

7. Epilogue

Considering that :

- the drystone knowledge and techniques have been registered in the Representative List of UNESCO for the Intangible Cultural Heritage of Humanity,
- the dry-stone constructions are friendly and compatible with the natural environment, forests, and biodiversity,
- intangible techniques and tangible dry-stone constructions constitute inseparable parts of history, civilization, and cultural heritage in many countries,
- SDS is a pluridisciplinary scientific society, that includes scientists, researchers, engineers, entrepreneurs, experienced stonemasons, and civil society volunteers from many countries,
- the natural environment, climate, biodiversity, and culture are a legacy from previous generations and at the same time a loan from future generations,

I think we must systematically inform young people about the purpose and the work of SDS, pass on to them the knowledge and experience of our members, invite them to participate in our events and conferences and to become members of SDS. We should also participate in similar initiatives of young people in our countries.

The future of the Planet belongs to the next generations, it is also their right and responsibility to care for this, so they must deal with global warming and climate crisis, but also with the rescue and the sustainable development of human civilization and cultural heritage.

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ACTES DU CONGRÈS

SESSION 4 :

LA PIERRE SÈCHE COMME RESSOURCE POUR L'IDENTITÉ ET LA CRÉATION

DRYSTONE CONSTRUCTIONS AS A RESSOURCE FOR IDENTITY AND CREATION

Modération : Michelangelo Dragone, architecte, Italie / Moderator: Michelangelo Dragone, architect, Italy.

- Borut Juvanec, docteur en architecture, Slovaquie : L'Italie en pierre / *Italy in stone / Italia in pietra.*
- Panayiota Pitta, architecte, Eubée, Grèce : Drakospita – Maisons de dragons en Eubée, Grèce. / *Dragon houses in Euboea, Greece / Drakospita.*
- Ioulia Papeftychiou architecte-ingénieur & Maria Sigala, Archéologue, Cyclades, Grèce : Constructions en pierre sèche à Kythnos, Cyclades, Grèce. / *Dry stone constructions on Kythnos, Cycladic islands, Greece.*
- Elisabeth Loir-Mongazon, conservatrice du patrimoine & Olivia Froidefon, France, Bretagne : Justement, pas si sèche la pierre sèche bretonne / *Indeed, not so dry, the dry stone in Brittany.*

Modération : Roselyne Pilat, enseignante, France / Moderator: Roselyne Pilat, teacher, France.

- Éric Leboucher, carrier et paysagiste, quarryman and landscape gardener France, Normandie : Économie constructive, durable et écologique de la pierre de Beauchamps / *Constructive, sustainable and ecological economy of Beauchamp stone.*
- Gwenn Gayet-Kerguiduff, ingénieure de recherche, France, Auvergne : La trachyandésite : sources et ressources, matière à projet/s / *The trachyandésite : sources and ressources, material for projects.*
- Pascaline Roux, chargée de mission au PNR des Monts d'Ardèche, France, Rhône-Alpes : La Pierre Sèche, diamant brut des Monts d'Ardèche / *Drystone, the diamond of the Monts d'Ardèche.*
- Michel Grillet & Denis Lacaille, bénévoles d'association du patrimoine, France, Provence : À Beaumes-de-Venise, bâtir un avenir agroécologique sur d'anciennes terrasses en pierre sèche / *In Beaumes-de-Venise, building an agro-ecological future on old dry stone terraces.*

Italy in stone

La pierre en Italie

La construction en pierre sèche est le principe de construction le plus simple : pierre sur pierre, sans mortier. La pierre, sans mortier n'est pas seulement utilisable pour les murs, mais aussi pour des objets complexes. À Mycènes, en Grèce, se trouve le Trésor d'Atreus, d'un diamètre et d'une hauteur de près de 15 m, construit il y a 3500 ans. La construction en pierre sèche a également été reconnue par l'UNESCO et figure sur la liste du PCI de l'humanité (Comité intergouvernemental pour la sauvegarde du PCI, 13^e Session du 26 12 2018).

De telles structures en pierre sèche témoignent des méthodes et pratiques utilisées par les peuples de la préhistoire à nos jours pour organiser leur espace de vie et de travail en optimisant les ressources naturelles locales. Elles jouent un rôle essentiel dans la prévention des glissements de terrain, des inondations et des avalanches, dans la lutte contre l'érosion et la désertification des terres, en améliorant la biodiversité et en créant des conditions microclimatiques bénéfiques pour la santé et pour l'agriculture.

On trouve des éléments en pierre sèche dans toutes les régions où l'on trouve de la pierre, ils sont particulièrement répandus en Europe et dans le bassin méditerranéen. La construction la plus simple en pierre sèche est l'encorbellement. Des assises horizontales de pierre se superposent, composant ainsi un lieu utilisable : une pièce. Ce débordement des pierres ne peut se faire que de la moitié de la largeur, mais le centre de gravité est concentré dans la construction inférieure ; la longueur du porte-à-faux est de plus en plus courte avec la hauteur.

L'Italie possède une architecture en pierre très riche : certains types de pierre peuvent être lités en couches, ce qui assure une meilleure construction. La pierre peut être taillée ou semi-taillée, mais la plupart des constructions sont faites de pierres ramassées dans les champs ou les oliveraies. Construire avec des pierres sans forme exacte n'est pas facile. Il faut faire preuve d'habileté et d'intelligence.

On trouve des constructions en pierre sèche dans presque toutes les régions d'Italie, mais les plus denses sont les suivantes :

- 1 Sondrio : de Tirano à Poschiavo, de part et d'autre de la frontière entre l'Italie et la Suisse.
- 2 Carso triestino : la région karstique de part et d'autre de la frontière entre l'Italie et la Slovénie.
- 3 Île d'Elbe
- 4 Les Abruzzes
- 5 Sardaigne
- 6 Les Pouilles
- 7 Sicile.

Drystone construction is the simplest building principle : stone upon a stone, without any mortar. It is not usable only for walls, but also for complex objects. In Mycenae, Greece, can be found Atreus Treasury, with diameter and height of almost 15 metres, built three and a half thousand years ago.

Drystone construction has also been recognized by UNESCO and is included in the List of the Intangible Cultural Heritage of Humanity (Intergovernmental Committee for the Safeguarding of the Intangible Cultural Heritage, 13th Session from 26th 12, 2018, Decision 13.COM 10.b.10) : 'Such structures testify to the methods and practices used by people from prehistory to today to organize their living and working space by optimizing local natural and human resources. They play a vital role in preventing landslides, floods and avalanches, and in combating erosion and desertification of the land, enhancing biodiversity and creating adequate microclimatic conditions for agriculture'.

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Elba.



Image 1 - The most significant object in stone is a trullo in Puglia, which consists of two types : the main trullo and a pagliaia. The corbelled construction of the trullo finishes with a pinnacle and pagliaia, has a massive staircase to the top.



Image 2 - Map of Europe and Mediterranean with corbelled shelters in drystone

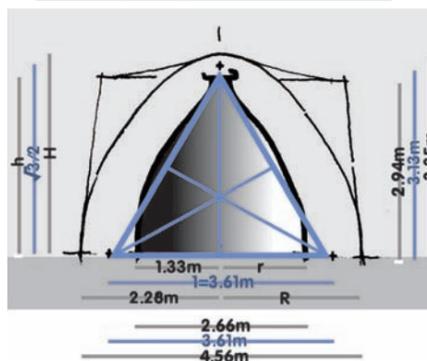


Image 03 - The construction of a false cupola in drystone is composed with the help of an equilateral triangle with the height being $\sqrt{3}/2$, if the baseline is equal to 1. It can be simply constructed with three sticks - without any knowledge of mathematics

Drystone objects can be found in every region with stone, and they are especially widespread in Europe and the Mediterranean.

The simplest construction in drystone is corbelling. Horizontal courses of stone overlap each other, composing a usable place: a room. This over-jutting can be made only to half the length of the width, but the centre of gravity is concentrated in the lower construction. The length of the overhang is shorter and shorter with height.

Gradual overlapping is the only solution for the cross section, in groundplan a circle is generally used. If the groundplan is rectangle or a square, it has to finish as a circle at the top.

The entire cross section is built with the help of the square root of three, divided by two. We know this mathematical expression with knowledge today, but our predecessors composed it with the help of an equilateral triangle: if the side is 'one', its height is equal to the square root of three by two.

An equilateral triangle is simple to build with three sticks of the same length.

4. The construction of corbelling has a more or less circular groundplan and horizontal layers of overhung stones. The final covering serves as counterweight and drainage for the rainwater.

Italy has very rich architecture in stone : some types of stone can be broken into layers, which is important for the same width and assures better construction. The stone can be dressed or half-dressed, but most constructions are made of found stones, collected on the pastures, fields or olive groves. To build with stones without exact shape is not easy. Skill and intellect are needed.

Drystone constructions can be found almost in every region, but the most dense are the following :

- 1 : Sondrio: Tirano to Poschiavo on both sides of the border between Italy and Switzerland
- 2 : Carso triestino: the karst region on both sides of the border between Italy and Slovenia
- 3 : Elba Island
- 4 : Abruzzo
- 5 : Sardinia
- 6 : Puglia
- 7 : Sicily.

Italy in stone follows these numbers :

Types of stone shelters differ in material, shape and the stone treatment : the construction is always the same: corbelling with a false dome.

6. Drystone shelters in Italy, northern part :
 - a/ Stone shelter in the Tirano region on the border to Switzerland.
 - b/ Hiska or caseta on the border with Slovenia.
 - c/ Caprile is a goat shelter on the island of Elba.
 - d/ Capano in Abruzzi.



Image 5 - Map of Italy with important types of stone shelters

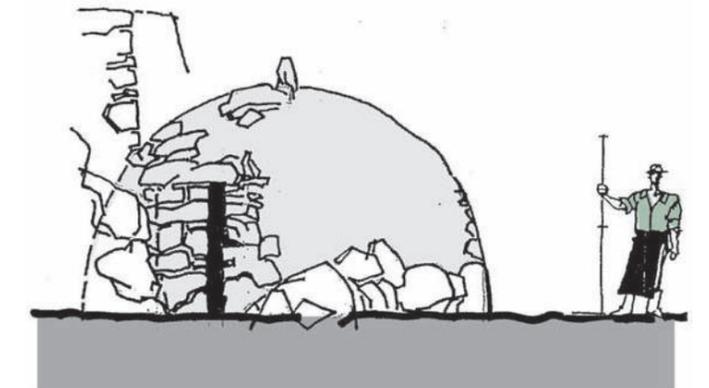


Image 1.1



Image 1.2

7. Drystone shelters in Italy, southern part :
 - e/ Pineta in Sardinia is still in use.
 - f, g/ Trullo: masseria Macherone near Alberobello, on the right: another type can be found near Lecce in the south of Puglia.
 - h/ Capano near Ragusa, southern Sicily.

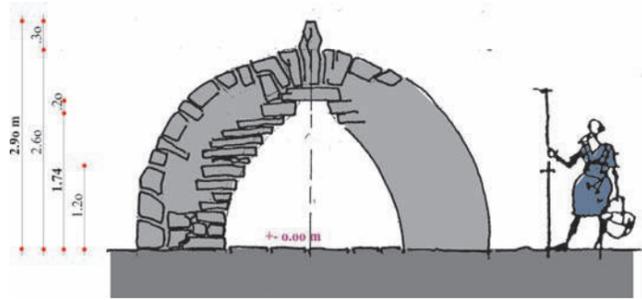


Image 1.3

Natural circumstances are used also for several purposes: water (as a stream through the object) chills the milk, water is usable for making the cheese (hygiene), fresh air from the underground caves ensures a stable temperature in wine cellars.

1.3 Inside construction is typical corbelling, outside is an almost perfect half-globe with a pinnacle on the top.

1. CASEL, CASSINA, CROT, SCCELLĒ

1.0 North of Italy, at the Switzerland's border. Sondrio region (Tirano IT), Graubunden (Poschiavo CH)

1.1 Shelters on the Italian side of the border with Switzerland are more or less abandoned, on the other side they have been reconstructed.

Typical shelters in the regions between Italy and Switzerland around Tirano in the region of Sondrio, and Poschiavo in the Bernina region in the Graubunden canton (Retor. Grischon, It. Grigioni, Fr. Grisons) have several names: Italian casel and cassina by Edoardo Micati and Romanch crot or scelĒ.

The construction is very exact, close to a half-globe, with circular groundplan and walls that follow a corbelled construction. A pinnacle can be found on the top.

1.2 Italian shelters are more or less hidden in nature. Decades ago they also served for smuggling between the two states.

The first use high in the mountains was as a herdsman's hut, but they also served for sheltering people smuggling between Italy and Switzerland. Near homesteads, they serve as cheesemaking objects, and in recent decades they have been used as wine cellars.

Near to villages, the corbelled construction is extremely exact, made of half-dressed hard stones; high in the mountains the objects are simpler, close to nature, using stones collected during clearing the pastures. The objects for living have simple furnishings: benches and niches.

Image 2.2

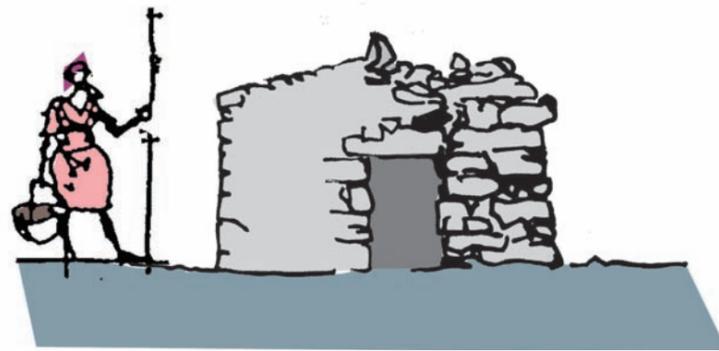


Image 2.1

Since 2000, some of them have appeared anew, as wine cellars. They have been reconstructed or built anew, but in extremely sharp geometric shapes, as half-globes. Some are unnaturally built in rows near roads.

2. Casita, Casetta, HIŠKA, HIŠICA, KOČA, OSSIA

1.0 North of Italy, at the Italian / Slovene border. Carso triestino (Friuli - Venezia Giulia IT), Kras (Slovenia SI)

2.1 Shelters can be found on flat karst terrain, but also as an underground cave.

A stone shelter on the Karst edge above the city of Trieste/Trst in the region of Friuli - Venezia Giulia in Italy and Kras in Slovenia has several names in both Italian and Slovene languages: hiška, hišica, koč, osia, casetta by A. Guacci 1982 and casita by E. Poli and D. Gasparo 2009. It appears on both sides of the border between Italy and Slovenia.

2.2 The object is constructed with stone found on the pasture, without any exact shape and just a few hewn details – only at the entrance, as a lintel.



Image 2.3

The construction is typical corbelling, with horizontal courses of stone, projecting each over another. The stone is gathered during clearing the fields, not dressed and of many, uneven shapes. The groundplan is in principle a circle, but can vary, because this modest object uses all possibilities in nature: bigger plates, rocks and even karst caves. It is often in-built in the walls that divide grazing places or fields and olive groves. The construction builds a false dome, covered by a stone plate or a wedge on the top with the help of the square root of three, divided by two (the height of an equilateral triangle).

The basic shape stands alone on flat terrain with a more or less circular groundplan: outside is circular, but not so strict because of the flat front side with an entrance. In cross section, it shows more or less vertical walls and a roof without projecting edges – the line of the wall continues from the floor to the pinnacle on the top in a single line.

2.3 The gathered building material (not quarry stones) does not allow exact shapes: a casita is built without exposed elements (vertical walls, overhangs, exact roof, hewn details).

Inside can be found some furnishings: stones as benches and the entrance normally has a flat lintel. The entrance is small because of the harsh karst weather conditions. This region is theoretically close to the sea (in places only some hundreds meters in air distance!), but with a definitely different climate, it stands about 400 metres above sea level. On the Slovene side can be found hiškas with a fireplace near the door, creating 'a warmth curtain' over the entrance opening. Early in spring or late in autumn the morning temperatures can be extremely low, and the wind, called the 'bora', can be unpleasant.

Like a Slovene hiška, the Italian stone shelter uses all the natural possibilities, some of them lean against a rock or are built into a karst valley or even a cave.

The object is no more in use, but since 2010 some of them have appeared, built anew with all the typical constructional details.

3. CAPRILE

3.0 Central part of Italy. Island of Elba

3.1 Shelters for goatherds on the island of Elba are located individually or in clusters.

3.2 The entrance of a caprile is oriented towards the common place between them, providing possibilities for the social life of shepherds. Elba is small island on the western Italian coast, close to the shore.

It has relatively high mountains but with gentle slopes, suitable for grazing small animals, mostly goats. The name 'caprile' comes from

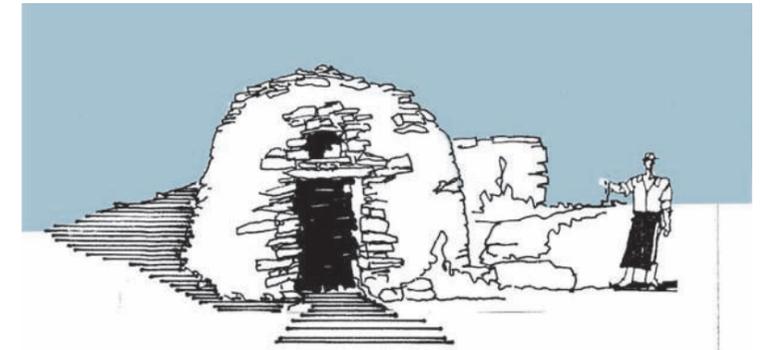


Image 3.1

Image 3.2

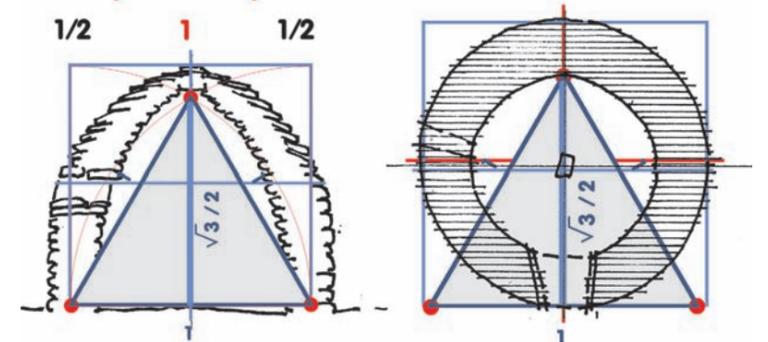


Image 3.3

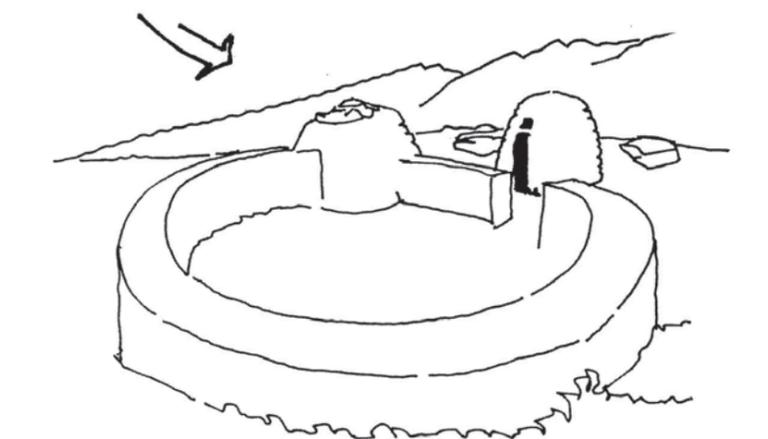


Image 3.4

the Italian word for goat. Some hundred meters above sea level, the climate is suitable for this type of economy – down at the shore it is not.

3.3 The construction is built very exactly: in cross section as well in groundplan, all with the help of an equilateral triangle and its height ($\sqrt{3}/2$).

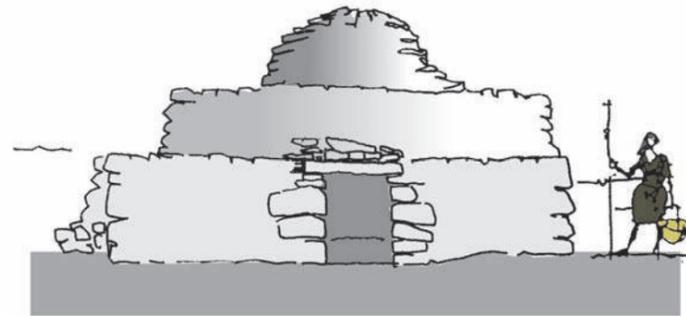


Image 4.1



Image 4.2

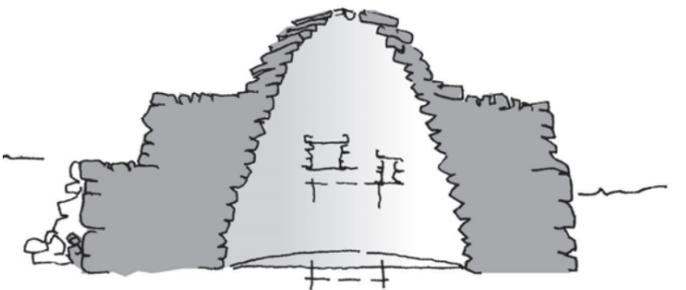


Image 4.3

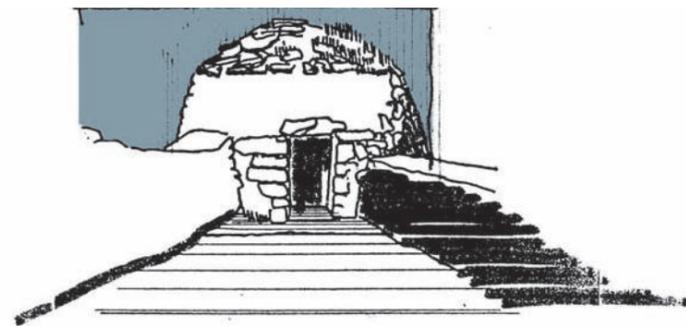


Image 5.1

Its construction is typical corbelling and the outer shape follows a false dome. Its appearance can be seen as a half-globe with a pinnacle on the top. Caprile is dedicated to the goatherds, not the animals. The most interesting is its composition in space: the entrance is at the front and enclosures for the flocks of goats are located back on the other side.

3.4 The animal part is a very important part of a caprile: behind the object can be found circular folds as protection against wild animals. Where several huts exist, the entrances are directed into small common squares. This is important for the social life of the goatherds, while the flocks are enclosed and secured in the folds outside.

4. CAPANO, CAPANNO

4.0 Central part of Italy. Abruzzi, mostly in Majella Mountains

4.1 Some capannas are composed very exactly in vertical terms, with rings, others can appear as simple heaps of stones or are in-built into underground caves.

4.2 A stepped construction is very common. Capanne are typical objects in the mountains near the Adriatic sea at Pescara and Chieti, mostly on the slopes of the Maiella Mountains, locally known as Majella (by Micati). The mountains reach a height of almost 3000 meters, but the huts can be found at a height of approximately 1500 m.

The gentle slopes are very stony, with a good possibility of using the stone as building material. The construction is typical corbelling with horizontal courses of stone, overlapping each other, composing a false dome. The construction or inner shape is always the same but the outside can be a wide variety of shapes: a simple hut, the outer shape of which follows the construction, with more or less vertical walls, with a topping stone, some can be built with stepped rings or leant against a rock, even built-into a cave.

4.3 Inside the construction is corbelling, the outside shape can follow it or be equipped with added rings. The pasture has to be cleared of stones, and a ring is a perfect use for them.

Pastures are today mostly abandoned, as are the huts, only a few exceptional capannas are still in use as goat houses near the rare homesteads there. Some capannas are interesting for tourists – as shelters leant against vertical rocks, high on terraces, and some underground caves are also used.

5. PINETA, PINNETA, SU PINETU, SU PINNETU

5.0 Island of Sardinia. Sardegna / Sardinia

5.1 Pinetas are still in use in the central parts of the island. Some of them have folds. The walls can also be more than two meters in height.

5.2 Some pinetas are built with dressed stones very exactly, some are not. Pinetas around Macomer are located on flat pastures, others are leant against rocks on sloping terrain.

Sardinia is a large island in the Mediterranean with a rich culture of drystone. The Nuraghe culture – with important military or communication architecture of towers are built in corbelling, mostly in several floors. Nuraghe culture started in the second millennium BC until 385 BC, when the Romans came to Sardinia. They conquered the people, but used the construction principle of corbelling, with an improvement: an arch.

Pineta, or locally pinnetta is a typical shelter on high plateaus and in the hills, mostly in the central and north-western part of the island.

5.3 Technical drawing shows its construction. This shelter has a corbelled construction, covered by half-dressed white stone. The shapes are more or less unified, with vertical walls, conical roofs, with a horizontal lintel over the entrance.

Some of them are devoted to herdsman. In the central part can be found some of the oldest objects, also with a wooden roof construction, thatched with straw. A timber roof has a conical shape and is made of juniper wood, called 'ginepro' locally.

5.4 A pinetas' height is equal to the $\sqrt{3}/2$, if the baseline is measured from the middle of the left wall to the middle of the right one (this can be simplified as the length from the beginning of the entrance to the depth of the corbelled room).

Other pinetas are mostly in use for the flock. Sheep flocks also live in clusters, made of several pinetas with walls up to two metres high.

Today pinetas are only seldomly in use, the flocks return every day from the pastures to home – narrow country roads can be occupied by them for hours.

Image 5.2



Image 5.3

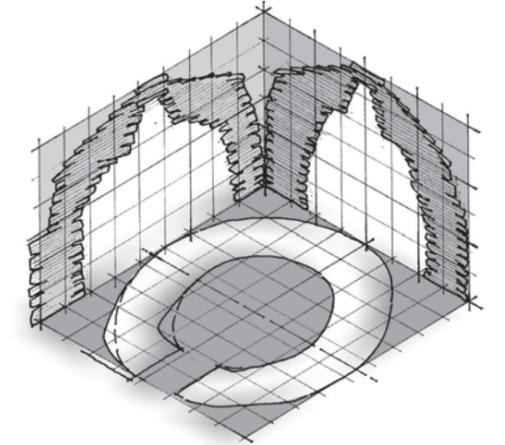


Image 5.4

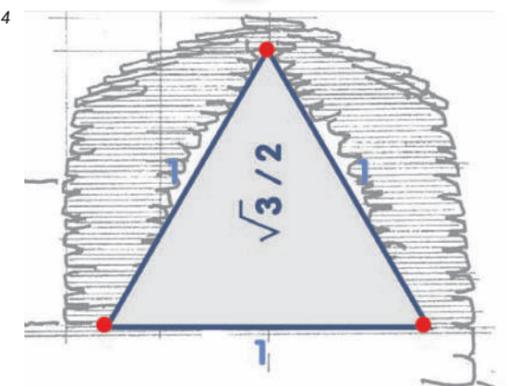
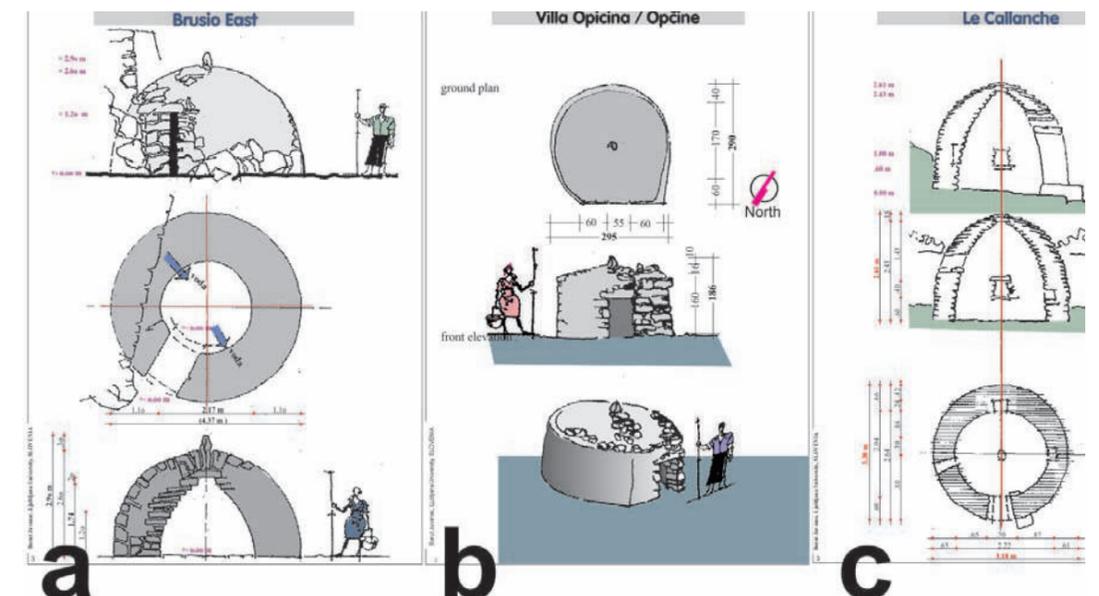


Image 06



6. TRULLO, CASELLA, PAGLIAIA

6.0 South of continental part of Italy. Puglia / Apuglia

6.1 A trullo homestead is a compound of buildings for people and animals.

A trullo is the most typical object in Puglia, composed with the help of corbelling, but with several varieties of shapes, use, locations and local names.

There are several names in use for a trullo: the oldest is 'truddhu', also truddi, trullo (singular, plural trulli), caseddhi, casella and pagliaia, pajare, paiara, pajaru, pagghiara, pajara, furnieddho (by E. Degano), furneddu, chipuro, casedda (by Rossi and Leserri).

The first typicality is its construction, corbelling, but in several variants of appearance. Trullo means the system of construction.

Several types of trulli can be found :

- individually located object as an auxiliary farm building in the countryside
- trullo system as a homestead
- trullo in rows in cities
- trullo beside the beach of the Adriatic sea
- auxiliary farm buildings in the south
- pagliaia, connected to trullo for storing straw.

The two most typical things of a trullo: its construction, with a conical roof, covered by stone plates with individual shaped pinnacles on the top and a sign drawn with lime on the front side of the roof.

6.2 Trullo composition in a homestead, masseria, with living part and other elements for the livestock.

The prime and oldest type is an individually located object, composed in corbelling and covered by stone, which shows its construction – like other shelters in Italy. The shape is more or less unarticulated.

A homestead in the trullo system consists of the living trullo, trullo for the kitchen, for animals (separated by height for donkeys, swine, chickens). This type has vertical walls, built with half-cut stone in a square shape until a height of two meters. The corbelled false dome is overlaid on this construction – with a circular groundplan of course. The living part occupies the entire floor and sleeping part has a wooden construction on the first floor, over the vertical walls and under the corbelling. The kitchen trullo has a massive chimney in the roof and a well on the floor, over the cistern. Water is collected from the roofs, with a gutter on the top of the walls – not reachable by animals.

Auxiliary buildings consist of the yard and the biggest trullo for donkeys or mules, a smaller one for pigs and the smallest for chickens. Entrances are from one to another.

In front the objects can be found a circular 'aia', threshing floor.

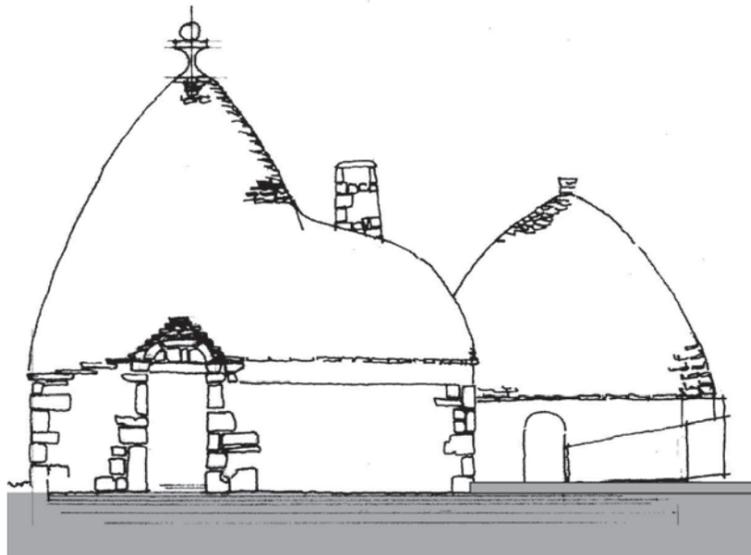


Image 6.1



Image 6.2



Image 6.3

6.3 The trullo system, composed in a city : Alberobello.

Trulli in three cities: Alberobello, Locorotondo and Martina Franca are squeezed together in rows, which compose the streets. The principle of building is the same as the previously mentioned system, but without auxiliary parts. Some trulli in the cities have terraces or garden beds in front of the entrance, but with a minimal size, not more than one or two square meters.

The main difference is collecting water: there are no animals in the cities and the streets are with polished stone plates – the water is collected from the roofs, but also from the street. There are no gutters at height, it provides much more water.

6.4 The most typical are the objects in the cities, but they can be found in the countryside too. Those hidden objects are unfortunately unknown. They are composed in extremely interesting shapes, mostly with staircases to the top.

Trulli beside the Adriatic shore are the same as typical trulli, but are in use as a remote station for the vineyards. The construction is the same, but the roof is covered by a sort of concrete. Yesterday it was natural 'Roman concrete', but today ordinary concrete can be seen.

6.5 Masseria Macherone near Alberobello: typical homestead with all the required elements. On the left is the living part with the kitchen and water cistern, on the right can be seen other rooms for the livestock, in front of the homestead is the 'aia' – threshing-floor.

In the south of Puglia can be seen another type of this construction, mostly with square groundplans, with staircases to the top. They could be double stairs, symmetrical around the entrance in the front. On the top was a place for drying fruit, inaccessible for animals and closer to the sun. Several types and shapes can be found in the countryside, smaller objects also stand in vineyards in the western part of the country.

Pagliaia (with several local names) is an outbuilding near a living trullo. The construction is the same, but on the top can be seen a circular stone plate, which covers the entrance to the object: for filling in straw. It is accessible by a simple staircase, in-built or built over the roof. The filled straw was used from the front door below.

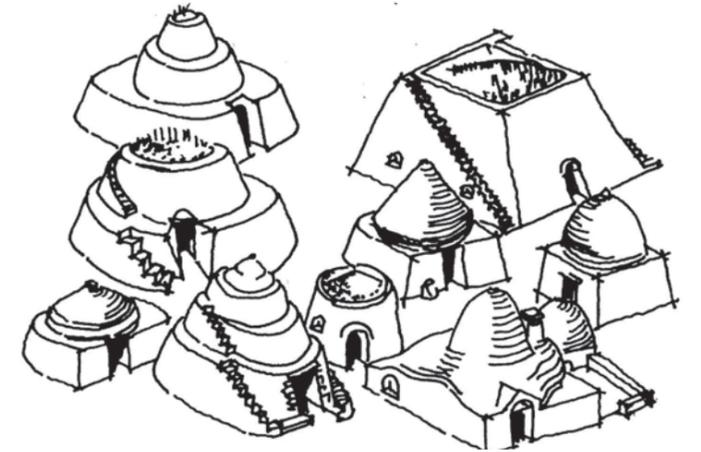


Image 6.4

Image 6.5

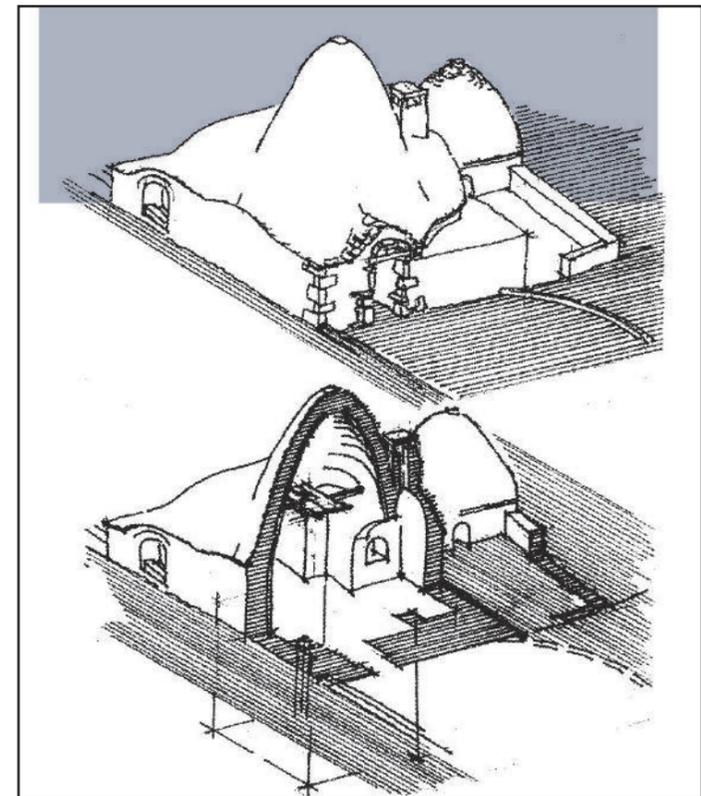
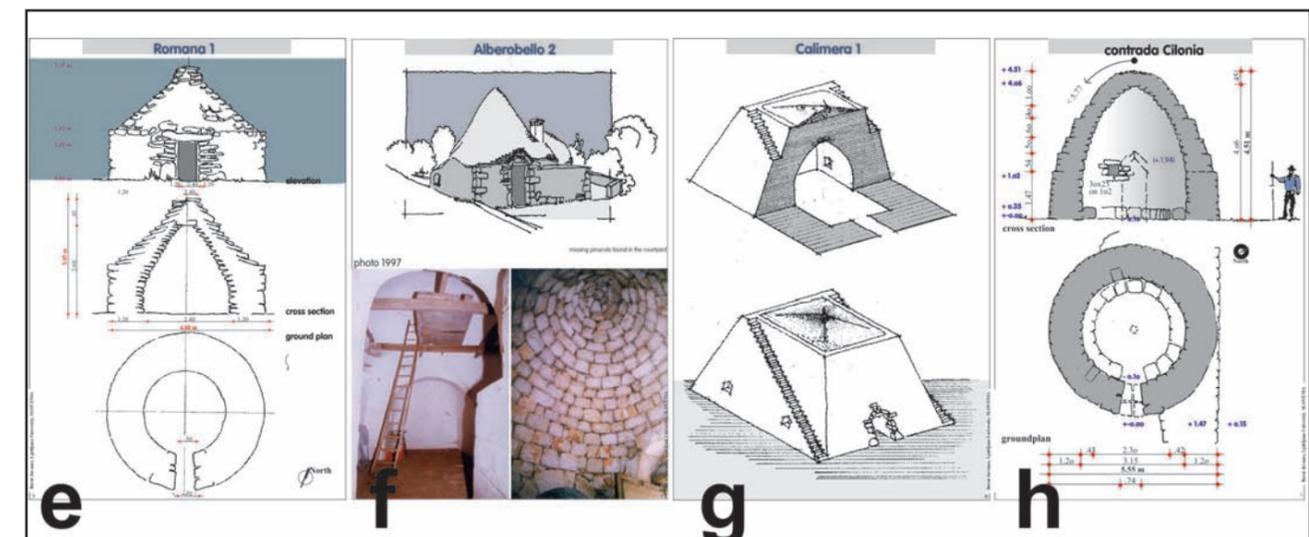


Image 7



7. CAPANO, CŪBBURO, PAGGHIARU

7.0 South of Italy, Sicily. Sicilia / Sicily

7.1 Capano is built in white stone and is visible in the raster of the walls between pastures near Ragusa.

Three types of stone shelters can be found in Sicily: capano near Ragusa, cūbburo north of Etna and pagghiaru west of Etna mountain.

7.2 Capano at the contrada Cilonia (Ragusa).

Capano is an interesting object in the environs of Ragusa city in the south of Sicily, in the Iblei mountains. They are made in white stone, half dressed and stand against a wall, in a wall or in the corner of an enclosed pasture. Its construction is theoretically perfect corbelling, with a circular groundplan, higher than a typical false dome with a stepped construction outside. The entrance has bigger stone plates for the lintel and a great many perfectly dressed elements for animals: bowls for food and water, tables for herdsmen etc. Because of its height and white colour, a capano is a very noticeable object on the plains, full of walls. Some of them also stand very near to the homesteads.

7.3 Capano is pretty high object, but is perfectly composed with the help of the height of an equilateral triangle.

Cūbburo is a non-typically shaped stone shelter for sheltering herdsmen north of Randazzo, on the southern slopes of the hills on the other side of Etna mountain. Its groundplan is theoretically a circle, but it depends on the natural possibilities. The construction is corbelling, sometimes very low with larger stone plates. The entrance is composed with stone lintels, a corbelled entrance is pretty rare.

7.4 Cūbburo North of Floresta, Vaccarizzo 2, 'Raloggiu'.

Pagghiaru in the north-western part of Etna mountain has a circular drystone wall to at least the height of the shoulder of a sitting herdsmen, a wooden construction sits on this foundation, thatched by a sort of straw. The carpentry uses hard wood, mostly ginepro (juniper tree) in a conical shape. Many of them have been reconstructed and prepared for tourist use.

An extremely interesting object can also be found there: murraghiu, an up to five storey high circular construction with a staircase to the top.

7.5 Pagghiaru on the slopes of Mount Etna.

Cūbburo is a numerous object, some of them are reconstructed on pastures and carefully denoted with information boards, pagghiaru, located on tourist trails are used as monuments of cultural heritage, capano stand on private ground, in enclosed pastures and are mostly abandoned.

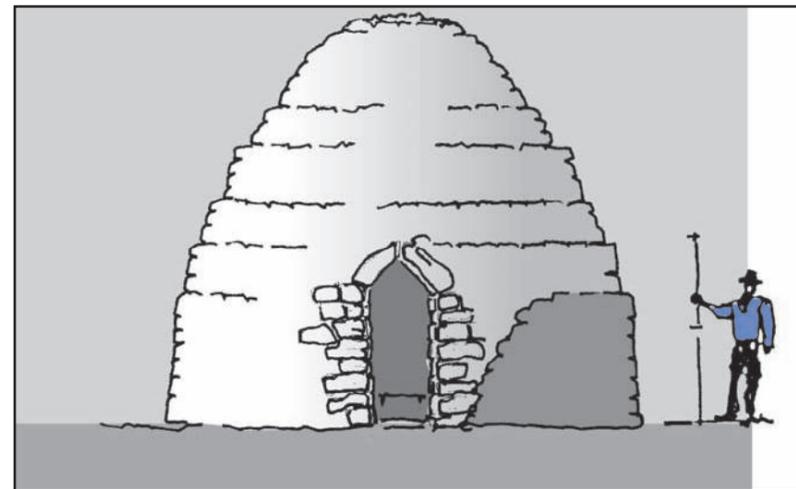


Image 7.1



Image 7.2

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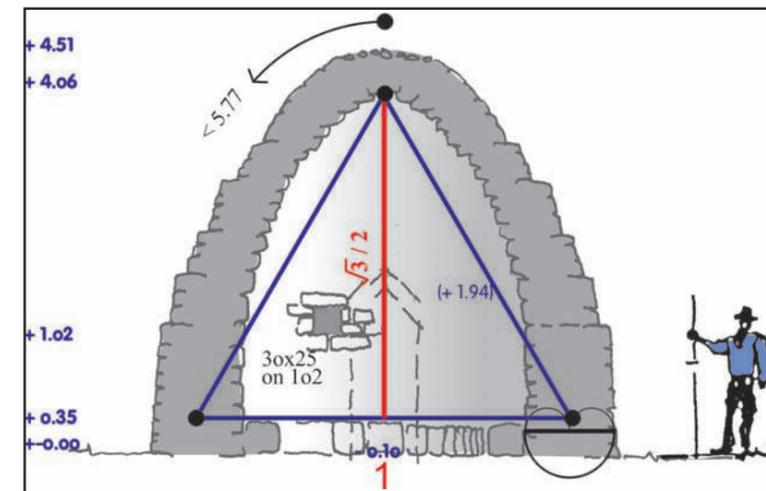


Image 7.3



Image 7.4

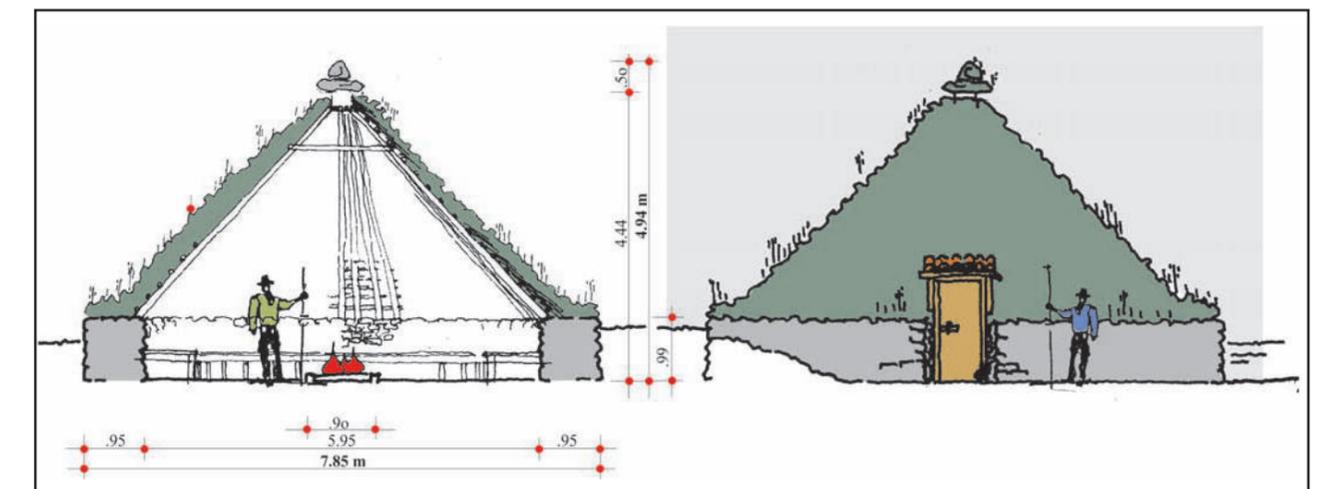


Image 7.5

“Drakospita” - “Dragon houses” in Evia of Greece

Drakospita » - Maisons des dragons : Eubée, Grèce

Les « Drakospita » sont des bâtiments énigmatiques en Grèce datant d'une époque très ancienne. « Drakospita » signifie maisons de dragons. Elles sont situées sur les pentes abruptes des montagnes et des collines, érodées par les intempéries. Selon les mythes grecs, les dragons étaient des créatures surnaturelles qui possédaient une force et une sagesse immense, des compétences nécessaires pour porter des pierres énormes et très lourdes et pour les utiliser selon une technique unique pour construire leurs maisons. La plupart des « Drakospita » ont été découvertes dans le sud de l'Eubée, dans la région de Styra et de Karystos. Des structures similaires, situées sur la montagne Hymettus en Attique et sur les îles de Tinos et d'Égine, sont également appelées « Drakospita » en raison de la similitude de leur technique de construction. Il ne fait aucun doute que ces édifices peuvent être classés dans la famille des « monuments mégalithiques », et leur nombre total s'élève à 25 dans la seule Eubée. Hérodote et Diodoros Siceliotis [historiens de l'Antiquité] affirment que les Dryopes ont immigré en Grèce méridionale, colonisant l'Eubée méridionale et les îles des Cyclades. On pense que les Dryopes sont les bâtisseurs des constructions mégalithiques découvertes dans le sud de l'Eubée, à Tinos, à Égine et à Hymettus, grâce à leur savoir-faire unique en matière de construction en pierre. La fonction de ces structures a été une énigme et a donné lieu à diverses interprétations de la part des érudits. Au cours des 18^e, 19^e et début du 20^e siècles, différentes opinions ont été exprimées. Certains de ces bâtiments peuvent être identifiés comme des tours de guet militaires ou agricoles. Par ailleurs, certains chercheurs proposent une relation avec les carrières voisines, suggérant qu'il s'agissait d'installations ou d'abris pour les travailleurs des carrières ou qu'ils servaient de lieux de culte. La maison de dragons de la montagne d'Oche, qui a la forme d'un mégaron monumental et dont la structure est de qualité supérieure, est considérée comme un temple dédié au culte de la déesse Teleia Hera ou aux noces d'Héra et de Zeus, ou encore à Poséidon. On pourrait probablement affirmer qu'au moins le célèbre « Drakospito » du mont Oche n'était pas seulement un lieu de culte, mais aussi un ancien observatoire astronomique. Les maisons de dragons ont été réutilisées aux époques archaïque, hellénistique, romaine et médiévale, ainsi qu'à l'époque moderne. Depuis le début du XVIII^e siècle, des voyageurs européens ont visité ces édifices intéressants et les ont mentionnés dans leurs rapports, impressionnés par leur caractère unique. Des informations importantes sur les maisons de

dragons proviennent de ces rapports et de publications d'érudits. La poursuite de l'investigation et de l'enregistrement systématique des sites en Eubée apportera davantage de réponses aux questions historiques et archéologiques concernant l'origine des maisons de dragons, leur fonction, l'époque de leur construction et leur relation avec d'autres sites en Grèce.

En outre, l'État devrait prendre soin, non seulement de l'environnement des maisons de dragons, mais aussi mettre en place des procédures de sauvegarde du site archéologique de ces monuments importants afin de permettre la coexistence de ces édifices en harmonie avec leur environnement, comme cela a été le cas pendant de nombreux siècles.

1. What are the Dragon Houses, and why they are called like that

The « Dragon Houses » are a number of enigmatic megalithic structures, which have existed since ancient times. They have impressed researchers since 18th century by their excellent construction, and when it comes to their identity, many different theories have been formulated from time to time. The name « Dragon Houses » literally means the dwellings of the Dragons.

In Greek Mythology, Dragon is a Creature with a Strong, piercing Gaze, and with keen attentiveness.

Dragons were the guardians of treasures, springs and the secrets of life.

The word Dragon comes from the verb “derkome” which means exactly that I have an intense gaze and strong attention.

In folk tradition, Dragons had a huge anthropomorphic appearance and supernatural power, and they are a continuation of gigantic characters of the Ancient Greek Mythology as the Cyclopes, the Giants, the Titans, and the Hecatonchères.

The Dragon Houses are structures built with massive blocks of stone weighing many tons, which were carved and built without any binding mortar, with amazing building precision, and stability that has lasted for millennia.

They are mostly found in inaccessible mountainous areas, and at high altitudes with strong winds.

In the Folk beliefs of locals in the area, who lived in small houses, these structures were nothing but the work of Dragons, and naturally, they were their houses, since the location of these buildings was distant and secluded (img.1) & (img.2).



Img.1

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Keywords :
Megalithic monuments,
Dragon house on mount
Ochi, Palli Lakka complex.

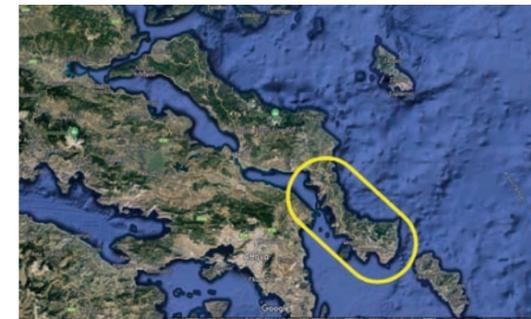


Img.2

Thus, Folk tradition called these buildings «Dragon Houses» or «Dragon Caves», «Dragons' Canopies» and «Drago». (Moutsopoulos N.K. 1982: 284), (Carpenter J.-Boyd D 1977 : 179), (Moutsopoulos N.K. 1992 : 47).

2. Locations of Dragon Houses, and how many they are

Dragon Houses have been found in SW Evia, Attica on Mount Hymettus, as well as in the islands of Aegina and Tinos. However, most of them have been discovered in southwestern Evia (img.3), the second biggest island in Greece, where there are as many as twenty-five, according to the studies and researches of Nikolaos Moutsopoulos and Theodore Skouras.



Img.3

Img.4



On Maria's Chiidiroglou map (img.4), one can see the locations of these buildings in SW Euboea, and, on Karl Reber's map, one can see their locations in the area of Styra . The dragon houses of Evia are cited in the books of both researchers Moutsopoulos and Skouras with their local names (img.5).

All of the dragon houses that we cite, are copies of each other, in terms of how they were built, while they differ, when it comes to the quality of stone carving, and their overall dimensions.

In this paper, we refer to the Dragon Houses of Evia, and mostly to the Dragon House on Mount Ochi, and the Palli Laka Drago complex, on the slope of mount Klioisi, since most research and literature has been focused on them.

(Skouras Th.1991), (Moutsopoulos N.K. 1992:49), (Chidiroglou M.2012:762), (Reber K. 2010:54).

Img.5

-The well preserved Dragon house on mount Ochi	-An anonymous dragon house near Chalkis on the Yiamina hill at an altitude of 410 m.
-Three (3) Dragon houses called “Palli Lakka drago”- near Styra	-An anonymous dragon house in the cape Tolia .
-The Dragon house called “Loumithel-Mariza drago” – site Metziti of Styra	-The dragon house known as “ Pyrgos” in the costal village Niborio at an altitude of 150m.
-Two Dragon houses called “Kroi Phtocht drago” – site Aminou NE of Styra	-Two (2) anonymous dragon houses in Kourthea at an altitude of 365 and 358 m.
-The Dragon house called “Tsouga drago” – near village Stoupaioi.	-The dragon house called “Viglia drago” on the hill Vglia near Nea Styra.
-The Dragon house called “Katasaro drago” – near “Tsouga drago”.	-Two (2) dragon houses called “Ilkizes drago” near the local Ilkizes of Styra, at an altitude of 520m.
-The Dragon house called “Limiko drago” – near Kapsala.	-Two (2) anonymous dragon houses in the area Makkou at an altitude of 430m.
-The small Dragon house called “Dardha drago”- near Rospilia.	-A small anonymous dragon house in the Steno position near the village Koila at an altitude of 230m.
-The dragon house called “ Kiouka drago” at the top of the hill near Mariza drago .	- An anonymous dragon house near Roukliasti lin the Lakes position at an altitude of 530m.
- An anonymous dragon house near the village Glyfada at an altitude of 160 m.	

3.The actual builders, and building construction dates

From research conducted on primary sources (Diodorus Siculus - 1st cent. B.C., and Pausanias - 2nd cent. A.D.), it emerges that, around the Middle of Late Helladic Period (LH 1,600-1,100 B.C.), the Southwestern part of the island of Evia had colonized by the Dryopes, a Greek Pelasgian, Proto-Hellenic tribe.

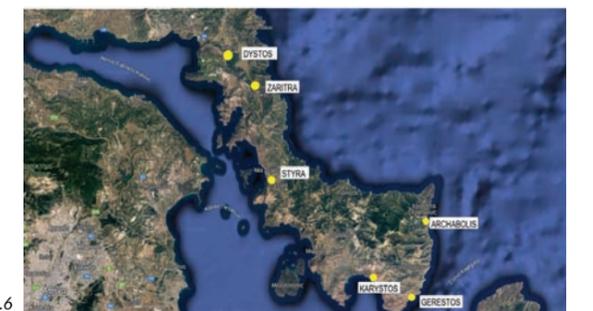
Both the presence of the Dryopes throughout Antiquity, and their cultural influence, are significant, and, according to many researchers, they are the builders of the megalithic monuments.

During the Middle Helladic Period (1900-1650 B.C.), the Dryopes lived in Central Greece, between Mount Parnassus and Mount Oeta, mostly towards the massif of Mount Oeta, in an area called Dryopis, and had kinship ties with the Pelasgians and the Dolopes. Their Name comes from «drys», a word with which the Ancient Greeks used to call all trees, and this shows their bond with nature.

Nowadays, traces of a Dryopian Polichni survive in this area.

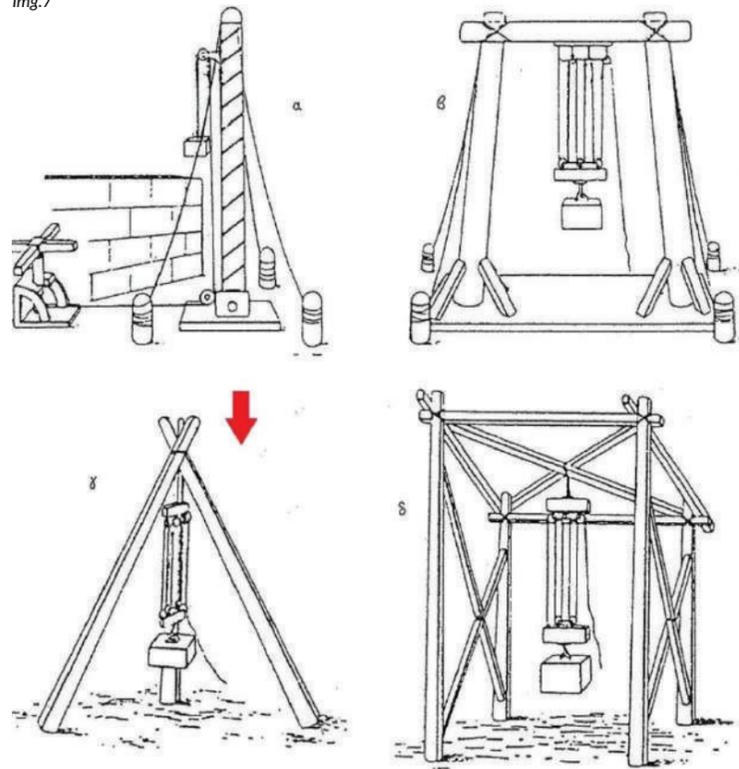
Dryopes moved to other areas in Central Greece, as well as to southwestern Evia, the Cyclades, Cyprus, and the Peloponnese, where they founded many cities and towns.

In Evia, they founded the following cities : Styra, Karystos, Dystos, along with the small towns of Zaritra, Geraestus, Archampolis, etc. (img.6) Traces of their presence in south Evia are the megalithic fortifications, and the so-called «Dragon Houses». These structures



Img.6

Img.7

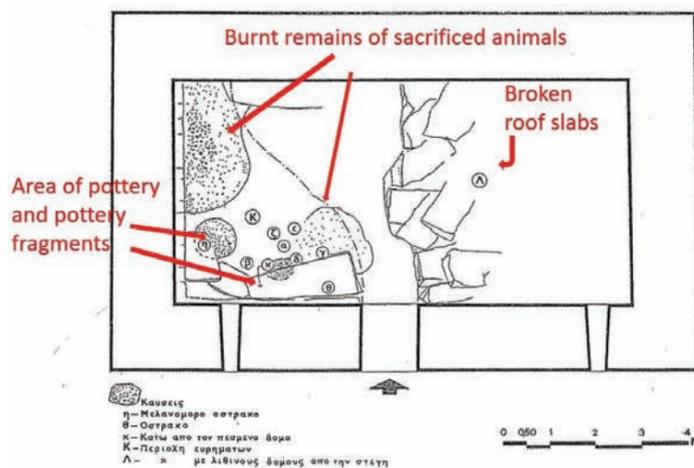


34. Τέσσερις ανύψυντες μηχανές σχεδιασμένες από τον Ήρωνα τον Αλεξανδρινό: μονόκυκλος (α), δίκυκλος (β), τριόκυκλος (γ), τετράκυκλος (δ).

show their specialist knowledge of stone processing, and high level of technical expertise in using lifting machines (img.7).

Their migration out of Central Greece, to the Cyclades and Cyprus, also manifests their naval skills and knowledge of means of long-range navigation, which is evidence of an advanced culture.

According to Homer's Iliad, Dryopian cities and towns took part in the Trojan War (1,194-1,184 B.C.). The megalithic monuments that we refer to were built before the Trojan War, at the same time with the Cyclopean Walls of Mycenae. (Chidioglou M. 2010 :21), (Lois G. 2015 :3,4,11,12), (Lazos C. 1993:46).



Εικ. 10. Κάτοψη του δρακόντιου της Όχης. Διακρίνεται η περιοχή των καύσεων (Κ).

Img.8

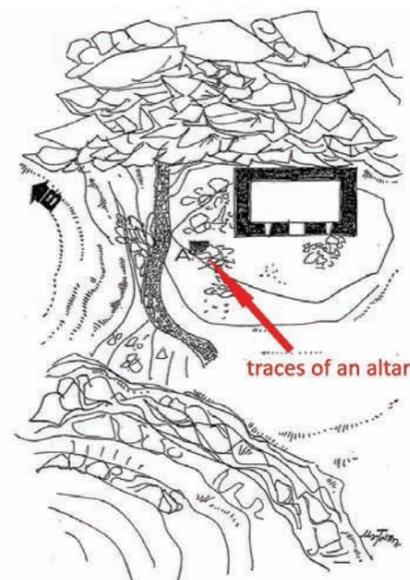
4. Function of the Dragon Houses

When it comes to Dragon houses' function, various theories have been formulated by researchers since the 18th century to the present day. It is believed that dragon houses with an elaborate structure, and where signs of sacrifices, pottery, and pottery fragments have also been found, were used for worship. On the other hand, it is believed that the least elaborate of them were used to store foods and as stables for animals.

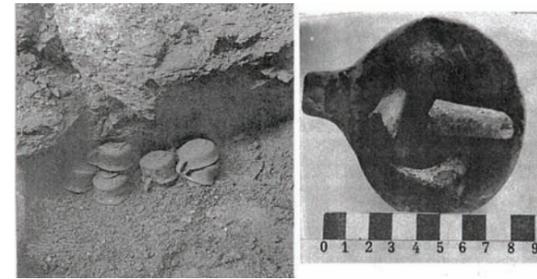
With regard to the Dragon House on Mount Ochi, in specific, researchers N. K. Moutsopoulos, Stephanus Byzantios, H.N. Ulrichs and J. Hawkins argue that it was used as a Temple dedicated to Flawless Hera or the wedding of Zeus with Hera, with this view also being supported by the narration of Pausanias (II, 36,1) and commentary of Theocritus (Carolus Wendel, XV, 64), according to which, the Dryopes worshiped Zeus and Hera at peak sanctuaries. During research and excavation that N. K. Moutsopoulos carried out on the Dragon House on Mount Ochi, as well as on the surrounding area, he discovered that sacrifices were performed both inside and outside of the building, because he found traces of altars, burned residues, many animal bones mixed with soil, and an abundance of pottery from various eras scattered around, along with some pieces preserved and arranged in orderly fashion in a depository as well as pottery fragments. These findings are evidence of a temple's operation for many years (img.8) & (img.9).

Furthermore, a niche is reported by 19th century researchers, as well as a protrusion that is shaped like a table, which were possibly used for statues or votive offerings.

N. Moutsopoulos rejects the theory, which was formulated by Ludwig Ross, that the monument was used as a house where shepherds lived,



Εικ. 4. Τοπογραφικό σχέδιο του δρακόντιου στην κορυφή της Όχης. Α: 4 βράχοι (απόθετες).



Img.9

and as a shelter to protect their flocks from wolves, due to harsh living conditions at such a high altitude. He also rejects the theory of Th. Wiegand and Franklin Johnson, that it was used as a phryctoria (beacon-tower), due to harsh living conditions, and also due to poor visibility, when it gets cloudy.

Furthermore, the view that it was used as a house where quarry workers lived, is weak, because the quarries are located at a lower altitude and faraway. (Moutsopoulos N.K. 1992:51,52), (Moutsopoulos N.K. 1961:13-15), (Moutsopoulos N.K.1982: 297,447-455).

Regarding to the three Dragon Houses at the Palli Laka site, according to researchers C. Bursian Baumeister and Girard, these three buildings served as Temples, and Bursian argued that Zeus - Demeter - daughter or Zeus - Hera - Hebe or Apollo - Artemis - Leto, were worshiped there.

Moutsopoulos found out that there is a hierarchy in the buildings, and therefore, they serve a different purpose. The square main building was probably designed for humans, and the side rectangular buildings for animals, because of their lower height. The closed form of the complex was perhaps chosen to provide shelter to both humans and animals (img.10). The carved stone in the shape of watering trough, which is attached to rectangular building B, and the stone shelves in the corners of building C, with draining grooves, suggest cheesemaking activities (img.11).

Apart from the dragon house on Mount Ochi, which was inaccessible to shepherds, because of its high location (1,400m.), all of the other dragon houses have been used by shepherds for their flocks to this day.

It could be argued that the location of the other dragon houses, (apart from that on Mount Ochi), due to their topographic position in desolate areas with pasture lands, and their low altitude, justifies the view that their current function as sheep pens could also be their original. But then the question emerges, that, if the sheep pens of the original builders were so solid and elaborate, their houses must have been similar, i.e. stone-made and with an elaborate construction ! However, no similar ancient settlements have been found so far, at least in the SW Evia mainland. Not any grouped cemeteries have

been found either, other than scattered graves, and these have been looted.

Modern sheep pens are made of poor materials, compared to the dragon houses.

Therefore, their function is still a Mystery. (Moutsopoulos N.K. 1982: 297,447-455).

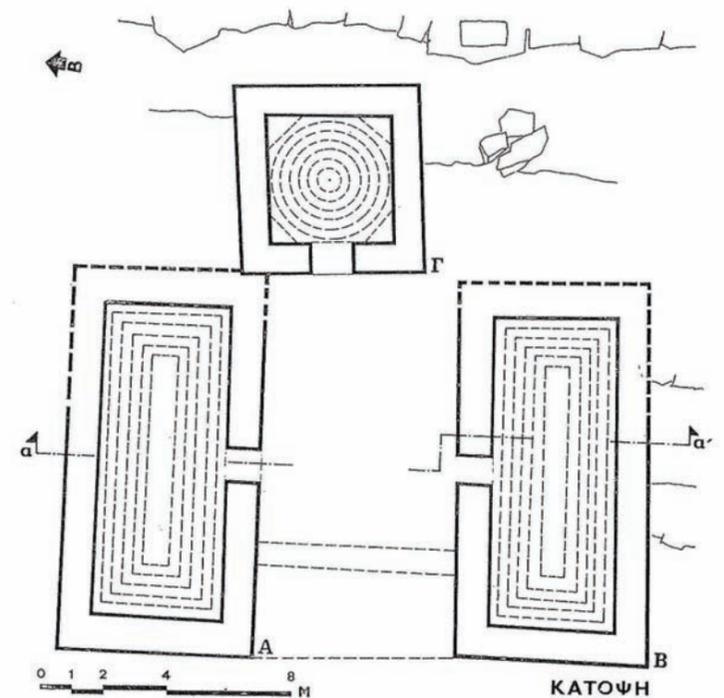
5. Materials and building method of the Dragon Houses

- Dimensions and orientation

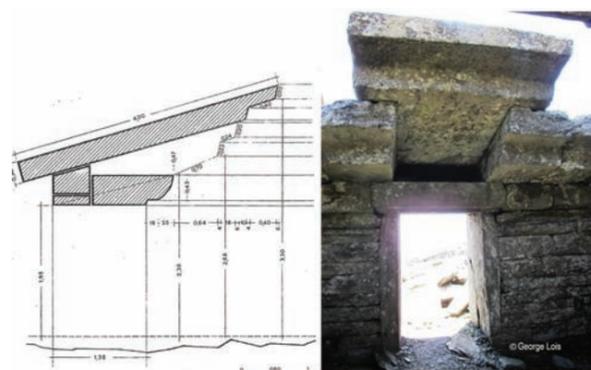
The dragon houses have several similarities, but they differ in their internal dimensions. The smallest one has an internal dimension of 2.00-2.50m, whereas the biggest dimension measured was 21.80m. Although the orientation of their longest axis varies, it has approximately the same direction, E-W, with an opening to the South.

The only building material is stone. It was used both in perimetric walls and in roofing. The thickness of perimetric walls varies from 1.00m. to 1.40m. Each stone that makes the wall has a low height, but a relatively big length. In some cases, there are wedges in-between the stones. Generally speaking, the building system is either isodomic or pseudo-isodomic, and the thickness

Img.10



Img.11



Εικ. 7. Τη άρραξη των «Όρων» εδωσαν κατά της δίρας αλάνες.

Img.12

of the walls consist of two series of stones to support the weight of the roof. Also there are often stones laid across - diatonic stones in-between.

In all of the dragon houses, the internal façade of the wall is more elaborate than the external. In the case of the Dragon House on Mount Ochi, the internal façade of the walls presents a perfect flawlessness.

The external corners of the dragon houses have been left half-finished.

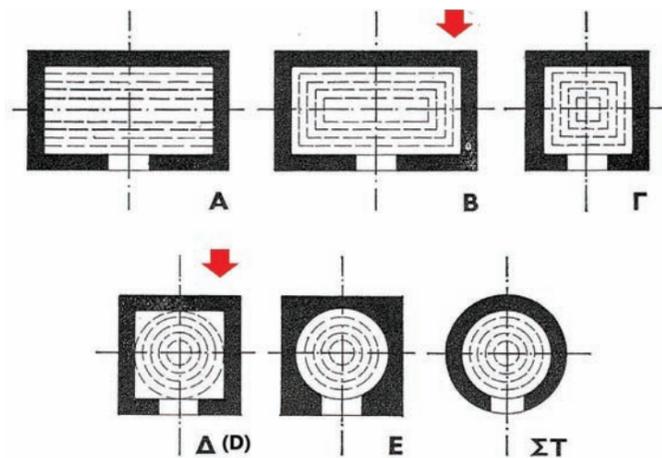
The construction material of the buildings comes from stones in their environment. It is green-brown marble of good quality. In the SW Euboea region, there are quarries known since the time of Strabo. These quarries produced green-brown colored marble, known as Karystos green stone (Cipollino). There are still remains of these major quarries, near the « kyliindroi » site, at an altitude of 650m., and 4km. away from Karystos, where some ancient columns have been preserved, and which are 12m. long and have a diameter of 1.5m. Besides, there are quarries near the town of Styra and the Dragon Houses of Palli Laka Drago. (Moutsopoulos N.K. 1982: 273,401-404), (Carpenter J.-Boyd D 1977:182), (Chidiroglou M.2010:23), Chlorokostas G. 2003:36,37), (Lois G. 2015:23) & (Moutsopoulos N.K. 1961:3,5).

• Openings

The openings, i.e. the doors, had a width of 0.80 - 1.25 m. No relieving gap was implemented above the lintel, except for the door of the dragon house on Mount Ochi (img.12). The



Img.13



Img.14

Εικ. 128. Θεωρητική εξέλιξη από το ορθογώνιο στον κύκλο.

orthostats and the lintel are made of monolithic slabs that form the Greek letter Π. There are not any windows in any dragon house, apart from the building on Mount Ochi, where there are windows on either side of the door.

The orientation of the door is South, apart from the three dragon houses in the Palli Laka complex, where the openings face a central yard. In these Dragon Houses, the door is covered by a monolithic slab that follows the corresponding course of the corbeled roof.

The lighting of the dragon houses was through the “Opaia” (openings), i.e. a number of circle openings at the top of the corbelled roof, where the smoke also came out from an internal altar or hearth. (Moutsopoulos N.K.1982 : 287,405,406), (Carpenter J-Boyd D 1977:184).

• Roofing

In nearly all of the dragon houses, roofing has been built by using the corbelling method, where the stones of the courses of one side of the building partly protrude from the lower course, and are actually inclined, until they meet with the opposite, similar roofing. The inclination is bigger in higher courses. In some cases, wedges are fitted into the slabs, in order to form a slope. The courses are usually 5-6, and the number depends from the opening to be covered (img.13).

The stability of the roof is also due to the counterweights, as well as to the fact that the total weight resultant goes through the load-bearing wall-base of the building. The corbelling method (corbel arch) has been known since Mycenaean times. In the table of (img.14), one can see the various types of corbelling roofing in megalithic structures in the Mediterranean. In the dragon houses of Karystos and Styra regions, type B roofing prevails. Type D of corbelled roof with a round corbelling method of slabs, gives it a shape that looks like a dome, where forces shift from a round, to a rectangular, structure. This type was applied to the middle Dragon House C in the Palli Laka complex (img.15) (Moutsopoulos N.K.1982: 406-428), (Carpenter J.-Boyd D 1977:183), (Moutsopoulos N.K. 1961:12).

It is interesting to refer to a number of special features of the most well-maintained Dragon Houses, which are the dragon house on

Mount Ochi, and the complex of three dragon houses known as Palli Laka Drago, on the slope of mount Kliossi.



Img.15



Img.16

Mount Ochi, and the complex of three dragon houses known as Palli Laka Drago, on the slope of mount Kliossi.

Dragon house at the top of Mount Ochi

The Dragon House on Mount Ochi which was probably an ancient temple was discovered in 1797 and impressed researchers and scholars by its uniqueness. It is located on the peak of Mount Ochi, at an altitude of 1,400 m (img.16). The monastery of Prophet Elias, with a church and four monk cells, is located at the same altitude. That shows a continuity in the worship

fragments with inscription. All the findings were recorded in detail. Traces of altars were found inside and outside of the building.

All these findings and observations point to the conclusion that it was a Temple. Its roofing is hipped with a corbel arch, and the walls built with an isodomic system. Regarding specifically this monument, it is admirable how the builders managed to treat the massive blocks of stone from the environment at this altitude, with the age-old means of their time. (Moutsopoulos N.K.1982 : 277,281-285,298-323), (Moutsopoulos N.K. 1961:7-19).

«Palli Laka Drago» dragon houses

These Dragon houses were named after the owner of the land, where these interesting buildings were found. The area near the buildings is called “Krya Vrysi”, which literally means «Cold Faucet», and therefore, they were built close to water. They are three in total, and are arranged in the form of the Greek letter Π, while they are not at the same level, due to inclined ground. At the highest point, there is the square dragon house with the vaulted ceiling. The rectangular dragon houses have been back-filled for leveling and therefore, their doors are low. Their external appearance is not clear, but it can be seen through the sides of the slope, half-buried into the ground.



Img.17

On the western side, there is a retaining wall, half-destroyed, with an attempt to repair it, made by the shepherds that use the buildings. There are two stone basins for water collection. The one is attached to the Dragon House B and the other is near the Dragon house C. Dragon house C is square, and also half-buried into the ground, and the entrance door is on the western side, approximately at the middle of it.

habits of the locals since ancient times, in building sanctuaries on mountain peaks (img.17).

The dragon house is rectangular, with a face and openings to the long SW side. Building's dimensions are 4.85m x 9.80m. A curved fence with dry-stone has been built towards its NW side. When the weather is very clear, one can see as far as the Cyclades and the coast of Asia Minor.

During excavation research conducted by N. Moutsopoulos and his students between 1956-1960, stratigraphy was performed to a depth of 1.70m, with pottery findings, and even pottery

The masonry of C is more elaborate than that of dragon houses A and B. The external corners of the dragon houses have been left unshaped. Inside C, the masonry does not follow the isodomic system, but it has large stones, roughly rectangular, which are intermingled with very small ones.

On the four corners of C, there are triangular stone slabs – shelves. The purpose of these shelves cannot be safely concluded. Under the shelf that survives, there is a crypt, and 45 cm from the ground and 0.80-0.95 cm from the corners, there are some holes, apparently for a number of wooden beams with an unknown function.

The roofing of C is interesting from inside, since it has a vaulted shape, and has been built with isodomic concentric courses of half-carved stones.

The rectangular buildings have corbelled, hipped roofing. (Moutsopoulos N.K. 1982: 370-381).

6. How did the dragon houses become known in modern times

Since the 18th century, many Researches and scholars dealt with these buildings. The main researchers are mentioned in the following list in chronological order :

- 1797 - John Hawkins (MP) British Engineer, first discovered the dragon house on the mount Ochi. His discovery was published in the study of Robert Walpole " Travelers in various Countries of East , being a continuation of Memoirs relating to European and Asiatic Turkey"(London 1820 pp285-293). In the book, there are two engravings captioned : "Western View of the Temple on mount Ocha" and " Plan and section of the Temple on mount Ocha".
- 1842 - Ern. Ulrichs published a study in Annali dell' Istituto di Corrispondenza Archeologica, t.XIV 1842 and in Monumenti inediti publicati dell' Istituto di Corrispondenza Archeologica III,XXXVII,1839-43,(pp 5-11) and in the magazine «Ευρωπαϊκος Εραμιστης-Greek» of Athens a study entitled «Περί του επί της Όχης ναού του Διός και της Ήρας : About the Temple of Zeus and Hera on Ochi".
- 1850 - F.G. Welcker published his study in «Kleine Schriften» (t. III, Bonn 1850, pp. 376-392) in which he names the Dragon House at Ochi as Heraion.
- 1852 - M. Rangabe published in « Memoires presentes par divers savants à l'Académie des Inscriptions et Belles -Lettres » (1^{ère} série, t. III, pp197-239. Pl.I-V) a study on the dragon houses of Styra, Palli Laka with sketches of floor plans and a perspective.
- 1851 - M. J. Girard published in his book « Memoires sur l' ile d' Eubee, Archives des Missions scientifiques et litteraires"(2, Paris 1851, pp708-714,724-725) & (Paris 1852,pp74-80,90-91) a description of the dragon houses Ochi and Palli Laka in Styra which he had visited himself.
- 1855 - C. Bursian published a study in the «Archaeologische Zeitung» (XIII 1855, pp.130-142) where he considers the buildings of Styra, named Palli Lakka drago, to be temples of Demeter and her daughter, and the Dragon House on mount Ochi also considers to be a Temple.
- 1864 - Aug. Baumeister published a study with the title "Topographische Skizze der Insel Euboea" (Lubeck 1864, pp26-27, 29-30) with detailed measurements of architectural parts of the dragon houses on mount Ochi and Styra and building descriptions.
- 1872 - C. Bursian, in "Geographie von Griechenland", considers that the three

Dragon Houses of Styra known as Palli Lakka drago, are a threefold ancient Temple.

- 1886 - Spyridon Lambros in the «History of Greece» (vol. A' 1886, pp. 31-32) deals with the dragon houses and considers them as the «The most Ancient Monuments of Worship in Greece».
- 1894 - Perrot-Chipiez in « Histoire de l'Art » (t. VI Paris1894, pp.654-655) consider that the Ochi monument is one of the oldest sanctuaries built in Greece.
- 1896 - Theodor Wiegand published an interesting study under the title «Der Angerbliche Urtempel auf der Ocha» (Ath.Mitt. XXI 1896, pp. 11-17) with the only until then Architectural plan and section of the dragon house on Mt. Ochi and a multitude of Architectural observations.
- 1925 - Franklin P. Johnson published a systematic comparative study titled «The Dragon Houses of Southern Euboea», (American Journal of Archeology XXIX , 1925, pp 398-412) , with images of facades of the buildings of Ochi and Styra.
- 1930 - K.A. Gounaropoulos in «Ιστορία της νήσου Ευβοίας από αρχαιοτάτων χρόνων μέχρι των καθ' ημάς : History of the Island of Evia from Ancient Times to our « (printed in Thessaloniki) considers that the dragon houses were the residences of the Dryopian quarry workers or later locals.
- 1954 - Th. G. Papamanolis mentions in his book "Karystos" (Athens 1954, pp..92-97, 119-128, 136) the various opinion and theories about the dragon houses.
- 1956 - Hugh Plommer in « Ancient and Classical Architecture » (Simpson's History of Architectural Development t. A' 1956, pp 2-3) published his scetches of dragon house on mount Ochi.
- 1960 and 1961 - N. K. Moutsopoulos published his study "το Δρακόσπιτο της Όχης: The dragon house of Ochi" in the magazine "Το Βουνο : The Mountain" (1961, pp.3-23) with an added German summary.

It is a preliminary report of his study where he describes the excavation he had carried out with his students in 1959 on the peak of mount Ochi and this report contains detailed physical description with photos and a plan of the dragon house.

- 1976 & 1977 - Two important studies carried out by Jean Carpenter and Dan Boyd. The first in the magazine Archeology (October 1976 vol 29,No4, pp.250-255)entitled «The Dragon Houses of Southern Euboea» and the second in A.J.A (American Journal of Archaeology, Spring1977 vol 81, N°2, pp. 179-215) entitled «Dragon-Houses : Euboea, Attica, Karia».
- 1982 - The most thorough research, study and recording of the Dragon Houses has been published by professor N. K. Moutsopoulos in the "Επιστημονική Επετηρίδα της Πολυτεχνικής Σχολής, Τμήμα Αρχιτεκτόνων-Τόμος Η' :Scientific Annals of Polytechnic School of Aristotle University of Thessaloniki Dept of Architecture-Volume, H' ", with the title " Τα Δρακόσπιτα της ΝΔ Ευβοίας- Συμβολή στην Αρχιτεκτονική, την Τυπολογία και την μορφολογία τους :The dragon houses of SW Evia - Contribution to Architecture, the typology and their Morphology."(in Greek, pp.265-478).

In this work of 213 pages, all the dragon houses of Evia are recorded in detail with photos, Architectural plans and sections and construction details. Full account of his finds and results of his study and excavation that he had carried out with his students is also presented in detail.

1991 - Theodoros Skouras, wrote a book entitled «Τα Δρακόσπιτα της Ευβοίας , Πρωτη παρουσίαση 13 αγνωστων κτισματων και κριτικη σε οσα εχουν γραφτει για αυτα : The Dragon Houses of Evia - First presentation of 13 unknown buildings and criticism of what

has been written about them» (Chalkis, 164p). In this work additional buildings in other locations of Evia are recorded.

1992 - N. Moutsopoulos published an article in the scientific journal of Archeology Vol.42 (March 1992, pp.47-54) entitled « Δρακόσπιτα: Drakospita » which is a summary of his study published in 1982.

Ever since then, these monuments have been the subject of study by History, Archaeology, Architecture, as well as Economics students. Moreover, they have been the subject of many websites and TV channels and an attractive destination for daring hikers. (Moutsopoulos N.K.1982 : 269-272), (Moutsopoulos N.K. 1992:49), (Reber K. 2010:54).

7. Newer buildings with a similar building method

In some regions of the Cyclades, as well as in other islands, for example in Crete, we can observe a continuity in the building method of walls, with dry-stone, and roof construction based on the corbelling method. On top of that, there are roof coverings with one-piece slabs that are quite heavy and made of slate, and also there are few small openings for lighting. These features can be observed in 20th century buildings, which are used as houses, churches (img.18), winepresses (img.19) and storage rooms.

8. Epilogue – Conclusions

The monuments described in this paper are important to the History of Architecture and Technology and the identity of the area. Unfortunately, however, they are at risk, because they are not protected. They are damaged by the weather, vandalism, and interventions by shepherds, who believe that they own them. What is more, their flooring has already been damaged by treasure hunters and antiquity smugglers. What saves them is their megalithic structure.

A new threat for these monuments and their environment is an attempt to set up Wind Turbines. The Ephorate of Antiquities of Euboea has blocked this attempt so far. Moreover, their surrounding area is neglected and difficult to access.



img.18

It is necessary to guard these monuments, protect them from any type of interventions, and also restore their micro-environment, so that Dragon houses continue to coexist harmonically with the landscape as it has been for millennia and they have become part of it.

In addition, further systematic excavation and research in the area around the dragon houses, which has not been implemented yet, could clarify their use, and provide answers to a number of Historical and Archaeological questions that refer to the time of their construction, and also their connection with Athens, the Cyclades, and the rest of Ancient Greece.

As André Malraux, the French author and politician, once said, « we must ensure that there is a future for the past ». (Moutsopoulos N.K. 1992:52,53), (Chidioglou M. 2010:25).

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*AJA = American Journal of Archaeology

**MAA = Mediterranean Archaeology and Archaeometry

Dry stone constructions on the island of Kythnos (Cyclades, Greece) Past, Present and Future

Cet article fait référence aux constructions en pierre sèche, humbles œuvres humaines aujourd'hui discréditées, situées sur l'île cycladique de Kythnos. Des constructions qui, sans exagération, ont contribué dans le passé à la survie des habitants de l'île, comme dans tout autre endroit où la nature offrait la pierre comme matière première. Les diverses constructions en pierre sèche que l'on trouve à Kythnos ont servi pendant des siècles toutes les activités productives de l'île, tant dans le secteur primaire que dans le secteur secondaire. Il s'agit, tout d'abord, des murs de soutènement, caractéristiques du paysage de Kythnos, qui soutenaient les terrasses, terres arables horizontales, nécessaires à la survie des habitants, selon la géomorphologie de l'île. Cependant, dans le passé, les activités agricoles et d'élevage dans les zones en pente ont nécessité, outre la création de terrasses, la construction de divers bâtiments. Les murs en pierre sèche délimitaient également les propriétés et les chemins, clôturaient les cultures et les pâturages. Sur l'île, on trouve également de nombreux logements permanents ou saisonniers en pierre sèche, les kellia. Avec la même matière première, à savoir les roches de la région, et avec la technique de la pierre sèche, des réseaux de chemins pavés ont également été créés, des murs de soutènement de routes ont été construits, des projets de gestion de l'eau ont été réalisés, des enclos et des écuries ont été érigés. Des dizaines de constructions diverses plus modestes, telles que des ruches, des puits, des aires de battage et des auges, complètent l'ensemble des constructions en pierre sèche. Enfin, à Kythnos, des installations préindustrielles sont conservées, telles que des fours à chaux, des moulins à eau, des moulins à vent et des fours, dont certaines parties sont en pierre sèche.

Dry stone constructions

The first part of this communication refers to the drystone constructions of the Cycladic island of Kythnos, the humble and nowadays discredited human structures. Structures that, without exaggeration, contributed in the past to the survival of the island's inhabitants, as in every other place where nature offered stone as a raw material. The diverse dry-stone constructions found on Kythnos supported for centuries every productive activity on the island, both primary and secondary. Besides, the landscape of the island is characterized by these constructions, which are visible from a great distance. These include, first of all, the retaining walls, characteristic of the landscape of Kythnos,

which supported the terraces, the horizontal arable lands, necessary for the survival of the inhabitants, due to the geomorphology of the island's soil (Mazarakis, 2019: fig.6, 7, 11, 12 & Filippa-Touchais 1998: 362, fig.25). In areas with steep slopes there is extensive terracing, usually abandoned today and in rare cases still in use. Unfortunately, today the terraced landscape is currently occupied by seasonal accommodation, usually in the form of tourist complexes. It is noted that the absence of extensive terraced landscape in the central part of Kythnos is due to the gentle slopes of the terrain. Slate retaining walls are also a strong presence on the island, used to support the slopes of properties and road works. In many cases, the construction solutions are elaborated with excellent aesthetic results, especially when the walls are of great height (fig.1). However, in the past agricultural and livestock activities, in the areas with sloping lands, in addition to the creation of terraces, required the construction of various projects and buildings. The field survey leads to the identification of numerous drystone structures, covering the full range of the residents' needs. Dry stone walls also demarcated properties and paths, enclosed crops



Fig.1 - Ormated retaining walls



Fig.2 - Fences covered with slabs to prevent the passage of animals

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Fig.3 - Network of paths

Fig.4 - Dry-stone shelters (Kellia)

Fig.5 - Recesses, fireplaces and feeders

and pastures. With the same raw material, i.e. the rocks of the area, and with the technique of dry stone, networks of cobbled paths were also created, road retaining walls were built, water management projects were carried out, paddocks and stables were erected. Dozens of smaller diverse constructions, such as hives, wells, threshing floors and troughs, completed the set of drystone constructions. Finally, in Kythnos, pre-industrial facilities are preserved, such as lime kilns, water mills, windmills, and ovens, parts of which are made of dry stone. The fences found on the island are of great length and delineate passages and properties, pastures and crops. They extend sometimes in a straight line and sometimes in successive curves, producing images of particular aesthetics. They are the most prominent feature of the island's landscape, along with the terraces. The height of the fences varies and their form depends on the rock of each area. Where limestone rocks are used, they are generally simple in form (fig.1), while the use of shale rocks results in elaborate and ornate solutions. Equally elaborate in construction are fences with slabs as a covering to prevent the passage of animals (fig.2).

Of particular interest is the network of cobbled and paved paths which extend throughout the island (fig.3). Besides, the upward trend in hiking tourism is well known, and has been boosted by the publication of a guide to the paths and the professional activity of some local residents (Tutt-Filippa, 2015). Dry stone retaining walls supported these paths and sub-paths in the past, providing safe passage for people. Today they are used by hikers and nature lovers who enjoy the island's nature.

The management of torrents and streams for water management is also of interest. Dry stone walls delineate their beds, both to prevent erosion of the slopes and to control the direction of rainwater flow. Despite their rarity, animal pens for stalling animals in rock cavities are also interesting structures. The natural cavities are used as living quarters for the animals, with additional dry-stone structures to prevent their escape. A solution for the temporary accommodation of farmers and stockbreeders, close to their crops and livestock.

A large number of individual dry-stone shelters of permanent or seasonal use, the cells,

(kellia in Greek), survive on the island (fig.4). They are generally found in remote and inaccessible areas and less frequently near settlements. They were used by farmers during the periods when they were working on their crops or herds or used for animal stalls. The cells are of various sizes and are generally rectangular in shape (Mamaloukos, 2022 : 672 fig.3-8). They are constructed with the corbelling technique (Sigala, 2018) and are roofed with large slates placed in rows. The openings are usually made of stone lintels and rarely of wood. Inside the cells there are recesses, fireplaces for cooking and heating the interior, and feeders for the animals when they are used (fig.5).

Finally, in the countryside of Kythnos, numerous threshing floors can be found in areas where cereal crops were cultivated in the past. Different construction solutions are encountered, depending on the soil morphology, the available rocks and the date of construction. The boundaries of the threshing floors are sometimes defined by upright slates and sometimes by low dry-stone walls, while the threshing surface is usually paved. The island's windmills are also found in the same areas, usually built on raised ground, supported by dry stone retaining walls. The operation of a watermill in ruinous form is also noted. Dozens of smaller structures of various uses, such as hives, cellars, wells and troughs, fountains, washhouses, lime kilns and ovens, complete the assemblage of dry-stone structures.

Dating dry stone constructions

Dating dry stone constructions is, in general and not only in Kythnos, very difficult (Sigala forthcoming 1: 50-54, for Kythnos 52-53). What makes it difficult is, first of all, their diachronic use. Many of them were built centuries ago but were in use till the middle of the 20th century or are still in use today, as, for example, dry stone walls retaining terraces. In Kythnos the traditional way of life was gradually abandoned between 1970 and 1990, which led accordingly to the abandonment of the traditional rural dry-stone buildings (Mamaloukos, 2022: 679). What is more, there are still craftsmen on the island who know how to build dry stone structures and actually repair or build new retaining walls in the old technique in a way which makes it difficult to distinguish the old from the new ones. Secondly, systematic research on drystone constructions is at the moment scarce and not enough to help date them. One reason for this, at least in Greece, is that the humble drystone constructions are not considered worthy enough to be studied, since there are so many grander monuments coming from the "glorious Greek past" and the other historic periods (Sigala forthcoming1: 56). One extra reason that they are not considered worthy to be studied is exactly that they are not dated. They are humble and only vaguely old constructions (one guesses they are old, but one is not sure how old). Thus, they are not worthy to be studied. They are not studied; they cannot be dated. That creates a vicious circle.

Yet, dating them is vital for their protection. According to the Greek Archaeological Law (Law No. 4858/2021) buildings and objects that are dated before 1830 are considered ancient monuments and are automatically protected.

The tools and the methods archaeologists use to date monuments, movable and unmovable, are the following :

A. Building inscriptions, which, though, are very rarely found on humble drystone constructions.

B. Written sources, direct or indirect which are equally valuable and rare.

For example, Olfert Dapper, a traveller who visited Kythnos at the end of the 17th century, mentions the famous cheese of Kythnos (Filippa-Touchais, 1998:338), an indirect information that husbandry flourished on the island at that time. From this, one can assume that some of the drystone constructions used as stables could possibly date from that period (fig.6).

C. Excavation is, of course, one of the main archaeological dating tools, since stratigraphy gives a relative dating of the finds -obviously what is in the lower layers is older than what is in the upper layers- and coins and pottery help to date any other finds. At least in Greece, though, no excavations have been undertaken specially to help date drystone constructions. Accidentally, though, drystone constructions have been benefitted from excavations. On Kythnos, excavations helped date dry-stone walls in Vryokastro to the archaic period (Mazarakis Ainian, 2019: 40 fig. 50, 83 fig. 126), at Maistrallia to the Hellenistic period (Papangelopoulou, 2012: Second half of the 4th - early 3rd century BC) and in Agia Maria to the proto-byzantine period (Unpublished rescue excavation done by Dora Papangelopoulou).

D. Comparison with similar buildings or other findings or objects -in our case with similar drystone constructions- elsewhere (Papaefthychiou, 2018), e.g. comparison with the medieval huts "the Kyphes" of Chalke (Papaefthychiou, 2008; Papaefthychiou, 2010; Sigala, 2019) and the drystone buildings of Astypalea (Papaefthychiou 2005) and Kea (Karademas, 2020).

E. The typology of buildings or objects which gives a relative chronology (this is older or later than the other).

The most characteristic and interesting element of the countryside of the island of Kythnos, in general, is drystone walls. The type of drystone walls that immediately catches the visitor's attention, is the one built with small stones, in which large flat pieces of stones or slabs called "panagies" (fig.7), probably because somehow, they look like icons, -icons of Panagia, which is the Greek word for Virgin Mary- are intervened. Still, there are various types of drystone walls depending on :

A. The needs they cover. For example, drystone walls covering and protecting stream banks are different from the ones restraining terraces or demarcating paths or property lands (Papaefthychiou, 2023 : 73 fig.6 & Mamaloukos, 2022:671)

B. The kind of rock round about.

C. The kind of masonry, of the building technique, in drystone walls which cover exactly the same needs and are built with the same kind of rock. In this case, different masonry probably means different chronological periods.

The question that arises here is, if it is possible at all to say when exactly, or when about, each kind of drystone wall was built. In Chalke, a small island in the Dodecanese group of islands, meticulous study proved (Sigala, 2011: 191-201, 202, 204, 208, 210, 212) that drystone constructions in the countryside are more or less of the same age as the chapels near which they are found (Sigala, 2019). The same method, that is, dating dry-stone constructions on the basis of other surely dated buildings and findings, can be applied elsewhere, of course with great caution and taking various factors into account.

On Kythnos, the drystone walls found in Vryokastro (Mazarakis Ainian, 2019: 40 fig. 50, 83 fig.126) and Maistrallia, a rural installation in southwest Kythnos (information from the panels in the Archaeological Museum of Kythnos), an archaic and a hellenistic archaeological site respectively, are different from the ones found near medieval monuments. The ones at Vryokastro are made with roughly worked, big blocks of stone, in which very small stones are intertwined. The ones found near proto-byzantine and medieval monuments in general, are the type built of small stones embroidered with "panagies". Similar are found in Kea, Andros, Tenos (Papaefthychiou 2023, 76, 77 fig.8). In Kythnos they are found at Agia Maria (=Saint Marina) where a proto-byzantine settlement was excavated (rescue excavation done and information given by Dora Papangelopoulou), near Taxiarches at Velidi, most probably a middle-byzantine church (Sigala, forthcoming 2, 6), in the area of Kastro tis Orias, a 13th c. castle inhabited till around 1600 (Veloudaki, 2020: 173-175) and in the area of Panagia at Theotokos, a late-medieval chapel (Sigala, forthcoming 2). All these dry-stone walls are not exactly the same, but are quite similar and can be compared with others in neighbouring islands, which are also found near byzantine chapels, like, for ex., Palioklisia at Tenos (Danousis, 2010: 51). At the same time they differ from others found near 17th century monuments, like Profitis Elias (Sigala, forthcoming 2).

Drystone buildings, used for seasonal residence and as stables, called, as it was mentioned above, kellia, are scattered everywhere in the countryside of the island (Mamaloukos, 2022: 671). According to a local, kellia used for residence are called kalyvares

Although it is difficult to date them, in most cases it is easy to tell vaguely which is older than the other when two or more are close to each other. In a few cases it is possible to date cells with the help of the chapels in the same area, following the example of Chalke, since chapels served the religious needs of the farmers and shepherds

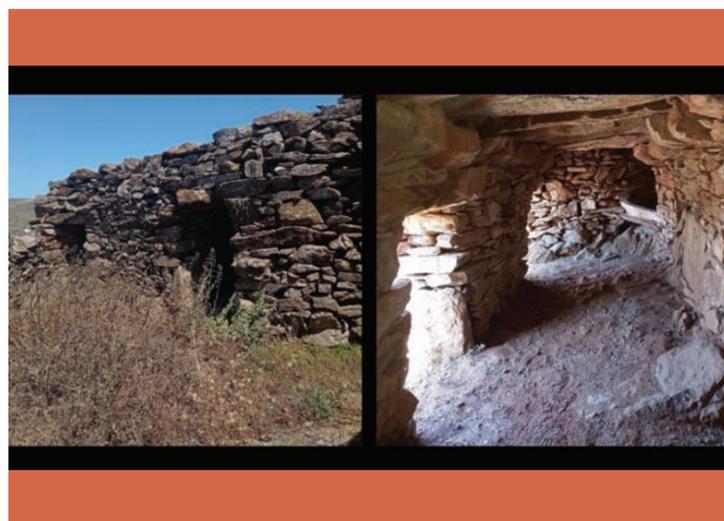


Fig.6 - Kelli (-stable), ca 1700



Fig.7 - Drystone walls embroidered with "panagies"

using the terraces and buildings in the area and they could have been built at the same or around the same period.

Thus, since many of the chapels in the countryside are dated to the 17th and 18th centuries (Sigala, forthcoming 2, 20), the kellia near them could be dated to the same centuries accordingly.

There is one case, the area around Agios Ioannis tis Julis, where four different types of kellia are found and which can be put in a chronological order. One of them, let's call it kelli A, quite near the remnants of a Hellenistic tower, is almost oval in shape, built in the corbelling technique (Sigala, 2018) roofed in the inside with oblong stones which are covered on the outside with earth. It is 7.85m long and 3m wide (fig.8). Its opening is only 1m highX0.90m wide. Comparison with the kyphes, the stone huts of Chalke (Sigala, 2019: 26 fig.2, 30-31), makes it possible to date it around 1500, which makes it the oldest known kelli on Kythnos.

Around 50m NW of kelli A, is the most recent kelli in the area, let's call it kelli D. It is rectangular, its corners are a bit curved on the outside, it is slightly corbelled and roofed both with stone and wooden beams. It has two different phases, the oldest being its northern part which is a bit lower than the southern, newer one. The curved corners and slight corbelling technique give an early date, around 1800 for phase B, which could date the first phase, A, even earlier in the 18th century. Between these two dates, 1500 and 1800 the other two drystone constructions can be put, kelli B and C, a residential kelli and a stable, which accordingly can be dated around 1700.

The project of dating dry-stone constructions of Kythnos is still at the beginning. Yet, even from this very beginning it becomes clear that the majority of them are archaeological monuments, according to the Greek archaeological Law, since they have been standing there at least for more than a century, if not for longer.

Conclusions: In summary and given the value of the drystone structures, we are led to the effortless drawing of conclusions, especially for the island of Kythnos :

1.The various scattered dry-stone structures and terraces need protection as bearers of historical, folklore and cultural memory for the island. Besides, they are unique ornaments of the countryside as a result of particularly arduous activities for the survival of the inhabitants in the past.



Fig.8 - Kelli A in the area of Agios Ioannis tis Julis and "Kyphoulka" on Chalke (Zyos)

2. The island's terraced landscape requires conservation and protection in order to prevent soil erosion and the consequent desertification of entire areas. At the same time, its ecological role in biodiversity will be preserved.

3. Given the alternative form of hiking tourism on the island, many of the dry-stone buildings have a utilitarian role and it is considered important that they are preserved in their original form.

Comparing the interest elsewhere in dry-stone structures - not only in the interdisciplinary research of the past and present, but also in the preservation of the newer dry-stone structures in the future - with the misunderstanding and devaluation they receive in Greece, there is an urgent need to raise the awareness of younger researchers of various disciplines and especially of the inhabitants of the areas with dry-stone structures.

In conclusion, it is stressed that this need is also intertwined with the future of the island of Kythnos and climate change, to the extent that the most common and simplest drystone structures, the retaining walls of the terraces, can prove to be a lifesaver in preventing soil erosion and the consequent desertification of cultivated surfaces. Besides, the island's special features, including the drystone structures, are development resources for the future as attractive elements for visitors. And especially for those involved in hiking tourism on the island.

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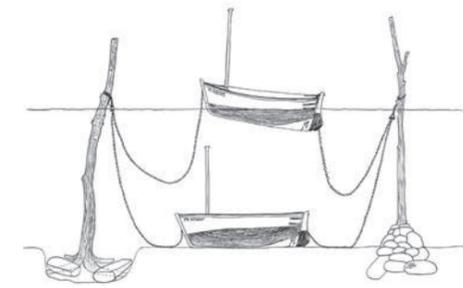
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Justement pas si sèche, la pierre sèche en Bretagne

Less emblematic than it is in other landscapes, dry stone is nevertheless intimately inscribed in Breton landscapes, both rural and coastal. Like everywhere else, it is fading, due to lack of maintenance, lack of hands to mend it, due to ignorance of its qualities. In recent years, however, it has begun to build an identity for itself, and above all to mobilize energies and promoters convinced of the answers it can provide, especially in view of today's challenges (rising ocean levels, coastal erosion, protection of biodiversity...). At the crossroads of several of its skills, this is the sense of the dynamic carried by the Brittany Region to recognize its interest, ecological relevance, heritage richness and diversity of its implementation: sea walls, coastal walls, dykes and slipways, quays, oyster farming grounds, fisheries, seaweed installations, cabins and shelters, dykes of tidal mill retention basins, anchorages, fords, roads, etc. The Inventory is a perfect tool for conducting this study on a regional scale, undertaking concrete actions to raise awareness, restore, and support stakeholders (PNR, municipalities, associations, craftsmen, individuals, etc.). This dynamic can only work with their support, in a fully participatory approach, and by multiplying awareness-raising supports: conferences, brochures, encouragement to include locally carried inventories in planning documents and other strategic documents, digital publications, participation in training... If these first steps are essential, it also remains essential to move forward with concrete actions. For example, all along the Breton coastline, dictated by the topography of the coasts and estuaries, kilometers of stone piles set at the height of the highest waters slow down the erosion that comes from below, protecting the land from the churning of the tides. Like all coastal structures, their degradation is accelerating. Faced with the rise of the oceans, the challenge today is to convince people of the merits of dry stone in the face of "always harder, always bigger". This is the meaning of the actions that are taking shape for the coming months, which can be extended to all the specificities of dry stone in coastal environments (last paleo-ports, remains of fisheries, etc.) and extended by an approach of recognition (protection?) in favor of the davits, astonishing constructions suspended above the void to "rectify" the cliffs and raise the seaweed... The proximity to Ireland and the creation of an inter-Celtic network around heritage finally invites strengthened exchanges and partnerships, undoubtedly in the form of volunteer projects or exchanges of young professionals to be put in place for the coming years.



Plus de 600 vestiges de pièges à poissons et pêcheries ont été recensés le long des côtes bretonnes.



Dessin de Jean-Yves Guillouët



Alignement de 43 pieux de mouillage et digue formant brise-houle au pied des falaises de Gwin Zegal à Plouha (Côtes d'Armor)

D'avantage qu'à la pluviométrie parfois moquée (mais de plus en plus jalosée) de la Bretagne, l'intitulé de cet article renvoie à l'adaptation des constructions de pierre sèches aux interfaces terre-mer, et notamment à l'alternance des marées.

La péninsule armoricaine dispose de plus de 3 000 km de côtes, avec une très grande variété de littoraux allant des côtes plates, aux falaises en passant par les dunes, découpées de rias, abers, et estuaires, ponctuée d'îles et îlots... Au nord, les côtes de la Manche sont parmi celles qui sont sujettes aux plus fortes marées de la planète, avec des marnages (différence de niveau entre marée basse et marée haute) allant jusqu'à 14 m dans la baie de Saint-Malo et du Mont-Saint-Michel.

En laissant l'eau entrer, puis s'écouler lorsque la mer se retire, sans avoir le temps de sécher avant la prochaine marée haute, la porosité des maçonneries de pierre sèche offre une réponse idéale à ces



Moulin à marée de Mordreuc, Pleudihen-sur-Rance (Ille-et-Vilaine). La digue qui serpente et que l'on repère grâce aux pieux vient fermer le bassin de retenue désormais envasé. Le bâtiment du moulin que l'on identifie au fond, dans sa verticalité, date de la toute fin du XIX^e siècle. La digue de pierre sèche est revanche bien plus ancienne puisqu'un moulin est attesté à cet emplacement dès le XVI^e siècle.

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Goémon, Paléo-port,
Intégration dans le paysage.

alternances et se décline pour de multiples usages d'aménagement du littoral dont certains sont millénaires. Les transformations des littoraux induits par les multiples enjeux d'usages et les évolutions environnementales les fragilisent aujourd'hui dangereusement.

De multiples usages de la pierre sèche en zones d'estran

Les pêcheries sont certainement les formes les plus anciennes d'aménagement côtier. Construites sur l'estran, elles consistent en une chambre qui se remplit à marée haute, se vide à marée basse en retenant les poissons. Seule l'archéologie permet de dater ces installations dont les formes se répètent depuis le néolithique. Très fragiles, elles subissent aujourd'hui les modifications des courants, notamment sur les côtes sableuses.

Le mouillage sur pieu est également une forme ancienne d'aménagement. Il n'en subsiste que deux sites : les ports de Gwyn Zegal à



Plateforme des fours à chaux de Mordreuc, Pleudihen-sur-Rance (Ille-et-Vilaine). Parfaitement rectiligne sur une très grande longueur, ce quai servait au chargement de la chaux produite dans les fours situés quelques mètres en arrière. Ils devaient donc résister au poids de charrettes avec de lourdes charges et permettre l'appontement de gabares et autres bateaux de charge avec des différences de niveaux de plusieurs mètres à chaque marée.

Plouha (22) et du Mazou à Porpoder (29), installés chacun dans des environnements très différents. Des troncs de chêne ou d'orme dont une partie du système racinaire est conservée sont positionnés dans des fosses creusées à marée basse, et stabilisés par des massifs montés en pierre sèche. Les bateaux, attachés aux pieux, se posent sur le sable à marée basse et retrouvent leur flottaison avec la marée montante, protégés par un épi brise-lame également en pierre sèche.



Muret périphérique du bassin de retenue du moulin à marée de Bili Gwen, Troguery (Côtes d'Armor). L'interpénétration des espaces terrestre et aquatique induit une intégration volontaire et organisée du végétal dans les maçonneries. Il est ainsi fréquent de trouver des arbres en tête de mur qui participent pleinement à la solidité du mur. Ils sont pour cela plantés avec une inclinaison pour déporter leur système racinaire vers le champ, à l'opposé du parement.

La puissance des marées et la topographie très découpée des côtes a permis de voir se multiplier les moulins à marée. L'estuaire de la Rance, entre Dinard et Saint-Malo, en comptait la plus grande concentration au monde. Le moulin est construit sur une digue fermant un bassin de retenue qui se remplit à marée haute. A marée descendante, le flux actionne la roue du moulin. A la différence du vent et du débit des rivières, l'énergie marémotrice présente l'avantage d'être régulière et prévisible. L'accessibilité par bateau du moulin facilite également l'approvisionnement en grain et l'expédition de la farine. Les digues sont souvent fixées dans la vase par des systèmes de pieux et maçonnées en pierre sèche formant chaussée.



Pleudihen-sur-Rance (Ille-et-Vilaine). Depuis la construction du barrage et de l'usine marémotrice de la Rance (1960), les hauteurs d'eau dans l'estuaire ne varient plus en fonction de la marée mais de la gestion assurée par EDF. L'utilisation de mortier pour la reprise de ce quai a accéléré sa dégradation en créant un « point dur ». En milieu littoral, l'érosion vient principalement par le bas.

La pierre sèche est également utilisée pour l'aménagement de murets de protection des terres contre les assauts de la mer. Leur dimensionnement varie en fonction des usages et de la topographie: simples murets-talus bas pour protéger les terres agricoles en fond de baie, murs réguliers incluant lorsque nécessaire des accès facilités à l'eau (escaliers, cales, quais...) ou de supporter des charges importantes (terre-pleins ostréicoles...). Un inventaire exhaustif de ces perrés le long de l'estuaire de la Rance indique qu'ils occupent plus de 50% de l'interface terre-fleuve.

Selon les endroits du littoral, les murets littoraux déploient des mises en œuvre différenciées, s'accrochant aux rochers, utilisant ici des galets, se confondant là avec des digues de polder et se

Perré de la baie de la Passagère, Saint-Malo (Ille-et-Vilaine). Face à face d'un cimetière de bateau et d'un muret littoral oublié, abandonné à une végétation non contrôlée.

noyant dans des marais littoraux ... Leurs lignes suivent la topographie des côtes et les accidents géologiques. Dans les endroits les plus exposés, leurs courbes permettent aussi de mieux résister à la houle. Ces éléments discrets et fragiles ont un rôle majeur dans la protection du littoral et de la biodiversité. Ils sont néanmoins fragilisés, peu identifiés et très inégalement pris en compte dans la gestion côtière.

Outre les paléo-ports mentionnés plus haut, la pierre sèche est également très employée pour les aménagements portuaires. Un grand nombre de plans d'ingénieurs (XVIII^e, XIX^e siècles) mentionnent le terme pour désigner des maçonneries sans mortier, autant semble-t-il en pierre taillées montées à joints vifs que de moëllons. Le fruit donné permet une meilleure résistance à la houle et, facilite également les appontements à des niveaux d'eaux différents. La généralisation de ciments à prise rapide à partir de la seconde moitié du XIX^e siècle annonce celles de maçonneries « en dur » qui ont ancré la conviction que face à la mer, le « en dur » est la solution la plus sécurisante. La fréquence et la puissance croissantes des tempêtes ont démontré le contraire ces derniers hivers. Les murs littoraux qui subsistent souffrent à la fois de cette idée persistante et de la carence en savoir-faire murailleur.

Pierre sèche et goémon

Bien que plus éloignés stricto sensu des interfaces terre-mer, les aménagements liés à l'activité goémonnière méritent également d'intégrer ce panorama des usages littoraux de la pierre sèche. Ressource essentielle, le goémon est utilisé depuis des siècles comme engrais, parfois comme aliment pour le bétail, comme paille ou matelas, ou pour remplacer le bois de chauffage trop rare et trop coûteux en zone littorale. On le ramasse sur les plages, accessibles avec des brouettes ou des



charrettes. Le développement de l'industrie verrière, gourmande en soude, à partir du XVII^e siècle, puis au XIX^e siècle des usages médicaux et photographiques consommateurs d'iode font exploser sa récolte notamment sur les côtes finistériennes qui en sont riches, pour produire des cendres d'algues. Sur tout le littoral se multiplient des fours aménagés à même le sol, et des usines à soude se créent dans les ports. L'apport financier aux économies domestiques est tel qu'on élabore des dispositifs permettant d'en récolter le plus possible, y compris lorsque l'accès direct à la grève est compliqué. On aménage les falaises en les rectifiant pour caler dans des anfractuosités et accrocher au-dessus du vide des plateformes en pierre sèche, au-dessus desquelles on fixe des treuils grâce auxquels on remonte cette manne financière.

La construction de ces dispositifs tout comme leur fonctionnement usant de poulies, cordes et cabestans sont empreints de pratiques maritimes. Avec la même agilité qu'on grimpeait dans les matures, on descendait sur l'estran pour en remonter les algues comme on avait monté ces constructions, suspendu au-dessus du vide. Le terme breton « davied » pour les désigner est lui-même tiré du vocabulaire de la marine (le davier désigne l'élément permettant de relever l'ancre à l'avant des bateaux). L'érosion des côtes et des falaises entraîne aujourd'hui la disparition de nombre de ces installations. Malgré le resserrement dans l'espace et dans le temps de cette pratique, on note des différences d'appellations, des variantes dans les systèmes de treuils et sans doute également dans les modes d'exploitation. La concentration la plus importante de plateformes se situe dans le Léon, notamment sur le site des Rospects à Plougonvelin (pointe Saint-Mathieu, Finistère nord). Des pierres plates percées d'un trou oblong sont intégrées à l'horizontal en encorbellement au-dessus du vide. Y était insérée une pièce courbe, généralement en orme, dans laquelle s'insérait un réa maintenu par un axe en bois ou en métal. Le panier arrivé contre la fourche, fait basculer celle-ci vers l'arrière pour faciliter la récupération de la récolte. Le gneiss qui affleure à Ploumoguer, peu apte au délitement, explique sans doute une variante avec des poutres de bois (aujourd'hui disparues) en place de ces pierres horizontales. Dans le Cap Sizun (Finistère sud), on retrouve plus souvent des systèmes de câbles tendus entre la grève et un mât – souvent un arbre mort ébranché dont le système racinaire est intégré dans un massif maçonné. Des pierres cette fois dressées, entaillées d'une encoche, permettaient de diriger le câble. Ce dispositif permet de décaler le mât légèrement en retrait du bord de la falaise, dans un espace plus stable et sécurisé. L'appellation vir a vod (vireur de grève) renvoie explicitement aux norias de paniers de goémon remontées depuis la grève. En Cornouaille, à Clohars-Carnoët, on repère encore des endroits où la falaise était taillée pour remonter la charge de goémon fixée à un patin en bois, et tirée grâce à un « kroug » (« potence » en breton). Ces pratiques géographiquement différenciées s'expliquent pour partie par la topographie, la géologie, les matériaux disponibles et la nécessité de trouver des solutions pour s'approcher au plus près de l'aplomb.

Le déclin de l'activité a débuté dans les années 1930. Les risques et efforts consentis pour leur aménagement témoignent des enjeux économiques que l'activité représentait. Du fait de leur totale intégration paysagère, ces œuvres d'équilibristes passent néanmoins le plus souvent inaperçues en dépit de la très forte fréquentation

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Vestiges de « vir a vod » à proximité du Castel, Primelin (Finistère). Les maçonneries de pierre sèche prolongent la verticalité de la falaise. Les pierres dressées pour guider le câble sont encore présentes.



Les brûleuses de varech, Georges Clairin (1843-1919). Huile sur toile (132 x 240 cm), présenté au Salon des artistes de Paris en 1882. Musée d'art et d'histoire de Saint-Brieuc. Gravure du catalogue du Salon des artistes, Paris 1882

du sentier littoral. Ce camouflage induit par la mise en œuvre de la pierre même de la falaise – déjà utilisé par les nombreuses cabanes de douaniers en pierre sèche qui ponctuaient aussi le sentier littoral – a également été mis à profit par nombre de blockhaus qui ont profité aussi de ces installations pour se dissimuler, contribuant aussi à leur fragilisation.

Même discrétion dans les sources : une enquête sur la pauvreté dans le diocèse de Saint-Pol-de-Léon (Finistère) indique en 1774 que le ramassage du goémon est une pratique courante mais qu'elle est rendue compliquée par la topographie des lieux. Un croquis de 1845 laisse deviner quelques dispositifs de lavage à la Pointe Saint-Mathieu. A la même époque, quelques ouvrages en décrivent des fonctionnements plutôt privatifs en Finistère nord alors qu'ils pouvaient être communautaires dans le sud, chaque famille possédant sa propre poulie amovible et une aire de récolte attribuée au pied des falaises.

Alors que la récolte du goémon sur les plages et son brûlage est un thème récurrent de la peinture régionale, appuyant la dureté du labeur et l'emprise des éléments, peu de tableaux – hormis celui de Georges Clairin (1882, musée d'Histoire de Saint-Brieuc, Côtes-d'Armor) – renvoient aux daviers. S'il permet de deviner la répartition sexuée des tâches (les hommes, non visibles, en bas des falaises et les femmes en haut, il fantasmait le paysage. La représentation très explicite du fonctionnement du treuil semble davantage correspondre aux pratiques du Finistère nord. Et le peintre n'a visiblement ni observé, ni compris les aménagements de pierre sèche dont il méconnaissait autant les fonctionnalités (quel serait l'intérêt d'un mur

ainsi aménagé parallèle à la falaise ?) que les règles de montage ! Il est d'ailleurs amusant de constater que le dessin qu'il livre pour le catalogue du Salon des artistes de 1882 offre une représentation différente des maçonneries, mais toujours peu réaliste.

Ce rapide panorama des usages de la pierre sèche en milieu littoral confirme la pertinence de la technique pour répondre aux enjeux d'aménagement et de vie sur le littoral, a fortiori lorsqu'il est impacté par le phénomène des marées. L'empirisme et l'ingéniosité des dispositifs défie les solutions génériques proposées aujourd'hui. Leur discrétion accentue néanmoins leur vulnérabilité face aux mutations d'usages des espaces côtiers, à la multiplication des aménagements, aux modifications des courants, au recul du trait de côte du à la montée des océans et aux changements climatiques...

L'enjeu est aujourd'hui de poursuivre l'effort d'inventaire, de documentation de ces éléments et d'intégration dans des stratégies d'aménagements. Il est aussi de reconstruire une culture favorable à ces mises en œuvre en démontrant ses multiples intérêts. Cette dynamique s'appuie également sur la structuration d'une filière professionnelle qualitative en mesure de prendre en charge la spécificité de ces chantiers.

Une entreprise de longue haleine qui commence seulement à émerger, portée aujourd'hui par quelques passionnés militants encore bien isolés, mais dont l'élan reçoit – pour chaque initiative – un accueil très encourageant. Votre accueil à ce XVIII^e Congrès international de la pierre sèche nous conforte encore dans cette dynamique et nous oblige.

Pierre Sèche en Normandie : Une technique ancestrale à redécouvrir

Dry Stone in Normandy: an ancestral technique to rediscover

For the past 40 years, in my profession as a landscaper, I've favored the use of local natural stone, especially Beauchamps stone, a schistose sandstone extracted from the Rocher Blin quarry at Mesnil-Villeman (50), as an alternative to concrete and the land artificialization. I've always defended the living in the garden, against trends towards artificialization and soil sealing.

Since 2015, in order to convince my landscaping colleagues of the dual relevance of natural stone and the dry stone technique in landscaping, I took steps to reintroduce this technique to our craft in Normandy.

I've invited a number of French wall builders to come to Normandy to produce reference works, and to train regional players. It was a way rediscovering an ancestral heritage through the creation of relevant works in our region.

My company now has recruited its first team of wallers and will soon have a second. Over the past two years, we have developed many technical and scientific collaborations.



Fig. 1 - Situation géographique

Situé entre le Mont-Saint-Michel (Manche, 50) et la Maison de la Nature et de la Pierre Sèche (Calvados, 14), le gisement du Rocher Blin au Mesnil-Villeman (Manche, 50) abrite la pierre de Beauchamps : une alternative de bon sens aux talus bâchés et aux murs de béton.

Depuis 50 ans, Paysages Conseil, l'entreprise de paysage fondée par Eric Leboucher au Bénv-Bocage (Calvados, 14) a fait le choix d'un enracinement rural, dans le bocage normand.



Fig. 3 - Au XX^e s., des soutènements en béton et des talus bâchés imperméabilisants



Fig. 2 - Avant, le bon sens du patrimoine bâti : une restanque normande

Elle crée des jardins naturels et pratique la pose de la pierre de Beauchamps. Ce matériau de construction et de décoration pluricentenaire, est d'une qualité exceptionnelle, reconnue en 2022 par les géologues des universités de Caen et de Rennes, par le laboratoire national officiel du CTMNC (www.ctmnc.polaris-creations.fr/home/pierre-naturelle) comme par les ingénieurs des projets national Dolmen <https://pndolmen.fr> et inter-régional Maillons <https://arpenormandie.org/nos-projets/ami-cpier-maillons> qui ont estampillé Le rocher Blin, « gisement vertueux » (www.pierre-de-beauchamps.fr).

C'est à partir de 2015 que notre entreprise a ajouté à son répertoire la technique de la pierre sèche qui sublime la pierre de Beauchamps, autant en élévations qu'en sols en pierre, par des murs de soutènements, des doubles-parements, des emmarchements, des pas japonais, des bassins naturels et de la pierre décorative.

1. Qui sommes-nous ?

Au fil des années, l'entreprise que j'ai créée avec mon épouse a généré un véritable Pôle d'activités fort aujourd'hui de 4 entreprises, 2 centres de formation professionnelle, 1 association d'éducation



Fig. 4 - Aujourd'hui et demain, des soutènements, écosystèmes drainants en pierre de Beauchamps et autres roches locales de qualité constructive

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Création paysagère,
Création d'emplois salariés,
Développement économique.

à l'environnement, auxquelles s'ajoute 1 réseau d'entreprises, associations et collectivités locales partenaires qui s'accroît d'année en année.

Des Paysagistes engagés du local au national
Membre de l'UNEP qui compte 3000 entreprises pour environ 70000 salariés ainsi que du réseau Alliance Paysage, réseau d'entreprises indépendantes, réparties sur toute la France représentant 3 000 salariés, Pierre de Beauchamps est aussi partenaire du Salon International Paysalia à Lyon, depuis 2013. Cet événement rassemble tous les deux ans les professionnels du paysage en France.

J'ai aussi adhéré à la fédération française des professionnels de la pierre sèche (FFPPS), dont je suis administrateur national, mandaté par l'assemblée générale de 2022 pour tisser des liens avec le monde professionnel du paysage (Boudassou Leboucher 2021), ce que je m'emploie à réaliser sans répit depuis 10 ans, en collaboration avec Yanick LASICA qui, depuis 2021, a progressivement rejoint notre équipe (Lasica, Leboucher, nd).

Des protecteurs d'un gisement

Afin d'empêcher sa fermeture définitive, nous avons, il y a 14 ans, sauvé le gisement vertueux d'une pierre de qualité exceptionnelle, la pierre de Beauchamps, un des fleurons de la très riche géologie du nord du Massif armoricain. Ainsi, nous sommes partenaires du Géoparc Mondial de l'UNESCO porté par le PNR Normandie Maine. Au contact des muraillers, nous avons affiné la connaissance, la maîtrise et le tri de notre pierre, améliorant ainsi fortement la qualité de l'approvisionnement des chantiers d'ouvrages en pierre sèche (Fig.5).

Des dirigeants de la formation professionnelle
Que ce soit au travers de notre Centre Qualiopi ou par notre engagement de plusieurs décennies dans le mouvement des MFR, avec en point d'orgue la présidence de la MFR du Paysage à Cerisy-Belle-Etoile (Orne, 61), nous sommes très investis dans la formation des jeunes, pilier fondamental de nos valeurs comme de l'avenir des métiers du paysage.

Fig. 5 - Gisement vertueux du Rocher Blin



Fig. 6 - Le chantier-école, socle de la formation professionnelle

Dans les MFR nous accompagnons les apprenants à réussir autrement, par l'alternance (entre des semaines en centre de formation et des semaines de stages) et la pédagogie Freinet (Fig.6).

Des dirigeants de 4 entreprises

Avec mes associés, nous avons successivement créé plusieurs entreprises au gré du développement et de la diversification de nos activités.

Une pépinière ornementale, un gisement vertueux, une entreprise de constructions paysagères en pierre sèche qui porte l'activité de centre Qualiopi précité de formation professionnelle de murailler. Une entreprise de paysage transmise à mon fils Emeric Leboucher.

2. Ce que nous faisons :

2.1. Redécouvrir le patrimoine et inscrire la technique dans l'excellence de la modernité

Nous oeuvrons pour le renouveau de la Pierre Sèche en Normandie en nous appuyant sur le patrimoine, qu'il soit bâti, immatériel ou environnemental, pour inscrire la pierre sèche dans l'excellence de la modernité.

De 1980 à 1997, nous avons sensibilisé à la réalisation de murs terre-pierre mais c'est en 2015 que nous avons pleinement pris conscience de cet art de bâtir.

2018 marque pour nous la découverte des journées de la Pierre Sèche en Côte d'Emeraude et Val de Rance (Bretagne).

De 2019 à aujourd'hui, nous participons à la veille et à la sensibilisation sur la Pierre Sèche en Normandie. En 2021, une nouvelle étape a été franchie pour communiquer et véhiculer l'information auprès des enfants et du grand public avec la création de la Maison de la Nature et de la Pierre Sèche, www.assomnps.com.

2.2. Créer une filière Pierre sèche en Normandie et autour

Nous créons et consolidons une filière Pierre Sèche en Normandie (Anonyme 2021).

D'une part en redéployant des gisements de pierres remarquables dans la région et en construisant des ouvrages de référence. Et

d'autre part en formant des salariés paysagistes, des apprentis et des stagiaires (privés ou de collectivités).

Nous réseautons du côté professionnel de sorte à développer le marché et générer un véritable éco-système au cœur du système d'acteurs national.

3. Avec qui ?



Fig. 7 - Le réseau de nos partenaires, véritable éco-système des acteurs du paysage

4. Nos objectifs pour demain

Après dix années d'investissement matériel et immatériel pour développer le métier de murailler du paysage à partir de la Normandie, notre feuille de route est aujourd'hui, clairement tracée :

Développer nos projets dans l'économie de marché

Forts actuellement d'une équipe de muraillers salariés, nous embaucherons une seconde puis une troisième, au gré du développement du marché des ouvrages. Ainsi nous sommes acteurs de l'ouverture d'un marché de l'emploi de murailler du paysage comme de celui des ouvrages en pierre sèche dans les jardins, les espaces verts et le grand paysage.

	Heures de taille des pierres	Espaces/joints entre les pierres	Nombre d'heures de travail	Prix
Mur paysan	- - - Pas ou très peu	+ + Tailles et formes variées	+ +	- -
Mur de biodiversité	+ Le minimum pour assurer calage et solidité	+ + Tailles et formes variées	+ + +	+ +
Mur signature	+ + + La majorité de pierres taillées	- - - Espaces réduits en parement	+ + + +	+ + + +

Tableau comparatif des trois niveaux de finitions

Communiquer sur les enjeux climatiques, environnementaux, sociaux et culturels

Les valeurs que nous portons (Beaudouin 2023) nous amènent à communiquer et agir sur ces enjeux contemporains essentiels. Notre crédo est simple : « Sauvons nos jardins, sauvons nos paysages ! ».

Protéger nos paysages et favoriser la biodiversité

Ces objectifs finaux sous-tendent toutes nos actions.

Former au métier de murailler

Notre centre de formation Pierre de Beauchamps, certifié Qualiopi, offre une gamme de modules courts. La Maison familiale rurale de Cerisy-Belle-Etoile propose des cycles longs de formations diplômantes en apprentissage, en formation initiale et pour adultes, intégrant différents niveaux de perfectionnement en pierre sèche.

Notre diagnostic des besoins en formation est sans appel : en France, il y a de la place pour, au moins, un murailler par commune. Au travail !

Créer des ouvrages adaptés à chaque client privé ou public

Nous proposons à nos clients, selon leur sensibilité, leur projet et leur budget, trois styles d'ouvrage résumés dans le tableau ci-dessous. D'un choix à l'autre, trois critères techniques varient :

1. Le choix de tailler, pas du tout, peu ou beaucoup les pierres ;
2. La dimension et la forme données aux joints entre les pierres ;
3. Le nombre d'heures de travail en conséquence, élément-clé du budget (le prix d'un ouvrage en pierre sèche se répartit entre environ 80% de main d'œuvre et 20% de fourniture en pierre + matériel) (Fig.8).

5. Vous voulez approfondir ?

Suivez - nous : <https://www.facebook.com/pierredebeauchamps.fr/>
Lorsque vous passerez en Normandie, venez nous rencontrer, visiter nos réalisations, vous former ou collaborer !

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Fig. 8 - S'adapter à chaque client, une première approche par trois niveaux de finition

Roches volcaniques auvergnates : sources et ressources, matière à projet(s)

Auvergne volcanic rocks : sources and resources, project(s)

The aim of this action research project is to (re)define and (re)learn about Auvergne's volcanic rocks. Volcanic rock has played a key role in the identity of the Massif Central, particularly in the construction of towns and cities since the 15th century, and its use has accelerated with industrial growth. The distinctive colour of this stone gives it a visual identity in the urban environment surrounding the Chaîne des Puys, and today it is one of the components of Auvergne's built heritage, forming an integral part of the landscape because it is at its heart. Could understanding the qualities of these materials (refractory stone; resistant to both gelifraction and acids; rare pyroscopic resistance) as local, low-carbon materials help to promote construction and/or restoration that can be described as geosourced? In the age of the Anthropocene and the global debate on environmental issues and energy transitions, we need to look at these local materials as resources, and in particular through their use (or re-use) in dry stone walls.

Cette recherche en action a pour ambition de (re)définir et apprendre à (re)connaître les roches volcaniques auvergnates. Participant à l'identité du territoire massif central, par la construction des villes depuis le XV^e siècle notamment, leur exploitation s'est accélérée avec la croissance industrielle. Si cette pierre constitue, par sa couleur si particulière, une identité visuelle de l'urbanité entourant la chaîne des Puys, elle est aujourd'hui l'une des composantes du patrimoine bâti auvergnat et fait corps avec le paysage, parce qu'elle en est au/le cœur.

Connaître les qualités de ces matériaux (pierres réfractaires ; résistantes à la gélifraction comme aux acides ; rare résistance pyroscopique) en tant que matériau local à faible émission carbone pourrait-il permettre de valoriser des constructions et/ou restaurations que l'on peut qualifier de géosourcées ?

A l'heure de l'anthropocène et des questionnements mondiaux sur les enjeux environnementaux et transitions énergétiques, il convient d'interroger ces matériaux locaux en tant que ressources, et notamment par leur emploi (ou réemploi) dans des murs de pierre sèche.

Les laves auvergnates ont participé à l'identité du territoire massif central, par la construction des villes depuis le XV^e siècle. Leurs exploitations se sont accélérées avec la croissance industrielle quand leur présence s'est développée et leurs utilisations déclinées sur le territoire français. Si ces roches volcaniques constituent, par leur couleur singulière, une identité visuelle du bâti entourant la chaîne des Puys, elle est aujourd'hui l'une des composantes du patrimoine auvergnat et fait corps avec le paysage, parce qu'elle en est au/le cœur.

Ces roches ne sont pas seulement présentes en zones urbaines du massif central, elles se trouvent régulièrement utilisées dans des déclinaisons différentes, notamment en zones rurales. Certaines catégories de roches volcaniques (la trachyandésite notamment) ont vu leurs emplois se décliner en pierre de taille, servant à la construction ou aux dallages. Les déchets de coupe ou d'extraction ont eux, longtemps permis l'édification de murs en moellons, la réalisation de murs de soutènement ou de terrasses et ce, le plus souvent au service des pratiques agricoles.

Différents métiers sont ainsi liés à cette filière pierre, associée aux roches volcaniques auvergnates et installée au cœur du massif central ; différentes maîtrises en lien étroit avec chaque roche en découlent. Spécifiques au territoire, les carriers sont porteurs d'un savoir-faire indispensable et important. Si les matériaux sont locaux, les techniques le sont également et s'adaptent de fait aux qualités et spécificités de chaque roche.

Le XIX^e siècle, âge d'or de l'activité des carrières, laisse plusieurs fonds d'archives témoignant d'exploitations actives sur le territoire auvergnat. Les propriétaires de carrières – également propriétaires de l'entreprise en exploitant la matière première – sont à l'origine d'une large diffusion de ces roches volcaniques, qu'ils nommaient par des termes génériques. Laves d'Auvergne, produits volcaniques

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Fig.2 - Gabions, terrain privé, commune de Saint-Genès-Champanelle (Puy-de-Dôme)

ou domite (Ledru, 1828 ; Legay-Chevalier, 1891 ; Roger, 1891) -ci employé comme un nom féminin, là utilisé comme nom masculin-, témoignent d'une faible connaissance de la composition pétrochimique des roches alors exploitées au XIX^e siècle (Brosson, 1828). [Fig.1] Les chercheurs et volcanologues les ont depuis répertoriées géographiquement et qualifiées précisément : trachyte ; trachyandésite ; trachybasalte ou encore basalte. L'emploi des termes génériques tels que « laves d'Auvergne » ou « domites » ne nous permet pas de pouvoir systématiquement identifier les carrières d'extraction ni les origines précises des pierres utilisées au XIX^e siècle, lorsqu'un site géographique précis n'y est pas associé. Un flou certain persiste donc sur les déclinaisons des matériaux employés au XIX^e siècle, notamment face à la grande diversité des roches présentes au sein du massif central.

Les roches volcaniques sont nombreuses et présentes en quantité dans les sols du massif central. Alors comment valoriser et employer à bon escient ces différents matériaux, et plus particulièrement celles issues de réemploi ou de déchets de coupe ?

Depuis l'extraction en carrières, quelles solutions peuvent être réfléchies afin d'une part, de minimiser déchets de coupe et prévoir un emploi de ces derniers ; et d'autre part, de valoriser son emploi local, dans une perspective de circuit court ?

Les enjeux sont de multiples natures : il s'agit tout d'abord de s'inclure dans le prolongement des spécificités du territoire massif central, mais tout autant d'inscrire nos actions dans la diversité et le géosourcé, dans le but d'apporter un élément de réponse aux crises actuelles.

Les Parcs Naturels Régionaux - et plus particulièrement celui des Volcans d'Auvergne - se positionnent en tant qu'acteurs de cette valorisation à venir.

Matériaux volcaniques, laves auvergnates

Au XIX^e siècle, suite à l'impulsion du Préfet de la Seine, Chabrol de Volvic, l'exploitation des laves d'Auvergne devient l'objet d'un commerce considérable, et plus particulièrement pour

la ville de Volvic (Puy-de-Dôme), de laquelle il est originaire. Activité prospère et en pleine expansion grâce aux progrès de la mécanisation, les exploitations de carrières fleurissent.

En 1923 à Volvic, plus de soixante carrières étaient en activité, comptant parmi leurs actifs environ 300 carriers et 700 tailleurs. Cette trachyandésite, ou lave de Volvic, est historiquement présente dans les constructions régionales (puisque exploitée depuis le XV^e siècle) et a marqué l'identité du territoire, par sa couleur singulière comme par sa résistance et ses nombreuses qualités constructives inhérentes au paysage et climat qui l'accueillent.

Sur ce modèle d'extraction et face aux qualités d'une telle roche, d'autres coulées de trachyandésite ont fait - et font encore - l'objet d'exploitation. Nous pensons particulièrement à la lave dite « de Chambois », dont la carrière est située sur la commune de Mazayes, au pied du Puy de Dôme. Cette roche est largement utilisée dans la fabrication de produits pour les bâtiments en usage extérieur (parements de façades, murs, dallages mais également pour la fabrication de mobilier urbain).

Située dans le massif du Mont-Dore, à 35 km au sud-ouest de Clermont-Ferrand, la lave du Mont-Dore, également appelée sancyte par les géologues, se caractérise par une couleur gris clair parsemée de phénocristaux blancs de feldspath. Cette autre trachyandésite se distingue par sa grande résistance aux variations de températures.

Ces roches volcaniques confrontent les chercheurs à plusieurs limites. Au-delà des recherches en action menées sur le matériau (histoire de son exploitation et de sa mise en œuvre), le manque de connaissances à son égard empêche une lisibilité des possibilités d'emploi, de réemploi ou de transformation. Force est de constater que les roches volcaniques auvergnates restent scientifiquement peu connues, au-delà de leur composition pétrochimique. Il n'existe pas de recherche universitaire sur l'histoire de leur exploitation, ni de leur emploi comme matériau constructif, urbain ou mobilier ; de même, s'il existe des carriers et sculpteurs, il n'existe pas de restaurateur d'œuvres s'intéressant spécifiquement à ces matériaux. Seuls les artisans et artisans d'art travaillant exclusivement ces roches volcaniques les connaissent réellement. Nommée de façon commune domite ou matériaux volcaniques au XIX^e siècle, l'appellation évolue vers un terme tout aussi générique au XX^e siècle : la « pierre de Volvic ». Témoignant d'une présence quotidienne dans le paysage urbain, et d'une connaissance partielle de l'histoire régionale par l'exploitation des carrières de Volvic, cette désignation demeure toutefois imprécise et souvent fautive. Les derniers grands travaux et réalisations mettent la plupart du temps en œuvre des trachyandésites de Chambois (comme pour les parements et surfaces de circulation du parc Vulcania, ou encore la gare du train à crémaillère permettant d'accéder au sommet du Puy-de-Dôme).

Malgré cette méconnaissance générale des matériaux magmatiques,

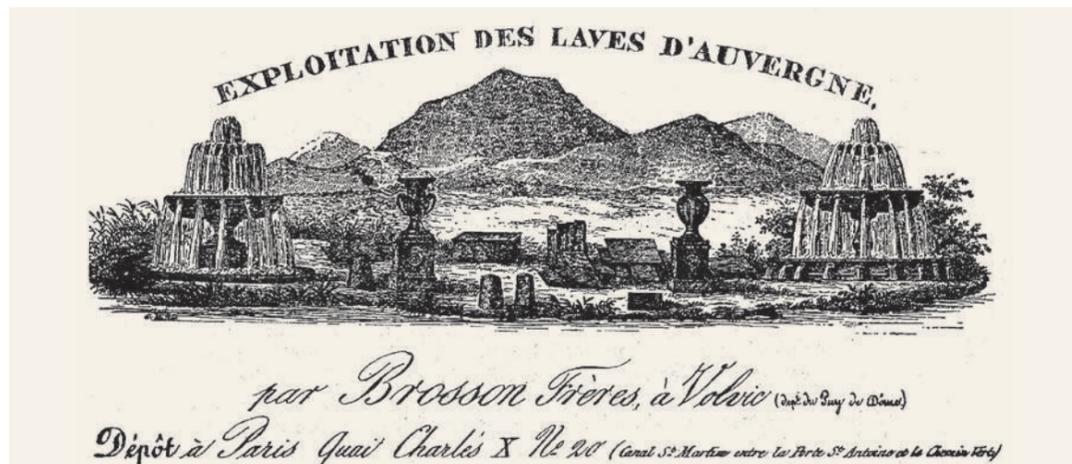


Fig.1 - Papier en-tête de l'entreprise Brosson Frères, exploitants de laves d'Auvergne (XIX^e siècle). Archives Dépt. du Puy-de-Dôme, cote 2S40

et suite aux premières recherches opérées, certaines caractéristiques nous permettent d'en saisir les avantages pour la construction, qu'elle soit ancienne ou moderne. Roche compacte, vacuolaire, dont la dureté oscille entre celle du marbre et du granit (selon les échantillons), sa composition bulleuse lui permet entre autres, de résister à la gélifraction, ce qui lui confère une grande qualité constructive dans sa zone d'emploi du massif central : zone de moyenne montagne. Qualifiée de « roche inaltérable » durant le XIX^e siècle, elle offre une grande résistance aux intempéries, devient étanche à partir de 12 cm, présente un faible coefficient de dilatation (mois de 7/1000), une résistance pyroscopique rare (ce qui lui permet d'être émaillée), et présente une bonne résistance aux tractions, flexions, compressions, ou écrasements. Enfin, elle résiste à la plupart des acides, ce qui lui vaut d'être encore employée dans l'industrie chimique (Gayet-Kerguiduff, 2021 ; Naud, 2021). La trachyandésite permet donc de nombreuses réalisations, qu'elles soient pour le secteur industriel, les produits de construction, ou bien de restauration.

Présentant de tels atouts, et notamment son adaptation aux changements thermiques, elle a participé à l'identité du territoire massif central depuis son emploi au XV^e siècle.

Certaines de ces qualités furent très vite appréciées, comme en témoigne cet extrait issu d'une réclamation datée de 1828, de M. Brosson, propriétaire exploitant de laves d'Auvergne (Brosson, 1828: 8) :

« Le but de ses premiers essais avait été d'approuver si le degré de dureté et de tenacité du Domite conviendrait à la solidité des ouvrages, et permettrait de le mettre en œuvre sous toutes les formes, avec facilité et à peu de frais. Satisfait des résultats, M. Ledru [architecte de la ville de Clermont-Ferrand (1823-1846) et architecte départemental du Puy-de-Dôme (1824-1851)] comprit qu'il pourrait être employé avantageusement dans un grand nombre de circonstances, principalement dans toutes les constructions qui exigent l'emploi de matériaux d'un poids léger; dans la fabrication d'un grand nombre d'objets destinés à résister à l'action d'un coup de feu ardent, à cause de sa propriété réfractaire ; à la filtration de toutes les espèces de liquides, en raison de sa nature spongieuse: aux carrelages, dallages, revêtements de murs, toitures, etc., etc., par la propriété qu'il a d'absorber les huiles, la cire, la résine, le bitume, et plusieurs variétés de ciments et peintures. »

Une centaine d'années après le Mouvement Moderne architectural, avec le développement de nouveaux matériaux et l'extension urbaine propre au XX^e s., qu'en est-il, des laves auvergnates, en 2024 ?

Il semble que la formation aux métiers de la pierre attire moins. Serait-ce un métier trop exigeant ? « Il ne s'agit pas seulement

d'attirer les jeunes en formation mais il faut aussi en convaincre les parents» (Masse, de Lâage, Létouffé, 2019 : 84-85) . S'il devient difficile de recruter des jeunes pour apprendre ces métiers de la pierre, nous remarquons une recrudescence de cursus atypique (et de reconversions) candidats aux formations des dernières années. L'IMAPEC, Institut des Métiers d'Art, de la Pierre et de la Construction, installé à Volvic depuis sa création en 1820 par le Comte de Chabrol (Gayet-Kerguiduff, 2021 ; Châtelet, Dumont, le Couédic, Diener, 2022 : 168), voit toutefois une baisse progressive de ses effectifs depuis plusieurs années, et ce, malgré sa spécificité liée au matériau trachyandésite et la reconnaissance des formations proposées.

Matière.s à projet(s) ?

A l'ère l'anthropocène et au temps des questionnements mondiaux sur les enjeux environnementaux et transitions énergétiques, il convient d'interroger ces matériaux volcaniques auvergnats, présents massivement sur le territoire – tels que les basaltes, ou trachyandésites – comme possible ressource. Ces matériaux sont-ils épuisables ? Qu'en est-il de leur accessibilité et des possibles conflits d'usage ?

Les carrières actuellement exploitées semblent se réduire et s'épuiser. Toutefois, le matériau reste disponible en quantité.

En effet, lors de l'extraction d'un bloc, un faible pourcentage de cette même pierre se verra devenir produit fini et livré au commanditaire. Plus de la moitié du bloc extrait devient ainsi un ensemble de déchets, que nous souhaiterions voir exploitables. Les déchets de coupe, comme les réemplois de pierres nous intéressent ici, notamment dans le cadre de la mise en œuvre de la Stratégie Nationale pour l'Architecture.

De cette dernière, nous soulignons la volonté d'un ancrage scientifique territorial ainsi que les encouragements autour d'un « permis de faire ». Favoriser l'expérimentation pour tenter d'allier techniques constructives actuelles aux matériaux locaux pourrait probablement donner de satisfaisants résultats. En ce sens, quels débouchés ou quelles propositions formuler pour la valorisation et l'emploi des déchets de coupe?

Si les chutes étaient auparavant utilisées en tant que moellons dans la construction de murs, cet emploi ne correspond désormais plus aux techniques de mise en œuvre actuelles, ni aux formations des maçons (qui adoptent d'autres matériaux et semblent de moins en moins formés aux techniques anciennes). Désormais, les chutes (notamment de basalte) servent davantage au concassage ou broyage, permettant ainsi de participer aux voiries. Nous remarquons toutefois que cette utilisation ne permet pas de valoriser un matériau local, bien qu'elle permette de libérer de l'espace au sein des carrières.

L'emploi des roches volcaniques dans le cas de murets en gabions apparait de façon ponctuelle [fig.2], permettant le réemploi de matériaux, souvent à petite échelle.

Enfin, nous proposons que l'enrochement puisse être une solution davantage valorisée et employée. Le manque évident de main d'œuvre et de savoir-faire devrait pouvoir être pallié d'une façon similaire à ce qui s'instaure actuellement par la formation aux constructions de murs en pierre sèche. Peu de murailleurs sont formés à ce type de constructions prenant comme matière première les roches volcaniques auvergnates et ce métier reste encore trop peu valorisé.

Le PNR des Volcans d'Auvergne, conscient de l'intérêt de ces matériaux et des qualités que revêtent les constructions en pierres sèche, s'est constitué partenaire depuis 2023, d'un chantier-école de construction de murs en pierre sèche. Inédit dans le secteur du Parc Naturel Régional des Volcans d'Auvergne, ce chantier école a accueilli huit jeunes en insertion pour une formation aux techniques

traditionnelles de construction de murs en pierre sèche. L'ambition première de cette formation était de valoriser l'intérêt agricole, écologique et patrimonial des "pailhats" (ces murets de pierre sèche qui structurent les terrasses cultivées). Elle souhaitait également pouvoir contribuer à la structuration d'une filière en demande croissante, et ce, à partir de roches volcaniques locales et présentes en quantité : un basalte issu de pierreries locales.

Aussi, les objectifs initiaux de la formation consistaient en la construction et restauration de murs de soutènements et/ou double parement en pierres sèches ; de former les stagiaires aux qualités environnementales apportées ce type de bâti ; de sensibiliser les stagiaires à la nécessité d'entretenir le patrimoine en pierre sèche ; tout en les formant à l'ensemble des étapes de construction (préparation des fondations, pose des pierres et calage des pierres de parement, pose des pierres tout-venant au cœur du mur, et pose du couronnement, mais également dimensionnement des murs selon leurs usages à venir, selon la nature du sol et la hauteur de l'ouvrage). Enfin, cette formation avait pour ambition d'initier le regard des stagiaires sur les diagnostics et pathologies des ouvrages, en leur soumettant une analyse théorique.

Les pailhats retiennent la poussée des terrains et en structurent les pentes, sans aide d'aucun mortier ni liant. La pierre sèche – en l'occurrence le basalte – permet ici de drainer et régulariser le taux d'humidité des sols à l'arrière des murets. Ce drain naturel permet de lutter contre l'érosion. Roche volcanique résistante, le basalte permet une durabilité des constructions dans le temps. De même, cette pierre volcanique, connue pour ses qualités réfractaires, a un effet de régulation thermique qui permet de favoriser la diversité des espèces végétales et animales au sein du mur. Absorbant la chaleur, et la restituant plusieurs heures durant, l'emploi du basalte comme matière première de murs en pierre sèche saurait favoriser les cultures.

Enfin, la mise en œuvre des pailhats permet d'optimiser surface comme l'entretien des terrains en pente, dans cette zone de moyenne montagne.

Ces constructions, sans mortier, faites à partir de matériaux locaux, souvent récupérés, présentent des intérêts en adéquation avec les enjeux environnementaux et préoccupations actuels. Le bilan carbone est sans nul doute meilleur que tout emploi d'autre matériau (nous pensons notamment au ciment).

Face à l'ère anthropocène, mais surtout au regard des crises actuelles, il nous semble nécessaire et indispensable - à défaut de pouvoir faire davantage - d'encourager, soutenir et accompagner les bâtisseurs qualifiés vers leur installation professionnelle. De l'ordre de la transmission immatérielle d'un savoir-faire ancien, par la connaissance des matériaux

locaux et du sol sur lequel ils édifient, ces emplois spécialisés valorisent ceux qui les pratiquent et le territoire sur lequel ils travaillent. Au-delà de la seule économie circulaire, l'engagement moral envers un futur conciliant réemploi, écologie, biosourcé et techniques constructives traditionnelles propose des solutions d'avenir aux crises présentes, actives et virulentes.

En ce sens, pourrait être envisagé de développer la filière économique de la pierre locale dans le massif central en proposant davantage de formations tout en favorisant un approvisionnement en roches volcaniques (à l'échelle des carrières autorisées ou d'un réemploi). Valorisant les ressources locales ; répondant aux besoins de formation aux techniques de construction des ouvrages en pierres sèches ; entretenant un patrimoine bâti et permettant d'en comprendre l'histoire (constructions vernaculaires, patrimoine local, pailhats) ; sensibilisant aux qualités techniques, environnementales, écologiques et paysagères comme aux techniques agricoles traditionnelles, les formations aux constructions de murs en pierre sèche pourraient être envisagées comme une solution à la revalorisation de la filière, en massif central, à partir des roches volcaniques existantes.

Nous sommes convaincus que ces matériaux auvergnats sont tant une source qu'une ressource pour les décennies à venir. Quel avenir ferons-nous le choix de dessiner pour ces matériaux qualitatifs et somme toute, encore quantitatifs, malgré le manque de moyens humains, et ce, à l'aune des transitions énergétiques ?

Parmi les initiatives déjà présentes et tous les enjeux que revêt la construction en pierre sèche, est-il possible d'entrevoir d'autres initiatives de valorisation de ces roches volcaniques auvergnates, qui nous permettent de penser en cohésion et de façon concomitante, l'existant (patrimonial ou non), l'architecture contemporaine et celle à venir ?

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Auvergne volcanic rocks: sources and resources, project(s)

Abstract

The aim of this action research project is to (re) define and (re)learn about Auvergne's volcanic rocks. Volcanic rock has played a key role in the identity of the Massif Central, particularly in the construction of towns and cities since the 15th century, and its use has accelerated with industrial growth. The distinctive colour of this stone gives it a visual identity in the urban environment surrounding the Chaîne des Puys, and today it is one of the components of Auvergne's built heritage, forming an integral part of the landscape because it is at its heart. Could understanding the qualities of these materials (refractory stone ; resistant to both gelification and acids ; rare pyroscopic resistance) as local, low-carbon materials help to promote construction and/or restoration that can be described as geosourced ?

In the age of the Anthropocene and global questions about environmental issues and energy transitions, we need to look at these local materials as resources, and in particular through their use (or reuse) in dry stone walls.

The lava rocks of the Auvergne have played a part in the identity of the Massif Central region, through the construction of towns and cities since the 15th century. Their exploitation accelerated with industrial growth, as their presence grew and their uses declined across France. The unique colour of these volcanic rocks gives them a visual identity in the buildings surrounding the Chaîne des Puys, and today they are an integral part of Auvergne's heritage, at the very heart of the landscape.

These rocks are not only found in urban areas of the Massif Central, but are also regularly used in different ways, particularly in rural areas. Some types of volcanic rock (trachyandesite in particular) have been used as dimension stone, for building or paving. Cutting and quarrying waste has long been used to build rubble stone walls, retaining walls and terraces, often for agricultural purposes.

The stone industry, associated with Auvergne's volcanic rocks and located in the heart of the Massif Central, involves a number of different trades, each with its own specific skills. Quarrymen, who are specific to the region, are the bearers of essential and important know-how. While the materials are local, so too are the techniques, which are adapted to the qualities and specific features of each rock.

The 19th century was the golden age of quarrying, and several archives bear witness to active quarrying operations in the Auvergne region. Quarry owners - who also owned the

companies that extracted the raw materials - were responsible for the widespread use of these volcanic rocks, which they called by generic terms. Laves d'Auvergne, produits volcaniques or domite (Ledru, 1828; Legay-Chevalier, 1891; Roger, 1891) - here used as a feminine noun, there used as a masculine noun - reflect a lack of knowledge of the petrochemical composition of the rocks mined in the 19th century (Brosson, 1828). [Fig.1] Researchers and volcanologists have since catalogued them geographically and described them precisely as trachyte, trachyandesite, trachybasalt or basalt. The use of generic terms such as "laves d'Auvergne" or "domites" does not allow us to systematically identify the quarries from which they were extracted, or the precise origins of the stones used in the 19th century, when a specific geographical site is not associated with them. There is therefore a certain vagueness about the types of materials used in the 19th century, particularly given the wide variety of rocks found in the Massif Central.

Volcanic rock is abundant and present in large quantities in the soils of the Massif Central. So how can these different materials be developed and put to good use, particularly those derived from reuse or waste from cutting ?

From quarry extraction onwards, what solutions can be devised to minimise cutting waste and provide for its reuse, and to promote local employment, with a view to short circuits ?

There are many issues at stake: first of all, we need to build on the specific characteristics of the Massif Central region, but we also need to make our actions part of a diverse and geo-sourced approach, with the aim of providing a response to the current crises.

The regional nature parks - and the Volcans d'Auvergne Park in particular - are positioning themselves as key players in this future development.

Volcanic materials, lava from Auvergne

In the 19th century, under the impetus of the Prefect of the Seine, Chabrol de Volvic, the exploitation of Auvergne lava became the subject of considerable trade, particularly for the town of Volvic (Puy-de-Dôme), from which he originated. Thanks to advances in mechanisation, quarrying was booming and flourishing.

In 1923, more than sixty quarries were in operation in Volvic, employing around 300 quarry workers and 700 cutters. This trachyandesite, or Volvic lava, has historically been used in the region's buildings (it has been quarried since the 15th century) and has left its mark on the region's identity, through its distinctive colour, its resistance and its many construction qualities inherent to the landscape and climate in which it is found.

Other trachyandesite flows have been - and continue to be - mined on the basis of this extraction model and the qualities of this type of rock. We are thinking in particular of the lava known as "Chambois", the quarry of which is located in the commune of Mazayes, at the foot of Puy de Dôme. This rock is widely used in the manufacture of exterior building products (facade cladding, walls, paving and street furniture).

Located in the Monts Dore massif, 35km south-west of Clermont-Ferrand, Mont-Dore lava, also known as sancyte by geologists, is a light grey colour dotted with white feldspar phenocrysts. This other trachyandesite is distinguished by its high resistance to temperature variations.

These volcanic rocks present researchers with a number of challenges. In addition to the research being carried out on the material (history of its exploitation and use), the lack of knowledge

about it means that the possibilities for its use, re-use or transformation are not clear. It has to be said that little is known scientifically about Auvergne's volcanic rocks, beyond their petrochemical composition. There is no university research into the history of their quarrying, or their use as building, urban or furniture materials; similarly, while there are quarrymen and sculptors, there are no art restorers specifically interested in these materials. Only artisans and craftsmen who work exclusively with these volcanic rocks have any real knowledge of them.

Commonly known as domite or volcanic materials in the 19th century, the name evolved into an equally generic term in the 20th century: "Volvic stone". Although it is a daily feature of the urban landscape, and reflects a partial knowledge of the region's history thanks to the Volvic quarries, this designation remains imprecise and often false. Most of the latest major works and projects involve the use of trachyandesite from Chambois (such as the facing and road surfaces at Vulcania park, or the cog railway station providing access to the summit of Puy-de-Dôme).

Despite this general lack of knowledge about magmatic materials, and following the initial research carried out, certain characteristics enable us to understand their advantages for construction, whether ancient or modern. A compact, vacuolated rock whose hardness varies between that of marble and granite (depending on the sample), its bubbly composition enables it to resist gelification, among other things, which gives it great constructive qualities in its area of use in the Massif Central : a mid-mountain region. Described as an "unalterable rock" in the 19th century, it is highly weather-resistant, waterproof from 12 cm upwards, has a low coefficient of expansion (less than 7/1000), rare pyroscopic resistance (which means it can be enamelled), and good resistance to traction, flexion, compression and crushing. Finally, it is resistant to most acids, which is why it is still used in the chemical industry (Gayet-Kerguiduff, 2021; Naud, 2021). Trachyandesite can therefore be used in a wide range of applications, in industry, construction and catering.

With its many advantages, not least its ability to adapt to thermal changes, trachyandesite has contributed to the identity of the Massif Central region since it was first used in the 15th century.

Some of these qualities were very quickly appreciated, as shown by this extract from a complaint dated 1828 from Mr Brosson, an owner and operator of Auvergne lava (Brosson, 1828: 8) :

" The purpose of his first tests was to approve whether the degree of hardness and tenacity of Domite would be suitable for the solidity of the works, and would allow it to be used in

all forms, with ease and at little cost. Satisfied with the results, M. Ledru [architect for the town of Clermont-Ferrand (1823-1846) and departmental architect for the Puy-de-Dôme (1824-1851)] realised that it could be used advantageously in a large number of circumstances, principally in all constructions requiring the use of light materials; in the manufacture of a large number of objects designed to resist the action of a fiery shot, because of its refractory property; in the filtration of all kinds of liquids, because of its spongy nature: tiles, paving, wall cladding, roofing, etc. , etc., because of its ability to absorb oils, waxes, resins, bitumen, and several varieties of ciments and paints ".

A hundred years after the Modern Architectural Movement, with the development of new materials and the urban sprawl of the 20th century, what is the situation with Auvergne lava in 2024 ?

It seems that training in the stone trades is less attractive. Could it be that the job is too demanding? " It's not just a question of attracting young people to training, but also of convincing their parents " (Masse, de Lâage, Létoffé, 2019: 84-85). While it is becoming difficult to recruit young people to learn these stone trades, we have noticed an upsurge in atypical courses (and reconversions) applying for training courses in recent years.

IMAPEC, the Institut des Métiers d'Art, de la Pierre et de la Construction, which has been based in Volvic since it was founded in 1820 by the Comte de Chabrol (Gayet-Kerguiduff, 2021; Châtelet, Dumont, le Couédic, Diener, 2022: 168), has seen a gradual decline in its numbers over the last few years, despite its specificity linked to the material trachyandesite and the recognition of the training courses on offer.

Project(s) ?

In the age of the Anthropocene, and at a time when the world is questioning environmental issues and energy transitions, we need to look at Auvergne's volcanic materials, which are massively present in the region - such as basalts and trachyandesite sites - as possible resources. Are these materials exhaustible ? What about their accessibility and possible conflicts of use ?

The quarries currently in use seem to be shrinking and running out. However, the material remains available in quantity.

In fact, when a block of stone is extracted, a small percentage of it becomes a finished product and is delivered to the client. More than half of the extracted block thus becomes waste, which we would like to see exploited. Cutting waste, like re-used stone, is of interest to us here, particularly in the context of the implementation of the National Strategy for Architecture.

In this context, we would emphasise the desire for a regional scientific base, and the encouragement given to a 'licence to build'. Encouraging experimentation in an attempt to combine current construction techniques with local materials could probably yield satisfactory results. In this respect, what outlets or proposals can be put forward for the recovery and use of cutting waste ?

Although offcuts used to be used as rubble in the construction of walls, this use no longer corresponds to current construction techniques or to the training of bricklayers (who are adopting other materials and seem to have less and less training in old techniques). Nowadays, offcuts (particularly basalt) are used more for crushing or grinding, making it possible to contribute to roadworks. We note, however, that this use does not make the most of a local material, although it does free up space in the quarries.

The use of volcanic rock in the case of gabion walls appears on an occasional basis [fig.2], allowing materials to be reused, often on a small scale.

Finally, we suggest that riprap could be a solution that is more widely used. The obvious lack of manpower and know-how should be remedied in a similar way to what is currently being done, through training in the construction of dry stone walls. Few wall-builders are trained in this type of construction, which uses Auvergne's volcanic rock as a raw material, and the profession is still under-valued.

The PNR des Volcans d'Auvergne (Auvergne Volcanoes Regional Nature Park), aware of the value of these materials and the qualities of dry-stone construction, has been a partner since 2023 in a dry-stone wall-building school. A first in the Parc Naturel Régional des Volcans d'Auvergne area, this workcamp has taken in eight young people on integration programmes to train them in traditional dry-stone wall-building techniques. The primary aim of the training was to promote the agricultural, ecological and heritage value of "pailhats" (dry stone walls that structure cultivated terraces). It also wanted to contribute to the structuring of a sector in growing demand, using local volcanic rock in abundant supply: basalt from local scree. The initial aims of the course were to build and restore dry-stone retaining walls and/or double-faced dry-stone walls; to train trainees in the environmental qualities of this type of construction; to make trainees aware of the need to maintain dry-stone heritage; at the same time as training them in all the stages of construction (preparing the foundations, laying the stones and wedging the facing stones, laying the all-rendered stones at the heart of the wall, and laying the coping, as well as sizing the walls according to their future use, the nature of the soil and the height of the structure). Finally, the aim of the course was to introduce trainees to the diagnosis and pathology of structures, through theoretical analysis.

Pailhats retain the thrust of the land and structure its slopes, without the aid of mortar or binders. Dry stone - in this case basalt - is used to drain and regulate the moisture content of the soil behind the low walls. This natural drainage helps to combat erosion. As a resistant volcanic rock, basalt ensures the durability of buildings over time. Similarly, this volcanic stone, known for its refractory qualities, has a thermal regulation effect that encourages the diversity of plant and animal species within the wall. By absorbing heat and releasing it for several hours at a time, the use of basalt as a raw material for dry stone walls is likely to encourage the cultivation of crops.

Finally, the use of pailhats optimises the surface area and maintenance of sloping land in this mid-mountain area.

These mortar-free constructions, made from local materials that are often recycled, are well suited to today's environmental challenges and concerns. The carbon footprint is undoubtedly

better than using any other material (such as cement).

In the face of the Anthropocene era, but especially in view of the current crises, we feel it is necessary and essential - if we can't do more - to encourage, support and help qualified builders to set up in business. These specialised jobs, which involve the intangible transmission of ancient know-how through knowledge of local materials and the soil on which they build, enhance the value of those who practise them and the area in which they work. Beyond the circular economy alone, the moral commitment to a future that reconciles reuse, ecology, biosourced materials and traditional building techniques offers future solutions to the current, active and virulent crises.

With this in mind, consideration could be given to developing the local stone industry in the Massif Central by offering more training courses while encouraging the supply of volcanic rock (from authorised quarries or reuse). By promoting local resources, meeting training needs in dry stone construction techniques, maintaining a built heritage and providing an understanding of its history (vernacular buildings, local heritage, pailhats), raising awareness of technical, environmental, ecological and landscape qualities and traditional farming techniques, training in dry stone wall construction could be seen as a solution to revitalising the sector in the Massif Central, using existing volcanic rock.

We are convinced that these materials from Auvergne are both a source and a resource for the decades to come. What kind of future will we choose to design for these high-quality materials, which, despite the lack of human resources, are still quantitative?

Amongst the initiatives already presented and all the issues involved in dry stone construction, is it possible to foresee other initiatives to make the most of these volcanic rocks from Auvergne, which allow us to think in a cohesive and concomitant way about the existing (heritage or otherwise), contemporary and future architecture ?

La Pierre sèche, diamant brut des Monts d'Ardèche

Les paysages de terrasses des Monts d'Ardèche traduisent la nécessité de rechercher une horizontalité pour la vie quotidienne. Les terrasses ont ainsi été le fruit d'un travail acharné pour vivre sur les pentes.

Les premières sources écrites mentionnant la présence de terrasses en pierre sèche datent du X^e siècle. Les terrasses ont connu leur apogée autour de 1860 lorsque la pression démographique a été la plus forte. Par la suite, les crises de la vigne (phyllloxéra), de la culture du ver à soie (pébrine) et du châtaignier (encre) ont conduit à l'abandon progressif de versants entiers.

Autour des cultures agricoles en terrasses (châtaigniers, vignes, oliviers, pommes de terre, maraîchages, etc.), un savoir-faire riche s'est développé. Des "calades" (chemins pavés) ont été bâties, des escaliers ont permis de passer d'une terrasse à l'autre, de multiples ouvrages ont canalisé l'eau (canaux appelés "béalières", "gourgs" pour arroser les potagers, voûtes protégeant les sources, etc.). L'habitat s'est développé de manière à préserver les meilleures terres agricoles. Les terrasses ont également été créées pour aménager l'espace autour de la maison (potagers par exemple) et ont servi de soutènement au-dessus et au-dessous des routes et des chemins.

De nombreuses spécificités agricoles sont attachées à ce territoire de pentes, la châtaigne, le vin, la pomme de terre, etc... autant de filières que le Parc accompagne et soutient.

Depuis 2001, le Parc s'est attaché à valoriser ces savoir-faire qui, outre leur valeur patrimoniale, culturelle et sociale, présentent également un potentiel économique et touristique.

Le Parc des Monts d'Ardèche valorise ce patrimoine et la technique constructive de pierres sèches en proposant différentes actions.

Depuis 2012, le Parc propose chaque année, aux porteurs de projets publics et associatifs, une aide financière directe pour la restauration de murs, calades ou petit patrimoine en pierre sèche. Accompagnés financièrement par la Région Auvergne Rhône-Alpes et le Département de l'Ardèche, ce ne sont pas moins de 1 million d'euros de travaux réalisés, essentiellement pour de la restauration de terrasses agricoles dont 450 000€ de subventions apportées par le PNR des Monts d'Ardèche.

Ces chantiers sont réalisés en grande majorité sous forme de chantiers formations. Les maîtres d'ouvrage sont incités à réaliser des temps de valorisation de la technique. Ce sont des temps d'initiation qui sont appréciés par le grand public, les artisans et les employés communaux.

Des événementiels pour le grand public sont aussi régulièrement organisés afin de faire découvrir aux habitants les paysages emblématiques des terrasses des Monts d'Ardèche. Ces temps forts sont l'occasion de découvrir des lieux d'exception, des rénovations exemplaires de murs et de participer à des chantiers démonstratifs.

En 2018, le PNR des Monts d'Ardèche s'est engagé dans une politique plus ambitieuse autour de la pierre sèche. Entouré des acteurs de la filière pierre sèche, des artisans aux donneurs d'ordre en passant par les organismes de formation, le Parc élabore un plan Pierre sèche qui permet de structurer un programme d'actions pluriannuel traitant des problématiques de l'approvisionnement, de la transmission du savoir-faire et des usages.

Le Parc mène ainsi différentes actions pour traiter la filière Pierre sèche dans sa globalité.

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Dry stone, the Monts d'Ardèche rough diamond

The terraced landscapes of the Monts d'Ardèche show the need for flat surfaces in everyday life. The terraces are the result of a tireless work to live on the slopes.

The first written sources mentioning the existence of terraces date from the 10th century. These structures have reached their peak around 1860 when demographic pressure was at its strongest. Later, crises concerning vines (phylloxera), silkworm breeding (pepper disease) and chestnut trees (ink disease) led to the gradual abandonment of whole slopes.

Around these cultivations (chestnut trees, vines, olive trees, potatoes, market gardening, etc.), a rich know-how developed. Calades (floors made of stones put on their edge or vertically) have been built, stairs from one terrace to the next, numerous works to channel water (canals called "béalières", "gourgs" to water vegetable gardens, vaulted roofs to protect springs, etc.). Housing developed so as to spare the best farming lands. Terraces have also been built to organize space around houses (vegetable gardens, for instance) and have been used as shoring above and below roads and paths.

These agricultural specificities are linked to this hilly territory and constitute whole sectors, which are accompanied and supported by the Park.

Since 2001, the Park has been seeking to value these skills which, beside their patrimonial, cultural and social value, possess also an economical and touristic potential. The Park values this heritage and this building technique in several ways.

Since 2012, it provides every year, to public and associative project promoters, a direct financial help to restore walls, calades or small dry stone buildings. With help from the Rhône-Alpes region and the Ardèche department, no less than one million euros worth of works have been achieved, mainly for the restoration of agricultural terraces, including 450 000 euros in grants provided by the Natural Regional Park of the Monts d'Ardèche.

These construction works are done for the most part through training sessions. The contracting authorities are invited to devote time to explain and value the techniques. The general public as well as the craftsmen and municipal employees enjoy these sessions. Events are regularly organized to enable the inhabitants to discover landscapes emblematic of the Monts d'Ardèche terraces. These important times are an opportunity to discover exceptional sites, exemplary wall restorations and to take part in demonstration works.

In 2018, the Natural Regional Park of the Monts d'Ardèche engaged in a more ambitious policy regarding dry stone. Together with the players in the dry-stone sector, from craftsmen to contracting authorities to training institutions, the Park set up a dry-stone plan in order to structure a program over several years to address supplies, the handover of skills and know-how from yesterday and tomorrow.

Thus, the Park carries out several actions to handle the dry-stone sector in all its aspects.



POSTERS

Modération : Philippe Hameau, anthropologue, France / Moderator : Philippe Hameau, anthropologist, France

- Sébastien Balestrieri, consultant en ingénierie culturelle, Laurent Tuccinardi, carrier, La Fédération Française des Professionnels de la Pierre Sèche (FFPPS)
- Sébastien Balestrieri, consultant en ingénierie culturelle, FFPPS & Antoine Bourgeau, anthropologue culturel, chargé de mission au PNR Préalpes d'Azur, France : Le PCI et la pierre sèche : quelles synergies entre les éléments inscrits ? / The ICH and dry stone : what synergies between listed elements ?
- Volubilis, Réseau euro-méditerranéen pour la ville et les paysages / Euro-Mediterranean network for cities and landscapes : Cartographie des initiatives de pierre sèche en région Sud France / Mapping of dry stone initiatives in the South of France region
- Maisons Paysannes de France, association nationale sur le patrimoine et les paysages ruraux / France national association on rural heritage and rural landscapes. Architecture de pierres sèches en Vaucluse / Architecture of dry stones in Vaucluse
- Amandine Schaus et Nathalie Squerens, Belgique : Création d'un réseau belge de la pierre sèche / Creation of a Belgian dry stone network
- Antoni Reynes & Philippe Alvaro-Frotté, Espagne, îles Baléares, Majorque : La route de la pierre sèche REPS (réseau européen pour la pierre sèche) / Dry stone route REPS
- Ass. Marti i Bella, Espagne, îles Baléares, Minorque : Les bénévoles de Marti i Bella pour la pierre sèche de Minorque / The volunteers of Marti i Bella for the dry stone of Menorca
- Alberto Cerda Mico, lawyer / juriste, Espagne : Murs en pierre sèche et sites de l'UNESCO à Castellón, Communauté de Valence, Espagne. / Dry stone walls and UNESCO sites in Castellón, Community of Valencia, Spain
- Nicolas Ilg, membre de la direction, Suisse, Fondation Actions Environnement (FAE) : Des murs pour tout le monde / Walls for everybody
- Simon Winzenried, Suisse - Schweizerischer Verband der Trockensteinmaurer (SVTSM) / Fédération Suisse des maçons de pierre sèche
- Rainer Vogler, Autriche : Sensibilisation du public aux murs en pierre sèche et projets pour les enfants en Autriche / Dry Stone Walling public awareness and children projects in Austria.