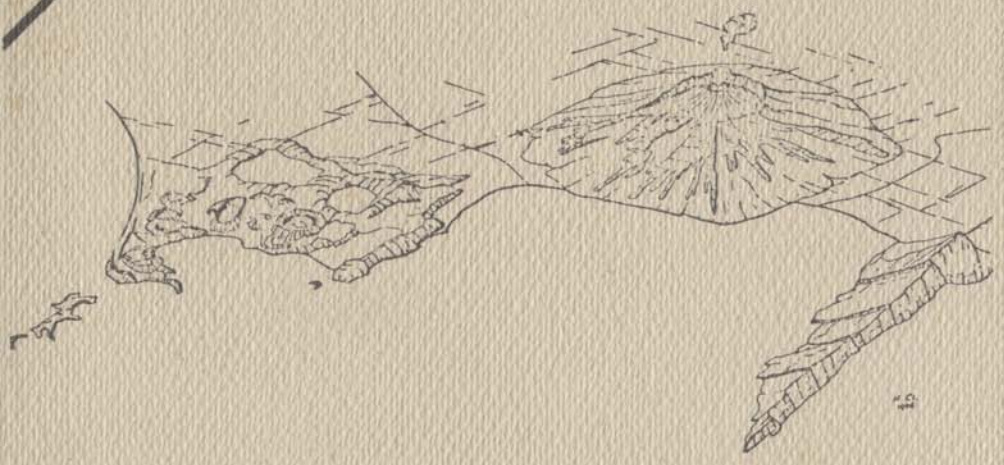
# guida alle escursioni

## 1-5 aprile 1978



PROCESSI PALEOCARSICI E NEOCARSICI
E LORO IMPORTANZA ECONOMICA NELL'ITALIA MERIDIONALE

ISTITUTO DI GEOLOGIA E GEOFISICA DELL'UNIVERSITÀ DI NAPOLI
GRUPPO SPELEOLOGICO DEL C.A.I., SEZIONE DI NAPOLI
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# 5. third excursion: paleokarstic and neokarstic processes in the murge-gargano structural-stratigraphic unit

## 5.1 The Murge-Gargano structural-stratigraphic unit.

The Murge-Gargano structural-stratigraphic unit individuated during the Pliocene, when the Apenninic chain underwent the last phases of the tectogenesis and the Bradano forethrough reached its present characters.

This unit differentiates from the large Apenninic carbonate structural-stratigraphic units already described because it is still rooted on its basement.

The central part of the original carbonate platform is well preserved (back reef lagoon deposits, often dolomitized). The western margin of the platform does not outcrop, because it is downfaulted below the Bradano Foretrough sediments. The eastern margin is known in the Gargano peninsula, where a large reef complex passes to scarp and basin deposits.

According to Ricchetti (1975) the sedimentologic characters of the eastern Murge carbonates inidicates a gently eastward batimetry increase during the Cretaceous, without evidences of scarp facies.

In the Gargano area almost the entire sequence (Triassic evaporites and Jurassic - Cretaceous carbonates) outcrops, whereas in the Murge only Cretaceous carbonates more than 3.000 meters thick are known (Ricchetti, 1975).

The lithostratigraphic units individuated in the latter sequence (Azzaroli & Valduga, 1967; Azzaroli, Perno & Radina, 1968; Ricchetti, 1975) are from below:

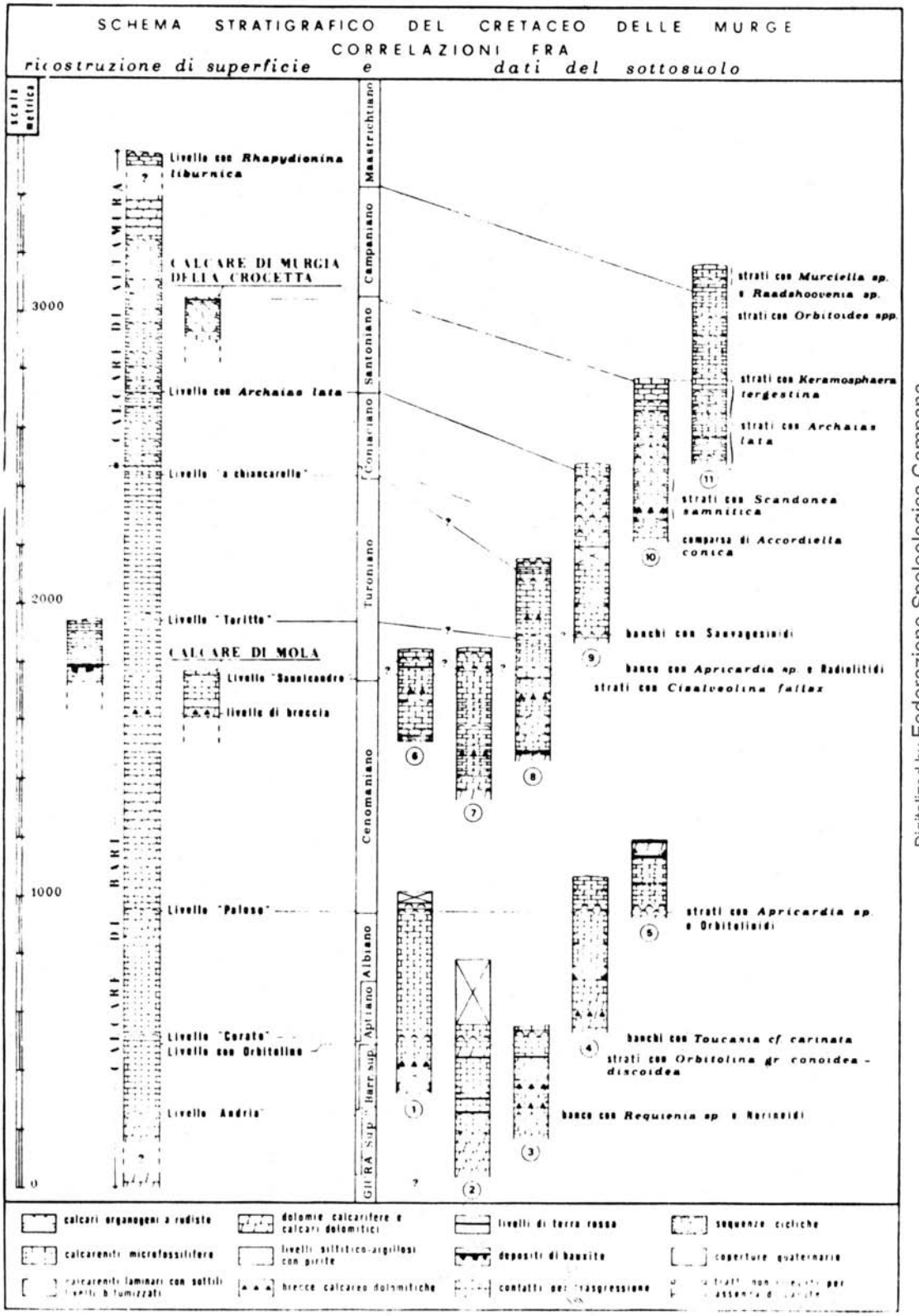
- Calcare di Bari, thickness over 2.000 m (upper Jurassic ? - Turonian). It widely outcrops in the northwestern Murge; in its upper part a bauxitic horizon

sometimes occurs (Spinazzola and Gravina Murge). Back-reef and tidal facies.

- Calcare di Mola, few meters thick (upper Cenomanian-lower Turonian ?) crops out in the central part of Murge. Back-reef facies.

- Calcare di Altamura, 1.000 m thick (Coniacian - Maastrichtian). Crops out mainly in the south eastern Murge. Rudistid banks are largely diffused in this formation. In the Spinazzola and Gravina areas disconformably overlap the Calcare di Bari and its bauxites.
- Calcare di Murgia della Crocetta, few meters thick (Maastrichtian), possibly transgressing over the Calcare di Altamura ( Murge di Gravina).

The Tertiary and Pleistocenic marine sediments are given by coarse to fine grained calcarenites, repeteadly overlapping the Mesozoic carbonate platform top. The depositional environment was generally a shallow open sea. Other Tertiary carbonates are of minor or local importance.



5.2 Window Geology

a. The outer Apenninic margin.

From Benevento we take the link for Napoli-Bari motorroad. Along the road, until we reach the Apulia Plain, several morphologic features of the Apenninic chain may be observed. From a morphologic standpoint we can distinguish 4main parts.

From Benevento to the Calore River bridge

Along the way towards the link for Napoli-Bari motorroad we can observe large flat areas, between Sabato and Calore rivers valleys, from 200 to 350 m. u.s.l., these areas, now very dismembered, are remanents of a large pleistocenic peneplaned surface parallel to the eastern chain margin. We can see at different elevations more or less extensive terraced areas which are tectonically displaced also many hundreds meters, and are characterized by a flat top with very old morphologic features.

Their margins correspond usually to recent faults and are deeply eroded by linear erosion and landslides. Main outcropping terranes are conglomerates, sands and marine clays of lower-middle Pliocene age and continental quaternary sediments which were deposited in a tectonic depression bounded by SW-NE faults (Benevento-Buonalbergo on the North and Parolise - Grottaminarda on the South ).

The lower-Middle Pliocene cycle sediments represent the marine youngest terrains outcropping in this interior area of the chain.

The Matese carbonatic Units lie at a depth from 1.500 to 2.500 m. below siliceous, marly and clayey terrains related to the Lagonegro, and Pliocene Units.

From the Calore River bridge to the Ufita River Valley

After the Calore River bridge, we enter in the large Ufita River Valley, near Grottaminarda. This valley is

upflooded filled by continental quaternary deposits and filled between Frigento structural high and Baronia syncline (respectively on the left and on the right orographic sides).

The Ufita valley is among the few flat areas of the internal southern Apennines, and is utilized for an intensive agriculture.

Here we have an important axial depression which causes the structures on the right (Frigento anticline, made of siliceous and marly Mesozoic terranes of Lagonegro Units; Baronia anticline made of lower-middle Pliocene clays sands and conglomerates) to disappear on the left of the motor-road. This, is to be related with the Pardise-Grottaminarda notable regional fault.

This recent fault, trending SN-NE, has determined a barrage and the follouring upfloouring of the Ufita Valley near Grottaminarda.

From the Ufita Valley to the Apenninic watershed Gallery

After the Ufita river valley the motor-road runs along the Fiumarella Valley, deeply boxed between clayey and sandy miocenic and pliocenic terranes on the orographic left and oligocenic and miocenic terranes of the Lagonegro Units on the orographic right.

The slopes of the valley are interested by intensive and localized superficial erosion phenomena and by diffused landslides that are very active expecially near the headland.

At the end of the valley, inside the tunnel. the motor-road crosses the superficial watershed which disjoins the Tirrhenian sea tributary basins (Sabato. Calore and Ufita rivers) from the Adriatic sea tributary ones, (Fiumarella and Calaggio streams, Ofanto river).

The Ufita river and Fiumarella stream valleys correspond to recent structures oriented NW-SE.

## From the Apenninic watershed to the Apulia Plane

After the tunnel, we enter the Fiumarella valley. This valley correspond to recent oriented SW-NE structures, and is boxed among clayey terranes characterized by intensively eroded areas with widespread landslides.

On the foreground we can see the top of the upsaid peneplaned areas; those on the orographic left are at an elevation of 600 m., while those on the right are displaced at 850 m., by the recent tectogenesis.

Going on along the way, we arrive at the eastern boundary of the chain, where the morphology becomes smoother and smoother when leaving the alloctonous terranes and entering in the autoctonous Pliocene and Quaternary deposits which fill the Bradano Foretrough with a thickness of some thousands m.

Near Candela we can observe afar some surfaces gently inclined towards NE which represent the top of the Pleistocene terranes.

The Calaggio stream valley is carved along the Bagnoli Irpino-torrente Calaggio fault, oriented SW-NE, which has caused a left lateral displacement of more or less 10 Km of the orographic right towards the Bradano Foretrough.

The alloctonous Units of the chain underwent the last important translation towards the Bradano fore through during the middle Pliocene and here they have a complexive thickness of about 4.000 m. They are superimposed to the lower and middle Pliocene Bradano Forethrough terranes.

Near Candela the Apenninic tectonic Units end in the subsurface.

5.2

b. The Lacone and Ofanto Valleys
(from Candela to Spinazzola).

After leaving the eastern Apenninic margin, we enter the "Tavoliere delle Puglie" which is on the Ofanto river orographic left.

At the motor-road sides and nearby the plio-pleistocenic sequence outcrops. Here the section is formed by argillaceous silts and fine-grained sandstones. The rocks constitute a NE dipping monocline. Often the marine deposits are covered by coarse deposits of alluvial facies.

After passing the Ofanto river near Canosa di Puglia, we approch the north-western side of the Murge relief, along which the Cretaceous limestones have been by faults directed NE-SW (antiapenninic) determining a graben structure towards the Ofanto itself valley.

Leaving the motor-road at the Canosa exit, we cross Gravina Calcarenites and "Subapennine Clays", which constitute the part of the marine Bradano forethrough filling (lower Pleistocene).

Along the way to Minervino Murge and afterwards we cross cretaceous outcrops of Bari Limestones Formation (Barremian-Turonian). This formation is made by micritic limestones with an homoclinal structure dipping mainly to S-SW. At 20 th Km. of the 97 Statal Highway we enter again the Bradano Forethrough quaternary terranes, along the Locone stream headland, where a large part of the sequence outcrops (M. Marano Sands, Irsina Conglomerate, Gravina Calcarenite).

The area is characterized by flat reliefs, that are the remnants of the old quaternary cycle regressive surface.

We now go up again the calcareous slope along the narrow Cavone Valley to reach the Spinazzola bauxite mining area. The bauxitic mineralizations of Spinazzola are loca-

ted near Murgetta Rossa and about 20 main pockets are known. Some of them are very deep and outcrop at both sides of Cavone Valley.

From the bauxite mines area crossing the high part of the Murge platean we go to Castel del Monte, which rises on the adriatic edge of the Murge relief.

From the castle it is possible to have a panoramic view of the wide plateaus parallel to the coast and degrading towards the Adriatic sea, gently dipping to NE.

Somewhere on these planes marine transgressive deposits of the lower Quaternary lay. They are calcareous bioclastic sediments locally called "tufo calcareo", which sometimes have fossilized carsified surfaces which residual "terre rosse" deposits in the cretaceous limestones.

5.2

c. The Murge (from Spinazzola to Locorotondo).

From Castel del Monte we take again the 97 Statal Highway towards Itria Valley and Castellana Caves, through Gravina di Puglia, Altamura, Gioia del Colle, Alberobello, Locorotondo.

Along the way we cross the Altamura limestone (Senonian age) somewhere covered by the ancient Quaternary deposits (Bradano forethrough series).

Near Gravina the first part of the road runs on the regression surface of the Bradano Forethrough sequence and flanks the high Murge cliff, which is controlled by an important NW-SE (Bradano Valley) Fault, Martinis, (1962).

Near Gravina it is possible to see some quarries in the Gravina calcarenite. Here also the deep erosional features interesting the quaternary calcarenites and the underlaing cretaceous substrate ("gravina") is also visible.

Going on to Altamura and Locorotondo we cross the Altamura

Limestone, a bioclastic, more or less coarsely grained limestone with abundant Ippuritides and Radiolitides.

Fig. 16 - View of Murge relief from Spinazzola

5.2

d. Itria Valley and Pirro's Canal

Locorotondo, as well as the other abovementioned villages (Castellana, Noce, Alberobello, Martina Franca) rests on a large NW gently inclined surface which is limited at SW by Fasano-Ostuni coastal cliff.

This area, with flat bottomed incisions ("lame"), shows a clearly karstic morphology with many dolines and poljes that are often filled by earthy deposits. There are also some deep holes, (locally "grave").

Some faults and fractures have controlled this morphologic features (i.e. the Itria Valley and Pirro's Canal).

From Locorotondo we can see a large and very singular landscape: the Murgia dei Trulli. It includes the large karstic depression of the Itria Valley, with NW-SE direction, a diameter of some Km and a depth of about 100 m. below the large plane.

The Valley bottom is rich of vineyards (this is the production area of very good wines(!) i.e. Verdeca) and of the famous Trulli: conical houses.

The other large karstic depression, Pirro's Canal striking EW, extends for 12 Km. On the polje bottom there are many sinkholes which are often masked by eluvial deposits. From Monte Laureto the whole extension of the Pirro's Canal is well observable.

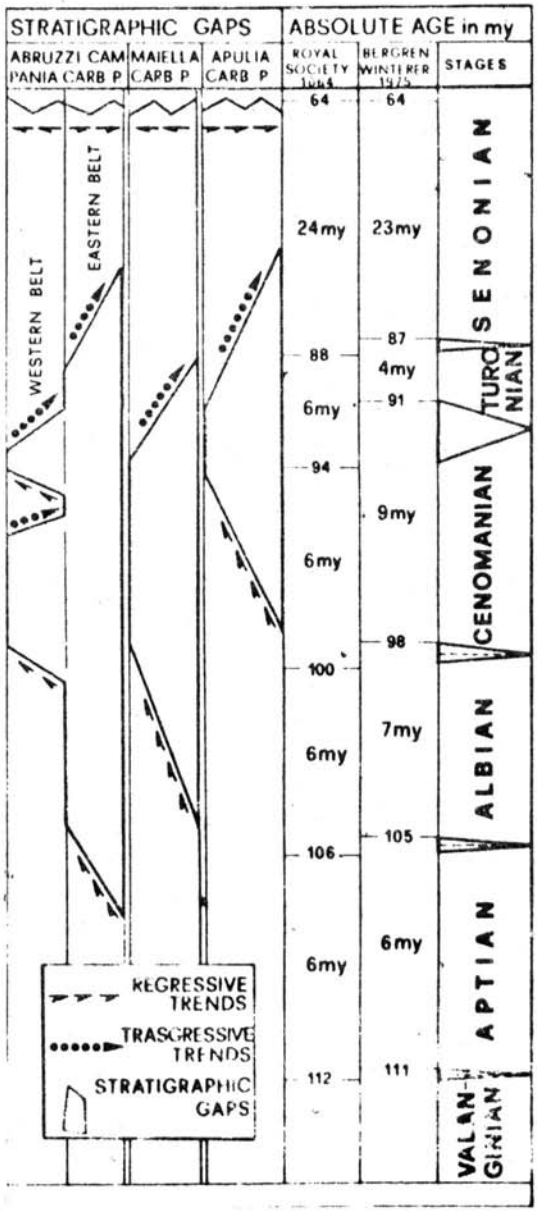



Fig. 17 - Stratigraphic faps in the Southern Italy Cretaceous sequences

## 5.3 Epigenic Paleokarst in the Murge Cretaceous terrains of Spinazzola.

Paleokarstic phenomena in the creataceous terrains of the Murge have been described by several A.A. (Anelli, 1964: Crescenti e Vighi, 1964; D'Argenio, 1969: Bàrdossy et al., 1977; Iannone e Pieri, pre stampa in questo seminario).

These phenomena were developed at the time of the emersion that interested, large ereas of the carbonate platforms during the Cenomanian and part of the Turonian in the Spinazzola's Murge we may observe narrow and deep cavities filled up by bauxites and covered, gently disconformably by the "Calcare di Altamura" (lower Senonian).

These cavities are connected by narrow ducts Locally canyon like depressions have been found; during the bauxite exploitation. The walls of the cavities and of the "canyons" are very steep. The bauxite deposits are 100 to 400 m long, 20 to 80 m wide and 10 to 15 m. thick.

Some cavities are almost 40 m. deep. The karstfication of the bottom is here the most intense among the several deposits of the peninsular Italy. Laterally the bauwites abruptly end.

For the Spinazzola bauxites may be made the same considerations that for those of the Matese Mountains (for informations related to their textural mineralogical and geochimical characters and to their genesis see what has been said before).

The total amount of the bauxites in the Spinazzola area and in northernward area of the Gargano (S. Giovanni Rotondo) is of about 20 millions of tons (Bàrdossy et al., 1977). Only a part has economic value.

## 5.4) Castel del Monte

On one of the highest hills of the western Murge chain at 540 meters above sea level and located south of Andria and southwest of Corato, Castel del Monte is considered the masterpiece of Swabian architecture in Southern Italy and an outstanding example of civil construction in the Middle Ages notable for both perfection and originality.

No precise documentation or citations exist which establish an exact date in which the castle was built. In a letter from Gubbio dated the 28 th of february 1240. Frederick II gave Riccardo di Montefuscolo (Giustiziere di Capitanata) the task of providing for the castle's pavement. From this we can deduce the year either that the construction had been completed or that the restauration of the pavingstones was in act.

Surely, Castel del Monte was at the beginning a residence only and not a fortress because there are no remnants of ditchs, draw-bridges or underground constructions, but only a sequence of large and sumptuous rooms. This is confirmed by the document dated 5 th of October. 1240, from Milan, upon which Castel del Monte is not listed among the Bari "Giustizierato" castles acting as fortresses.

Many are the cultural components in the castle's architecture. Structural elements take up technical solutions used for cirsteciense churchs and echos the roman tradition, tipical of classicism in Frederick's era are evident in the sculptural decoration. On the other hand. on the origin of the iconography, different hypothesis have been formulated. For example, that the castle was first a roman imperial villa, later used for its elevated location by Longobards and Normans and finally restored by Federico II.

The name of the architect of the castle, called the gre-

atest Swabian civil construction, is unknown even if traditionally the designor is considered to be Federico II himself.

Upon the basis of either historic data or stylistic components, German and French scholars to attribute their fellows with the construction of Castel del Monte, but there is no real proof for their suppositions. On the contrary, it has been ascertained that every measurement of the castle is a multiple or a submultiple of the Napoletan "hands", used in Puglia for a long period, and not at all corresponding to either the German or French foot, which might demostrate that the building was locally designed. Local and foreign workmen seemingly partecipated in the actual construction and decoration of the building, together with Arabian workers, whose possible presence can be deducted from the complexity of the hydraulic system.

The first name of the castle was Castello di Santa Maria del Monte, after a benedectine abbey, famous in the XII century and no longer in existence. The present-day name can be found for the first time in a law of Ferdinando d'Aragona proclamed in 1463 at Altamura.

Federico II lived, perhaps for short periods in the castle, built not for defence but for recreation and hunting meets. In 1249, the marriage of Federico's natural daughter Violanta with Count of Caserta Riccardo, was celebrated. When the Swabian dinasty ended Carlo D'Angiò imprisoned Manfredi's children: Enrico, Federico and Azzolino, here, together with some exponents of the philo-Swabian party.

From excavations in the neighbouring area, the castle appears to have been protected by a surrounding wall which was, according to some, threefold and octagonal and according to others, with sixteen sides at 12 meters distance. The form of the castle is a regular octagon to which the internal octagonal yard corresponds. On the

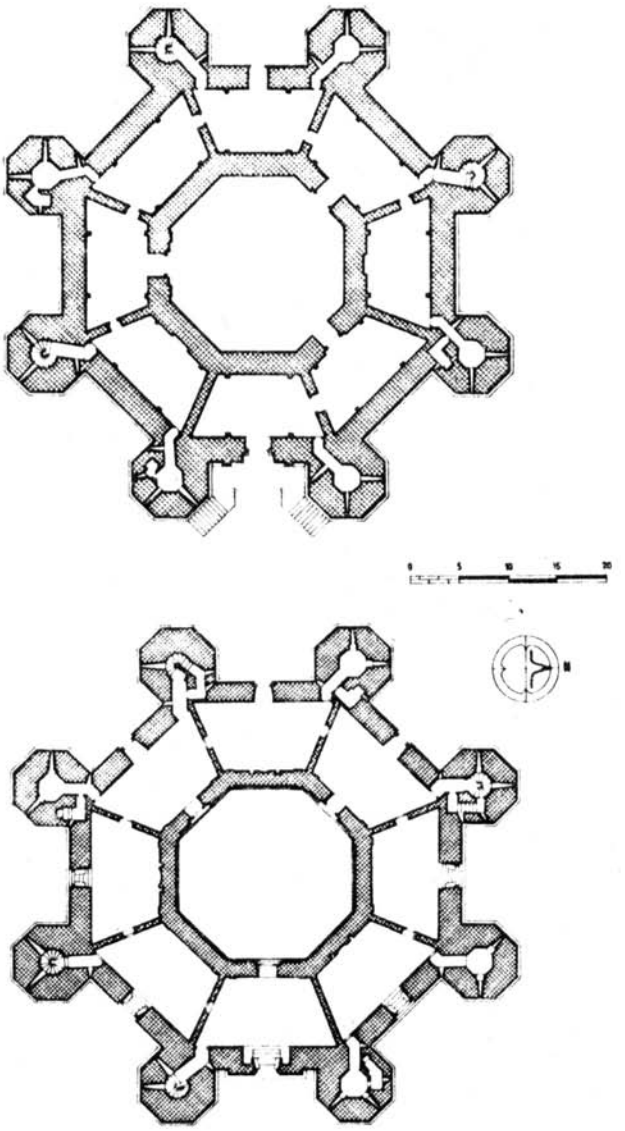
external corners there are eight octagonal towers. At half height the deeply broad founded building is surrounded by a frame showing the internal has eight identical rooms, one at each octagonal side.

There are two portals, one at E and there other at W. The main one shows classic and gothic influences but also romanic echoes. On the other six sides at the first floor there are six windows "monofore".

At the second floor there are eight windows (seven "bifore" and one "trifora" in front of Andria). The towers are crossed only by narrow slits ("feritoie") three of them have spiral staircases and the rest contain bothrooms o maintenance with ribbing resting on sculptured mantlepieces and toilets provided with an inventive system of airing and cleaning.

The castle rooms are designed on the basis of isosceles triangles, with cross vaults bordering a center square space. Two pieces of ogival vaults cover the side triangle. The capitels of the piers have been finely sculptured and sculptures with masks or vegetable and animal themes adorn the boss of each cross vault. The internal walls of the rooms were once covered with marble or limestone breccias.

The courtyard repeats the octagonal plan of the building and has eight walls and pointed arches. Doors and windows have been situated without any exact symmetrical order. Three portals open onto the ground floor. Initially there was a marble vat in the courtyard, which today is a cistern collecting the rain waters of the middle drains of the terrace. Outer drains, on the other hand, lead rain waters to the toilets in the turrets.



Castel del Monte - Pianta del Castello

(da De Vita, 1974).

## 5.5 The Castellana Caves

The Castellana Caves are situated in the upper Cretaceous limestones (Altamura limestone) and show a NW - SE general trend corresponding to the main and more recent tectonic direction.

We can separate three distinct stretches: 1) the first from the entry (la Grave) to "Il Precipizio"; 2) the second from "Il Precipizio" to the "Duomo di Milano" and 3) the third from this last point to the end.

1st strike:

"La Grave", at the entry, is a great cavity aligned along the main tectonic direction. It has been widened by marked gravi-chemioclastic processes accompanied by collapses (chiefly in the north-eastern wall). Due to these processes the vault has cut the external surface. From here on, the cavity has an interstrate section with records of chemioclastic action.

The west branch shows, on the contrary, a typical diaclasic section along which a number of vertical ortovacua formed. Successively these were unified by a collateral parabasal association. The north-east branch has a more marked diaclasic section, with two contrasting walls: the upstream one very rich in stalactites, the downstream one very poor and marked more by faults.

Quite interesting is "Il Precipizio", a cavity with marks of collapse. The lower level derive from a series of passages successively widened due to many wells caused by ortovacua strongly developed in a downward direction.

2nd strike:

Typical here are diaclasic sections while concretions are poor, and from place to place some marks of collapse can be found. Frequent are also the composite sections with interstrate characters in the lower part and diaclasic characters in the upper one.

The last part shows more or less the same characters of the entry. Here the chemioclastic and collapse featuring vere favoured by a pattern of diaclases according to two systems. The younger, which is the principal system, has already been described while the older one is aligned along a NS-EW direction.

3nd strike:
The pattern of diaclases controls also this 3nd strike, particularly at the end (between "La Cupola" and "La Grotta Bianca") where there are many concretions. In the west branch ("La Voragine") a series of vertical ortovacua gave origin to the lower level.

From the point of view of the genesis, the cave seem the result of the influence of the tectonic system already mentioned. Probably the great interstrate cavities began to form on both two levels during the first tectonic stage when the water table was very near.

In a later period, its deepening caused either the vertical development of ortovacua, or the fusion of the formed cavities in a complex.

The persisting situation of the water table favoured the chemioclastic morphology and formation of the great concretions wherever it was possible.