th century landscape in the Tavoliere coastlands have been to the medieval or to the Roman inhabitants? If the 19th and 20th centuries have seen the demise of the Tavoliere lagoons, when was their decline noticeable? Considering only the recorded drainage history the impression is that only in the late 18th century was there need to take measures to improve the physical environment. What were the outlines of the medieval and Roman lagoons? There is no question of a 'new' lake or of the wholesale disappearance of an early one; in this respect the Tavoliere coast has been stable. But there have been significant changes in the relationship between lagoon and sea, and these are now examined (figure 15).

Very little is learnt of early Lago Siponto from documentary and cartographic sources. Partly this reflects its small size, which cannot have been more than one square kilometre even at its maximum extent. Partly, too, this may reflect a familiarity with the lagoon which obviated the need for detailed description. Thus Galanti dismisses the lake with a succinct comment that "the Sipontinian marsh is known to all" (Galanti, 1786, p.125). The extent of the lagoon at Siponto did not vary much, for it is strictly defined to landward by limestone and breccia outcrops. In this respect, Lago Siponto was unique among the Tavoliere lagoons for there was little scope for lateral encroachment of either lagoon water or marsh. The history of the lagoon has been largely deciphered from its sediments (see page 176) but the answer to one important question lies in the documentary record. This concerns the date of closure of the lagoon.

The only maps to show any of the lagoons unambiguously as open are those by Gastaldi (1564), Danti (1580-1), and the maps purporting to show Lago Andoria (1557, 1607). The latter group do not attempt to show Lago Siponto. That means only Gastaldi showed the Sipontum lagoon open; in Danti's map it is portrayed closed by a narrow strip of land. Gastaldi's map was published twenty years before Danti's but although it is fairly certain that Danti had access to some very up-to-date information it is not known how old the information that Gastaldi had was when he drew his map. Thus it would be unrealistic to insist that the Siponto lagoon was effectively closed precisely between 1561 and 1580-1. It does seem reasonable to suggest, however, from this evidence, that the date of closure for the Siponto lagoon lies in the middle or during the first half of the 16th century.

It is unfortunate that Alberti's reference is ambiguous. He visited the site of ancient Sipontum shortly before 1550 and was describing how the waters of the spring just below the walls of the city ran, in a clear stream, "towards the sea-coast" (<u>la marina</u>), (Alberti, 1550, p.221). The

sea-coast is today nearly a kilometre distant from that spring, and those cool, clear waters mingle now with the unromantically murky water of a drainage ditch. Just how much of the ancient lagoon remained between the spring, where Alberti stood, and that sea-coast? It is difficult to admit that this phrase acknowledges that even a relict of the ancient lagoon lay within the observer's view.

The part of the ancient lagoon that might have been used by bigger craft, the vessels that carried pilgrims and crusaders for instance, is of restricted extent. Once the bar and barrier beach had developed the northern end of the lagoon would have been too narrow and too shallow for any but the small boats of fishermen. But it can be inferred, from the Compasso di Navigare, that there was nothing unusual about the port of Sipontum in the mid-twelfth century. The approach was described as easy, the port acknowledged to be highly satisfactory (see page 46). Unfortunately we have no means of discovering by what criteria a port might have been so judged. The most obvious point of disembarkation would seem to have been just opposite the former opening into the lagoon (figure 46). Nothing is known, as yet, of this locality or of its buried features but it is a likely place for the former quays and landings. There access to the sea was direct; the lagoon water would have been at its deepest; yet the area would have been relatively sheltered. Field work in this zone might be most rewarding.

None of the classical authors made any attempt to describe the Sipontum coast. Lucan gives an attractive impression of ... "the Salapian pool ... and Sipus below the hills" (Lucan, Civil War V 380). This reads poetically but the implication that there was no lagoon at Sipontum might be correct, for our sedimentary studies suggest that no lagoon existed until relatively late in the classical period.

With Lago Salso the matter is as different as it could be. The basic question, as to the date of closure of the lagoon, still applies but there is no doubt that during, and for a time after, the classical period, Lago Salso was so open a lagoon as to be more accurately termed a gulf. The

closure of this gulf is by far the most significant single morphological change in the Tavoliere coastlands during the last millennium.

On the openness of Lago Salso in the 16th century there is agreement amongst the leading cartographers. Magini (1620) was the first to show the lagoon as wholly closed by the barrier beach. Danti (1580), who was supposed to have based the Vatican Gallery maps on surveys sent in from the provinces, showed an island in the otherwise wide opening. Gastaldi (1561) also had a small island drawn. It is less accurately placed with regards to the gulf of Lago Salso but this may have been a cartographic problem of overcrowding. The two Andoria maps are very schematic but undoubtedly intend to shown an open gulf with, less convincingly, spits encroaching into the opening from either north (Ziletti, 1557) or south (Rosaccio, 1620). The earliest maps also show the gulf very schematically but boldly; Berlingheri (1480) has added a small island approximately opposite the opening.

In short, there seems no doubt that on two matters the early cartographers were agreed. That Lago Salso had been an open gulf; and that this openness was being threatened by the development of barrier islands and (or) by the longshore growth of spits. By implication these changes were noticeable by the end of the 15th century. By the 17th century (if not already at the end of the 16th century) we may take it that the gulf had been effectively closed.

Recognition of the former Lago Salso as an open gulf, rather than a lagoon, is the key to the interpretation of the classical descriptions of the Tavoliere coastlands. Both Strabo (1st century B.C.) and the Peutinger Itinerary (c. 3rd century A.D.) account for one lake and one river as the notable features of the ancient coastlands. The Peutinger Itinerary might be expected to concentrate on features that would impede the traveller. Normal sized rivers for instance would not merit comment and so the specific mention of a <u>fluvius</u> south of Siponto (before Anxanum) implied that a major

Figure I5

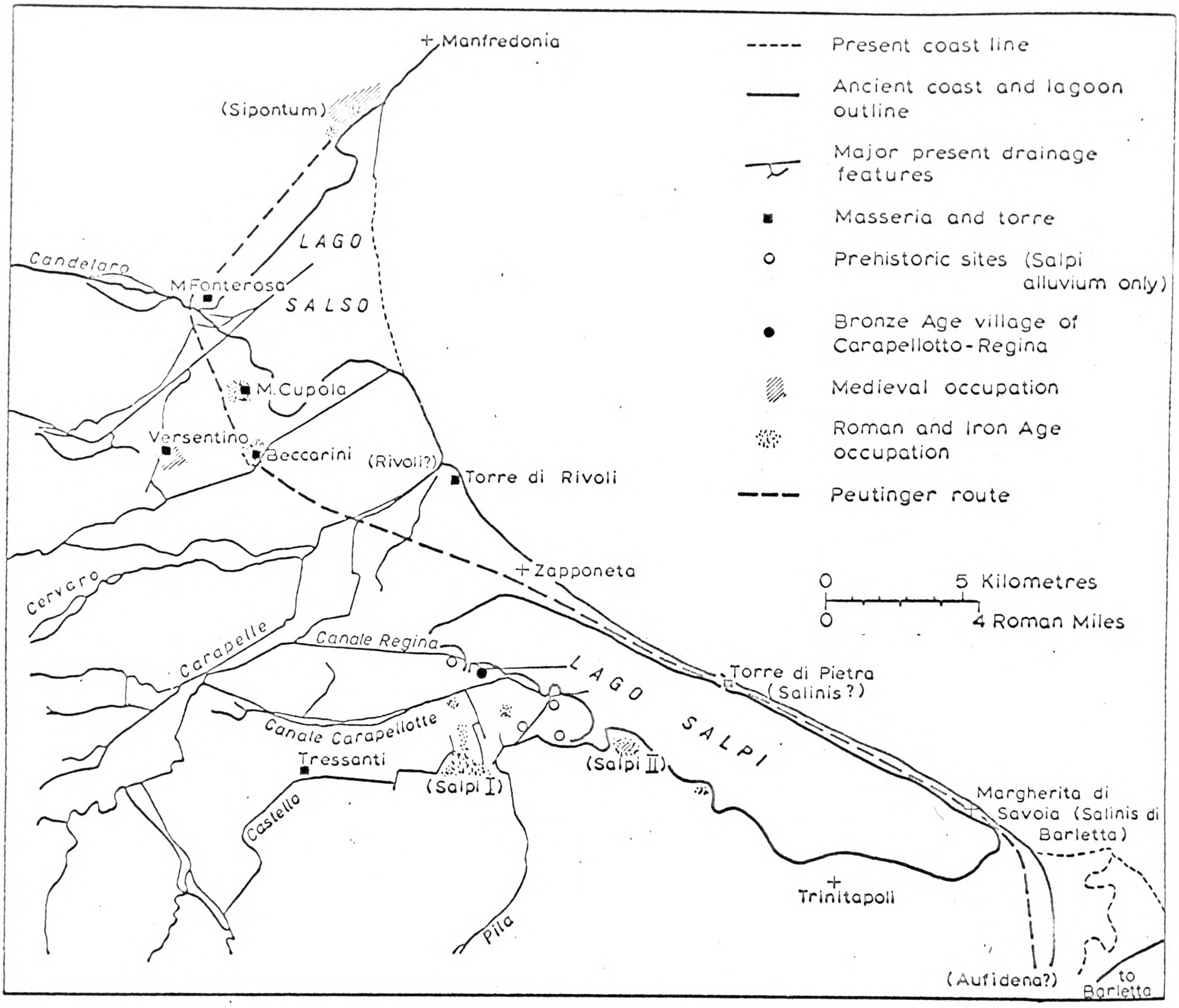


Figure 15. The ancient coastlands, showing the gulf of Lago Salpi, the lost villages, and the route described in the Roman Itinerarium.

river crossing had to be effected. This can have been none other than the Candelaro. It would never have been an easy crossing. Even in 1973 the bridge was unsafe and it was impossible to cross here except on foot; the detour (by Candelaro on the Foggia-Manfredonia road) adds 17 kilometres to the journey south from Siponto. However, there was a bridge here by early in the 17th century (Greuter, 1657) though earlier ferry crossings may have been more common. In the documents of the San Leonardo cartulary, mentions of the road to Versentino are frequent but no reference is made to the river crossing and one may assume that it was a traditional one, not worthy of special description.

But standing at this crossing point today, not far from Masseria Fontanaraosa and just below the Gargano scarp, it is easy to appreciate why Strabo based his description of the Lago Salso of his times (στομαλιμνη μεγαλη) on the Greek word στομα . For this designates the mouth of a river. Marin (in Biancofiore et al 1970) fails to see the pertinence of this element but indeed a Lago Salso open to the sea, with the Candelaro flowing in, could rightly be described as an estuary, or a large, open, river mouth. It was not, to judge again from Strabo's words, a deep-water gulf, for the element λιμνη could indicate a degree of stagnation or isolation. Today the Candelaro debouches into marshes but the landscape is almost as flat as it would have been during the last centuries B.C., when only water filled the view to the east. (plate 28)

The chief implication of Lago Salso as having been an open gulf is that the coast route, as defined today, did not then exist. It simply would not have been possible to reach Torre di Rivoli by travelling along the dunes until very recent centuries. The "coast road" south, in Roman and early medieval times, could only have been that which followed the foot of the Gargano. Only having crossed the Candelaro and passed close by what is now Masseria Cupola and then by Beccarini, would the traveller have been in the position of selecting an eastward turn to the dunes. For at this point,

the traveller would have found himself at the northern end of Lago Salpi, the lacus noted in the Peutinger Table. A decision was inevitable: to skirt the lake on its eastern flank, along the dunes, making for Salinis or to skirt the lagoon along its western flank, towards Salpi? The route the Peutinger Itinerary advocated, for reasons we may never know, was the former: to make for Salinis from Anxanum.

That Strabo mentioned only one lake is therefore no problem. However prominent a feature the gulf of Lago Salso, it was an integral part of the coastal outline, not, as Lago Salpi, a peculiarity of the coastal hinterland. It is Lago Salpi that is to be envisaged as the navigable lagoon mentioned by Strabo and by virtue of which Salpi functioned as a seaport in Daunian, Roman and Medieval times.

There is one anomoly in the Peutinger Table concerning Lago Salpi. Normally one would expect the natural features mentioned in the Itineraries to be strictly relevant to the potential traveller's progress. River crossings or lakes, that had to be traversed or avoided would have ranked high in priority of mention. Why, then, was the lacus between Anxanum and Salinis mentioned? If one recalls the supposed causeway across the lake between Torre Pietra and Salpi II, and is tempted to wonder if the Itinerary route intended to direct travellers across the lake by this means, then why is there no mention of Salpi, under whose walls the traveller would have had to pass? One has to conclude that while mention of the (Candelaro) river was by way of implying an obstacle to be dealt with, mention of the (Salpi) lake was merely directive. It was north of Salpi that the traveller had to make a decision and, assuming he was bound for Salinis, select the correct road, the coastal one.

Of the other lakes in the coastlands rather less need be said. The cartographers of the 16th and 17th century were in agreement that near both the biggest lakes, Salso and Salpi, were smaller lakes or ponds. VERSENTINO , for example, is usually depicted quite clearly, either wholly separate from

Lago Salso or as an inlet. Many maps are of too small a scale, or too crowded with other detail for these smaller lakes to be shown, so their omission does not necessarily constitute negative evidence for their existence. Thus too much should not be made of the fact that no lake of Versentino was shown in 1580/1 (Danti's map) while Matteo Greuter (1657) shows it very distinctly. It is difficult therefore to reach conclusions from the cartographic evidence as to the date of origin of these lakes.

However, from the 16th century comes written evidence of changes in the fief of Versentino, by this time under Dogana administration. Giustiniani compares two sets of figures contained in Dogana records for the fief, one set from a survey of 1565 and the other from an early survey. The figures quoted are:

early survey: Total 130 carra and 15½ versura of farmland in the locatione of Versentino

1565 : Total 135 carra 12½ versura of which:

19 car. 5 vers. are lake

5 car. 6 vers. are reed-bed.

Thus, he concluded, "the lake had grown in the interval" (Giustiniani, 1797, p.175). This could be taken to imply that the lake had grown in extent or was encroaching on farmland at its margins. More likely it seems that a lake had appeared where none existed previously. However, until a sedimentary check is carried out the full answer cannot be known. It is plausible that changes did affect the coastlands in the late 15th and during the 16th century in a manner that resulted in the ponding back of stream water instead of its free discharge seawards. In such a way flooding by the otherwise small Faraniello streams might become permanent, giving rise to perennial submergence and the development of marsh and the reed-beds (paglieto).

Associated with Lago Salpi, likewise, was a small pond. This appears on the early maps, always at the north-western corner of the lake (Magini,

1554; Cagno, 1582; Greuter, 1657; Blaeu c.1640), and its identification with a certain area of recent marsh is clear enough. This marshy zone, which totalled about 300 hectares earlier this century, is known today as the Marana (marsh) di Lupara and is the marsh that partly surrounds the site of Daunian Salpi. The ancient city overlooked a small lagoon linked to the main body of Lago Salpi by one or more inlets or channels. Confirmation of the cartographic evidence has been recovered from the sediments that have infilled the former pond (figure 36). A stream, the Castello, flows into the Marana di Lupara and is shown on several of the ancient maps. While the Marana di Lupara is never named, many maps show a Fontana di Pesce either in this area or further upstream (Greuter, 1657; Blaeu, 1640; Zanonni, 1808). This name has distinct economic implications and evidence of, for instance, fish farming might be expected. Close to the Marana di Lupara, under the eastern side of the Daunian ramparts is a curious feature: a long rectangular basin of unnaturally regular sides. (figure 44). Formerly this basin would have been fed by the Pila, before canalisation. The association of this basin with fish farming cannot be overlooked and awaits further investigation, both documentary and sedimentary.

Happily the former lagoons of the Tavoliere coastlands have not been completely effaced from the landscape by the last two or so centuries of attempted drainage. The network of drainage ditches and dykes is a testimoney to the former extent of the lagoons. But both Lago Salso and Lago Salpi to some extent continue to defy engineers and planners. The Candelaro marshes are still a haven for wildfowl and wildfowlers; the special wildfowl reserves betray, however, the fact that the Tavoliere lagoons cannot be fully eradicated by drainage. Why not, when so much has been achieved in a relatively short period? The persistence of a wetland environment indicates that there are factors involved in the formation of the Tavoliere coastlands that are beyond the human control; sea level, for example.

In the next section, a look is taken at the very substance of the

coastlands, the sediments. It will be demonstrated how the ancient lagoons have become obliterated by infilling and how the early landscape was one of much more varied relief than might be guessted at from the modern flatness. The significance of the buried relief pattern for early settlement is considerable, for economic assessments of the past environment must be based on the ancient landscape itself.



Plate 14. Saltpans at Salpi. Torre Pietra is on the skyline; the stoney foreground is part of the Medieval ramparts; the break of slope in front of these marks the edge of the Roman occupation area.



Plate 15. Saltmarsh at Salpi.



Plate 16. The port at Margherita di Savoia occupies one of the outlets (foce) from the saltpans



Plate 17 Foce Aloisa today, showing siltation on the seaward side.



Plate I8. Lago Lesina.



Plate I9. Reclamation of Salpi marshes.

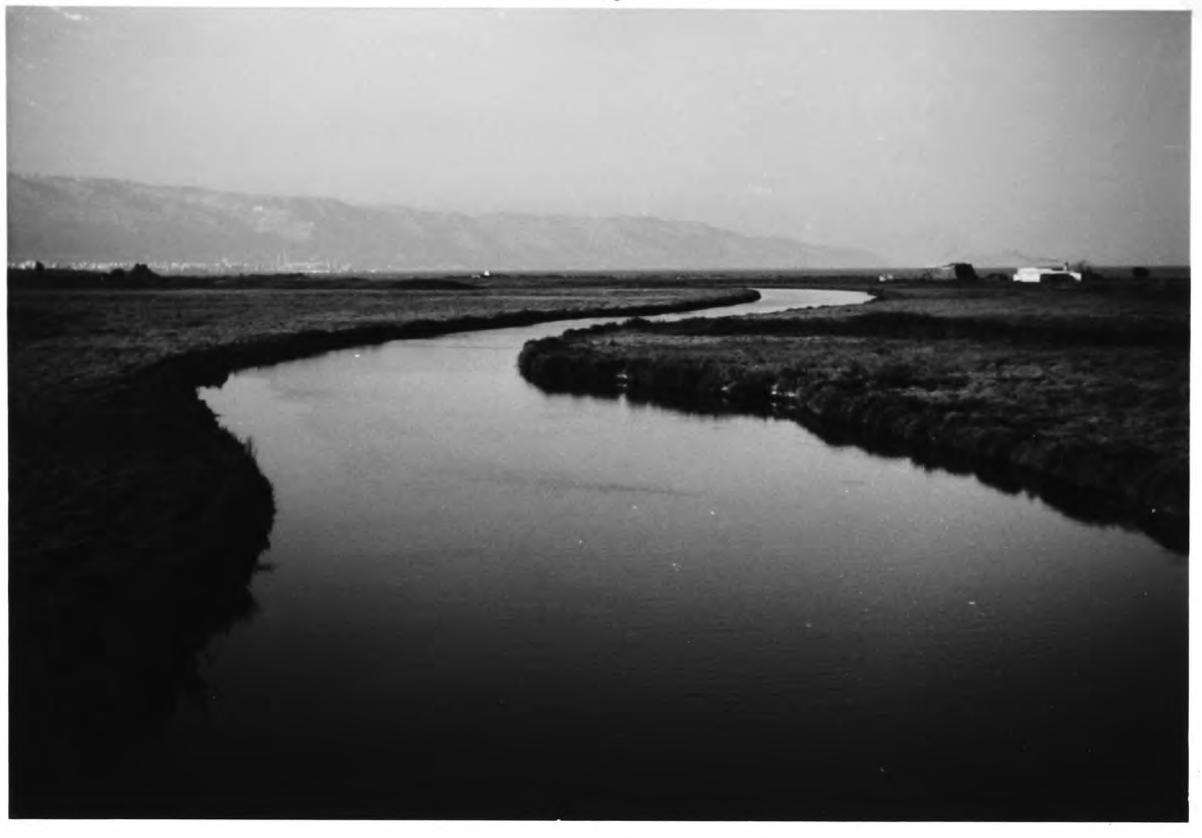


Plate 20. The Candelaro near its mouth today. Manfredonia shows up clearly at the foot of the Gargano.



Plate 2I. Land use in the Candelaro marshes.

II

CHANGES IN THE COASTLANDS

B. Buried relief: towards a reconstruction of the prehistoric coastland.

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Figure I6

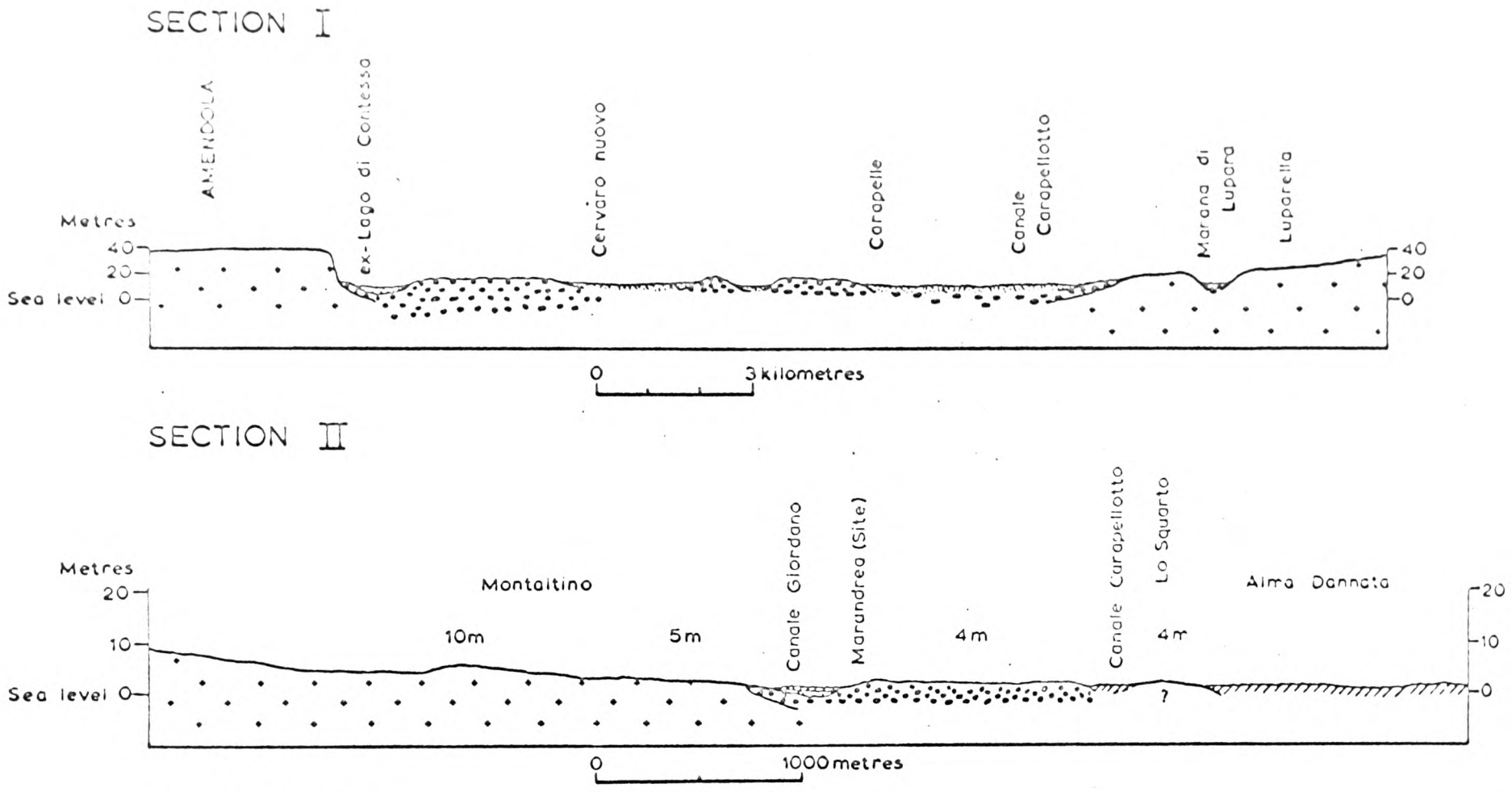


Figure 16. The coastlands today: in profile, showing geology.

§ 1 The Tavoliere coastlands today

It is aphoristic to remark on the flatness of the Tavoliere, for the word 'Tavoliere' - meaning a tableland - is itself sufficient. Nor is it geomorphologically accurate; the interdigitation of terrace interfluve and valley bottomland, and the three-fold elements of relief that summarise the morphology of the Tavoliere have already been described. Nevertheless, about seven percent of the total area of the Tavoliere of Foggia lies at below 5 metres above sea level and it is in these lowlying coastlands that (if the word is permitted in a geographer's vocabulary) flatness is the keynote.

The flatness is partly an impression gained from the bareness of the landscape, and partly real, as reflected in the geological profiles (figure 16). The bareness is real too. There are no hedgerows, no obvious boundary fences, no villages, few houses and fewer trees. There are not even many telegraph poles in evidence, furniture without which few otherwise scenic views in many parts of Italy would be complete! Roads and tracks are disarmingly straight, and dykes and canals look as though they had been laid out with a ruler; as indeed they have been, straight from the engineers' blueprint for the drainage of the former lagoons. From the cross-sections it is seen that there really is remarkably little relief in the coastlands. From Siponto to the Ofanto, a distance of over fifty kilometres, there is no point higher than 3 metres even, in some places, up to eight kilometres inland. Even where there are interfluves of Early Holocene or Pleistocene terrain forming low ridges or knolls, altitudinal variation rarely exceeds 10 metres above sea level. These upstanding knolls, or 'ischia', are significant as settlement sites. They have received, however, exaggerated respect: Mont-altino is only 8 metres higher than the neighbouring marshes (and only 11 metres above sea level) while Monte di Salpi (site of the Romano-Medieval city) only just reaches 12 metres above sea level (plate 38).

After two centuries of concerted drainage attempts, and post-war technical and administrative improvements, the Tavoliere coastlands today begin to present signs of economic achievement if not actual prosperity. There is a new network of roads. Many that were dirt tracks early in the 1960's are now tarmacadamed and smart white lines on some of them betoken a new concern with motor traffic. There are two or three times as many farmsteads and farm buildings than there were sixty years ago. There are caterpillar-tracked machines and ploughs with vicious, gleaming, steel shares turning over the soil from a metre deep. Along the sandy shore there is an ever-increasing horror of flag-bedecked lidos. There is, in short, not only dry land today in the Tavoliere coastlands, but it is productive land.

Yet, less than two centuries ago, probably hardly less than half of this area was wetland, lagoon or marsh. The early 19th century government survey contains the following figures for the part of the coastal area that falls into the commune of Manfredonia (Riccione, 1942):

lakes	4240	tomolo
ponds	80	"
marshes	1040	"
	5260	" (or approximately 1614 hectares)

In fact, there is still a good deal of water and marsh. Two extensive wildfowl reserves have been created in the last few years, as much to make good of the fact that total drainage is evidently impossible, or impractical, as to preserve the Tavoliere's long-cherished reputation as a wildfowler's paradise. Lago Salso gleams brightly under the summer sun and the saltpans of Salpi are of course none other than the central and southern parts of Lago Salpi: the latest, and biggest, extensions to the Saline were made in 1927. More generally though, a maze of ditches and dyked canals, some of them completely infilled and dry (Canale Carapellotto and Canale Regina in the Salpi have been blocked at least since the 1930's), old levées and former stream courses, all tell the same story; of intensive, but relatively

recent, efforts at reclamation and at flood control in the coastlands.

The Tavoliere coastal landscape, then, is a new one. Not only with regard to farming activities and settlement pattern, but also in terms of the superficial sediments themselves. Appropriately, the geologists distinguish most of the coastland sediments as colmate alluvium, that is, fine deposits resulting from artificially induced infilling, whereby the discharge of the Tavoliere streams is directed into dyked basins (vasce) and held there until all the material carried by the water, or held in suspension, ultimately settles. Hence, these colmate alluviums tend to have a higher silt/clay fraction than do the 'natural' floodplain loams.

However flat the landscape may appear today, it was not always so. As we have already seen from a perusal of the literature, documents and ancient maps, there is ample corroboration that this was formerly an area of lagoons, relatively little marsh, and greater variation in relief. To discover something of this buried relief pattern, however, one has to look below the present surface and under the mask of the colmate alluvia. There is no other way. These chapters describe the steps of such an approach. But first the geomorphological elements of the coastland scene are introduced.

It is not difficult to identify the framework of the recent sedimentary history of the Tavoliere coastlands. This is an area of mixed continental and marine environments. Both land and sea have contributed to the sediments. Of the four classes of such mixed sedimentary environments (littoral, delta, estuarine and marginal lagoon) we have to deal with the last-named, what in the recent literature is termed a lagoonal coast or, especially, a barrier island coast. (Twenhofel, 1926; Termier and Termier, 1963; Valentin, 1952; King, 1972; Zenkovich, 1967; Schwartz, 1973). This is a form of coast that is thought to develop best in unconsolidated rocks (Zenkovich, 1967).

Figure I7

Figure I8

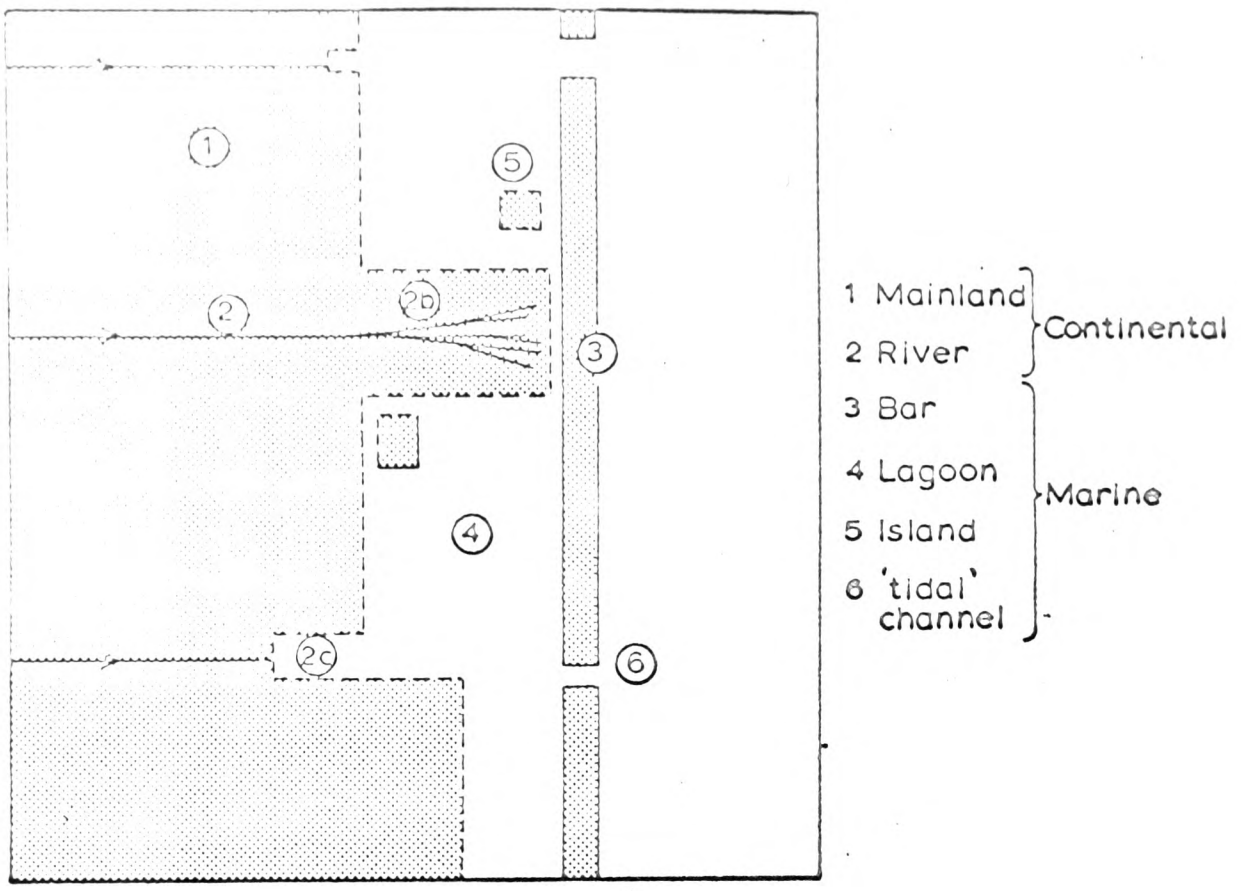
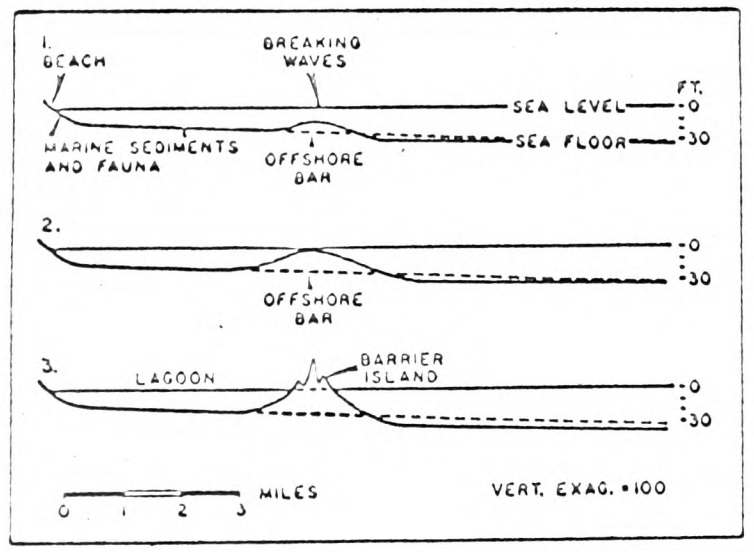
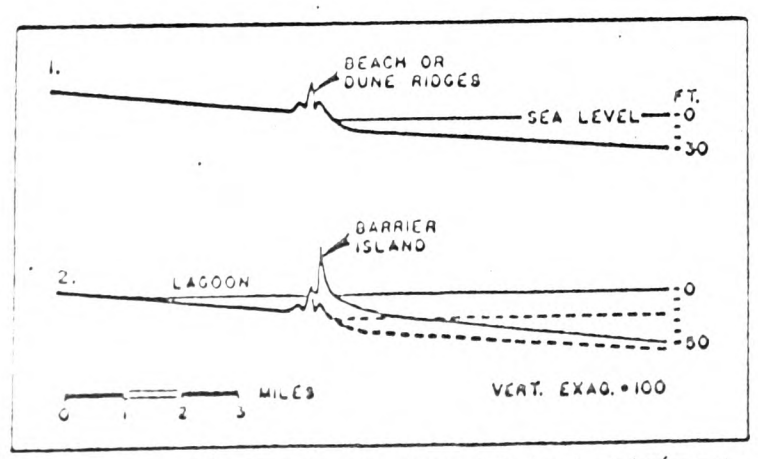


Figure 17. Elements of a lagoon coast.



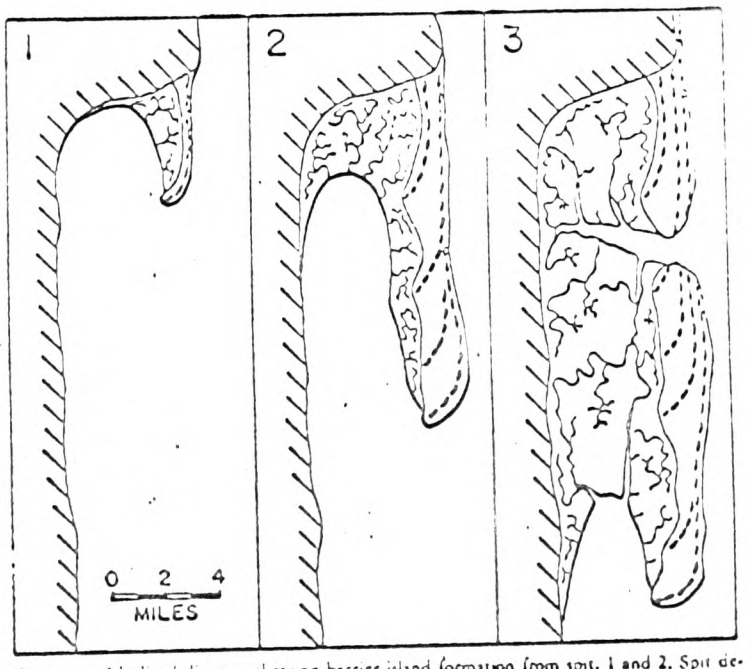
a

Figure 3. Idealized cross sections showing barrier island formation from an offshore bar. 1. Waves agitate sea floor and deposit sediment to form bar in area of energy loss. 2. Sediment accumulates to near sea level. 3. Bar is converted to island with lagoon on landward side.



b

Figure 5. Formation of barrier islands by submergence. 1. Beach or dune ridge forms adjacent to shoreline. 2. Submergence floods area landward of ridge to form barrier island and lagoon.



c

Figure 4. Idealized diagram showing barrier island formation from spit. 1 and 2. Spit develops in direction of longshore sediment transport. 3. Spit breached to form barrier island

Figure 18. Formation of a lagoon coast (from Hoyt 1967)

If this is the case, the broad, open, lowlying Tavoliere plain offered excellent conditions of development. It is also a form that may be temporary if there are, for example, changes in sea level. Thus the concept of a 'lagoon cycle' takes account of the development of a lagoon and its eventual reclamation by terrestial silts and sands from the barrier itself. It is precisely such a cycle that would seem to be involved in the physical changes in the Tavoliere coastlands.

The major elements of a barrier coast, summarised in schematic form in figure 17, are introduced briefly. The mainland (1) is typically, of low relief, low altitude and of largely unconsolidated strata. It would have reached the sea without cliffs and with a relatively irregular outline, with inlets where streams debouch and promontories marking the interfluves. These streams (2) are also part of the continental factor. Their discharge patterns and the character of their sediments may reflect climatic and erosion conditions far inland, such as snowfall or over-cultivation on the hills. The outlets however may be different. In the model, one stream is depicted as having built up a delta (2b) that has all but divided the lagoon into two separate water-bodies. Another stream reaches the coast at the head of an inlet or small estuary (2c).

But the key element is the barrier beach itself (3). This is usually defined as a series of discrete islands "in essence elongate sand bodies parallel to the depositional strike that lie in the zone that separates marine from non-marine deposits" (Pettijohn et al 1972, p.482). The barrier beach is comprised of dune and water-transported sands. Its seaward face is more or less steeply inclined according to such beach-building factors as tidal range, wave-power, exposure, submarine relief and, importantly, sand size. Barrier beaches tend to migrate landwards and the landward face may have a flatter and less stable profile. On the landward side it is directly affected by waves only during storm-surges, when seawater may wash material over the barrier islands. Normally wave and tidal action is

felt on the landward side of the barrier only as currents passing through inlets or breaks in the barrier. These inlets (6) are a vital element in the lagoon coast, for so long as they remain open, and marine contact is maintained, so the lagoonal coast retains its transitional character. Once they are closed, however, terrestrial agencies predominate and an uninterrupted process of infilling results in the reclamation of the entire coastal zone. The inlets may be numerous and narrow, or they may be so wide that the lagoon is better described as 'open'. According to these characteristics and to tidal ranges so marine currents, bringing fresh seawater and marine deposits, pass through the inlets to more or less distant parts of the lagoon.

Between the barrier beach and the mainland is the lagoon itself (4). This is normally a broad, elongated, generally shallow body of water. The water is brackish, more or less saline according to the balance between stream discharge, freshwater from other sources such as springs, and inflow of seawater. Salinity may vary seasonally and according to proximity of freshwater source, tidal channel or to the efficiency of internal circulation of water. Given an exposed position and unfavourable conditions the surface of a shallow lagoon can be quite rough.

Around Mediterranean coasts true saltmarsh formations are rare, for the tidal range is usually insufficient, but in tidal areas this would be an important feature of the lagoonal environment (Allen, 1970). There are however saltmarshes in the Tavoliere coastlands, in the vicinity of Salpi for instance (plate 15), where the predominant vegetation is salicornia and where, in summer, salt effloresces onto the bare surface of the mud. It has been suggested that in Mediterranean areas these should be more correctly termed floodplain swamps (Kraft, 1972). The marsh is prone to regular or frequent flooding, chiefly from surface water, discharge from the drainage channels or storm rain. Only under occasional storm surge conditions or when onshore winds are particularly strong might it happen that seawater

spills through the silted inlets into the former lagoons behind (e.g. at Foce Aloisa, plate 17).

No geomorphological study of the Tavoliere coast and its origins has been made that the writer is aware of. The origins of barrier islands in general, is the subject of an extensive literature but the main arguments are summarised in a recent collection of papers (Schwartz, 1973). There are three views concerning the origins of barrier islands: that barrier islands develop from a submarine offshore bar; or from the breaching of a spit; or from submergence of a coastal ridge (Hoyt, 1967). Each view has had its protagonists but there are some who point out that none of the views can claim to account for all the observed barrier islands (Schwartz, 1971). It is not intended to embark here on a detailed discussion of the Tavoliere barrier island, which is beyond the scope of this study, but it may be of interest to draw attention to evidence that may support the multiple causality accepted by Schwartz.

The main objection to the view that barrier islands have resulted from the building up of submarine bars seems to be that the neritic, or open sea, deposits that would be expected on both sides of the barrier are usually absent from the inner side (Hoyt, 1967) (figure 15). In the case of the Tavoliere there is insufficient data from which to comment authoritatively on the nature of the sediments in the inner side of the barrier. The first problem here is that the Tavoliere mainland is itself composed of marine deposits, of Pleistocene and Plicocene date. The distinction between recent marine deposits associated with Holocene coastal formation and more ancient, possibly reworked, deposits may not be easy to make. No attempt was made in the present study to resolve this question. Published wellbore data (Tramonte, 1955) reveals only that the commonest material to, say, 20 or 30 metres depth, is either sandy gravel or gravelly sand. There are a few mentions of 'conglomerate' but more frequently dark clay is indicated. Marine sands are so identified only in one locality but as this was

in the village of Zapponeta, very close to the sea and on the barrier island itself, it is insignificant. One mention is made of a peaty deposit, close to the surface at Beccarini. But further than these observations it is not possible to go at present. The stratigraphy is incomplete and it is impossible to discern from the well-bore data where Holocene deposits pass into Pleistocene (figure 33).

On the face of the evidence, then, it seems unlikely that open sea sediments are to be found in the inner side of the barrier. There are other problems peculiar to the Manfredonia Bay that may have bearing on this view of barrier origins. These are discussed more fully in the next section and concern the amount of material available for bar building from the sea bed, which might be less here than expected elsewhere. Finally, from the ancient maps and documents it was remarked that while some parts of the barrier island have appeared only relatively recently (closing Lago Salso sometime in the 16th-17th centuries A.D.), other parts, such as between Zapponeta and Margherita di Savoia, are much older, (bearing a Roman settlement site, for example) and may date from the earlier half of the Holocene.

Both other views, however, may have some place in accounting for the Tavoliere barrier islands. The second suggestion, supported by Sheppard (1963) is that some barrier islands result from the "accretion of sediments transported along the shore by littoral and longshore currents" (Hoyt, 1967, p.252). From our own investigations at Siponto it is difficult to doubt the relevance of spit formation in the creation of lagoons by barrier islands. Compare figure 31a with Hoyt's idealised diagram (figure 18c). Hoyt's paper, with this diagram, was first encountered some time after the interpretation of the Siponto sediments had been written up and the diagrams constructed.

The third suggestion, apparently made independently by both Zenkovi and Hoyt (Zenkovich, 1962; Hoyt, 1967, p.250) concerns the submergence, by

rising sea level, of a lowlying alluvial plain. Former coastal ridges such as dune alignments, remain above water level and separate the lagoons from the open sea (figure 18b). It is also suggested that the width and depth of the lagoons is a function of continental slope and amount of sea level rise (Hoyt, ibed). While there is no direct evidence from the Tavoliere coast to support this theory, two preconditions are fulfilled. That the coastal hinterland is of a suitably gentle and uniform slope, and that there is local evidence for rising sea levels during the latter part of the Holocene.

In summary, the Tavoliere coast, however it may have originated, has all the features of a classical barrier island coast. From a sedimentary point of view this means not only a considerable variety of sediments should be expected but also highly complex patterns and structures. The former reflects the variety of sedimentary environments found in transitional coasts, the latter reflects the instability (or dynamism) that is typical of barrier coasts, and that has been stressed in recent literature (e.g. Hoyt and Henry, 1967). While our own investigations have been on too small a scale to reveal structural aspects of the sediments, a variety of deposits and depositional environments has indeed been encountered. Summarising the highly simplified situation portrayed in figure 17 thus:

2	continental elements (mainland, rivers)
2	" sub-elements (delta, estuary)
3	marine elements (barrier, lagoon, inlet)
3	" sub-elements (subtidal, intertidal)
10	

it is noted that any samples drawn from the soil auger may have come from any one of ten different sedimentary contexts.

Before turning to the details of the sedimentary analyses and the characteristics of the Tavoliere coastland deposits, however, it may be useful to consider some of the salient factors affecting the Tavoliere coastal-building processes. Accordingly, in the following chapter, the

Bay of Manfredonia is described and related factors of coastal sedimentation briefly discussed.

Figure I9

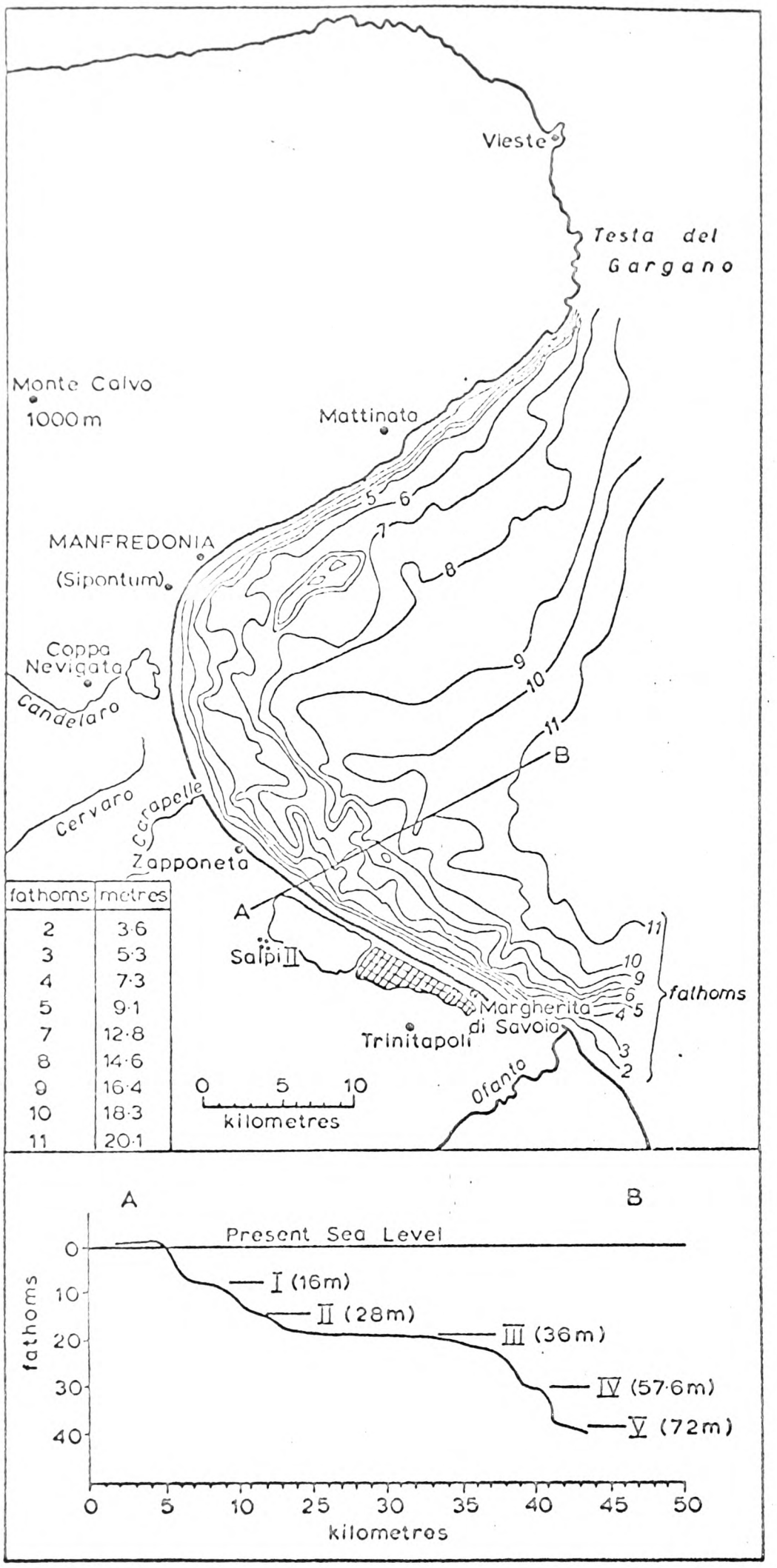


Figure 19. The Bay of Manfredonia, showing off-shore relief.

§ 2 The Bay of Manfredonia and factors of coastal sedimentation

The Bay of Manfredonia is the only gulf on the Adriatic side of the Italian peninsula (figure 19). It is a large one, measuring nearly 55 kilometres from the Testa del Gargano headland to the mouth of the Ofanto and nearly 30 kilometres out from the shore. Two types of coast make up its northern and western sides. They contrast highly in physical appearance but are strangely alike in one respect: both are inhospitable coasts and even today relatively unpeopled.

Across the north of the bay, as across the northern part of the Tavoliere, the Gargano massif is boldly upstanding. It pushes far out into the Adriatic and is the first highland sighted by seafarers coming north from the Straits of Otranto and from the Ionian Sea. Monte Calvo, at 1,000 metres the highest point on the Gargano, is less than 20 kilometres inland from the port and town of Manfredonia. From Manfredonia to the headland is a straight-line distance of only 17 kilometres but, apart from the village of Mattinata (5,271 population, 1961) which is set well back from the shore at the head of a small alluvial plain surrounded by mountains on three sides, there are no settlements and very few inhabitants. The road to Vieste follows a sinuous route far inland and high in the mountains, for the cliffs here are steep. Monte Saraceno is over 200 metres and Monte Barone nearly 300 metres, above the sea. Only from Mattinata can the high plateaux of the interior be reached relatively easily from the eastern coasts, and most of the other tiny bay-head beaches are best approached from the sea.

There may be few settlements, but there is no shortage of landmarks along the Gargano headland. Mattinata itself, the Mediterranean Pilot notes, "shows up well" amongst the cultivated land and there are no less than eight torre (excluding lighthouses) before the Testa is rounded.

The massive Secondary limestone strata that make up much of the structure of the Gargano headland are noted for the horizontality of their

bedding, accentuated by narrow bands of dark flint facies that were so important in prehistoric times on the Tavoliere. Karstic as well as marine factors no doubt account for the formation of many caves of this coast, now extolled by tourist-conscious local authorities, and for the stacks and islets that add to its scenic attraction. Submerged 'reefs' or limestone blocks have been more hazardous to sea-goers; the Pilot recommends (p.536) that when the Bora blows, the "Testa del Gargano should be rounded at a prudent distance"!

While the rocky Gargano coast of the Manfredonia Bay bears all the hallmarks of erosion, the rest of the Bay is composed of an aggrading or accumulative type of coast. From Manfredonia south to the Ofanto, a low sandy shore arcs in a smooth curve, apparently without break or interruption, for a distance of 50 kilometres. Behind this shore the undulations of the Tavoliere are scarcely noticeable and the Apennine periphery of the plain is too far inland to be conspicuous except on the clearest of days. Thus it is always the Gargano coast that dominates the northern skyline of both bay and plain.

The sandy shore of the Tavoliere is remarkably featureless. There are two settlements, apart from Manfredonia; S. Margherita di Savoia in the south and Zapponeta in the middle. Both are in unlikely and uncomfortable-looking positions, astride the dunes, with the sea in front and (formerly) the lagoons behind. Zapponeta was created in the 1770's as a reform settlement and still has fewer than 2,000 inhabitants (population 1559 in 1961). S. Margherita di Savoia, in contrast, has become a busy, bustling industrial and tourist centre based on the salt industry and on spa attractions; its population has grown phenomenally during this century (from just over 6,000 in 1901 to 13,233 in 1961). The low white houses of the two settlements offer landmarks to sailors out in the Bay. In addition there are the torre, towers set at the mouth of the main channels across the barrier beach, always on the southern bank. Torre dell' Ofanto

is white and square; Torre Pietra marks one of the outlets (foce) from the saltpans; Torre di Rivoli is perhaps the most beautiful, marking the mouth of the Carapelle river; but Torre Carlone, opposite a former outlet from Lago Salso, is scarcely noticeable (plates 12 and 13). Formerly the sole landmarks along this lowlying shore, today they are dwarfed by tourist developments, lidos, tall blocks of buildings, and clumps of eucalyptus pine.

The Tavoliere coast has been as inhospitable in its own way as the precipitous cliffs of the Gargano. The problems are essentially similar; the difficulty of making a landing in any but fair weather, and the difficulty of reaching any settlement, once landed. The narrow sandy shore offers little in the way of beaching facilities or anchorage. The river mouths are too small; now they are silted though they were once navigable. Roads between the lagoons and across the marshy hinterland were few. They were brutish tracks, uncomfortably hot in summer, blasted by winds in all seasons, liable to flood, and the distances great. Before Zapponeta was built, for instance, the first dwellings reached from Torre di Rivoli would have been at Beccarini, seven kilometres inland in a straight-line distance, apart from one or two farms.

There are dunes all along the Tavoliere coast but nowhere are they higher than 3 metres. Some seem to be stable, where vegetation all but masks the light coloured sand, but others seem to be in the process of erosion. In front of them is a narrow beach, perhaps 100 metres wide with a single berm or shelf marking the normal highwater level. Beach sands are dark, almost black south by the Ofanto, but become paler further north; they are greyish around Zapponeta and paler still by Siponto. Below the water's edge the gradient may fall unexpectedly steeply in the trough between the bar and the beach. The bar should be present along most of the coast but was recorded with an echo-sounder only off Torre di Rivoli. It has the normal asymmetrical profile of a bar, with steeper face towards the shore.

Further out, the SUBMARINE SLOPE of the Manfredonia Bay appears to descend in a series of platforms (figure 19). These are of varying width and height and are doubtless to be related to the various sea-stands of post-glacial eustatic rise. The first platform reached from the shore lies at about minus 16 metres. Close to the outer edge, its profile rises in a 2 metre ridge and suggests a former bar accumulation. The second level is reached at minus 28 metres; the third, at minus 36 metres, is at least 10 kilometres broad. Between this and the mouth of the Gulf, two other shelfs can be traced, one at minus 58 metres and, finally, one at minus 72 metres. These are very approximate levels, derived from a few profiles drawn up from soundings published by British and Italian nautical authorities. If anything, the gradient of the submarine continuation of the Tavoliere in the Bay of Manfredonia is rather less even than that of the plain itself: a depth of 100 metres is reached only 60 kilometres out into the Adriatic.

Off the Gargano coast, hardly surprisingly, the submarine profile is very much steeper. At Testa del Gargano the eleven fathom contour (20.1 metres) lies only 5 kilometres out while further south this same contour serves as a convenient indication of the mouth of the Bay.

If submarine gradients are muted off the Tavoliere coast, the same cannot be said of submarine relief. The most striking feature was a number of well-marked gullies or channels perpendicular to the coast. Each has a slightly different orientation but is three or four kilometres long, starting not nearer than two kilometres to the shore. Three can be easily followed by the 5-metre contour, for instance. One is on a level with Coppa Nevigata, far inland; the second with Torre di Rivoli and the third can be lined up with Romano-Medieval Salpi (Salpi II). Other contours reinforce the presence of these three off-shore channels and draw attention to a fourth, further south, beyond Trinitapoli.

In default of an authoritative study these channels are interpreted

Figure 20

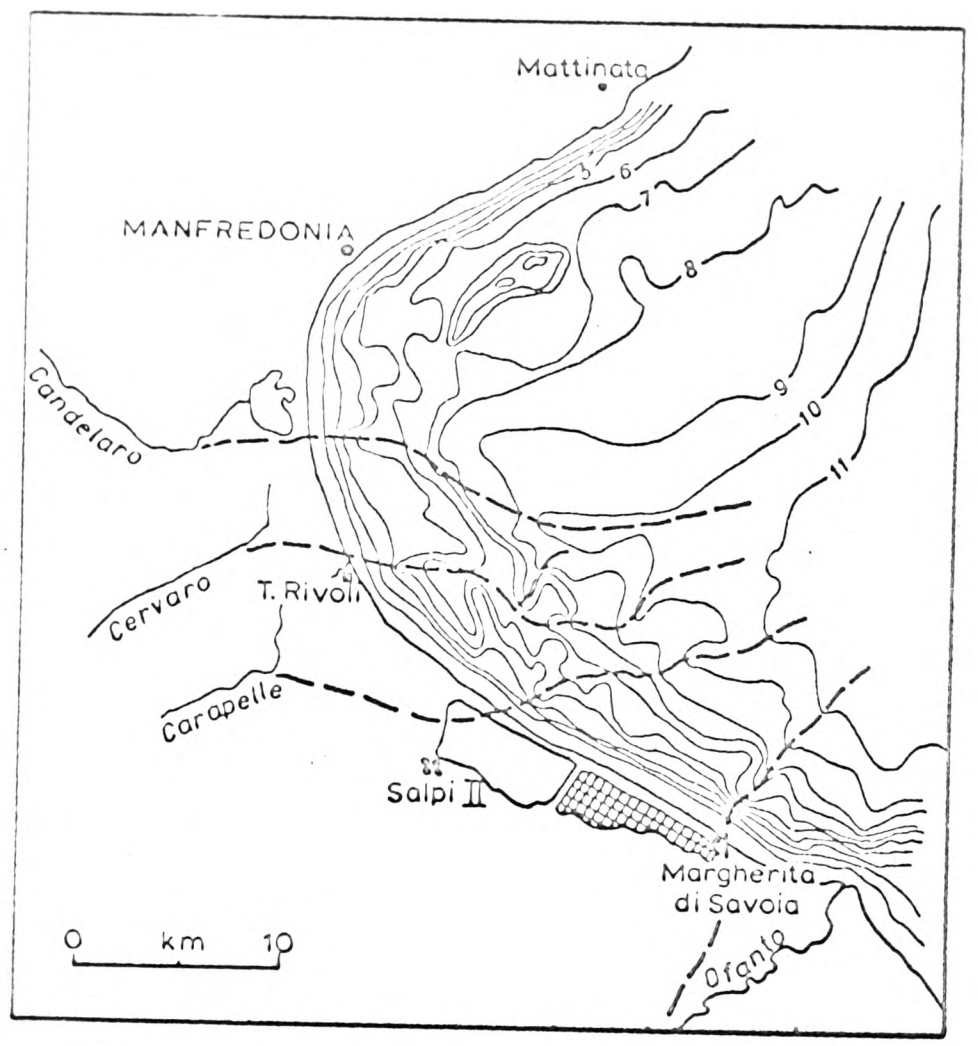


Figure 20. The Bay of Manfredonia and submerged valleys.

as submerged valleys. The fact that there is no morphological evidence (from either the charts or an echo-sounder run) for them within the first off-shore kilometres is readily explained. They would have been infilled by the longshore movement of material that has contributed to the accumulation of the barrier island itself. This also implies a reduction in stream discharge, for otherwise it would be expected that "water-bearing channels of sufficient volume will check [longshore] sand-drift" (Møller, 1964, p.46).

If these channels are indeed submerged lower reaches of Tavoliere streams, there should be close correlation with the present-day courses of the surface rivers. Two indeed do match the Candelaro and the Ofanto, allowing for slightly earlier alignments (figure 20). But it is too facile to relate the Torre di Rivoli channel with the Carapelle, since that would leave both the Salpi channel (to the south) and the Cervaro river (to the north) unmatched. No major outflow from the saltpans alone would be sufficient. If, however, a branch of the Carapelle has always entered Lago Salpi from the north-west, it can be supposed that the Salpi off-shore channel once related to outflow from this stream. The other branch of the Carapelle, together with the Cervaro (as the united Rivoli river) would have accounted for the channel off-shore from Torre di Rivoli.

The sediments encountered by the diving team close to the shore opposite Torre di Rivoli were largely blue-grey muds. The soundings reported on the Admiralty charts show that BOTTOM SEDIMENTS in the Bay of Manfredonia are not very varied. Mud is by far the commonest sounding both close in-shore (especially in the vicinity of river debouchments) and further out. Only one rocky outlier is recorded, a block lying less than 5 metres below water level three kilometres from Manfredonia. Two coral soundings are noted, both from depths of about 13 metres, but coral was encountered at shallower depths during the search for 'Santa Pelagina'. There are also sand and shingle soundings.

Compared with the depths of the Gargano, the Manfredonia Bay off the Tavoliere coast is shallow. Compared with conditions around Testa del Gargano, the sandy shores of the bay are sheltered. These are two important points to bear in mind when the four basic factors of coastal sedimentation are held to account for the accumulation forms of the Tavoliere coastlands. These factors are: material available for deposition; regularity of the sea-bed; water depth; and water agitation (King, 1972). Two factors have already been introduced, albeit summarily (regularity of the sea-bed and water depth) and the remaining two will be described herewith.

MATERIAL is made available for deposition along a coast from the sea-bed, as alluvium of continental origin or from coast erosion. With regard to the former source, a steep off-shore profile limits the amount of material that can be moved coastwards by even the strongest waves or currents. The 'most gentle of submarine slopes', too, is apparently unable to furnish much material for shoreward movement at least under stable conditions. When sea-level rises, however, and if a "flat, terrestrial surface of unconsolidated deposits is invaded by the sea" (Zenkovich, 1960, p.99) two things may happen simultaneously. Material accumulating on the upper part of the submarine slope also migrates coastward while, sooner or later, the waves themselves act on the terrestrial deposits and to some extent, sooner or later, erode them, thus adding further material.

These circumstances, elucidated by Zenkovich, may have been applicable to the Tavoliere coast in the post-glacial period. But for times when sea-stand was at or about its present position two qualifications should be made. First, the stepped profile of the sea-bed of the Manfredonia Bay must have limited the area from which material may be drawn coastwards to some extent. In fact, however gentle the overall gradient of the Bay, the effective submarine slope must be the width of the highest step. For it is unlikely that waves of even the most powerful oceanic kind would have much

success in pushing material up what appears to be a fairly steep cliff some 16 metres high. It should be noted, too, that the short waves of the Mediterranean have limited reach in depth. (C.A.M. King: personal communication). Only material in suspension would reach the shore, together with some material swept from the top of the highest platform. This argument suggests that the amount of material available for coast-building in the Manfredonia Bay from the submarine slope is relatively limited, although Afan de Rivera believed that the sudden and violent squalls of the Adriatic disturbed bottom deposits and accounted for coastal siltation. (Afan de Rivera, 1838). There is, secondly, a continental source of material. From the traditional Mediterranean model of inland erosion - coastal deposition it might be anticipated that this source would be abundant. Not much information is available on the load of the major Apulian rivers, still less the Tavoliere streams. But there is no doubt that the quantity of river-borne alluvium reaching the Adriatic*, and especially the Manfredonia Bay, is very small when compared with that disgorged into the Tyrrhenian or even the Ionian.

This is a point worth elaborating, for it affects a number of archaeological preconceptions as well as the matter of immediate concern. Some data are available for the Ofanto and the Fortore, the 'big' rivers of northern Apulia. The Ofanto used to have an annual load of 601 tons per square kilometres, the Fortore one of 1309 tons/square kilometres. (Tramonte, 1969). (The volume and load of both rivers - indeed, all rivers in the Tavoliere - have been affected by hydraulic improvements.) But compare those figures with the material carried by other Italian rivers. The Po is reported to carry 18×10^6 tons in suspension only each year. The Tiber was found to bring down 4 to 5 million cubic tons of silt each year (Le Gall, 1953). The Crati, a southern river, has buried the Hellenic city of Sybaris by silts some over 6 metres thick (Ward Perkins, 1963).

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* exception made for the Po!

The annual contribution of the Tavoliere streams is risible compared with these figures, sketchy though they are, for even the Ofanto and the Fortore are low on the national scale.

These contrasts in load-bearing capacity might be expected from the different characteristics of the basins of the Tavoliere and the other rivers considered. The characteristics in question are those that affect a stream's velocity and volume (hence carrying-capacity) such as: precipitation, the geological nature of the basin, permeability, friability of the rocks, vegetation cover, steepness of slopes, overall fall to the sea and land use. Lacking data for a detailed comparison of Italian river loads, the salient points are summarised in a few comments and in table 4.

Tavoliere streams are short; have small catchment areas or basins; rise on the (dryer) lee of the Apennines; have a short fall to the sea and are, moreover, lowland streams for at least two-thirds of their courses. In contrast, the other Italiam streams cited are very much bigger in terms of total length and catchment area; they rise and flow on the wetter side of the Apennine chain; and they all have a much greater fall to the sea, being mountain or hill streams for the greater part of their courses.

The Tiber is about 400 kilometres long and has a basin of 16 or 17 thousand square kilometres; the Arno is a mere 250 kilometres in comparison, with a basin of at most 8 thousand square kilometres. The southern Crati may have a length of 93 kilometres, almost the same as the Candelaro, but its basin is nearly 1,800 square kilometres (compared with the Candelaro's 974 square kilometres). Also, it rises at 1,500 metres above sea level in the Sila massif which not only receives up to 2,000 millimetres of orographic precipitation but is predominantly of impervious crystalline rocks. In contrast, one or two of the headstreams of the Candelaro, Carapelle and Cervaro may be found at an altitude of 1,000 metres but total annual precipitation on this side of the Apennines rarely exceeds 800 millimetres. The sand-gravel terrain that comprises most of the Tertiary strata of the

Table 4. Some Comparative Data for Tavoliere and other Italian Rivers.

	(a) Length (km)	(b) Basin (km^2)	(c) Altitude of headstreams	(d) Precipitation of upper part of course	(e) Geology of upper part of course	(f) Volume (m^3)
Po	650	26,788	c.3000	2000	crystalline schists & gniesses	
Tiber	403	17,156	c.1300	1500–1200	sandstones; interbedded clays, sandstones, and schists & limestones	20–245 (Rome)
Arno	250	8,444	1700	1500–1200	as above	100
Crati	93	1,790	1500	2000	sands & gravels; crystalline schists & gniesses	
Fortore	98	c.1250	1150	900–800	clays & marls	
Ofanto	116	2,716	1493	1000–800	(clays & marls; (volcanics	
Candelaro (with tributaries	92 –	974 1,788)	1000	1000–600	(clays & marls; (sands & gravels	
Carapelle	80	657	1000	800–600	as above	
Cervaro	90	772	1000	800	as above	

Sources: Admiralty Handbook Vol.I; Le Gall; Annali Idrologici; Encyclopaedia Italiana; T.C.I. l'Italia Fisica; Ranieri.

Note: Because of the variety of sources, not all figures are as consistent as would be desired, and are to be taken as approximations only.

Apennine foothills is highly absorptive. In short, the quantities of material of continental origin derived from some of the bigger Italian rivers are simply not to be expected in the Bay of Manfredonia; the role of the rivers in Tavoliere coast-building is a minor one.

There is no doubt however that LONGSHORE DRIFT does take place and has taken place during at least the last two millennia. This movement is conven-

iently recorded in the distribution of black, heavy-mineral rich sands, derived from the Ofanto basin, along the Tavoliere coast as far north as Manfredonia. The dark hue is due to a very high proportion of heavy minerals, mostly pyroxene and magnetite, of volcanic origin (Sartori and Quaratesi d'Archiardi, 1966) in the marine sands. The parent volcanic mass is Monte Volture, 60 kilometres inland. But the heavy minerals do not survive sub-aerial weathering and exposed sands are quickly leached, becoming at first grey and finally a slightly 'dirty' coloured buff.

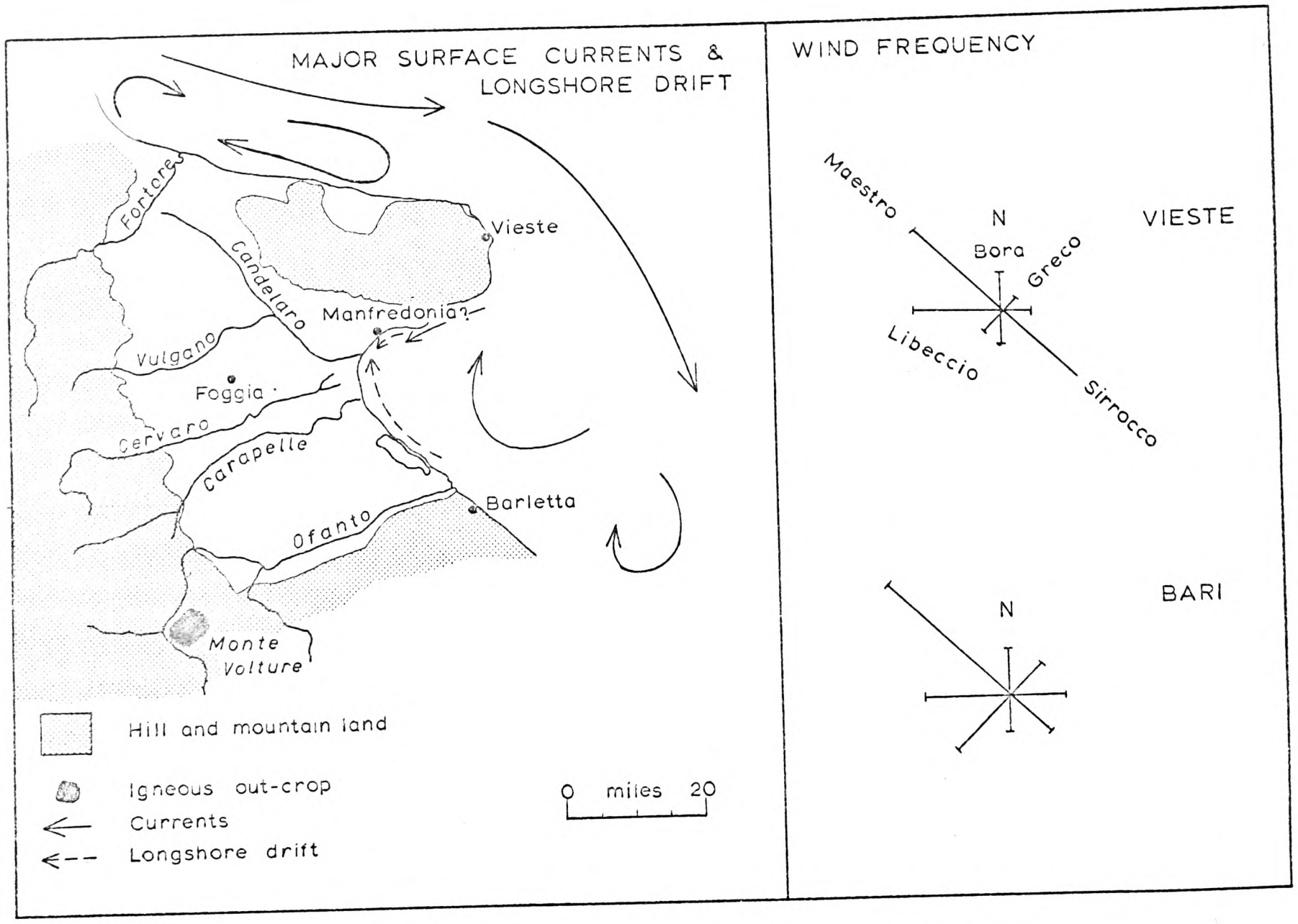
So the dark-hued Ofanto sands provide convincing evidence of coast-wise sand drift. There are other indications of such movement too. From air photographs, for instance, it is seen that at river mouths small spits have developed. These are always on the southern side, indicating that the direction of movement of material is from the south. This concords with the direction indicated by the Ofanto sands, which are found as far north as Siponto. However, there are signs that north of Manfredonia, as far south as Siponto, sand drift is in the reverse direction, from north to south. At Siponto, yellow sands, quite distinct from those of Ofanto origin, were encountered in the profiles and on the air photographs it is seen that material accumulates on the outer side of the northern breakwater of Manfredonia harbour. Pollution, presumably from the harbour, was noted off the Siponto beaches. Finally and conclusively, sedimentary studies at Siponto revealed that the barrier sheltering the lagoon was in fact a spit that had developed southwards from the rocky promontory at Siponto (figure 31). In short, two directions of longshore drift are found in the Bay of Manfredonia, meeting at Siponto. Along the Gargano coast, there is movement of material towards Manfredonia. From as far south as the mouth of the Ofanto, there is sand-drift in a northerly direction along the Tavoliere coastlands as far as Siponto (figure 21).

The factors accounting for longshore movement in the Bay of Manfredonia and for this duality of direction are currents, winds and tides. In very

Figure 2I

Figure 21.

The Bay of Manfredonia: surface currents, longshore drift and wind frequency.



(Sources: Mediterranean Pilot; Admiralty Handbook; observations).

general terms, the Bay of Manfredonia can be thought of as a potentially depositional area simply because of the shelter afforded by the Gargano headland; water agitation is considerably reduced compared with that further out in the Adriatic. The slowing down of debris-laden currents is held to be one of the most important conditions leading to the development of coastal accumulation forms. Most effective, according to some schools of thought, is deposition at the point where two opposing sand-moving streams converge (Zenkovich, 1960 and 1967). The necessary "curve or re-entrant in the direction of the initial coastline" is a reasonable description of the Manfredonia Gulf.

The effect of the Gargano headland on the main Adriatic currents is shown in figure 21. The main surface current of the Western Adriatic normally follows the Italian coastline fairly closely in a south-easterly direction. But it is deflected by the Gargano promontory and does not reach close inshore until off the Ofanto and does not enter the Manfredonia Bay. Instead, a return or compensatory eddy sweeps into the Bay from the south, passing northwards close to the Tavoliere shore. There is no indication, however, of a south-flowing current implied by the southward longshore drift north of Manfredonia, and it is perhaps relevant to bear in mind that the importance of this surface current with regard to transport of coast-building material has not been established. Alone, it may not account for much sand-drift. The Mediterranean Pilot notes that all Adriatic currents are very superficial and liable to deflection, or cancellation, by winds.

However, the currents are not the sole agents predisposing the development of accumulation forms or the movement of material along the Tavoliere coast. Winds and tides may concord with the direction of water circulation sufficiently, at certain times at least, to ensure sand-drift. The tidal range at Manfredonia is very small, as might be expected in the Mediterranean basin. A range of 0.37 metres is normal, the lowest water occurring during

February, March and April. Tidal streams alternate twice daily but the small tidal displacement may be exaggerated by strong onshore breezes. Local fishermen, for instance, are conscious of changes in water level and plan their work accordingly if a few centimetres change in water depth would affect their activities. Thus the diving team (notwithstanding compressed air cylinders) were advised to wait for low water before searching for 'Santa Pelagina'! In 1839, in conjunction with improvements at Lago Salpi, a tidal gauge was set up at Torre Pietra but nothing is known of these records, or, indeed, if any were ever kept. (Afan de Rivera, 1845).

A low or moderate tidal range is itself a factor predisposing coastal accumulation forms and, in particular, barrier island formation. But however relevant the tidal factor might be in the development of Tavoliere coastal forms, it is of small importance compared with the effect of winds. Winds in the Manfredonia gulf are dominated by those from the south-east, west and north-west (figure 21)./South-west and west (libeccio)/blows in heavy and violent squalls and although it is an off-shore wind, of short duration, it can raise heavy seas (Naval Intelligence). Winds from the northern sector, especially the Bora, give real concern to sailors particularly those beyond the shelter of the Gargano. The degree to which northern winds might affect coastal building processes or the movement of material alongshore is not entirely clear. It has been suggested that "however hard in the offing, the wind (the Bora) seldom blows hard near the land and the sea is never very heavy at the anchorage (of Manfredonia)" (The Mediterranean Pilot, p.536). On the other hand, there is no doubt of the existence of sand-drift south towards Manfredonia and if the wind factor is to be discounted then the sole agent of such movement must be the currents of the Adriatic system.

Further south in the Manfredonia Bay, off Salpi and Margherita di Savoia, the Bora and other winds from the northern sector might be expected to have more effect on coastal conditions. It would have been the maestro

(NW) that created the largest waves in Lago Salpi early last century and that alarmed the inhabitants of Salinis di Barletta (page 86). But it is precisely for this part of the coast that the Mediterranean Pilot reports that bad weather from the eastern sector is responsible for the shifting of the bar across the mouth of the Ofanto river. So we are led to conclude that winds from the south-east (the wet sirocco) and the main eddy current combine to account for movement of material in a northerly direction along the shore of the Tavoliere from the Ofanto as far north as Siponto. The chief agent in the movement south of Gargano material, to Manfredonia and just beyond (as far as Siponto again), would seem to be a current. The role of wind in emphasising this southward sand-drift is not known. Nor can the place of tides in coast-building be attributed. The undeniable efficacy of these movements, however, is demonstrated in the sedimentary pattern uncovered at Siponto and in the history of the Siponto lagoon.

Figure 22

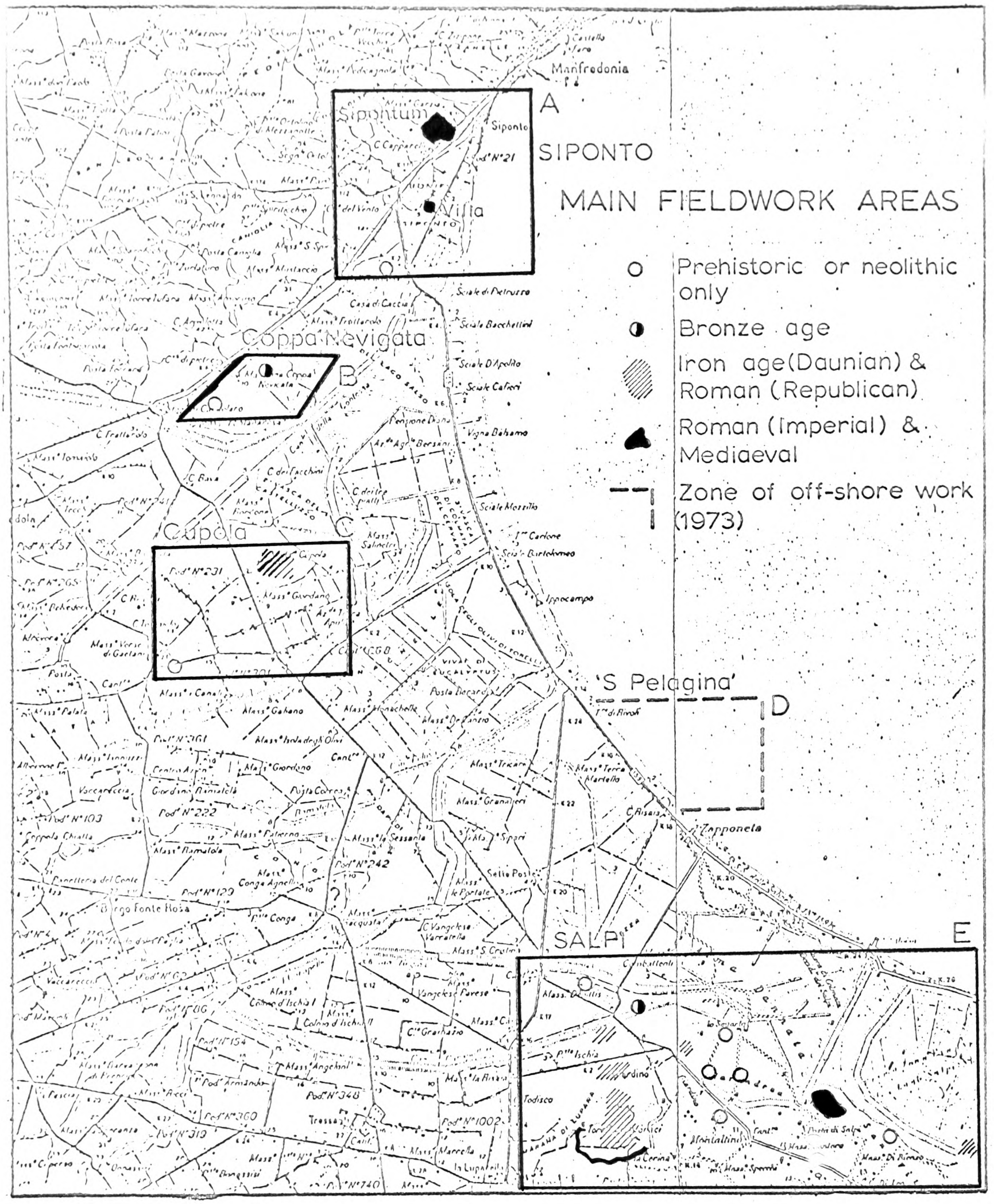


Figure 22. Fieldwork areas in the Tavoliere coastlands.

§ 3 Approaches: fieldwork and sedimentary analysis.

(a) fieldwork
(b) granulometric analysis
(c) carbonates
(d) colour
(e) molluscs
(f) plant matter
(g) the sediments summarised.

(a) Fieldwork

This section concerns the approach to, and methods employed in, obtaining and studying the infill sediments of the Tavoliere coastlands. The search for archaeological features has been described already but it is stressed that the two parts of the fieldwork programme were often intimately associated in the field. The problem of defining the former shores of Lago Salpi, for instance, illustrates this duality particularly well (page 193).

The lagoonal nature of the Tavoliere coastlands implies, as already noted, a considerable range of potential sedimentary environments. Another circumstance contributes to the inherent variability of the recent sediments of the Tavoliere coastlands. That is, the effect of human activity in attempting to control the infilling process and its undesirable consequences, to check river floods and to drain the marshes. The point is that these efforts have taken place in different parts of the coastlands not only at different times but also in different ways. Thus discordances in the sediments may be expected according to the pattern of drainage and reclamation. Diomedes' canal, the saltpans of Lago Salpi, the need for navigational access to, or between specific points, are factors that may be as relevant to the sedimentary profile as the factor of, for example, sea level changes.

The aim is a detailed, dated, account of the sedimentary profile as a record of the sequence of events through which the morphological and ecological transformation of the lagoons was effected. The total area of interest covers about 300 square kilometres (figure 22). The archaeological sites within the coastlands are not small. Daunian Salpi (Salpi I) has an

area of some 6 or 7 square kilometres. The Bronze Age village of Carapellotto-Regina covers no more than a quarter of a square kilometre but to understand this as a former settlement, and not simply as a find-spot, means that another 6 square kilometres of surrounding terrain need close working over before the former physical setting can be described. The unravelling of the coastland's recent sedimentary history in relation to these sites alone entails close attention to detail. At the same time the aim is not merely an inventory of topographical studies, the environmental history of a number of individual points of archaeological interest, but the chronology and process of post-prehistoric changes. The individual site studies, involving as they do very different occupation dates, are no more than temporal and spatial stepping stones in the study of changes in the Tavoliere coastlands since prehistoric times. To date, attention has been deliberately confined, as far as possible, to the areas around the two most important settlements, Salpi and Sipontum. As these two ancient cities are found at each extremity of the coastland, additional advantage is gained from their different locations which, as it proves, means contrasting sedimentary environments.

The sole tool of the research programme has been the hand auger and, within its limits, it was found to be not only a successful piece of equipment, but very desirable in a survey to a considerable extent exploratory and even experimental. But the full post-prehistoric profile has not yet been recovered, and the sedimentary profiles investigated to date relate probably to little more than the last two millennia. Up to a point, this is of not consequence, for once the infill of the lagoons has been accounted for, the presence of sediments at the base of the profile could be taken to indicate the persistence of lagoons since and during the Neolithic. To project back in this way, from the observed (historic or proto-historic) to the supposed (prehistoric) environment, would be to defeat the fundamental precept of this study. However, until a selected number of mechanically-drilled

profiles, of greater depth, have been investigated it has to be accepted for the purpose of this (interim) report that the former lagoons were indeed in existence by the mid-Holocene and the Early Neolithic. In fact, there is no reason to doubt this and sufficient indirect evidence is to hand to substantiate it but it is desirable to demonstrate it and to check by means of a few mechanically-drilled profiles. There is, for example, a very real problem concerning the possibly smaller extent of the Salpi lagoon during the Bronze Age and the relationship of its inner shore to sea level at that time (page I94).

Mechanical drilling is needed, then, as a complement to the hand-auger, not as a substitute. There are reasons for stressing the secondary role of the mechanical drill. Quite apart from the financial question, a real enough problem, hand-augers are highly portable, discreet, and speedily operated. These are distinct assets in fieldwork when there is not much time available for negotiating access rights with landowners and farmers, not to mention physical problems that can impede access. A selection of deeper profiles is needed, however. The archaeological excavation of the Sipontum villa and of the Canale Carapellotto-Regina Bronze Age village may help. But a reference framework of a few full-depth profiles can be gained only with the use of a mechanical drill. It is hoped that this may be achieved in the near future.

It has been taken as axiomatic that augering should be the main approach. An alternative starting point would be a comprehensive altrimetric survey. In Professor Jacobsen's exemplary study of the Tønder Marshes in western Jutland (to which this study owes a good deal), this was the preliminary step. Using a plane-table and tacheometry, as many as a thousand spot-heights per square kilometre might be surveyed! (Jacobsen, 1964). For the Tavoliere however an altrimetric survey was not deemed appropriate. For one thing, it is impractical: the Tønder Marshes had been studied over a twenty-year period and are almost within commuting

distance from Copenhagen. More academically there is no need for such a preliminary survey in the Tavoliere coastlands. Much of the Tønder Marshes are under grass or other permanent vegetation and in these areas levelling is the only way to discern the micro-relief that is so critical to the archeological study. Much of the Tavoliere coastland today is cultivated and, clear of vegetation for two or three months each year. Micro-relief is discernible by eye because it is usually emphasised by soil colour changes and, since archaeological sites are concerned, by a scatter of pottery and other occupation debris in the soil. For the Tavoliere, in short, field walking is a quicker, cheaper and, more relevantly, a more useful preliminary than an altrimetric survey would be. Surveying is carried out in the Tavoliere but for descriptive, not diagnostic, purposes; it is essential to survey each augered profile, for instance, as accurately as possible in order, ultimately, to relate each profile to a common base, such as present day sea level.

The technique of hand-operated augering is a familiar routine to geomorphologists if not to many historical geographers. But each region under investigation has its own idiosyncracies in terms of terrain, just as each fieldworker may have his preferred equipment. A very real problem, in the Tavoliere coastland was to find a tool suitable for Apulian terrain.

Two hand-augers were taken to the Tavoliere for each field season. The most impressive was the least useful. This was the Holman Mackintosh 'Boring and Prospecting Outfit'. The set comprised: a dozen metre-long steel rods; two driving points (for hard and for soft ground); and a variety of sampling heads (clay core tube, sand core tube, screw auger). The chief problem encountered was that Tavoliere 'clays' are not like other clays; in fact, very few truly clayey deposits were sampled, and none with this auger, but even "sandy-loams", with a fine fraction of less than 20%, were irretrievable from the clay core tube. The second problem was that the alternative, a screw sampling head, yielded so small a sample and so inconven-

iently, that it was an unrealistic tool. The third problem with the Mackintosh was the danger of being unable to extract the tool at all. After a trial run in the Car Dyke (Lincolnshire), when a fork-lift tractor had to be pressed into service to rescue four lengths of steel and a screw-head, the Mackintosh was treated with great respect, and finally abandoned.

The most effective auger was provided by Professor Jacobsen. The original design is Belgian (plate 49). The head is 30 centimetres long, with a maximum width of 5 centimetres, and comprises two parts. There is a 'bucket' which holds a core 15 centimetres long, virtually undisturbed, which can easily be studied before removal. There is, secondly, a share-like blade that provides torque but also itself holds an appreciable sample. The advantage of this auger, apart from the fact that it operated successfully and relatively easily under Tavoliere conditions with two metre-long rods, is that potsherds may be contained in the core.

Field conditions on the Tavoliere are fairly individual and, on the whole, difficult. During the summer months, the drying out of surface deposits to a depth of 50 centimetres or more may mean that augering is simply not possible through these horizons. On the other hand, a wetter season (and even a wet summer) brings problems of saturation and a high level of the water-table which anyway is often scarcely a metre below ground level. Many profiles were terminated by water problems. The other limiting factor in augering was "rock". Sometimes this would be the hard carapace of the calcrete sub-stratum but more frequently, and less predictably, it might be no more than an inconvenient stone derived from the neighbouring archaeological site.

Published profile data, from water or petroleum well-bores, was examined. Some exploratory petroleum drilling has been carried out on the Tavoliere - and S.N.I.A. VISCOSA Ltd. are to be thanked for surveying Marana di Lupara in 1968 - but mostly inland or on the interfluves. For this reason, as well as for the fact that their stratigraphic records are of

limited use when details of Holocene stratigraphy are required, it was decided not to pursue that source further. More accessible are the records of some 900 water wells sunk during the inter-war period. These were published in 1955 by Engineer R. Tramonte. But of course the published data is biased towards hydrological aspects, phreatic, artesian and karstic sources for instance, and descriptions of the strata are succinct, subjective and often incomplete.

The two fieldwork seasons that were devoted to the sedimentary programme had to be short, less than a month each. In the first season the intention was to test the augering procedure and to gain acquaintance with the sedimentary environments. Two transects were augered at Salpi. The Marana di Lupara transect was selected because it could be linked to Signora Tinè's excavation there in 1968. Marandrea was selected for augering because it was the most coastward prehistoric site then known. In addition, investigations into the Siponto lagoon were initiated. These were continued during the second field season, a session which resulted in an unexpected archaeological discovery, that of a villa urbana at the southern end of the lagoon. This discovery has provided a circumstance as fortunate for the sedimentary programme as for the archaeological. In the second season a good deal of attention was also devoted to the Bronze Age village site of Carapellotto-Regina (discovered during fieldwork in 1971) in anticipation of an eventual excavation. Profiles were augered further south, at S. Vito (site of a Hellenistic domus) and at Coppa Nevigata, the famous Neolithic and formerly the only known Bronze Age site on the Tavoliere.

From these activities a total of 35 useful profiles, each between one and three metres deep, were obtained and just under 200 samples brought back to England. In addition there were a number of trial, or abortive augerings and data derived from inspection of unlined wells. But if the Tavoliere profiles are not very deep (under 4 metres), they did not lack variety. Some facies measured only 4 to 5 centimetres and a deposit of

15 or 20 centimetres would be a relatively thick one. After a close, descriptive, inspection, the samples were handled in the laboratory of the Department of Geography in the University of Nottingham. At first there were five steps in the analysis, carried out over a full twelve-month period by Mrs. E. Pyper. After the second season, three steps only were needed and as only many weeks.

(b) Granulometric analysis

One of the reasons for studying sediments from the geomorphological point of view, Professor King has pointed out, is to find out what processes operated, and what conditions prevailed, at the time of their deposition, for it is these processes and conditions which give the sediments their peculiar characteristics (King, 1966). One of the most important and fundamental characteristics of a sediment is the size of the particles of which it is composed. A rough idea of this is already gained in the field when basic textural differences are recognised, and sands, for instance, distinguished from loams without problem. But a more complete account of the particle size distribution is necessary for several aspects are not only measureable (and thus available for a quantitative comparison of samples) but highly informative as to the processes and conditions at the time of deposition. The intention, therefore in undertaking particle size analysis was to investigate:

- the sorting and distribution of the different particle size grades in each sample
- their relationship, if any, between particle size and other characteristics of the sample, discovered by subsequent analyses

- the relationship between the particle size distribution and the sedimentary environment, the interpretative stage following the analyses.

The basic laboratory procedure involved in particle size analysis is dry-sieving. Samples of 100 grams are weighed, broken up with pestle and mortar, treated for the removal of carbonates and organic matter, placed in the uppermost of a nest of sieves which is then shaken, mechanically, for a specified length of time. Eighteen mesh sizes were eventually recorded for the Tavoliere samples. These ranged from 12.7 millimetres diameter to 0.064 millimetres, which seems to be the smallest, practical mesh aperture for sieving. These eighteen sizes were collapsed into six particle size classes, adapted from the British Standard Code of Practice (1947) (King, 1966). This allows verbal description. The classes were:

description	mesh size	Ø unit	mm.
gravels	½" - 8	-3.66 to -1.04	12.7 - 2.05
coarse sand	12 - 22	-0.5 to 0.5	1.405 - 0.699
medium sand	30 - 60	1.0 to 2.0	0.5 - 0.251
fine sand	85 - 170	2.5 to 3.5	0.178 - 0.089
coarse silt	240	4.0	0.064
fine silt and clay	base pan	over 4.0	under 0.064

A further step was carried out on a few selected samples, that of sedimentation for the measurement of the clay fraction. This is a lengthy analysis and it did not seem justified to subject all 70 or so samples to this test. This technique involves eleven measurements of settling velocities for each sample. This gives particle sizes ranging from 0.625 millimetres to 0.00195 millimetres.

The results of the sieving were plotted in two different ways. Histograms were drawn out for all samples. These gave a quick, if traditional, view of the range and the groupings in the particle size distribution. As it turned out, this was a reasonable description of the sample's granulometric composition. In addition, however, graphs were constructed for just over 20 selected samples. The cumulative percentages of each sieve size

(expressed as ∅ units) were plotted on arithmetic probability paper (King, 1966). In this way, a normal sediment appears on the graph as a straight-line curve. Selected histograms and graphs are shown in figures 23 and 24. From the graphs three measurements were taken to highlight important granulometric characteristics of the sediment. The central tendency of the sediment is expressed as the mean, or average, particle size (in ∅ units). Secondly, the degree to which the sample is sorted is measured as the standard deviation but can be expressed according to a verbal scale devised by Folk and Ward (1957):

σ_1 or ∅		
	under 0.35	very well sorted
	0.35 - 0.5	well sorted
	0.5 - 1.0	moderately sorted
	1.0 - 2.0	poorly sorted
	2.0 - 4.0	very poorly sorted
	over 4.0	extremely poorly sorted

Thirdly, the skewness of the sample was indicated as the departure of the mean particle size from the median (the 50% value). Where the mean and the median coincide there is no skewness and the particle size distribution is symmetrical. A negative degree of skewness indicates that the 'tail' of the particle size graph is composed of coarse elements (as might be expected in the case of beach sands, for instance) while a positive skewness shows the reverse, that the 'tail' of the graph is composed of 'fines' (as might be expected in a dune or aeolian sediment). In the particle size analysis, use was made of the formulae suggested by Folk and Ward (1957) (see also Folk, 1966; King, 1966) and the calculations worked out with the aid of a computer. For the latter, the writer has to acknowledge the advice and help of R.G. Dugdale (Department of Geography, University of Nottingham) who also kindly made available his own programme for the purpose. For the sieving, acknowledgements are due to Mrs. E. Pyper who also helped in the drawing of the graphs. Professor King commented on the graphs.

The particle size analysis confirmed and quantified the initial field (and histogram) descriptions of the sediments. The difference between

sediments from Salpi and from Siponto is an obvious one; the sediments at Siponto are in the main marine sands, those at Salpi are sandy but are classifiable as loams of riverine or flood-plain origin.

Table 5. Particle size characteristics

Sample		Mean	Sorting		Skewness
		Ø units	σ_1 or Ø		
SIPONTO					
Profile I	11	3.06	0.76	moderate	- 0.02
	123	3.07	0.59	well sorted	0.08
Profile II	13	2.94	0.71	moderately well	0.00
	14	2.25	1.75	poorly sorted	- 0.33
	15	2.58	1.03	poor-moderate	- 0.27
	16	2.95	0.58	well sorted	0.25
Profile III	133	2.97	0.31	very well sorted	0.12
	146	3.16	0.80	moderate	0.27
SALPI					
Torreta dei Monachi	29	2.45	1.36	poor	0.07
	30	2.12	1.50	poor	0.04
	36	1.85	1.61	poor	0.05
	37	1.91	1.56	poor	0.07
	39	2.05	1.54	poor	0.04
Hole B	61/73	1.97	1.52	poor	0.27
	62	2.31	1.51	poor	- 0.02
Hole C	75	2.45	1.47	poor	0.19
	76	2.50	1.34	poor	- 0.00
	77	2.49	1.33		- 0.07
Marandrea	124	2.84	1.24	poor	- 0.24
	126	2.76	1.19	moderate-poor	- 0.11

The Siponto sands are discussed first and some of their particle size characteristics listed in table 5. All the graphs drawn show at least something of an S-shape (figure 24). The mean ranges from 2.25 Ø to 3.16 Ø and corresponds to fine or very fine sands respectively in the terminology of the full Wentworth scale (King, 1966). All the samples analysed from Siponto had good sorting, especially compared with the Salpi samples, and although there were one or two interesting exceptions, most were very well,

Figure 23

Figure 24

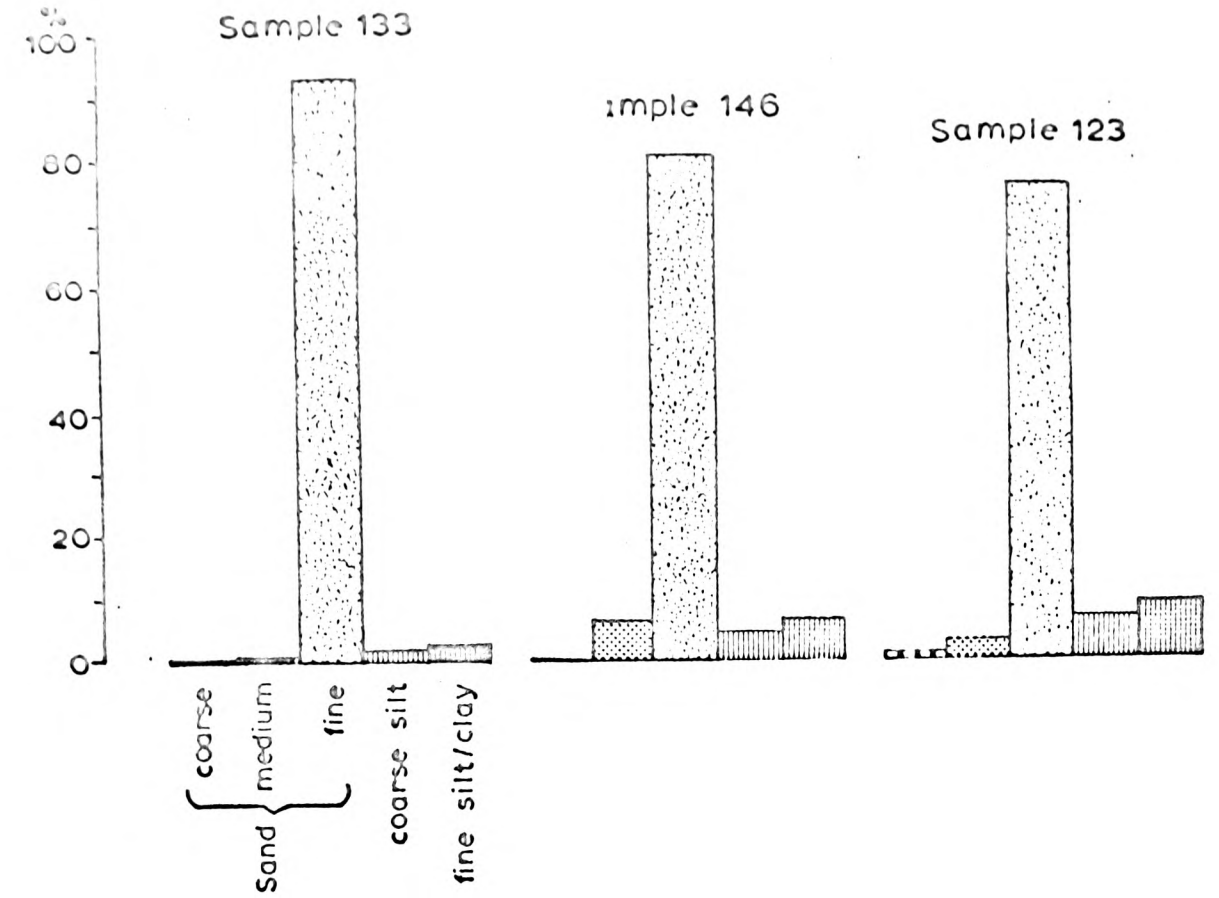


Figure 23. Granulometric characteristics of the sediments: Siponto sands.

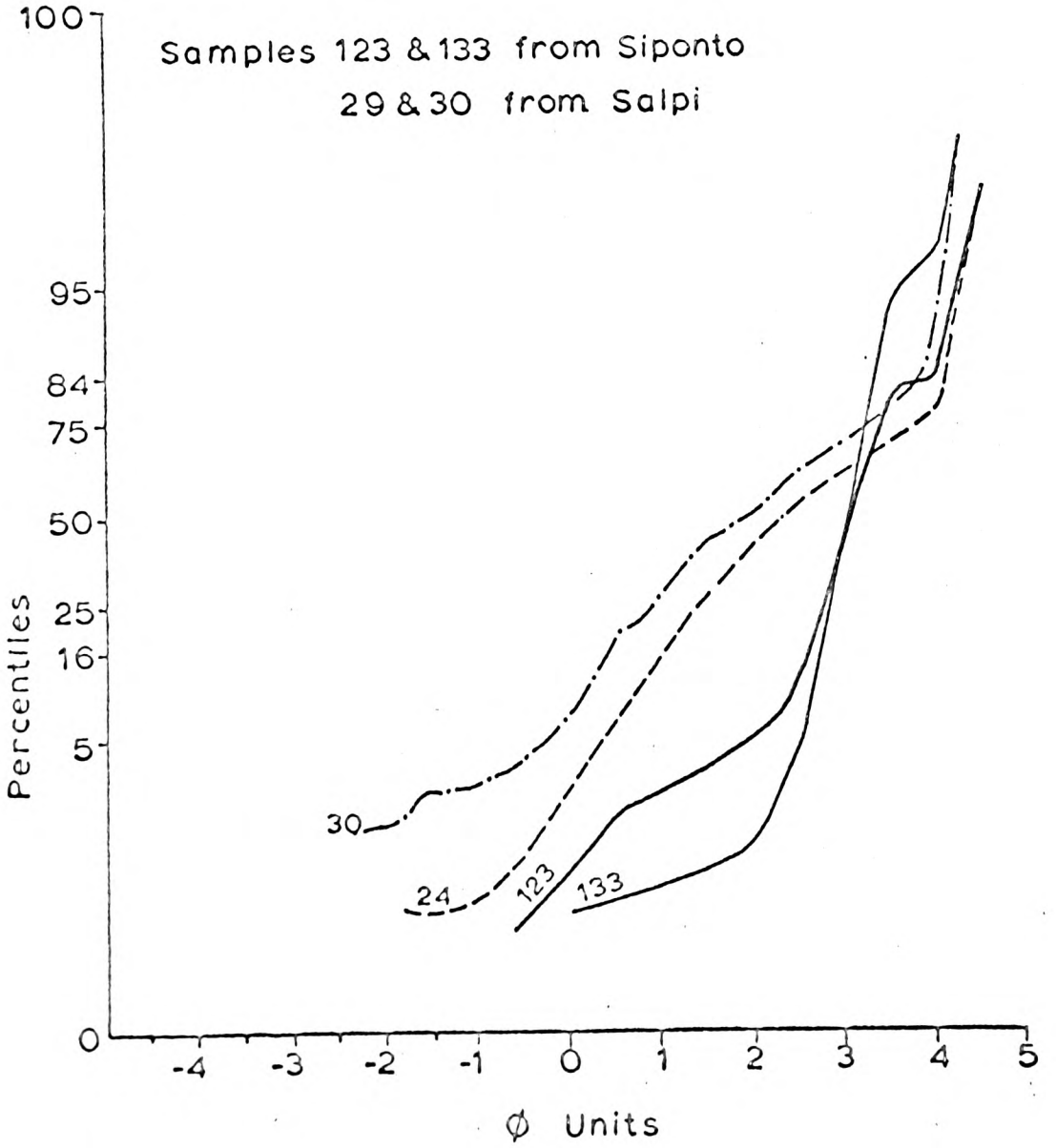


Figure 24. Granulometric characteristics of the sediments: particle size graphs of Siponto sands and Salpi loams.

well, or moderately sorted. An example of the former is sample 123 (sorting index of 0.31) which comes from close to the surface at profile III of the S. Maria series (see figure 31 for the location of the profile) while the lowest sample from the same profile was only moderately sorted (sample 146 with an index of 3.16). Skewness reflects the fact that many samples had an unusually fine 'tail' to the graph considering these are beach sediments and that a sizable clay or silt fraction is present. This must represent material blown in or settled out from suspension in particularly quiet water conditions. This range of particle size also is shown clearly in the histograms (figure 23). One sample (113) is seen to be composed of almost entirely a single class of grade of sand size (94% of fine sands) while the other two samples shown have significant tails of finer sizes (samples 146 and 123) with 6.5% and 9% respectively of the fine-silt/clay fractions.

The picture gained from the histograms for the Salpi samples (not illustrated) is very different. The different particle size grades are much more evenly represented, indicating a very poor degree of sorting in every case (52 samples analysed from Salpi). This is confirmed by the graphs (figure 24). The curves are remarkably straight. They show little of the S-tendency noted at Siponto and only an occasional kink at the coarse end (sample 30 for instance). The means showed that the sediments are relatively coarse overall (table 5) since the average particle size ranged only from 2.8 (fine sand) to 1.8 (medium sand). All were poorly sorted, with a single exception (from Marandrea) which was only slightly better than the rest. Degree of skewness was small and showed, as at Salpi, that the 'tail' was sometimes coarse (negative skew) and sometimes fine (positive skew).

Amongst the samples with a tendency to positive skew are those whose curves most nearly approached a straight line (sample 29 and sample 61/73 for instance). Both of these came from a surface of Marana di Lupara, the for-

mer from the Torreta dei Monachi profile, the latter from Hole B (see figure 36 for location of profiles). Lower down in each of the profiles the samples tended to be coarser. The contrast between upper and lower parts of the infill is easily explained. The colmate process of reclamation in the Tavoliere coastlands (page 107) means that floodwater is deliberately ponded into basins, or vasce, until all its load, including fine particles carried in suspension, settles out. The resultant alluvium is typically very poorly sorted and contains a relatively high proportion of the finest elements. This latter point was confirmed by the separate analysis of the clay content by sedimentation technique. The three samples quoted below are arranged according to their place in the profile and it is seen that the clay proportions increase towards the top of the profile and in the most recent sediments:

Profile C	sample	69	13.7% of total sample
	sample	74	10.8
	sample	80	10.0

A similar effect would be achieved through the natural pounding of flood water were natural drainage impeded and relatively fine alluvium is not necessarily confined to the most recent sediments or to the process of colmate. The economic significance of this granulometric change in the alluvial infill is discussed later (page 243). It may be noted here that although the Salpi sediments are shown on analysis to be of relatively coarse texture, they are very heavy and sticky when encountered in the field, no doubt difficult to work and certainly difficult to extract with a soil auger! The clay fraction is normally small (see below) so the excessive stickiness must be due to the characteristically poor sorting (C.A.M.King, personal communication).

As regards general texture, only three out of 52 samples sieved from Salpi were not loamy sands or sandy loams. About 75% of the loams were qualified as sandy, that is, having a combined silt/clay fraction of over 20% but less than 50% (Krumbein and Sloss, 1963). Thus even a very heavy

and sticky sample from Marandrea with a silt-clay fraction of 39% is classed as a loam. This was an unusually high proportion of the finer particle sizes; more commonly the proportions varied between 20 and 25% for this sandy loam group. The loamy sands were so designated by virtue of a very slightly lower silt/clay fraction. This was usually 15 to 20% of the total sample. Very few of the samples contained much, it will have been noted, in the way of gravels. Apart from the one sample at Torreta dei Monachi, the more gravelly samples tended to come from the channel deposits at Marandrea (or from the clays at Siponto villa which are not included in these analyses). Thus these two gravelly sand samples from Marandrea and the detrital layer at Torreta dei Monachi were the only exceptions to the loamy texture of all the Salpi sediments.

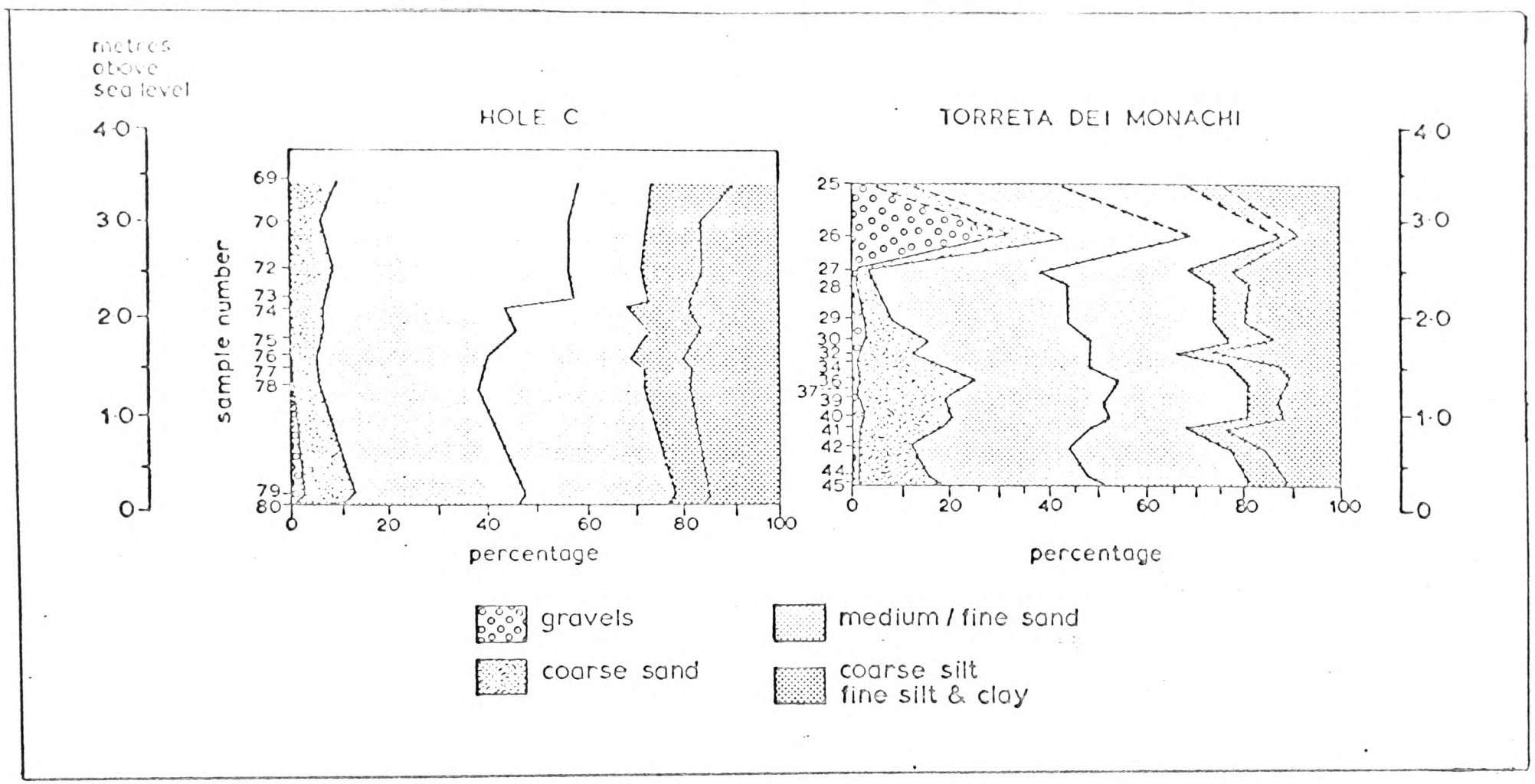
Neither at Salpi, nor even at Siponto, did the particle size analysis provide the main basis of distinguishing facies in the sedimentary profiles. At Siponto villa the fundamental granulometric contrast, that between clays and sands, was obvious in the field and in the case of the S. Maria profiles it was other diagnostics that proved more telling; namely colour and molluscal content. The particle size analysis, apart from providing a quantified description and data for comparison, did however reveal that there is little evidence for sands other than of beach origin at Siponto. Such fine elements as were encountered seem to have come as much from colmate as from aeolian sources. There are, in other words, no or few dune sands.

At Salpi the fundamental contrast, the distinction between infill and lagoon sediments, was achieved both in the field and in the laboratory on the basis of colour and general texture. The infill sediments are indistinguishable as facies on all the other counts (colour, mollusca, organic and carbonate content) that particle size analysis will have to be the basis for distinguishing facies and phases of deposition. But this demands very close sampling and a much more intensive analysis than was attempted

Figure 25

Figure 25.

Granulometric profiles from Marana di Lupara.



for present purposes. There are signs, however, that further work in this respect may reveal a good deal about the history of the infill itself. For instance, it was noticed that in the granulometric profiles certain samples characterised as relatively fine stood out as peaks (figure 25). Normally, sediments with a fine 'tail' would be associated with flood-plain deposition (or with the colmate process already commented on). Such peaks, therefore, may be interpreted not only as overbank deposits but as indicating periods when floods were more frequent (for it is unlikely, under Tavoliere conditions, that a single flood would result in as much as 10 centimetres of deposition). On the other hand, coarse levée or overbank deposits have been encountered. This could be because too few profiles have been investigated to locate such lateral accretions if the stream responsible for the flood water has shifted course at all from its present canalized alignment. Otherwise, it could be argued, the profiles are too far from the stream itself to contain any bank material. The extra-ordinarily coarse layer from Torreta dei Monachi profile (sample 26) includes so much pottery as well as pebbles that it would seem to have been swept off the ramparts of Daunian Salpi not far distant.

So at present nothing further can be said about these phases. On altrimetric evidence there are at least four in the infill sediments. A future line of investigation does suggest itself in respect of these flood-phases and those noted, from very different characteristics, at Siponto. There, two phases have been identified as transgressive, from the mollusca data (figure 28, profile I) and general texture (figure 30, profile III, the upper clay facies in the loam infill). A more intensive scrutiny of particle size analysis, which may reveal other phases at Siponto (e.g. sample 16 at S. Maria), is needed before the chronological coincidence of the Salpi and the Siponto phases can be worked out.

Thus, it has been made clear that the present study is only a preliminary survey. The main aim of the present study was to distinguish infill sediments

from lagoon sediments in order to establish the former outlines of these and to reconstruct the buried relief pattern. In this, particle size has proved to be less revealing than some of the other characteristics of the Tavoliere sediments, shortly to be discussed. However, for a second stage of research, there is no doubt that particle size analysis may prove illuminating on certain aspects and in the light of what has so far been discovered. The most urgent topic, implied by these relatively fine phases and in the apparent 'transgressive' phases at Siponto, concerns sea level changes.

(c) Carbonates

The carbonate content of each sample was measured. The resultant percentages represent loss of weight after treatment of the sample in a heated dilution of hydrochloric acid. The striking fact noted from the results is less the range involved (from 50 to 5%) so much as the considerable variation within the profiles. In the event no really significant pattern could be discerned and the carbonate analysis could not be used as a diagnostic in reconstructing the past sedimentary environment. Reviewing the factors involved in the precipitation of carbonates this was not a surprising conclusion, for the subject is admittedly complex and incompletely understood. However, some general points are made here concerning the carbonate content of Tavoliere samples.

It was expected that the prior removal of small shells and larger gravels for separate examination would have an appreciable effect on the results. The writer was prepared to suggest that the percentage from a prepared sample (i.e. one with mollusca removed before treatment with

Figure 26

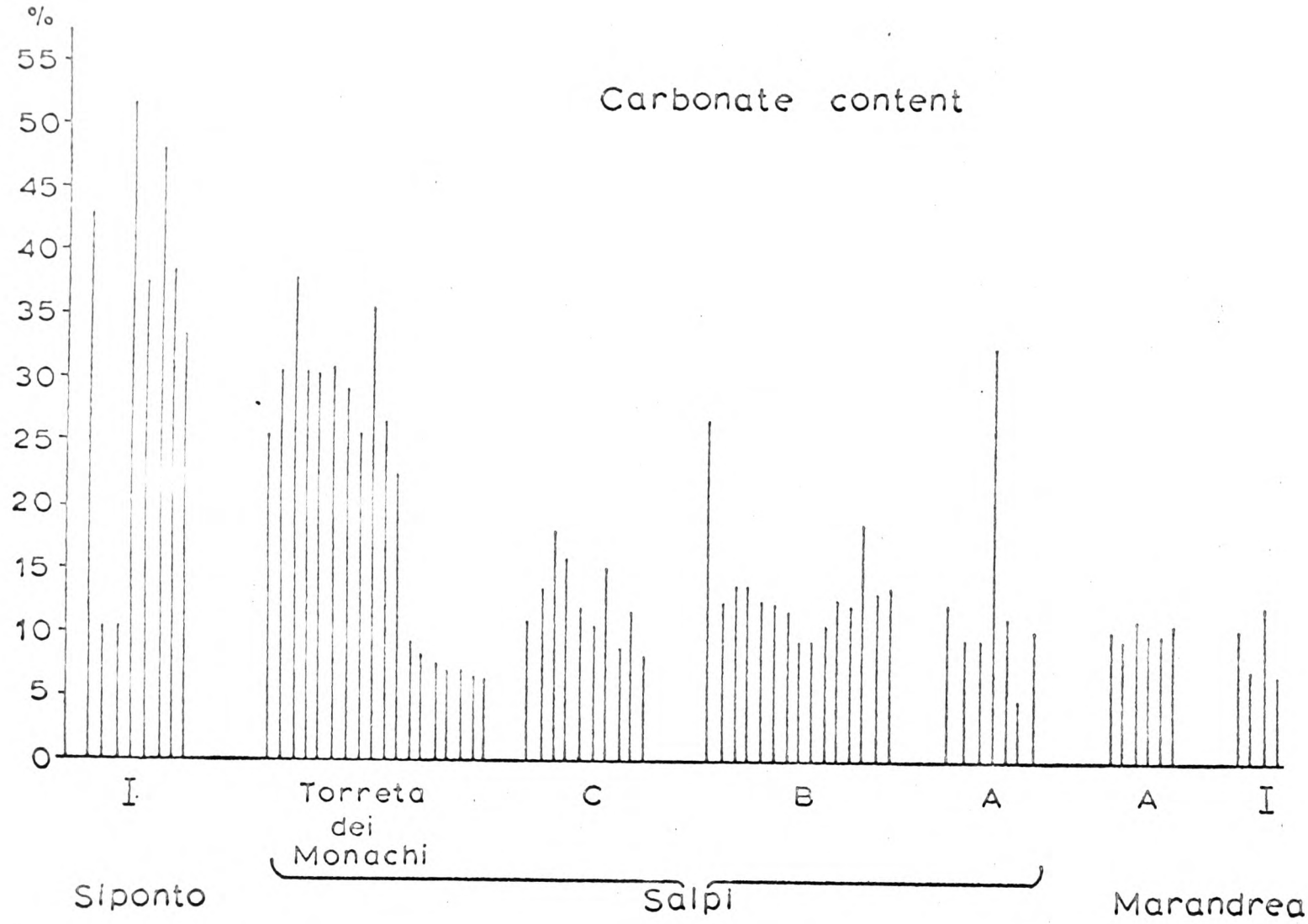


Figure 26. The carbonate content of Siponto and Salpi sediments.

hydrochloric acid) might reflect the 'true', i.e. the sedimentary rather than the ecological, character of the deposit. However, a set of control measurements were made which revealed rather astonishing results. A small number of samples were treated in two ways. In the first method, all shells, calcium gravels etc. were removed before analysis; in the second method, the sample was analysed just as it came. The results (from Siponto):

	method I	method II
sample 8	39.96%	40.30%
sample 9	35.48	36.25
sample 10	35.97	37.78
sample 12	35.08	36.20

show that there is minimal difference between the two methods and that the percentages are only very slightly higher for the unprepared samples!

One or two broad generalizations can be ventured from the graph (figure 26). The samples are arranged in each group in descending order so that the first sample on the left of each group represents that at the surface. A broad pattern can be suggested according to the main sedimentary environment. Thus, first, the highest carbonate contents invariably come from Siponto samples. This accords with the fact that all samples from the former lagoon area represent marine deposits, for which very high carbonate contents would be expected. The highest is 52% (sample 118) but there are two neighbouring samples with very low percentages (10% in sample 116 and 117). These latter represent silty sands of the more recent, colmate, period which, again, might be expected to have less carbonate in them, just as they have relatively low mollusca content.

The lowest values, taken overall, come from the infill silts of the Marana di Lupara and from the Marandrea channel. Some of the samples from the plough soil (e.g. sample 61/73)seem to have a greater carbonate content, otherwise it is from these profiles that the lowest percentages are recorded. A third group is represented by the Torreta dei Monachi profile. The

carbonate content throughout is relatively high compared with the rest of the Marana di Lupara silts, averaging about 25 to 30% but still does not approach the figures for the marine sediments at Sipontum. A possible explanation would be that this profile is not very far from calcreted terrain and that a certain amount of carbonate is derived from there, swept down by run-off and soil moisture.

It is worth bearing in mind that field soils on the Tavoliere in general tend to have high carbonate content. A check on some of these was carried out in 1966 and the samples analysed (by titration) by Dr. K. Atkinson of the Department of Geography, University of Durham. Then it was found that common carbonate content from field soils on the interfluves further inland would be in the order of 45%. Such averages, however, are not characteristic of the bottomlands. Valley soils sampled always had less carbonate, say 17% as a rough average. There may be considerable vertical variation, however, in present-day profiles. From the interfluve above the Candelaro crossing (the Amendola terrace), the following carbonate profile was noted from soils over a well-developed calcrete stratum:

- topsoil 79%
- lower soil 59%

An interesting question is the extent to which present-day carbonate content would be similar to that in prehistoric times. The palaeosol from below the Iron Age huts at Marana di Lupara had a carbonate content of 32-39%. To what extent soil carbonates are fossilized on burial is not known but if this figure represents even approximately the original carbonate content it suggests that early in the first millennium B.C. the percentages were rather lower than at present. On the other hand, factors governing carbonate content in soils are numerous and complexly interrelated; much can be ascribed to ploughing and arable cultivation. For instance, it is likely (but by no means impossible) that the Iron Age

huts were built on uncultivated land whereas the data for modern surface soils comes from plough land. Another relationship that suggested itself concerned the texture of the sample. In several instances a high carbonate percentage correlated with a granulometrically 'fine' sample in the Marana di Lupara infill. On the whole, higher carbonate values might be expected in coarser deposits, simply because the looser texture is reflected in soil temperature and ease of moisture and air circulation. But the pattern is insufficient for more to be made of it, and it is not consistent.

No study has been made of the source of the carbonate found in either present-day field soils or in the buried deposits. Generally speaking it has been found that both the sea and the geological hinterland are contributors. Verger (1968) found a consistent relationship between the geological hinterland and the overall carbonate values in Recent deposits on the French coast, with generally high values in Normany and Picardy (structurally part of the Paris basin) and low values in the Atlantic coast deposits (associated with the predominantly Tertiary deposits of Aquitaine). Likewise, in the case of the Tavoliere coastlands, it may be assumed that the Gargano limestones, the calcaerous strata of the Apennine foothills, and the marine origins of much of the unconsolidated strata of the Foggia plain itself, are all factors contributing to the generally high carbonate values in the Tavoliere coastal deposits. Locally, other factors may operate. An increased mollusca content, for instance, (which could be wholly artificial, through, for example, the creation of an oyster bed), might be reflected in a locally highly calcareous bottom deposit. Standing water in hollows and depressions or ill-drained soils might locally depress carbonate values while downwash from calcium-rich slopes would exaggerate them.

Lagoonal deposits, too, are expected to have relatively high carbonate contents, sharing this attribute with the marine element of the sedimentary environment. The contact of fresh and saline water may have something to

do with precipitation of carbonates, however, and in the more brackish parts of the lagoons (near river mouths, for instance) "sediments may be very poor in carbonates" (Kukal, 1971, p.271). This observation might account for the relatively low values of the Marana di Lupara basal sediments. Their white colour and the presence of a fine fraction in itself is often apparently associated with biochemically deposited carbonates. But the basal deposits at Salpi seem surprisingly low in carbonate content, especially compared with the 'estuarine' clays at Siponto which were obviously very much affected by open sea water.

The behaviour of carbonates and the factors governing their precipitation are too varied and complex to be discussed here. The salient factors have been mentioned; the role of marine or continental source, of the depositional environments, and of the cultivation factor. To this one might add the climatic factor, for it is undoubtedly relevant. In terrestrial deposits, seasonality as well as absolute temperatures tends to promote soil moisture movement by capillarity and most certainly this has resulted in the formation of calcrete since the Roman period. In aquatic deposits, the temperature of the water normally has bearing on the precipitation of carbonates (Twenhofel, 1950), but temperature may reflect the depth of the water body primarily. So the appearance of carbonate deposits on gravels in some of the Siponto villa deposits, for instance, would probably indicate a shallower lagoon rather than a warmer climatic period. Likewise, the yellow, calcareous facies closing the lagoon series at Salpi may be best attributable to a shallowing water body (page 169).

(d) Colour

The colour of sediments is acknowledged as one of the most readily observed characteristics but perhaps one of the most difficult to observe objectively. (Krumbein & Sloss, 1963). For the Tavoliere coastal deposits it proved to be a most useful diagnostic both in the field and subsequently. A Munsell Soil Colour Chart was used, always in natural daylight. Even so, a good match between sample and chart was often difficult to decide upon. Reference is made therefore to soil colours by name rather than by the Munsell coding, to avoid a spurious accuracy.

One problem was that certain samples changed colour quite rapidly on exposure to the air, even to the small amount enclosed in the polythene bag. In these cases the sample was cut into to check on the unoxidised colour (which had also been recorded in the field note book). Black mud samples from S. Vito (Salpi), for instance, oxidised to grey. Another form of colour variation encountered was mottling. Black spots or streaks were common in many of the grey clays. These are thought to be concentrations of incompletely decayed vegetable matter but apparently precipitated ferrous sulphide, likewise characteristic of sediments accumulating in damp, ill-drained terrestrial flats, gives a similar effect (Twenhofel, 1926). White streaks were usually associated with disintegrating carbonate crumbs. In one or two samples, rust-coloured spots, giving a bright orange streak, would seem to indicate some form of iron concentration. These could be tiny, soft, nucleations of hydrous ferric oxide (limonite), a suggestion supported by the observation that the clay in which this was most common came from an estuarine rather than from a strictly lagoonal environment (Sipontum villa profile). Iron coloration is not usually associated with deposits of high organic content such as lagoonal deposits (Twenhofel, 1950).

In the main, however, all the samples taken from the Tavoliere coastland augerings fell into a narrow colour range: grey, black or white. Virtually all were matched on one colour card (10YR) from the Munsell field book.

Most common was the grey hue but there was considerable variation from very dark to very light. Only a few of the Marana di Lupara deposits had a distinctly olive hue; these alone were matched with another Soil Colour Card (5YR). There were also brownish-greys and grey-browns, all from the Carapellotto-Regina profiles or from Marandrea. Brownness indicates, normally, a higher degree of oxidisation than in the case of the grey sediments, and indeed the Carapellotto-Regina sediments are associated with the better drained conditions of a former levée, in contrast to the water-logged Marana depression. In all, roughly two thirds of all samples were grey in some way.

Very few deposits really deserved to be called black. The fine muds from S. Vito were originally a dense blue-black. This is due to biochemical factors, associated with the anaerobic conditions that prevented decay of organic matter and encouraged formation of black-coloured chemicals (Twenhofel, 1950). Thus they indicate a permanently submerged sedimentary environment. The blackness of the Siponto sands, however, is due to an entirely different reason; the presence, in quantity, of dark-coloured heavy minerals. Where these minerals have been leached out, the sands are yellow or grey in colour.

White samples came from the basal sediments of the Salpi profiles, i.e.: from the lagoonal deposits. Some, notably the uppermost facies of these sediments, were distinctly yellow-tinged; others had a blue-green tinge. The Siponto villa profiles contained some very pale clayey deposits but nothing quite so distinctly white as those at Salpi.

Explanation of the colours is due primarily to conditions of deposition. One of the commonest soil-colouring constituents is iron. The normal form of iron (in well oxidised soils, that is) is <u>ferric oxide</u> which usually means the soil has a reddish brown, red or yellow colour (Backman & Brady, 1960). Where soil aeration is poor or absent, as in water-logged deposits, iron occurs in the reduced form of <u>ferrous oxide</u> and

the soil colours tend to be subdued, notably greys and blues.

Twenhofel has the most to say on the colour of sediments:

> "Under aerobic or oxygenated conditions all organic matter is devoured by the many scavenger animals ... or destroyed through bacterial decomposition. None is left to accumulate with the sediment. The prevailing colours are therefore white, cream color [sic], or pale green." (Twenhofel, 1926, p.548)

We may infer, then, for the white and near-white deposits from the Tavoliere coastlands that they were laid in well-stirred and clear sunlit water with more or less of carbonate from suspension or from shell debris. The greenish tinge may reflect an argillaceous mud fraction.

In the case of the black deposits or the blue-black muds, Twenhofel continues:

> "Under anaerobic conditions ... the organic matter is not entirely destroyed, but part of it becomes incorporated in the sedimentary deposit. In these "reducing" areas [seas, ...lakes...marshes] grey, green and black are the prevailing colours."

Hence it is unwise to assume that the blackness, or the darkness of a grey deposit, simply indicates a formerly dense plant population. Rather, the waters in which the deposits were accumulating should be envisaged as still with little circulation, probably opaque or turbid, especially if shallow. It is true, though, that a dense halophitic or sub-squatic vegetation (for example, in a marsh) would itself impede water circulation.

Finally, Twenhofel points out that the lighter grey or some deposits may reflect the inflow of "residual organic matter deposited with the muds or river deltas" rather than the presence <u>in situ</u> of some colouring matter. The problem of reworked or secondary material is never very distant in the case of transitional sedimentary environments.

Turning once more to the Tavoliere samples, it is interesting to find that the only well-oxidised terrestrial deposits in the coastlands came mainly from the Carapellotto-Regina profiles. This is a locality over which a good deal of relatively coarse levée material has been deposited,

at least in the most recent period. The sandy alluviums, moreover, are often associated with rises or ridges, the former levée itself. Both features, texture and micro-relief, give better soil-drainage and hence aeration, factors contributing largely to the brownness of the soil colour.

The white colour of the basal (lagoon) deposits is of interest. A high carbonate content was at first expected but this was not reflected in the carbonate analysis and was evident only where there were actual calcareous gravels (as in the uppermost, yellowish facies). Thus the paleness would seem to be a direct reflection of environmental conditions. Good oxygenation in the former water body and good aerobic bottom conditions were promoted by swiftly-moving or well-stirred waters. This is in keeping with a channel or estuarine sub-environment rather than with some interior, or backwater, area of the lagoon. In contrast, the blackness of the soft, clean S. Vito muds reflect the quite stilled, enclosed, water body of the Saltpan channel in which the deposit is found today. Today, at Coppa Nevigata, there are shelly black sandy muds associated with permanent lagoonal conditions during which five centimetres of black-blue mud was deposited at Siponto (Villa profiles).

It is seen that although the colour of a sediment cannot be entirely divorced from textural aspects, it has been particularly informative an attribute in the case of the Tavoliere samples.

(e) Molluscs

The object of this analysis of the Tavoliere coastland sediments was to recognise the major habitat characteristics of the fauna contained in the samples. It was anticipated that this would be a rewarding study,

particularly in the Siponto deposits, since the mollusca are varied. However, the intricacies of shell taxonomy are all but defeating for the uninitiated and acknowledgement is due to several people for their help in the identification of the species. Professor G. Clarke, University of Nottingham, made preliminary and encouraging comments; Mr. B.W. Sparks, University of Cambridge, gave generously of his time and experience to identify the brackish species; the marine molluscs were identified by Mrs. S. Whybrow of the Mollusc Section of the British Museum (Natural History).

The samples studied most closely came from the Siponto profiles and from Coppa Nevigata. The shells were hand-picked from the washed sample and a single sieving operation helped to separate the smaller species. It has been argued, in the context of microfaunal analysis (Kruit, 1955) that by concentrating on the larger shells, the chances of identifying re-worked species is much reduced. This must hold too for the Tavoliere molluscs, all of which were visible to the naked eye. Some counts were made but these should be regarded as approximations. Where the samples contained only comminuted shell debris, as was common in the case of marine fauna, it was difficult to attempt more than an overall percentage by weight for the total content, and to name any individual species that could be recognised. Mollusc from occupation sites were treated separately. These would have been carried into the occupation area as economic commodities and it is not surprising that the range was very different from that found in the stratified deposits; evidently those shell-fish had been obtained from off-shore or relatively deep-water zones not studied in the current sedimentary programme.

As already noted, conditions on the Tavoliere are strongly alkaline with pH values of 7 or 8%. This favours preservation of the calcium carbonate skeletons of snails and marine invertebrates, while, it is precisely under these conditions that pollen is least likely to be found. So, as

Evans points out, a study of the malacological characteristics of a sediment can be of outstanding value in the case of lime-rich deposits (Evans, 1970).

Certain preliminary points should be made. One is that, as with pollen, most useful as environmental indicators are the species with the narrowest tolerance. But these are just the ones least likely to be found in mixed sedimentary environments such as that of a lagoonal coast. The coincidence of several species, though, in faunal assemblages (and of course, their association with the other sedimentary characteristics, such as texture) gives an idea of the sedimentary environment quite adequate in the context of this study. Another point to bear in mind is that shells may have accumulated in a given deposit in one of three ways. The animals may have been autochonous, that is that they lived in or on the surface of that deposit and are thus in situ. Their normal habitat characteristics may be referred to as a guide to that particular depositional environment. Other shells, allotochonous, may have been transported from their normal and possibly very different habitats. Thus, land snails are commonly found in fluvial deposits, though not in great numbers. The transporting agency in this case is a natural one, stream-water or surface wash. The turbulence of such a transporting agency, however, means that few shells survive intact; this was observed in the case of the Salpi loams, where traces of shells were present but in very comminuted and uninformative state.

Even so, the presence of land species in fluvial deposits may help in specifying the former nature of the stream. West and Sparks (1960, p.117) have pointed out that ... "in true river deposits land snails are abundant and include a high proportion of dry land species transported by the river" whereas their absence from an assemblage of freshwater species in a fluvial deposit was taken to indicate that the stream in question had been but slow-moving and rich in plant-life.

Two other general points may be added. Few species will tolerate very

unstable or frequently changing condition. In estuaries, for instance, turbidity and salinity may vary significantly not only seasonally but even daily (especially, of course, in truly tidal areas) and mollusc populations may be scant here (Twenhofel, 1926). Secondly, and related to this, it has been noted that estuarine forms tend to be of very much small individuals than the same species in their preferred habitat (ibed). A small-sized mollusca population from a relatively coarse-grained, light-coloured, water laid sediment might be interpreted in the light of the first qualification. Thus, the absence, or paucity, of molluscal debris from most of the Siponto villa deposits conformed with the general indication of the deposits, that these are to be associated with an estuarine or channel environment.

No faunal investigations were carried out on samples from localities known to have been dry land in, and since, the prehistoric period. So very few LAND species were encountered. Field soils today are rich in members of the zonite and helix families but these have large and fragile shells and would be particularly vulnerable to the rough treatment of fluvial transportation. The tiny shell fragments picked out from the infill deposits at Marana di Lupara would seem to have come originally from members of these families but close identification is not attempted. Shells in the lagoon infill at Siponto and in the Coppa Nevigata sediments, however, were in better condition. Two other land gastropods were found here. One or two representatives of the clausilia genera came from Siponto. These are described as essentially rupestral species (Evans, 1973) and are common in, say, southern England too. Their main taxonomic features are a left (sinistral) opening, a long cylindrical and striated shell, and a prominent 'tooth' in the opening (figure 27). They usually inhabit rocks and drystone walls, seeking the shady spots.

The second land gastropod, a member of the pupa family, was likewise found singly in the samples from Siponto. But in one deposit (Sample 116) there were five or six individuals, namely 5% of the total assemblage.

Figure 27

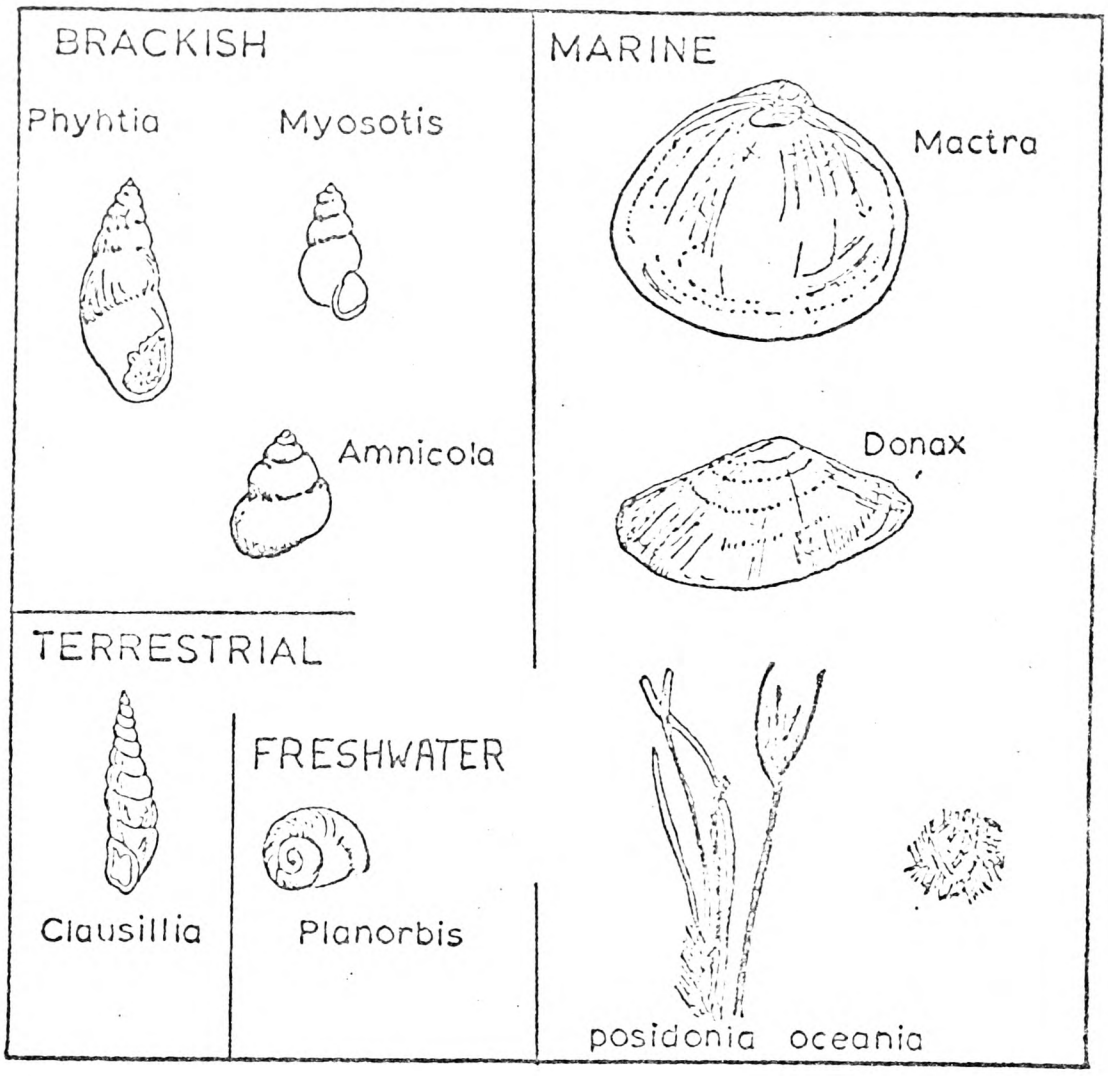


Figure 27. Characteristic molluscs and posidonia from Siponto.

The presence of these land gastropods in otherwise aquatic assemblages is not a problem. Both species are small (under 3 millimetres long) with robust, tightly whorled shells. None of the sampled profiles are at any great distance from terrestrial habitats; rocky limestone outcrops along the western edge of the ex-lagoon at Siponto and a breccia promontory closes it to the south. The shells would travel relatively well and could survive intact.

Turning to the aquatic molluscs, we find only two FRESHWATER species represented. From one Coppa Nevigata sample (No.63) came a few ostracod. These microfauna are usually regarded as freshwater species but as having some tolerance of slightly brackish water (Sparks, personal comment). More commonly encountered as individuals in the assemblages was Planorbis laevis (Smooth Ram's Horn). As its popular name suggests, this has a smooth, flat shell "with three to four compact and rounded whorls and a nearly circular aperture" (Ellis, 1926, p.126). It is usually 6 to 6 millimetres across. Its habitat is given as lakes and ponds that are "generally near the sea" and it lives there "among the weeds or on bare stems (Sparks and West, 1968, p.478 quoting Boycott, 1936). Again, this freshwater species may tolerate some salinity. P. laevis was encountered in the Tavoliere samples only as an occasional individual in the brackish assemblage; as in the case of the land species it is likely to be allotochonous, coming perhaps from habitats near spring waters not distant from the former lagoon.

By far the most numerous molluscs were those normally associated with saline water. These were both gastropod and bivalue species. As a generalisation, useful in the field, it is reasonable to say that all the gastropods were typical of brackish water and lagoon or estuarine habitats, and the bivalues, of the sea. But, fortunately for our studies, the individual gastropod species can be associated with different degress of salinity.

Of the BRACKISH water gastropods, one of the most common was

Pseudamnicola confusa (Swollen Spire shell), a species usually preferring the freshwater end of the salinity scale. This species was particularly numerous in the upper deposits at Siponto and it was found at Coppa Nevigata too. It has a tubby, cylindrical shell, 4 millimetres tall and 3 millimetres wide which is ... "swollen, thin, pale horn-coloured with 5 or 6 convex whorls ... the last very large" (Ellis, 1926, p.81, called here Amnicola confusa). With pseudamnicola was found the commonest of the brackish gastropods, Phytia myosotis. This species is both the largest and apparently the most tolerant of salinity variations. Its shell is distinctly brown in colour and is the largest of the gastropods enccuntered in the lagoonal deposits; Ellis gives its height as 6 to 8 millimetres and breadth as 3 to 3½ millimetres but one or two individuals from Siponto profile I measured more nearly 9 millimetres. Another instructive feature of Phytia is the tooth or teeth (tubercules) on the lip. Its first body-whorl is relatively full compared with the tight end whorls. Phytia "lives in mud flats and by brackish water in estuarines, under drift-wood, rubbish and plants ... (Ellis, 1926, p.96). In the Siponto samples it was indeed found, together with Pseudamnicola, amongst a good deal of vegetation debris in the silty sand deposits of the upper part of the S. Maria profiles. At Coppa Nevigata, however, where the deposit was a fine mud but still with a fair amount of plant matter (e.g. sample 66) it was less numerous.

The third species in the brackish assemblages was Hydrobia ventrosa. This has well-rounded whorls, a rightwards (dextral) opening, but is cylindrical like those just described. Its length is given as ⅛th inch (3 millimetres) and breadth as "about ⅓ of its length" (Ellis, 1926, p.77). It was one of the commonest brackish species in England during the interglacials (Sparks, personal communication) and is generally attributed to habitats of relatively saline water where "it lives amongst algae and mud" (Ellis, 1926, p.78). Barret and Yonge (1958, p.139) point out that although

H. ventrosa is very small, it may be "so numerous that the surface of the mud appears granular"; this would have obtained at Coppa Nevigata in the deposit presented by sample 65.

A rough count of the species from selected samples gives the following distributions:

Table 6. Mollusca content of selected samples.

	SAMPLE			
	Siponto		Coppa Nevigata	
	116	120	63	65
Total number of individuals	128	approx. 39	60	approx. 59
SPECIES (%)				
P. myosotis	48.5	7.5	20	6.6
P. confusa	46.0	85.0	77	± 45.0
H. ventrosa	-	-	-	± 45.0
P. laevis		5	-	-
Others		-	(n.c.ostracod)	-
Unidentified sp.	5.5 (3 species?)	-	(1 species)	(1 species)
Marine	-			
	100.0	100.0	100.0	100.0
	n.c. not included in count.			

Although it was suggested that Pseudamnicola confusa and Hydrobia ventrosa came from opposite ends of the salinity scale, both appear in roughly the same proportions in sample 65 at Coppa Nevigata.

One or two winkles and whelks were found but only in two samples. These are the most saline-tolerant gastropods encountered in the Siponto deposits but again they were found only as individuals and do not constitute a dominant species. Both species are normally associated with marine habitats but also with the seaward end of estuaries. The whelk's habitat is

normally muddy (Barret & Yonge, 1958). Interestingly the dominant species of the two, consecutive, samples in which these were found were quite different. The lower sample (number 121) was dominated by marine bivalves; the overlying sands (no.120) contained the other brackish gastropods (mainly Pseudamnicola). This distribution pinpoints the transition from predominantly marine (and highly saline) conditions to predominantly brackish (or lagoonal) and less saline conditions.

About seven different MARINE bivalves were identified from the Siponto samples, but by far the commonest was Donax. There are probably two Donax species represented, Donax vittatus (the banded or purple toothed wedge shell) and another species with more pronounced radiating striations on the outside. Both are oblong, almost triangular shells, usually over 3 centimetres long, pale-coloured on the outside but with the characteristic purple inside (Tebble, 1966). The inner margins are finely toothed. It is an edible mollusc and very common not only in Apulia but around the British Isles too. D. vittatus apparently "prefers clean and firm sand on exposed shores, from just above low-water mark to a depth of about 10 fathoms" (Tebble, 1966, p.142; see Barret and Yonge, 1958). It was common in all the lowest samples from the S. Maria profiles at Siponto and, in other words, from the strictly marine deposits that predate the formation of the lagoon. Few shells remained intact, however, and most of the shell assemblage was comprised by highly fragmented debris.

In contrast, Mactra corallina (rayed trough shell) was found in excellent condition, neither worn nor broken, despite its very brittle and thin shell. These were the largest stratified shells encountered, measuring up to 4.0 centimetres in length (although Tebble gives 5.08 centimetres as a normal length: 1966) and 4.5 centimetres in breadth. Their habitat is described as being clean sand ("very rarely muddy") that is exposed only for a short time; that is, from near the low-tide mark and in off-shore zones. At Siponto, Mactra was found in great quantity in very clean sand

in the only marine deposits represented in the villa profiles. A single Murex trunculus was collected from one of these samples too.

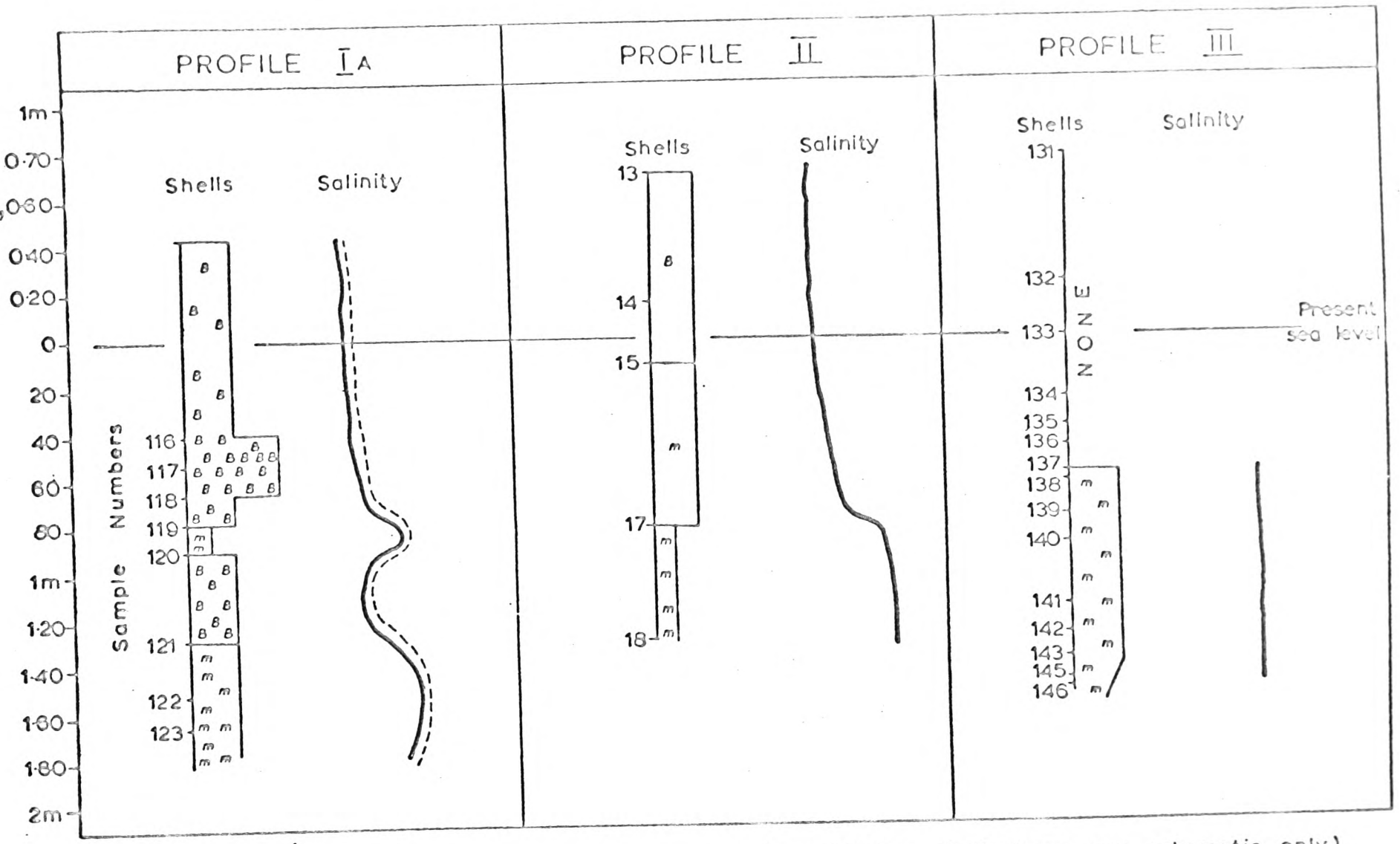
Another deep-burrowing, clean sand, off-shore species was found in one of the S. Maria profiles (profile III, sample 141); this was Ungulina oblonga. Lower down in the same profile one or two shells of Lorpies lucinalis appeared complete, and were represented in two samples from higher in the dune sands of the same profile (samples 138 and 139) evidently thrown up by waves or high water. This species is described as reaching 1.9 centimetres diameter, while in colour, with concentric sculpture and very fine radiating lines (Tebble, 1966). Although normally an inhabitor of clean sands, this bivalve also burrows into clayey sand and even muddy gravel. Both the last mentioned species were found with a good deal of Donax, and a single example (sample 145) of Spisula elliptica, alone to be associated with "muddy sands, muddy gravel, fine gravel and shell-gravel" (Tebble, 1966, p.131). This is an oval shell, big (over 3 centimetres) with clean growth stages, whitish in colour and brittle.

These three species, together with Donax, were found only in profile III of the S. Maria sequence at Siponto. That is, under the sands of the present-day barrier island. From the marine horizons on the inner (lagoonal) side of the barrier, the marine assemblages were likewise dominated by Domax but included a fragment of a young common piddock, the umbonal portion of Pholas dactylus. This bivalve is a borer, associated with "sand peat, marls, wood" into which it bores by a mechanical rather than a chemical technique (Tebble, 1966, p.179). It can cause a good deal of damage to piers and other marine structures. The living mollusc is phosphorescent.

The marine bivalves in the Siponto deposits are very consistent with regard to the depositional environment they betray. They are all off-shore species, that is they normally live in sub-tidal zones or very close to low-water mark, sometimes (like Donax) in very great densities. This fits the

Figure 28

Figure 28. Interpretation of the mollusc content of selected Siponto profiles, showing degree of salinity in the lagoon (profile 1A), on the fringe (profile II) and in the centre of the barrier beach (profile III).



observation that all, except Mactra, were found in such a state as to represent beach debris, an inference supported further by the nature of the plant debris accompanying the comminuted shell debris. All this fits well with the supposed barrier island environment of the profile. Only the Mactra shells are out of place; from the appearance of the sand and from, above all, their very intact state of preservation, it must be inferred that these were deposited, or transported, by water of some depth at that locality.

From the mollusca assemblages at Siponto it is possible to infer some sort of 'salinity curve' and to add this to the mollusca and sedimentary profile (figure 28). The histogram for each of the three profiles portrayed indicates in general terms the larger or small quantities of shell debris found in each sample and the nature (brackish or marine) of the dominant species. Against this, and based on that information, is set an approximation of the degree of salinity (greater or lesser).

Profile IA, from the ex-lagoon, is the most varied. Starting just over two metres below the surface of the ground, in dark sub-tidal sands, the moderate amount of shell debris in samples 123, 122 and 121, is composed almost wholly of marine bivalves. One or two brackish individuals (Phytia and Pseudamnicola) are included at the bottom. These 50 centimetres of deposits, then, are interpreted as reflecting highly saline conditions. But by sample 121, in which a young whelk and a winkle appear, together with one or two brackish gastropods (Hydrobia), the indication is that salinity is already less high, although Donax debris is still common. This tendency, towards more brackish conditions, is affirmed by the fauna from sample 120, where there is again the mixing that is so common of transitional environments in the process of change. One or two planorbis are added, indicating that a flow of freshwater was reaching the lagoon; there is a winkle too; but the dominant species are the brackish gastropods Phytia and Pseudamnicola. This phase, during which about 40 centimetres of dark sands accumulated, is terminated however by a return to

very distinctly marine conditions and water of high salinity (sample 119) but as only 10 centimetres were deposited one may suppose the event to have been of relatively short duration. There is not much shell debris, which would suggest that the depositional environment is not the same at this stage as it was at the base of the profile. But almost everything is recognisably Donax debris.

After these marine-brackish fluctuations comes the big change evidenced in one way or another in all the profiles at Siponto. From this point (1 metre 20 below the present surface) the deposits were accompanied exclusively by brackish gastropods. An occasional land (Clausilia) or freshwater (planorbis) snail, or even a fragment of marine bivalve appears but obviously this was a 'stray', washed in or, possibly, even blown in. Phytia and Pseudamnicola predominate. The beginnings of this brackish era were abrupt, as seen from the mollusca record. Samples 117 and 116 represent a total of about 20 centimetres of sandy, highly organic deposit with an outstandingly dense molluscal population - 4% by weight (of the total sample: considering the lightness of these tiny shells, a considerable proportion). There is no doubt that living conditions were eminently suitable for the animals, and clearly very wet. Since Pseudamnicola is still very common, salinity would not have been high. We may infer a lagoon environment par exellence, in which both faunal and floral populations flourished in a reasonable depth of water.

After this period the quantity of shells gradually declines towards the surface. They remain preponderantly brackish and are so today even though the ground is cultivated. We infer a progressive drying of the molluscal habitat, to be associated with the greater quantity of silt appearing in the sands.

The other two profiles present very different sequences but are consistent given their different location. Profile II was located about 230 metres distant from that just described. The molluscal sequence here is

much simpler. In common with profile IA are the marine assemblages at the base of the profile (two metres below the surface of the ground). The quantity, though, is small (samples 17 and 18), there is little vegetation but there are one or two rounded 'beach' gravels, and the environment would have been a marine one. Salinity, accordingly, was high, but was followed by a well-marked change to much less saline conditions. Few marine bivalves are found in sample 15 but the rest of the rather small assemblage is composed of Pseudamnicola. This situation remains throughout the profile: very little shell debris at all, a rare marine shell and the rest are brackish gastropods. The depositional environment, we may suppose, remained relatively dry.

The third profile (Profile III) shows yet another sequence. Bearing in mind that this profile comes from the middle of the barrier island, some individuality is to be expected. The uppermost one and a half metres of light-coloured sands contain neither molluscs nor vegetation debris. But once the dark beach or sub-tidal sands are reached, a different picture emerges. There is a good deal of vegetation (posidonia) and also shell debris. Save for one brackish freshwater gastropod (planorbis, in sample 142) all are marine bivalves, as already described. From the abrupt discontinuity described in profile III we may infer that a submerged marine (and highly saline) environment was replaced by the dry (and mollusc-less) environment of an emerged, dunal barrier. Only on the very surface, in the cultivated sandy plough soil, are rootlets and land molluscs (helix especially) encountered.

Salinity is the most important factor affecting the molluscal assemblages in the Siponto sediments, and those from other localities. But the factors controlling salinity are many, particularly in the case of the mixed sedimentary environment of a lagoon. Water circulation, for instance, and the mixing of saline (sea) and fresh water may be promoted by tidal currents and stream flow or, more usually (away from the inlets) by thermal energy (Krumbein & Sloss, 1963). The depth of the water body, the absence

or presence of features impeding circulation (piers, breakwaters, shoals etc.) also have to be accounted for. There may have been internal changes affecting water depth, its circulation, its temperature etc.. But it is true too that there may equally well have been external changes having similar effects; climatic changes or, above all, changes in relative land and sea levels. A marine transgression, for instance, would result in not only a higher level of water but also its altered quality. Sea water, sea sediments and marine organisms would encroach landwards, over all the most lowlying parts, unless otherwise impeded. There would be increased salinity and the mollusca populations would have to adjust themselves accordingly.

Precisely which set of factors, internal (or local) or external (and general) have been operating to effect the changes in the mollusca population of the Siponto lagoon, is not necessarily clear from the malacological profile above. But two directives may be borne in mind for when the time comes to offer an interpretation of the sedimentary analyses in terms of morphological changes in the Tavoliere coastlands. A general event, such as a change in relative land-sea level, would have had a simultaneous effect over a wide area, even though the nature of this effect might vary according to the individual locality. This means that spatial continuity of the apparently transgressive horizon is an essential indicator of a general change such as sea level changes. But a variety of factors may underly a common occurrence and it is essential to identify the horizon in as many sedimentary characteristics as possible.

(f) Plant remains

As good as conditions are in the Tavoliere coastlands for the preservation of molluscal skeletons so they are to be expected to be poor in plant remains. It is well known that alkalinity predisposes the decomposition of plant matter. On the other hand, the Tavoliere sediments contained more interest in terms of vegetational content than might be anticipated. This is because most of the deposits under examination were either laid down in water bodies or have remained relatively saturated since deposition so ensuring the anaerobic conditions that check plant decomposition. Rate of accumulation is also a factor in the preservation of plant remains. Plant remains were not found in sufficient quantity or suitable form to serve as a major diagnostic in the interpretation of sedimentary profiles but in certain cases, corroborative evidence emerged.

Information on plant matter was found in the samples in both direct and indirect form. The indirect form involved chemical analysis and the measurement of the organic content of the sample as a percentage of its total weight. This is carried out as part of the normal pre-treatment of sediments before sieving. Organic matter is removed by heating the sample in a steam bath with hydrochloric acid. (The organic content of field soils analysed in previous years at Durham University was removed by combustion.) The weight differential before and after treatment provides the basis for the percentage. The direct form of information on plant content of the sediments comes from the actual remains preserved in the sediment.

Apart from these actual remains, most of the organic content reflects the chemical forms (cellulose, waxes and lignia) of the original plant which are the last to decay (Backman & Brady, 1960). Such humus is normally black in colour and its presence in quantity tends to blacken the deposit. It has already been noted, however, that grey is the most common colour of Tavoliere coastal deposits and it may be suggested from this that humus or organic content of the deposits is indeed generally low. Certain

of the lighter coloured clays and loams have black flecks denoting small highly localised concentrations of undecayed plant matter. But it is important to recall that the expression of the organic content of a sediment is not necessarily indicative of the density of its original plant cover or content, merely of the completeness or incompleteness of the subsequent decay of whatever plants had been present (not forgetting that a high proportion of organic matter in flood plain deposits is detrital in origin). (Kukal, 1970). This, as we have already seen, depends on the aerobic condition of the sedimentary environment, that is, on the degree of aeration in the deposit whether it is an aquatic or a terrestrial deposit.

Kukal suggests that flood-plain sediments have an organic content ranging from 1 to 10%. In this respect the Salpi loams conform. While 10% is indeed the highest organic content, from the Marana infill, from anywhere in the Salpi area, some of the earliest infill deposits had as little as 1% or less organic content (e.g. Hole C). In general it can be stated that the earliest infill deposits are characterised by very low organic values, but that these tend to increase, (say by 5%) in the second part of the infill. Since the effectiveness of plant decay is associated with soil aeration and, therefore, with soil drainage, there is obviously a close link here with the infilling process and the organic profile. During the later period of infill, it may be postulated, soil drainage was worse and less effective than during the initial phase.

A second general point may be made in connection with the organic content. Since the acidic carbon dioxide that is a product of plant decomposition tends to dissolve calcareous matter (Buckman and Brady, 1960), a close correlation between the organic content and the carbonate content of a deposit might be expected. This is observable, for instance, again in the Marana di Lupara profiles, in some cases. Both in Hole C and in the Torreta dei Monachi profile there is an exact coincidence in the carbonate

peak and the organic low (samples 72 and 27 respectively). In both cases the deposit in question differs in organic and in carbonate contents from the underlying and the succeeding accumulations. However, elsewhere in the same profiles such a coincidence does not obtain and a positive correlation is found instead: a high carbonate together with a high organic content (samples 73 and 30 respectively). Only one suggestion is offered in this case: that this has something to do with the former cultivation of that particular layer. Though it must be admitted that this situation does not appear to be evident in other palaeosoils analysed, these need not, of course, have been cultivated (the palaeosoil below the Iron Age huts at Marana di Lupara, for instance).

At Siponto, organic percentages, in part for similar reasons, were very much higher than those from the Salpi deposits. But while at Salpi there was no visible plant matter worth mentioning, at Siponto the organic percentages could be compared with the various amounts of actual plant debris extracted from the samples. Values tended to be low at the base of the profiles, from the dark sands with marine mollusca (5% in Profile I) and amounts of actual plant debris very small indeed; in Profile III the merest traces only were found. Under the following brackish conditions, plant content and organic values increased. But the most spectacular increase occurred during the reversal to high salinity and marine fauna (sample 119) where the organic percentage in this sample totalled 17%.

Plant material that remained in undecayed form in the deposits was varied. There were roots but these tended to be found only in the most recent sediments, often related to present plant cover or to crops. Some seeds were found but few have been identified. A number of leguminosa seeds (probably vetch) were identified (acknowledgements to Mr. P. Porter of the Institute of Archaeology) and present interesting implications. These came from 1 metre below present ground surface in Trench II at Marandrea. Yet today, surface soils here are not only saturated even in

summer, but so highly saline as to be abandoned as uneconomic for farming. The presence of a group of vetch seeds could be accidental, a chance occurrence. If this is not the case, however, two questions should be considered, that of the former salinity of the soil, and that of its former land use.

A considerable amount of charcoal accompanied undecayed plant matter throughout the Siponto (S. Maria) profiles. Some pieces were as much as 7 or 8 millimetres long but most were much smaller. If natural conflagrations are discounted, then it would seem that a good deal of vegetation burning, for cultivation or for clearance purposes (or possibly in association with localised industrial activities such as glass-firing or iron-founding) was being carried on in the Sipontum area, and that the charcoal eventually reached the lagoon deposits.

The undecayed plant matter also included fragments of leaf blades, stems and other parts of the plant itself. So fragmentary, however, is this material that identification is no simple matter and would involve the specialist and his microscope in hours of careful study. Some comments can be made, however, from a careful examination of the most common plant matter.

Present day natural vegetation in the Siponto ex-lagoon is limited now to ditch banks, and even these are periodically, if not seasonally, cleaned and burnt. Even so, there is usually a dense cover of <u>phragmites</u>; robust, grey-green leaved, perennials, with a rhizone structure, these are tenaceous reeds. From one sample (sample 8) at about 1 metre below ground surface, a substantial piece of undecayed plant was recovered, about 8 centimetres of what might well have been <u>phragmites</u>. But other fragments of relatively broad leaves, though fairly common throughout the profiles, are small and damaged. Moreover, there is another ribbon-leaved herbaceous plant that dominates the plant remains.

This is <u>posidonia</u>. Probably, since the species is common around Italian shores, <u>Posidonia caulinii</u> (T.C.I., 1958). It is a herbaceous



(P. Porter)

Plate 22. Posidonia sp. From right to left:- leaves; tufty base of stem; aegagropyle or ball of fibres (specimens by courtesy of P. Porter, Institute of Archaeology.

plant, of modest height (about 20 to 40 centimetres) with a very characteristic feature. It has several ribbon-like leaves, each about one centimetre wide, that grow from a thick scaly stem. Just at the point from which the leaves emerge, is a dense, asymmetrical, tuft of red-brown fibres (plate 22 and figure 27). If the leaves are not recognisable in the floral assemblages from the Siponto samples, then the fibres most certainly are. They are common throughout the profile until the period marked by an outstandingly dense mollusca population (samples 117 and 118, Profile I, for instance.

Normally posidonia is found in shallow but definitely sub-tidal water and is common off the more sheltered coasts of the Mediterranean (Harrant & Jarry, 1960). Normally it is not uncovered in its growing position but, torn up in storms and rough weather, dead plants are thrown up on sandy and rocky shores alike to accumulate in great piles and mats. Very typically, as a consequence of wave action and as a result of movement during transport, the fibres are first worn off the plant and then agglomerated into the firm, densely-packed balls that constitute so much of the beach debris. These balls, known as aegagrophyle, are also common beach debris around the Mediterranean. (Harrant & Jarry, 1960). In the Siponto sediments it was observed that while in some samples posidonia fibres predominated, in others there were many blade fragments as well. These may have come from the leaves of posidonia or, possibly, from other phanerograms such as eel-grass (zostera). Another distinction could be made; in some samples the short fibres had been packed by rolling while in others they were longer, looser and, it could be inferred, were in an earlier stage of breakdown.

It is surmised, therefore, that in some cases the posidonia fibres should best be described as beach debris; that is, the fibres were small and had been compacted if not into the typical spheroids, at least into dense tufts, evidence of a period of transportation. From such samples,

the blade-fragments were absent. In other cases, however, (for example sample 119, from the transgressive deposits) not only were the fibres larger and apparently less worn, but the plant sample also contained a high proportion of fragments of leaf blades which may have come from posidonia. If this were the case, it would seem unlikely that either fibrous or leaf portions of posidonia had travelled far. Indeed, it is possible that the plants had been growing, as a typically "dense, flat mass in shallow water" close to the site of the auger-hole (T.C.I., 1958, p.235). This would reinforce the suggestion that the sample indicates a reasonable depth of sub-tidal waters.

A further point may - though it is a tentative suggestion - strengthen that argument. What effect such an overhead vegetational carpet might have on the mollusca distribution in the off-shore zone is not commented on in the available literature. It may be suggested that the blanketing effect would be disliked by the mollusca as it interferes with the availability of food and circulation of fresh sea water. This would explain the relatively small amount of shell found in sample 119. In short, considering the mollusca and plant information for sample 119 together, it would seem that the deposit was accumulating in sub-tidal but shallow, highly saline, water, and not, as the sparsity of shell debris and unexamined plant debris at first suggested, higher on the beach.

Some authorities suggest that posidonia, amongst other species, are also found in salt marshes at the earliest stage of marsh development (Chapman, 1960, p.27). It is suggested that such a salt marsh commonly begins, whether in an estuary or behind a barrier beach, "as a mud or sand flat on which algae may be found" and which in due course is colonised by eel-grass (zostera) and posidonia . Professor Chapman also points out that there may be a stage at which the flat is bare, when it has become insufficiently wet for those plants and is not yet dry enough for sub-aerial colonisation (grasses).

Such a suggestion, that the posidonia in the Siponto profiles may be associated with salt-marsh development behind the barrier rather than with the seaward side of the bar, does not affect the interpretation of the plant evidence. The first important point is that posidonia is a halophyte, i.e. that it will not tolerate non-saline water; and that it is a phanerogam, that is, will not tolerate even temporary uncovering from sea water while living. The second point is that it would seem possible to distinguish, from the sample debris, that which has been transported from that which must have originated locally. Correlation of such points with the other sedimentary characteristics of the profiles, will be of interest when it comes to the interpretation of the sedimentary history of morphological changes in the Siponto lagoon.

(g) The Sediments summarised

Up to now, the various characteristics of the sediments have been described as classified in the field record, that is as samples. Close touch was maintained with the profile for two reasons. It is, first, a good check on accuracy of observation. It becomes all too easy to attribute to a sample characteristics it does not have. Secondly, it is unavoidable in view of the mixed nature of the Tavoliere coastland sediments. But just as it is hardly advantageous to describe here each of the profiles in detail, one by one, so it is not really necessary to attempt to present a complete register of each horizon except when reconstructing the morphological changes from the sedimentary history. This will be the next stage of the sedimentary analysis. However, some sort of summarising description is appropriate.

This summary description is based on the two criteria that were found to be most useful in the context of the total sedimentary history: genesis and texture. In this way some of the salient events in the recent sedimentary history of the Tavoliere are anticipated. From the hand-augered profiles four main classes of Very Recent sediments are distinguished: lagoon deposits; loams; clays; and sands. There are also some pebble layers but nowhere are these extensive or developed enough to warrant more than passing reference.

The LAGOON deposits are best seen in the Marana di Lupara profiles. The prime diagnostic is colour. These are white sediments though distinction should be drawn between the very white layers and the uppermost yellow-white layers. Although only a small number of granulometric analyses could be made (samples were generally too small for sieving, owing to difficulties with auger extraction) it would seem that there is no clear-cut granulometric distinction between these and the infill deposits. Indeed, in the Torreta dei Monachi profile, a 'fine' phase, such as those characteristic of the infill, also was noted in the basal deposits. The lagoon sediments here are sandy (30% each of medium and of fine sand) with only a small fine silt/clay fraction (12 to 14%). They might best be described as a sandy mud.

The yellowish sub-facies however is gravelly; sometimes 20% of the total sample weight was accounted for. The gravels are all soft calcareous crumbs, which is a contrast with those in the very pale clays of the Siponto villa profiles. The yellow sub-facies had, too, a slightly higher carbonate content than did the rest of the basal strata; as much as 18% (sample 60) in comparison with a maximum of 9% from the white deposits. The sub-facies is of variable depth, reaching 40 centimetres at Torreta dei Monachi but only 30 centimetres out in the middle of the depression (Hole B), and in one locality it was also overlain by a shallow bed of the white deposit (Hole C). No shells and few floral relicts were

recovered from the basal deposits. There were no artifacts or recognisable terrestrial debris.

These white and yellow-white facies present characteristics compatible with their interpretation as lagoon or, better, lagoon-channel deposits. The high sand fraction is normally associated with stream inflow (Twenhofel, 1926). The very white colour also indicates excellent aerobic conditions, consistent yet again with a channel environment within the former lagoon complex.

The development of the yellow facies and the appearance of a considerable amount of carbonate reflects a change in the sedimentary environment towards the end of the lagoon's life as a water body. Evidently this sub-facies represents a period during which precipitation of calcium carbonate in the lagoon was greater than usual. Some suggestions are offered as to the nature of this change. As already noted the factors governing carbonate content of lagoonal (and terrestrial) deposits are complicated and various. Undoubtedly, salinity is a major one in this context and the only one to concern us here.

In general, it has been found that the higher the salinity, the greater the carbonate content of the deposits (Kukal, 1971). This relationship is connected with the temperature of the water; warmer water having, apparently, a lower threshold for carbonates in suspension. Today, sea water on entering the lagoon (via Foce Foccechia) has a salinity of 35‰ but even after only the first stage of evaporation, from a depth of 40 to 50 centimetres in the Salpi Nuovo basin this has risen to 70‰ (Candida, 1951). From these observations it is suggested that the precipitation of carbonate in the yellowy sub-facies of the lagoonal sediments reflects <u>primarily</u> an increased water temperature and <u>secondarily</u> increased salinity. It seems unlikely that an influx of sea water, for instance, consequent on rising sea-level, would have been sufficiently warmed (allowing for the increased volume of water in the lagoon) to account for the precipitation

of carbonate crumbs. A warming of the lagoon water through, on the other hand, a shallowing of its depth, could be expected to result in the yellowy, carbonate-rich deposits encountered.

It is, however, a circular argument and without independent evidence as to the causal factors, impossible to resolve. For the present all that can be said is that it looks as though the final phases of the lagoon as a water body (in the Marana di Lupara depression and Marandrea Channel) were marked by a period of increased salinity due to either shallower conditions, warmer conditions, or to the absence of fresh water. In the former event, the main natural factor that could be called upon to explain this change would be a drop in sea level. The second contition would be explained by the change in depth itself or by a (considerable) climatic change. The third condition could be satisfied by either an increase in sea water or a decrease in inflow of freshwater from streams and springs. The phase was not permanent, however, for where the yellow sub-facies was not immediately succeeded by material of continental origin, it was succeeded by a short-lived reappearance of the white, gravel-less facies (Hole C). Evidently the water body had shrunk considerably by this time.

There are no white deposits at Siponto but there are some pale coloured clayey sands that, taken with other characteristics, seem to have been laid in a channel sub-environment of the lagoon complex. These contained material recognisably terrestrial in origin. It is clear, however, that augering at Siponto nowhere reached sufficient depth to identify with certainty the 'basal' deposits and these do not appear in the sedimentary profiles.

The rest of the deposits comprising the Tavoliere coastland profiles differ in two respects from those just described. Firstly, they nearly all belong to the infill phase of the lagoon cycle. Secondly, they are distinguished not by colour but, in the first place, by texture. On this basis, three major classes are described: loams; clays; and sands. Within each class, facies or sub-facies may be recognised by colour, faunal or vegetation attributes.

The pedological definition of a LOAM is that the deposit contains between 40% and 70% sand. In this way a loam presents all the advantages of a sand (good drainage, good aeration, warmth) but none of the disadvantages, the clay fraction holds sufficient moisture and plant food but is not big enough to interfere with drainage. Generally, loams are regarded as prized agricultural land. The Tavoliere is fortunate in that most of the non-alluvial soils are so classed. But the loams of the Maran di Lupara are colmate loams and they have a higher clay fration, and are lowlying, ill-drained and too saline to be of much use as arable land. Only about half the Marana has been ploughed, and that only in recent years. The rest is grazed, mainly by water buffalo.

The loams of the Tavoliere coastlands, including buried and surface loams, have originated in one of three ways. There are loams resulting from downwashed material, often including a scatter of occupation debris. These are characteristically found spread out at the foot of a break of slope, especially around former occupation sites, as at Salpi villa, where much of the loam infill of the channel between harbour wall and the villa itself must have come from the Mascherone terrace. The detritus of the 'flash-flood' layer (sample 26) at Torreta dei Monachi most certainly originated higher up on the ramparts of the city site for it contained sherds of Daunian pottery. The sort of sheet erosion responsible for such downwash may well have been accelerated by cultivation; Leopold notes that this can result "in the aggradation of small valley bottoms at rates of 0.12 foot per year or more." (Leopold et al, 1964, p.436). Considering the spread of downwashed silts and potsherds from the Siponto villa (post lagoon phase: figure 30) it would come as no surprise were this final accumulation to be dated to the time the newly-reclaimed bonifica zone at Siponto was first brought under the plough: during the early 1940's.

There are, too, overbank or flood-plain loams. Typically "gravels are few" in these loams but "sands are common" (Twenhofel, 1926, p.569). Grain-size distribution is held to be the most reliable indicator of riverine

sediments (Kukal, 1971) and this was so in the case of the Marana infill loams. Characteristic, too, of flood-plain silts is their dark, dull colour. In comparison with the alluvial soils of the Tavoliere in general, the Marana buried loams have a higher organic content: 5% at Torreta dei Monachi, 8 or 9% further towards the centre of the depression but only 2.5% on average over the rest of the Tavoliere. (Consorzio , p.50). A concentration of carbonates in overbank deposits is also noted as typical (Twenhofel, 1926) although amounts vary according to local geology and to the local climate.

Flood-plain loams are supposed to have well-marked and regularly laminated bedding, and often "perfect grading from coarse to fine" marking individual floods (Kukal, 1971, p.90). However, it is noted that in regions where the low-water period is also a climatically dry season, the exposed sediments of the flood-plain are liable to dry out and to crack, and the seasonal alternation of what is often very deep and severe dessication with wetting and closing up in winter results in "partial or complete obliteration of lamination and bedding" (Twenhofel, 1926, p.570). While the Tavoliere field programme was not designed with an examination of sedimentary structure in mind, it is true that such lamination has not been in evidence, whereas the annual drying and wetting described by Twenhofel is observable in the Tavoliere coastlands today.

Flood plain, or overbank, silts account for the entire infill at Marana di Lupara, where they rest directly on the yellow-white lagoonal sediments. At Marandrea, similar loams have half-filled the channel and also rest on the white sediments of the lagoon series. Their texture is varied. The most recent deposits (the upper-most 50 centimetres) are finer than any in the Marana; although classified as sandy loams there is as much as 31% of the total silt/clay fraction. Below this is a gravelly facies (sample 100) that has no counterpart in the Marana profiles: 10 centimetres thick, it has nearly half its sieved weight in the gravel class

(particle size 3 to 2 millimetres).

At Carapellotto-Regina the superficial deposits are also fluvial in origin but are sandier and are associated with former levées and distributaries of the Carapellotto conals and outlets. At Siponto there are some loams. These are found on the landward side of the harbour walls at the villa. Although not strictly in a flood-plain environment, they have loam characteristics, are terrestrial sediments, and their deposition seems to have been associated with channel flooding. This would have been a consequence of the blocking of the deflected 'estuarine' current by encroaching marine sands.

The third type of loam is the colmate alluvium. Really concentrated efforts at the drainage of the former coastlands and lagoons dates, as far as is known, from the closing years of the eighteenth century. The aim of such attempts was to create dry land from the marshes and palude. Thus deposition of riverine sediment into basins was deliberately encouraged and the resultant colmate deposits contain all grades of particle-size in an ill-assorted sediment. It may be too, that with the closing of the barrier inlets and the cessation of water movement in the lagoons, certain sources of material were no longer available; less sand, for example, would reach the landward Siponto profiles, except as blown sand (samples 7 and 8).

SANDS, absent from the Salpi area, are the commonest deposits at Siponto. Since sands are composed mainly of silicate and are therefore pedologically 'inert' (that is, neither containing plant food nor having any capacity to hold water or fertilizers) the agriculturalists view sands with misgiving (Russell, 1961). They are always 'hungry' or 'thirsty' as soils. But the sands encountered in the Tavoliere coastlands are exclusively marine in origin, whether water-laid or aeolian (beach or dune) and of such recent date that it is doubtful whether they were cultivated prior to the reclamation policy of the 1930's. (Further south, between Zapponeta and S. Margherita di Savoia, however, dune sands have been cultivated since

the late 19th century). The importance of colour as a diagnostic of the source of sands reaching Siponto needs no further stressing, but both mollusc and vegetation content of the sands yielded one of the most illuminating analyses of the buried sediments. This provided the basis for distinguishing not only sub-environments in relation to the developing lagoon barrier, but changes in the quality and depth of the water behind the barrier and, thus, by implication, changes in relative land and sea levels.

The remaining sediments encountered are the CLAYS and MUDS. Clays, being defined accoring to a high preparation (40%) of the finest fraction (below 2 microns), feel very heavy and stiff (Buckman & Brady, 1950). Some of even the sandy clays from the Siponto villa profiles not only retained thumbprints and were generally mouldable. But clays and the softer muds occupy little space in the stratigraphic column. Muds are found most commonly at the surface, mostly associated with existing marshes (as at Coppa Nevigata) or at the bottom of ditches (drainage and salt-ditches) where they are dry only for very brief periods in the summer (e.g. S. Vito). Clays came only from the Siponto villa profiles where, as in the case of the Marana di Lupara basal sediments, all the indications were consistent with a former estuarine or better, lagoon-channel environment at the southern end of the lagoon.

The Siponto clays however, afforded a disproportionate amount of interest in the context of the sedimentary history of the lagoon. For it is through differences in the clays in the Siponto villa profiles that a date is available for their deposition. This is the only firm date, moreover, for any of the Tavoliere post-prehistoric deposits so far available. This is described in the following section.

§ 4 The Coastlands yesterday: profiles and outlines.

(a) The Siponto lagoon.

The recent sediments of the former lagoonal area at Siponto form a triangle bounded on the east by the sea and by Gargano limestones and breccias to the west and south. They total roughly 12 square kilometres. Two cross-sections based on the sedimentary profiles were studied in an analysis of the main stages of the lagoon's development. We see, in fact, possibly the entire life-span of the lagoon; from the time when there was no barrier, and when an open sea reached the limestone shores, to the present day, when a belt of dry arable land, as much as 1½ kilometres wide in places, has been gained from the sea. A simple chronology of sedimentary events is fairly easily established by relating each profile to present-day sea level, and this would be considered to constitute a sufficiently rewarding and illuminating exercise in itself. (Morrison, 1973). However, it is yet more gratifying when stages in the process of deposition can be dated, and the discovery of the Sipontum villa urbana (1973) was timely in that it provides an archaeological key to the sedimentary history of the Siponto lagoon.

The northern series of cross-sections, referred to as the S. Maria cross-sections, are based on data from four bore-holes augered in 1971 and 1973. These are more or less aligned on an east-west axis (figure 29). The most westerly bore-hole was made on the limestone shelf just outside the walls of the Roman-Medieval city and is included in the cross-sections only as a reference point, to indicate the position of the former rocky shore. Over 700 metres away (straight-line distance) is the other end of the cross-section based on data from bore-hole III. The location of this profile had been selected to represent roughly the middle of the barrier sands.

The southern series of cross-sections come from just over a kilometre further south. The profiles involve a more localized investigation in the

vicinity of the Roman villa. From a number of bore-holes augered here, three profiles have been selected to demonstrate the sedimentary history of this part of the lagoon. They cover an horizontal distance of 30 metres (figure 30).

It is proposed to start with a description of each of the cross-sections. In this way, the main stages of the lagoon's development can be isolated. From this cross-sectional view however we shall proceed to attempt to reconstruct in plan the salient outlines of the lagoon as it might have been at various stages in its development during the historic period. Two major problems are encountered in these exercises deriving from the fact that former positions of sea level are not known. All profile data is related, in the first place, to present-day sea stand and only if it is really clear from the sedimentary profiles that sea level must have been very different during the phase in question is some approximate indication of this former level attempted. Secondly, the vertical displacement involved in a change in sea level must have some bearing on the position of the coastline. The horizontal variation of the coastline will be significant only where the land is lowlying or where it shelves very gently to the sea. This is not the case around most of the former lagoon except at the eastern edge of the breccia promontory (the Mascherone terrace). No investigations have yet been carried out here to check the depth at which bedrock is reached here so the former position of the coastline at this point remains questionable.

Despite such problems, which largely concern details, and despite the incomplete nature of the investigations to date, it is felt that the essentials of the buried outlines of the Siponto lagoon have been discovered through these sedimentary studies. Subsequent work will add considerable detail and may suggest points for revision but the salient outlines of the lagoon's history are presented with some confidence.

In the first cross-section that has been isolated from the SANTA MARIA

profiles, a time is shown when there was no lagoon. During this pre-lagoon phase (figure 29-I), interpreted from the horizons at the base of the sedimentary profiles, a submerged bar lay not far off-shore just opposite the ancient city of Sipontum. The crest of the bar would have been close to bore-hole II; that is, not less than 350 metres from the limestone shore that was close by the city walls. The bar was, as is normal, asymmetrical but there is no means of ascertaining its width from the available data since the contemporary sea stand is not known. The next 'moment' shown (figure 29-IIa) covers a period of time long enough for about 40 centimetres of deposit to have accumulated (e.g. Profile I). The main change was the upward growth of the bar so that it was now exposed. In the profiles (II and III) light-coloured sub-aerial sands are found overlying the dark sub-tidal, Ofanto sands. How much dune or beach sand had already accumulated by this stage is impossible to tell but it is clear that sea level must have been lower than it is today (possibly by at least 40 centimetres) unless the dunes had reach present-day altitude. This would be unlikely, since the sands are distinctly grey in colour, showing that sub-aerial leaching had not had much time to remove the heavy minerals before the surface was once again buried. The emergence of the bar, now better termed a barrier island, is significant, for it means that there was a belt of sheltered LAGOON water to landward. The mollusca analysis has shown that this enclosed water was distinctly brackish (figure 28). Freshwater, perhaps from the limestone springs, was mingling with seawater to temper its salinity.

The next stage isolated records that a short-lived 'event' affected not so much the outline of the lagoon which from now remained more or less constant until quite obliterated by sedimentation, but its quality; namely, increased salinity (figure 29-IIb). This is the occasion of the transgressive phase remarked on in the mollusca analysis, during which about 10 centimetres of material was deposited. It is not known how much vertical dis-

placement was involved; probably not very much since the barrier island remained unsubmerged. Beach sands, we may presume, even continued to accumulate on it but the lagoon water had become markedly saline. It would seem that seawater had penetrated into the lagoon in greater quantity than previously, unless another factor, such as the cessation of freshwater supply, explains the alteration in salinity.

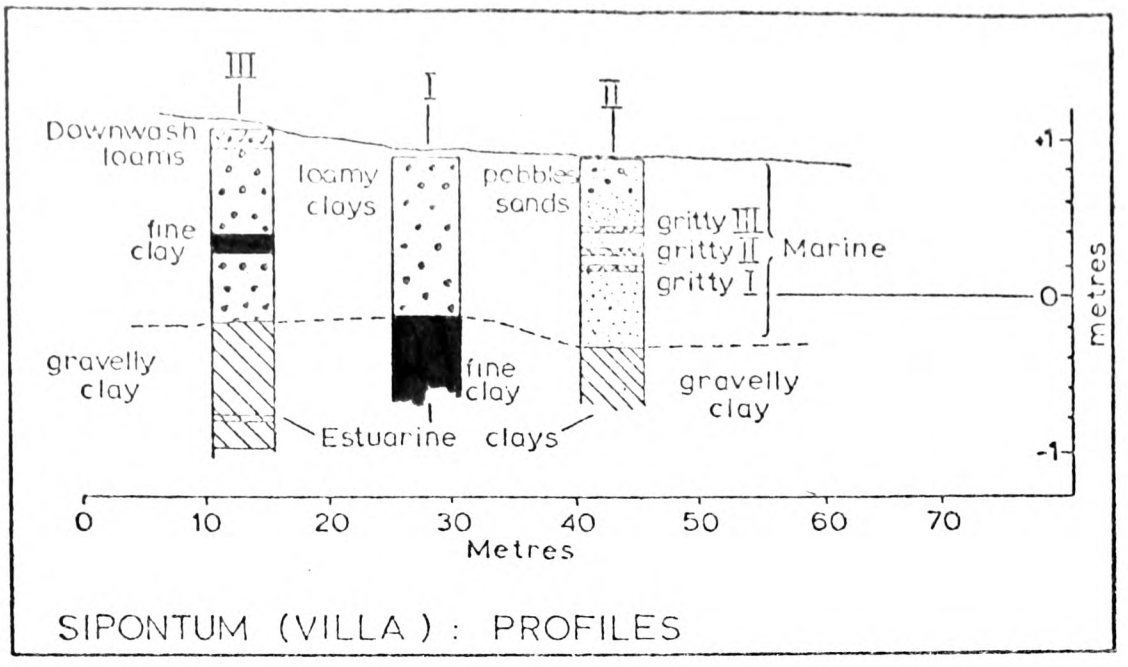
A return to brackish conditions is recorded in the deposits in the next cross-section (figure 29-IIc). However, conditions at Profile I were not quite the same as during the earlier brackish phase. To judge from the much smaller quantities of shell and vegetation debris found in the samples the locality may have been dryer, as in the case of a position slightly higher up the beach. Either sea level (or, at least, the depth of water in the lagoon, which may not reflect that factor) had dropped a little at the close of the transgressive phase, or the head of the lagoon was already becoming silted. This phase is probably contemporary with the building of the villa further south.

Of considerable interest is the picture presented in the following cross-section (figure 29-IId) for this shows the period during which the outstandingly shelly deposits accumulated, reflecting the existence of brackish conditions par excellence. Molluscs (P. myosotis and P. confusa) and aquatic plant life flourished. The sediments are still predominantly sandy and this, together with the presence of some fibres of posidonia is a reminder that the sea is never far away. But the mere fact of the intensity of plant and molluscal life may be taken as a sign that the demise of the lagoon was approaching.

And after this stage, indeed, things changed radically in the Siponto lagoon. The final cross-section presented (figure 29-III) shows how siltation terminated the lagoon). Since then and during the period shown in the diagram, nearly 1½ metres of silty sand accumulated. The fact that sand is still predominant in the deposits would suggest that sand was being

Figure 30

shore bar was still submerged. The light hue of the clays reflects aerobic



SIPONTUM (VILLA) : PROFILES

swept into the silting lagoon by on-shore winds. Certainly the terrestrial contribution to the infill seems remarkably small, at least when compared with the loam infill at Salpi or even at the villa end of the Siponto lagoon. However, the presence of brackish gastropods throughout the infill would seem to indicate a high degree of saturation if not actual submergence. The barrier island, in contrast, remained unaffected by this colmate process. Here, the sands of the upper part of Profile III become lighter in colour, suggesting that the rate of accumulation was slower than previously and that leaching of the heavy minerals had time to be effective. This phase ends at the present day, when artificial drainage started in the 1930's accelerated the process of infilling and completed the obliteration of the former lagoon.

Even a preliminary glance at the three sedimentary profiles of the VILLA end of the lagoon shows that this was a very different depositional environment. Sediments at S. Maria are almost wholly sandy (figure 30) and mainly derived from the Ofanto. In contrast, the villa deposits are predominantly clays and gravelly clays. There are sands but only in the upper part of one of the three profiles (Profile II) shown. The fact that the sands do not all come from the Ofanto is of less importance. Fieldwork problems meant the profiles were not augered all to the same depth and two go down only just over one metre. So the earliest sedimentary stages are recorded only in Profile III. As it happens, the fact that Profiles I and II are not deep enough to alllow cross-correlation is a major disappointment (to be rectified at the first opportunity) since the opportunity for a possible dating for the early transgressive phase has been lost for the sake of 10 or 20 centimetres!

The first of the villa cross-sections (figure 30-I and IIa) records a period during which 30 to 40 centimetres of clay accumulated. This correlates altrimetrically with the PRE-LAGOON phase at S. Maria, when the offshore bar was still submerged. The light hue of the clays reflects aerobic

conditions and good oxygen replenishment; the importance of finer fractions reflects deep or calm water and imply the presence, to seaward, of some features giving shelter; the gravel content testifies to the strength of the current, sufficient to move on occasions, gravels up to 2 to 3 centimetres long. These gravels, significantly, are almost all of hard, white, (probably Cretaceous) limestone and are sub-angular, which indicates a local, terrestrial origin and short distance of travel. On the other hand, the absence in the gravels of other materials, most notably silicates (from the Gargano flint facies), would suggest that the surface streams were not the chief transporting agent and the gravels had not been drawn in from a great distance. The villa sub-environment was a CHANNEL, or estuarine, environment corresponding to the lagoon inlet. Equally clearly it was not the Mezzanotte torrent that was either the chief supplier of material or the only agent that promoted an outward flow of swiftly moving water past the villa; one has to accept that spring flow may have been the chief supply of an outgoing freshwater current.

The cross-sections at Sipontum villa, at the southern end of the lagoon, start then with a series of clay deposits, more or less horizontal and flat, over which passed, seawards, a fairly strong, smooth, current of terrestrial origin. The gravels of the upper facies of these deposits tend to have a thin carbonate film on what must have been, in situ, the uppermost side. This would suggest that water conditions were relatively warm and/or shallow. The transgressive phase noted further north is recorded here only in Profile III, the other profiles not being deep enough. Here it takes the form of a thin (5 centimetre thick) layer of pale bluish-grey clay (without gravel), that contrasts with the yellow-brown gravelly clays both under- and overlying it. (figure 30-IIb). The nature of such a sediment is consistent with deep water depositional conditions, the deepening caused by a net inflow of sea water.

The third of the villa cross-sections (figure 30-IIc) is the first to

involve all three profiles. It is also the most interesting of all, since it gives the only direct date so far available for any of the Tavoliere coastland deposits. The cross-section covers the period during which as much as 80 centimetres of clay was deposited. It correlates with the brackish phase of the lagoon noted at S. Maria (Lagoon phase IIc). Two outstanding characteristics should be noted. First, that whereas the clay deposits in Profile III and Profile II contain a good deal of gravel, there is virtually no gravel at all in the dark grey clays of Profile I. Secondly, that there is 20 centimetres of difference in the depth of the clays accumulated. Only 60 centimetres were deposited in the eastern, seawards, profile (bore-hole II) as opposed to 80 centimetres or more in the other two.

It is true that Profile I, the central one, came from a bore-hole not located exactly in line with the other two but set back by about 30 metres (to the south). Thus, it could be argued that while the gravel-bearing current flowed past the localities of bore-holes III and II, conditions were stiller and calmer along the shore of the 'estuarine' channel. This, however, is not the whole story for it does not convincingly explain the vertical discrepancy between profiles I and II, only 15 metres apart, (straight-line distance). All can be explained quite simply if reference is made to the villa and its associated structures. If these had been built by this time the quiet conditions of Profile II are seen to be no mere natural backwater but a moat or channel between the eastern walls of the villa itself and the 'harbour' wall that runs parallel to it, 30 metres further out (figure 49a). On the seaward side of the 'harbour' wall, estuarine sediments accumulated less quickly (due perhaps to scour?) than on the more sheltered side, and so the deposit is shallower. This means that all the sediments accumulating during the phase represented by this cross-section were deposited at the very earliest after mid-1st century A.D., date of the construction of the villa. This is why it is tantalizing not

to know if the previous transgressive phase also occurred after the building of the villa or had taken place just before.

The cross-section shows that estuarine conditions are maintained at the southern end of the lagoon and continue after the building of the villa in the middle of the 1st century A.D., The villa's harbour structures account for depositional sub-environments, such as the quiet conditions of the channel. Since the top of these estuarine clays is found only 20 centimetres below present-day sea level it could be argued that sea stand must have been higher than at present; would a water-depth of 20 centimetres in the channel have been sufficiently fast-flowing to maintain the transport of the limestone gravels and the fairly good aerobic conditions reflected in the yellowish-brown clays? On the other hand, the gravels towards the end of this phase have carbonate deposits noted earlier as possible indicators of warmer, and hence shallower, water. A higher sea stand need not be envisaged yet.

Subsequently, however, conditions become very different and a relative land-sea level change would have been involved. The cross-section (figure 30-IId) covers another long period of deposition, to judge from the depth of material accumulated (though this is not necessarily a reliable index). One metre of deposits has accumulated on the landward side of the wall but 1.20 metres is found on the seaward side. The outstanding change in this period is that conditions are no longer 'estuarine'. Nor are the sediments on each side of the harbour wall any longer identical. Those on the landward side are best described as clayey loams. Evidently the estuary or channel was silting up and the southern end of the lagoon subjected to riverine floods. One or two pottery pieces have been found in the samples, indicating that possibly downwash from the villa site contributed to the silting. The colour of the sediments is brown and the deposits more closely resemble those at Marana di Lupara than anything else encountered at Siponto.

It would seem that the stream or spring flow that had kept the channel clear had been diverted or blocked and that surface flow from the higher land around the lagoon was being ponded in the lagoon. A hint as to the cause of this change is found in the nature of the sediments on the seaward side of the harbour wall, for these are all marine sands and gravels. The sands are relatively coarse, are yellow in colour and are almost certainly not of Ofanto origin. At certain levels they contain large quantities of mactra and more occasionally cardium. Since mactra shells are very fragile, their presence here not only in quantity but also undamaged would suggest that the sands were laid in relatively deep water, and that this water was being held back from the villa by the harbour wall. Characteistically, the marine sands alternate with thin gravelly layers. Shingle appears only in the uppermost part of the profile and has been brought to the surface by ploughing. Quite large pebbles, 5 to 6 centimetres long, are found mixed with the sands. They are clearly visible on the surface and have been observed not only in the immediate vicinity of the villa but also 500 metres away, seawards. Their presence implies that marine factors played an important role in the blocking of the lagoon, for pebbles of this sort are not typical of stream load in this part of the Tavoliere and it is difficult to account for an alternative source.

This period of deposition saw the total closure of the Siponto lagoon. As marine sands encroached, held back from the villa only by the harbour walls, so the lagoon water body shrank and the outgoing stream was deflected, and finally all but lost in the sands. Today only the merest relicts of the former channel are indicated by short stream sections amongst the barrier sands (figure 48). A point to note however is that the blocking sands at the villa were all water-lain; certainly neither the mactra shells nor the pebbles could have been transported by winds. This could imply that sea level was, at the time, higher than it is today, relative to the land. Sands and pebbles reach the present surface at an

altitude of one metre above present sea level. Since this means that all the sands in Profile I, for instance, are above present sea level, sea stand could have been as much as 80 centimetres higher during recent centuries.

On the other hand, it could be argued that there is no need to invoke a change in relative sea level. If the open sea formerly reached the harbour wall at Siponto villa, these sands would represent merely a normal beach series. As this built up so the shoreline was pushed further out until it reached its present position nearly one kilometre east of the villa. But that argument fails to explain the reasons for a build up of marine sands on such a scale without involving some change in sea level, however small. But a general rise in sea level of the order of 80 centimetres would involve the submergence of the barrier islands further north, since these today are only just one metre above sea level. There is no evidence in the profile investigated (Profile III of the S. Maria sequence). Tilted land movement, however, could be called upon to explain a greater degree of submergence at the southern end of the lagoon; the earthquakes to which the region is particularly prone might be a factor in such tectonic displacement.

The final phase, portrayed in figure 30-III is the post-lagoon period. By now, effective communication between sea and lagoon through the villa channel had ceased. Material encroaching from the sea and, possibly from the Candelaro, contributed to the build up of sediments blocking the former lagoon and ponding back silt-bearing run-off and stream flow. The southern extremity of the lagoon became stagnant, shallow and silt-filled. Around the villa itself, however, very little changed once the marine sands had built up on the seawards side of the harbour wall. Against the harbour wall, on the landward side, loams of terrestrial origin, with signs of a transgressive/phase, or flood/ were spread by floods, continued to accumulate and to bury the walls. On top of this only a few (15) centimetres of



Plate 23. Siponto lagoon today; the ancient city lay just behind the trees. The polythene bags (bottom right) mark the borehole for Profile I (S. Maria section).



(R.A.F.)

Plate 24. The former coastline at Siponto and Lago Salso.

downwash loan has since been spread from the mound that marks the site of the villa. It seems, therefore, that the sedimentary history record at the villa stopped fairly early after the closing of the lagoon. It could be that this cessation of marine deposition reflects the return of sea stand to its present level.

There is no archaeological evidence for the date of the closing of the lagoon. But the survey of the ancient maps shed some light on this interesting point and it may be suggested that the terminus ante quem for the marine sediments at Siponto villa was in the mid -17th century.

The two series of cross-sections, based on sedimentary profiles obtained at the northern and southern ends of the former lagoon, have enables the major phases in the evolution of the Siponto lagoon to be isolated. The stages are summarised in table 7 below.

Besides leading to the identification of these stages, the study of the profiles has shown that four quite different elements comprised the lagoonal environment at Siponto. There has been the barrier island itself. Secondly, the lagoon it sheltered. Thirdly, the 'estuarine' channel through which contact was maintained between the lagoon and the open sea environment. Fourthly, the open sea; once it reached the limestone shore, not far from there the Foggia-Manfredonia railway now runs; today the open sea laps at a sandy beach well over a kilometre and a half from that point, and farmland covers the interval. The information gained from the profiles and the cross-sections can now be integrated as the history in plan, of the Siponto lagoon. Another set of diagrams (figure 31) illustrate the points.

In the PRE-LAGOON stage, the rocky shore forms an L-shaped inlet in the innermost corner of the Manfredonia Bay. The Gargano here reaches the sea and its limestone hills form the hinterland of Siponto, truncated on this south-eastern side by a major fault line, which explains the angularity of the inlet's outline. South of Manfredonia, the Gargano limestones reach the sea and the shore is rocky though low. But opposite the

Table 7. Main Stages in the Sedimentary History of the Siponto Lagoon.

Villa Sediments	STAGE	S, Maria Sediments
Estuary (light-coloured, gravelly clays)	I PRE-LAGOON	Submerged bar (dark sands and marine fauna etc.)
Channel (gravelly clays)	II LAGOON (a) Beginnings	Emerged barrier island and lagoon (grey sands on barrier, brackish fauna on landward side)
Channel (10 cms. fine, pale blue-grey, gravel-less, clays)	(b) Transgression*	Barrier island and lagoon (marine fauna and beach debris; dunes)
Channel (usual gravelly clays outside fine gravel-less clays in shel-tered channel	(c) Villa period* (mid-1st c.A.D.)	Barrier island and lagoon (brackish lagoon but drier, i.e. siltation at head of lagoon)
Channel (becoming blocked by flood-plain or marine sediments on appropriate side of harbour wall)	(d) Infilling (high S.L.?)	Barrier island and silting lagoon (brackish fauna and flora par excellence; very marshy)
Dry land (not much change from the previous period)	III POST-LAGOON (from mid-17th c.) at latest	Reclaimed land (colmate: silty sands)

*The villa was built in mid-1st century A.D.: the transgression may have post-dated this but evidence is temporarily lacking. This is the first transgression; there are probably others but these have not yet been fully investigated.

site of ancient Sipontum, the limestones are over a kilometre distant from the sea and the intervening space is filled with the sediments just described. Both Cretaceous and Miocene limestones are found at Siponto, the latter forming a relatively shallow cover which has been largely quarried

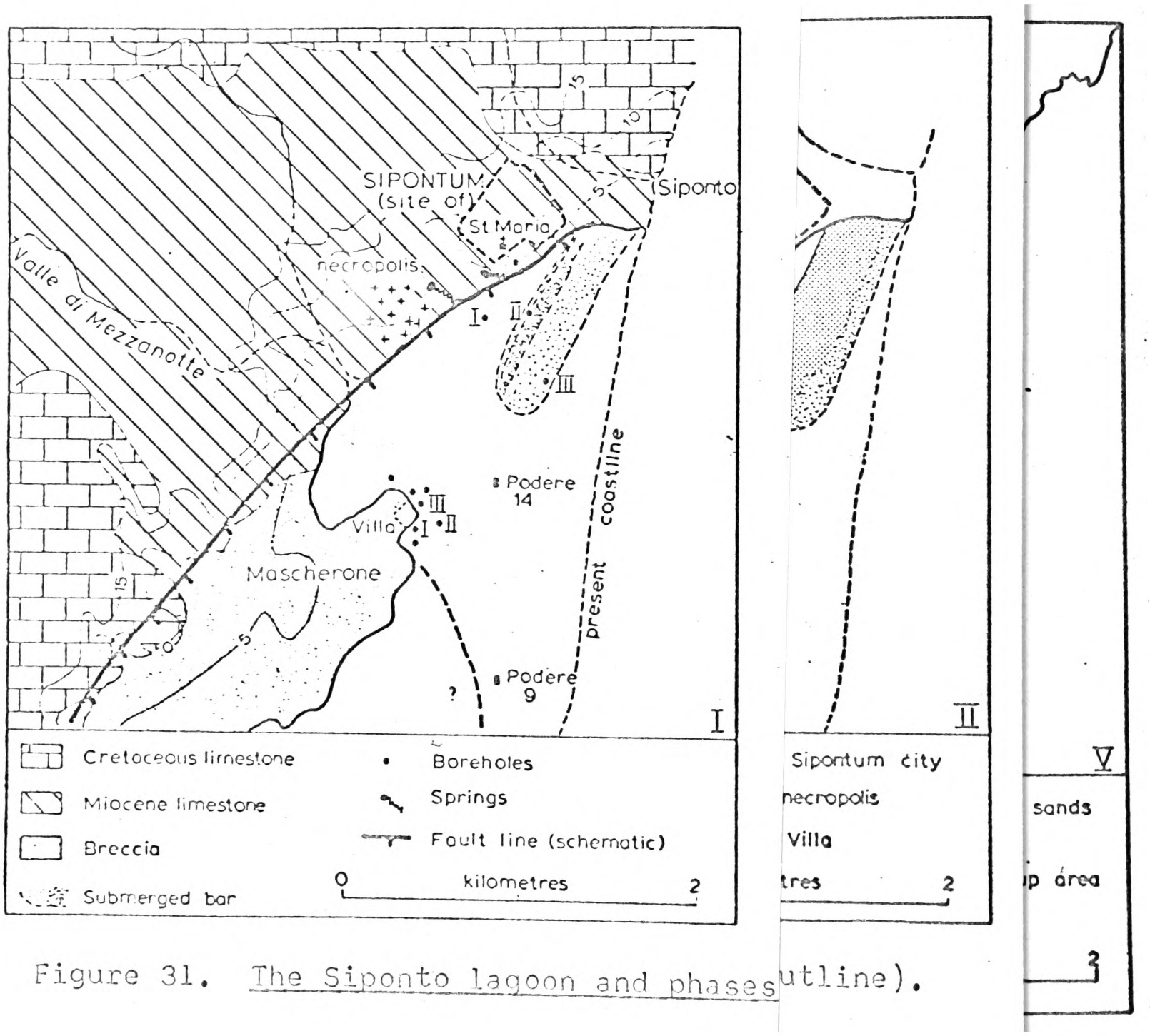


Figure 31. The Siponto lagoon and phases utline).

away. This has left the knolls on which the ancient city and its necropolis are sited separated and surrounded by rather exaggerated depressions (plate 39). Cretaceous limestone has been used for building, notably for the opus reticulatum at the Roman villa, and in the city walls. It is hard, though, and the softer, yellowish, highly fossiliferous Miocene 'tufa' has been the preferred building material, a fact which accounts for the extensiveness of quarrying in the vicinity of both ancient and modern urban centres.

At the contact of Miocene and Cretaceous strata are a number of springs. At least two have been observed but others are known to exist (at Siponto, for instance) although none is indicated on any geological or topographical map. One in particular attracts attention today as it did early in the 16th century when Leardo Alberti visited the already deserted city of Sipontum. It lies just below, and outside, the city walls at the south-eastern corner. It is difficult not to imagine that this has once been landscaped and that the mulberry tree that today overhangs the pool was not carefully and lovingly planted. Spring flow, even in summer, is strong and the clear water slightly brackish. It hurries away over pebbles towards the ex-lagoon and, most unromantically, into a drainage channel.

Two valleys interest the former lagoon area. They are cut into the Miocene but have been so heavily quarried that it is difficult to trace their courses accurately. Both are now dry but their united stream flow would once have debouched into the sea, or into the lagoon, opposite the northern end of the Mascherone promontory and the Roman villa. The southern valley is known as the Valle di Mezzanotte; the other is tributary to it, and passes to the south of the necropolis.

The southern end of the lagoon is closed by a low promontory of breccia on which stands today Masseria Mascherone. It is an important feature in the topography of the Siponto lagoon for it separates the lagoon from the Candelaro-Salso sediments and marshes further south. Today the promontory

has a gently sloping surface, between 7 metres and 5 metres above sea level. It is possible that in earlier times the promontory projected still further east and that encroaching sediments have since buried the seaward edge of the breccia outcrop. The northern, lagoon, side of the Mascherone promontory is very irregular. A deep embayment, containing the southern extremity of the former lagoon, is formed by a small, lowlying shelf or headland; at the very end of this was built a stylish villa urbana early in the first century. Originally, the villa would have been surrounded by water on three sides.

At some time early in the classical period, though not so very long before the construction of the villa, a submerged bar began to develop out from the limestone shore where now stands the reform borghate of Siponto. Currents from the north may have been the chief agents in building the sands up into a spit formation. There is no documentary or other evidence to suggest an inlet or opening at the northern end, between the spit and the limestone shore. It also seems certain that the spit did not extend right across the bay to the Mascherone terrace, for the sediments here indicate quiet water conditions and the presence of a current flowing out of the lagoon. Precisely how these quiet water conditions were assured, if the barrier island outline was exactly that shown in figure 31, is not clear. Possibly the Mascherone terrace did in fact extend further towards the present coastline before it was submerged by encroaching sands. Thus it might have kept sands out of the villa area. Otherwise, the sheltered conditions would have been created by another barrier bar lying against, or opposite, the eastern edge of the Mascherone terrace. The latter idea is attractive but no work has been done in this area and the question remains unresolved. The outer edge of the barrier beach and the Mascherone end of the coast, therefore, should be regarded as a provisional sketch only.

According to the evidence available however, the LAGOON period started with the emergence of the bar into a barrier island (figure 31-II). Behind

the barrier, the partially enclosed water became brackish but further south this development had no effect on the sedimentary pattern and clays continued to accumulate in the villa area. No major change occurred in the lagoon when the villa was built, probably about the middle of the 1st century A.D. By this time, (figure 31-III) the city of Sipontum had already been in existence for two and a half centuries. By this time too, accumulating sands at the head of the lagoon may have led to shallower or even dry conditions there, although at the villa end clays continued to accumulate to a considerable depth.

As time passed, the lagoon outline remained unchanged but encroaching marine sands at the southern end began to have an effect on the outward flow of water in the channel (figure 31-IV). Instead of the quiet water conditions that led to the accumulation of clays, deposits of terrestrial origin began to fill the villa moats. This means that the flow of water in the channel must have been deflected away from the villa area or partially overwhelmed by the encroaching beach sands. Sufficient estuarine flow remained, however, not only to maintain a river running parallel to the eastern edge of the Mascherone terrace but one that was of sufficient importance to the inhabitants of Sipontum to merit the construction of a massive wall, or quay, in an apparent attempt to keep this channel free for navigation (plates 24 and 45). Finally, however, the lagoon was not only completely closed but ultimately obliterated. In the POST-LAGOON period (figure 31-V) the marine sands closed the channel completely and continued to build up on the outer side of the barrier island. The lagoon itself became shallower and more silt-filled. Marshes developed, the famous arena et paludes. The Roman villa had long before disappeared and would have been lost to view amongst these sands and marshes. By now, too, the great city of Sipontum would have been abandoned in favour of the new Manfredonia. The story of the Siponto lagoon comes to an end.

Compared with the main barrier island further south, the barrier island at Siponto seems to have been a late development, a fact which emphasises

Figure 32

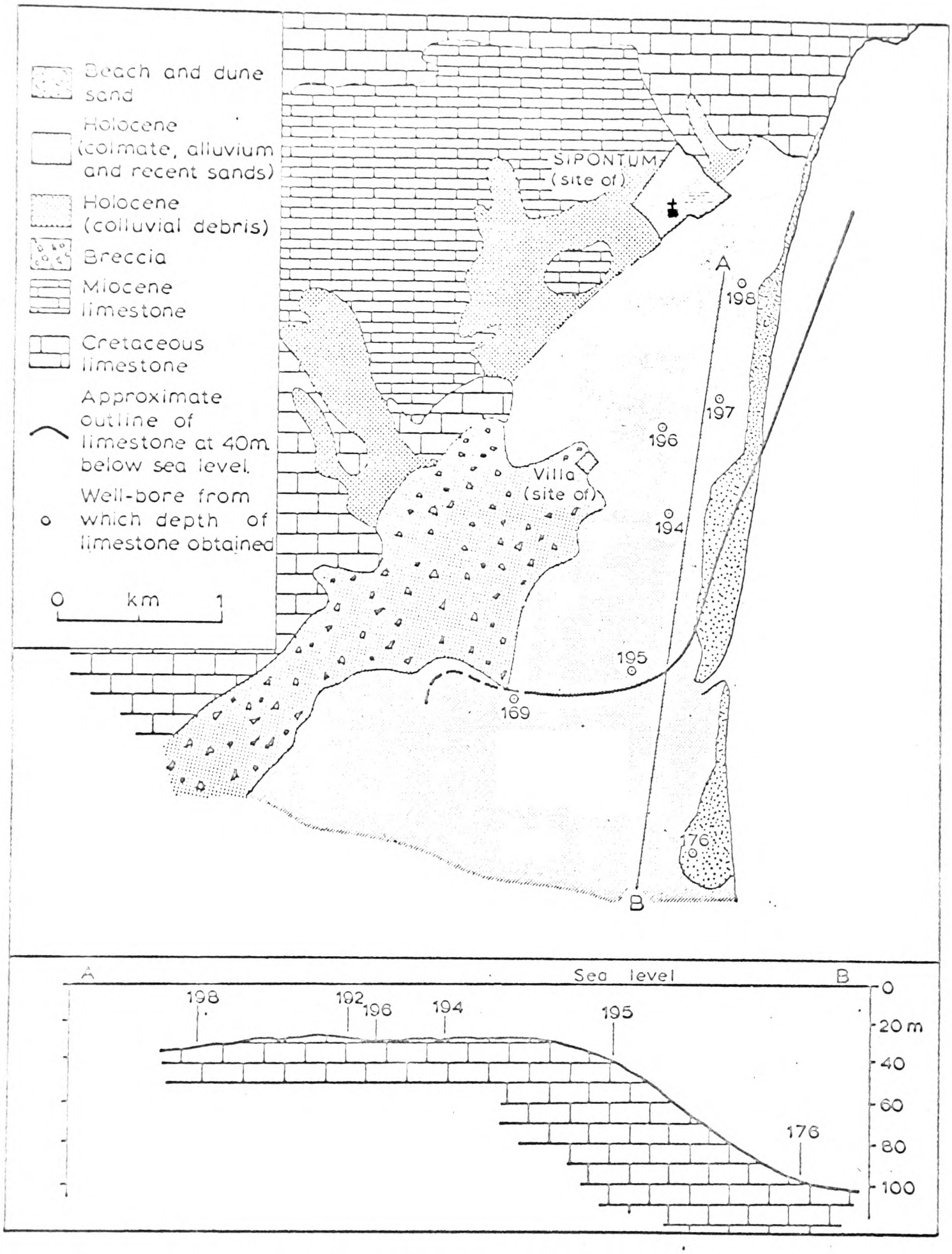


Figure 32. Geological structure at Siponto, showing the limestone platform below the lagoon area.

its transience. The key to this contrast would seem to lie in geological structure far below the lagoons. Unlike the main coastland area Siponto is underlain at relatively shallow depth by limestone. From the well-bore data available (Tramonte, 1955) for the Siponto area it is seem that calcareous strata area reached scarcely 40 metres below the present coastline (figure 32). South of the Candelaro, however, this limestone is not encountered with until 100 metres below ground level. Further south still, there is no sign of the limestones even at 120 metres below the surface of the ground (figure 33). Instead, the gently shelving, soft, Pleistocene deposits of the Tavoliere would have presented just the conditions considered by many coastal geomorphologists as predisposing the development of accumulation forms along the coast. In contrast at Siponto the limestone shelf, which is no doubt part of the Gargano structure, forms an abrupt and rocky submarine profile. Not until post-glacial sea rise had reached a certain point could a barrier island form off the Siponto coast. This was the time, too, that the gap represented by the Gulf of Lago Salso began to be narrowed by the gulf, enclosing the vast water body of Lago Salso and creating a true coast road between Siponto and Manfredonia.

(b) Sediments at Salpi.

In many respects the Salpi lagoon poses very different problems from Siponto. To start with, the total area involved in the investigations is considerably, and dauntingly, larger. There are two major ancient settlements in the area to take account of and neither presents so neatly defined an occupation zone as Sipontum. Daunian Salpi, in particular, is an extensive (covering some 9 square kilometres) and ill-defined archaeolog-

ical zone. The later Salpi (Monte di Salpi) comprises a prominent mound of only 2 square kilometres area but the Roman site underlying it was a good deal bigger (see page 266). Including not only the immediate environs of each site but also the area between, at least 46 square kilometres are of potential interest. Some of this would have been lagoonal, much would have been occupied land but one of the problems is to draw that distinction. In comparison, the entire Siponto area, lagoon and archaeological zone, totalled not more than 14 square kilometres.

Secondly, the former Lago Salpi was itself a very much bigger water body, in all respects except perhaps depth, than the Siponto one could ever have been. By all accounts it was the biggest lagoon in northern Apulia, including the Lesina and Varano lagoons, and at its maximum extent probably measured 20 kilometres in length and 4 to 5 kilometres in breadth. In comparison, the Siponto lagoon could not have been longer than 2.3 kilometres nor wider than 600 to 700 metres. An associated problem is that Salpi has long been the focus of drainage efforts. Canalization is an obliterative process and quite minor alterations, intended to improve stream flow and check flooding, are compounded into a plethora of sedimentary features. The distinction between canal and stream, as Verger noted in the French coastlands, has no real meaning in such a context. (Verger, 1968).

The third major problem, already hinted at, is that Salpi lacks the rocky structures and outcrops that so conveniently define the former inlet at Siponto. To begin with, it is not easy to distinguish even 'original' (i.e. mid-Holocene) terra firma from post-prehistoric infill. The youngest strata described on the geological map is an alluvium. This, labelled Q^3t, is dismissed by the geologists simply as 'Holocene'. Yet, from a study of the distribution of Neolithic sites over all the Tavoliere it is plain that Q^3t was already terra firma by the time of early Neolithic settlement. For over one third of all sites plotted are on precisely this alluvium. Ditches for settlement enclosures and for the individual compounds were dug into this strata and there is no doubt that this terrain should be specified (for the

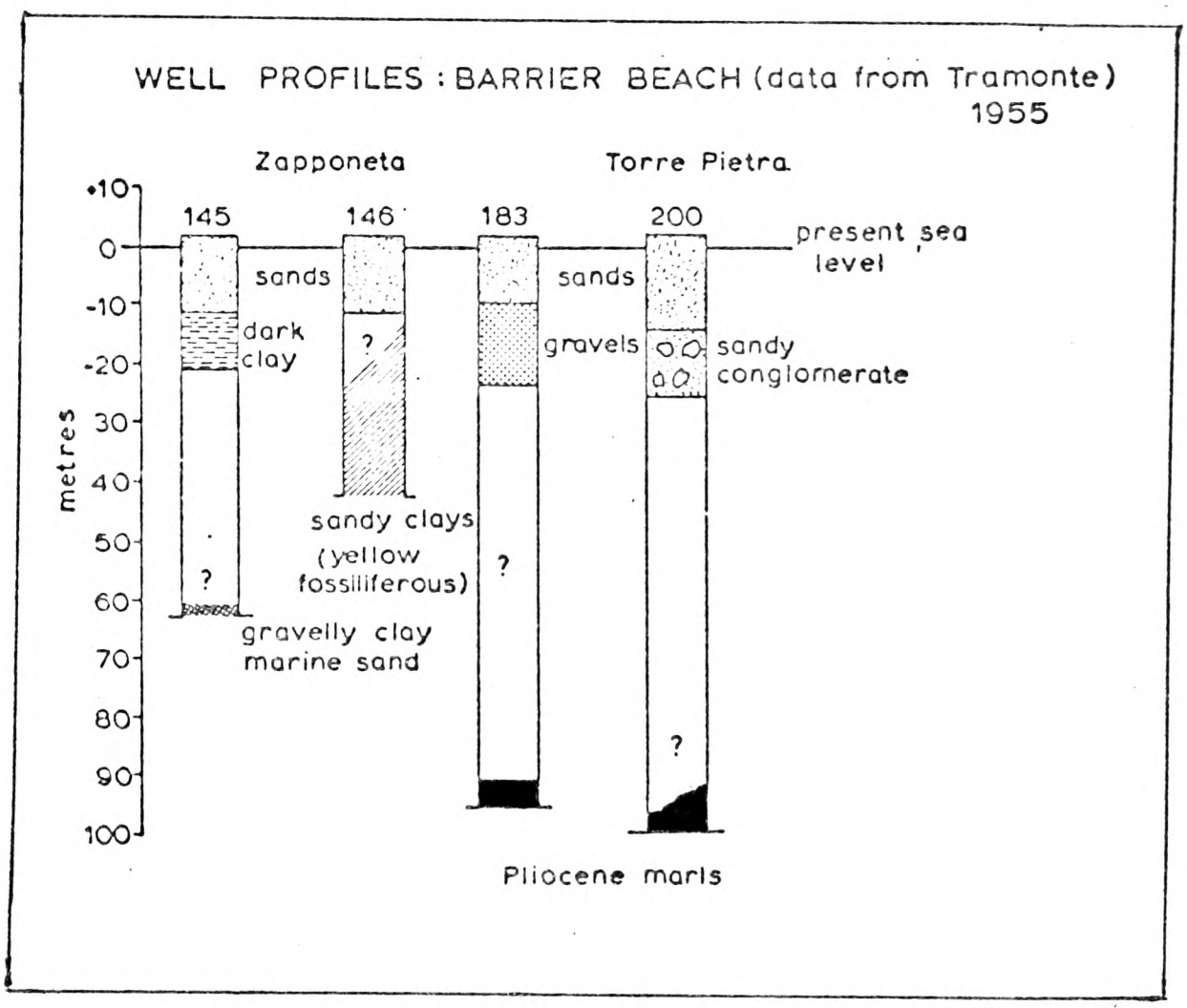


Figure 33. The Tavoliere barrier beach: sedimentary profiles derived from published well-bore data.

Figure 34

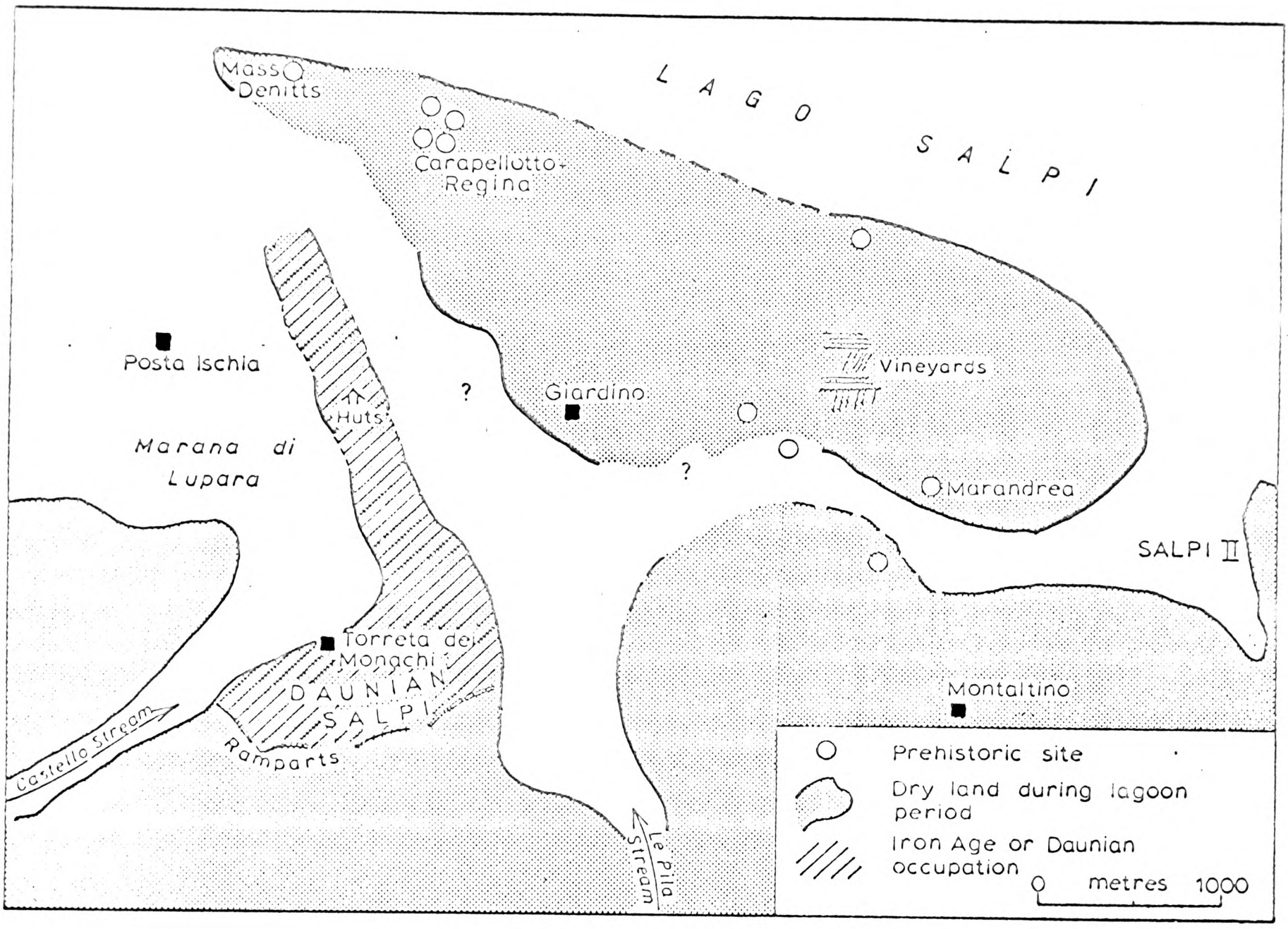


Figure 34. Neolithic terra firma at Salpi (provisional outlines), showing the promontory across the Lupara lagoon and the Marandrea channel.

purposes of this study at least) as Early Holocene. (figure 40).

Over most of the coastland, this Early Holocene terrain is readily identified by its calcrete substratum. At Giardino, for instance (shown on the geological map as Q^3t terrain) calcrete is found in thicknesses of between three and six metres (Tramonte, 1955). At Masseria Denittis is another, smaller, island of calcreted Q^3t terrain. It forms an elongated knoll two or three metres above the general flatness around. But this is not marked on the geological map (Sheet 164). At Marandrea, likewise mapped as part of a great extent of colmate (infill) alluvium covering the former lagoon, only fieldwork revealed the presence of calcrete just 60 centimetres below the surface. The calcrete substratum identifies the Marandrea terrace as a broad promontory, or outlier, of Early Holocene date, that is pre-Neolithic. Observations such as these, of Neolithic sites and occurrences of calcrete have enabled a line to be drawn between pre- and post-Neolithic alluvium in the Salpi coastlands (figure 34) as a means of identifying the precise outline of former Lago Salpi. But the complete outline of the former lagoon cannot be obtained in this way, for the calcrete is not ubiquitous and the distribution of Neolithic sites not sufficiently dense. Moreover, Bronze Age sites appear to be sited on different geological strata.

At the Bronze Age village of Carapellotto-Regina, for instance, there appears to be no calcrete although the site lies on a line between Marandrea and Masseria Denittis. In this case, it becomes even more difficult to make the distinction between Early and Later Holocene sediments (that is, between pre- and post-prehistoric alluvium). It is always a possibility that the sedimentary profiles investigated have not been deep enough, and that calcrete lies over 1.50 metres below ground level, but this would be unusual. It is also unlikely that the calcrete stratum undulates for this has not been observed elsewhere on the Tavoliere. It has been noted, however, that calcrete does not occur in valley alluvium and it is possible that there was a shallow valley or channel at Carapelle-Regina at the time calcrete was

forming elsewhere in the Salpi coastland.

The date of the geological strata on which the occupation layers rest has yet to be ascertained. There has not been any archaeological excavation at this site and the exact position of the occupation horizons in the sedimentary sequence is not known. A guess can be made, however, for there is an obvious colour and textural contrast between the uppermost grey, loamy, infill and the sandy, calcareous pinkish-yellow deposit observed in most of the profiles about a metre below ground level. While deep ploughing has reached the occupation layers (and scattered pottery fragments in the topsoil) it has not (usually) brought up any of the underlying deposit. It is unlikely that the pottery comes from the infill itself, so it may be supposed that the occupation layer will eventually be found just between the two sedimentary series, that is, at about one metre below ground level. That still fails to answer the question of the date of the pinkish-yellow stratum. Again, one can only assume for the present that it is more likely to be pre-Neolithic that pre-Bronze Age.

The fourth problem at Salpi is that the loam infill sediments are very much less idiosyncratic than the sands and clays at Siponto. There is no mollusca data, for instance, or plant remains. Facies in the loams are scarcely identifiable through granulometric analysis. Colour is of no help, except in differentiating the lagoonal deposits from the infill. Thus, while the buried relief pattern at Salpi can be reconstructed, however laboriously, it is much harder, indeed almost impossible, to suggest the history of the subsequent infilling process once this had started.

The first concern, then, at Salpi was to trace the exact outlines of the former lagoon, to identify these on the ground or, at least, to relate them to occupation features and to the early settlement patterns. In this context it was a hindrance that the area is so little known archaeologically, as it meant that the settlement pattern and occupation evidence had first to be discovered. However, from the limited amount so far achieved it is clear

Figure 35

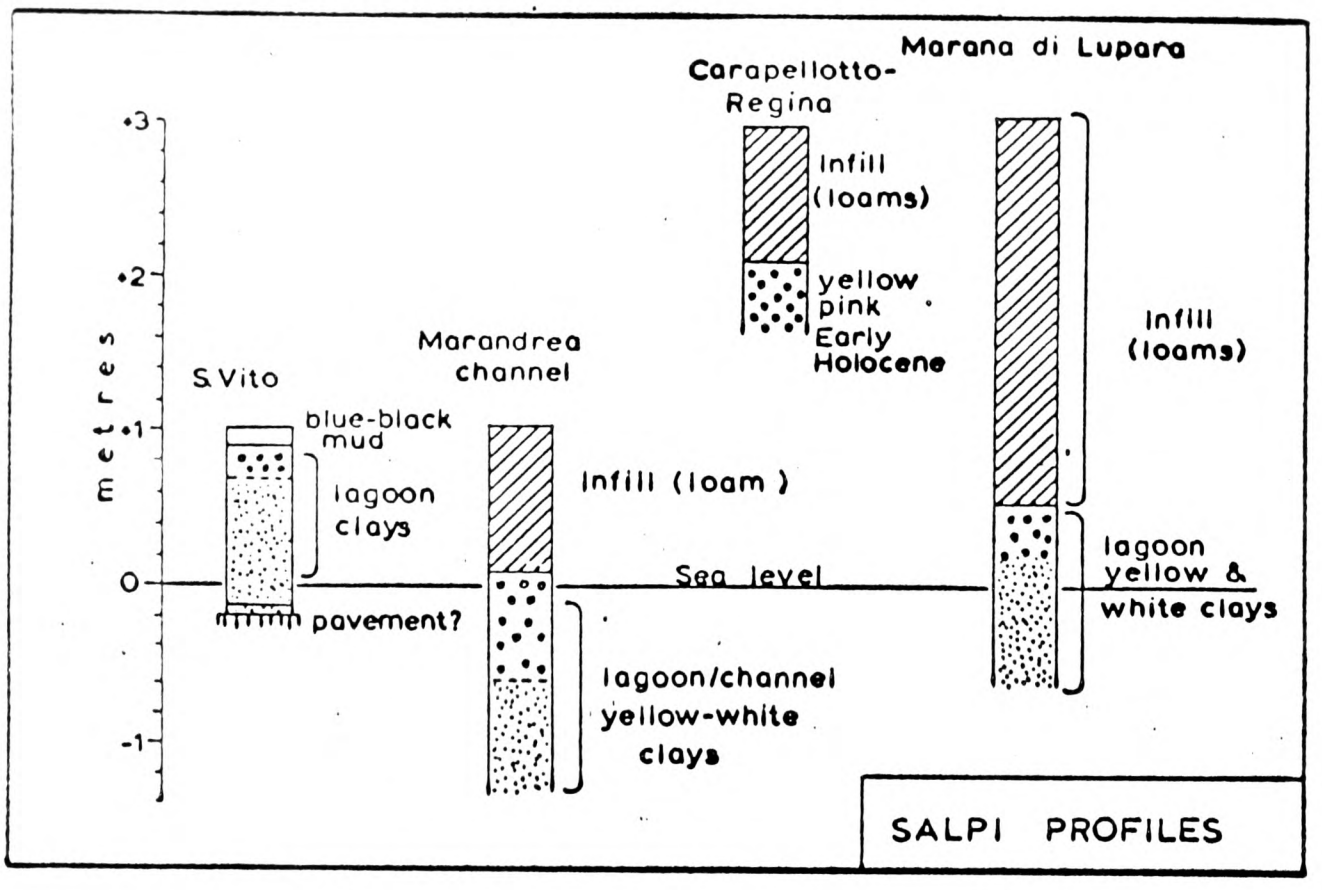


Figure 35. Sedimentary profiles from the Salpi lagoons (not to horizontal scale).

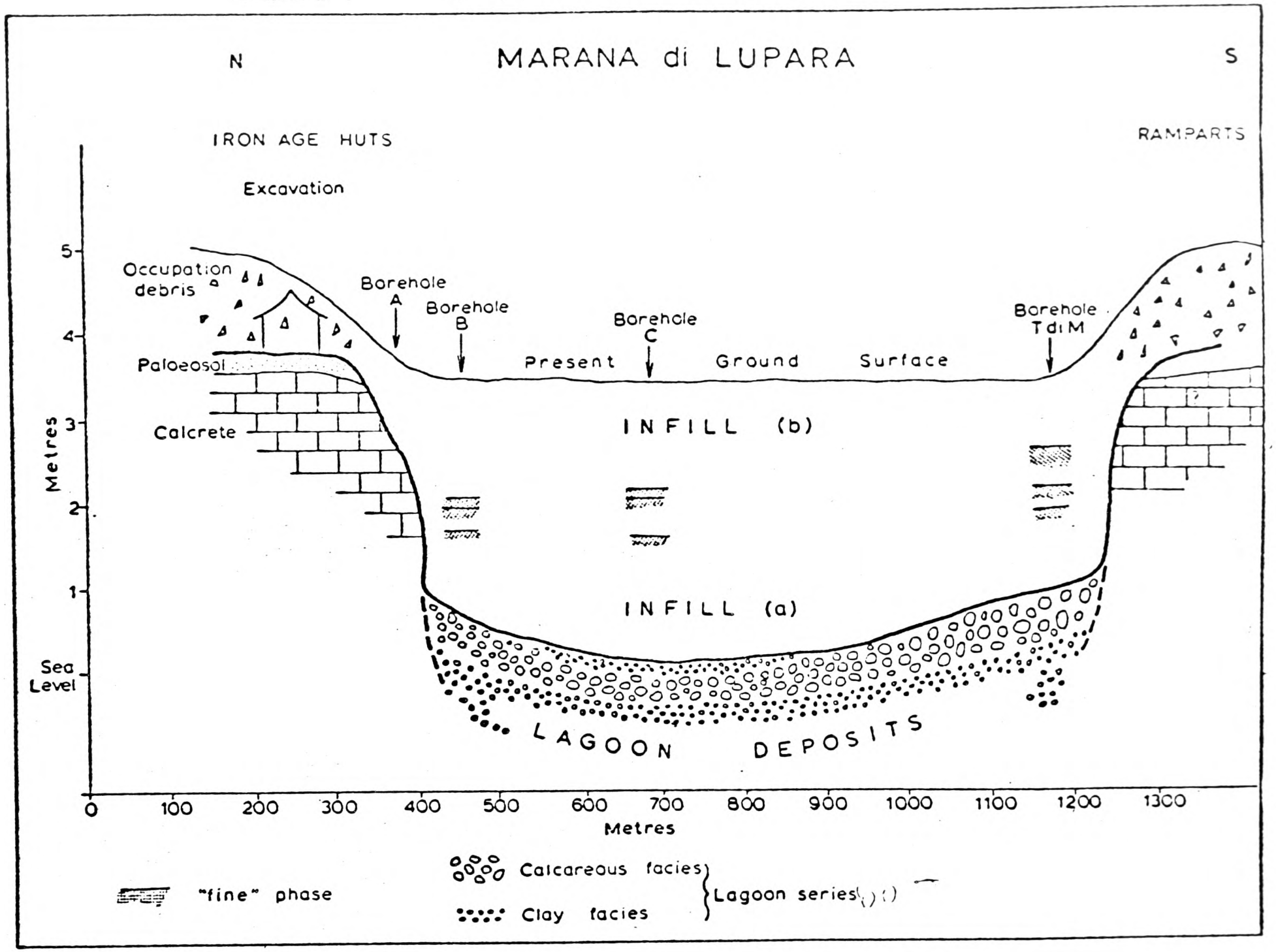
that the western shores of Lago Salpi were far more irregular in prehistoric and classical times than in Afan de Rivera's time (compare figures 14 and 37, for instance). In pre- and proto-historic times there were several inlets or channels that penetrated deep into the Pleistocene and Early Holocene mainland and that linked, in some cases, with the ancillary lagoon at what is today Marana di Lupara.

One of the first steps in drawing the lagoon outlines at Salpi in detail was the identification of Early Holocene terrain at Marandrea and of the channel that separates this from older terrain at Montaltino. The Neolithic site of Marandrea was described in 1967 (Gambassini and Cesnola, 1967). It was the first site apparently in the marshes to be made known. But the geological assessment of the site was so erroneous that the significance of its discovery was not immediately seized upon. It was stated (page 5) that "the superficial geological formation is constituted by an alluvial deposit almost exclusively silty". Fieldwork in 1971 showed this to be misleading for, immediately outside the archaeological site, to the west of the ditched enclosures, is a sharp break of slope of 2.7 metres. This is the edge of a broad, shallow, channel that has contained, since the late 19th century, Canale Giardino (plate 30). Beyond the channel the ground rises relatively steeply to Montaltino. Certainly there are silts at Marandrea, but they are in this channel, and the saline soils here remain waterlogged even during the summer. The ditched prehistoric site itself, however (to which the authors were presumably intending to refer) lies high above these silts and on a dry loamy soil, some 50 to 60 centimetres deep, underlain by calcrete and associated with Early Holocene terrain.

Investigations were made into the sedimentary profile of the channel. From two trenches and several bore-holes the sequence in the channel was found to be one metre or so of loam or clay infill (more varied in texture than at Carapellotto-Regina or Marana di Lupara) with yellow-white lagoonal deposits below. The top of this layer, the highest facies of the lagoon

Figure 36

Figure 36. Cross-section of the Lupara lagoon, showing buried relief.



series lies about 13 centimetres above present sea level (according to altrimetric data supplied by the Consortzio). The top of the lagoon series underlying Marana di Lupara, nearly 3½ kilometres inland from Marandrea, was found about 10 centimetres higher (figure 35). Evidently, a very similar sedimentary environment to that at Marana di Lupara predated the infill phase both at Marana di Lupara and in the Marandrea channel. A broad, lagoonal channel, with moving but clear water, once lay between.

The sedimentary profiles investigated at Marana di Lupara revealed that the depression was formerly some 2½ metres to 3½ metres deeper than at present (figure 36). The white or yellow-white lagoonal series underlies an infill of remarkably homogeneous flood-plain loams. The buried landscape is not a dramatic one but its reconstruction adds considerably to understanding the distribution of the archaeological evidence and, in other words, to the former topography of Daunian Salpi. For it looks as though a long narrow ridge projected north across the Marana almost dividing the former lagoon here into two (figure 34). Possibly the ridge was not continuous but composed rather of a string of islets, represented today by the isolated scatters of occupation evidence found along this promontory (figure 37). Into both parts of the lagoon flowed a small stream, the Pila and the Castello. The current from these streams would have ensured the stirring of the lagoon water body and the good circulation that is indicated by the colour and nature of the lagoon deposits, and it also assumes that there was an outlet from the Marana di Lupara lagoon into the main body of Lago Salpi.

The question of this outlet has not yet been resolved. One or even two directions can be suggested for the linking channel. The most obvious alignment would seem to be that followed today by the Giardino canal, the depression between Giardino and Montaltino. This would link the south-eastern corner of the Lupara lagoon with the Marandrea channel. The sediments at Marandrea strongly support such an alignment, for the water in the former channel at Marandrea was also well-stirred and clear, which suggests a reason-

able current. However, sedimentary data obtained from well inspection in the lowest portion of the depression between Giardino and Montaltimo fails to confirm this hypothesis. In one well, for instance, three metres of grey loam rest directly on calcrete; in two other wells, a clayey infill overlies the pinkish-yellow stratum noted at Carapellotto-Regina. If there has been a natural channel in this depression, in prehistoric or in proto-historic times, as the Tinès would like to think (Tinè, 1969), then it must have followed the course of the nineteenth century Giardino Canal so closely that it is largely hidden by it.

An alternative direction for the outlet would have been to the other side (north) of the Giardino ridge. This channel would have passed very close to the Bronze Age settlement at Carapellotto-Regina. There are signs on the air photographs of an irregular levée that could have bearing on this hypothesis, but it is too discontinuous to allow a firm interpretation. A new (1960's) dyked drainage channel now obscures the levée and no other sedimentary investigations have been carried out at the end of the Giardino ridge. A relict levée has been observed transverse to the supposed outlet but this concerned an artificial cut and is probably of recent date (plate 10). The altitude in the col is at least a metre above the lowest part of the Marana di Lupara (4 metres above sea level, instead of 3 metres) but this is similar to altitudes south of Giardino.

The history of the disappearance of the Lupara lagoon is briefly outlined, since much less can be read from the infill sediments here than from those at Siponto. The scene opens on a small lake or lagoon occupying the depression now known as the Marana di Lupara. The date is conjectured but it seems likely that this could have been the pattern at the turn of the first millennium B.C.. The exact outlines of the Lupara lagoon have not been traced but areas of Pleistocene and Early Holocene around the Marana given an approximate outline. These are indicated by the geological map (in the case of the Pleistocene) and by fieldwork (in the case of Early Holocene

terrain). Thus the long, narrow, promontory that almost divided the lagoon has a well-developed calcrete sub-stratum just 30 centimetres below the surface of the palaeosol. The promontory (or series of islands) would have not risen high above the water level of the lagoon, being at most a metre higher. The Pila and Castello streams may have brought some sediments into the lagoon but were more effective in maintaining good circulation in the water. One or two outlets linked the lagoon with Lago Salpi, passing to the north and/or south of the Giardino ridge. Possibly part of the latter outlet, a broad channel ran west from Lago Salpi itself between what is today the site of Roman-Medieval Salpi and the Marandrea terrace, and then(turning north) between Marandrea and Montaltino. Somewhere in the north-western corner of the main body of Lago Salpi, one of the Carapelle distributaries entered the lagoon.

While these lagoon outlines were maintained, a general environmental change occurred that is recorded in the yellow, calcareous facies of the lagoon sediments. The water in the lagoons and in the channels seems to have become distinctly warmer, possibly shallower. If the general water level dropped, the banks of the Lupara lagoon would have stood a little higher but the lagoon would not have appeared very much smaller. In contrast, the next stage in its history is marked by a very much shrunken lagoon area and by the onset of siltation with terrestrial material. The deposits of the relict lagoon (recorded in Hole B of the Marana di Lupara sequence) reflect a return to water conditions that had earlier left very white, fine and rather sticky muds. Perhaps such water as remained in the lagoon was cooler, or even deeper, even though of restricted extent. Elsewhere, in the Marandrea channel as well as in the erstwhile Lupara lagoon, dark riverine loams had quite abruptly begun to accumulate over the pale lagoon series. An explanation of this change has not yet been elucidated but it was noted that not only land snails but also minute splinters of pottery or of brick appeared in the infill. This would suggest that the

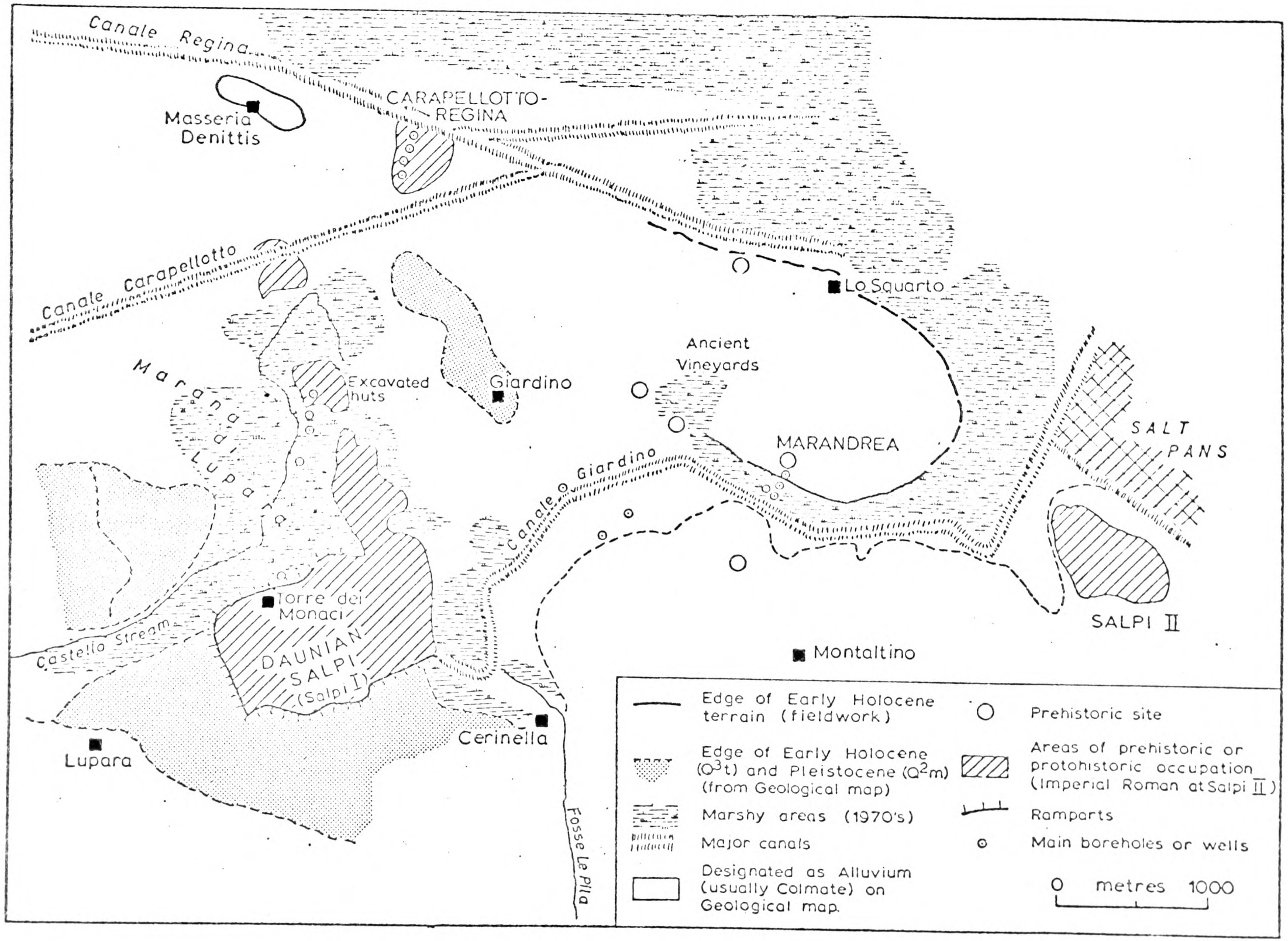
infilling process started during or after the occupation of Daunian Salpi; that is, no earlier than the 9th century B.C. and possibly very much later.

Once infilling started, there was no return to lagoon conditions. The lagoon of Lupara became the Marana of Lupara that it is today, a marsh of some 300 hectares. There may have been differences in the rate of accumulation of the infill loams, and even periods when the surface of these was cultivated. The pattern of sedimentation changed according to channel shifts in the stream responsible for the floods in the depression as is indicated, perhaps, by the granulometric variations already noted (page 140). It has not proved possible to date any of the stages of infill. The only recognisable sherd recovered from the sedimentary profiles (sample 26 at Torreta dei Monachi) was Daunian and plainly had been swept off the ramparts nearby during a flash-flood/or period of considerable run off in recent centuries. The most recent period of sedimentation is obviously that associated with 19th and 20th century attempts at drainage and reclamation, for these are colmate alluviums. The silts are much clayier and often olive-tinged, indicating poor aeration and water-logged conditions. Either a higher proportion of fine material was being brought into the depression than before or, surface drainage out from the Marana was impeded, intentionally or naturally.

Changes in the main body of Lago Salpi itself have not been fully investigated and only from one locality has a lagoon-side profile been obtained. This comes from San Vito, south of Romano-Medieval Salpi (figure 38). At San Vito there was once a large and apparently stylish domus of Hellenistic style close to the edge of the lagoon. Its foundations are found between the outer dyke of saltpans built in 1927 and the perimeter dyke of Lago Salpi built during the 19th century. Part of the structures are submerged during most of the year. The domus has been excavated (Marin, 1964) but it is not possible to be precise about the relationship between the sedimentary profiles and present sea level, for accurate altrimetric data

Figure 37.

General map of the Salpi area, showing former lagoons, channels, and early occupation sites.



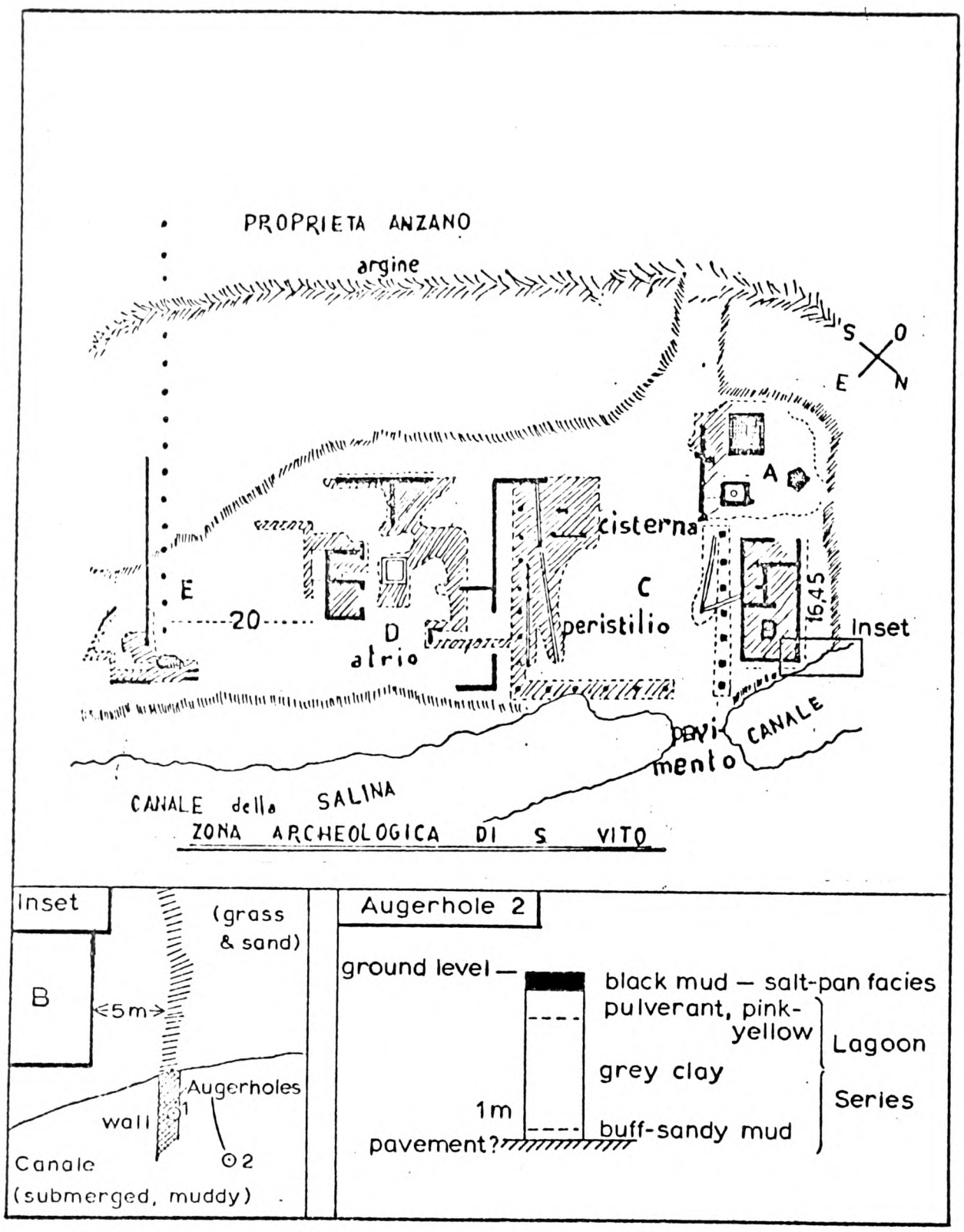


Figure 38. San Vito (Salpi): sketch of the domus site (from Marin 1964) and sedimentary profile.

are not available. On the seaward side of the site, the floor of the salt-pans must lie below sea level, for sea water enters through gravity flow (Candida, 1955). On the landward side of the site, the ground rises relatively steeply to 5 metres above sea level within the first kilometre. The domus must today be about one metre above present sea level.

Sedimentary profiles were augered as close as practicable to the outermost exposed walling of the house complex (figure 38). The wall in question is not indicated on Marin's plan but it seems to have been part of the outer structure or an enclosing wall. Paving is thought to run along the front of the building (Marin in Biancofiore et al, 1970). Accordingly, when the auger head struck a firm, reverberating 'rock' just over one metre below surface, it was accepted that the impediment was part of the domus structure and more or less in situ, the pavement in fact. This would mean that sediments lying on top of this pavement could have accumulated at any time since the 3rd century B.C.. On the other hand, the walls clearly have not been below water level throughout the whole of the post-classical period, so in the event the San Vito domus is rather less than useful in providing a terminus post quem for the metre of sediments comprising the profile.

Altogether, the lagoon series at San Vito comprises 98 centimetres capped by another 15 centimetres of blue-black mud which oxidises to grey on the surface. The first of the lagoon sediments is a very sandy, soft, white mud (5 centimetres thick), the sands giving the deposits a buff colour overall. This is followed by a grey mud, also sandy, for another 70 centimetres, and then by very calcareous, crumbly, dry deposit, pinkish-yellow in colour. The latter is associated with conditions similar to those accounting for the yellow facies of the lagoon serie at Marana di Lupara or in the Marandrea channel. This is a plausible link between the deposition of this sediment and the period at the end of the 18th century during which the lagoon was so shallow and so saline that neither fish nor plant life could survive. The depth of the lagoon at that time was no more than 5 palmi

(1.3 metres) (Afan de Rivera, 1845). In another profile at San Vito the same sediment was encountered immediately over part of the domus wall itself, which would suggest that despite the tendency of the Lago Salpi to become shallower, there was a net rise in the lagoon water level and encroachment of the lake over its shores. This could have been the effect of early attempts at improving Lago Salpi by diverting Ofanto and Carapelle water into the central portion of the lagoon (see page 90).

(c) Coppa Nevigata.

Little attempt has been made to recover the post-prehistoric sedimentary history of the zone between Salpi and Siponto. Since the three Tavoliere streams all reach the sea in this interval, a sedimentary programme based on the hand auger would be inappropriate. Were time available, however, some investigations would have been carried out in the vicinity of Masseria Cupola. It seems likely that the Daunian settlement here would have been surrounded by lagoons much as Daunian Salpi was, but on a larger scale. A cursory programme, however, was attempted at the famous prehistoric site of Coppa Nevigata.

Coppa Nevigata was occupied during the Early Neolithic, again during the Bronze Age and into the early Iron Age (Puglisi, 1955; Trump, 1966). It lies on the extreme south-east corner of the Gargano, overlooking the Candelaro valley and Lago Salso (figure 42). The site is located on a shelf of breccia and fault detritius at the foot of the Gargano. Behind it, the ground rises to the San Leonardo plateau (about 50 metres) but Coppa Nevigata itself is at 10 metres above present sea level. The modern coast is over 5 kilometres away. Marshes fill the space between Gargano and the

sea, marshes that have replaced the once open gulf of Lago Salso.

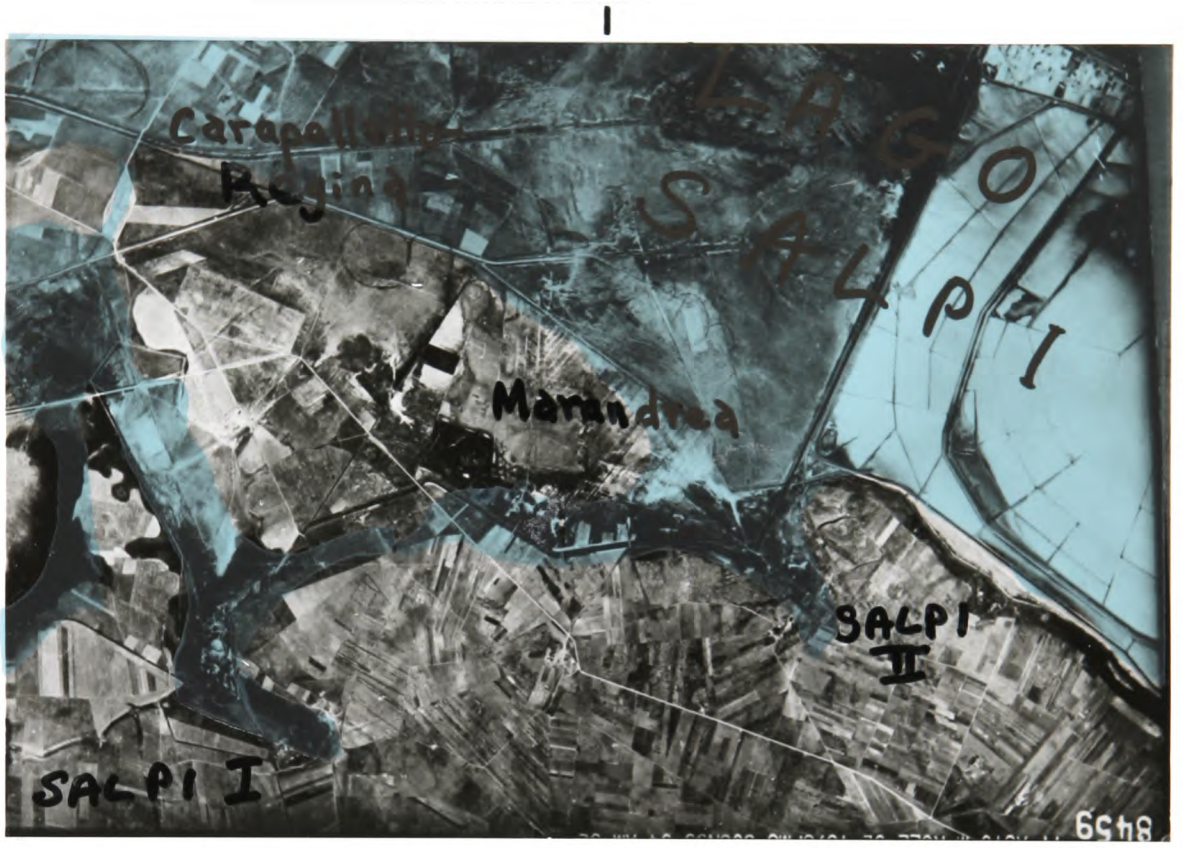
It is to be supposed, therefore, that during prehistoric times the inhabitants of Coppa Nevigata would have found themselves close to the shores of a wide gulf open to the sea. Certainly they took advantage of the natural products of an estuarine or gulf environment such as shell-fish (cockles and mussels), for which there is abundant evidence in the archaeological record (see page 250). But there are grounds for suggesting that the actual shore would have been further out from the site in prehistoric times than it is today, and that, as at San Vito, marshland and marsh sediments have recently encroached on the land. For instance, there are three structures in the Candelaro marshes that almost certainly were built on dry land (figure 42). According to local view, and the writer's kind guides, the stone structures represent ancient bridges. No information was forthcoming as to their alignment (transverse to, or parallel to, the Gargano) and adverse field conditions (plate 28) prevented personal inspection to gain a better idea of their original function and date of construction. It would be logicdl, though, to assume that they were built on dry land once part of the shore of Lago Salso. By the first decade of the 19th century, however, a series of islands had appeared along this shore (figure 10). Now, even the islands fail to stand out amongst the Candelaro marshes.

A single profile was recovered from Coppa Nevigata although the intention was to carry out a combined sedimentary and resistivity survey. It was hoped to obtain post-Bronze Age sediments by augering over the great wall that enclosed Coppa Nevigata on the landward side and that (it is presumed but not proved) continues at least a little way under the marsh sediments. But, unexpectedly, soil conditions prevented the preliminary resistivity survey and the operation is postponed for a more suitable occasion.

The profile obtained was 2½ metres deep. It revealed a sequence of phases of alternately greater or lesser marshiness. The period of colmate, for instance, has plainly introduced more water to the area of marsh just

by Coppa Nevigata. The uppermost 65 centimetres of the profile is composed of blue-black mud similar to that covering the bottom of the channel at San Vito and that is associated with standing water and anaerobic conditions. Below this, in contrast, were silty loams. These were a metre thick, brown-grey colour, with plenty of molluscs (brackish gatropods and a few ostracods) and no gravel. The sequence is then repeated further down the profile; a layer of black mud, without snails is followed at the base of the profile by a brown-grey sandy mud, with plenty of snails (gastropod, in sample 67, see table 5). No interpretation of the profiles, however, is attempted until further fieldwork has been carried out in the vicinity of Coppa Nevigata.

A certain amount of field walking was done between Siponto and Salpi. The main purpose was to check on the ground soil and vegetation marks noted from the air photographs. A number of marks had attracted attention as of potential archaeological interest. Generally, these formed circular patterns. On inspection these proved to be archaeologically negative. The key to such marks came from the Carapellotto-Regina site, where to the east of the pottery-strewn occupation area, air photographs showed a complex of over-lapping circles. These were found to be natural soil markings. The central feature was a sandy patch and it is the darker sediment around that shows on the air photograph as a circle. Such patterns are to be associated with minor meanderings of distributaries or with flood patches.



(I.G.M.)

Plate 25. Former lagoon outlines at Salpi.



Plate 26. The Lupara lagoon today: the higher, paler soil marks the occupation area at C (figure 44) and the site of the huts shown below.



Plate 27. Iron Age huts at Marana di Lupara, excavated by F. and S. Tinè.



Plate 28a. The Candelaro marshes: the structures on the left are supposedly remains of ancient bridges.



Plate 28b. The Candelaro marshes: the view from Coppa Nevigata over ex-Lago Salso. In the foreground is the part of the Bronze Age mound destroyed through excavation of material for the dyke.

III

PAST PATTERNS OF SETTLEMENT AND LAND USE IN THE COASTLANDS

A. Prehistoric settlement.

§ 1 The distribution map

When John Bradford (1949, p.60) said that the Tavoliere "had one of the densest comcentrations of prehistoric settlement yet known in Europe" (in an area of comparable size) he had in mind about 200 newly discovered sites. Even allowing for his own qualification, that "probably this number would be double if further systematic air photography was undertaken" (ibed. footnote 5), this palls besides the 1000 or so cropmark sites known to Professor Tinè to date. In this respect, Bradford's astonishing discoveries have been happily substantiated. The quantity of known prehistoric sites on the Tavoliere increases, literally, almost daily.

Qualitatively, however, less advance has been made. Three decades have passed since the first of the Royal Air Force photographs revealed the extraordinary palimpsest of the Tavoliere. Yet not so much more is known of the archaeological details of prehistoric, Roman and medieaval settlement than had been discovered by the time Bradford wrote his book (1957). That this is despite some excellent work in recent years (see: Manfredini, Puglisi, Tinè, Trump, Whitehouse, for example) is partly a reflection of the size and complexity of the problem presented by the archeological evidence for the prehistoric period alone.

The corollaries of this paucity of detail and precise fact on settlement and on economic activities in the prehistoric period are several. The misleadingly general term 'prehistoric' is frequently used throughout this study although at no time are we concerned with periods earlier than the mid-Holocene, or the Neolithic in archaeological terms. This is because, although it is now known that some sites were occupied in the Bronze Age, it is equally clear that this period on the Tavoliere is extremely imperfectly understood. There is, for instance, no way of distinguishing Neolithic from Bronze Age sites from the general distribution map. Another problem is the relatively small amount of information available for settle-

Figure 39

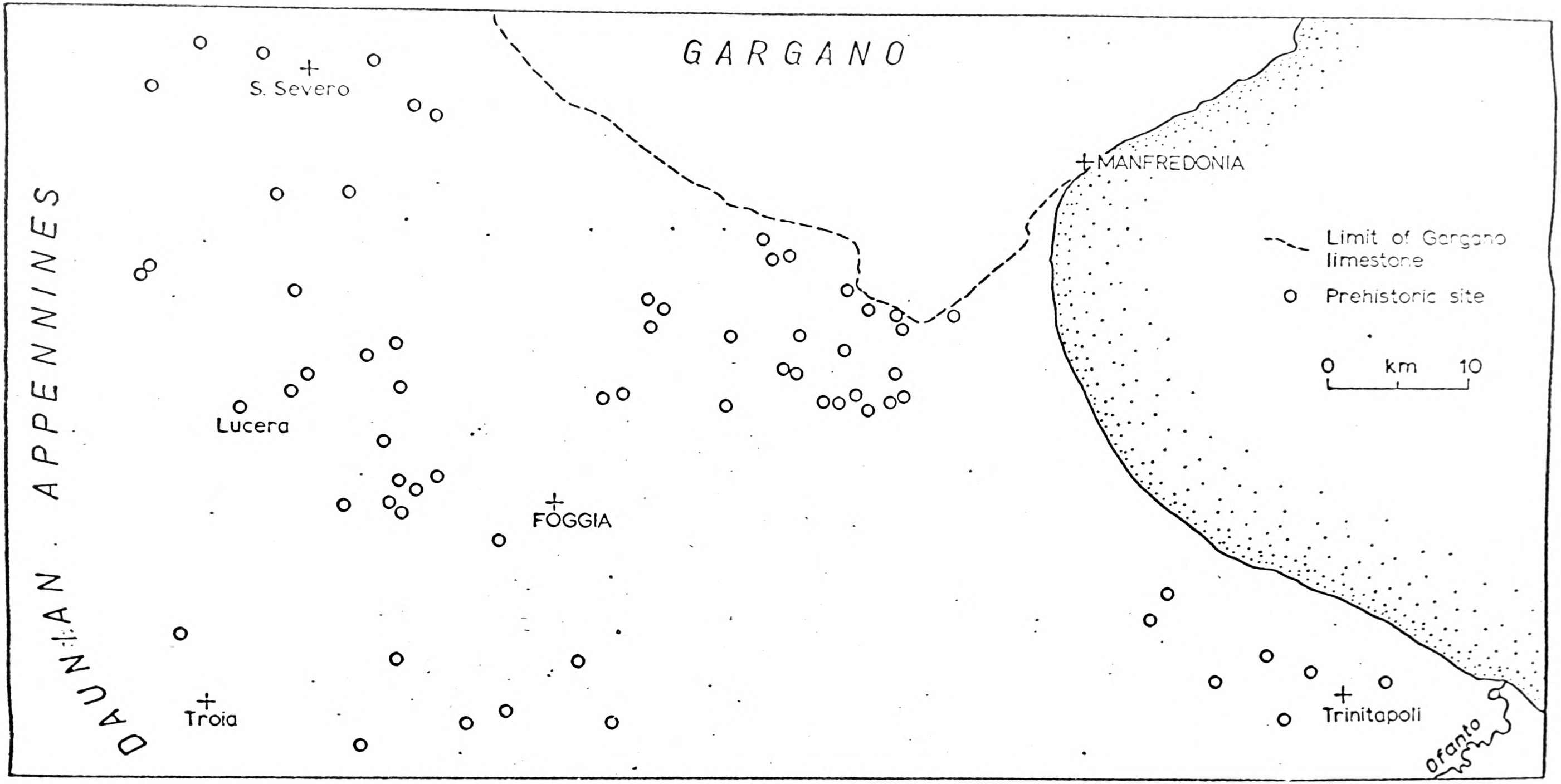


Figure 39. General distribution of prehistoric settlement on the Tavoliere, excluding coastland sites discovered since September 1971 (based on J.P. Bradford's site list and sites published in R.S.P.).

ment form and economic activities. This has meant that for the present coastland study, many basic facts have had to be gleaned from sites widely distributed over the Tavoliere.

Only 70 or 80 prehistoric sites, out of 200 spotted by Bradford, are shown in figure 39. Two things in particular account for this spatial incompleteness: the lack of air photograph evidence in some parts of the Tavoliere and the absence of a compensatory field survey in these areas. The lack of air photographic evidence is only in part due to the incompleteness of cover. The earliest (R.A.F.) air cover is no more complete for the coastal area than for the Tavoliere as a whole. The Italian air cover is complete but it was flown nearly two decades later and in the interval ground conditions changed so much that it must be assumed that many sites were not longer recordable. For one reason, there was a significant increase in deep-ploughing, to judge from the number of tractors on the plain in 1961 (7,700) compared with those available in 1951 (1,200) (Consortzio). Then there are the inevitable limitations of the air photograph record, emphasised by Bradford himself (Bradford, 1957). A single flight cannot be relied on to record all the potential archaeological evidence. Apart from climatic conditions and ground variations, agricultural activities within, even, a single field may vary from year to year and crops conducive to revealing buried features may not have been planted the year of the flight. Not all of the Tavoliere terrain is equally suitable for cropmarks. Where calcrete is absent or ill-formed (as in the Cerignola district for instance) or the ground saturated (as in the coastlands), the archaeological record may be particularly scant.

In such areas the role of fieldwork, always essential, becomes of paramount importance. Because, for instance, there are no prehistoric sites on any of the alluvial areas of the Tavoliere (except for Motta della Regina), the absence of sites from the coastlands passed without comment for many years. Close field inspection, however, in the 1971 and 1973 seasons

revealed that there are a number of prehistoric sites - of Neolithic and of Bronze Age dates - even on land mapped by the geologists as colmate alluvium. Many are unrecognisable from air photographic evidence alone and the Bronze Age site of Carapellotto-Regina is a case in point. This is in fact boldly marked on the air photographs but shows up as irregular areas of soil discoloration. Since such forms of evidence were unknown, Neolithic sites being indicated by ditched enclosures, the Bronze Age village attracted no attention until a field check was carried out 'just in case'! But, as has already been pointed out, the sort of systematic and intensive field survey needed to 'ensure' the spatial completeness of the distribution map of Neolithic and Bronze Age sites in the coastlands (let alone for the entire Tavoliere) is a major task. It may be beyond reach in terms of time, effort and expense.

The absence of prehistoric evidence from the inland alluvial areas of the Tavoliere was for long accepted more or less unquestioned. It was easy to assume that the valley bottoms were regarded as 'unattractive' or 'inhospitable' for by prehistoric inhabitants. More recently, however, stress has been laid on the absence of evidence rather than on the absence of prehisoric settlement from certain areas. The case against a supposed pre-Anglo-Saxon avoidance (Taylor, 1968) of claylands in Britain parallels the Tavoliere problem. For one thing, even if only one Neolithic site (Motta della Regina) is found in a relatively lowlying situation and on valley alluvium, it is worth being prepared to reconsider the proposition that the bottomlands were deliberately avoided for prehistoric settlement.

The crux of the matter lies in the problem of site discovery. In the first place it is extremely unlikely that buried features in alluvium will ever be revealed by aerial photography. Cropmarks reflect on the differential moisture capacity of the soil within reach of plants; soilmarks reflect more directly the same thing, the differential water holding capacity of 'bed rock' and the infill of the buried ditch. Neither condition is likely

to be satisfied in valley bottoms where alluvium is relatively homogeneous and well over one metre deep. Accordingly, almost by definition, cropmarks almost all come from the interfluves, where the calcrete sub-stratum is a major factor in their creation. It is clear that aerial photography is unlikely to reveal buried features in the alluvial soils of the Tavoliere.

Secondly, it is also clear that even field inspection is of limited use. In the case of the coastland sites, it was sufficient to inspect the surface of the ground for micro-relief, soil colour changes and artifact scatter to be fairly certain of detecting areas of former occupation, prehistoric or later. But such discoveries have all coincided with terrain that is either erroneously mapped as colmate alluvium (e.g. at Marandrea) or where the colmate alluvium deposit is so shallow that recent deep-ploughing has brought sherds and artifacts to the surface in considerable quantities, (e.g. at Carapellotto-Regina).

It has to be faced, therefore that the chances of discovering sufficient prehistoric sites from areas of valley alluvium to be reasonably confident of the spatial completeness of the prehistoric settlement distribution are extremely remote. Only towards the margins, where the overlying alluvium is thin, may features show through the alluvial mask (e.g. Motta della Regina). It has been suggested that in the case of a site 1000 years old, the proportion of original pottery likely to remain on the present surface was 0.01% (Kirkby, 1973). In the case of a site only 100 years old, 35% of pottery fragments might be expected. These figures were based on a modest rate of sedimentation of 0.25 centimetres per annum. However fanciful the actual figures might be, the point can be taken: that the chances of site discovery in alluvial areas becomes increasingly remote with the age of the site, and that the task of searching for, say, Neolithic sites, becomes too formidable for serious consideration.

An equally serious limitation on studies of prehistoric settlement patterns on the Tavoliere or in its coastlands is the chronological incom-

pleteness of the map. Not even for the small proportion of prehistoric sites plotted can dates of occupation be given except in individual cases (i.e. where there has been systematic fieldwork). This means that instead of a series of early settlement maps, arranged chronologically, we have merely a single distribution representing the amalgamation of some of the inhabited sites during a period that may have been 4 millennia long. The exact chronological significance of groupings based on cermaic styles is by no means certain.

The greatest uncertainty on the Tavoliere concerns the Bronze Age. The tendency hitherto has been to accept that by far the majority of sites were occupied during the Early and the Middle Neolithic (say, between about the mid-5th millennia and the mid-4th millennia B.C.). There was, however, until the last two years a startlingly persistent absence of evidence for occupation during the Late Neolithic and throughout the Bronze Age (until the early centuries of the last millennium B.C.). The Post-Mid-Neolithic break seemed so complete that archaeologists were insisting that "to all intents and purposes that densely peopled area (the Tavoliere) was abandoned at the end of the Middle Neolithic and part from occasional visitors remained deserted until the Iron Age" (Trump, 1966, p.56). Even more recently, Professor Tinè felt constrained to write that "it would seem archaeologically attested ... that after ... about the mid-4th millennia B.C. life on the Tavoliere became rarer, even if it did not wholly vanish" (Tinè, 1973). However unreasonable such an 'empty millennium' seemed on geographical grounds, there was little case to argue prior to the discovery of Bronze Age occupation sites and to the finding there of potsherds of Apennine or Sub-Apennine styles (page 234).

Those sites in the coastlands that have been sherded have yielded pottery evidence of a wide range of occupation dates. None should be considered as having been exhaustively surveyed in this respect, however. The earliest occupation would seem to be that represented by the so-called

Sipontinian material; impressed pottery, flint artifacts, and the scarred cockle shells typical of the best (and hitherto only) known site of this date, Coppa Nevigata (Trump, 1966). Apart from Coppa Nevigata though, there now seem to be at least two other sites (in the Salpi area) from which similar assemblages have come; Alma Dannata (G.R. 807855); Giardino-Alma Dannata (G.R. 800846). Other sites have impressed pottery but no shells; Marandrea, for instance. The largest collection of painted Neolithic ware (La Quercia style), which is thought to represent the Middle Neolithic period, comes from Versentino. There are no sites with the plain, burnished ware that, when found on its own, is associated with the Passo di Corvo style or period. Whether or not some of the sherds from the Canale Carapellotto-Regina site may represent Late Neolithic occupation rather than Bronze Age, seems to be a relatively minor point besides the assurance that the major component, at least, is Bronze Age (Apennine). Late Bronze Age (Sub-Apennine) material was collected from the Marandrea area and possibly from Daunian Salpi.

Bearing in mind the time-scale implied in any of these stylistic or cultural designations, we have at best but broad chronological boundaries for the periods of occupation of any site. Nevertheless, the pottery evidence does provide a basis for the ranking of sites. One further problem is that the total number of localities known to have been occupied during one period or another is far too small for generalisation about their siting to be significant with regard to sedimentary changes. For instance, on the face of the evidence, it seems that Bronze Age settlements occupied terrain geologically quite different from that selected by Neolithic inhabitants, but then one has to recall that no more than two or three sites are in question. Another factor limiting the discussion of settlement chronology and its implications is that very little of the material from the newly discovered or investigated sites in the coastlands has received full attention at the time of writing. Dr. R. Whitehouse confirmed C.A. Smith's comments on the

first (1971) collection of material (Delano Smith and Smith, 1973); Signor V. Russi was very helpful during the 1973 season; and Professor Tinè has confirmed in general the Bronze Age date of pottery collected from Canale Carapellotto-Regina in 1973. But the full report on all the sherded material is still awaited at the time of writing. To these, however, the writer is grateful for their help, while remaining cautious in her comments on the ceramic aspects of the prehistoric sites in the coastlands.

Before turning to the individual sites for a very brief survey of each, the following two chapters are devoted to more general aspects of the Neolithic on the Tavoliere.

§ 2 The Tavoliere in prehistoric times

An appraisal of the prehistoric pattern can be attempted from three viewpoints: the opportunities for settlement on the Tavoliere in terms of the physical environment, or the regional setting; the expectations of the inhabitants, or their perception of the area; and the environment as a resource base, the immediate setting or the local economic area.

The first and third terms are Butzer's (1964). They provide a comprehensive framework for an analysis of the environment and for the marshalling of available evidence and information. On the other hand, it has to be accepted that from the start there never will be direct evidence of the behavioural aspects of the former inhabitants of the Tavoliere, and that there is little information to marshall under the heading 'perception'. Yet it is well established now amongst geographers (e.g. Kirk, 1951; Wreford Watson, 1969, 1973; Goodey, 1971; Prince, 1971) that what people think of their homeland, in terms of its possible productivity, has been an important factor in their use of local resources and in the area's economic development.

However incomplete the prehistoric settlement map for the Tavoliere may be, that for the whole of south-eastern Italy is no better. Enough information, however, has been collected to indicate that there was a remarkably general distribution of Neolithic sites over south-eastern Italy (Whitehouse, 1968; Trump, 1966; Peroni, 1967). With the probable exception of the high Apennines, no major topographical or geological areas appear to have been shunned or found unduly attractive. Considering the unusual propensity for the preservation and revelation of archaeological evidence on the Tavoliere, it may even be suggested that Neolithic settlement was as dense on the apparently inhospitable limestone Murge as on the lowlying Tavoliere. Interestingly, then, "the two chief areas of Neolithic settlement in Southern Italy - the Tavoliere and the Materano ..." are found on very different types of terrain with (it might be thought) very different economic potential. However, bearing in mind that there would have still been a decent depth of soil on

the Murge limestones on the one hand, and that on the other, the sub-soil calcretes of the Tavoliere present a similarly calcareous environment, one realises that there would have been very little to choose between the two areas (ecologically and agriculturally) in Neolithic times. Ecological change, not geological contrast, is the key factor in the distribution of Neolithic settlement in south-eastern Italy (see Delano Smith, 1972).

The REGIONAL ENVIRONMENT of the Tavoliere has already been introduced so only selected aspects, relating to the opportunities the Tavoliere might have presented to its early inhabitants, are summarised here. Altitudinal variation is not great. Although the Tavoliere contains land rising to 400 metres above sea level, from the figures below it is seen that less than 17% of the Tavoliere lies above 200 metres (Consortzium):-

0 - 5	metres	above	sea	level	-	6.8%
5 - 10	"	"	"	"	-	2.5
10 - 25	"	"	"	"	-	6.5
25 - 50	"	"	"	"	-	15.3
50 - 100	"	"	"	"	-	24.2
100 - 200	"	"	"	"	-	28.9
200 - 400	"	"	"	"	-	16.3
over 400	"	"	"	"	-	0.4
						100.0

It is not only lowlying but a relatively flat area. No slope map has been drawn but it is hardly necessary to take measurements to suggest that possibly 80%, or even 90%, of the Tavoliere can be described as having insignificant gradients. Dissected terrain is found only towards the inner periphery of the plain, and the Apennine foothills, where land rises above 200 metres. Elsewhere, steep slopes are found only along the valley sides. These seem prominent but cannot add up to a considerable area of land.

In the absence of major relief features, the main differences in rainfall distribution reflect changes in altitude (figure 8). At least 35% of the Tavoliere may expect to receive on average no more than 550 millimetres of

precipitation per annum, and most of the coastlands can expect no more than 400 millimetres. Only on higher land, at the margins of the plain, is the annual average as much as 700 millimetres. But rainfall is not a wholly satisfactory index of available soil moisture. Sub-surface flow and ground water may contribute to moisture available for crops, for instance, and few areas on the Tavoliere should be considered absolutely dry with regard to domestic water supply, either now or in prehistoric times. The streams were not perhaps an important source of domestic supply but even so the maximum distance any settlement need be from a stream is 7½ kilometres (between the Celone and the Cervaro, south of Foggia). In most parts of the plain the water table is rarely more than a couple of metres below ground level. At the deserted medieval village of San Lorenzo, for instance, mid-way between the Celone and the Cervaro, seepages give rise to marshes and the locality has long been known as the Patano of San Lorenzo. Today phreatic water is not recommended for human consumption but this is only because better water is available from deeper wells that reach artesian flow, supplied by water from the Gargano limestone massif. Well water was the normal source of domestic supply until the arrival of the Aquedotto Pugliese in 1939 and many, if not each, individual farm or family group had its own well. Excavations of Neolithic sites (Passo di Corvo for instance) show that this was normal too in the Neolithic period.

Neither does the Tavoliere lend itself to differentiation according to geology. The entire plain is covered by unconsolidated, relatively recent (Pleistocene and Holocene) sediments; sands, gravels and clays. The limestone plateau of San Leonardo is neither officially nor traditionally recognised as part of the Tavoliere, and only in the case of the coastland sites at its foot (Monte Aquilone, Coppa Nevigata, Masseria Fontanarosa etc.) or on the breccia promontory of Mascherone are these rocky areas taken into consideration in discussions of Tavoliere settlement.

On all these counts, therefore, the Tavoliere can be considered a homo-

geneous area. There is no significant terrain differentiation with reasonable access of any point on the plain. This does not mean to say there is no variety, for within such a radius there will be alluvial bottomlands and calcreted interfluves; heavy and light soils; dense, deciduous vegetation and open, evergreen oak wood. Settlements located towards the periphery of the plain, in any direction, would need a slightly modified model. In the coastlands, for example, the lowlying alluvial soils may have been slightly saline, and there would have been the lagoons. Near the Gargano or the San Leonardo plateau, there would have been limestone upland in place of (or in addition to) calcreted interfluve. Further inland, the territory of some prehistoric communities might have included hills, terrain and a variety of geological and soil conditions, more temperate vegetation and a slightly cooler, wetter climate.

For this reason alone (apart from the defects of the map) there is little point in analysing the prehistoric settlement pattern on the Tavoliere in the hope of detecting responses to some environmental dictates. However, one or two premises and a certain number of observations can be made concerning the distribution of prehistoric sites over the Tavoliere. The premises concern particular constraints or attractions the physical environment might have had. Only two constraints in fact might have counted with the prehistoric inhabitants; the possibility of flood in the lowest parts of the valley cottoms, and (a rather less certain factor) the relatively damp and dense woodlands of the river alluviums. As already noted, the apparent lack of prehistoric sites on riverine alluvium may be a function of lack of evidence rather than a real distribution. On the face of it, though, it must be admitted that no prehistoric site (apart from the easily explained Motta della Regina) is listed as actually on river alluvium. Instead, they are so commonly found at the very point of contact between the alluvium and the soils of the interfluves that considerations other than simple avoidance might have been operating. A possible attraction operating

on the regional scale, on the distribution of prehistoric settlements might have been the lagoons of the coastlands. Despite the incompleteness of the distribution map, however, there seem to be no grounds for suggesting that Neolithic settlement was for any reason drawn towards the coast, a point that is made again shortly.

In an attempt to instill a measure of objectivity in comments on the Neolithic settlement pattern, a number of measurements were made for the 71 sites available. It should be recalled that besides the statistically unacceptable smallness of the sample, these 71 sites were not necessarily contemporary. They represent, after all, a very long period, something like one and a half thousand years.

The distance between each site and the coast was measured. This, it was postulated, could be seen as a measure of trading position or of location in relation to external (sea-borne) contacts. It may be of greater relevance when a date of occupation for each site becomes available, for it was based on the archaeologists' assumption that the earliest Neolithic immigrants approached the Tavoliere from the coast (via Coppa Nevigata: Trump, 1966). Distance from the coast was measured to either the eastern or the northern coast, whichever was the nearer. The Manfredonia Bay was in fact nearly always the relevant one. The maximum distance between coast and the Daunian Apennines is 85 kilometres. Only one site (La Lamia, near Bovino) lies in what might be regarded as a continental location, over 50 kilometres from the coast. On the other hand, a third lie within what might be considered as double the maximum distance for daily contact viz: 15 kilometres. A second clustering was noted at about 40 kilometres from the coast where 20% of the sites are found. Only two points are worth making with regard to this distribution. first, that there was no marked tendency in the aggregate pattern to cluster within daily reach of the coast. And secondly, that the distribution of Neolithic settlement closely echoes that of more recent times and clearly reflects factors other than a conscious coastwise link.

An alternative measure of centrality was made, concerning the distance between each site and the geometric centre of the plain. The geometric centre is located about halfway between Foggia and Castiglione (about 6 kilometres north-east of Foggia). Nothing, of course, is known of Neolithic administrative structure nor of the relations between contemporary settlements so no significance can be attached to the observation that the biggest Neolithic settlement (Passo di Corvo); possibly the most important Daunian city(Arpi); and the capital of Capitanata since the later Middle Ages (Foggia); are all located within 8 kilometres of each other and of the geometric centre. On the other hand, the compact shape of the plain is probably the chief factor in this central tendency rather than political forces. The dispersal graph showed that very few Neolithic sites were over 30 kilometres distant from the geometric centre (only 9 sites) while over a third of the sites lay between 14 and 17 kilometres distant.

The altitude at which each site is found was noted. The Tavoliere rises towards the Apennine foothills and merges into the hills at about 400 metres above sea level. Neolithic sites are found as low as 3 metres above sea level but no higher than, usually, 250 metres. Only two (suspected) sites come from over 300 metres (Serra Traversa at 320 metres and Monte Cavallo at 360 metres). Thus the majority of prehistoric sites are on the plain proper, i.e. below 200 metres. The median is at 40 metres above sea level.

The depth of water-table at each site was estimated from published data. Tramonte recognised four classes of water-table depth: less than 5 metres below ground level; between 5 and 10 metres; between 10 and 20 metres; and below 20 metres (Tramonte, 1955). However, it was possible to provide this information for only 56 of the 71 sites. Even so, there seems to be little relationship between the Neolithic settlement site and the modern depth of the water-table. The distribution of prehistoric sites between the first three classes was very close: 32%, 38% and 30% respectively. No prehistoric sites come from areas where the water-table lies below 20 metres.

Insofar as the isohyets closely coincide with altitude, it might be felt that the amount of precipitation the area around each site might be expected to receive is hardly worth measuring. Out of 75 sites only 5 lay in areas of relatively high rainfall (700 millimetres or over) and 12 in areas that might receive between 600 and 700 millimetres precipitation each year. All the remainder were in areas of, on average, less than 600 millimetres, of which half would expect no more than 500 millimetres and possibly over 400 millimetres. That means that nearly 40% of the prehistoric sites are very close to the aridity margin.

To what extent has the regional environment altered since the early Neolithic? This is a critical question in attempting to assess the habitability or economic value of a 'palaeo-land', to adopt Fedele's term (Fedele, 1973). Apart from siltation of the lagoons, the most obvious landscape change has been the disappearance of woodland. On level and non-calcareous terrain, however, disforestation has probably had much less effect on soil conditions than it had had elsewhere in the Mediterranean in hillier areas or on limestones (Delano Smith, 1972). Clearance of the valley woodlands on the Tavoliere may not have been widespread until quite late in the Middle Ages but other factors have more certainly led to a significant change in the agricultural potential of valley soils.

Post-prehistoric aggradation in the valleys, consequent on or associated with aggradation at the coast, undoubtedly has meant that "The accumulation of the younger fill profoundly modified the economic significance of the Mediterranean valleys" (Vita Finzi, 1966, p.103). But Vita Finzi does not return to this point and fails to evaluate the precise nature of the changes or their implications. In the absence of a field programme concerning river alluviums on the Tavoliere, only one point can be suggested here. It was noted that, in the case of coastland floodplain sediments, later deposits tend to be different from the earlier horizons of the same infill in respect of the proportion of fine silt and clay fractions to the rest of the granu-

lometric profile (page 138). The increase of fine elements in the most recent sediments is easily explained, since in the colmate system of reclamation flood water is deliberately held back until the full sedimentary load has settled out. Even where there has not been intentional colmate interference with the efficiency of natural drainage may affect the granulometry of deposits further upstream. The significance of this textural difference between later and earlier alluvium lies in their amenability to cultivation. Today, the Consortzio authorities recognise that soils developed on heavier alluvium are more difficult to cultivate than those on lighter alluvium. Accordingly, soils on heavy alluvium are ranked as of second class quality. It may be surmised that ancient soils developed on the older, relatively coarser alluvium would have been easier to work and, even, apparently more 'fertile'. Thus we may agree with Vita Finzi and other writers that soils on the so-called Old Fill would have been markedly different from those on the historic or New Fill (Vita Finzi, 1969; Bintcliffe, 1973). But we cannot agree that the spread of the New Fill in southern Italy was necessarily a major asset, or that it led to the creation of Elysian fields on "rich bottom lands" (Vita Finzi, 1966, p.178).

How much the valley alluviums were cultivated before modern times is not known. There is some documentary evidence for arable farming in the Candelaro valley in the 18th century (Dogana, 1735) but on the whole it may be safer to assume that such cultivated areas would have been relatively uncommon in earlier times and that large areas remained wooded. In prehistoric times, the woodland cover was probably even less susceptible to clearance for arable purposes. The only relict of valley woodland is in the grounds of the Sanctuary of Incoronata, south of Foggia. This is today a rather mixed woodland. The dominant species include deciduous oaks (Quercus pubescens, Q. Apennica) as well as the evergreen Mediterranean oak, the Holm oak, (Q. ilex); elm Ulmus montana, U. campestris); ash (Fraxinus excelsia); with poplar (populua alba) and, of course, willow common close to the river channel itself.[1] It

1 I am indebted to M. Salgue (Department of Botany, University of Montpellier) for help with the identification of plant species from the Tavoliere.

is therefore an essentially cool-temperate woodland type, tied to phreatic water. The soils may be rich in nutrients but relatively compact and cold.

In contrast there are the broad, level, expanses of the interfluves. Over the calcrete sub-stratum soils would have been light and dry, easily worked and, usually, well drained. In prehistoric times much of the climax vegetation would still have survived, and the plain would have had the open landscape of a tree-steppe. In the Mediterranean 'forest', crowns of individual trees rarely touch and may be separate from each other by up to 30 metres. None of this forest has survived for comparison with the Incoronata woodland, and there is no pollen evidence, but sufficient is known of the ecological structure of Mediterranean forests in general to permit a reasonable reconstruction. Moreover, in areas recently protected from grazing, there has been sufficient regeneration to confirm that the Tavoliere interfluves may have been forested and that trees could grow as well as the shrubs that are found there today.

It is likely that the dominant species was the evergreen oak, Q. ilex; today this is rare. Other small trees in the ilex association would have included most of those now dominant: Pirus amygdaliformis, Prunus spinosa and Rhamnus spinola. In the open spaces, the herbaceous cover would have been rich and well-developed. Today, it contains an astonishing variety of species. One botanist (Sarfatti, 1949) accounted for ten clovers (trifolium sp.), a variety of stipa grasses, numerous medika plants (Medicago sp.), euphorbes (Euphorbia sp.) and thistles (Cardus. sp.)

Soils on the interfluves are most commonly sandy loams. They may be more or less calcareous or more or less deep over the calcrete according to the locality. One can only assume that similar soils and soil depths would have been found in prehistoric times. Today it is rare to find more than one metre of soil over calcrete, and very often there is much less. A few palaeosoils were encountered in the sedimentary profiles. These were at most 30 centimetres deep but this is not very significant since in

all cases the soils came from occupation areas or even formed the floor of (Iron Age) huts and may have been compacted as a consequence. With a denser vegetation cover there should have been more humus in the soil but even today only four out of fourteen soil types recognised by the Consortzio are described as of poor quality, accounting for about a quarter of the Tavoliere by area.

The regional environment of the Tavoliere, therefore, seems to us to have provided good opportunities for farmers from Neolithic times. But such an objective appraisal is only part of the assessment; to what extent were these opportunities appreciated by the farmers themselves? To what extent may the PERCEPTION of Neolithic and Bronze Age people have been different from that of peasant farmers of more recent and modern times? This is an important question but one on which there can be no direct evidence. Only a few conjectural points can be proffered here.

The expectancy of a rural population with regard to the economic potential of its environment might, up to a point, be judged by reference to the origins of that population. There is no doubt that conditions of living and patterns of farming in a homeland contribute largely to the traditions and practises of immigrant farmers. This has been illuminatingly documented in the case of Puritan immigrants to Massachusetts, for instance (Powell, 1963). It would be a mistake to emphasise unduly the role of immigrant farmers, for colonisation is a very short-lived phase, but the original homeland traditions may be expected to survive many generations despite the possible presence of an indigenous population, with different styles of living, which sees the contribution of another element to the traditions of later generations.

Apulia in general, and perhaps the Tavoliere in particular, is seen as a key area in the transmission of the Italian Neolithic from the eastern Mediterranean (Bradford, 1957; Trump, 1966). In the transmission process, actual immigrants are assumed. Bradford pointed out that although Apulia

lay off the main axis of drift navigation from Greece to Sicily or to the extremity of the Italian peninsula, point-to-point voyaging was by then a cardinal factor in the diffusion of the Neolithic. In this respect, the Tavoliere would have been highly accessible and open to incomers from the Manfredonia bay through the lagoons.

To assume that the Tavoliere was an empty, uninhabited and unused area at the outset of the Neolithic hardly seems reasonable. There is as yet little accepted evidence for a Mesolithic population on the Tavoliere, although Ruth Whitehouse has argued a case for associating a mesolithic type of economy (hunting-gathering) with the microlithic layers of occupation at Coppa Nevigata (Whitehouse, 1971). Certainly this is a question that suffers from lack of evidence, and particularly excavated evidence, rather than from lack of pre-Neolithic inhabitants. Some of the later sediments of the Early Holocene (and even calcrete formations) may mask their sites. But although both Ruth Whitehouse and the present writer are happy to assume that there would indeed have been dwellers on the Tavoliere before the arrival of the (Neolithic) farming population, each stresses a different aspect of their role with regard to the innovators. Whitehouse attempts to show how "The indigenous communities were forced to adapt their traditional economy to the changing environment created by the farmers" (ibed, p.254). The present writer would like to draw attention to the other side of the relationship, the role of the native population on the incomers.

Assuming (again) that the appearance of the new farming techniques on the Tavoliere owed at least something to the arrival of the farmers themselves is to imply a colonizing movement of some sort. The new arrivals may not have been particularly well-informed about their future homeland. But this 'period of ignorance', if it existed at all, would very likely have been of short duration. In a very few months, sufficient experience and information would have had to be gained to allow a reasonably comprehensive appraisal of the basic opportunities offered by the new territory. In the

aquisition of such information the local population cannot have failed to have played a part. For instance, the volcanic cone of Monte Vulture would not have gone unnoticed for long; although over sixty kilometres distant it is clearly visible from certain parts of the Tavoliere, Salpi for example. It is highly likely that the desirability of obtaining its igneous rocks for quernstones was early appreciated, if not from first-hand experience then from local contacts.

Avoiding the archaeological discussion as to which ceramic or artifact assemblages represent 'the first farmers', it is accepted that at some time in the Early Neolithic farming - much as we know it - made its appearance on the Tavoliere. Whether the inhabitants of Coppa Nevigata, and other sites with impressed pottery and Sipontian assemblages, really were amongst the first farmers, as has been generally supposed (but compare Trump, 1966 and Whitehouse, 1968a) is beyond the scope of this study. For our purposes it is sufficient to accept that at some early stage, new agricultural practices were acquired from the Eastern Mediterranean and that in their diffusion at least some immigrants played an important role.

The newcomers to the Tavoliere would have viewed their new homeland as people who had always derived their livelihood through farming and who were accustomed to agricultural conditions in the drier parts of Greece and the Aegean. There is no evidence to suggest that these were not mixed farmers. This means that in Neolithic times a peasant or subsistence economy of some form typical in southern Europe and documented since classical times can be assumed. It is important to appreciate this, and that such an economy incorporates the growing of some sort of cereal for bread and the raising of some livestock for other food and domestic necessities, for manure and (some times but not inevitably) draught. Also, that it may include not only the growing of such fruit and vegetables as were available or that the farmer cared to grow, but also the collecting of products (for food, fuel, etc.) from uncultivated land. The 'mixed farming system', therefore

is both flexible and variable. There is no set pattern or established proportion of cropping to husbandry, say, or of bread crop to any other crop. Not all the community need be full-time farmers, providing their food-supply is assured by others. There are always those who have to spend at least some time as specialist potters, carpenters, traders, administrators even. The definition of subsistence farming does not exclude the possibility of a limited amount of external barter for specialist necessities. In the case of the Tavoliere Neolithic farmers, Lipari flint, Monte Vulture quern-stones would be cases in point. The emphasis in farming, given that an adequate food (and seed) supply is assured each year, may reflect individual preferences as much as environmental dictates. There may be differences within a single community, between the settlements of a region or between different but adjacent regions.

For instance, it is unlikely that the food potential of rivers and lagoons would have been ignored by the Neolithic farmers of the Tavoliere. Farming is extremely time-consuming and there may have been little time available for non-agricultural pursuits except in the 'dead' season. But certain communities, or individuals, in the coastlands may have substituted fish for meat or have taken advantage of the agricultural summer slack to collect lagoon resources. Thus, the archaeological record at Coppa Nevigata and some of the Salpi sites includes shells of cockle, presumably an element of local diet then as today. Another marine shell that appears to have been enjoyed at Neolithic sites (as in medieval settlements such as S. Chirico) is the edible donax. The distribution inland of donax might prove an illuminating tracer of coast-plain trade.

Another point to recall in connection with the traditional peasant economy, is that any economic 'specialization' would have been within the parameters of the system. Thus, gathering of cockles for instance, would be merely a variant within the general pattern of ensuring a livelihood in a rural area with, in this case, maritime opportunities. This is not a true

case of economic specialization, for it is (arguably, see page 252) not an exclusive activity. Real economic specialization develops with a commercial economy and would normally be associated with exchanges on at least an inter-regional, if not national, scale. It is not found on the Tavoliere until the Bronze Age. One factor in its development is 'political' hegemony (to which the key must be an economic one, in the final analysis at least) which is not apparent in southern and central Italy until the Bronze Age. During the Neolithic, lives were still being lived, and livelihoods gained, on a local scale.

The LOCAL SETTING, therefore, should be described. This is defined as the immediate resource area of an individual community. It should be assessed according to the requirements of farmers as portrayed in the mixed farming model. This is why Chisholm (Chisholm, 1962), rather than Butzer (1964), reached the heart of the matter in focussing on the essential requirements of a farming community that must be assured from local resources. Butzer reviewed the local setting from outside, noting the advantages the local environment might have for the inhabitants. In a sense, Chisholm's study was an exercise in perception.

Chisholm points out (p.113 et seq) there are only five basic necessities for a rural community: water supply, arable land, grazing land, building material, fuel supply. Without one or all of these, a rural community would not exist satisfactorily, and so one has to expect that all five commodities can normally be supplied from that community's own territory. Thus, the minimum radius of such a territory is determined by the amount of land needed to support all the community. The maximum radius, where settlements are not closely spaced, may be more fluid but will mark the distance beyond which it is uneconomic to travel to maintain daily or frequently needed necessities. In practice, the daily journey-to-work on arable land is the effective yardstick of a rural community's territorial radius. In actual distances, this might mean a radius of about 5 kilometres in the case of intensive arable farming, perhaps as much as 10 kilometres for extensively

farmed land. Applying this model to the Tavoliere, the local setting of each prehistoric settlement can be assessed in terms of the availability of the five basic necessities within a radius of not much less than 5 kilometres and not more than 10 kilometres. The siting of prehistoric settlement on the Tavoliere with regard to these basic necessities will be discussed in the next chapter. Meanwhile, it is sufficient to observe only that given the lack of environmental contrast on the Tavoliere, where there are no outstandingly wet or dry, hilly or rocky areas, it is the general availability of the basic commodities that is reflected in the very general distribution of prehistoric settlement already noted.

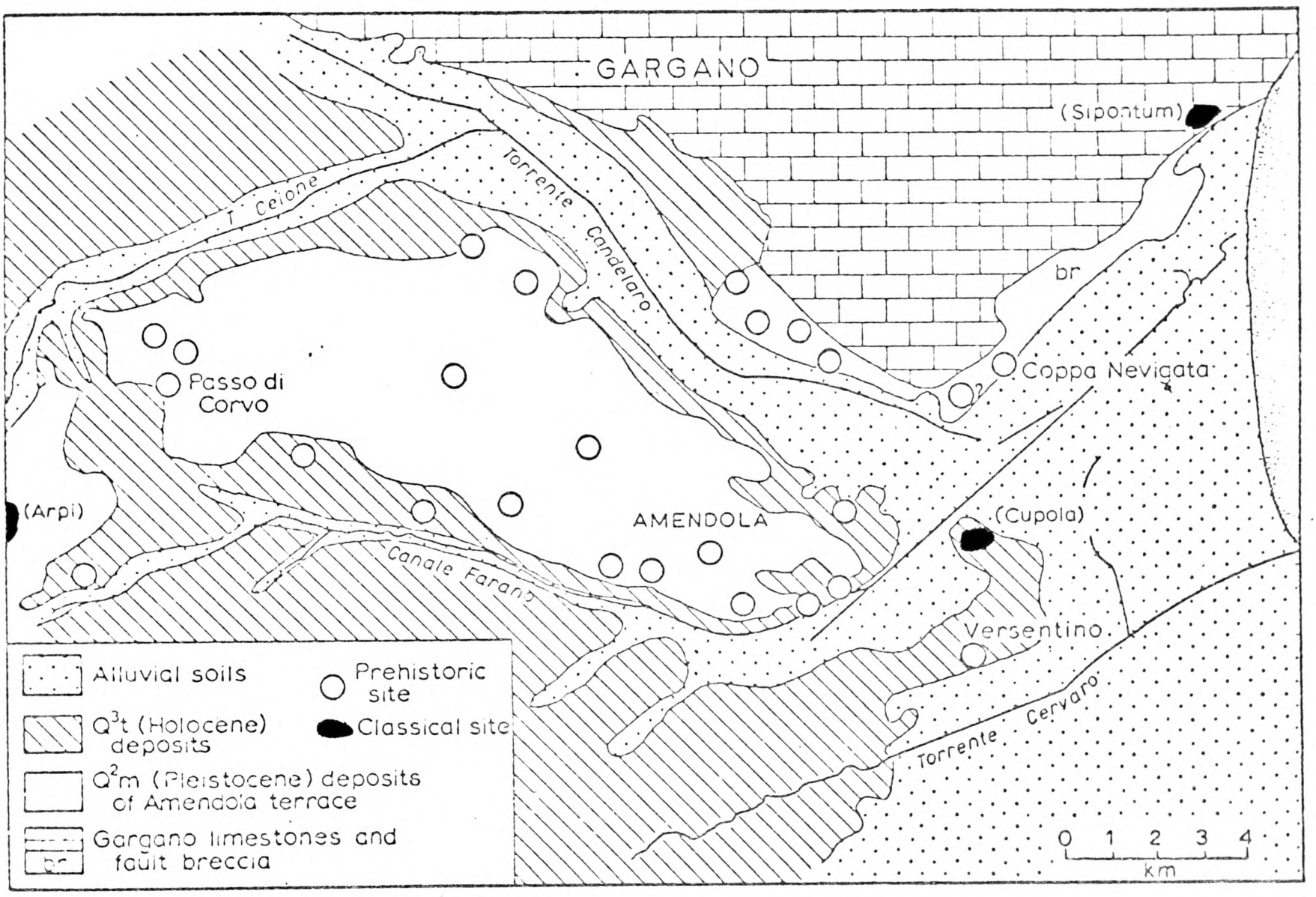
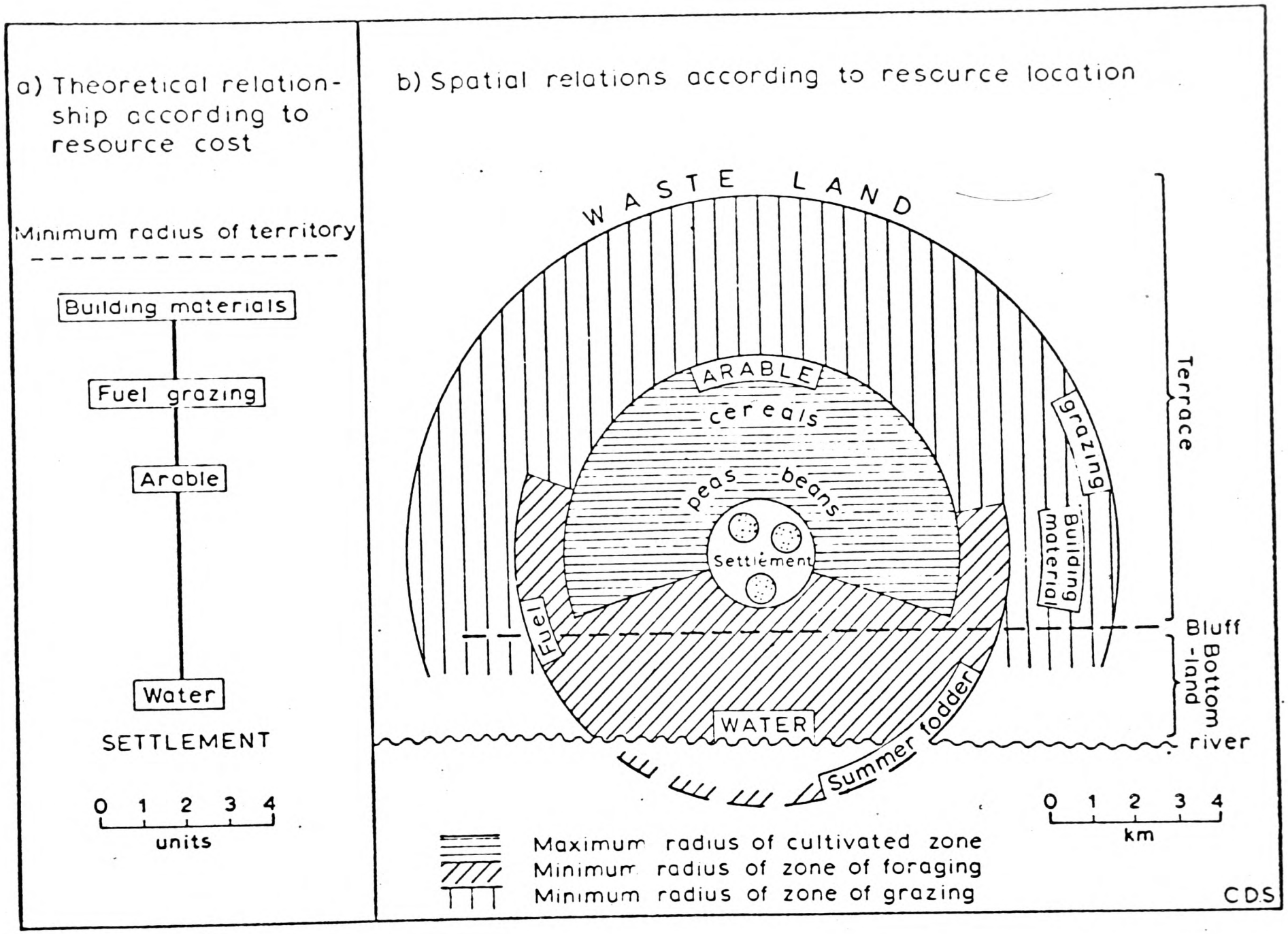


Figure 40. Prehistoric settlement and geology in the north-eastern (Amendola) part of the Tavoliere (based largely on J.P. Bradford's site list).

Figure 4I

igure 41.

land use model. In (A), all ive commodities are regarded s essential for normal rural ife (Chisholm, 1962) but have nequal value according to ortability and/or frequence f usage. In (B), the possible and use pattern is based on errain capabilities of a eolithic site at Ponte lbanito (see plate 2).



§ 3 Settlement site factors

While the local setting can be appraised in terms of the general availability of the five basic necessities outlined by Chisholm, the spatial relationship between the settlement site itself (the home of the farmers) and the resources (the fields, quarries etc. that the farmer makes use of) should be assessed in terms of accessibility. If it is accepted that without all five commodities (water supply; arable land; grazing land; fuel and building material) no rural community can survive, the ideal choice of site for the dwelling place would be the central point in relation to all five commodities. Hence the radial structure of the model (figure 41 (b)).

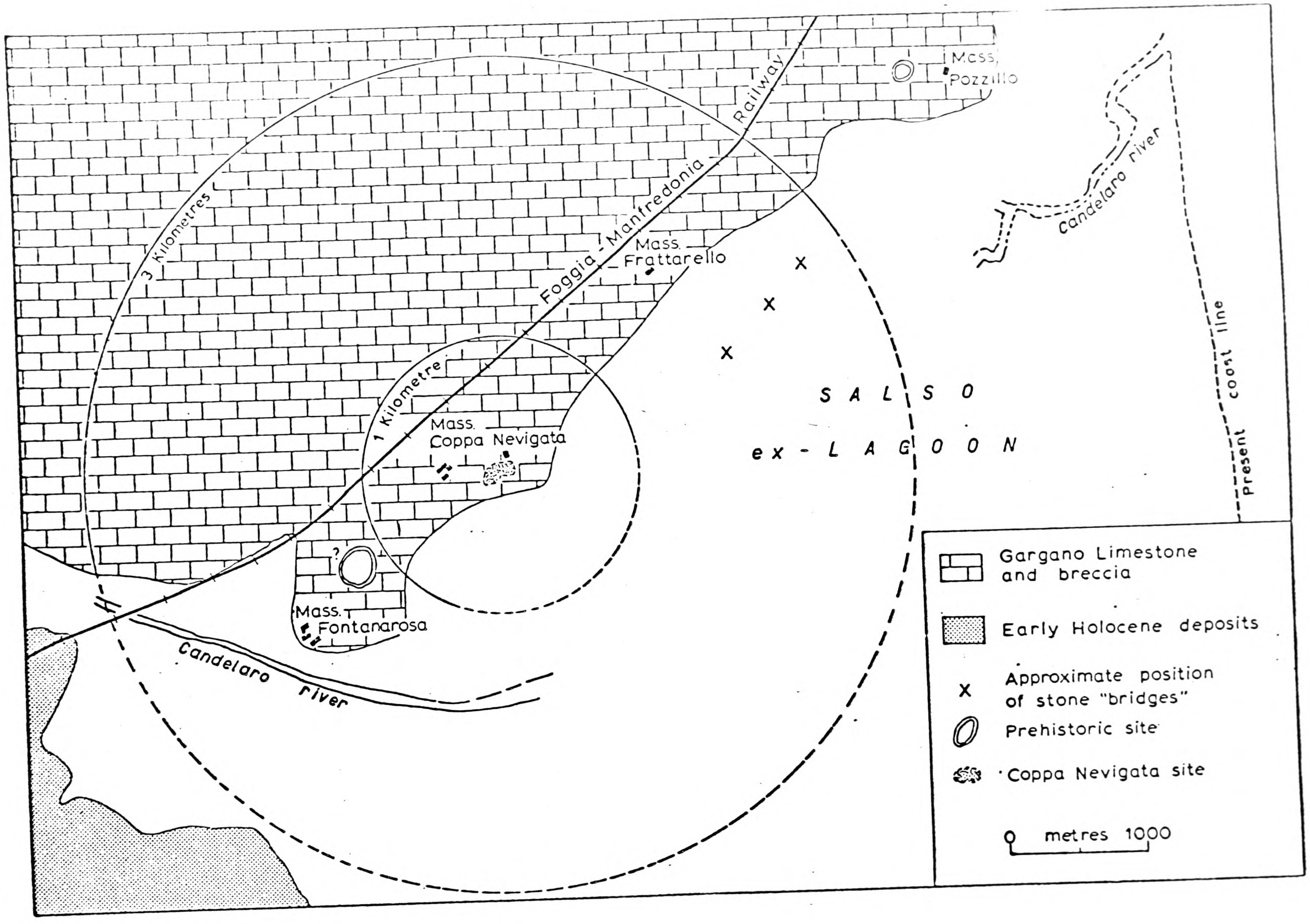
On the other hand, equidistance between site and each of the five commodities is neither necessary nor practical. According to demand, the five commodities are not of equal value, as Chisholm points out (Chisholm, 1962, p.113). However heavy and inconvenient it may be to transport building materials from the perimeter of the settlement's territory into the dwelling area itself, the demand for such material occurs only occasionally once the houses have been built. In contrast, water is relatively easily transported and there are circumstances (in Africa, for example) where domestic water is fetched daily from a source 10 kilometres distant. But on the whole, since it is in daily demand, it is useful to have the main source of domestic water close to hand. On these arguments Chisholm suggests a weighting for each of the five commodities that governs the land use pattern and may be decisive in site selection (figure 41 (a)). Given the amount of time spent in cultivation of the arable land, and that it is highly valuable but not transportable (as are livestock) in times of danger, it is normally preferred to have the arable lands as close as possible to the dwelling area. Vegetables are normally fitted into the land use pattern as close to the house as possible, grazing land occupies the perimeter beyond the arable.

No known Neolithic or Bronze Age settlement on the Tavoliere appears to

Figure 42

Figure 42.

Coppa Nevigata and its economic area. The former shore probably lay well to seaward of the actual site.



have been sited in such a position that a major distortion of this model was needed. From nearly every settlement, of the 71 sites analysed, a radial territory would have been possible. Whether this obtained there is no means of knowing, for no boundary markings indicate the extent or shape of the prehistoric village territories. In some instances, though, such a radius would have included a large segment of lagoon and it may be surmised either that the actual territory took some other shape, extending further on the landwards side, or that there were rearrangements of land use within the radial territory that took account of the actual situation. In the case of Coppa Nevigata, for instance (figure 42) it may be that fish resources were an acceptable alternative, or complement, to animal resources. For many of the inland sites, too, in fact, a similar rearrangement of land use within the territory could be suggested. A very high proportion of Neolithic settlements were sited at the contact of the alluvial soils of the river bottom-lands and the dry soils of the interfluves. In these cases, permanent meadow for instance would have been available from the bottom-lands, which were anyway unsuitable as arable. So (figure 41) the suggested land use pattern takes account of local topography. In short, there was not one prehistoric settlement on the Tavoliere, out of the 71 analysed together with the coast-land sites since added to the general map, that would not have been assured of a regular supply of all basic commodities in one form or another from a more or less radial territory, were this shape to be insisted on. In fact, many territories might, more conveniently, have been linear, stretching between the river and the interfluve much as parishes on the Lincolnshire Wolds were laid out (Orwin and Orwin, 1967). This could have been characteristic of the bluff-edge settlements, particularly where there was relatively dense contemporaneous occupation.

Since there are so few obvious influences on the distribution of prehistoric village territories over the Tavoliere, the matter of site selection of the village itself may have involved factors other than those of the physical environment. If the starting point was an area of land from

which the basic resources would be drawn, what was the factor that governed the decision to build the settlement at just that particular point at which it is found today? The factors that may have been important in the decision, religious, tenurial, political considerations for instance, are not observable from the archaeological record. Only by analogy with present-day societies and comparable environments might some idea be gained of the role of these behavioural factors, otherwise the question remains unanswerable.

In an attempt to assess as objectively as possible the place of physical factors in prehistoric site location, the same 71 sites as analysed previously were taken. No statistical tests were considered worth attempting until further information as regards contemporaneity of neighbouring sites is available.

It has already been remarked that it is difficult to find a point on the Tavoliere further from a water course than 7½ or 8 kilometres. The problem encountered in attempting to measure the distance between prehistoric sites and present-day streams is that the latter have shifted from their prehistoric courses. Abandoned meanders, relict streams and linear depressions in the valleys testify to this. So, since the meander zone may be up to three kilometres wide (e.g. the Cervaro at Incoronata) measurements were taken from the middle of the valley, without regard to the actual water course. On this basis, only four sites lay further than 2.5 kilometres from a surface stream: Amendola aerodrome (2.9 kilometres); Masseria Cascavilla (3.5 kilometres); Ovile Nazionale (4 kilometres) and Pozzo delle Capre (3.0 kilometres). The median was a distance of one kilometre.

The valley bluffs stand out as providing virtually the only relief feature on the Tavoliere. Without doubt, this was also recognised by the prehistoric inhabitants of the plain. Over half of the Neolithic sites are located at, or very close to, the bluff edge, overlooking the valley bottomlands. A few (9 sites or 13%) lay far further back or even in the middle of

the broad interfluves. Only 3 sites were located below the break of slope or on the valley side, one of which was Motta della Regina.

The question of aspect was considered. An eight-point scale was used to find that only 3 sites were on land that sloped down towards the north-west quarter. This is not very significant, since the pattern of relief on the Tavoliere is such that it is very difficult to find a west-facing slope. Only the great terminal bluffs of ridges such as those at Troia and at Lucera present a western aspect. To observe that the majority of Neolithic sites were on land that sloped (if at all) towards the east or the south, is little more than a comment on the arrangement of relief rather than on deliberate choice.

In respect of geology there seems to be little significance in the distribution of sites according to the different surface deposits (figure 40). One third are found on Early Holocene terrain (Q^3t), and one third on Late Pleistocene (Qm^2). Only three sites of all analysed are found on the breccia of the Gargano fault-scarp (Coppa Nevigata, Masseria Pozzillo and Masseria Fontanarosa). Motta della Regina is the only Neolithic site on river alluvium. There are the coastland sites at Salpi that appear to be on colmate alluviums but in fact are on Early Holocene terrain.

Finally, the distribution of sites according to the nine soil classes distinguished by the Consortzio was examined. It was found that over 40% of the sites come from strongly calcreted soils and a further 30% from those soils in which the calcrete is less well formed (calcareous clays and calcareous sands). Thus it might appear that the prehistoric settlements were located on soils that are at best of only modest quality according to the modern assessment. But it should be remembered that it is only in the last few decades that alluvial soils have become available as farmland and that these head the list. Also, that soil fertility is judged today against a very different technological background from that of even recent centuries. Yet for historic times, references to the quality of the soil on the

Tavoliere have been consistently favourable. The Roman agronomist Columella, for instance, remarked that:

> "They say that Mysia and Libya produce enormous quantities of grain, but that the fields of Apulia and Campania are not wanting in rich crops."
> (On Agriculture III.viii.4)

There is little reason to doubt that prehistoric farmers, almost wherever they were on the Tavoliere, would have found in their territory good, if not excellent, cereal land.

In conclusion, there is very little that can be said about the location of prehistoric settlements on the Tavoliere. The nature of the environment is such that once a basic model of site selection and territorial requirements is established, there are few, if any parts of the Tavoliere (the coastlands included), in which these requirements could not be met. The standard Neolithic settlement was located at the very contact of different ecological zones. These zones might include a shore or lagoon element or, more commonly, the bottomland woods of the inland valleys. It was very close to a surface stream (though this was probably irrelevant for domestic water supply and of more concern to livestock). It probably faced south or east. It had good soils within its territory. Its territory was unlikely to receive more than 600 millimetres rainfall per annum (according to the present climate), nor to be at an altitude higher than 200 metres above present sea level. How far it was from its nearest neighbour there is, at present, no way of telling, for the analysis of the prehistoric settlement pattern of the Tavoliere must remain incomplete.

§ 4 New Neolithic and Bronze Age sites in the coastlands.

The Neolithic sites of the Tavoliere have been adequately described in the archaeological literature (Bradford, 1946, 1949, 1950; Trump, 1966; Tinè, 1972, 1973; Manfredini, 1968, 1969, for instance). The outstanding characteristic of the Tavoliere sites is that almost in each case the dwelling area was enclosed by one, or more, ditches. Some of the largest sites measure 500 to 800 yards overall (Bradford, 1946) though not all are so large. Passo di Corvo (Foggia) is the most famous and is of the dimensions mentioned. Within this enclosure, concentrated in one sector, are something like 100 smaller, domestic compounds. Each of these may measure 45.70 feet in diameter and though there are some that are larger, few are smaller (ibed.).

The outer enclosure ditches are sometimes single, more commonly double and occasionally more (eight at La Quercia!). They are deep (2 to 3 metres), excavated into the calcrete, and sufficiently wide (up to 6 metres) to help keep livestock and animals within the settlement or to prevent them from entering, as the case may be. The ditches of the domestic compounds were revetted with dry-stone walling on the outer lip (plate 29), which suggests the latter concern was uppermost. Excavation has shown that the ditches were carefully designed, one end of the C-shaped ditch being shallower with a hollow or cistern (Passo di Corvo). Adjustments had been made and re-alignments found at Passo di Corvo. It is also generally accepted that they were deliberately back-filled. Within the ditches compounds excavation has revealed wells, grain silos and post-holes.

Some of these ditched sites have been found, or are suspected, in the coastlands. Marandrea was the first to be published (Gambassini and Cesnola, 1967) together with two other sites: Mezzana Communale and Posta Piana, both near Trinitapoli. From the air photographs the outlines of Marandrea are discernible as two overlapping pairs of ditched enclosures (figure 46). The smaller measures between 250 and 220 metres in diameter. The second

must have been almost twice that diameter but because of the overlap its outline is incomplete. There are faint signs of internal compounds, perhaps two or three, but the site has not been excavated and no other details are yet available. Sherding, both by the authors and by the present writer, indicated that the site was occupied in Early Neolithic times and that it may have had, too, a Sipontian assemblage. A certain amount of Bronze Age pottery was first found in 1971 immediately outside the ditched area at Marandrea but in the channel and not on the calcreted Early Holocene surface on which the Neolithic site lies and it is thought to have been derived from further up the channel, nearer Giardino.

The other Neolithic sites of the Salpi area are less well known. From the air photograph a large, heart-shaped, single enclosure to the south of Romana-Medieval Salpi was observed by Bradford (GR 846830). It lies today immediately outside the main ex-lagoon dyke in the Marana di Salpi but it has not been sherded as far as is known. Another single enclosure also shows up clearly on R.A.F. photographs (GR 807855). This lies close to the opposite edge of the Early Holocene terrace at Marandrea, about 1½ kilometres from the Neolithic site. It was visited in 1971 and in 1973. The diameter of the ditched enclosure (figure 47) is about 75 metres, and coincides in the field with a low, circular, stony, mound. It is under plough land although much of the land to the west of the site remains masked by a scrubby marsh vegetation. To the east of the site, known to the writer as Alma Dannata, would have been Lago Salpi. The pottery, coarse material, is predominantly Early Neolithic in date. In our archaeological report it was noted that

> "It includes several sherds of large, coarse, Impressed Ware vessels, two Sipontian 'flint jack-knifes' and a cockle shell with opening scar. This suggests occupation at the site very similar to the early levels at Coppa Nevigata. There are, however, also a few other Neolithic sherds of much finer character including burnished wares, one sherd of which is scratched and may belong to Whitehouse's 'Matera Scratched Ware' of the Middle Neolithic." 1

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1 Drawn up after the 1971 field session by C.A. Smith (Department of Classics and Archaeology, University of Nottingham) after consultation with Dr. R. Whitehouse.

Some building debris and Roman pottery also came from this site.

About 1200 metres west of the Alma Dannata site, close to the track between Salpi II and Giardino, another prehistoric site was found in 1971 through sherding (GR 800846 Giardino-Alma Dannata). Unlike the former site, no soil colour change or micro-relief feature marks the site, which is indicated only by the pottery scatter in the plough-soil. As in the case of the last three sites described, it lies on terrain classed as colmate alluvium on the geological map. In this case there is an overlay of such alluvium but it must be shallow, since the pottery has been brought to the surface by recent deep-ploughing. Pottery was also found in the up-cast of a drainage ditch. The archaeological report for this site reads:

> "The bulk of the assemblage is of Neolithic date, being a fine collection of Impressed Ware sherds, but there are also some burnished sherds of Passo di Corvo Type. No painted sherds were found. The assemblage includes a cockle shell with opening scar and a flint blade, suggesting that a Sipontian element may be present."

The upstanding, calcreted, ridge of Masseria Denittis seemed a likely point for prehistoric occupation. It was visited, too briefly, in 1973 but sherding was unrewarded since deep-ploughing had broken up the calcrete for a new vineyard and the former topsoil, together with any archaeological material it may have contained, was utterly lost amongst fragments of cal-crete. A single, buff-coloured, burnished sherd, that might be of Neolithic date, was found lower down the slope and it is felt that the ridge merits further investigation.

In the central part of the coastlands only the Versentino knoll was visited (1973). Much of the occupation debris here is medieval but an astonishing variety of Early and Middle Neolithic sherds were collected from the immediate vicinity of the old masseria (plate 33). From the air photograph, however, there are signs of possible ditched enclosures further east and quite clearly the entire Versentino area is another area meriting an intensive field survey for prehistoric material as well as for its later history (see page 66).

The site of Coppa Nevigata is well known. But between the modern masseria of Coppa Nevigata and Fontanarosa, to the south, the air photograph records what looks very like a major ditched enclosure (GR 687005). It is not known whether Professor Puglisi has checked this while excavating at Coppa Nevigata, but the area would merit a visit. Like Coppa Nevigata this (possible) site lies well above sea level and is located on the breccia strata of the Gargano series. It would have been close to the former Candelaro estuary and to Lago Salso, as was Coppa Nevigata.

Further north, similarly located on the breccia terrace but to the north of the Candelaro marshes, another prehistoric area of occupation was detected by sherding in 1973. This is near Masseria Pozzillo (GR 726041). Flint artefacts and a reasonable quantity of prehistoric pottery were collected but the archaeological report on these is still awaited.

From the Siponto area there is little to report. Partly this reflects intensive land use and occupation of the area since classical times. In the course of Signora F. Tinè's excavations of the northern wall of Sipontum city, some signs of "prehistoric" occupation were noted. These were artificial hollows in the limestone bedrock just inside the city walls but the pottery found there was Iron Age in date.

The Bronze Age was formerly deemed not to exist on the Tavoliere. It is most satisfactory that the new finds of Apennine and Sub-Apennine pottery come from the coastlands. Fieldwork by the present writer has been more recently substantiated by Vittorio Russi's finds in the Lesina area. The 'empty millennium', there is no doubt now, had been born of lack of information. The ceramic details cannot be given here as at the time of writing the archaeological report on the 1973 finds has not arrived from Foggia. But sufficient confirmation of the presence of a Bronze Age element at certain sites has been given by Professor Tinè for the following comments to be made with some confidence.

Hitherto the only Bronze Age site known on the Tavoliere was Coppa

Nevigata. In addition, though, there was evidence from the Gargano of occupation there during this period and, especially, from the Gargano coast at Grotte Manacore (east of Peschici) (Baumgartel, 1951). It would have been strange therefore if there had indeed been total avoidance of the Tavoliere between the Late Neolithic and the Early Iron Age, an interval of at the least a whole millennium and perhaps more. But in 1971 what appeared to be genuine Apennine or Sub-Apennine pottery was found at Marandrea and in parts of Daunian Salpi. Very recently Dr. Ruth Whitehouse has written to admit that:

> "It is quite possible that we have 'lost' a late/final neolithic/copper age phase, characterised by undecorated dark burnished wares lacking very distinctive forms."
> (for publication in P.P.S.)

The discovery (in 1971) of what can be described only as a village complex of Bronze Age date, between the Carapellotto and Regina canals at Salpi, must be one of the most significant finds on the Tavoliere in recent years.

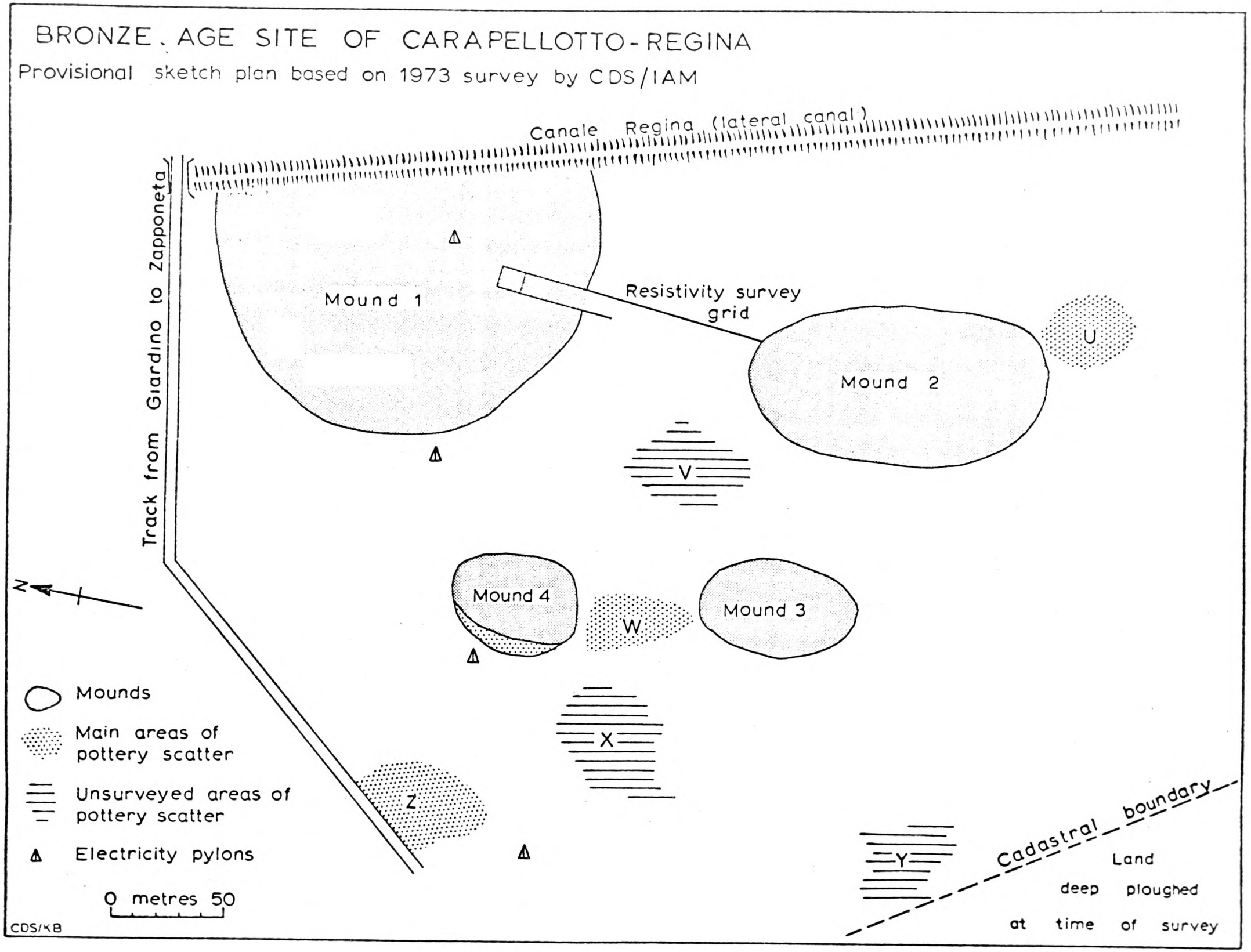
Comments on the Marandrea pottery finds have already been published (Delano Smith and Smith, 1973) so little need be added here. It should be stressed that notwithstanding the quite remarkable intactness of some of the potsherds from Marandrea, there is considerable doubt that this material is *in situ*. It cannot have travelled far, however, and may have originated in the Montaltino-Giardino area, possibly even from the Giardino-Alma Dannata site itself. Its presence at Marandrea is associated with the pattern of sedimentation of the Marandrea channel and should be investigated in that context.

Signs of Bronze Age occupation have come from the Daunian area of occupation of Salpi. Collections were made from Marana di Lupara in general but no systematic sherding was attempted since the area includes the location of Signora Tinè's excavations. The bulk of the sherds represent (Tinè and Tinè, 1969) occupation from the 9th or 8th century B.C. to the period of the Roman Republic. But our own archaeological report had

Figure 43

Figure 43.

The Bronze Age site of Carapellotto-Regina



to comment:

> "There is ... good evidence for an earlier phase of occupation in the latter part of the Bronze Age. A number of pieces can be quite closely paralleled in fabric at Coppa Nevigata and at Marandrea and the surface treatments and forms are also broadly similar. Applied cordons and swags are also present though there is no true Appennine decoration. Closest parallels seem to be within the Carapellotto-Regina site which are dated to the Bronze Age on independent evidence."

Immediately to the north of the Marana di Lupara is the outermost mound of the Daunian Salpi area of occupation (Area D on figure 44). Daunian material was of course abundant but in addition "six coarse, hand-made, undecorated sherds" were found in the 1971 collection. The report continues:

> "None of these show any close affinities with known Neolithic material but all can be fairly closely matched in the Coppa Nevigata, Marandrea and Carapellotto-Regina collections of Bronze Age material".

However much discussion there may ensue amongst the archaeologists concerning these supposedly Bronze Age collections, there is no doubt that the Carapellotto-Regina site (GR 785863) does introduce a quite new element into prehistoric settlement in the Tavoliere coastlands. The site was discovered late one summer's evening in 1971 but even in the falling light the site was outstanding. Light-coloured soil highlighted a large, low, mound, silhouetted against the dyke of Canale Regina (plate 9).

The air photograph features had already been noted for field checking but the results were unusually rewarding! The site was again visited in 1973 and some time devoted to a tacheometric survey and a trial resistivity meter run.

The site lies on what the geological map classes as <u>colmate</u> alluviums, at an altitude of about 3-4 metres above present sea level. The sediments have already been described (p. 193). The plan (figure 43) is based on the 1973 survey. From it, it is seen that the site is a complex of occupation scatters and mounds, confined to the north-western end of a trian-

gular field defined by the great dykes of the Carapellotto and the Regina canals and the track from Giardino to Zapponeta. Formerly it would have lain very close to the shores of Lago Salpi and it is possible that the outlet from the Lupara lagoon passed between the site and Masseria Denittis. Four mounds have been distinguished and there are probably another six areas of pottery scatter although some of these may be spreads from the mounds (areas W, V and U for instance). By far the most impressive single feature is Mound 1. This has been truncated, on its eastern flank, by the two Regina canals. It rises no higher than 70 centimetres above the general level of the field but the relevation is emphasised by the paleness of the soil. In outline it is roughly circular, with a diameter of about 165 metres. A pit had been excavated in the centre of the mound for an electricity pylon but although this was over 130 centimetres deep it revealed neither bedrook nor archaeological structures or features. A resistivity survey was made as a transect 10 metres wide and 120 metres long, running from the southern edge of Mound 1 up to Mound 2.

A point of interest concerns the former limits of the occupation area. The reason that the site had gone unremarked for so long is that there is no sign of the enclosure ditches so characteristic of Neolithic sites not only on the Tavoliere but in Apulia in general. The aim of the trial resistivity run was to check this absence of enclosure ditches and to confirm that the usual field diagnostics (micro-relief, soil colour change, and pottery scatter) did indeed mark the limit of the archaeological site. The latter point can be regarded as assured. On the former point, there is less certainty but it seems very unlikely that there is a buried ditch surrounding the mound. Rather, the operator (Denis Mott) reported "a confusion of what would seem to be structures and walls" under the mound. As in the case of Coppa Nevigata, excavation may demonstrate that the Bronze Age settlements of the Tavoliere were enclosed by walls, not by ditches.

Mound 2 is lower (60 centimetres at most) and distinctly oval or elongated in outline in comparison with the first mound. The other mounds were

not difficult to identify(Mound 3 and Mound 4 are 30 centimetres and 60 centimetres high respectively) but were less clearly outlined in relation to neighbouring pottery scatters. Artefact and pottery collections made from the mounds and from many of the scatters were kept as separate as possible (plates 31 and 32). In general terms there seems little reason to doubt that mounds and scatter areas comprise a single settlement complex but detailed study of the sherds (now in the Museo Civico at Foggia) may reveal slight chronological differentiation.

As far as could be ascertained in 1973 there is no sign of calcrete below the Carapellotto-Regina site. This has made the task of identifying the geological stratum on which the site was located more difficult but it does seem that it was not on the Early Holocene surface selected for settlement by the Neolithic inhabitants of Marandrea or Alma Dannata for instance. This surface slopes from Masseria Denittis (5 metres above sea level) to Marandrea (3 metres). It has been suggested (page 193) that the absence of calcrete just at this point indicates that there was a channel or lagoon inlet here in Early Holocene times preventing the calcrete from forming.

Whatever the geological reasons for the absence of calcrete, the location of a major Bronze Age settlement at so low an altitude (compared with the Neolithic sites) and so close to the shores of the former Salpi lagoon may have big implications in terms of the former physical environment. In the first place, the case for a relatively low sea stand during the Bronze Age could be a strong one. Secondly, an appraisal of the topography of the Bronze Age 'village' will have to take into account the buried relief. But whatever future research at the Carapellotto-Regina site may have in store, an outstanding contribution has already been made together with the other newly discovered coastland sites; that is, towards pinning down the outlines of the lost lagoons just as much as to the filling of the 'empty millennium'.

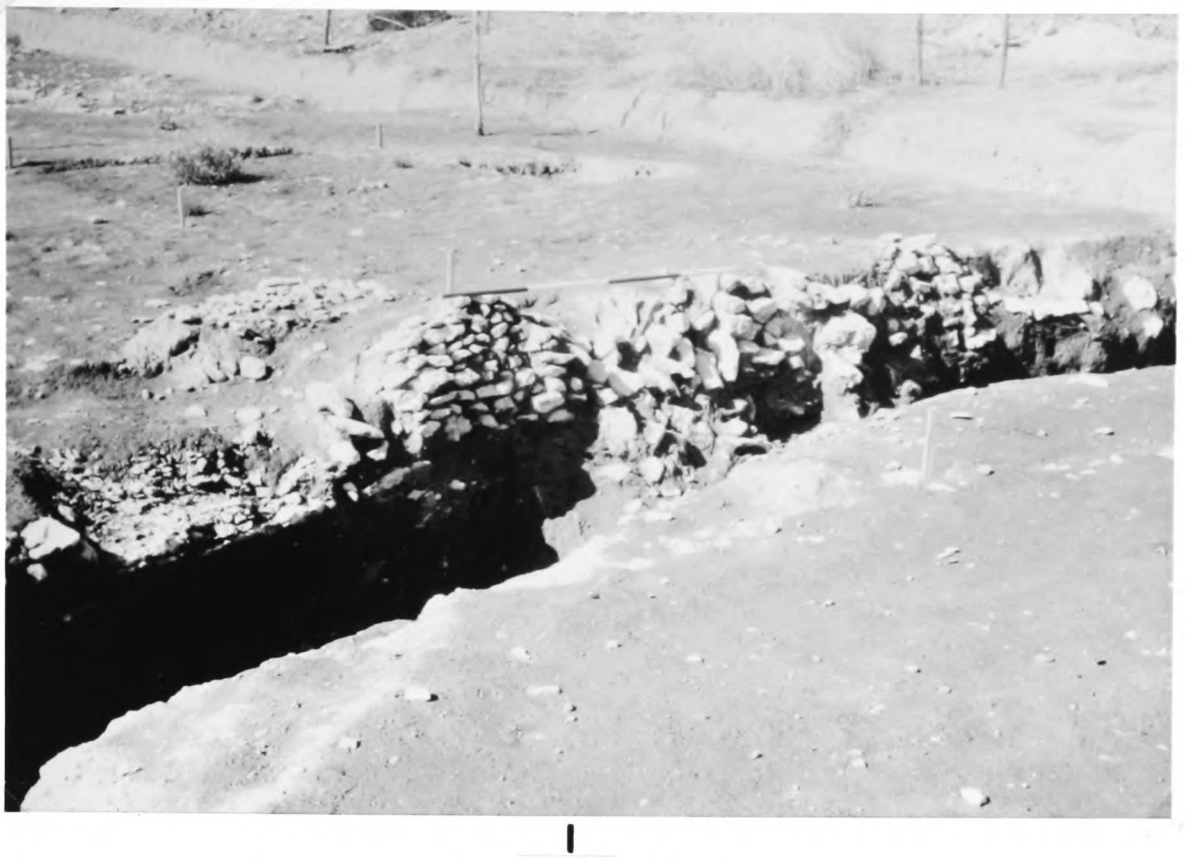


Plate 29. Passo di Corvo: walled ditch surrounding a domestic compound. (Excavated by S.Tinè).

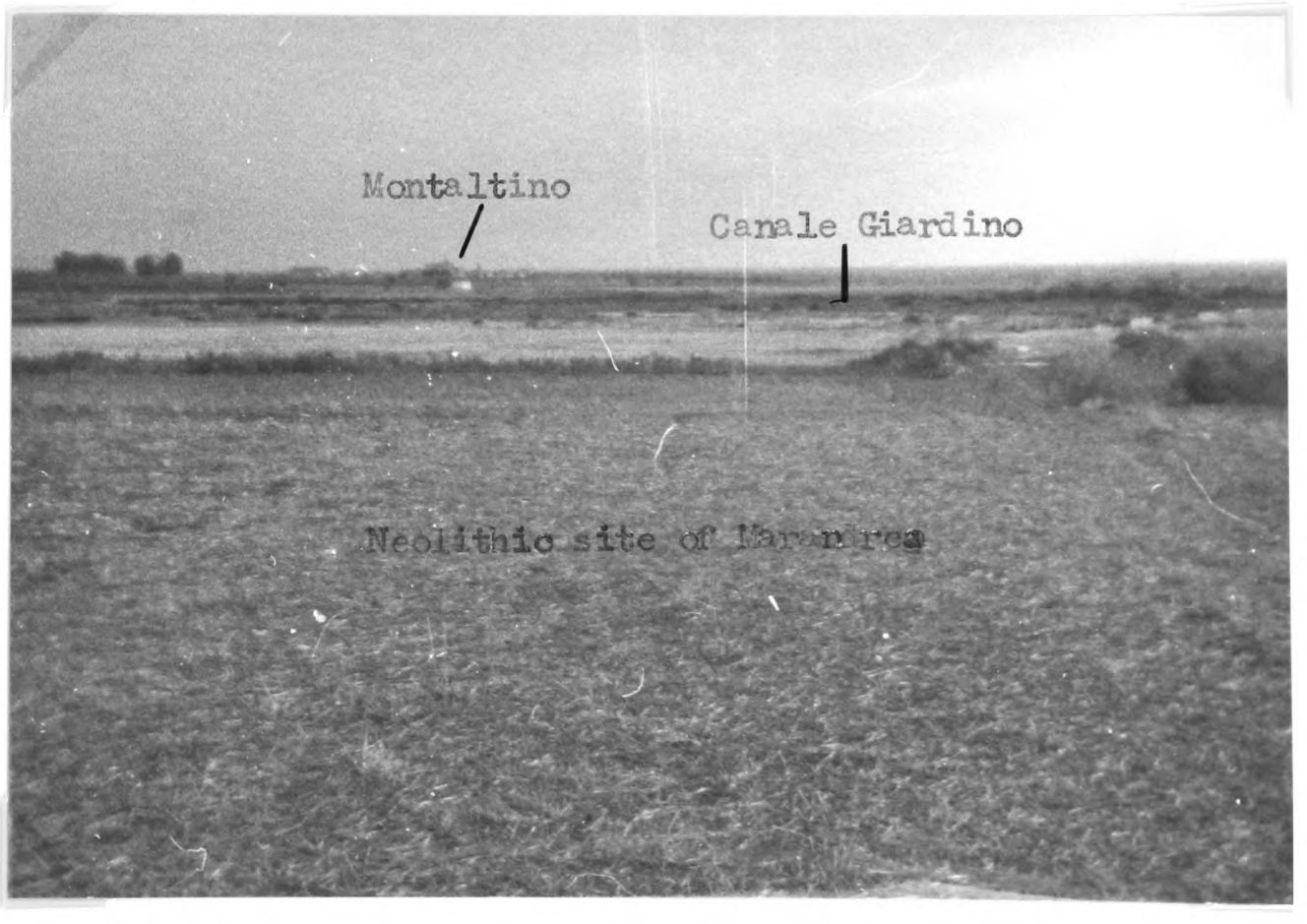


Plate 30. Marandrea: looking west across the channel.



(I.A.M.)

Plate 31. Potsherds from Carapellotto-Regina: carinated bowl fragments of Appennine style (Bronze Age).



(I.A.M.)

Plate 32. Potsherds from Carapellotto-Regina: probably from the later Bronze Age.



(I.A.M.)

Plate 33. Potsherds from Versentino: impressed ware from the Early Neolithic, a burnishing tool, and pieces of Gargano flint.



Plate 34. Woodland on the Tavoliere: deciduous oaks on bottomland alluvium at Incoronata.

§ 5 A. Aspects of Neolithic and Bronze Age economics in the coastlands.

It has become fashionable in archaeology to attempt to interpret the evidence for economic activities in relation to the environmental context (see, for example: Davidson, 1970; Jarman et. al. 1972; Higgs; 1972). Such reconstructions, however, demand a sane balancing of the actual evidence for the economic activity on the one hand and its interpretation as an economic system on the other.

The fact has to be faced that direct evidence for the economic system will remain unobtainable; remains can indicate that certain crops were grown and that certain types of livestock were kept but there is nothing to show how the farm operated or to reveal the balance of different crops or activities, management aspects etc. all of which are integral components of a functioning farm. Recourse to analogy can take one only a little way beyond a straight account of the actual economic and environmental evidence, the rest is surmise, however sound and reasonable it may be. It is particularly important, therefore, to present the facts straightforwardly and, of course, accurately, since there are so few of them. Not all attempts at reconstructing territorial models have been sufficiently meticulous: the only one so far published for a Tavoliere site is a case in point (Jarman, 1970). This concerns one of the Neolithic sites, Monte Aquilone, located on the northern valley slope of the Candelaro (although this river is nowhere mentioned) and just below the limestone plateaux of San Leonardo. But there are misjudgements of the present and past physical environments and the value of a potentially illuminating contribution is somewhat reduced.

There is remarkably little direct evidence for farming activities on the Tavoliere in the published accounts. Evidence for the ARABLE side of Neolithic farming includes "almost every typical item of Neolithic equipment ... (and) small blade fragments bearing the gloss that comes from use when set to form a sickle." (Bradford, 1950, p.87). That list referred to Passo di Corvo but more recent excavations both there and elsewhere have added

nothing new to the list except carbonised grain. It might be a useful caution to recall that little of the evidence constitutes an unambiguous index of arable farming. Quernstones could, for example have been used for crushing and grinding gathered products, acorns, say; the gloss on flint sickle teeth might be no more than a pointer to the cutting and harvesting of graminaes rather than of planted crops. But on the whole such material can, in the aggregate, be taken to indicate the former practice of arable farming.

With regard to the environment, it was suggested that it would have been the lighter soils of the Tavoliere that were preferred in prehistoric times for cultivation just as they were until the very recent arrival of the tractor and of mechanised ploughing. Many of these soils overly calcrete and are less than a metre deep. Most of the arable soils in the coastlands would have come from calcreted terrain. It is possible to argue that the shallowness of the soil cover increases the problem of aridity but in fact it is much more likely that a certain degree of dryness would have been a distinct asset. For one thing, neither the digging stick nor the light ard plough disturbs much more than the top 20 to 30 centimetres of the soil. For another thing, dryness is probably more conducive to good cereal yields than dampness, since plant competition is minimal. Certainly the cereals can be expected to have better keeping qualities.

It has been suggested that it was precisely the ecological and climatic dryness of southern Italy that contributed to the region's importance in the diffusion of the new agriculture in southern and western Europe. Raikes, for instance, has pointed out (Raikes, 1967) that the majority of Neolithic settlements in the Near East from which the earliest evidence of arable farming has come are located in areas that receive an annual rainfall average of no more than 300 to 500 millimetres. The absence of plant competition (alias weeds) is an accepted condition for successful cereal cultivation for a considerable expenditure of time and labour may be involved in weeding. (Clarke and Haswell, 1966). Instead of weeding, an alternative would be to

select regions so dry that plants less tolerant of an early summer drought or an overall low soil-moisture content than cereals simply do not survive in sufficient numbers to jeopardize the cereal yield. On this argument, Raikes based his view that the tendency in prehistoric times would have been for arable farming to expand first into the arid rather than the moister margins of the Near East and Mediterranean basin. In this respect, the drier parts of southern Europe (Greece and south-east Italy) would have played a key role in the diffusion of the new agriculture into western Europe.

In the Middle Ages, Tavoliere grain enjoyed a high reputation for its keeping qualities. Grain (hard wheat and barleys predominantly) was expected to keep for 10 to 15 years, even 20 years, in a well-built underground silo (Bouard, 1938). Some of these municipal silos survived until recently. One remains below Piano della Croce in Foggia but there are several at Cerignola. Domestic silos have been excavated at Passo di Corvo. In recent decades dry-farmed cereals yields varied between 20 and 30 quintaux per hectare, equivalent to a five or seven fold increase. This might seem optimistic as a return under prehistoric conditions but no conclusions can be reached on this point. Nor is there any means of deducing what cultivation system was operated by Neolithic farmers, and whether a shifting system or the traditional Mediterranean system of alternate fallow (based, of course, on dry-farming) was followed. It is a point, however, that could have bearing on the settlement pattern, for to postulate a shifting system might lead to suggesting that a number of settlements sites in fact belonged to a single community, who moved from one to another in a regular cycle, as Soudsky has done for Bylany in Czechoslovakia (Soudsky, 1968). It is not a hypothesis favoured for the Tavoliere, however, where the alternate fallow system has worked well for at least two millennia without the necessity of moving the dwelling point every now and again.

Land evaluation in subsistence farming would certainly have been based on the nature of the soils at the farmer's disposal, but only up to a point.

There may have been other considerations; technological, social, local expediency. For example, it is usually assumed that "the poorest soils are reserved for grazing" (Chisholm, 1962, p.113) but this does not always follow. There may be circumstances when the prime consideration is with good quality pasture in order to ensure adequate numbers and quality of livestock. The animals are regarded as essential for maintenance of yields on the arable and some authors suggest a close relationship between the area of arable that can be farmed by a community and the amount of manure available to that community (Schlicher von Bath, 1964). Or a commercial venture may be in question (Powell, 1964). Arable land can, after all, be in some measure improved through cultivation techniques but ensuring feed for valuable stock can be critical.

It is difficult to see that there would have been any sites without good or adequate arable land. For instance, Early Holocene or older terrain in the Salpi and Versentino areas would have provided as good arable land as did such terrain further inland. In the Coppa Nevigata-Siponto area, most arable land would have been on the breccia and the limestones but these would then still have the soil cover since lost through vegetation degradation and soil erosion. From soils surviving on the Gargano and from analogous situations in Mediterranean France (Delano Smith, 1972) it is suggested that prior to degradation the soil profile would have comprised, first, a dark surface layer of brown (Mediterranean) forest earth that, second, rested upon bright terra rossas (a palaeosoil). Even of this, little survives today on the San Leonardo plateaux except in the diaclases and in broad depressions that are still cultivated.

With these points in mind, it is impossible to accept Jarman's view that "... The limestone hills themselves (referring to the San Leonardo plateau) can never have offered sufficient soil for profitable cultivation" nor that they would have been used "as rough grazing in the past as today" (Jarman, 1970, p.723). For a start, a good deal of cereal cultivation is

still carried on on the plateau (see the T.C.I. Land Utilization Map, for instance). Secondly, the alluvial soils of the Candelaro valley, at the foot of the plateau, would not have been acceptable to early farmers as arable unless the older alluvium is much lighter in texture than the present sediments (see page 138), and would have taken second place to the limestone soils.

But arable activities (which includes the growing of pulses, such as peas and beans, as well as cereals) would have been only part of the early farming economy. Some sort of PASTORAL element is an essential component of the mixed-farming system not a mere adjunct. Archaeological evidence for animal husbandry on the Tavoliere is neither richer nor less ambiguous than it was for the arable side but there is sufficient to point to its existence. Whorlstones, for instance, indicate spinning and one presumes the wool was not imported. Various styles of flint or bone scrapers and awls can be interpreted as appropriate to leather working. Ditch outlines at many of the Neolithic sites has been seen as pertaining to a kraal function (Bradford, 1946). At Passo di Corvo it was remarked how the dwelling area was confined to one sector of the enormous general enclosure, as if in the other parts livestock were herded. The dry-stone walling on the outer lip of the domestic compounds at Passo di Corvo (plate 29) make sense of this suggestion. But much more satisfactory is the first animal bone analysis from a Tavoliere Neolithic site, made available by Professor Tinè (personal communication 1973). This gives not only direct evidence of the pastoral element but some details as to the animals reared.

The pre-eminence of cattle in the Early Neolithic at Passo di Corvo confirms the pattern observed elsewhere in Europe. Changes, with sheep and goats coming into first place, can be usually associated with vegetation changes (Delano Smith, 1972). Bone evidence for the later Neolithic and for the Bronze Age is not available yet but, apart from the influence of the Dogana on the sheep population in the post-medieval period, it seems

Table 8. Animal Bones, Passo di Corvo (1973).

Animal		Number of animals represented	Percentage
Cattle	(Bos sp.)	332	47.4
Goat/Sheep	(Ovis/capra)	259	37.0
Pig	(Sus scrofa)	63	9.0
Dog	(Cavis sp.)	25	3.6
Wolf	(Vulpes rulpes)	9	1.3
Deer	(Cervus elephas)	7	1.0
Tortoise	(Testudo)	2	0.3
Bear	(Meles meles)	1	0.1
Hare	(Lepus europ.)	1	0.1
Bird	(Aves sp.)	1	0.1
		700	100%

Homo sapiens: 21 fragments!

Total number of bone fragments: 3236.

that the Tavoliere was known throughout the historic period for a wide range of livestock. Strabo, for instance, remarked that "This whole country produces everything in great quantity, and is excellent for horses and sheep; but though the wool is softer than the Tarentino, it is not so glossy." (Geography, 6.3.9). From the early name of Arpi (Argos Hippium) it may be inferred that the environmental affinity between the Tavoliere and the Argos plain in the Peloponnese did not go unremarked by Greek colonists on the Tavoliere. From an entirely different context, and a later date, comes Geoffrey Chaucer's approving simile:

> "Quick-eyed, as horsely as a horse can be,
> Like an Apulian steed, as highly bred."
> (The Squire's Tale)

Cattle have been reintroduced, on a commercial scale, only in post-war decades when irrigation became common for the growing of fodder crops. After the clearance of the valley woods and before irrigated feeds became available, it would have been difficult to be sure of sufficient summer

grazing for cattle. But in earlier times, such as the Neolithic, deciduous trees (elm notably) and ivy could have been collected for livestock feed in the manner described in the Roman agricultural treatises. In the coastlands, however, there has been less of a grazing problem in recent centuries and buffaloe have been traditional graziers, contributing milk for the cheeses for which Apulia was well known in the 17th and 18th centuries. Buffaloe however were introduced into Italy from India only in the 6th century, during the Lombard period (but through Byzantine contacts with the East, presumably), and would not have been found on the Tavoliere at all during the prehistoric period.

From the table it is seen that pigs appear not to have been very numerous. In historic times swine were the peasants' standby and their absence might suggest a relatively prosperous community. Alternatively, socio-economic preferences (as in some African communities) might be reflected. Weight for weight, it may be that cattle were considered more useful than sheep (one mature cow (one Live Animal Unit) is equal to five sheep) so far as meat, milk and hide is concerned. But sheep would have provided the clothing and the much-needed sheepskin for the cold Tavoliere winters.

It is impossible to reconstruct the former carrying capacity of the Tavoliere and almost meaningless to proffer analogous data. But it is relevant to observe that neither of the dominant livestock species are incompatible in their grazing demands. What cattle find unpalatable (e.g. mullein) sheep will graze down to ground level. Swine rootle, half wild, for acorns, roots and young plants untouched by either of these. Until the supply of summer fodder and grazing no longer met the total demand there would have been no need to look further afield for summer grazing than the Tavoliere itself and its peripheral hills. But in the coastlands there may have been an additional source of grazing, the saltmarshes. With aggradation and the disappearance of the lagoons the area of marsh greatly

increased in recent centuries, though, and one wonders if there would have been very much marsh when the lagoons were still major water bodies. But since the recent salicorne associations of the Salpi were outstanding enough to attract attention from writers (Giustiniani , 1797) it may be worth digressing from the strictly prehistoric environment to elaborate a little on these.

Strictly speaking the halophytic associations in the Mediterranean are not true saltmarsh. They have developed on saturated and saline flood-plains and not in an inter-tidal zone. However, the main plant colonizers of the most frequently and permanently flooded muds at Salpi are salicornes. These are plants adapted to the physiological aridity that is imposed by an excessive concentration of Sodium chlorate in the soil (T.C.I. 1958) and so the term saltmarsh seems justifiable. There are several species: Salicornia fructicosa and S. herbacea, for instance. Arthroenemum macrostachyum is also found here but not much else. Moving inland, or towards slightly drier ground, a greater variety of plant species is found: soda or kali grass (Salsola kali, S. soda); sea blight (Sueda herbacae), the pink-flowering thrift (Statice limonium or Limonium vulgare). On still drier soil, usually forming clumps of vegetation around which the flood waters part, are found rushes (Juncus acutus or Scirpus maritimus) and a varied herbaceous stratum. At Salpi this has grasses such as Bromus tenuis, Cynodum dactylum (coach grass); marsh bedstraw (Galium maritimum); a chicory (Chicoryum intybus); mullein (Verbascum sp.). On the highest soils, one or two shrubs may be found, pistachios for example at Marandrea, together with herbaceous and trailing plants sommon further inland, such as wild asparagus (A. acutifolius).

The saltmarsh has its uses. At least one of the salicornes, the annual Salicornia stricta, is collected and cooked as a vegetable. Salt effloresces in depressions in the muds in July and August. Just as this was taken advantage of in the 18th century by the inhabitants of Margherita di Savoia so Neolithic people would have been able to collect a highly prized commodity.

The various grasses provide summer grazing for sheep as well as buffalo and cattle.

How much time or inclination Neolithic farmers may have had for HUNTING AND GATHERING besides farming cannot be ascertained. Certain animal bones in the Passo di Corvo record suggest more than a casual encounter; bear-hunting in the Daunian Apennines, for instance. But for the enormous variety of vegetable, reptile and mollusc foods that can be gained from the Tavoliere environment, there is no archaeological evidence. However, something should be said of these opportunities for collecting, hunting and fishing as it is unlikely that they were totally ignored. It should be stressed that gathering foodstuffs is as integral a part of the normal peasant pattern of life as the growing of foodstuffs. Today, though, it tends to be the poorer townsfolk of southern Italy who are the most interested in 'country salads' and meats garnered from waysides, fallow, stubble or wastelands. This is probably significant as an index of living standards rather than of the availability of ecological opportunities. The Italian peasant can extract an amazing variety of foodstuffs from the apparently most desolute wasteland, as Danilo Dolci's poignant verbatim reports from Sicily reveal (Dolci, 1966).

From the grasslands are gathered plants valued for their leaves (and thus harvestable only during the cooler part of the year) such as species of the chicory family (Crepis bulbosa and C. foetida). The latter is too bitter to be eaten uncooked. The blue-flowered commercial chicory (Cicouria intybus), abundant at Salpi even in summer, species of the lettuce family (Lactuca perennis); of the dandelion (Taraxacus gen) and nippleworts (Lampsana gen) are all gathered. The asparagus family is represented by A. acutifolius, picked early in the year before the young shoots harden into a prickly trailing liana, and by A. officinalis, much appreciated in Roman times. The 'weeds' of vineyards, olive-groves and fallow provide edible leaves: the sow-thistle, for example (Sonchus oleraceus) the milk-thistle,

(Silybum marianum) which used to be eaten in England too, either fresh or cooked.

Other plants are dug or pulled from the ground for their roots; salsify (Tragopogon porrifolius) and creeping campanula, (Campanula ranpunculoides). Still other plants provide oily seeds; members of the flax family (Linum gen.) in particular have been valued even recently as a source of vegetable oil rather than of fibre. Today's proliferation of the cereal family (Avena vulgaris, A. barbito, Triticum cillosum) may be derived from cultivation but almost certainly wild oats, and possibly wheat and barley, would have played a large part in the original plant composition. Theophrastus knew that berries of the black nightshade (Solanum nigrum) can be eaten raw and its leaves boiled as a spinach. The slow-burning properties of the giant fennel (Ferula communis) so prominent in the dessicated grassland of high summer, made it valuable as tinder. (Polunin and Huxley, 1965).

Taller shrubs and even trees have a culinary usefulness in addition to their timber. Gums from the pistachios (Pistacia terebinthum, P. lentiscus) are used for mastic, in wine preservation as well as a sealing for fishermen's craft. Similarly the ash of the bottomlands (Fraxinus ornus) provides 'manna', an exudate for which the tree is cultivated in Calabria and in Sicily. The peculiar but tasty 'strawberry fruit' of the arbutus (Arbutus unedo) are used to produce an alcoholic distillation. A common berry-producing tree and shrub of the Tavoliere steppe is the sloe (Prunus spinosa) which tends to be found along moisture-containing buried features such as Neolithic or Roman ditches. It provides a rich crop of berries, used as a purgative, and of soft, green leaves which even in summer could have constituted a useful source of animal feed. Another familiar tree is the hawthorn; the fruit of two species (Cratagaegus oxycanthoides, C.pyracantha) are still valued for jam and jelly making, and so are blackberries. The other common tree-shrub of the Tavoliere steppe, Pirus amygdaliformia,

produces curious crab-apple type of fruit, no doubt also edible. Oak foliage was well known in history as an important livestock feed (together with almond and ivy) but acorn 'flour' has not been unknown either. In association with oak forests a variety of fungi may have been found in the damp litter of the valley forests and on limestones of the hills around.

To judge again from the success of modern gatherers of snails and frogs in Palermo there would have been no less an intriguing variety of faunal resources. Three sorts of snail, frogs and eels are also collected by the 'salad gatherers'. One small snail is collected during summer straight from the dried fennel stems to which it clings in great numbers for the dormant season. These are members of the Helix family, known in France as 'moissoneuses' precisely for their availability during the harvest; Sicilians know them as 'babaluce'. The other snails have to be gathered during the winter on rocky terrain where stones provide the cool damp dark crevices that these species seek. One sort is eaten raw rather than in the usual stew. Besides snails, there is good meat on frogs and certain of the larger snakes that are also found on the Tavoliere made a favourite peasant stew in Provence. One toad alone might weigh ½ kilo, so it was relatively easy to gather 150 kilos during each year.

For the hunter no less than the gatherer, the Tavoliere must have abounded in game and wild fowl, perhaps a more rewarding source of food than gathered salads and snails. Once again the different ecological provinces of the plain and its surrounding hills make available a remarkably wide variety of game within a comparatively restricted area. Bears were common in the Apennines in Roman times and are reported to exist today, as do a few boars and wolves. Fox, deer, and roebuck, rabbit and hare are found on the Tavoliere or on the Gargano and Murge. The coastal marshes are, to believe the Italian Tourist office, 'a wild-fowler's paradise'; quail are shot in large numbers in the spring and the Tavoliere certainly was Frederick the Second's paradise for hawking. Medieval place-names such

as 'Serracapriola' suggest a noteworthy abundance of goats in that locality at least, though the rocky plateaux of the Gargano and Murge would have been eminently suitable for wild goat and sheep.

These resources would not have been out of reach of the prehistoric as well as the modern and historic inhabitants of the coastlands. Here however, there would have been other, possibly more attractive resources, than those from the lagoons. The archaeological record reveals only a small proportion of these resources, for only mollusc shells are represented. But there is no lack of these and it may be assumed that many of the fish, crustacea and the cephalopods that are still enjoyed on the Tavoliere, had their place in the prehistoric diet.

The edible cockle, Cardium edule, has been found on almost all coastland sites. The cockle is a burrowing animal and thus fine sands, rather than coarse, offer a suitable habitat though it will live in both as well as in muds. Since "in suitable areas (the cockle) exists in almost astronomical numbers" (Yonge, 1959, p.258) it may be that very little time or energy was in fact expended in gathering an appreciable quantity of cardium.

The presence of a cockle shell, or numbers of cockle shells, on a site does not automatically imply that it was gathered for its food value, although the cockle (together with the mussel and oyrster) is one of the relatively few shell species deemed worthy of commercial exploitation around the British Isles today for its food value. Cardium decoration on pottery was one of the characteristic styles of the earliest Neolithic pottery in southern Europe and individual shells may have been obtained with that purpose in mind. But the cockle shells from excavated horizons at Coppa Nevigata have one peculiarity which betrays a preoccupation with the animal inside rather than with the shell itself. Each shell edge was damaged near the hinge, where the living animal had been prised open with, it is thought, a specially designed flint awl. This assemblage, together with the associated impressed pottery, has been termed the Sipontian culture (Puglisi, 1955;

Trump, 1966; Sansoni, 1962). There is another cockle in the archaeological report but it was found in a much later context. A prickly cockle (Acanthocardia echinata) shell was retained from Signora Tinè's excavation of a Daunian tomb in the centre of Daunian Salpi.

Mussels, like razor shells, are common today in the fish market. They have been found at Coppa Nevigata possibly only in the later horizons. Normally the mussel likes a rocky shore or artificial structures to which it can attach itself by strong byssus threads. More commonly observed in sherded sites is the shell of Donax vittatus. These occurred in abundance not only along the coast but at the Neolithic site of Masseria Fonteviva, at the Medieval site of Petrulla (Santa Chirico), and are still sold in the Foggia market.

A variety of dog cockle unknown to British waters was found at the Bronze Age village site of Carapellotto-Regina. This is Glycymeris violascens, also edible which is why, no doubt, it is known to the French as 'sea almond'. Ark shells (Arca tetragona) were recovered from the same tomb excavation at Daunian Salpi as the prickly cockle: another arc species (A. noe) is known to be edible so Arca tetragona may be too.

Three different species of murex have been collected from coastland sites, mainly from the later centres of habitation, Sipontum villa and Salpi but also from the Bronze Age site of Carapellotto-Regina. Only one is renowned as the source of purple dye: Murex brandaris. One of the others is the short-syphoned M. kusterianus, and if this was not gathered for its dye content (or by mistake) it may be that it is edible.

There are today several cephalopods and of course many species of fish that reach the market. Sipontum, Strabo tells us, took its name from the sepius, cuttle fish, that was (and is) so common along the Manfredonia Bay shores. Octapus and squid are fished. But up to the late 18th century it was the lagoons that were famed for their fish resources. Eels were reported from Lago Salso and the Versentino-Contessa lakes; the Palermo

prisoners affirmed that it needed three men to catch eels. Other fish obtained from Lago Salso in recent centuries have included:-

capitoni	-	gudgeon or carp
cepomazzi	-	?
cefali	-	mullet
granchi	-	crab or crayfish

(Giustiniani, 1797).

It has been the place of the cockle in the diet of Neolithic inhabitants at Coppa Nevigata (and at other coastland sites, it may now be added) that has been greatly discussed. Since shells were the commonest find in the two metres or so of refuse at Coppa Nevigata, while animal bones were conspicuous only for their absence, some archaeologists have gone so far as to state that "the staple diet seems to have been the cockles" (Trump, 1966, p.32). To insist, however, on a specialist diet (implying no farming activities) is a quite different matter from merely acknowledging that the evidence seems to suggest that a specialist activity was maintained as an adjunct to, or even part of, local economic arrangements. There is surely far too little of a true shell-midden anyway at Coppa Nevigata to support the suggestion that the inhabitants were "strand-loopers", people (usually Mesolithic) who subsisted on shellfish (Evans, 1969).

It is as unreasonable as unnecessary to postulate such a dietary exclusiveness. It has already been repeated that the all-round farming opportunities at Coppa Nevigata, as elsewhere in the Salpi coastlands, would not have been substantially different from those at any of the inland sites. At the time of writing, Trump did not know that other sites sharing (it would seem) the Sipontian culture were to be found in the Tavoliere coastlands. Their discovery merely strengthens the argument that the place of gathering of cockles in the local economy of the coastlands should not be exaggerated.

An interesting point, however, was raised in conversation by Professor Puglisi, currently excavating at Coppa Nevigata. He pointed out first, that the excavated cockle shells are not structurally identical with those from

the present day cardium. Secondly, he stressed that interest in, or availability of, the cockle is virtually confined to the Neolithic strata. He was unable to specify to the present writer the taxonomic differences of the early cockle, but it is known that cardium from estuaries and similar localities of low salinity tends to have a slighter shell, fewer ribs and be more asymmetrical than its marine counterpart (Yonge, 1959). It would be pertinent to the thesis of lagoon change to know more of this aspect of the Coppa Nevigata cockles, particularly as Professor Puglisi's second point may be allied to this.

Nothing definite can be said on the exact process and chronology of sedimentary changes at Coppa Nevigata. It has been shown that Lago Salso was probably finally closed from the sea only after the Middle Ages. Earlier, however, there would have been in the estuary the sort of qualitative changes that were noted from the sediments at Siponto (page 178). Changes in water level may have affected the location of the cockle beds (and cockles have a notorious reputation for migrating) and would have affected the salinity of the water. On the other hand, there is little doubt that the general economic context of the Tavoliere sites was different in Bronze Age times from that of the Neolithic period. Under these new circumstances, interest in sea foods, or more particularly, in cockle collecting may have declined as a matter of course and with no environmental significance.

In the archaeological evidence from Bronze Age sites in southern and central Italy there are thought to be signs of two economic 'novelties', or activities not previously evident. This is not to suggest that the new developments replaced or displaced the basic farming pattern of the Neolithic. There is nothing convincing in the archaeological record, so far as I am aware, to suggest that all mixed farming activities on the Tavoliere would have simply ceased. So these new developments of Bronze Age times (transhumance and maritime trade) may be taken as indicators of an increased

economic complexity and of the increased scale of activities, extra-regional or sub-continental, rather than local.

Evidence for transhumance in southern and central Italy during the Bronze Age rests primarily on the occupation of sites so high in the Apennines that subsistence, based on the normal mixed-farming system, would have been uncomfortable or impossible. The Gran Sasso sites (Campo Pericolo and a cave-dwelling, Grotta a Male) are quoted as examples (Trump, 1966) both at about 2500 metres above sea level. Nearer to the Tavoliere there was occupation at Camposano, near the peak of Monte Taburno (Beneventum, at about 1250 metres). The nearest Bronze Age Apennine site to the Tavoliere, however, is La Starza, at Ariano Irpino, at only 750 metres or so. Secondly, however, archaeologists have remarked on the unusual degree of cultural unity that appeared for the first time in the Middle Bronze Age. This has been formalized as the 'Appennine Culture'. Professor Puglisi would like to see this explained in economic terms, as a pastoral or stock-breeding hegemony over all the Italian peninsula, (Puglisi, 1959). Thirdly, and supporting this thesis, it is in Bronze Age horizons that the specialist pottery forms, milk boilers for instance, associated with pastoralism are found (Trump, 1966).

On the other hand, evidence for arable activities is not lacking from Bronze Age sites: quernstones, carbonized grain (wheat and barley), stores of acorns, the horse bean (Vicia faber) field pea (Pisum arvense), a millet (Panicum miliaceum) were recovered from caves at Belvedere (Tuscany) (Trump, 1966). Moreover, there is no question, apparently, of a depleted, stagnant or poor culture. The pottery apparently indicates as high a degree of artistic appreciation and skill as in the Neolithic but a new degree of inventiveness too.

From the Tavoliere in particular, there is very little evidence of economic activities during the Bronze Age. All that is known has come from Coppa Nevigata. Until further information is forthcoming, it has to be assumed that activities on the Tavoliere in the Bronze Age would not have

been significantly different from those at any other site at comparable altitude. That is, that some sort of mixed farming continued to be the normal system of assuring a livelihood as in the previous period. Even before the recent scotching of the myth of the 'empty millennium', the writer found it hard to accept uncritically the postulated bias of the Bronze Age as an exclusively pastoral economy. The case for transhumance, and the appearance of high altitude settlements in the Apennines, should be separated from the question of economic changes on the Tavoliere, whether these are associated with the desertion of the plain or not.

The appearance of transhumance in the southern and central parts of the Italian peninsula in the Middle Bronze Age has interesting implications which will be discussed. But first it is important to establish the context in which the need for transhumance would have developed, for in preceding pages it was suggested that livestock were maintained on the Tavoliere during the Neolithic as part of the normal mixed farming system, without the regular, seasonal, and long distance movement in search of pasture that transhumance normally involves. A point that should not be overlooked is that transhumance can only be carried on under relatively settled or orderly conditions; that is, where reciprocal or mutual arrangements have been made between the inhabitants of two discrete territories. It arises from a seasonal shortage of fodder or grazing and is not confined to Mediterranean lands. For the shortage can be a winter one, in the case of mountain or high latitude regions, or a summer one as is the case in lowland areas around the Mediterranean. Accordingly, the movement can be described as 'up' or 'down'. In Roman times for instance, it is clear from Varro's account of his own farm in the Abruzzi that the movement involving the Tavoliere was regarded as a downward one:

> "I had flocks that wintered in Apulia and summered in the mountains around Reate, these two widely separated ranges being connected by public cattle trails, as a pair of buckets by their yoke."
> (On Agriculture II II 8-12)

Under the Dogana too, although the sheep were registered at Foggia, it was Abruzzi shepherds that were responsible for bringing them down each autumn before winter snows covered the grazing: it was at this time that the Tavoliere became known as the 'tomb of the Abruzzi'. On the other hand, the shepherd at Lo Squarto (Marandrea) was accustomed to taking his sheep 'up' each spring, until half a dozen years ago.

The appearance of temporary settlements high in the Apennines in the Bronze Age must suggest that the movement was initially an upward one, taking people into the mountains for the first time, so to speak. The appearance of permanent settlements at these altitudes would suggest the reverse, that there were people in the high Apennines who would be needing an alternative pasture for their stock during winter. But an important qualification has to be made. Neither mountain nor lowland dwellers would have needed alternative pasture were their herds still small enough to be maintained through the season of shortage by stored fodder. The mere fact of transhumance, in other words, implies that large numbers of livestock were involved. It is worth examining this point a little further.

The shortage of summer grazing on the Tavoliere, which was not envisaged as of significance during the Neolithic, could have arisen in one of two ways. Either the total number of livestock had outgrown local resources or local resources had actually or effectively been reduced. The effective reduction in grazing resources could have come about because of a general population increase and an increase in number of settlements. This would have meant (as it did in northern Europe during the later Middle Ages) that there was no more 'waste' land between the territories of individual settlements for expansion, or for new (daughter) settlements. The actual reduction of grazing resources would have come about through the disappearance of woodland or grassland (claimed for arable to satisfy the increased demand for food) or because woods and pastures had been degraded so that the carrying capacity was greatly diminished. This latter change may have been associated

with a change in the balance of livestock. A territory that formerly could accommodate cattle as well as sheep might no longer have vegetation suitable for cattle.

The total number of livestock could have increased in one of two ways. An increase in population or multiplication of settlements, would have meant an increase in the number of the individually quite small herds normally associated with peasant farming. But in the aggregate (as Hoskins found in medieval England (Hoskins, 1963)) the number of beasts from one community or from one region would be very large indeed, though each domestic herd remained as before. Secondly, there may have been a deliberate trend towards very large herds, commercial grazing or ranching, in other words, on farms that would have very little to do henceforth with the arable side but who would be able to buy in basic human foodstuffs no longer grown at home. This sort of ranching certainly occurred during Roman times, in addition to other systems of livestock raising (White, 1970), and there are many references in the classical literature to Apulian latifundia. Seneca makes a general comment about the tendency to "broaden(s) lands until they become the dimension of provinces" (Epistolae xc 39) but elsewhere is more specific in describing one who "... takes delight ... in huge herds and flocks that need whole provinces and kingdoms to provide them with pasture" (de Beneficiis VII 10). Juvenal wrote with reference to Apulia of ... "all those pasture lands that tire out the kites" (Satires, X 54). Pliny the Elder apparently refers to a ranch owned by a freeman which contained 4116 herdsmen, 3600 span of oxen, 257,000 sheep. These may be the sort of instances that would make headline reading even today, but there is no doubt that this sort of ranching was big business. It goes without saying, too, that it would have involved transhumance.

None of these developments are mutually exclusive; all may have been operating in southern Italy. Something of this commercial development in farming, for instance, may have already appeared in the Bronze Age. The

development of a well stratified social hierarchy, testified in such features as warrior burials, may very well have a great deal to do with such a farming system, which implies both wealth and power. Another pertinent factor would be the cultural unity, already remarked on, in the peninsula during this period. It may be nothing other than a sign of economic hegemony, based on a much more sharp division of labour and of community wealth that was typical of the preceding millennia. Too little evidence is available for the Tavoliere to allow this theme to be pursued further, and too few studies have attempted to look soberly at the evidence available more generally (but see Barker, 1971). An open mind, consideration of the flexibility of the 'traditional' patterns of rural life in Southern Europe, and an objective display of all the available evidence, would remove the need to recourse to drastic external factors (such as climatic change) to explain a gap in the archaeological record or even a change in the economy.

About the second development in the Bronze Age general economy there has been less controversy. Both at Coppa Nevigata and in the Manacore cave on the Gargano headland there is, apparently, evidence for trans-Adriatic trade. This was new, for trade during the Neolithic seems to have been local or at most trans-Apennine. For instance, although no mention is made in Bradford's reports of the type of rock favoured for querns in the Neolithic period, fragments of andesite found at Carapellotto-Regina must have come from the igneous rocks of Monte Vulture. Obsidian from the Lipari isles, is common on Neolithic sites on the Tavoliere. But the copper and tin needed for the bronzes of Manacore must have been imported and Baumgartel suggests that "connection by sea with the opposite shores of the Adriatic has always been easier for the people of Monte Gargano than communication by land" (Baumgartel, 1951, p.30). She supports this by pointing out that "the museums of Zara, Sarajevo, Ljubljana etc. contain much material closely related to that from Manacora" and more was said recently on this point at

the Colloquio sulla Preistoria e Protoistoria della Daunia held at Foggia early in 1973.

In Trump's view that Adriatic trade at Manacore was impoverished compared with that carried on at Coppa Nevigata (Trump, 1966). In Ruth Whitehouse's view, the pattern of activity at Coppa Nevigata by the 13th and 12th centuries B.C. earns it the status of an urban settlement (Whitehouse, 1973). Both writers insist on the overseas element in this trade. Whitehouse stresses the links with the Aegean. Trump stresses the accessibility of Coppa Nevigata as a port and suggests that it was not only engaged in "a flourishing sea trade" but even had a good harbour. Of this nothing is known though the outline of the great wall, if it can be traced on the marsh side of the site, might be a pointer. But to affirm that "the silting up of its harbour killed its flourishing sea trade" (Trump, 1966, p.150) is probably jumping over the evidence to unjustifiable conclusions. For there is little evidence as yet that aggradation in the still-open Lago Salso would have been effective at so early a date.

But neither writer examines the corollary to maritime trade; the landward links. Trump states that Coppa Nevigata was more accessible than Manacore on the Gargano and presumably had in mind landward communications since this would have been the problem at Manacore. Certainly Coppa Nevigata would have been in a commanding position with regard to the Tavoliere, just as Sipontum probably always tended to have a slight advantage over Salpi. Surely this must suggest links with other Bronze Age sites on the Tavoliere and not just La Starza (Ariano Irpino). Whether, however, the newly discovered coastland sites came within the orbit of Coppa Nevigata, or whether the Carapellotto-Regina complex will prove to be a proto-Salpi, only excavation will tell.

There is little doubt however that not only were the lagoons of the Tavoliere coastlands accessible in later prehistoric times, but that many of the rivers too would have been navigable in these early millennia as

they were in Roman times and even later. Strabo made this clear and Pliny also. Pliny commented on the harbour at the mouth of the Fortore. Canne, now 10 kilometres inland, was ~~being~~ an emporium in classical times which means the Ofanto must have been navigable at least that far upstream. Arpi was reached by water-borne transport on, presumably, the Celone, tributary of the Candelaro. This may not have been a particularly good water-way, since Strabo also recounts that Diomedes (the traditional founder of Arpi) was supposed to have attempted to cut a canal towards the sea, from somewhere on the Tavoliere. It is curious, however, that it was Salpi (i.e. Salpi I) that was the outport for Arpi and not Sipontum, which would have been closer to the Candelaro estuary if there ever was a Daunian Sipontum. In 1766 the rudder of a boat of blackened oak was recovered from the Fortore, 25 metres below the surface, and "two miles from the bridge at Civitate" (Monti, 1939, p.142). No indication is given whether this was up or downstream. If some of the Tavoliere rivers retained something of their navigability in the historic period, it may be reasonably assumed that in the prehistoric millennia, they would have been no less suitable for navigation by small river craft.

In conclusion, it is clear that as the coastlands were transformed through appgradation, so their value to local inhabitants was altered. The transformation of the Tavoliere coastlands from lake and marsh to terra firma and arable - so ardently striven for in recent years - is probably as complete as it ever will be. During the years of transition, marshiness, unhealthiness, and flood hazard in the coastlands have meant that the area was viewed with dislike. This is the assessment that has passed into the literature and colours our appreciation of the environment today. But in prehistoric times, when the lagoons would have been still well-defined water bodies with distinctive outlines, as at Marana di Lupara, much could be said for the economic advantages of such a coastland. Water from inflowing streams would have helped maintain a measure of freshness in the lagoon water: the reputation of Lago Salpi as a fishing ground was lost only in

the late 18th century. On the surrounding interfluves and headlands, wherever there was subsoil calcrete, arable opportunities would have been every bit as good as further inland; that is, excellent for dry-farmed cereals. The lagoons themselves would have meant an opportunity for additional economic assets, in terms of diet (fish, for example), commercial exploitation (salt, shells) and navigation. To view the early coastal environment as an area ... "of halophytic and hydrophilous vegetation [which]can have been of little importance for man, although locally reeds, rushes etc. were doubtless used for basketry and building" (Whitehouse, 1968b, p.339) is to come dangerously near to false analogy. The only way to appreciate the human past in a 'dead flat' landscape is to look below its surface.

B. Lagoon cities: Salpi and Sipontum.

Figure 44

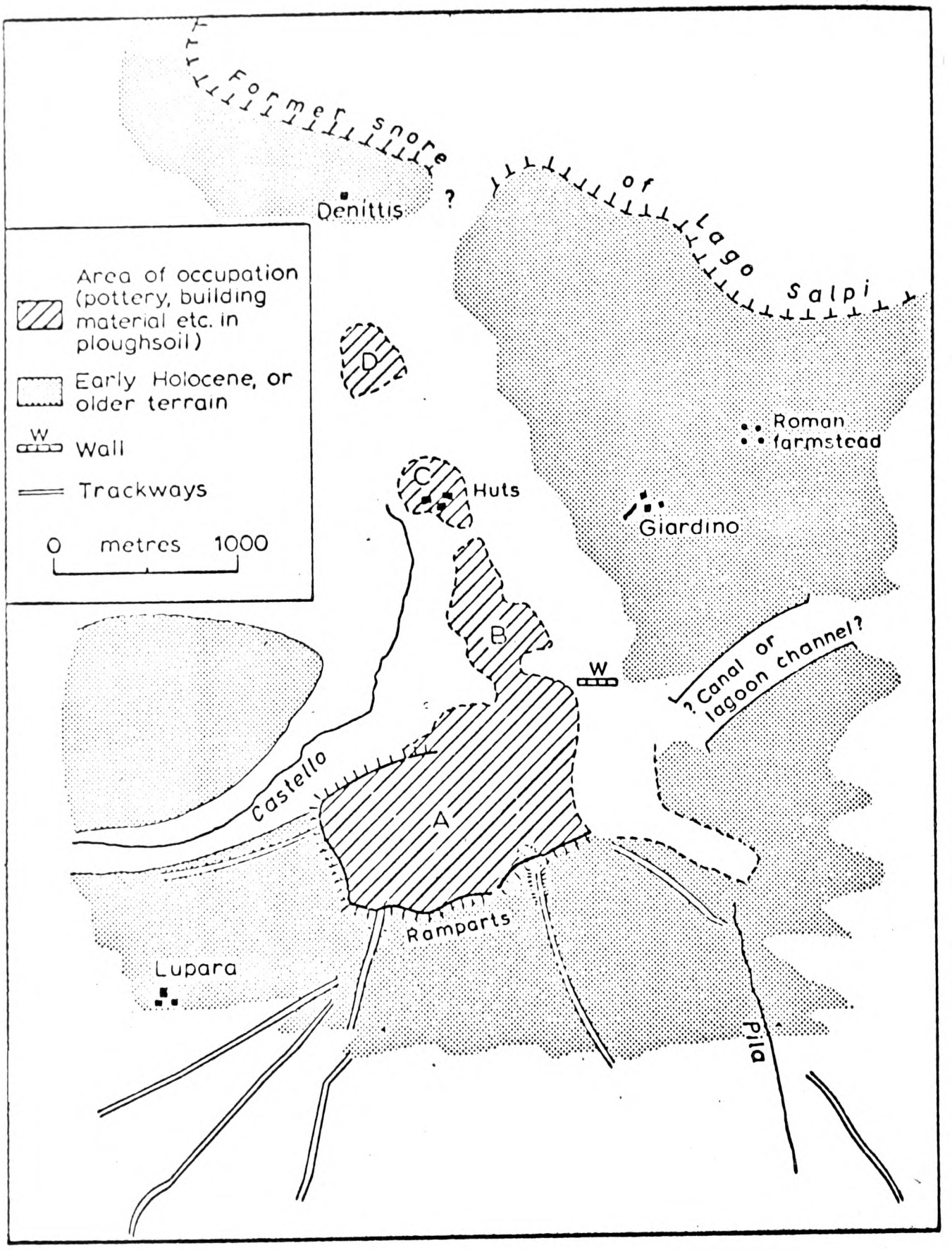


Figure 44. Topographic details at Daunian Salpi.

B. LAGOON CITIES : SALPI AND SIPONTUM.

At the beginning of the 1st millennium B.C., then, it may be supposed that the Tavoliere coastlands would not have been substantially different from those at the beginning of the 1st millennium A.D. At this later time, it may be recalled, the salient features were still the lagoons that have since disappeared. Lago Salso was sufficiently open to the sea for Strabo to be justified in describing it as an estuary and for the 16th and 17th century A.D. cartographers to be uncertain as to how far siltation had closed it. Lago Salpi was still open to shipping that reached settlements on the inner shore and was sufficiently navigable for the Venetians to be very anxious to acquire control of the port of Salpi early in the 13th century. The little lagoon of Lupara would still have been, at the early date, filled by clear, well circulating water. At the early date, though, there would have been no sign yet of the Siponto lagoon.

Previously there had been much discussion as to the precise location of pre-Roman SALPI (Salpi I), not only in recent centuries but even in Alberti's time. It was from air photograph inspection, however, that Schmiedt was able to direct ground investigation to the Marana di Lupara area (1964) and as a result of the archaeological excavations (1967-8) the identity of this impressive site as pre-Roman Salpi seems irrefutable.

The archaeological zone extends over some 200 hectares, according to Professor Tinè (plate 35; figure 44). It is by no means a ccmpact area, nor have the outlines of the former area of occupation been closely established. Fragments of pottery and building material are scattered thickly in the ploughsoil, and according to these traces and to concordant changes in micro-relief and soil colour four occupation areas can be described. Occupation in parts of pre-Roman Salpi is now known to date from 700 or even 800 B.C. (Tinè and Tinè, 1969).

By far the largest and most impressive feature in the landscape is a compact, oval area (Area A) partially surrounded by an agger, former ramparts.

This area is the highest part of the archaeological site, varying between 5 and 7 metres above sea level. Although the ramparts stand out very distinctly on the southern, western and north-western sides, their alignment on the east and north-east is less clear. A modern dyked canal parallels the ramparts in the vicinity of Torreta dei Monachi and then cuts across the site towards Montaltino and Marandrea. So it is not entirely certain whether Area B would have been within the ramparts or whether it represents extra-mural settlement. But considering the former promontory form of the site, a rampart on the northern side would not have been necessary.

Area B is a long narrow zone of dry, calcreted terrain, rising imperceptibly above the surrounding marshes of the Marana. Recent deep-ploughing has upturned not only potsherds but parts of buildings such as the capitals or bases of columns. Beyond the dyke that today defines the marsh-land that lies immediately east, part of a substantial wall was recently uncovered and investigated by the Tinès. The presence and direction of this wall suggests that formerly this part of the Daunian city was much broader or, more likely, that there were major structures, such as port installations, on this side of the city. But without a sedimentary or sub-soil survey (resistivity or magnotometer, for instance), further comment on the topographical details of Daunian Salpi on the north side of the settlement is not possible. The other two zones of occupation scatter (Areas C and D) are today separate from the main area and 'channels' of colmate alluviums render the impression that these were once islands. It is more likely, however, that at least Area C would have been merely a continuation of the narrow promontory of Early Holocene terrain that stretched across the Lupara lagoon. Area D (near Posta Iscia) on the contrary, may have been cut off from the rest of the promontory by Carapellotto distributaries or by the lagoon outlet. In brief, the topography of Daunian Salpi would seem to have been very similar to that of Brindisi more recently (figure 45).



(I.G.M.)

Plate 35a. Daunian Salpi from the air.



Plate 35b. Daunian Salpi: vestiges of a wall apparently running out from occupation area B and possibly associated with quay or port structures.

Figure 45

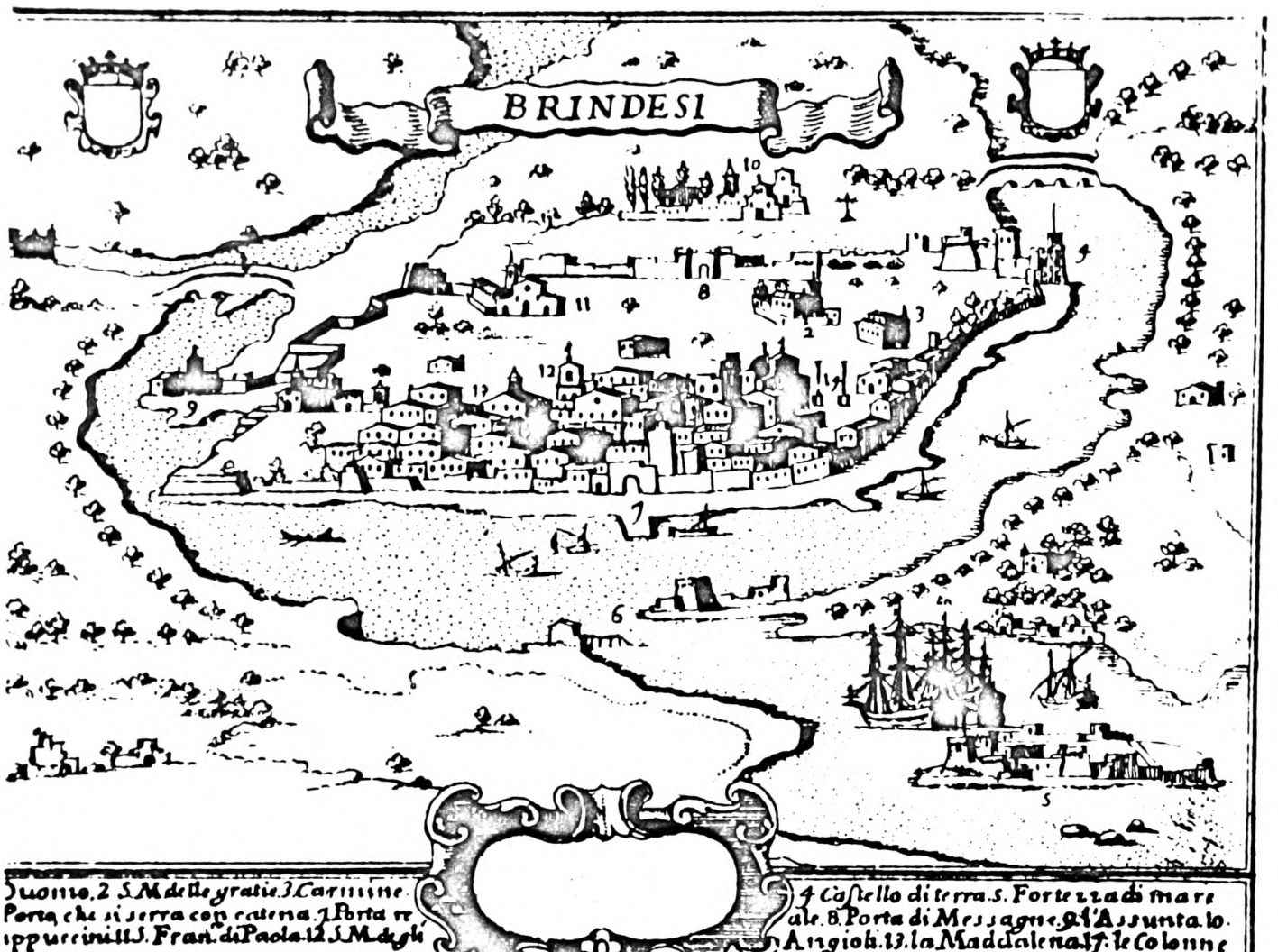


Figure 45. Brindisi (Apulia) in the early 18th century. Compare the peninsula outline with that suggested for Daunian Salpi (figure 44) (reproduced from Pacichelli, 1703).

Against such a vast area of archaeological interest, the excavated area looks very small. Apart from some trenches in the centre of the ramparted area, which revealed tombs, archaeological as well as sedimentary investigations were limited to Area C, today a low knoll surrounded by marsh vegetation and colmate alluvium (plate 26). Signora Tinè reports three distinct occupation horizons in the 3 metres or so of archaeological accumulation (Tinè, 1969). The earliest horizon comprised the remains of several houses. Their outlines and postholes are traced in a sterile palaeosol about 30 centimetres thick below which is the calcrete stratum. In plan (plate 27) the houses were rectangular but with an apsidal end. The hearth was inside the hut, towards the absidal end. Three such houses were uncovered, each dating to the 9th or 8th century B.C. Later on the same area was used but this time as a burial ground and 233 tombs of the urnfield type were cleared. Finally followed the second residential horizon.

Thus pre-Roman or Daunian Salpi seems to have been inhabited uninterruptedly from the 8th or 9th century B.C. until the close of the 2nd century B.C., after which there was virtually no occupation. It is just at this time, 2nd century B.C., that Vitruvius places the move from the old Salpi to the new (see page 60). The Tinès assume that the old site had become uninhabitable and suggest that siltation in the lagoon was a direct consequence of a climatic change that resulted in an increased river load. Certainly the channels linking the Lupara lake with the main lagoon were small enough to have easily become blocked. The resultant ponding of stream flow (from the Pila, Castello and possibly the Carapelle) would then have brought about the onset of siltation that is so clearly indicated in the sedimentary profiles. However, many factors (anthropogenic as well as physical) might also be responsible for this sort of siltation and the role of climatic change is of doubtful relevance, although other writers see in this the key to post-classical aggradation (Vita Finzi, 1969).

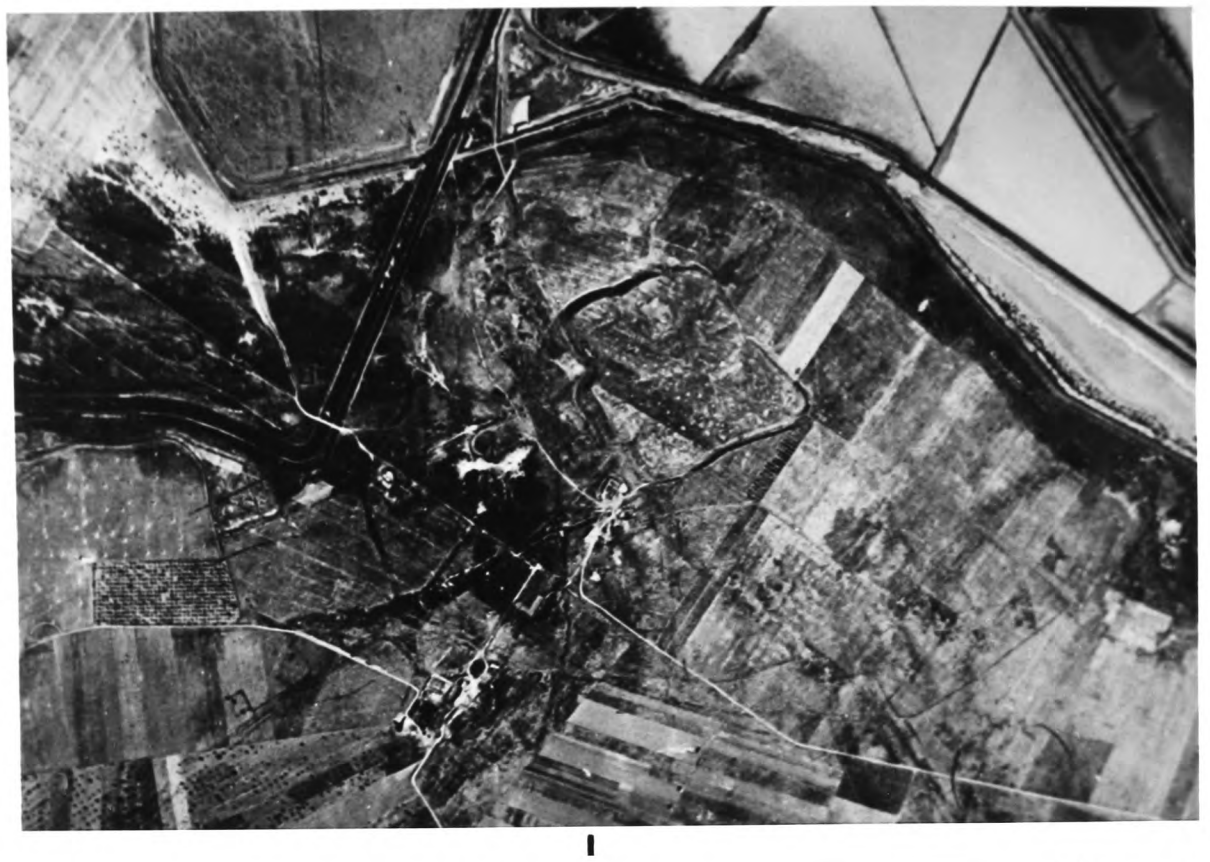
The new Salpi was provided with a port. It would seem from Vitruvius'

account that this move was taken for granted and entailed no discussion, for no explanatory remark is forthcoming. That being so, the implication would be that the old Salpi had had one too. But the precise location of the harbour at Daunian Salpi remains undetected. A case might be argued for the most likely area lying to the north-east of the ramparted zone and Area B, in the marshland. The wall that ran out from Area B towards the lagoon could well be associated with such installations.

There are other features of ancient Salpi however that are more clearly discernible both on the ground and on air photographs. These are the track-ways which converged on Salpi and entered the ramparted areas at clearly marked points. From ground level, the tracks appear as hollow ways; one measured 16 metres at the bottom of the hollow and 92 metres from crest to crest.

It is generally assumed that Strabo, writing about the Tavoliere as it was during the period of Greek colonisation, had in mind the new Salpi, since he himself lived during the 1st century B.C. It would seem that he was unaware of the antecedents of the new Salpi, for he mentions nothing on the change of site. He refers to Salpi as an outport of Arpi. Both Salpis would have been as accessible from the lagoon whether traders came by the open sea or via the Carapelle. What is odd is that it is Salpi, and not Sipontum or a more centrally located settlement (Anxanum or the Daunian Cupola site for instance) that should have been linked with Arpi. A cross-country haul from the inland city would have been excessively long (35 to 40 kilometres) while the water route (via the Celone, the Salso Gulf, the open sea and into Lago Salpi) would have been devious in comparison with that to the alternative ports.

The new Salpi, ROMANO-MEDIEVAL SALPI (Salpi II) was sited on the shores of Lago Salpi about half way (as it would have been then) along its western shore (plate 36, figure 46). The relief is indistinctive; there is a gentle slope towards the ex-lagoon and the Romano-Medieval site lies on a terrace today 5 metres above sea level. To the north of the city was an



(R.A.F.)

Plate 36. Romano-Medieval Salpi.

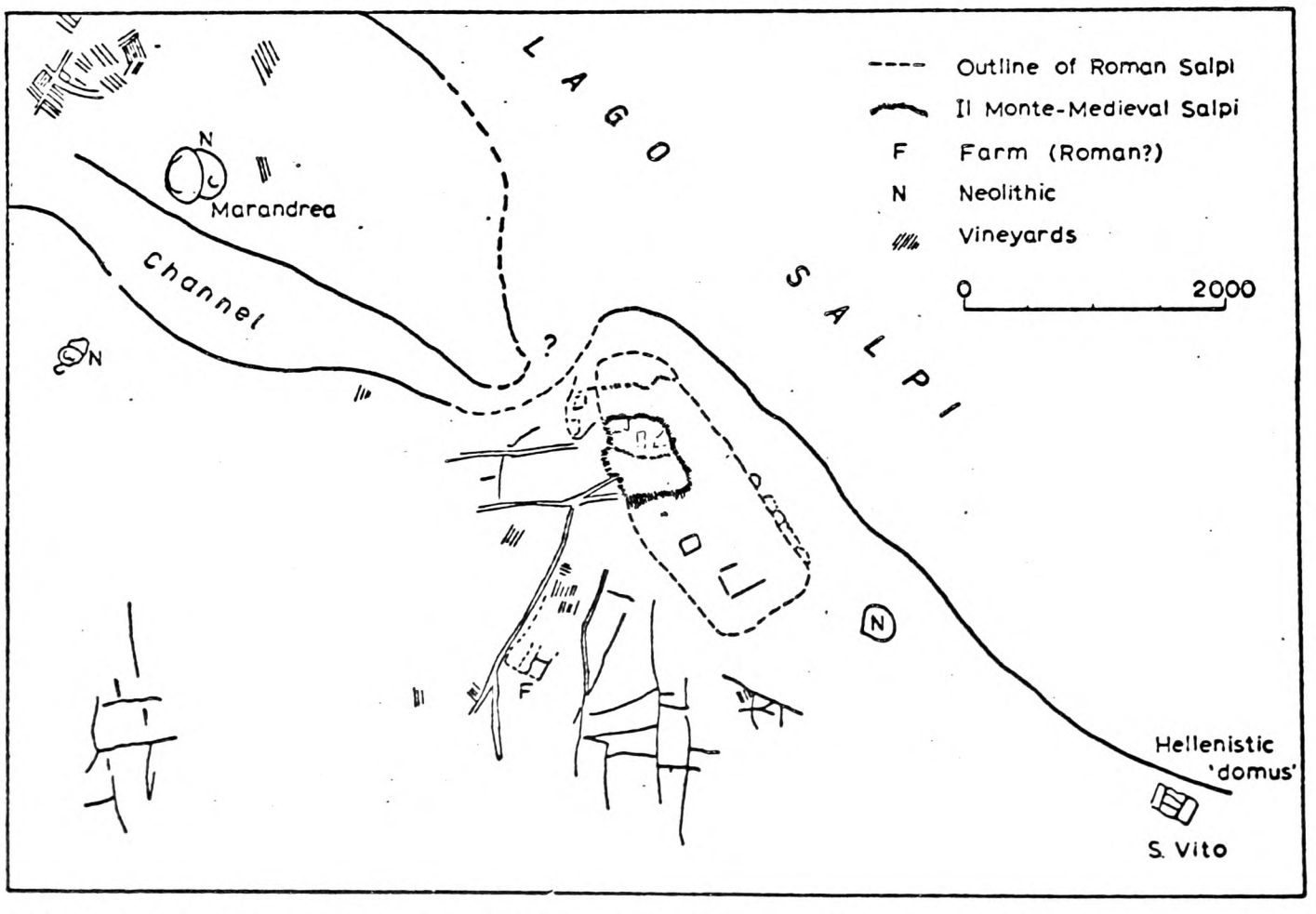


Figure 46. Topographic details at Romano-Medieval Salpi (after Schmeidt 1964)

inlet which may have given shelter to boats, and certainly gave a promontory aspect to the northern side of the new Salpi. Further along, the inlet became the channel that passed between Marandrea and Montaltino. It is not easy to see what advantages the new site had over Daunian Salpi, except possibly having an unsilted and more open port area. Cicero comments on the 'pestilences' on Salpi territory but he would have been referring to the new city.

Today the site of Roman Salpi is dominated by the Medieval ramparts. These form a striking, compact, almost square mound lying on top of the Roman occupation area (figure 46). The Medieval ramparts are at least 5 or 6 metres high and Schmeidt identifies the ramparted area with the former acropolis (Schmeidt, 1964). The Roman area is less obvious a relief feature except on the northern side, and extends further east and south-east along the lagoon shores. That it was formerly walled is clear from Vitruvius' description and from other documentary references, but from a distance, the view of Salpi from further north along the lagoon shore must have been very similar to that of Lesina today (plate 37).

Unlike Daunian Salpi, from which no Neolithic evidence has been recovered yet, the lagoon shores in the vicinity of Salpi II had been relatively densely occupied in previous millennia. Apart from Marandrea and those already mentioned Schmeidt has pointed out at least six within less than a kilometre from the city. It is assumed that the lagoon-side was more or less open country when the Consul Hostilius had the site laid out in the grid iron pattern of a New Town, divided into insulae that were made available to prospective inhabitants. But it would be nice to know how the farm indicated by Schmeidt, 500 metres distant from the walls of the Roman city, had been affected by the new foundation.

A good deal is heard of Salpi during the Second Punic War but not much at other times. The city gained some fame through Hannibal, who was reported to favour the town (and certain of its inhabitants: see the quotation from

Pliny, (page 48). It served, for example as a grain port for the supply of Hannibal's troops, about to winter on the Tavoliere. Grain was brought to Salpi, by sea

> "from the districts of Metapontum and Heradea; for the summer was now over and he (Hannibal) thought well of the place for winter quarters"
> (Livy XXIV xx.15)

It was a strategic point from which to replenish other supplies too for, as Livy continues:

> "From it Numidians and Mauri were sent out to plunder the Salletine territory and the nearest forests of Apulia. From these places not many other cattle were driven off as booty, but chiefly herds of horses, about 4000 of which were distributed among the cavalry to be broken."

Not much more is heard of Salpi until the Middle Ages. This is chiefly because of lack of documentation, though it has already been pointed out that it was not Salpi that was the staging point in the Itineraria but Salinis, a small settlement on the far side of the lagoon. There are no real grounds for discontinuity of occupation for all the town from the archaeological record, although nearly a metre of rabble and soil separated the last of the Roman and the first of the Medieval building levels in Professor Bari Jones' excavation (personal communication), for this concerns only a very small area. As in the case of so many towns in Europe in the later Roman period, the total population may well have declined so that many individual house-plots lay vacant for decades, even centuries.

In the Barons' Catalogue, Salpi is listed as a fief . It was held by Boamundus and was expected to raise (between 1150 and 1168) 25 knights (milites) for the extraordinary military force demanded by King Roger of Sicily, together with 45 mounted auxiliaries (servientes) (Jamison, 1972). If manpower gives any indication of the former size of the fief, or of its total population, then Salpi must be judged as one of the larger towns or territories on the Tavoliere. What exemptions to the levy were granted is not known, but in comparison Sipontum was responsible for only 2 knights,

and other places for only a few more (Lesina for 8 knights, Biccari 3, Casal novo 1 only for instance).

Throughout its documented history, Salpi seems to have played an active but somewhat independent political role. Its tendency to side with the losers might account for some of the major burnt layers observed in the archaeological sections. During the Punic War, for example, the Salapians were divided in their party politics but were lucky enough not to antagonise the Roman government and have their territory confiscated, as was the misfortune of many of the other Tavoliere cities (Arpi, for one instance). Toynbee even goes so far as to suggest that this was because the Roman government (in 210 B.C.) viewed the gain of Salpi (and, presumably, above all, the port) as of particular value (Toynbee, 1965). Under the Normans, Salpi was involved with the rebel dukes of Apulia (in 1129, for instance). But by 1240 politics seem to have settled down and in that year Frederick II ordered payments to be made towards the upkeep of his birds (falcons?) at Salpi and at nearby Tressanti (Huillard-Bréholles, 1852). It was Frederick II, too, who allowed the Venetians' autonomy over the ports of Salpi and Barletta in return for military aid and political support (Kantorowicz, 1931). By the Angevine period there was hardly "a city, large or small, in which Venetians were not represented" (Nicolini, 1965 preface). This penetration of Venetian traders had started, however, under the Normans, and was merely reinforced by the Swabians and their successors.

But how useful the port of Salpi would have been to Venice by the later Middle Ages is a moot point. There are clear indications that by the early 16th century, at the very latest, the city was in sufficient decline for the ecclesiastical authorities to attempt to merge the bishopric with that of Trani. This was finally achieved in 1547, at the second attempt. A remnant population however must have survived for some time, for the Dogana records show that in 1560 there was extensive cultivation at Salpi, although in the Dogana maps of 1687 there is no sign of the township itself.

Figure 47

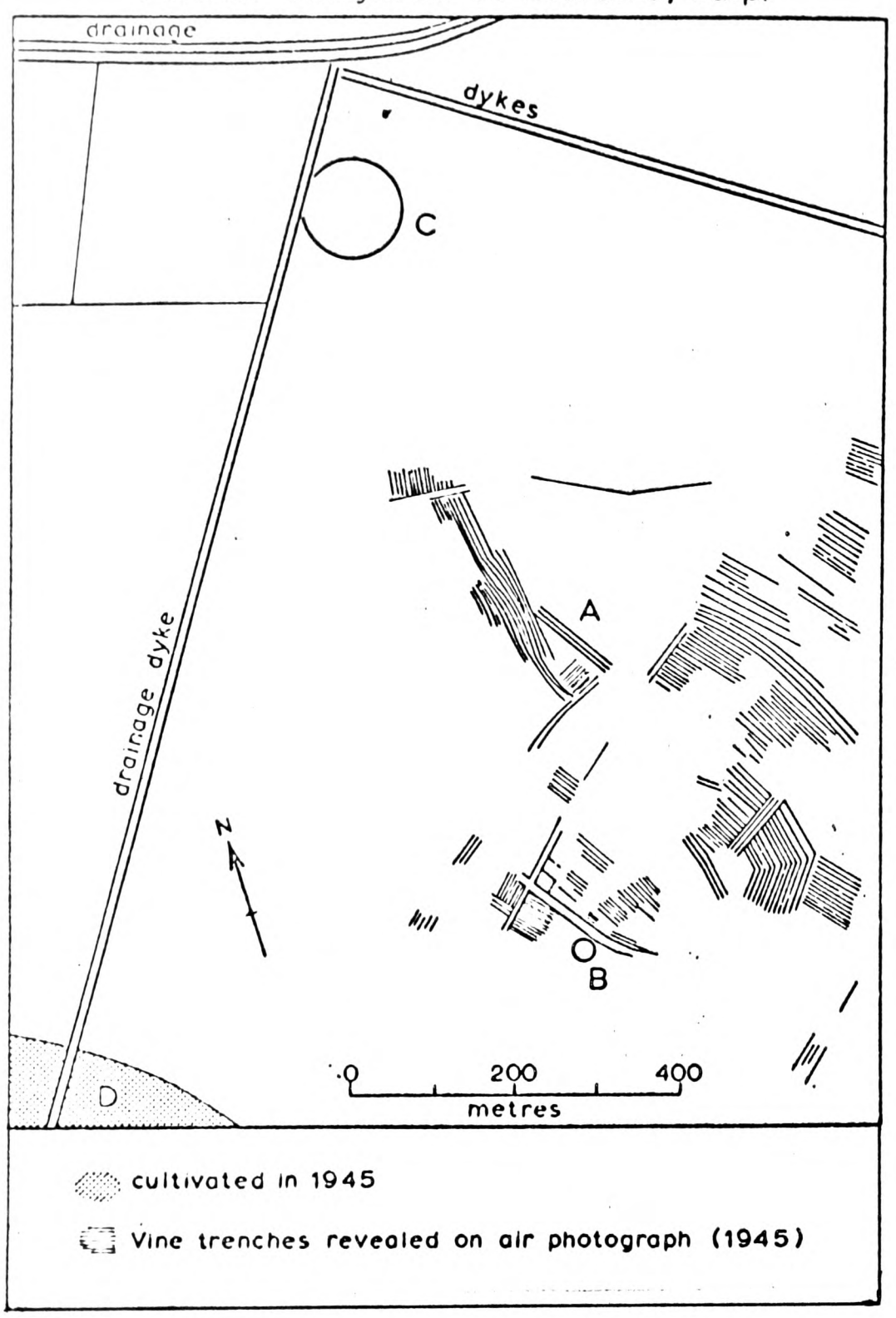


Figure 47. Former vineyards in marshland near Giardino (Salpi), probably medieval, traced from an R.A.F. air photograph. The Neolithic site at C is Alma Dannata.

Alberti, travelling to gain information for the Descrittione di tutta Italia which he published in 1550, actually visited Salpi but it is difficult to know just what to make of his observation on "the city (Salpi) which is today visible" (page 221). It sounds as though Alberti saw little of a standing or inhabited town but just its site. By the 19th century, notwithstanding Lenormant's mention of "the miserable village of Salpi", there would have been no more left of the port-city than there is today, the ramparted mound and two rather derelict masseria (Lenormant, 1831).

Whatever the role of the sedimentary changes in the lagoon, it is difficult to overlook the fact that associated with the final demise of the settlement would have been the pressure brought to bear on the surviving population in the 16th century by the Dogana authorities. Even in its heyday, most of the inhabitants of the city would have been, to greater or lesser extent, directly dependent on farming. Theirs were the small, squarish suburban fields that show up so astonishingly clearly on air photographs not only of Salpi but of Casalnuovo (Delano Smith, 1973b), Santa Chirico, San Leonardo etc. From information given in the cartulary of San Leonardo, it is learnt that these plots contained vineyards, olive groves, occasionally orchards or vegetables, or were used for grain. In 1115 for example, a certain John of Salpi held a house (casa), vineyard and other land just outside the city (Carabellese, 1924 doc. 3) and one presumes the latter were just these suburban plots. In 1192 one Maraldo of Macedonia, inhabitant of Salpi, presented the monastery of S. Matteo of Salpi with "his goods within and without the city of Salpi" (ibed, doc.13). Even in 1560, the Dogana registers show there was still a good deal of cultivation within the territory of Salpi. There were 46 carra under wheat, and 24 carra under barley, making a total of 70 carra (or about 91 hectares). There were also vineyards, perhaps including those visible on the air photograph from between Marandrea and Giardino (figure 47). But by 1603 the Dogana records account for no cultivated land at Salpi. The change was



Plate 37. Lesina and Lago Lesina: a view that could have been that of Salpi six or seven centuries ago.



Plate 38. Monte di Salpi today: "... the silence of the lagoon ..."

supposedly because of the 'bad air (Dominicis, 1781). Instead, there were over 6000 head of livestock grazing. Knowing the Dogana's interest in extending grazing land, even at the expense of arable, it is difficult to avoid the conclusion that pressures deliberately effected this land use change and that unavoidable environmental change may have been a very secondary factor.

After its demise Salpi was visited by few people. Mainly it was an antiquarian who passed by, such as Romanelli who describes the finding and exploration of tombs in the Salpi area. Later it was engineers, anxious to solve the drainage problems of Lago Salpi. Meanwhile the road pattern had changed. By the 19th century (figure 10) the main tracks bypassed the former city, and the ancient tracks fell into disuse, disappeared and are revealed only on the air photographs.

Today the site of Romano-Medieval Salpi is one of the least accessible and most melancholy corners of the Tavoliere. As evening falls, the salt-pans reflect, as the lagoon would once have done, the declining sun. A few late birds wheel, crying, overhead; perhaps a hunter shoots. Sixty kilometres away, to the south-west, the cone of Monte Vulture stands out against the black and orange sky; so does Frederick's masterpiece, Castel del Monte, nearer (on the Murge) but still distant. A deep silence falls once more on the abandoned site of the ancient, bustling, factious port-city (plate 38).

SIPONTUM could not be much more different. Its story has a clear-cut beginning and a decisive end. Its site is traversed daily (if unheedingly) by an impatient, tootlingly-noisy, stream of traffic on the Foggia-Manfredonia highway. Far from being inaccessible and lonely, it is close to the rapidly-expanding tourist centre of Siponto and the umbrella-shaded lidos. It is fortunate that the villa urbana, discovered in 1973, is at Siponto, and not at Salpi, since its proximity to the tourist centre will amply justify its excavation and preservation as a public monument.

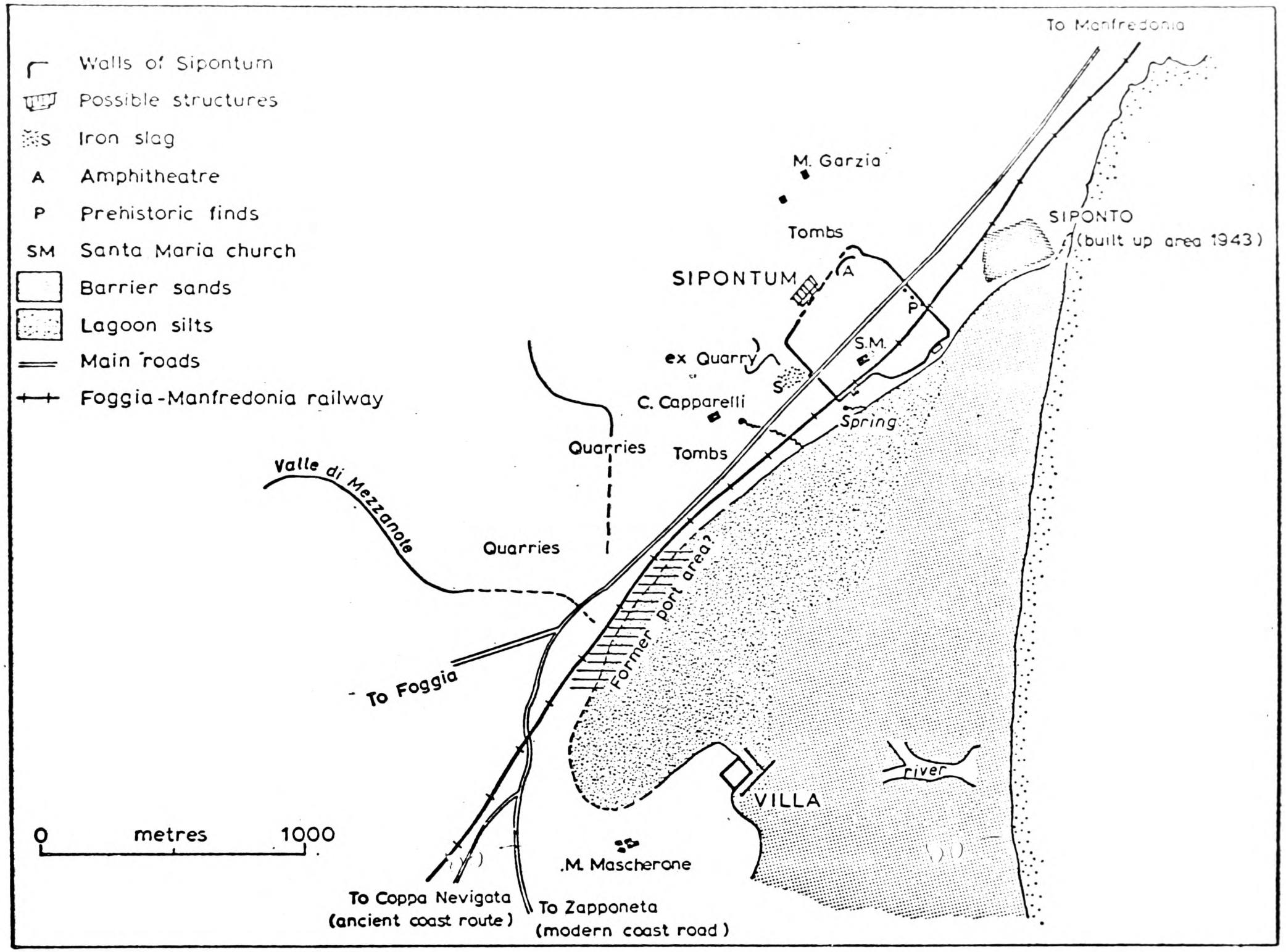
The origins of Sipontum have presented problems. According to Strabo it was one of several Greek colonial foundations on the Tavoliere (together with Salpi and Arpi) but nothing of these antecedents is acknowledged in the archaeological record. Excavations opened in 1937 around the church of Santa Maria; continued in 1953/5 when lengths of the walls were cleared and again in 1965 when Signora Tinè exposed 126 metres of the northern wall and 4 towers. The only hint of prehistoric occupation, from this last excavation, is a rock-cut feature just inside of the wall between the second and third towers where rare pottery fragment suggests an Iron Age date. There are, apparently, no recognisably Greek or even Daunian features. Accordingly, Signora Tinè is tempted to identify the first Sipontum, the Sepius of the Greeks, with the archaeological evidence at Cupola (page 66). She sees the progressive siltation of the Salso estuary as the reason for the move northwards of the settlement to the rock outcrops at the foot of the Gargano (Tinè and Tinè, 1969), a suggestion with which the present writer has little sympathy, at present anyway, on precisely those environmental grounds.

The documented history of Sipontum begins with Livy's account of the abortive founding of a Roman colony in 194 B.C. on land expropriated from Arpi at the close of the Second Punic War (Livy XXXIV 45). But a few years later, a Roman consul, Sp. Postumius Albinus, while touring on business found the colony deserted and it was reconstituted in 186 B.C. Despite Cicero's description of Sipontum as 'dry', too much environmental significance should not be read into the abandoning of the first colony. Toynbee pointed out (Toynbee, 1965) that enrolment in the coastguard colonies had always been an unpopular service which implies that reasons for abandonment should be sought in conditions of military service or of colonial settlement. It is thought that the original colonial families may have numbered 300, as was usual in the planting of coastguard colonies, but it is not known who the settlers were or from what region of Italy they had been drawn, a relevant point.

Figure 48

Figure 48.

Sipontum - the general area.



The outline of ancient Sipontum is in many ways clearer than that of Salpi (figure 48). Excavation has shown that there were two quite distinct phases of wall-building. At the base are isodomal blocks, dated to the end of the 3rd century or the early 2nd century B.C., that should probably be associated with the new colony (if they are not Greek). The wall was continued later (1st century B.C.) with plain ashlar blocks, about 80 centimetres by 40 centimetres, making a total height of about 5 metres. The later wall, extant during the Middle Ages, was originally double with an inner rubble filling, several metres wide. Most of the outer blocks, together with some of the rubble infill, was robbed for the building of the new Manfredonia (Palumbo, 1952). The towers are associated with the first wall. Signora Tinè's excavations identified two 'working areas' contemporary with each wall-building phase, as well as a good depth of burnt material in the interval. A medieval cistern lay immediately outside the walls on this north-eastern side.

The outline of Sipontum is usually presented as a simple trapezium(figure 48) but ground inspection in 1971 suggests that it was once much more irregular in detail. Its orientation, on a south-west - north-east axis, concurs with the general geological structure of the Gargano limestones at this point. The eastern, seaward, wall would seem to have undergone a complicated sequence of enlargement and rebuilding for there are two or three irregularities on this side. There are fragments of masonry which suggest some sort of masonry abutment, such as a gatehouse, which would have served, for instance, those who had had business with the port: seafarers and traders, pilgrims and crusaders. Further along, just behind the church of S. Maria (currently being vigorously restored), the wall makes a sharp re-entrant. This leaves an open rectangular tract of rocky limestone between the south-eastern corner of the city and the sea or lagoon shore. Today most of the wall is disguised by soil, vegetation and field walls but the break of slope (2.6 metres) is a sharp and clear pointer of the city outline.

There are a number of extra-mural structures in this area of later, probably Byzantine, date. On the southern side the excavated sections reveal not only the wall but part of a gateway. This is located immediately to the west of the modern road, indicating that the modern road alignment into (if not right across) the city substantially accords with the ancient route. The original walls on the western side are less clearly discerned, for here a substantial terrace has been built and rebuilt as a field wall over 6 metres high. Many of the ashlar stones from the ancient city wall, obviously displaced, as well as field clearance stones, are included. At the north-western corner, near the remains of the amphitheatre, is another re-entrant, on the northern side. This is a small feature, however, and might mark no more than effective stone robbing of the wall itself.

The walls enclose an area of just less than 18 hectares. Only two features remain <u>in situ</u> inside this enclosure, the amphitheatre and the church. Part of the amphitheatre survives in the ground plan of farm-buildings near the north-western corner. A band of <u>opus reticulatum</u>, about 80 centimetres high, is exposed in the outer walls of these buildings. The church, S. Maria Maggiore, lies in the opposite corner, nearer to the lagoon. It was damaged in the last war and has been in a very bad state of repair. The present structure dates from 1117 and is in Romanesque style but it overlies a late Roman-Byzantine structure. On the northern side of the church, prewar excavations uncovered a basilica of Roman date.

For the <u>opus reticulatum</u> of the Roman structures the local Cretaceous limestone seems to have been selected. This is a hard, compact, limestone that one would think rather unsuitable for working into the regular shapes needed for such facings. But it seems to have been the standard material for such work both at Sipontum city and at the villa. It is found at Matinatta too, on the Gargano. For the city walls, however, the other local stone was evidently preferred, in Roman times as in the Middle Ages and even today. This is known as <u>tufa</u>. It is the yellowish highly fossiliferous,

calcareous series (Miocene) that overlies the Cretaceous limestones in the Siponto area. It is much softer, and though easier to work, was presumably deemed unsuitable for decorative work of the nature of opus reticulatum. So much in fact, of the Miocene tufa has been quarried from the immediate environs of Sipontum (for example, between the southern wall and the necropolis) that the relief (and geology) of the area has been substantially altered. Many of the depressions and hollows are thus of historic origin. In these cases, without a ground check, the air photographs can be misleading. The embayment to the south of the city bore, at first sight, a striking resemblance to a small harbour, being lowlying, with waterlogged soils and angular outline. Field work showed, however, that only a metre of colluvial infill masks the Cretaceous bedrock and both the outline and the depression itself is largely the result of tufa quarrying.

There is evidence for extra-mural occupation and industrial activities on this side of the city. A considerable quantity of slag was picked up from the plough soil below the line of the walls. According to the farmer, a tradition of iron working is attached to this spot (plate 39). The predominant pottery here is Roman (Arretine) and there may be a chronological association between these finds. The material is being prepared for publication.

Like Salpi, Sipontum would have been surrounded by suburban settlement and other features. No farms have been found but the rocky areas, to south, west, and even north (below modern Siponto) are scattered with rock-cut tombs of various styles, some obviously Christian. There would have been several roads leading out of the city but only sections of the main route southward have apparently been traced at the foot of the Gargano (G.B.D. Jones; personal communication). But the most important extra-mural feature so far discovered is undoubtedly the Sipontum villa. This was a villa urbana, located on the northern extremity of the Mascerone terrace and about 2.7

Figure 49(a)

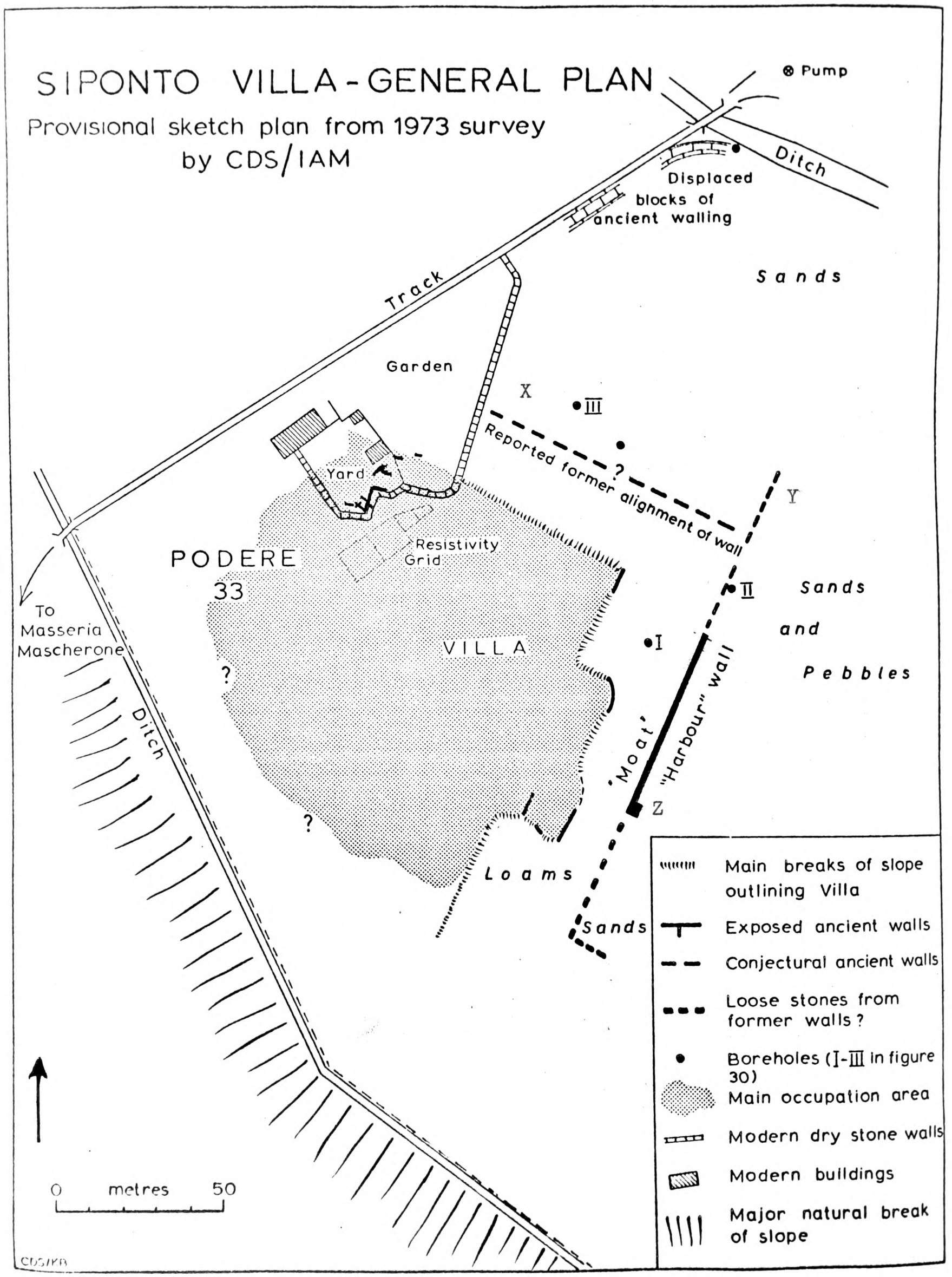


Figure 49(a) The Roman villa at Sipontum.

kilometres real distance from the city (taking a circuitous route around the end of the lagoon). It was discovered in the early stages of fieldwork in 1973, thanks largely to the Russo family of Siponto. It is a key factor in the dating of the sedimentary history of the lagoon and has already been introduced in this context (page 182). It is described here in more general terms.

A low, more or less level-topped, mount occupies the site (plate 40). One of the podere farmhouses, constructed in 1939, lies so hard against the villa's northern side that some of the foundation walls of the villa have been exposed in its farmyard. The main area of the villa, covering about 1,2 hectares, rises high above the farmyard and its duckpond. Apart from the breaks of slope, pottery and building material in the ploughsoil and short sections of external wall occasionally visible at the break-of-slope mark the villa's outline. The villa was roughly quadrilateral but on the seaward side were at least one, and probably two, rounded, apsidal projections (figure 49 and plate 42).

The villa lay at the very end of so small a promontory that it would have been surrounded on two, if not three, sides by water. Unlike some of the rich villas around the Bay of Naples this one does not appear to have been built out actually over the water but there is no doubt that some sort of moat-like arrangement was incorporated into the design. For, apart from the villa structure, there are two or three outer walls whose arrangement appears to enclose a moat on two sides of the villa and a harbour immediately to the north. (Walls X, Y, Z on the plan.) These now-buried walls impeded the cultivation that started here early in the last war, and a few years ago much of the walling was broken up and the blocks dragged to the side of the field. These blocks show that the very solid walls were faced with opus reticulatum on the upper section. A layer of yellow or reddish brick separated the upper section from the foundations, which were composed of small, well-mortared, polygonal blocks, some of which could

have been river cobs. It is difficult to be sure where these uprooted blocks came from, for the farmer, though willing up to a point, was intentionally vague and obviously feared a sinister motive behind our enquiries and field investigations! He indicated that one line originally ran parallel to the northern side of the villa and beyond. The other line, of which something still remains in place, would have been at right angles to this, so that a large rectangular area of lagoon would have been partially enclosed, forming a sheltered haven close to the villa on its northern flank. The surviving portion of the outermost wall is the most interesting feature so far investigated. It is this wall, the so-called 'harbour wall' (page 182), that kept marine sediments separate from the terrestrial infill that obliterated the haven just described. The portion still in situ is about 68 metres long. It runs parallel to the bow-fronted eastern side of the villa and leaves a channel or moat about 15 metres wide in front of the villa. It is today flush with ground level and might have gone unremarked but for the fact that a small drainage ditch was recently cut alongside it on the seaward side. Thus about 50 centimetres of the wall are exposed (plate 41).

If there was any opus reticulatum on top of the remaining portion, it has vanished with little trace. What is visible is a stout wall of polygonal, slightly rounded, stones. The larger measure perhaps 18 by 26 centimetres, even 23 by 30 centimetres. Interestingly, and significantly, the wall has been faced with a layer, 2.5 centimetres thick, of opus signinum. This type of mortar, made here with local shelly sands and gravels, was commonly used in Roman times to render aqueducts and cisterns water-proof. The marine function of the wall is thus beyond question. Appropriate to a marine structure, the wall was solid. It measures 1.70 to 1.80 metres wide. The northern end has been much damaged but the southern end is clearly in its original shape. Here the wall terminates in a neatly constructed rectangular end, projecting seawards, that doubles the width of the wall. The

Figure 49(b)

maritime nature of the sediments (sands and beach pebbles) on the outer-side of the wall, and the contrast of these with the clays and loams of the moat on the inner side, has already been described and discussed (page I82).

Of the internal walls of the villa itself there is very little to be seen other than the foundations exposed in the farmyard. At one corner of the villa some brick walling was noticed but so little is visible that it is difficult to be sure that this is not no more than an extra thick 'damp-course' of the usual style. Almost certainly, though, the walls in the farmyard represent only the foundation levels. This fact has been useful in estimating the altrimetric position of the original villa in relation to present sea level. There is no opus reticulatum facing below the tile layer, a good indication that it is the original foundation layers that are today visible below the bricks (plate 43).

A resistivity survey was carried out on the buried part of the site immediately adjacent to the farmyard (but 2.5 metres higher). The resistivity equipment was loaned by Mr. A. Aspinal of the department of Physics, University of Bradford and operated in the field by Denis Mott. The micro-photograph portrays the findings. The rectangular outline of buried buildings showed up clearly as positive readings (white on the photograph). There seems to be a good deal of buried field clearance rubbish, accounting for the big white patches outside the building. The relationship of the walls revealed by the resistivity survey with those exposed in the farmyard can be seen from the plan. (figure 49b).

The ploughsoil over the villa contained much of interest. The dominant pottery was Arretine (Samian) ware. Some of this was very thin, other fragments had attractive motifs in bas-relief. Some high quality glass fragments were collected, together with a large amount of coarse-ware. But there were many pieces of cut marble, tessallated mosaic, and some moulded and painted stucco (plate 44). This tells a good deal about the quality of the original

buildings. The marble, in plaques or triangles between 1 and 2 centimetres thick, was white and would have been brought all around the peninsula from the famous Carrara quarries. Other coloured marble may have been brought from North Africa (Dr. E. de Juliis, personal communication). So there is little doubt that the villa was a sumptuous affair in its time, luxuriously sited at the water's edge.

The date of construction suggested is the mid-1st century A.D. (Dr. E. de Juliis, personal communication). But there is little evidence that it survived very long and certainly had been in ruins long before the Middle Ages; virtually no Medieval pottery was found. It is possible that any inhabitants remaining after the 3rd or 4th centuries A.D., moved to higher ground, possibly to Masseria Mascherone. There is no doubt that the promised excavation of this villa will benefit not only the sedimentary studies of the Tavoliere coastlands, but the general public of modern Siponto and Manfredonia. A general display, on the lines of the Fishbourne site at Chichester, England, incorporating the history of the city of Sipontum and of the lagoon, is envisaged.

If there was good living at Sipontum in the 1st century A.D., there was also prosperity at the time when Sipontum would have been one of the 'tolerably rich' cities of Apulia referred to by Paul the Deacon in the 8th century A.D.. Later, it was a busy crusader port and a pilgrim port. The pilgrims were bound for the Sanctuary of Monte San Angelo on the Gargano just above Sipontum, one of the three the great European places of pilgrimage (after S. Jaques de Campostello and Canterbury). Presumably, too, Sipontum had its fair share of Apulian trade, for the Adriatic coast has never been well-endowed with ports north of Brindisi. As the city grew new land, even on the rocky Gargano slopes, had to be taken into cultivation.

But medieval Sipontum had more than its fair share of vicissitudes. There were raiders, of course, such as Sclavians from Friuli who, in 642 A.D., constructed deep ditches near the town by which to entrap the Lombard

Figure 50

Figure 50.

The New Town of Manfredonia as it was early in the 18th century (reproduced from Pacichelli 1703 by courtesy of The British Library).



defenders. A few years later, vengeful Greeks plundered the Sanctuary of Monte S. Angelo, also held by the Lombards. By 1155 however, the city had been so shaken by earthquakes that the description "civitate diruta" was repeated time and time again in the documentary records of the cartulary of San Leonardo. First mentioned in 1156 by 1201 the phrase ran "from the time that Sipontum was ruined" (Camobreco, 1929). There may have been, also, problems of silting; the name Patano appears in the records, but no explicit reference to this problem has been yet encountered. There may have been malaria, as there certainly was later. Camobreco suggests that one of the names by which San Leonardo, much further south and nearer the Salso marshes, was known in Middle Ages (Nebularia) is an indication of such 'bad air'. A more certain fact is that there were further earthquakes early in the 13th century, in 1223 and 1255 for instance.

By this time the decision to lay-out a new site just two kilometres to the north had already been taken. The year 1250 is usually cited as the year of Manfredonia's foundation, although building may not have started until a couple of years or more later. (Palumbo, 1952). The decision to build a new town involved many factors, however, and this has been discussed elsewhere (Delano Smith, 1973b). As in the case of Salpi, the conclusion is reached that the sedimentary changes might have been contributory but unlikely to have been causal. The earthquakes, for example, would have been considered as opportune for the clearing up of an old, and no doubt over-crowded, settlement as was the Great Fire of London in 1666. Surely one of the key factors, however, would have been the Hohenstaufen desire, or need, for a new town and new port. Frederick II was a noted New Town developer (Leonard, 1954) and had created eleven in Apulia already. For his young son and successor, Manfred, there would have been much political gain from following the example of the 'stupor mundi', had he lived to profit from it. As it happened, 'new Sypontum' survived its creator to become one of the major post-Medieval ports on the Adriatic.

Building in the new town started in 1263 or 1264 under Manfred. Stone from the old settlement was taken for the new, and inhabitants enticed not only from the ancient Sipontum but also from Civitate (Teanum Appulum, an ancient city overlooking the Fortore) to Manfredonia with ten-year tax concessions that ran from March 1265 (Palumbo, 1952). With bitter irony, it was during the Angevine siege of Lucera that the new port first demonstrated its usefulness in assuring supplies for the besiegers, long-standing enemies of the Hohenstaufen. Then in 1278, while Lucera castle was being repaired, work on the city walls at Manfredonia was embarked on (or continued); Angevine-style, round, towers enclosed - as if to obliterate - the more angular ones of Manfred's castle (plate 46). The quadrilateral fortifications were given four major gateways; one towards Foggia, another towards Monte San Angelo, one in the Jewish quarter in the north, and one giving access to the quays (figure 50). There were later destructions and damages; the Turks sacked the city in 1620 and again later in the same century. But the Angevine walls still contained the town when Huillard-Bréholles visited it in the fourth decade of the 19th century and there was virtually no extra-mural building. Today, however, the town has far outgrown the medieval circuit though much has survived of the walls and the towers. For example, on the north side the double line of walls, still stands a good 13 metres high, a space of about 10 metres between each wall, which is of coarse rubble.

As a slight to Manfred, the new town was for a time known as Sipontum Novellum. Functionally its importance was to be derived from external trade. Neither with a bishopric, nor a mint (transferred by Manfred from Brindisi) nor through general European interest in the Sanctuary of Monte San Angelo, did Manfredonia gain particular administrative or regional importance. But as a port, it succeeded almost immediately (plate 47). Scarcely 30 years after its foundation Manfredonia contributed newly-built ships, perhaps very similar to those still being built there today (plate 48),

to Charles of Anjou's Sicilian campaign (Renouard, 1936). By the middle of the following century, port development permitted vessels of 500 tons to reach the quay, not possible anywhere else along the coast. The export of cereals to famine-stricken Armenia in 1336 reflected the activities that were typical of Manfredonia as a major cereal and wine port and a major trader with Ragusa (Dubrovnick) until the nineteenth century. To these cargoes should be added imported timber and above all, later, the wool export that made the Tavoliere famous.

In contrast, nothing is known of the port of ancient Sipontum. Even its location remain conjectural. Our sedimentary investigations show that it was unlikely to have been at the northern end of the lagoon, for here the water would have been shallow once the barrier beach had formed and most prone to siltation. The most reasonable location to suggest is opposite the inlet into the lagoon. If there were harbour facilities here in Roman times, it would be reasonable to explain the villa's harbour structures, just opposite, as part of more general arrangements, perhaps accommodating a naval or municipal officer of consequence rather than as the private establishment of some rich citizen.

Walling of a very striking character was discovered further south, nearer the present coast (plate 45). These walls appear to have been originally so massive that they must be associated with something like a sea-wall or quay function. There are sufficient remains visible to indicate that the wall may have comprised two sections, at a slight angle to each other. The largest piece, about 9 metres long, is nearly 3 metres wide, with a well-fashioned surface of blocks of regular shape but varied size; the average perhaps measuring 30 by 50 centimetres (plate 45). The cement contains gravel, pebbles and fragments of brick or pottery. Much more of this wall, which was perhaps intended to check the lagoon-ward drift of beach sands, is said to remain below ground level. The date of construction is uncertain. The local inhabitants think of it as a road leading up

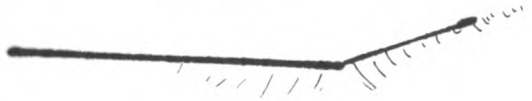
onto the Mascherone terrace; they call it Ponte S. Lorenzo, after the patron saint of Manfredonia. There may be much else, in the way of buried walls, to be discovered around the ex-lagoon of Siponto. An opportunity for further investigation is awaited. It is hoped, however, that it will not be too long before the topographical details, as well as the outlines, of the extra-urban region of ancient Sipontum, and of its port will be written, together with the full sedimentary history of the lagoon.



Plate 39. Sipontum city today: viewed from the south-western corner.

harbour wall

mound



moat





Plate 40. The Roman villa at Siponto seen from the south.

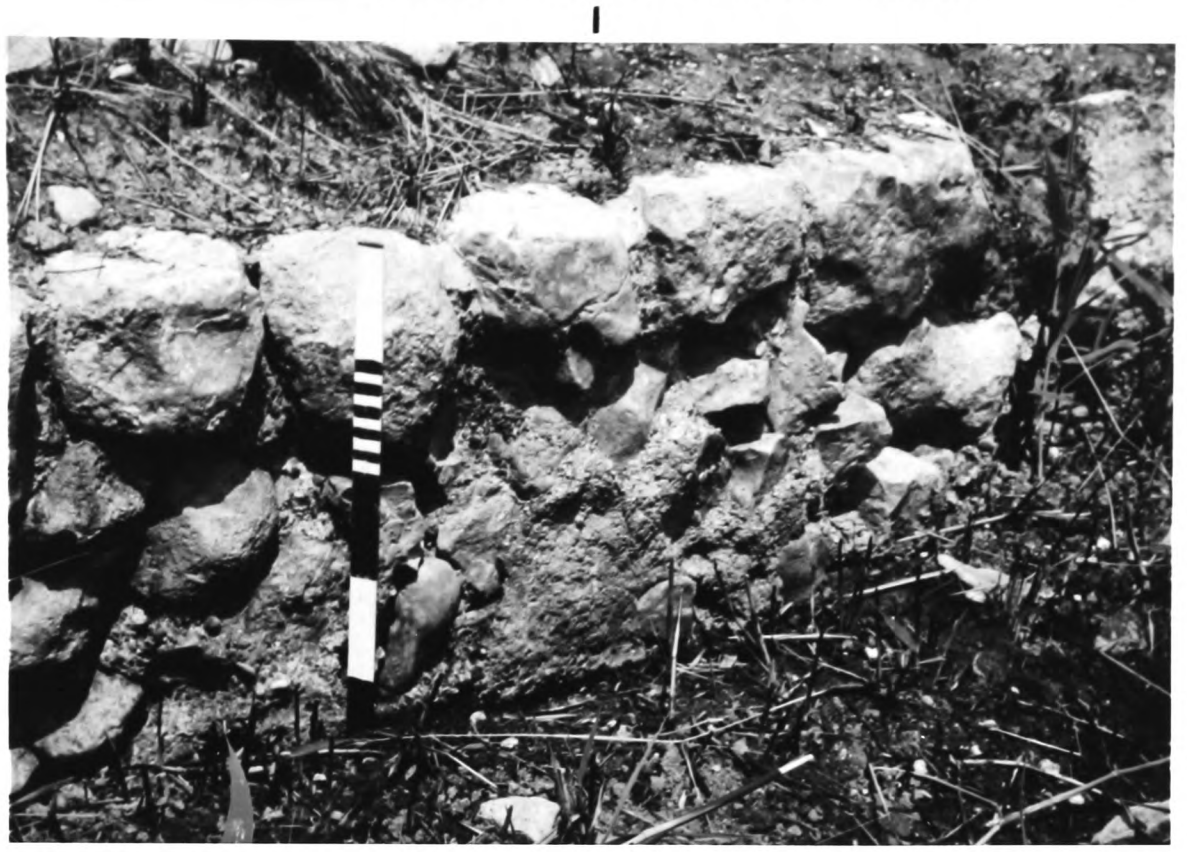


Plate 41.

The 'harbour' wall; note opus signinum.



Plate 42.

Part of the rounded frontage.

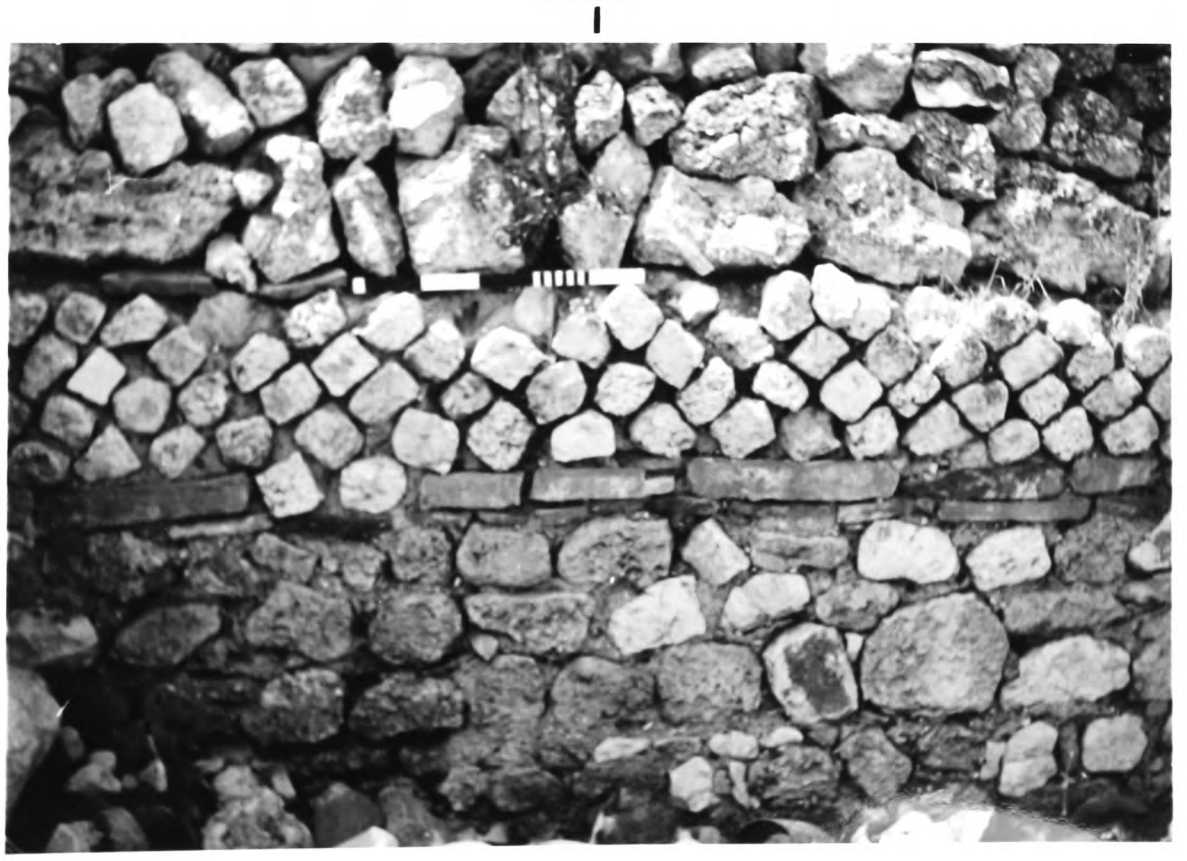


Plate 43.

Partially disturbed walling near duckpond. Note different courses.



(I.A.M.)

Plate 44. Sipontum villa: coloured marbles, mosaic and decorated stucco from plough-soil.



Plate 45. The ancient 'sea wall' at Siponto.



Plate 46a. Manfredonia: the castle, showing rounded Angevine bastion enclosing a rectangular Swabian tower.



Plate 46b. Manfredonia: vestiges of the walls of the I3th century New Town (northern side).

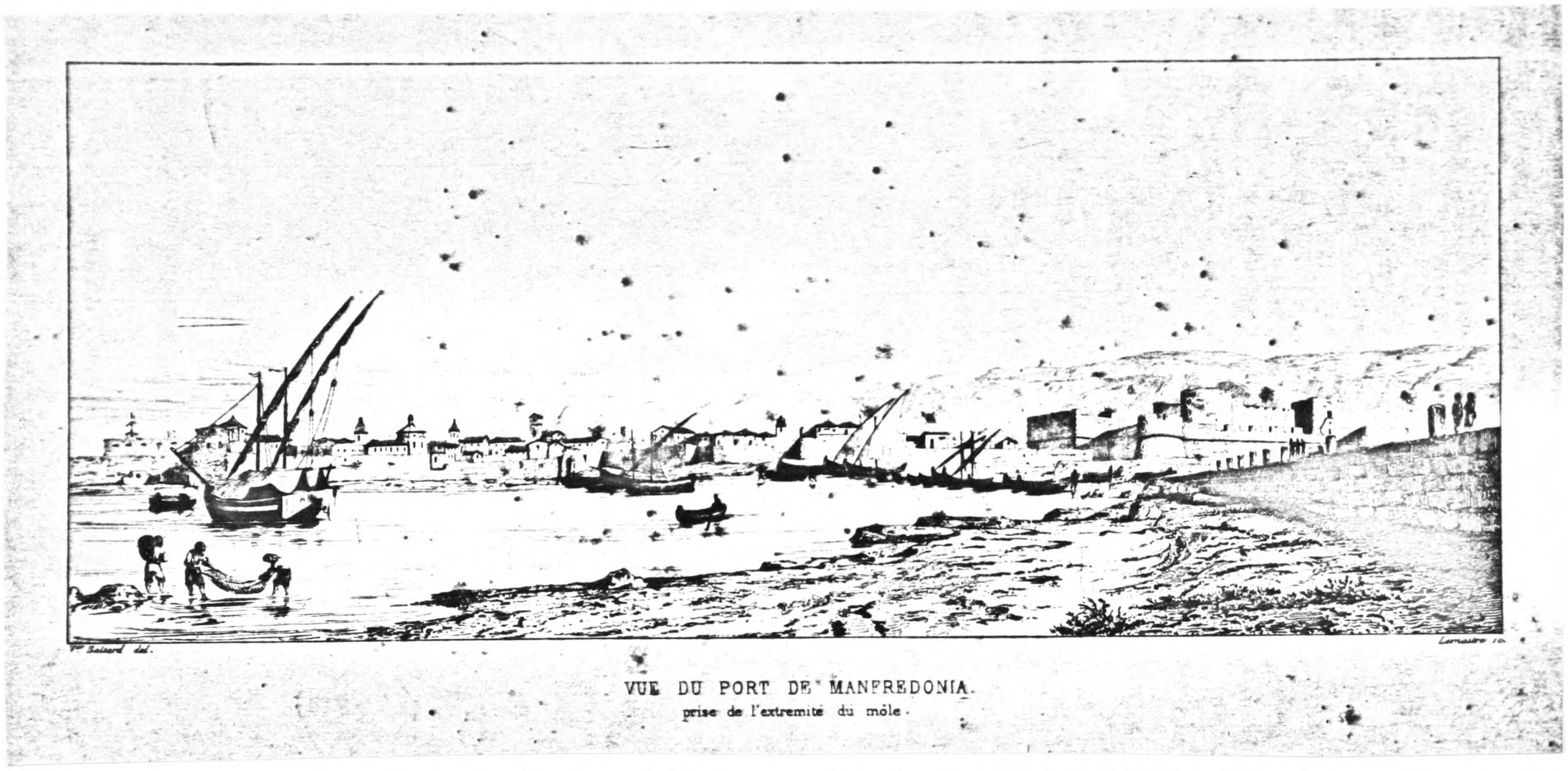


Plate 47. The port of Manfredonia in 1844: engraving by Huillard-Bréholles (courtesy of The British Library).



Plate 48. Boat-building at Manfredonia.

IV

CONCLUDING REMARKS

Factors of change.

IV CONCLUDING CHAPTER : FACTORS OF CHANGE.

Having observed some of the post-prehistoric changes in the Tavoliere coastlands, it would be a logical step to consider the causes of these changes. Although this chapter is by way of conclusion to the present study it is not in fact intended to pursue the question of factors of change or even to attempt to draw conclusions from the observations so far made. In the first place, each of the possibly relevant factors of change demands close, individual, attention for which there is no place here. In the second place, it would be premature to attempt to conclude or to generalise from work that is so patently incomplete and currently in progress. It is hoped that these omissions will be made good in a future publication on the Mediterranean coastlands. However, something of the tip of the iceberg should be intimated at this juncture and so the three most important factors of environmental change in the Tavoliere coastlands are mentioned here. Improperly charted, they tend to be the salient points on which unwary voyagers to the realm of palaeo-environment risk foundering.

The topic of CLIMATIC CHANGE since prehistoric times has generated a vast literature. This is appropriate to a factor that is at once close to each individual, as part of his own experience (weather), and that can have far-reaching implications for patterns of living and likelihood. A significant change in the climatic parameters of cropping conditions, for instance, might undermine an established economy. There is no longer much doubt, for instance, that the Sahara and its margins have seen such changes, or that there are individuals who have seen glaciers advance and retreat over their alpine fields within the span of their, and their immediate forefathers', lives (Ladurie, 1972). However, the bond that has developed in men's minds between climate and economic activity has become so intimate that the question of historic climatic change is rarely viewed objectively. There have been the sound, major specialist studies (e.g. Ladurie, 1972;

U.N.E.S.C.O., 1963; Lamb, 1966; Royal Meteorological Society, 1966) but too many writers have found it all too easy to precipitate to a link a major human event and a climatic change. A case in point would be the apparent abandonment of the Tavoliere in Late Neolithic times and throughout the Bronze Age (that we now see has to be qualified by the discovery of so much Bronze Age occupation, in the coastlands at least) for which dessication of the climate was put forward as an explanation (Trump, 1966; Tinè, 1973). But events that are chronologically coincident are not necessarily causally related. This is not to suggest that historic climatic change be ruled out out of hand but to plead, first, for a proper definition of 'climatic change' in the historic context and, secondly, for an objective appraisal of the facts.

Three points that the present writer has come to believe are fundamental are made here, albeit briefly. First, it is important to know, in measurable terms, just what constitutes a "significant" change in the climate of the region in question. Second; it is also important to establish, again in measurable terms, just what are the parameters of the "normal" climate of the area. After all, climate is a notoriously unstable factor in its normal pattern. Even the English Law Lords, in ruling on insurance matters, accept this:

> "We call it [an exceptionally heavy rainstorm in July in the delightfully mild spa town of Cheltenham] extraordinary, but in truth it is not an extraordinary storm which happens once in a century, or in fifty or twenty years; on the contrary, it would be extraordinary if it did not happen. There is a French saying 'that there is nothing so certain as that which is unexpected.' In like manner, there is nothing so certain as that something extraordinary will happen now and then."
>
> (Bresler, F. Law in a Cold Climate. Punch 19/26 December 1973 p.1006, quoting Salmond on Torts, 1973 edition)

Thirdly, it is important to take a long, critical look at the actual facts, the evidence for the past climate(s) of the area in question.

The second point is taken first. When all elements of the climate of

Figure 5I

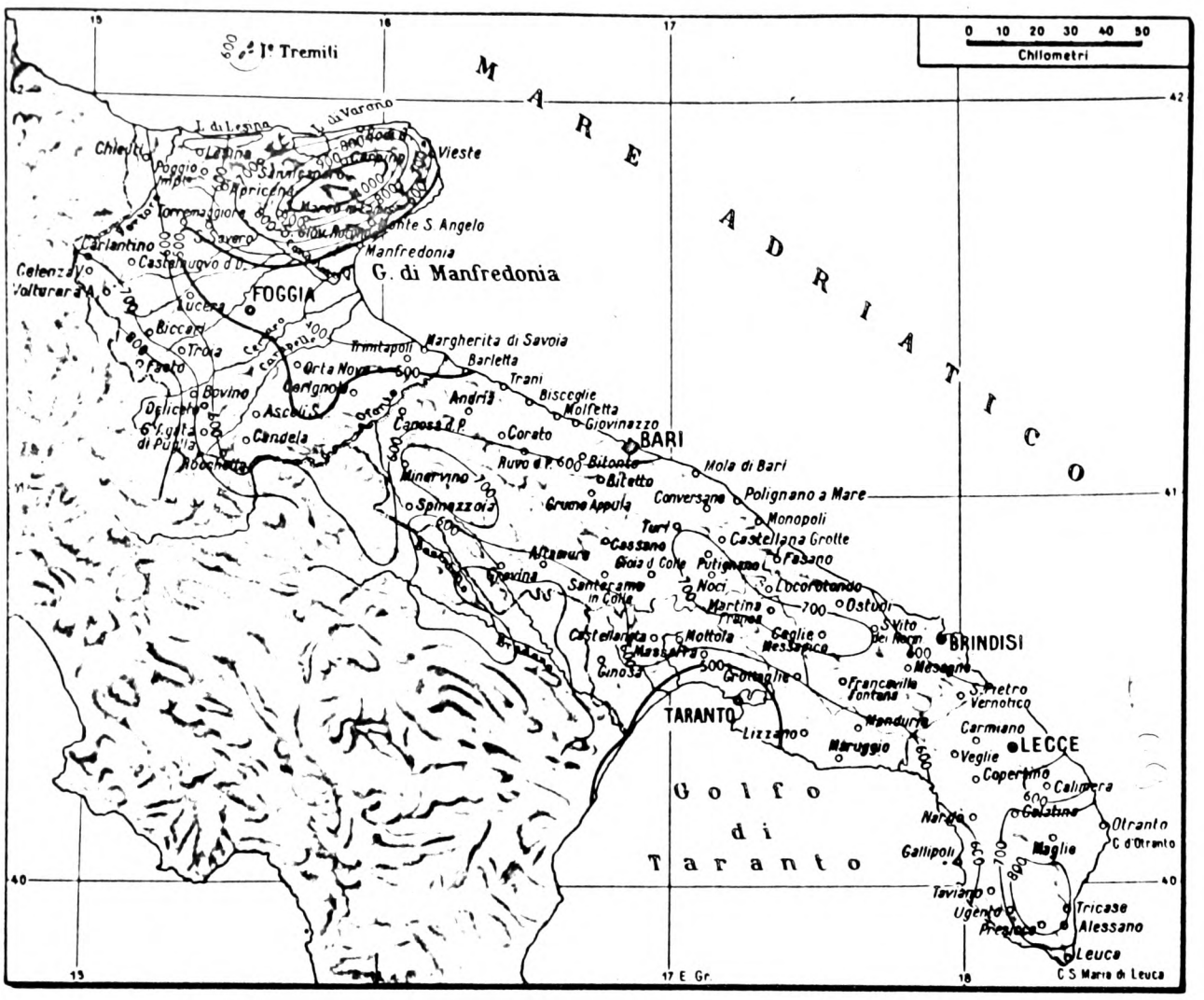


Figure 51. Precipitation in Apulia (from Baldacci 1962)

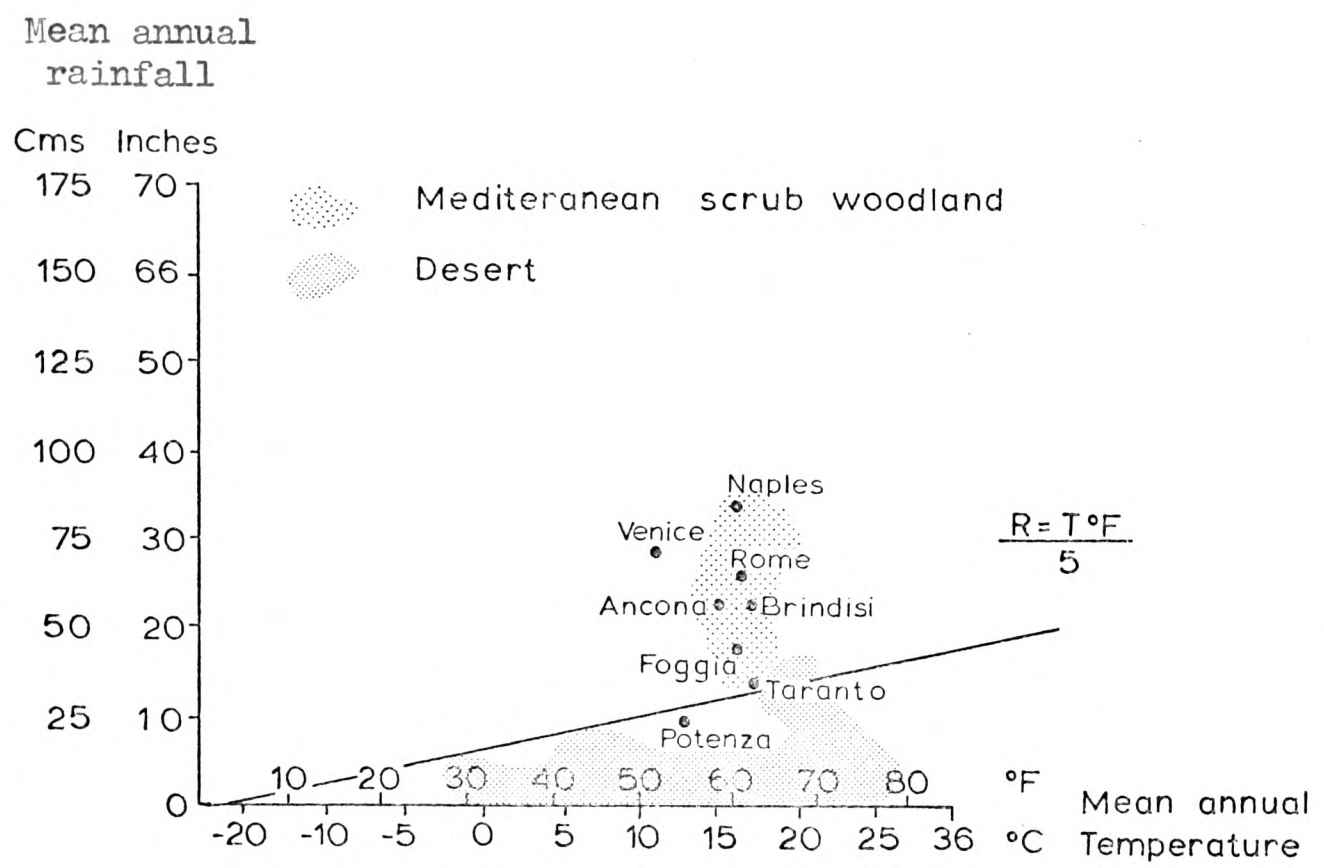
a particular locality have been accounted for (temperature, wind, pressure, precipitation etc.), it is, in the final analysis, rainfall that governs the ecological cycle season by season. Climatic studies concentrate on precipitation figures for another reason: the absence, commonly, of the requisite data on soil moisture conditions, and on the water-balance that is the really effective factor from the point of view of plant growth. Therefore, inadequate as this may be in theory, it has to be the isohyets that are studied as an indication of average moisture conditions on the Tavoliere today. Considering these (figure 51) the striking point emerges that of all south-eastern Italy it is the Tavoliere that is one of the driest areas in Italy. It is also the largest area that can expect, on average, not much more than 500 millimetres per annum. In the coastlands the average is lower, 400 millimetres or less. Only in a very small region around Taranto is there a similar degree of aridity. The implications of this expectancy of relatively low annual rainfall figures for an area with an average annual temperature of 15.5° Centigrade is conveyed in table 8 below and in figure 52. From the table it is seen that the Tavoliere (as represented by the data for Foggia) lies very close to the boundary between sub-arid and arid. This is not for a moment to be taken to suggest that Foggia has even a near-desert climate but to drawn attention to the fact that it does not lie so far as all that from a potentially critical ecological threshold.

It has been pointed out that the

> "successful growing of grain (the lowest rainfall demanding crop) in East Africa ... is regarded as 30 inches p.a. with a specified reliability"
> (Whyte, 1963, p.383)

Without knowing the appropriate temperature, the figure of 30 inches (76 centimetres) is irrelevant in comparison with the question of reliability, but it is higher than that received by most of the Tavoliere. The climate of the Tavoliere has been described in detail elsewhere (Delano Smith:

Figure 52



After A.A. Miller

Figure 52. The climatic marginality of the Tavoliere (based on A. Miller 1966).

Table 9. Defining the desert limit.

Annual Rainfall defining the desert limit according to	Mean Annual Temperature					
	°C. 25	°C. 20	°C. 15	°C. 10	°C. 5	°C. 0
	cm.	cm.	cm.	cm.	cm.	cm.
Köppen (1918)	32	29	26	23	20	16
Köppen (1923)	41	36	31	26	21	16
Thornthwaite (1931)	37	30	25	20	15	-
De Martonne (1)	50	40	30	20	10	-
De Martonne (2)	35	30	25	20	15	10
Miller (1950)	40	35	30	25	20	15

(After Miller, A.A. 1953, p.86)

The Neolithic landscape of the Tavoliere; for the Society of Antiquaries) and attention drawn to the characteristic variability and unpredictability of the present-day rainfall pattern. For the sake of the present argument, the pertinent passage is quoted here:-

> "The most significant characteristic of rainfall regime on the Tavoliere is precisely this irregularity ... In 1947, 234 mm only was recorded as the annual total in one of the drier areas of the plain towards the coast (Azienda Terra Apulia). In 1932 no more than 337 mm was recorded for Foggia. But in 1915, 916 mm fell during the year, with more for the month of August than during the whole year of 1876 (249 mm and 237 mm respectively)."

Nowhere is it suggested that the Tavoliere became uninhabitable in these dry years though the harvest must have been affected to some degree. This is where the question of overall water-balance and of soil moisture (rather than simple precipitation totals) becomes critical. It can even be said that the concept of average, in so far as it involves an aggregate of annual precipitation totals, is meaningful in this context. For Whyte goes on to say that "a relatively slight climatic change is expressed in the total amount of rainfall for a sequence of seasons above and below the critical threshold values." The sometimes wildly ranging rainfall

totals for the Tavoliere are, therefore, consistent as the 'normal' rainfall parameter for the region.

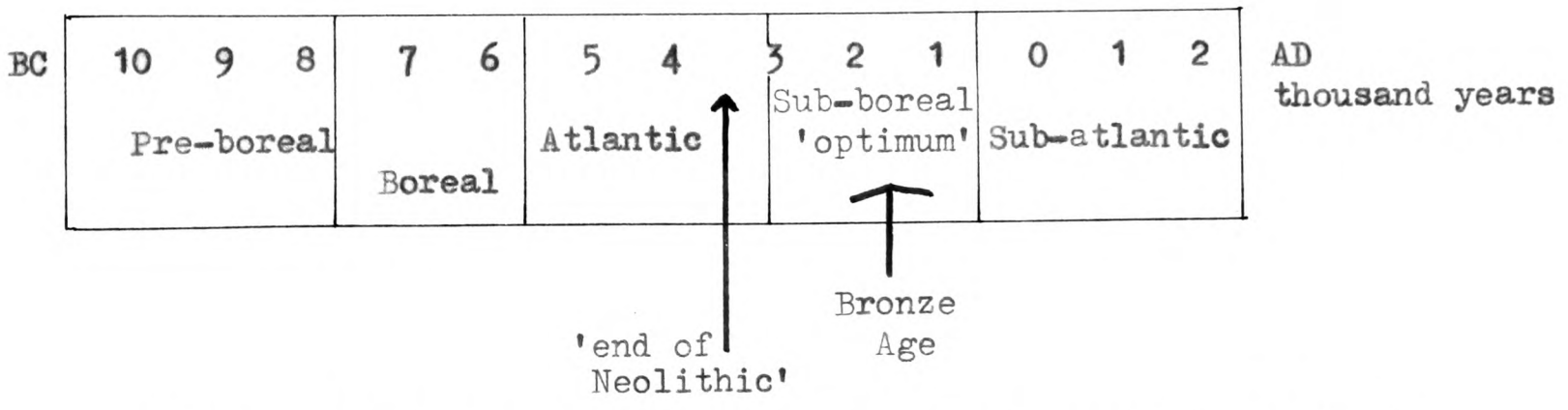
In other words, for ecologists and agriculturalists, climatic change (in arid zones) is expressed in terms of long term reliability of the critical threshold. This brings the discussion back to the first point: what, quantitatively, would constitute a "significant" change of climate on the Tavoliere? It seems fairly clear that a permanent tendency towards a rainfall aggregate lower than at present could jeopardize cereal cultivation in all but the moister parts of the plain. At best, the Tavoliere would become a region of unreliable growing conditions; at worst, it would be technically marginal. On the other hand, any tendency to increased rainfall, over a sequence of seasons, should benefit arable farming, providing that the increase was not so great that weed control could not be dealt with in the course of the existing farming calendar. However, it must be admitted that precisely what amounts might be involved in a change to a significantly 'wetter' or 'drier' climate cannot be stated here, without a detailed investigation into aspects of soil moisture and water balance.

But a glance at the accepted climatic periods of the Holocene shows that it is unlikely that climatic change would have had, alone, any significant bearing on the pattern of settlement and economic activity on the Tavoliere. For instance, the so-called climatic "optimum" of the sub-Boreal period has been assessed in terms of conditions in cool-temperate Europe, where most of the work on palaeo-climatology has been carried out. There, a slight dryness from the Atlantic period (described as warm and wet) to the sub-Boreal (described as warm and drier) would have been advantageous to cereal farmers. Professor Lamb has suggested that the increase in temperature involved might be in the order of 2° centigrade for the average annual temperature, (Lamb, 1966). Such a tendency on the Tavoliere, if translated into a decrease in rainfall, would almost certainly not have been

welcomed with the accolade of 'optimum'!

However, whether or not the sub-Boreal period was dangerously dry on the Tavoliere for arable farmers, it is still an unwarranted jump to associate this causally with the 'end of the Neolithic' there. It is true that the climatic divisions are often crude, described in terms of half millennia (Professor Lamb suggests the Atlantic climatic period drew to a close between 5000 and 3000 B.C.) but the archaeological dating is not much more precise: the 'end of the Neolithic' is placed about 3500 B.C. (Tinè, 1973). In table 10 the climatic divisions have been taken from Pennington (1969) and are held to be as exact as any. If this is so it is quite clear that the effect of the climatic change need not have been translated into economic and settlement adjustments until long after the supposed 'end of the Neolithic'. This sort of juggling with prehistoric dates is plainly unsatisfactory. But as there is decreasing archaeological evidence for such an 'end of the Neolithic', and for the desertion of the Tavoliere during the whole of the Bronze Age, the question can be left from further discussion.

Table 10. The coincidence of climatic and archaeological phases



Thirdly, and finally on this topic, there is the question of the evidence for climatic change in the latter part of the Holocene. Not all sedimentary analysis has been completed yet. For instance, the sediments from the ditch infill at Passo di Corvo have not been examined although they were collected with this question in mind. But to date it is clear that no field, or documentary, evidence has been noted that cannot be explained more

plausibly by variations in other factors. For instance, the thin films of post-Roman calcrete that have been found at Salpi II and near San Severo probably have far more to do with local soil drainage conditions than any general factor such as regional climate. Likewise, the calcareous facies in the lagoon sediments at Marana di Lupara and at Siponto are as likely to be the result of changes affecting the water body (depth, salinity) other than annual temperature.

This is the crux of the matter, so far as Late Holocene climatic change in general is concerned. In the final analysis, it has to be admitted, past climates leave no adequate and unambiguous record. This is one of the two good reasons, in the writer's view, for never turning to climatic change as a major factor of environmental (still less of economic or social) change until it is certain that no alternative explanation is satisfactory. (Delano Smith, 1973a). Of all the environmental variables, climate alone leaves no <u>direct</u> record of itself. Except as an actual and accurate measurement (of rainfall, temperature etc.) it is intangible and is visible only indirectly in the various ecological phenomena such as the soil (its colour, precipitates etc.), vegetation, fauna, and so on. The second reason is that these other features are themselves highly variable, susceptible to changes for a wide range of physical and anthropogenic reasons.

The question of SEA LEVEL CHANGES during the later Holocene has also generated an extensive literature. There may have been rather more written on Mediterranean sea levels than on Mediterranean palaeo-climates but this is scarcely an advantage, considering the controversies and conflicting views that have been put forward. Most controversial are precisely the last 6000 or so years, those which are of particular relevance to this study, and views over sea level changes in this period are admitted to be "much disputed" (Jelgersma, 1966).

The details of the disputes are not of consequence here. Jelgersma

has distilled them into three basic opinions. There are those (headed by Fairbridge, 1961) who believe that, having reached a post-glacial level by the middle of the Holocene, sea level has merely oscillated above and below present sea level since 6000 B.P. with an amplitude of perhaps 6 metres. There are, secondly, those who hold that sea level (in relation to land level) has remained steady since about 5000 B.P. and that all apparent variations are due to land movements. Finally, Jelgersma identifies those who hold that sea level is continuously (if with decreasing vertical amplitude) rising and that such a rise goes on at the present time. On the basis of recent, and as yet unpublished, study of the subject in North-western Europe, Dr. I.A. Morrison of the University of Edinburgh has put forward an objective analysis demonstrating that both the first and the third opinions contain the elements of the real situation. Thus we are invited to accept that sea level does tend still to rise overall, though in diminishing degree over time, and that the pattern is oscillatory. (Morrison, 1973b).

This latter view certainly seems to fit the evidence so far culled from the Tavoliere coastlands and from the region in general. Without embarking on a detailed analysis, mention is made of the apparent submergence of Roman Mattinata (in a different tectonic region from the Tavoliere, however); of the submergence of ancient buildings at Lesina; of the land bridge that existed in historic times between Lesina and the Isola di Clemente; of the sedimentary profiles at Siponto; and of the persistence of water in the coastlands despite all modern drainage attempts. From further south along the Apulian coast the reported evidence would seem to point the same way (Geronimo, 1970).

For the Tavoliere coastland evidence, in particular, a little more can be said. For instance, although it is not possible to demonstrate this at present, it is felt that it will be very difficult to explain the geological aspects of Bronze Age site selection in the Salpi area (see

page 238) without postulating a lower sea stand at that time, in relation to land, than the present sea level. Also, it is fairly clear from the Siponto villa profiles that there has been a post-classical higher level of sea in relation to land. Profile II, for example, shows that there are beach pebbles close to the surface of the ground over a wide area and whole, undamaged, mactra shells in the sands below. These deposits have brought the land surface to some 85 centimetres above present sea level. There is also the clay facies at Sipontum villa (profile III) and the mollusca changes at Siponto S. Maria (profile I), both evidence for a possible transgressive phase early in the first millennium A.D.

But the observation that the sea stand in historical times was higher in relation to the land that at present is not at all the same thing as suggesting that it is sea level itself that has changed position. Besides the eustatic factor there is also the question of a tectonic factor in an area noted for its instability, at least so far as earthquakes are concerned.

In general, it is thought (Almagia, 1959) that the Tavoliere coastal accumulation forms reflect at least in part the operation of negative tectonic movement. Just how much of the possible 80 centimetres or so of displacement recorded in the sediments at Siponto is due to an eustatic rise and how much should be attributed to a downward (or otherwise) tectonic movement is impossible to resolve on present evidence. Until the Salpi profiles can be more accurately related to present sea level, though a series of profiles running from Salpi to the coast, there is little further that can be usefully said on the matter.

There are two fundamental and general points to make at this juncture. In the first place, it may be important not to overlook the possible relevance of even very local tectonic events to the sedimentary record. After all, the sedimentary investigations are carried out on a highly local scale. Secondly, despite the relevance of tectonic movements, it would probably be a mistake to see all apparent post-prehistoric changes in relative land-sea levels in these terms. Some researchers (e.g. Flemming, 1968) in the

eastern Mediterranean, may tend to do so but while there is a distinct possibility that evidence from different parts of the Apulian coastline, and from different tectonic zones along that coastline, will match when studied more closely, the eustatic factor cannot be discounted.

However, to establish that there have been changes in relative sea-land levels since the mid-Holocene is not the same as suggesting any sort of causal link between higher, or lower, sea stands, and the sort of environmental changes noted in the Tavoliere coastlands since the Neolithic. For instance, there is little doubt that a relative rise in sea level would contribute to the deposition of riverine sediments in the coastlands and so to the infilling of the lagoons. But the sea level change would be little more than an 'accessory after the deed'. Through ponding back river discharge, a higher sea stand would be reflected in the deposition of that load, but it would be unlikely to increase the actual amount of load available for deposition in the coastal area. Such an increase would be effected by factors of erosion inland, possibly far inland. These might be stimulated by, on the contrary, a fall in sea level as far as this is felt in the hinterland. On the other hand, a host of ANTHROPOGENIC FACTORS (disforestation in particular, cultivation techniques etc.) are of considerable relevance to the question of inland erosion and remain to be discussed.

Sufficient is known, from recent studies around the eastern Mediterranean and in Italy, to appraise the pattern of post-prehistoric sedimentation objectively. Two points have been established. That of the ubiquity of aggradation since the mid-Holocene, affecting coastlands and valley bottomlands alike. And secondly that these sediments are chronologically concordant and date, essentially, from the post-classical period (the Recent Fill of Vita Finzi's terminology). This means, that whatever local factors have affected the pattern or amount of deposition, a general factor only can account for such a general phenomenon as the Recent Fill is

now acclaimed to be. Eustatic changes can be discounted. Butzer (1964) points out that aggradation of stream beds continued even when sea level was falling and Bintliffe (1973) that since aggradation occurred simultaneously in distant inland basins and on the coastal plains the role of this factor seemed minimal. Climate can be discounted. The Mediterranean climate is a much more varied factor, in spatial terms, than is usually acknowledged. For instance, the regional climate of various drainage areas can be very different, even non-Mediterranean, and it is hard to accept that there could be such a blanket climatic change that would result in such a uniform phenomenon as the Recent Fill. This leaves one major factor for consideration, the role of anthropogenic factors in post-prehistoric environmental change.

This acknowledgement of the possible effectiveness of human and human-induced activity in Mediterranean lands is no novelty. From the time of Plato, comment on the nature and effect of environmental changes in the Mediterranean have been remarkably consistent. The tradition is too familia to require elaboration. As Plato noticed, writing in the 4th century B.C. (Critias III), deforestation may be held responsible for denudation and soil loss inland in the hill areas. As Pausonias described (VIII xxiv §5), in the 2nd century A.D., this soil is carried by the river towards the sea. The model which has passed into the literature as an integral part of the Mediterranean tradition is a simple association of upland erosion, initiated by anthropogenic factors (aggravated or not by climatic change as the case might be), and lowland flooding and siltation (aggravated by neglect of drainage channels and, possibly, by a higher sea stand).

It is difficult to envisage that the pre-eminent role of this factor in the environmental change of the Tavoliere coastlands will ever be proved. But a good argument, based on a sound appreciation of past settlement patterns and the detailed history of land use <u>inland</u> (and, particularly, within a single river basin) may yet emerge at a further stage in this

inter-disciplinary study of the Tavoliere. Already there are pointers to the Bronze Age and the early Iron Age as being the critical periods in human activity leading, for example, to the erosion from which the Recent Fill would have been derived. In the final analysis, the cultural hegemony of the Bronze Age, already remarked on, could turn out to be the vital index of a far-reaching economic development that is highly relevant to the siltation of the Tavoliere coastlands. It was, it seems, during the Bronze Age that the high mountains of the Italian peninsula were first incorporated into the 'economic area' of the by then traditionally settled hill and lowland regions. It may not have been for the first time ever but it was certainly the first time the interior had been intensively settled or used since the arrival of the farming techniques and the development of farming practices that are now traditional.

However, important as the role of anthropogenic factors may prove to be, the role of the sea in fashioning the configuration of the coastlands and in disposing of sediments both marine and continental cannot be disputed. Our own studies of the Salpi and, in particular, the Siponto sediments has emphasised this duality underlying the aggradation of the Tavoliere coastlands. The fundamental question concerns the balance of the forces, the physical and the human.

With this question left open and without a conclusion, this study of the Tavoliere coastlands is brought to a close. The study of post-prehistoric changes in the Tavoliere coastlands leads not to the rejection of the secular tradition of aggradation but to its reappraisal. The model, set up many centuries ago, has been tested by many but not found wanting. Today, therefore, we can afford to aim to focus on the processes involved. Not just processes of sedimentation but those of human adjustment to, and role in, changes in the very physical environment upon which man is so dependent. It also leads, inevitably, to an interdisciplinary approach, which would be no novelty to the ancient writers. The approach is much

proclaimed today but has proved elusive. One thing that has been learnt is that the factual foundation must be sound, the more so the more complex and valuable the edifice proposed. To achieve even some understanding of the post-prehistoric changes in the Tavoliere coastlands - so far as achievement is deemed possible in a study of this nature - it has been necessary to concentrate on uncovering the evidence objectively and in detail. The study has been guided by the challenge, perhaps not too successfully fulfilled, from the eminent historian Marc Bloch: (1931, preface)

"History is above all the science of change"

What more urgent an objective could be formulated for an historical geographer, to whom the spatial vision (the arena of change) comes as naturally as the temporal? In her study of post-prehistoric changes in the Tavoliere coastlands, the present writer has tried to bear in mind that the 'long march of everyman', whose every step brought change, whose every step is measurable, and whose every step has touched the ground, has always taken place in a regional context.

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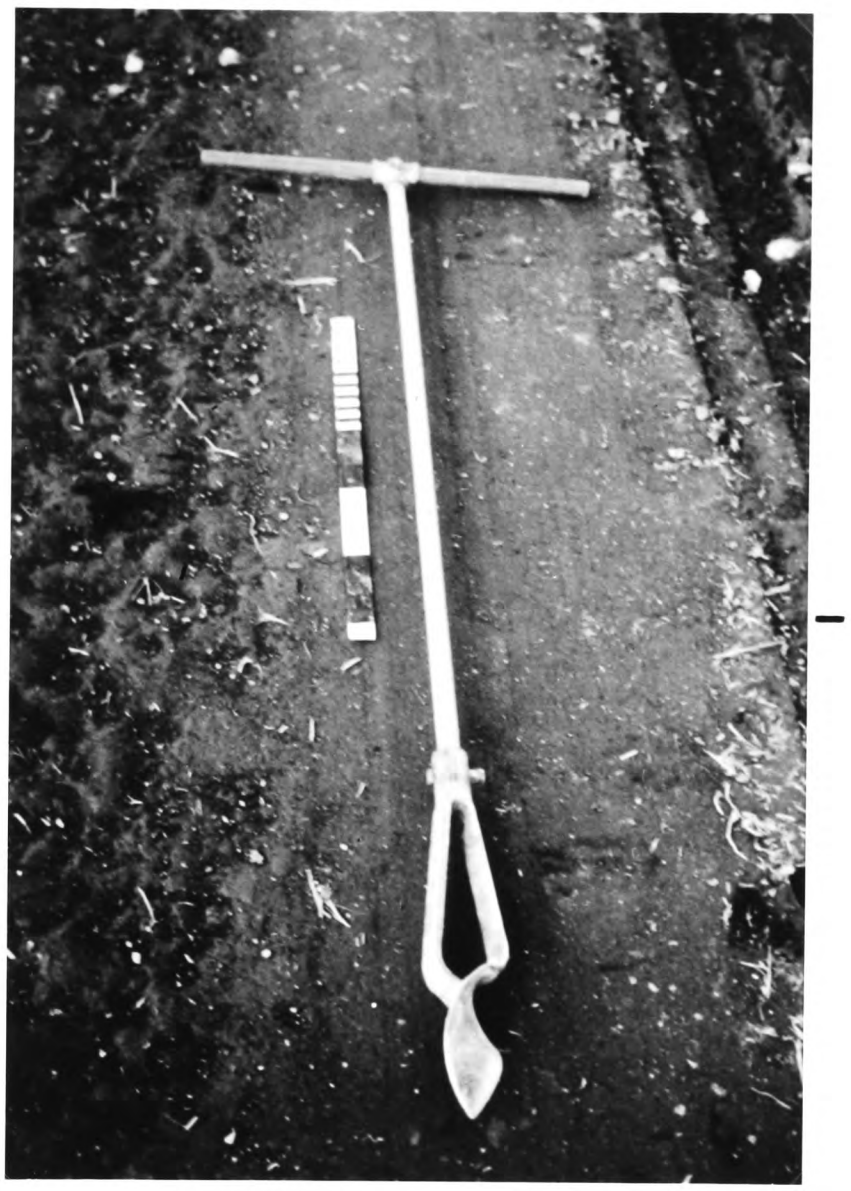


Plate 49. The soil auger.

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164I NW, NE, SW, SE
164II NW, NE, SW
165III NW, SW, SE

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