The Matienzo Valley

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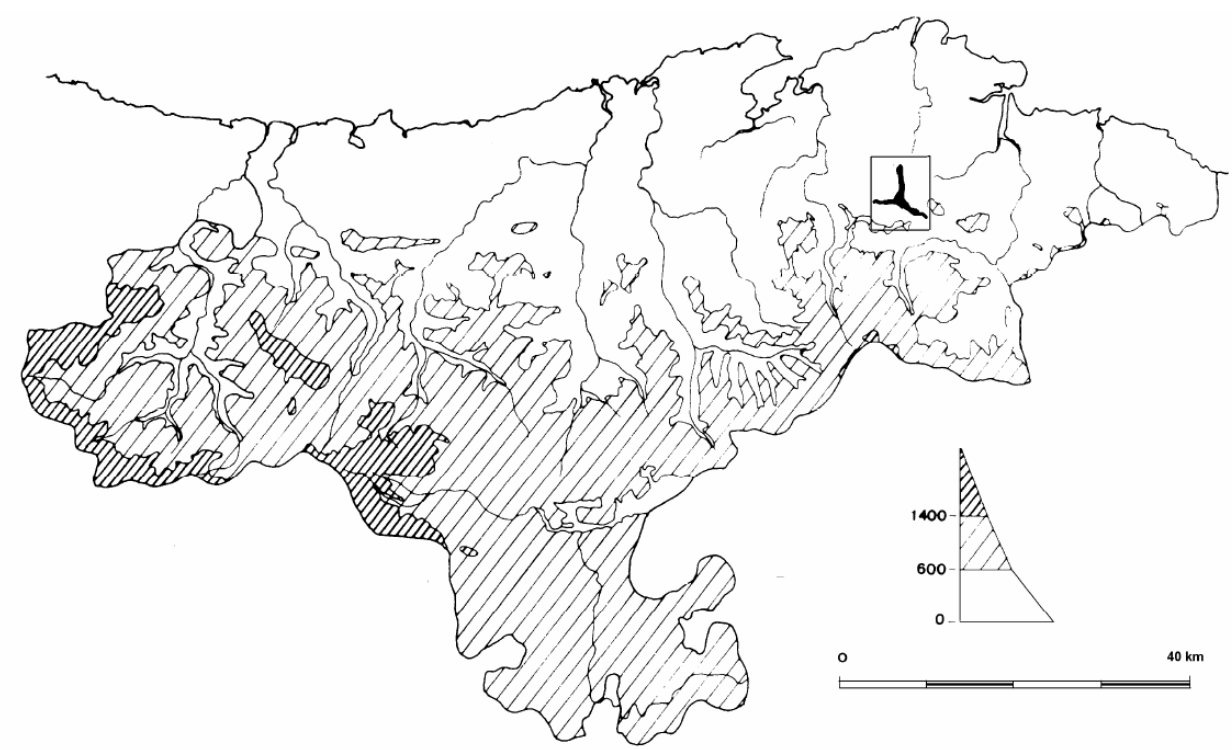
General View of the La Vega – Seldesuto Branch

1. The Matienzo Depression: The landscape.

The archaeological sediments in Cueva Cofresnedo can only be understood in a very defined ecological and spatial context: the Matienzo valley. Its position within this setting, at its geometrical centre and, at the same time, somewhat elevated, makes the two elements, cave and valley inseparable.

Matienzo is a place with a very distinctive landscape*:* a small valley completely enclosed and surrounded by mountains. Perhaps the most remarkable feature of the landscape arises from the contrast between the light tones of the limestone that forms the hillsides and peaks, with the dark greens of the woods and lighter greens of the meadows. The flat valley bottom, covered in pastures and crops, is green as is a small part of the hillsides. Among the summits that frame Matienzo, Monte Mullir, a long limestone ridge enclosing the valley on its eastern side, stands out. One of its foothills, La Colina, is a markedly conical prominence directly above the village. The valley, seen from either of the passes that give access to it, gives the impression that time has stopped, for it lacks nearly all the references we expect of the century we live in.

The houses appear to be untidily scattered on the valley bottom and some, the smallest, on the hillsides. The valley's houses are built of limestone with gabled roofs and in the centres of population are usually joined together to form terraces along the narrow roads which connect the different groupings. The



The position of the Matienzo valley in Cantabria

valley has only one village, Matienzo, in which a small number of people live in well separated neighbourhoods. To the North is La Secada and to the Southeast are Cubillas, La Vega and Hozana. On a good part of the hillsides and tops scattered cabins can be seen. These are much smaller than the houses in the valley and nearly always surrounded by a large field enclosed within a dry stone wall.

The unique phenomenon that has called the attention of scientists to this valley is its subterranean formations, its large caves and deep shafts. Currents of water appear from beneath the rock and immediately submerge again to come out several kilometres further on as a spring.

Nearly forty years now, a team, collaborating with the Provincial Museum of Prehistory, carried out an in depth study to document the valley's caves. A few years later visits began by English scientists, belonging to various groups and institutions, but united in the one project. They have spent three decades investigating the karst systems of the Matienzo depression.

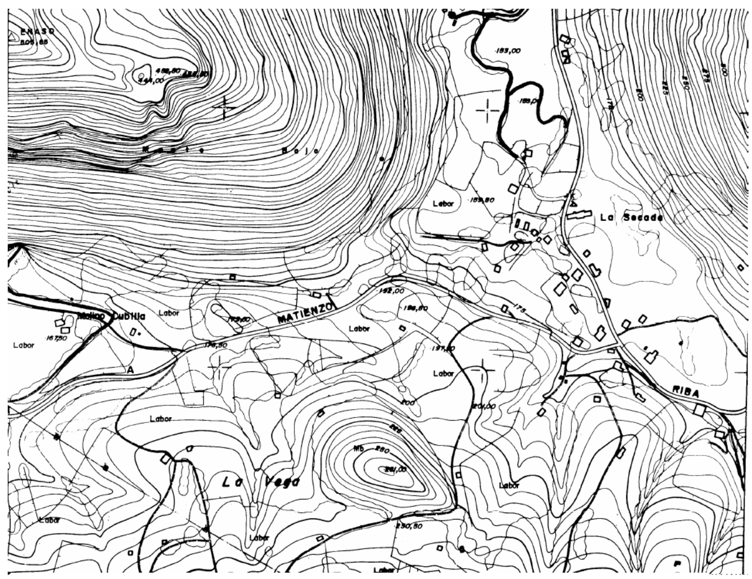
The fruit of this work is the high level of knowledge about the karst of this area that exists today. This has been one of the main reasons why, in the mid 1990s, we began to develop a programme of archaeological investigation centred on the study of the prehistoric culture that used this space. The other reason, perhaps the main one, has been the character of the "enclosed" area, the restricted space, of uniform ecological features.

When this programme began, with the title," The Recent Prehistory of the Matienzo Valley", the basic objectives were: the systematic cataloguing of the archaeological deposits and the prospecting of many of the known caves. It began with the investigation of sediments in the open air, the study of the sources of supply of raw materials, and of the archaeological collections then in existence. But the detailed archaeological study of a series of deposits in caves and shelters, and the inclusion of its results in the regional framework, has guided their own project**.** Today's medium term objectives have become the reconstruction of the way of life and the patterns of the use of space and resources by different groups of humans which, through the length of prehistory, have occupied Matienzo.

1.1. The Relief

The area of study is delimited by a combined series of watersheds, formed by the sierras that border the Matienzo depression, which together form a roughly triangular shape. The line of demarcation largely coincides with the municipal administrative boundary of Ruesga, except on the southern edge. To the north the valley is enclosed by the pass of Fuente Las Varas and to the west, in the form of an arc, by the line of summits from La Muela (531m) to Puerto de Alisas- La Nevera (703m). The range that closes the south side is made up of the Alto de Linares (776m), La Rasa/ El Somo (around 680m), la Piluca (674m) and El Castro (605m). From here the hillside gently descends to the pass of La Cruz de Usaño (347m) before ascending again to El Cotorro (512m). The grand mass of Monte Mullir, - summit 839m- forms the eastern side of the valley, and its northern foothills join Fuente Las Varas. The total area of the depression is some 30 square kilometres, of which only slightly more than 3 square kilometres applies to the valley bottom. The rest corresponds to extensions of the hillsides, in general with medium and high level slopes and summits, with very few level areas. The relief energy is therefore emphasized at all points except the very flat valley bottom, which has acted as a sedimentation basin.

Thus three levels of relief can be differentiated as: summits, hillsides and the valley bottom. The summits, which combine the highest altitudes with moderate relief are grouped in three sectors, forming three sides of a triangle: the north-western, the southern and the eastern sides. The first of these is a hill range with an average altitude of 527 metres, reaching a maximum altitude of 703 metres (La Nevera). Its minimum altitude corresponds to the height of the Collado de Fuente Las Varas. This is an essential passage – a traditional passage and a present day one- that links the depression with the valleys of Solórzano and Riaño. The hills that shut off the valley to the south have a somewhat higher average altitude of 577 metres, though this is more variable. Its highest point reaches 776 metres at the Alto de Linares, and its lowest point is 347 metres at the hill, or pass, of Cruz de Usaño, the natural communication between Matienzo and the Asón valley. The eastern range is steeper presenting an average altitude similar to the southern and north-western sides and its maximum height is far greater (El Copete: 839m). Its lowest point, 406m, is at La Collado de Esquila, the pass leading to Llueva and Voto and the nearest route to the sea from Matienzo. Its use as a pass has continued up to the present day.



The central zone of the Matienzo depression

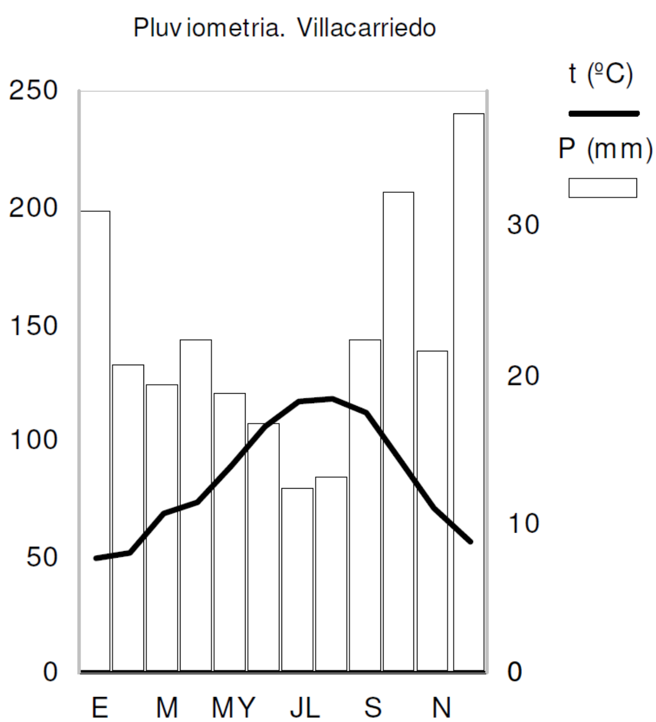
The most prominent feature of the hillsides is the variability of the slopes and the energy of the relief, always either quite or very high, and closely related to the type of substratum. On the commonest substrata, the limestones, the slopes are usually high and, in general, so is the relief energy. In these areas the contrast between the valley bottom and the edge of the hillsides is very clear cut. Where the substratum of the hillsides is composed of clays, marls and sandstones, concentrated in the south eastern sector, the slopes are gentler.

The valley bottom is characterized by its uniformity. The depression is shaped like an inverted “T.” The western arm is the Seldesuto- La Vega valley; the arm which heads south-east is the Hozana valley, and the branch which heads north is called La Secada. In nearly all of the depression the valley bottom is below 200m, mostly between 170 and 200m, and sometimes much less. The lowest part, at 145m, is to be found in La Secada. The Hozano sector has a somewhat higher valley bottom than the rest of the depression with a low point of 245m.

1.2. The Climate

View of the Northern sector of Matienzo from Mullir.

The climate conditions of Matienzo are largely those of the damp temperate zone of the strip that lies between the Cantabrian cordillera and the sea. It is an oceanic climate, of which the most outstanding feature is the intensity of its rainfall, with a mean of above 1500mm, distributed throughout the year, though the maximums occur during the autumn and winter. The second defining feature is the evenness of its temperature, with very limited seasonal variation. The mean difference between the summer and the winter is about 10°. According to data from the nearby station at Arredondo, calculated over the last 30 years, the mean temperature in Matienzo would be 13° for the valley and 12° for the hills. This range is intermediate between those registered on the coastal platform, 13°-14°, and of the interior where the mean temperature drops to 8° and 10°.



Pluviometry: Climogram, Villacarriedo station

As regards rainfall means in the area of work situated between the 1800 and 2000 isolines, this is an area of high rainfall with important differences through the year, from 100 l/m² in June and August to 240 l/m² in December. Snowfall is only considerable above 1000m altitude so the Matienzo area is only partly affected by this phenomenon, in its mountainous sectors. The winds normally blow from the west. When the wind comes from the North West it is known as "Galician" and is accompanied by fine, persistent rain.

Hillsides of Bosmartín (Matienzo)

The orography plays an important role in the local climate of the depression in that it protects the lower areas from the intensity of the prevailing winds and causes one of the most notable features of Matienzo, the frequent and persistent mists. On a large proportion of the days of the year the mist does not lift from the valley until midday and, while the limestone hillsides are in brilliant sunshine the valley bottom remains immersed in cold, damp mist, which has a marked effect on the vegetation.

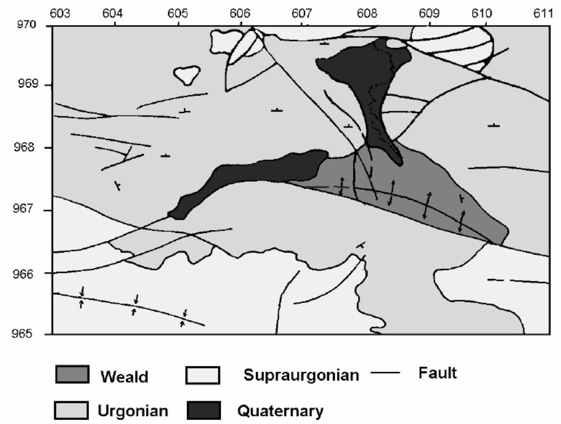
The cabañas of the high areas are of Pasiegan construction

This cool, wet climate explains the search for shelter throughout history, on the part of humans, and the selection of the warmest and least exposed sites. Thus the caves and shelters most used for human habitation are those situated on the south and west facing hillsides. The traditional rural architecture is also a reflection of the climate and so the doors and windows are small and narrow and never face either the Galician or the north winds. On the slopes and hilltops that surround Matienzo are many examples of cabins following the Pasiegan model, many of them in ruins nowadays, while on the valley bottom a greater mix of traditions can be found.

1.3. The Substrata

From the geological viewpoint the Matienzo valley is a small part of the Miera – Asón limestone massif, situated in its extreme north. In this area orogenic pressure has produced a series of waves of alternate anticlines and synclines, in an east – west direction, associated with the Esles- Selaya- Arredondo group of faults, which account for its main morphological and structural features.

Basically, Matienzo has been carved out of a block of limestone some 600 to 700m deep**,** thanks to the effects of inverse erosion that acted above the axis of the anticline which coincided with the line of the La Vega and Hozano depressions. Thus the oldest materials, detrital materials, emerge at the nucleus of the anticline and build up on the hillsides, they appear to be the youngest layers. The basic features of the lithological series which appear in the area of study, is discussed below.



Geological sketch of the Matienzo area. Source IGME (1978)

a) The detrital core

The oldest materials correspond to the detrital and continental facies of the Wealden, and appear in the central- southern section of the valley, as a relatively reduced extension. Of the important mass that constitutes the Wealden in this part of the region, with a depth of 800m, only the highest section emerges. It is made up of alternate series of micaceous, medium grained, cream and reddish sandstones, with siltstones. Specifically, in Matienzo, both sandstones and siltstones outcrop, corresponding to the last section. According to Pujalte's definition (1974), the sandstones are medium or coarse grained with cross stratification, intercalated with thin siltstone beds. From the aspect of karst dynamics, this detrital mass, given its impermeable character, constitutes the base level of the hydrological network. Because of their plasticity prehistoric humans have been able to use the clays and siltstones that appear in this section as primary materials for making ceramics.

The reef limestone masses of Monte Limón – foreground – and Mullir – background

b) The Urgonian Complex

The reef limestones that constitute the major part of the surface of the area of study lie above the detrital base. They consist of a series of layers, in the main part thick limestone levels with a total depth in the area of 600 – 800m. This facies has been reviewed for the region by Ramirez de Pozo (1971), who characterised it as a very variable complex of sediments formed in both reefs – bioherm, biostrome watercourse deposits and lagoon facies.

The first layers, laid down above the Wealden materials, correspond to the Lower Bedoulian, which in this area is some 100 – 130m thick and can be found in the centre and south of Matienzo, constituting the valley floor of the depression in those areas not covered by the clays of decalcification. This section starts with sandstones and sandy clays which include orbitolina fossils. The first blocks of limestone are biomicrites with orbitolinas, rudistes and polyparies, also including *Toucasia* fossils. Concentrations of black silex nodules, of fossil origin, appear in these layers.

The next block, probably belonging to the middle and upper Bedoulian is, in the Matienzo zone, a section of massive limestone some 450-500m thick, with *Toucasia* and *Orbitolina* organized in thick bands. Given its character and its distinctive resistance to mechanical erosion supposes a prominent relief, very different to the light grey and whitish tones, with steep slopes on all the sides of the depression. The slopes that reach from the edge of the depression up to some 450m begin in the central zone of the valley, and many of the valley's caves emerge in this section. Dolomitation, of more or less importance, and usually associated with fault zones, can be seen locally as on the east slope of Monte Naso above the Cubija valley, caused by a N.E. – S.W. line of fractures.

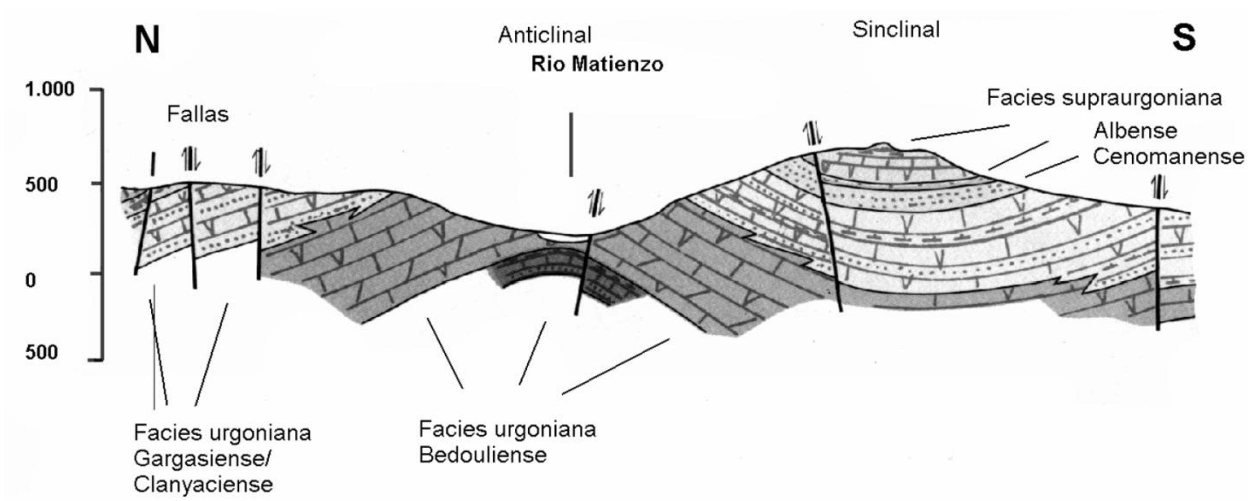
The last level of the Urgonian facies, of the Gargasian Clansayense, is formed of reef limestones which start to alternate with layers of detrital material – sandstones, marls and clays. In Matienzo, following the structure of the anticline, with the more modern materials on the periphery, this level forms the shape of an arc in which are carved the peaks of Monte Naso, El Cueto and half of the higher slopes of the Sierra de Beralta. In general, given the presence of intercalations of softer material, the relief tends towards somewhat gentler slopes, and in some areas the typical profile is that of steps, although the presence of many faulted blocks breaks the homogeneity of the relief, above all in the north east sector of the depression. Only the highest caves, situated above 350 – 400m, appear in this level. The high position of sandstone layers intercalated between the limestones, and their resistance to chemical erosion, causes the presence, in the terrigenous infill, of dolines, on the slopes and also in the layers of alterites which cover the gentlest slopes. These consist of not angular and, in some cases, quite rounded sandstone boulders. These light coloured boulders have sometimes been used by prehistoric peoples. In the highest part of this block, and also in the first Albian layers, strata with large nodules of black flint can be seen. In these places evidence has been found of their exploitation in prehistoric times.

c) The Supra-Urgonian

The post Urgonian facies, made up of the Albian levels (in reef facies) and Cenomanian, imply an increase in the diversification of materials. They outcrop on the East and West sides of Fuente Las Varas, in the sierra of Los Trillos – El Castro, which encloses Matienzo to the South and in the area that covers Cruz de Usaño pass to the top of Cotorro. In general these banks show a sub horizontal stratification, and cover the Aptian layers in the form of a ridge in the highest parts of the basin on the periphery of the area of study.

The lower limey Albian sections are very similar to the latest Aptian levels and are formed of grey limestones – biomicrites – with rudistes and orbitolinas. The Lower Cenomanian level, with a depth of some 75m, is made up of limestones, sandy limestones and calcarenites, intercalated by sandstones followed by grey limestones and calcarenites. The most modern layers to appear in the region are Upper Cenomanian and constitute a large limey block, some 150m deep, formed of brown and brownish limestones with some detrital intercalations. These materials form the upper part of the sierra of Los Trillos – El Castro and in the extreme South east, the summit of El Cotorro.

In Matienzo erosion has eliminated the sediments from the periods that followed. In the Turonian to the Campanian phases the area was submerged under a very deep sea at the bottom of which marls and clayey limestones were deposited. After it receded sediments associated with a coastal environment formed. In successive phases, during the Tertiary, a relatively shallow sea covered the area, although these sediments no longer remain.



Geological cross section through the Matienzo valley from North- South. Source: IGME 1:50,000 (sheet 59) modified.

Only in the Miocene did the sea retreat and no materials from this era remain. At that period, some 25 million years ago, the first phases of the Alpine orogeny took place, causing the folding, the current structure and the erosion of a large part of the preorogenic materials- the late Cenomanian layers. The Alpine orogeny then produced a series of folds which affected the materials deposited from the Wealden to the Cenomanian.

d) The Quaternary layer

Basically two types of overlying formations appear in Matienzo: debris slopes and clay infill of the karst basins. The first is the result of the destruction of limey cliffs by repeated freeze- thaw action that has the effect of lowering the rocky surface and produces regular slopes. This process results in accumulations of limestone boulders and blocks interspersed with micaceous sandstone boulders, coming from the detrital facies. These accumulations take the form of: cones of debris, chaotic deposits, deposits of a heterogeneous character or of many different sizes, with little uniformity, situated on the edges of the valley and on the hillsides. So the regular slopes, like the scree cemented in breccia are considered genetically related to cold conditions (Frochoso, 2001) which, in Matienzo, would be periglacial and would therefore be in the recent Pleistocene.

The products of decalcification infill the basin and they appear to cover a good part of the bottom of the three basins - Hozana, La Vega and La Secada- that make up the Matienzo depression and are formed of red clays, a residual product of the dissolution of limestone. They include, as well as the colloids, other insoluble elements such as silts, sands, ferric mineralization etc. Its depth is difficult to establish, although it is probably in a metric range, and above all it forms soils of the terra rossa /terra fusca type.

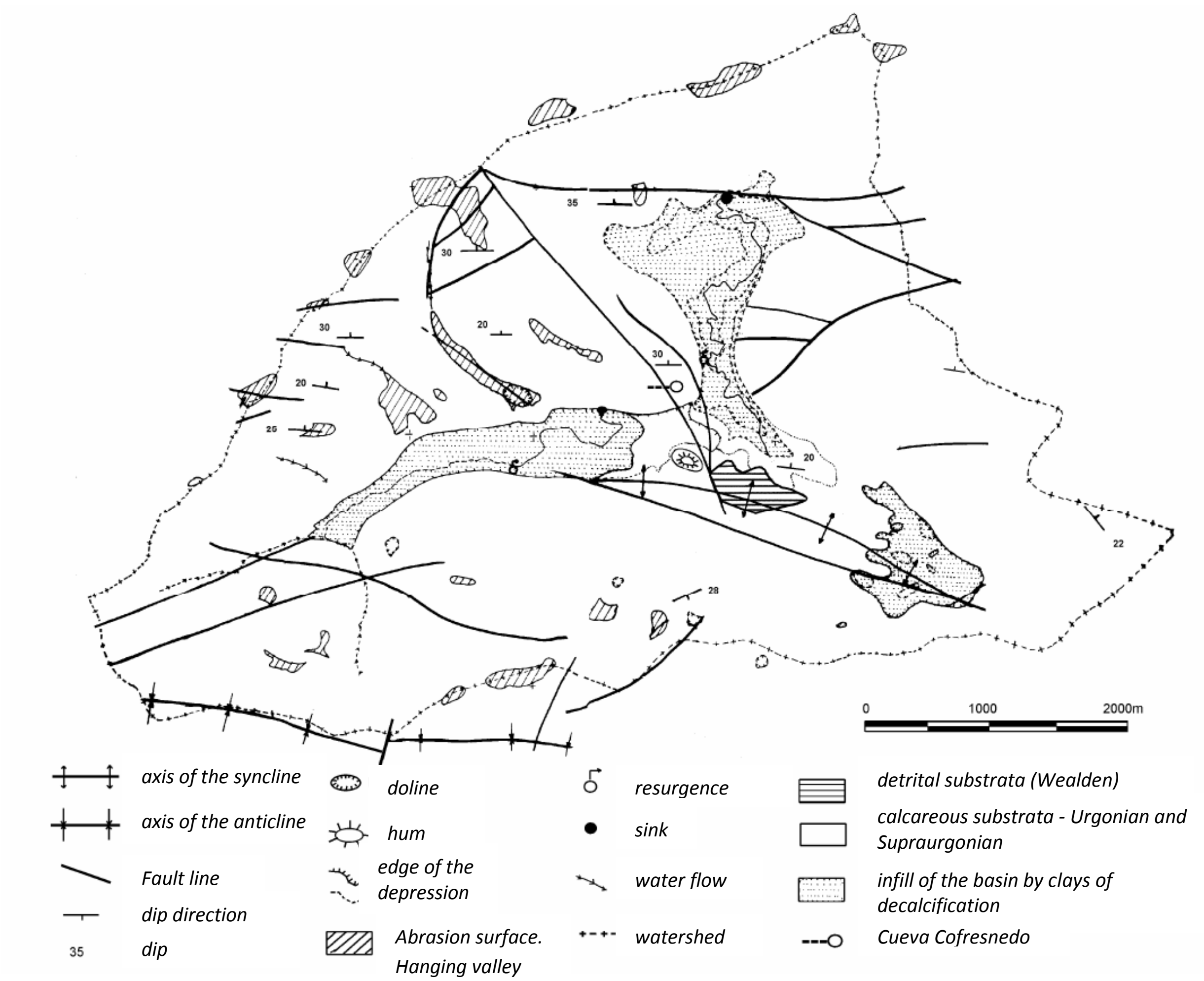
1.4. The structural dynamic

The structural form most representative of the area is the Matienzo anticline: here the beds form a gentle fold, of an anticlinal type, whose upper part was later stripped away by erosion leaving uncovered its core of most ancient materials – the series of clays and sandstones of the Wealden facies- and on its periphery the more modern sediments Urgonian and Supraurgonian reef limestones. At the same time as the limey materials were being uplifted during the Miocene, in what later became the Matienzo valley, the ridge of the anticline was becoming thinner, weaker and therefore more susceptible to erosion according to what is known about how inversion relief begins. Also, as a result of these movements, an extensive network of faults was produced, that cut the terrain into blocks of varying sizes and that acted as a starting point in the first phases of erosion.

During the Pliocene a levelling of these erosive surfaces was produced and the fluvial network began to be restricted to the valleys following the system of faults and cracks, to form the valleys.

The present day features of the relief were produced in the Pleistocene, in that successive terraces were formed in accordance with the watercourses going deep into the valleys and the limestone platform began to dissolve chemically. Relatively long periods of stability in the erosion resulted in hanging valleys and abrasion surfaces. The best examples of hanging valleys in Matienzo are Cubija, with a structural basis, and Arnilla, both at levels of 250m, that is 80m above the bottom of the depression. Regarding the abrasion surfaces, although they appear at various levels they have been very deformed by chemical erosion. The best example is the stretch at 500-530m, which appears as much on the summits as on the hillsides, above all on the western flank of the valley.

It is very difficult to imagine what the relief was like before the erosion and formation of the Matienzo depression. In the literature on this theme the idea that the Matienzo valley formed part of the valley of the river Asón is discussed. It is thought that the river would have followed the North-South axis from the Cruz Usaño pass until leaving by the coll that is now Fuente Las Varas pass, to then flow through the Solórzano valley towards the sea. (Fernández Guriérrez 1966, Mougnier 1969. This theory has not been proved, and nowadays has been called into question. For some authors, such as Tony Waltham (1981), there is as much proof that the River Asón followed a course towards the North as in the opposite direction. In whichever case the river Comellante would run along this Vega valley and would form an abrasion platform eroding the dome of the anticline. At that time the pre-karst surface would be at an



Geological sketch of Matienzo. My own work.

altitude of some 250m above the present day level of 200- 220m, that is at 450 -500m.This primitive valley would be bordered by a series of summits whose present day remains are Monte Mullir, La Muela, Piluca and Trillos. Perhaps these abrasion surfaces, some 250m above the present day ground, could be related to the marine abrasion platforms – coastal levels- situated at +200 – 220m above present day sea level, and that would suppose a late Miocene- Pliocene chronology. (i.e. between 6 and 12 million years) (Moñino et al 1987)

The limestone substrata, in combination with the network of faults and fissures, generated the distinct lateral depressions in the valley. This would be the case in the Hozana depression which would have had a truly Karstic origin, given that its flat bottom is to be found at some 240m, an altitude some 70m above that of the rest of the valley.

1.5. The evolution of the valley

The valley was born from the combination of two processes: the recession of the sides and the deepening of the bottom through karstic and mechanical erosion. The valley's sides went on evolving over time, undergoing a series of mechanical and chemical processes which together moulded them, making them less steep, bringing them closer to the level of equilibrium, to the point when the stored sediments retreated to the base of the talus.

Two slope processes can be seen on Matienzo's hillsides today: creeping and the effects of gravity on the hillside, above all the falling blocks type. Creeping is a kind of slow displacement of surface material on the ground -20- 30cms- and is caused by gravity. This phenomenon shows itself externally in the curvature of the base of the trunks of trees that grow on the hillsides, as on the South slope of Monte Naso. Creeping affects the thin soils formed on the long calcareous slopes, mostly composed of angular pebbles coming from the fall of blocks and a poor terrigenous matrix.

Chemical erosion of the rock is fundamental to the understanding of Matienzo's present day landscape. The dissolution of the limestone by rainwater acting upon the network of joints and fissures in the rock brings about the formation of a system of karstic conduits**.** These spaces are what mankind has used, throughout history and prehistory, as part of our cultural strategy of adaptation to the environment.

The most characteristic exokarstic formations of the area are the limestone pavements and the dolines. Both forms are generally found together, and the stretches of pavement usually surround the dolines. When the dissolution by water acts upon the massive Aptian beds it can be easily seen that it follows the network of joints, and in

Doline surrounded by limestone pavement. Summit of Naso

the most evolved phases typical needle karst appears.

When the limestone beds are thinner fields of stones, of mixed morphology, can be seen. The exokarstic geomorphology of Matienzo has been studied monographically in the area of La Vega, and its results can be extended to cover the whole depression. (Ullastre and Martorell 1975)

What also stands out is the presence on the hills and slopes of at least two abrasion surfaces. The highest forms an inclined plane at between 520 and 480m, forming peaks and hillocks in the mountains that encircle Matienzo. The second level is found between 260 and 230m and is distributed very uniformly, although no detailed study of it has been made. It appears as much on the hillside terraces *as* in the hanging valleys. Especially significant is the one in Cubija – carved from a fault line – and that of Arnillo, both on average around 260m maximum altitude. At this same height- 261m – a peak of residual relief, a hum, known as El Mazo, can be found. Moreover, at this same height, an important part of the big Matienzo caves are found, among them Cofresnedo, which appears to suggest a long period of stability in the valley's evolution, with a base level in this range.

Structural pavement, slopes above La Vega

A series of sedimentological and speleological studies have tried to learn the dynamics and chronology of the formation of the network of caves in the depression. Specifically for Matienzo, and apart from the previously mentioned, more general work, of Fernández Gutiérrez, a Karstogenetic plan, published by the group MUSS (1982) has been made. In it the idea of the possibility of differentiating at least three stages of karstic activity, separated by periods of stability, was put forward. In the first three basins, perhaps with a single drainage system, unlike the present day, would have existed in the Hozana, and La Vega and Seldesuto depressions. In this first stage the La Secada valley would have been independent of the other two depressions, at a time when the caves of Los Grajos (410m) and La Cubía would have been active. The Hozana depression would have drained through caves like La Codisera between 350 and 400m above sea level. In these first phases of drainage the flow was directed by the tectonic fragmentation derived from the geological substrata affected by the La Vega anticline.

There is evidence of the lowering of the phreatic level by some 100m in the second stage. The main sink would have been in the North of the depression, in Emboscados (situated at some 220m altitude). This sector would have captured the drainage from the La Vega and El Naso area where the caves of Soterraña and Cofresnedo, among others, would have formed.(225 and 235m) The Hozana basin would have been independent and still drained through Codisera or another as yet unknown cavity.

Subsequently the drainage of the Hozana basin would be captured, orientating the present day drainage towards the North East. There is still a cave which drains to the South, Orillón. The cause of these captures can be found in the predominance of the drainage of La Secada towards the North which produced a shorter and therefore quicker access to the sea, implying a steeper slope than the drainage routes towards the south. Thus the La Secada flow would capture that of all the other parts of Matienzo, first that of La Vega and afterwards that of Hozana. These phases can be identified thanks to the existence of three levels of caves in Matienzo. Thus, three caves can be seen, one above the other, on the side of El Naso, from top to bottom Rascavieja (300m), Sotarraña (225m), and Cueva Molino (165m), situated at base level. (Muss 1982)

New data obtained in the last few years by this same group creates the necessity of revising the previous model. The current information points to the existence of a very complex system of networks of galleries, though the available data is insufficient to permit a global design based on a solid foundation.(Corrin 1992)

In the Asón area, a study of the karstogenesis of the Peña Lavalle massif has been undertaken, identifying a series of phases of active karstification. Uranium Thorium dating in the caves of Cañuela, Cueva Fresca and Coventosa has allowed some of these episodes to be dated chronologically. (Delannoy and Mouverand, 1989)

The first phase of cave formation that can be identified would have dated roughly to the Mio- Pliocene. Networks, broken up by the current topography, can now be found at heights of 800m above sea level. The second level, which can be assigned to the Pliocene, corresponds to a time of tectonic and climatic stability, in which networks of caves situated today at between 650 and 500m, were formed.

The fossil network of Coventosa and the upper levels of Cueva Fresca and Cañuela were formed during the Old Quaternary. Chronologically this time could be placed at around 1.6ma. The intermediate levels of Coventosa, at heights of about 320 -380 m, can be set at some 320,000 years ago, according to U/Th dating. (Delannoy and Morverand 1989) Straw Gallery in Coventosa, situated now at 200m, the height having descended some 100m more, has been dated by U/Th at 66,000 years ago. The next level of this same cave has been dated to 37,000 years ago, in the Recent Quaternary.

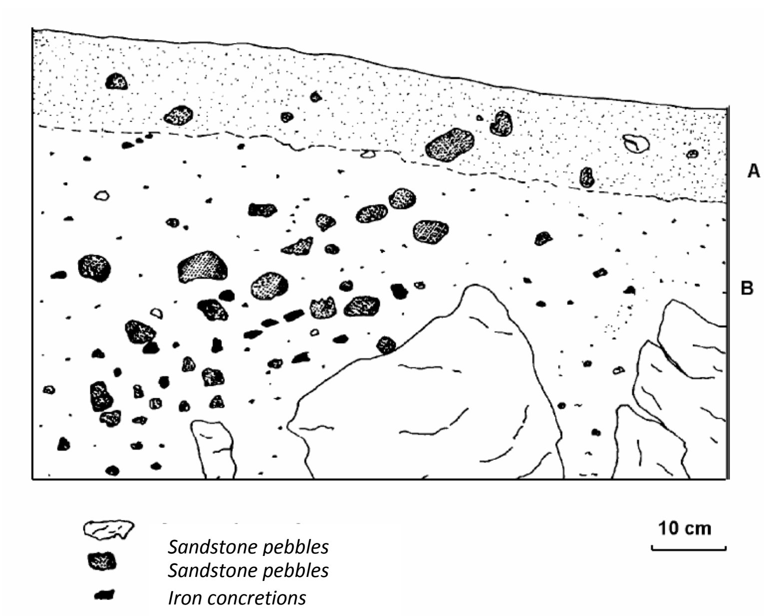
The application of this way of thinking to the caves of the Miera valley seems to give positive results, and the caves of this area can be grouped at the same levels, except for slight differences that can be explained by local landscape factors, according to a recent comprehensive study of the karst of this area (Fernández Acebo 1994).

A different approach to the problem of chronology and the formation of the Matienzo cave networks has been carried out by Mills and Waltham (1981) and Waltham (1981), based on the erosion rates of limestone. These authors calculated the volume of limestone missing from the valley, from its lowest ledge – Hozana, at 364m- to the current ground level. Supposing an erosion rate similar to the present day, calculated from the analysis of carbonates in the resurgences, between 1.8 and 2 million years would have been necessary to produce the valley as it is now. This calculation starts from a series of hypothetical assumptions, but the result is very reasonable, and is consistent with the results of other models. So a chronology of the early Quaternary-1.8 million years- is suggested for the 400m level in the studies carried out in the Miera and Asón basins.

The latest, and perhaps also the most interesting, line of investigation into the genesis of the karstic systems of the valley, starts with the study and comparison of the sediments deposited in the caves (Quinn 1995). Specifically, the magnetic susceptibility of various samples of sediments from different caves was compared and a statistic analysis of the cluster type was made, defining a series of the most similar groupings. It was found that caves with similar sediments appear, in general terms, to be at similar heights in respect to the valley, which allows the explanation that these groups of caves belong to the same time or chronological horizon.

After the valley was formed sedimentary infill began. In certain sectors accumulations of scree, of colluvial origin, appeared, made up of angular sharp edged clasts of a size not usually more than half a metre long. Deposits can be found at the foot of steep hillsides, as in the case of Montes Colina, Muela and Mullir and are the product of the repeated process of freezing and thawing. The valley bottom appears to be covered with important accumulations of red clays, clays of decalcification, which fill the basin**.** These deposits of Quaternary clays have given place to the rich soils that have conditioned human activity throughout prehistory.

The valley soils are of the *terra rossa* to *terra fusca* type. The *terra rossa* - chromic luvisols- is a decalcified soil, dark red to dull red in colour. This colour comes from the presence of colloids, partially dehydrated iron oxides that form concretions which impregnate the whole soil mass. If they are not well protected from the effects of erosion they evolve towards *terra fusca* passing through reds to more dun tones, though maintaining their structure.



Cross section of *terra fusca*, hillside N.W. of the Cubija valley

The *terra fusca* type of soils – orthic luvisols- present an A (B) C profile with *lehm* characteristics, developing above limestone, dark ochre to dull red in colour. They are plastic, decalcified soils with abundant peptitized iron hydroxide. The A horizon is poor in humus and thin; it is compact and separates into hard aggregates*,* analogous to those of horizon B, but thinner. Horizon B is also compact, presenting a very developed columnar prismatic structure that separates into units of several centimetres. It appears fissured into cracks in which filaments and secondary calcium carbonate dust form, resulting in the percolating water containing minerals. It is brightly coloured and forms a paste when wet and when dry has a nearly rocklike structure, making it very difficult to work. It constitutes a typical soil of the meadows and this is one of its basic uses in the area (Guitian et al. 1985).

In many parts of Matienzo patches of the soil type *Terra fusca* , a very fertile limestone soil, can be seen. It is peculiar in that it contains a lot of sandstone pebbles whose tones range yellow to white in colour. These materials come from the stripping off of layers of sandstone interstratified among the massive beds of Aptian limestone. The incline of the slopes has allowed the sandstone pebbles to roll and accumulate at the edges of the valley or to be incorporated into the clays that fill the dolines. In some archaeological deposits items manufactured from this material can be seen. Frequently the soils in level B on these slopes have lost their structure, due to an accumulation of mineralized iron.

2. The present day ecological environments

The whole North West sector of Cantabria is included in the biogeographic Orocantabrian province, which in turn forms part of the Euro-Siberian region. This is the domain of the oak woods of *Q. robur,-* practically wiped out today and replaced by hayfields and by *Q.ilex,* holm oaks***,*** on the limestone outcrops; much better conserved today because they are economically unprofitable***.*** As regards levels of vegetation in the Matienzo, it is almost completely within the hill range of 0 – 700m altitude, only some summits being within the mountain level of 700 – 1800m. The first two levels are forestal, but the concentration of human activity in the hill level means that the extent of woodlands has been reduced nowadays.

Today, in Matienzo, we find a mosaic of plant and animal partnerships, the fruit of the changing natural landscape. Because it is a relatively isolated and poor valley the human influence has not had the same impact as in the rest of the region, organized natural communities still remain, although it is difficult to establish when they were formed. The main characteristics of the biomes that have developed in the area of study are summarized in the following lines.

2.1 The valley bottom: riverbank and mixed woodland

Basically, the valley bottom is taken up by cultivation - above all hay meadows with some maize and small vegetable gardens near houses and, to a much lesser extent, by woodland along the riverbanks***.*** Given the narrowness of the Matienzo valley deciduous woodland would have covered the whole valley floor until a few hundred years ago***.*** Today the tree species on the edges of the depression are diversifying and merge with the plant communities on the hillsides.

The ecosystems here are very rich in species. Multispecies woods in which can be found oak (*Quercus robur*), chestnut (*Castanea sativa*), ash (*Fraxinus excelsior*), hazel (*Corylus avellana*), birch (*Betula alba*) and bay (*Laurus nobilis*), intermingled with lianas and epiphytes, which meet the shrubs and herbaceous nemoral plants of the shady areas, are places of great structural and functional complexity. The riverside groves consist of alder (*Alnus glutinosa*) and poplar (*Populus*). The shrubs include various willow (Salix) species that typically form the linear growth along the river banks. Species such as wild garlic (*Allinum ursinum*) or soapwort (*Saponaria*

Characteristic mixture of river bank species

officinalis) appear in the herbaceous level. These zones, close to water, are the habitat of a wide variety of mammals. Among the rodents the presence of the harvest mouse (*Micromys minutus*) stands out. It lives in pastures, crops and along river banks, a similar habitat to the field vole (*Microtus agrestis*). The common vole (*Pitymus pyrenaicus*) lives in damp meadows and pastures; even more tied to the water is the water vole (*Arvricola terrestris*). The shrew group is represented here by the water shrew (*Neomys fodiens*), which lives near rivers and pools, and the crowned shrew (*Sorex coronatus*) which inhabits damp woodland. Also common is the common mole (*Talpa caeca*) and the hedgehog (*Erinaceus europaeous*) although this species is much more widespread. Something similar happens with the shrews which also occupy wooded and scrubby areas. The polecat (*Mustela putorius*) appears in diverse biotopes, but as it is a good swimmer, likes to live close to rivers and streams. Although they disappeared in Matienzo half way through the last century otters (*Lutra lutra)* can still be seen on nearby tributaries of the Asón.

Dam and mill at La Cuevona on the Matienzo river.

Various species of fish, such as the minnow (*Phoxinus phoxinus*), the European eel (*Anguilla anguilla)* and the brown trout *(Salmo trutta fario)* live in Matienzo's rivers. In some water courses there are still white clawed crayfish *(Austropotamobius pallipes)*, extinct in most of the region. A reptile, the viperine water snake *(Natrix maura)* can also be found in the rivers and streams.

2.2 The hillsides and summits

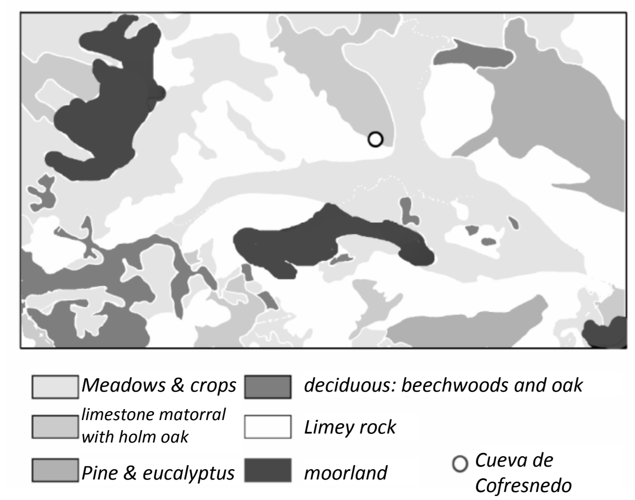
The vegetation of the hillsides and summits is much more as it was before humans had any impact**.** On limestone substrata- the greatest surface extension- typical karst vegetation, holm oak thickets, and in certain places beech, has developed. Deciduous woods, basically beech and oak as well as more mixed woodland, can be found on marls and Wealden sandstone substrata.

The limestone hillsides: the Cantabrian holm oak woods

The potential vegetation of these zones, with high infiltration rates produced by the limestone substrata, consists of shrubland of Mediterranean evergreens and beechwoods. Today much more than half of the former have been preserved. So very dense woods and copses of matorral can be seen at high altitude, in which the dominant species is the holm oak accompanied by perennial Mediterranean sclerophyllous species associated with Atlantic flora. They appear to be always linked to calcareous soils.

MAP: limey rock

moorland Cueva de Cofresnedo



Map of present day vegetation surrounding Cofresnedo. (After MAPA (1985), simplified.

Protected by the limestone cliffs species such as hawthorn (*Crataegus monogyna*) and some figs (*Ficus carica*) can be found accompanying the holm oak (Quercus ilex).The shrub layer is composed of bullace *(Prunus insititia),* strawberry tree *(Arbustus unedo)*, the labiérnago *(Phyllyrea latifolia),* the bay *(Laurus nobilis)*, the spindle tree *(Euonymus europaeus)*, the wayfaring tree *(Viburnum lantana),* the buckthorn *(Rhamnus alaternus)* and the wild privet *(Ligustrum vulgare).*The shrubby plants are represented by heaths *(Erica arborea, E.vagans, Daboecia cantabrica),* heather *(Calluna vulgaris and Ulex europaeus)* and brambles *(Rubus ulmiformis).* This level includes a multitude of different species such as columbine *(Aquilegia vulgaris),* common madder *(Rubia peregrine)* and the wood spurge *(euphorbia amygdaloides).* Also, and above all in the more closed holm oak woods, is a dense epiphyte level, with sarsaparilla *(Smilax aspera),* ivy *(Haedera hiedra)* and black bryony *(Tamus comunis).*

On Matienzo's limestone hillsides more or less isolated holm oaks can still be found, integrated into a mosaic of stretches of matorral and hay meadows that on occasion, due to the abandonment of the fields, form grassland with low scrub. Important beech woods can be found on the limey lithosols on some north facing slopes, as in the extreme southwest of the valley from Sel de Suto to the heights of Alisas and Linares. (M.A.P.A. 1985) But in the reconstruction of the potential vegetation holm oak matorral seems to cover most of half the slopes and summits, around 70% of the total surface.

The Atlantic matorral

Atlantic heathland covering large areas has arisen as a consequence of the degradation and disturbance of the deciduous woodlands. It is only a major feature on very steeply sloping, generally significantly sunny areas. This last factor, the southern orientation, is decisive in determining its extent. It is made up of patches of various species of heaths and gorses. First the frequency of the gorse (*Ulex europaeus),* known locally as árguma, must be mentioned. It grows on acid soils and is the basic plant of the moors. Among the heathers the Irish heath *(Daboecia cantabrica),* is common as is ling *(Calluna vulgaris),* the Cornish heath *(Erica vagans),* and in certain places where the soil is siliceous, the cross-leaved heath *(Erica tetralix).* The herbaceous layer includes some species of grasses and small plants.

In the holm oak matorral, as in the siliceous matorral, live a wide variety of small mammals as well as various reptiles such as the Iberian cross adder *(Vipera seoanei),* the smooth snake *(Coronella austriaca)*, the three toed skink *(Chalcides chalcides),* the European green lizard *(Lacerta viridis)* and in poorly drained areas the viviparous or common lizard *(Lacerta vivipara).* The lower slopes with matorral and rocky areas are used by various rodents, like the wood mouse *(Apodemus sylvaticus),* or the field vole

(Microtus agrestis). The common vole *(Microtus arvalis)* inhabits fields, meadows and pastures and the garden dormouse *(Eliomys quercinus)* is found in shrubby places and the matorral, as well as in stony areas. Rabbits and hares are today represented by the brown hare *(Lepus europaeus)* in open areas with scattered matorral.

As regards predators, it is said that various species of shrew, such as the pygmy shrew *(Sorex minutes),* the greater white toothed shrew *Crocidura russula),* and the lesser white-toothed shrew (*Crocidura suaveolens*) which prefers dry and sunny hillsides, hunt here. The genet *(Genetta genetta)* lives in dry matorral or rocky and tree covered areas. Among the mustelids, it is worth noting the presence in these areas of badgers *(Meles meles),* the weasel *(Mustela nivalis)* and the stoat *(M. erminea),* which as well as open land visits other biotopes, like water courses. The only wild canine in the area is the red fox *(Vulpes vulpes),* though the nearby heights of Soba are occasionally visited by groups of wolves *(Canis lupus)*. During the Atlantic the presence of two species of caprids was noted in the environs of Matienzo: *Capra pyrenaic,* the Iberian ilex or wild goat, and *Rupicapra rupicapra,* the chamois, both hunted by prehistoric humans. The two species utilized the hillsides and summits, but in different ways. The chamois penetrates deeper into the woods than the wild goat which can live in the steeper zones, though it frequents the highest belt of woodlands, a fringe made up of birch, *servales*, and maples that mark the lowest limit of their distribution.

The deciduous woods

Although beech is the best represented woodland in present day Matienzo, differences in conservation must be taken into account. The beech prefers shady hillsides which receive less sunlight because this means more water is available to the plants, making this species compete more favourably with other Fagaceae like the oaks. (Acedo et al. 1990) The location of the beeches in shady areas has played a good part in the fact that they have survived better than the oaks which prefer sunny slopes which are more attractive for agricultural use, as they are more productive. Therefore we can assume that on the south facing slopes (those on the northern side of the valley), today used as pastureland, oak woods and mixed woodland (only partially preserved today), would have established themselves. Beech trees *(Fagus sylvatica),* cover part of the arc of the south eastern hillsides, facing towards the north. This is the beech wood of Los Trillos, below the Puerto de Alisas. Another smaller area can be found on the side of the Monte del Duengo, near Fuente Las Varas.(M.A.P.A. 1985)We can suppose that, before the deforestation, beech woods would have covered all the Southern hillsides - a wide expanse facing North. The following can be found in the beechwoods; yew *(Taxus baccata),* pedunculate oak *(Quercus robur),* common ash *(Fraxinus excelsior),* rowans or whitebeam *(Sorbus aria),* as well as hazels *(Corylus avellana),* hollies *(Ilex aquifolium),* and heathers *(Genista sp. and Erica sp.).* The ground is covered by a layer of fallen leaves on which only very small species grow, owing to the limited amount of light that reaches this level. The mixed woods and oak woods were basically economically important to the groups of humans who lived in the tardiglacial and holocene periods in this area, as can be seen in the section on the study of resources.

The wooded places are populated by a diverse and complex fauna, a large proportion of which also occupy adjacent biotopes such as the matorral and rocky places. The bank vole (*Clethrionomys glareolus)* appears among the microtus, and the pine vole *(Pitymys pyrenaicus)* is frequently found in less densely wooded areas. The wood mouse (Apodemus sylvaticus), though very widespread, is found in the woods. The red squirrel (*Sciurus vulgaris*) is abundant in wooded areas with a preference for hazel thickets and relatively more abundant in beech woods is the edible dormouse (*Glis glis*).

Beech wood on limestone pavement at Sel de Suto

Several species of shrew, like the crowned shrew *(Sorex coronatus)* also appear among the pure insectivores, as does the hedgehog (*Erinaceus europaeus).* Among the carnivores, the marten prefers the beech woods, the beech marten (*Martes foina)* likes scrubby, rocky places and the least weasel *(Mustela nivalis)*is more ubiquitous. The wildcat *(Felix sylvestris)* has not been accredited with a present day presence, but it appears in the Holocene series, as in that of the Cubio Redondo. This species is a typical inhabitant of the woods and areas of matorral around Cantabria.

The wild boar (S*us scrofa)* prefers the woods but frequents other environments, such as clearings, meadows and glades where it feeds, being abundant in the mountains of Matienzo today. Groups of roe deer *(Capreolus capreolus)* are also often seen and heard on the mid height and high slopes of the Asón. This species, together with the red deer *(cervus elaphus)* and the wild boar played an important role in the survival of groups of humans during the Late Glacial and Early Holocene in the zone, as has been shown by the study of sets of bones found in its sediments. The roe deer lives in woods with clearings. The red deer completely disappeared from Cantabria half way through the 19th century and was reintroduced later in the Saja Reserve during the 1960s with the reintroduced animals coming from other places in the peninsula. It is linked to leafy forests but also occupies coniferous woods and scrubland. (Altuna 1995)

In a reconstruction of the valley's potential vegetation during the holocene we could place the mixed deciduous woods in the valley bottom, and beech woods on the north and west facing limestone hillsides. The rest of the limestone slopes would, like today, be covered with matorral and holm oak and on the hillsides with clayey, marly and mixed substrata would be mixed deciduous woods dominated by oaks mixed with other deciduous species. The present day vegetation is the result of a series of factors that, over the last three or four centuries, have had a dramatic effect. During the seventeenth and eighteenth centuries developing pressure on the forests to supply the ironworks -by means of vegetable charcoal - and the shipbuilders became very intense. All the woods in the coastal sector and in the east of Cantabria were harvested before the twentieth century. (Garcia Alonso 1999). It was precisely the exhaustion of this resource, combined with other factors that caused the decline of these industries. It is paradoxical that, in recent years, the forests are recuperating.

However, the regeneration of the vegetative groupings has not necessarily reproduced the associations that existed previously. Species like the holm oak, which don't require the same levels of humidity as the deciduous woods, have occupied zones that, until the middle ages, would have been occupied by oak woods. As a result of all this it is very risky to assume a scheme of past vegetation based on the present day.

3. The evolution of the biotopes

This article is only dealing with the period between end of the Pleistocene and the Holocene because most of the available bibliography contains very limited chronological data. In order to get closer to the evolution of the human ecosystem we must sketch a picture of the earlier climate, which specifies the climatic evolution during this period.

Neither pollen nor paleobotanical information is available in the deposits or peat bogs located in the area of study, so information has to be extrapolated from other deposits, specifically in the nearby valleys of the Miera and the Asón. In the first information is available on the Cueva Del Rascaño sequence (González Echegaray y Barandiaron 1981) which brings together sedimentological (Laville and Hoyos 1981) and pollen information (Boyer-Klein 1981) and which covers Late Glacial development. In the lower Asón basin the cave of Otero provides some data on the landscape of the coastal platform at the end of the Late Glacial and the start of the Holocene. For the reconstruction of the landscape and climate of this last period other, external deposits must be turned to; so we remain without precise information about the first part of the Upper Palaeolithic.

The similarity between the landscape and ecology of the mid course of the Miera, where the cave of Rascaño is situated, and the Matienzo depression, permits the extrapolation of their conclusions to include a reconstruction of the landscape**.** Rascaño is found in a narrow valley, some 50m above the river bed, 20 -25 kilometres from the sea. It is also set in a limestone environment and in both cases long and pronounced hillsides protect the valleys. Nowadays the slopes are covered in matorral with some hazels in sheltered spots. On the valley bottom oaks, alders and ash trees appear as well as some eucalyptus.

Chronological climatic and cultural plan

study	chronology B.P.	climate	regional cultural age
Holocene/postglacial			
Sub boreal	5300 – 2700	temperate wet	Chalcolithic/Bronze
Atlantic	8100 – 5300	temperate wet	Mesolithic/Neolithic
Boreal	9400 – 8100	cool wet	Mesolithic
Preboreal	10200 – 9400	cool wet	Azilian
Final Pleistocene/ Late glacial			
Dryas III	10800 – 10200	cold/wet	Azilian
Allerod	11800 -10800	cool/wet	Final Upper Magdalenian
Dryas II	12300 – 11800	cold wet/dry	Upper Magdalenian
Bölling	13300 -12700	cool wet	Middle Magdalenian
Dryas I	16200 – 13399	cold- cool/wet – dry	Lower Magdalenian
Lascaux	18000 – 16200	wet and cool	Solutrean
Older Dryas	18800 – 18000	wet and cold	
Laugerie	20000 – 18800	wet to very wet; cool	

The pollen analysis of Rascaño reflects well the characteristic alternation of cold dry and more temperate and wetter periods produced during the last phases of the Wurm. The 8th and 9th levels, dated at up to 30000 B.P., and with sporadic Aurignacian occupation, appears to have formed in a cold, but not intensely cold, climate. At the 7th level, radiocarbon dated at up to 27000B.P. the climate became more temperate, and it has been interpreted as the end of the cold phases of the previous levels. Also, the increase in sandy and limey materials can be seen as a reflection of the humidity (Laville y Hoyos 1981) After an hiatus caused by the reactivation of the system as a result of increased precipitation, the 6th and 5th levels (these last dated to 16433 B.P.) were deposited under temperate and damp climatic conditions, and the artefacts can be ascribed to the Archaic Magdalenian III, which coincides with the Lascaux interstadial. The temperate character of this climate is also reflected in the pollen series in that, although the arboreal pollen does not exceed 17%, juniper and hazel appear alongside pine. The importance of the filicales, as well as the presence of aquatic plants and cyperaceae, demonstrates the importance of the humidity.

As the occupation advances and levels 4-1 and 4-2 (dated at 15988B.P.) are formed the climate becomes colder and drier. These levels have been assigned to the climate phase that follows Lascaux, the Dryas I (Hoyo's Cantabria III). The pollen sequence clearly reflects this cooling, and so the hazel disappears, the juniper decreases and only pines, which disappeared in the coldest times, remain. The humidity indicators- filicales (ferns) and aquatic plants-are radically reduced and the grasses, which in the previous block exceeded 20%, are, in a good part, substituted by *carduaceae* and the *caryophyllaceae*, which dominate the herbaceous strata. The percentages of pollen reveal a small more temperate pulsation within this cold period, with an increase in arboreal pollen, dominated by pines but with various willows present, reflecting a definite increase in humidity. But this is followed by a return to the cold conditions of the base level. This group is attributed to the Lower Magdalenian.

That the human occupations of level 3 are intercalated between levels of a fluvial genesis, is evidence of the reactivation of the circulation of water within the karst, interpretable as an increase in rainfall. This level, dated to 15173 B.P., is considered to have been formed in the interstadial of the Angles or Cantabria IV, according to Hoyo's sedimentological plan. Culturally it can be assigned to the Middle Magdalenian. This improvement in the climate is reflected in the pollen series with an increase in arboreal pollen that reaches 10% and includes hazel and juniper. The increase in humidity is reflected in the higher percentage of the filicales and cyperaceae (sedges). Also oak appears in some samples.

The following climatic period, Hoyo's Cantabria V pulsation, does not appear in the sequence because of the existence of an erosive lake. The sediments from this time were eliminated by the reactivation of the system during the next period. The climate during the Cantabria V period was variable, from wet and cold at the start to wetter and less cold at the end. The next climatic period, the Bölling interstadial, (approximately equivalent to Cantabria VI) commences with a very wet period which explains the hiatus of more than two thousand years in the level 2.3.

The levels 2.3, 2.2 and 2.1 have been dated at between 12896 and 12282 B.P., and their artefacts can be assigned to the Upper and Final Upper Magdalenian. Climatically, they were formed during the end of the Bölling and the Dryas II (in Hoyo's Cantabria II), with a climate characterized by cold, wet at the beginning and later somewhat drier. Specifically the 2.3 and 2.1 levels show solifluxion contributions which include crioclastic elements. These are separated by a 2.2 level the powdery texture of which indicates that it was formed at a time a little hydrological activity. The grouping can be interpreted as being formed in a cold, not very wet, climate followed by a drier period becoming somewhat wetter towards the end. Only one pollen sample from this group, from level 2.1, has been analysed, and contains a reduced number of grains. It presents with low values of tree pollen, about 6%, but with an important amount of hazel which dominates the pine. It is a relatively wet period as is shown by the intermediate filicale values.

The next level, 1.3, dated to 10486 B.P. B. sits In a discordant manner above 2.1 and reveals the existence of another erosive lake. This supposes the hydrological reactivation of the system that would be produced during a wet climatic period, which has been identified as the Allerod (Cantabria VII). The climate at this time was wet to very wet and cool, so causing the erosion. The formation of levels 1.2 and 1.3 in Rascaño took place in the last cold pulsation of the Tardiglacial, the Dryas III, which approximately coincides with Cantabria IX. Level 1.3 presents indicators for gelivation and can be interpreted as a cold, dry climate. In level 1.2 there is less gelivation and the abundance of fine materials shows a wetter environment. So this group can be considered to have formed in a climate that started cold and dry and became wetter at the end. It is thought that, in general, the cold in the Dryas III was less intense than in previous interstadials. At this time Rascaño was occupied by Azilian groups. The pollen samples from these levels show an interstadial character with a notable rise in arboreal pollen, the majority of which is hazel. Other indications of this improvement are the appearance of other tree species such as the oak and the alder and the fact that filicale levels remain high.

These pollen frequencies of the various plant types in the Rascaño series allow a sketch to be made of the vegetative environment in these limestone basins during the Tardiglacial. The more temperate moments, the interstadial phases, usually coincide with increases in humidity. Then little woods of pine trees (*Pinus silvestris)* mixed with scattered groups of birch *(Betula)* appear on the more sheltered hillsides. On the dry limestone slopes, where other trees cannot grow, groups of juniper *(Juniperus)* develop, combined with stretches of stretches of scrub composed of a thin covering of- Ericacea- heather and gorse. The shrub and herbaceous level includes a significant variety of grasses and mixed vegetation. Mixed woodland which includes hazel *(Corylus)* grows along the valley edges and also along the riverbanks where alders *(Alnus)* and willows *(Salix)* also grow. The development of ferns and mosses was very important at this time in wide cracks in the hillsides. At this time the development of ferns and mosses in wide cracks in the hillside, at the base of cliffs, on the walls of cave mouths and in the areas protected by woodland, became very important.

The tree stratum recedes considerably in the cold dry interstadials, giving way to matorral and ericaceae and the grasses of the herbaceous layer. On sheltered slopes at lower altitudes some smaller woods of pine with some spots of birch appear. On the valley bottom some willows can grow. The ferns become much less significant, reacting to the decrease in humidity, which they faithfully reflect. The corollary of a cold, dry climate is reflected in the increase of *Cicoriaceas.*

The cave of Otero can be found in a sheltered place in a hilly area near the estuary of the river Asón. In its stratigraphic series we can find a terrigenous layer with Magdalenian occupations covered by a calcite layer that separates it from a probable Azilian level. *(Leroi- Gourhan 1966)* The pollen diagram shows a general increase in deciduous tree pollen, with oak, alder, lime and boxwood in the Final Magdalenian. Also higher levels of filicales can be seen which can be interpreted as an indication of a damper spell. So landscape features reveal the presence, in cool periods, of greater ecological diversity that must be explained by their positions in an area with many places protected from the prevailing winds.

Level I of Otero, with an epipaleolithic occupation, must have formed in a Pre-boreal period, and so in its pollen diagram a wide representation of species appears, showing the climate becoming more temperate. The Pre-boreal is the first period of the Holocene, a wetter and colder time than the Dryas III. The warming of the climate increases progressively and is now irreversible, except for some cold spells. It corresponds to the development of the Azilian.

In the next climate period, the Boreal, (8800 – 8100 B.P.) the trend towards a gentler climate is reinforced, temperatures and humidity increasing, although at the end a drier spell can be detected. Mesolithic deposits of the midden type are formed in caves and shelters during this phase, as much on the coastal fringe as in the interior.

Information about the next period, the Atlantic (8100 – 5300 B.P.) comes, above all, from peat lands and from deposits. This time was what is known as the "optimal postglacial climate," a warmer and wetter time than the present, which concluded the process of improvement. It is characterized by temperatures higher than the Boreal and also by an increase in humidity. The increase in the vegetative association, *Quercum mixtum,* is appreciable, accompanied by high values of hazel as well as alder, ash and lime, with the beech progressing as well. Culturally, the Mesolithic continues to develop and, at its end, the presence of Neolithic techniques and production methods can be detected.(*circa* 6000B.P) Pollen studies made in peat lands with wide radiocarbon studies, have detected the expansion of the beech, which could be related to human activity, at a time that is culturally Neolithic.

The Sub- Boreal (5300 – 2700B.P.) does not differ climatically from the previous period. Everything indicates that at these times, the Boreal and the Atlantic, temperate deciduous woodlands dominated by oaks and hazels, were present, with a few pines in coastal areas. At altitude pines continue to dominate the groves but now the deciduous trees appear in greater numbers.