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GUIDE FOR THE EXCURSION FROM SAN JUAN DE  
LA PEÑA TO VALLE DE TENA

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Summary: High Aragon and its climate.- 2. Description of the itinerary. a) Jaca - Santa Cruz de la Serós. b) Santa Cruz de la Serós - San Juan de la Peña. c) San Juan - Oroel. d) Oroel - Sabiñánigo. e) Sabiñánigo - Biescas. f) The Tena Valley.

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### HIGH ARAGON AND ITS CLIMATE

The high Aragonese climate is clearly marked by two important phenomena: a predominant air flow with a NW-SE course and a series of mountain ranges in an E-W arrangement that intercept that flow. These two phenomena produce a successive föhn effect under the lee of each mountain range bringing about a progressive drying of the air, a lesser thermic inertia and, in short, an increasing continentality from NW to SE. The annual thermic oscillation changes roughly from 20°C to 30°C from one extreme to the other.

The pluviometric situation follows a parallel course, from an Atlantic type with its maximum in winter and its minimum in July at the farthest NW region, to a continental type under Mediterranean influence with a spring maximum, a lesser one in autumn, a primary minimum in July and a secondary one in January - February at the farthest SE region.

Towards the end of spring and the beginning of summer, a large scale convective activity commences, especially in the sunny areas of the high mountain ranges. The originating clouds are blown by the westerly winds and precipitate as storms in the Sobrarbe region. For this reason the drought point in July is very important and probably more intense than in any other area of the Pyrenees. In mid August the convective activity becomes general and in September it joins the Balearic cyclon effects, which produces abundant autumn rains in the Mediterranean and affects, although slightly, this region.

In spring the territory shows great climatic variations. The convective activity is still too weak to become general, and the Atlantic cyclons are frequently counteracted by the anticyclons, or its branches, originating in the Azores Islands. Although the pluviometric average is high, the interannual variability is enormous. Once the spring is well advanced, thermic drops are also relatively frequent especially in those regions subject to inversions. In March - April strong winds, coupled to low humidity (at times less than 10%) produce brutal evaporations that, in spite of their short duration, affect seedlings and bud shootings. This spring variability conditions many aspects of the high Aragonese communities and it often induces a strong genetic heterogeneity, as it happens for example, in the oaks.

The NW-SE gradient, present nearly in all climatic characteristics of the region, is modified by the most important relief formations. The great limestone barrier of the Interior Mountain Ranges, Alanos, Bisaurín, Aspe, Telera, Tendeñera, exercises a considerable screen effect on the Cantabric air, separating to the North a generally depressed region, made of soft materials, slate, clay, etc., with frequent ascensional condensations and a marked Atlantic character. Here the mountains are covered with beech forests and misty pastures, the most representative of which is the "cervunal ansotano". The föhn effect is very pronounced in the Southern borders of the mountain ranges, creating a landscape very well adapted to wind and drought, a sort of oro-Mediterranean steppe in the highlands and patches of evergreen oaks at the entrance of the gorges that cross the Interior Mountain Ranges.

Flanking the Southern borders of the aforesaid mountain ranges, there is a many-folded territory of median height made of clay-marls and sandstone in thin alternate layers (flysch). Its shady places sustain coniferous tree forests and the sunny ones, greatly eroded by nomadic crops, present a scrub of box with little patches of oaks. The ridges are often rounded and have a better preserved soil covered with vegetation well adapted to wind and with open groves of Pinus sylvestris and Echinopartum horridum (prickly pears). In general winter precipitation is abundant causing the marly strata to pass rapidly from flooding to drought.

To the South of the flysch territory, there is a wide valley running from E to W, traversed most of it by the Aragon River, which receives several names along its course: Canal de Berdún at its Westernmost end, Campo de Jaca at its center and Val Ancha at its Easternmost end. The valley is carved from marly materials, covered mostly by sediments that form extensive systems of glacis and terraces. The dominant air flow is from the West, superposed by mountain breezes that traverse it also alternately in longitudinal direction. The average annual temperature at the Westernmost end is about 13°C and the precipitation about 700 mm. with a clear maximum in winter. The natural vegetation consists of evergreen oaks. Generally the excess water in winter favors the leaching and acidifying of the upper layers of the soil. The average annual temperature at the Easternmost end is 10°C, the precipitation nears the 900 mm. point with equinoctial maximum in late spring and autumn. Marcescent oaks constitute the natural vegetation and local phenomena of thermic inversion are frequent.

The pre - Pyrenean country proper extends still further to the South, separated from the Canal de Berdún by the conglomeratic reliefs of San Juan de la Peña, Escalatin and Oroel. This territory is very uneven and made of clays and sandstone alternating in powerful banks, greatly eroded and broken up by nomadic cultivation, covered with bushes, Genista scorpius, groves of Juniperus oxycedrus, dispersed groves of marcescent oaks and Pinus clusiana, or evergreen oaks in the drier sunny areas. The air reaches this region in a very low hygrometric state, having discharged its humidity along the aforesaid mountain ranges. The character of this region, therefore, is very continental. Sharp thermic oscillations, summer heat, pronounced local temperature inversions, abrupt alternating situations of flooding and drought, cryodisturbance phenomena of the soil favoring aeolian and hydric erosion, are the characteristic climatic phenomena of this pre - Pyrenean region that exert a high selective environmental pressure on its biotic communities.

The abrupt Exterior Mountain Ranges, of limestone, whose altitude ranges from 1.500 m. to 2.000 m. separates the above region from the Oscense Somontano. Here the upper part of the shady places still show ascending condensations with relatively frequent fogs, and pine groves (Pinus sylvestris) with beech trees, box and large quantity of moss on the ground acting as effective hydric regulator of the ecosystem, abound. The sunny places, however, subject to pronounced drying effects, are covered with dry scrub, degraded with Quercus coccifera and Juniperus oxycedrus. The relict Arbutus unedo groves deserve special mention. They take refuge in gorges with topoclimates of greater evenness and humidity and are remains of a prequaternary lauraceous plants (laurisilva).

## 2. DESCRIPTION OF THE ITINERARY.

a) Jaca - Santa Cruz de la Serós.- On leaving Jaca, the road to Pamplona, which follows the Interior Depression, is taken. Seven kilometers down the road the Center owns a property named "El Boalar", where the Center will be builded in the future. This property forms part of the ancient "Boalar de Jaca", a territory where cattle wintered, being used, besides, in the extraction of fire wood. The lower part, on coluvial slopes that descend to terraces of the Aragon River, was always exploited with cereal crops. The Center has installed irrigation by aspersion and has initiated a reconstruction process of the edaphic resources, maintaining a type of pasture adapted to the environmental conditions of this territory (Festuca arundinacea and Trifolium pratense). The better preserved plots, adjoining the Atarés river, are used to study wild ecotypes of possibly valuable pastoral species. The rest of the property, set on alternating layers of sandstone and thick marl, shelter a good representation of the pre - Pyrenean landscapes and species. The shady parts sustain little developed woods of Pinus sylvestris, marcescent oak, maple - trees and Sorbus torminalis, whose structure, productivity and nutrient cycle are studied. The sunny parts maintain dry marcescent oaks with ever green oaks in rocky ridges of poorer ground. In the upper parts, with a relatively flat relief, marcescent oaks, acidified by intense winter leaching, are found. A tower with a gothic window rises at mid slope, the remains of a feudal castle, behind which the Center plans to build a zoological garden. A small try in this matter has already been done in the lower part of the shady places, near the cultivated land, with wild pigs in semiliberty. The property landscape is very similar to that of the little mountain ranges than border the South of the Interior Depression. The mountain chain to the North of the Aragon River constitutes the Southern border of the flysch territory. The glacis that descend from its slopes can be seen from here. They join high terraces with shallow soils, somewhat rubified, warm in spring, but dry and greatly affected by the wind. The subsequent erosion of those glacis and terraces produced their dissection, forming ample depressions, with deep vertic soils, very difficult to till, subject to winter swamping and spring colds.

Four kilometers from "El Boalar", the road to Pamplona is left and a side road to the South leading to Santa Cruz de la Serós, is taken. The Canal de Berdún, away of this side road, that follows the Aragon River on its downward course, presents a more Mediterranean landscape with ever green oaks in glacis and upper terraces that evidence an important climatic change. Here the road crosses a little mountain chain of clay - marl and sandstone, similar to the one described at the Boalar and reaches the village of Santa Cruz de la Serós, at the foot of the massif of San Juan de la Peña, very sheltered, especially in winter, from southerly and westerly winds. This town, of great architectural beauty, possessed a monastery of Benedictine nuns dependent of the monastery at San Juan de la Peña, founded in the tenth century. It possesses two churches of special interest, the small parish church, dedicated to St. Caprasius, situated at the entrance, and the conventual church of Santa María.

b) Santa Cruz de la Serós - San Juan de la Peña.- A recently constructed forest path is taken from Santa Cruz, which penetrates the stream that bears its name. After driving for three kilometers, a clearing, arranged for picnicking, is reached. From here it is easy to obtain a first idea of the structure of the San Juan massif. It is the remains of a massive conglomeratic synclinal that rests on the marls of the Interior Depression, constituting an inverted relief through differential erosion. Steep cliffs border the synclinal, but its interior relief is relatively smooth with a gradient difference of nearly 400 m. between the highest and lowest points. San Salvador, at the westernmost end, is the highest peak and has an altitude of 1.556 m. above sea level.

Coniferous forests occupy the upper part of the conglomeratic shield, with Abies alba and beech trees in the depressions and drainage lines, and Pinus sylvestris in the ridges. A forest of Pinus sylvestris with beech trees in the depressions and undergrowth of holly trees, occupies the lower part, known as Monte Pano. Pinus clusiana trees appear on the steeper sunny slopes.

Groves of evergreen oaks are found at the foot of the Southernly oriented cliffs, colonizing the colluvium and the sunny slopes to the left of the Santa Cruz gorge. Mixed forests, with a rich variety of species, such as beech trees, linden trees, ash trees, maple trees, hazel - nut trees, etc. appear at the foot of the Northernly oriented steep rocks. Mossy pine groves, with Pinus sylvestris and box in the undergrowth are found further down, always on the shady side.

Prickly pads of Echinopartum horridum occupy the crests that border the synclinal.

Detailed topoclimatic studies are being conducted on this massif, given its variety of relief and exposure. To this purpose a transection of meteorological stations equipped with graphic instruments of weekly control, have been mounted. It starts at the upper part of the synclinal, passes through the shady slope, the bottom of Santa Cruz stream and ends at the evergreen oaks groves of the sunny slope. Thermopluviometric stations have also been placed in the territory that surrounds the massif: Santa Cruz, Binacua, Bailo, Botaya.

The transection station mounted on the lowest point is found at the picnic area. From here the mossy pine forest can be seen along the shady colluvium. Above it, a narrow strip of mixed forest at the foot of the cliffs. In the sunny slope a scrub of evergreen oaks and Arctostaphylos uva ursi on very thin soils.

The forest path keeps mounting, crosses the stream at its head and rises until it reaches the stair between two layers of conglomerates. It has traversed the entire mossy pine grove before reaching the old monastery, located in a crevice of the conglomeratic shield. Its foundation dates from the ninth century and their surroundings are an example of the environments in these rocky windings oriented to the North with a mixed forest growing in them. The climate is cold, humid, with little variations and with input of nutrients in the high edaphic horizons coming from the percolation of the upper part of the conglomeratic synclinal. These cliffs present very interesting communities with colorful flora, like the king's

crown (Saxifraga longifolia) and are rich in endemisms, relics of antique flora that have survived under the shelter of these stable topographic climates (Petrocoptis sp. Ramonda myconi, Valeriana longiflora, etc.).

From here the road mounts to the plane known as Pano, where the new monastery is located, built towards the end of the seventeenth century. The entire landscape of this region is marked by a pronounced endopercolative character. The soil, evolved on the conglomeratic substrate, is rubified in its lower horizons and subject to an intense leaching process of both clay and nutrients. The pH sways between 5 and 6. Local dissolution of the conglomerate facilitates vertical percolation, hindering thus oblique transport and superficial drainage organization. Ascending condensations often produce haze. A meteorological station in the ample clearing surrounding the monastery records the climatic conditions outside the forest. The average annual temperature is 8°C and the annual precipitation hardly nears 1.000 mm. The plot where various ecological studies are conducted, is in the thick of a forest of Pinus sylvestris with holly. The forest has undergone various types of intervention in most of the Pano plane: farming and subsequent reforestation (to the West of the forest house), clearing of the undergrowth of holly - trees, etc.

A path from the Western side of this plot climbs to the "Pyrenees Look - Out" at the Northern edge of the cliffs. From there one can see the solid wall of the Interior Mountain Ranges, the flysch territory and the Canal de Berdún. Patches of mixed forest are also found at the foot of these cliffs, as the one seen at the old monastery. On the rocky edge, with little soil and wind - swept heath of prickly Echinopartum horridum and a tall gramineous plant (Helictotrychon filifolium), grow. The important rôle of the prickly cushions in the formation of the soil, intercepting dust and contributing nitrogen rich organic matter should be noted. Little flat strips with scant soil, heavily leached in winter and remarkably dried in summer, are also frequent in these edges of the cliffs. Only little annual communities can survive in them (Scleranthus annuus, Trifolium glomeratum, T. striatum, etc.). Bulbous plants like Crocus nevadensis and Tulipa australis, abound among the cushions of Echinopartum on a soil very much affected by the freezing - thawing phenomena. The cliffs offer excellent nesting places to carrion - eating and predatory birds, and at the same time facilitate their "sailing" flight by provoking ascending currents of air, even in stable situations, thanks to the day's mountain breezes.

c) San Juan - Oroel. - The road leaves the plane of the monastery and descends almost on the ridge formed by the thick conglomeratic layers with sharp dips in the strata towards the South, from San Juan de la Peña on the East to the Escalatin Mountain chain.

At the beginning the road follows the aforesaid heath on the crest. The depressed pre - Pyrenean clay landscape of Osia and Ena can be seen to the South. Further away, towards the East, the limestone barrier of the Exterior Mountain Range rises with a higher massif known as Guara.

On arriving at Bernués, near the old road from Jaca to Zaragoza over the Oroel pass, a meteorological station mounted on that sunny area is seen. It detects the drying effect of the air that descends from the conglomeratic mountain chain that goes from San Juan

to Oroel and separates the Canal de Berdún from the southern Pre -  
- Pyrenean country. The evergreen oak heath with Arctostaphylos  
uva ursi and juniper (Juniperus oxycedrus) near Bernués, are wit -  
- nesses of this windy and dry habitat.

The road has numerous curves as it traverses the conglome -  
- ratic mountain chain on its way to Jaca. The Escalatin, covered  
with evergreen oaks shrubs on sparse rubified soil in the sunny slo -  
- pes, and with mossy pine groves with beech trees in the upper part  
of the shady slopes, can be seen to the East.

On reaching the mountain Peña de Oroel, a marly depression  
at 1.080 m. above sea level, with heavily eroded edges that runs  
from East to West, is crossed. The pass is formed from numerous  
colluviums and glacis that descend from Peña Oroel and lean on the  
sandstone banks seen in the Center's Boalar property. Once again  
a highland landscape with Echinopartum, Arctostaphylos uva ursi and  
Genista cinerea, often found on these wind-swept mountains, is found.  
Here the steppe of Echinopartum cushions on top of Oroel (1.750 m.  
above sea level) on the colgomeratic shield, the powerful cliffs of  
the sunny areas and the lower colluviums, covered with box, shrubs,  
can be seen. Small communities of mixed forests with hazelnut  
trees, similar to the ones at San Juan, are found at the foot of  
the Eastern cliffs to the West. They show the lateral contribution  
of water and nutrients as well as the frequency of ascending haze  
from the interception of westerly air flow.

d) Oroel - Sabiñánigo.- From the mountain, the road descends  
towards Jaca. The eroding facility of the crumbly materials can be  
seen near the road, as well as the shrub that colonizes the resul -  
- ting lithosoils (Echinopartum, box, Amelanchier ovalis, Arctostaphy -  
los uva ursi). On the shady areas of Oroel there are extensive pine  
groves of P. sylvestris with box in the lower part, Abies alba gro -  
- ves in the upper part and dispersed Pinus uncinata groves climbing  
up the cliffs.

When the road reaches the country near Jaca, it traverses  
an ample glacis subject, as most of them, to grain cultivation. Its  
shallow soil, stony and somewhat rubified, is worthy of note. The  
road descends later to cross the Gas River, an affluent, on the left,  
of the Aragon River, skirts its little system of terraces and runs  
East under the old city walls of Jaca.

The road, then, follows the Val Ancha, climbing gently to the  
divide between the Aragon and the Gállego Rivers. Here the evergreen  
oak shrub can no longer be seen. The marcescent oak is in full sway,  
with Pinus sylvestris on the eroded slopes. Echinopartum horridum  
descends to 900 m. above sea level on thin soils and the climatic  
conditions become more continental. On the other hand the Santa Oro -  
- sia massif, with its 2.000 m. above sea level, closes the valley to  
the East and gives rise to orographic precipitations with humid Wes -  
- terly winds.

The Sabiñánigo Valley, surrounded with peaks and high glacis,  
can be seen on descending towards the Gállego River. The air draina -  
- ge is difficult to the South, and the area presents a large cold air  
captation territory throughout the entire Tena and the high Acumuer  
valleys. For this reason thermic inversion phenomena are very pro -  
- nounced. The location of the villages is worthy of note. They are

always at moderate altitude, at the edge of the Val Ancha or on outcrops of the flysch territory, coinciding approximately with the most frequent position of the thermic belt.

Before reaching Sabiñánigo, the road takes a detour to climb to the Cartirana glacis, then descends to cross the Aurín River and follows up the course of the Gállego River to the North.

e) Sabiñánigo - Biescas. - The Senegüé frontal moraine, quite well preserved, separates two distinct environments: the Val Ancha to the South and the Biescas valley to the North. The latter region consists of a fluvioglacial plain of great fertility, to which converge the fans of several dejection cones, more or less stable. The main lateral valleys are partially closed by lateral moraines, hiding very fertile regions within (Aso, Yésero, etc.). The lower part of the fluvioglacial plain, near the frontal moraine, presents at times problems due to swamping, remnant of the ancient lake that must have occupied this region.

When Northerly winds blow, the entire region is exposed to drying effects produced by the barrier of the Interior Mountain Ranges and the gorges carved in them by the Gállego River. Under stable conditions, the air retained by the relief of the frontal moraine causes very low minimal temperatures. On the other hand, the thin soil, especially in the dejection cones, presents very high surface temperatures, where shrubby communities tied to this phenomenon grow, such as Berberis vulgaris, Hyppophae rhamnoides and Botriochloa ischaenium, a gramineous plant of tropical origin. Shrubs of the aforesaid can be seen in the Arás ravine, whose brook is at present undergoing an important correction on orders from the forestal administration authorities. The ensemble of the aforesaid phenomena gives this region a remarkably continental character.

Approaching Biescas, a good view of the Interior Mountain Ranges is had. They are formed by a huge limestone slope, steeply slanting to the South with sheer drop cliffs on its Northern side. Its western side named "Sierra Telera" and its Eastern side "Sierra Tendeñera" with altitudes approaching 2.800 m. above sea level. The last swells of the flysch territory, lean on these Mountain Ranges, reaching an altitude of 2.200 m. with smooth rolling crests, covered with oro - mediterranean type pastures above the tree line, often with deep soils, well structured and with great biologic activity, due probably to the protection of the winter snow cover and the summer strong thermic contrasts and periods of drought, circumstances that favor the polymerization of organic compounds and hinder their leaching. Forests of Pinus uncinata that gradually turn to Pinus sylvestris and terminate in marcescent oak heath at the lower part of the slopes, are found below the 1.800 m. mark.

f) The Tena Valley. - To the North of Biescas, the valley keeps narrowing and appears partially closed by a series of rocky banks, with little patches of rich sediment near the water, very fertile and used as natural pastures. Soon the cleft open by the Gállego River in the Interior Mountain Ranges is reached. On the left slope, a chapel to St. Helen is located on top of a "tophrock".

Here the Tena Valley begins. It is a clearly individuated region, shut to the South by the recently crossed Interior Mountain Ranges, to the East and to the North by the granite massif of Panticosa



and to the Northeast by the Midi d'Ossau and the Aneu Mountain chain. The nucleus of this region, modeled mostly on soft slate materials, presents a smooth and depressed relief, with numerous moraine remains, terrace levels and jutting shoulders that evince many erosive cycles. Such orographic arrangement favors screen effects and imprints a continental character to this valley. There exists a quite good chain of climatological stations that furnish data on these Gállego River headwaters: Formigal, La Sarra, the upper part of the Balneario de Panticosa, Sallent and Escarrilla in the middle, Pueyo y Saqués in the lower part, and finally the evaporimetric station near the Bubal reservoir provided with a model "A" tank.

Pastures for mowing, with hedges of ash - trees and other river border trees constitute the dominant landscape in the lower part of the valley. It is an appropriate region for stable cultivation, but it has practically been destroyed by hydroelectric works. Oak groves, rich in thermophile species (Escarrilla), grow in the sheltered sunny areas of the limestone bars. The mossy pine groves of Pinus sylvestris that must have occupied the valley slopes, have been practically substituted by pioneer communities of birch trees and tremblings, thanks to the strong human intervention practised from remote ages. The granite massif of Panticosa, with clear forests of Pinus uncinata and Rhododendron ferrugineum climbing to the upper part of its slopes, can be seen towards the Northeast.

The villages of the Tena Valley were grouped in three corporations or communities for exploitation that received the name of "quiñones": that of Panticosa, which embraced Panticosa, Pueyo de Jaca and Hoz de Jaca; that of Sallent which included Sallent and Lanuza; and that of Partacua, on the right bank of the Gállego River, which included Escarrilla, Tramacastilla, Sandiniés, Saqués, Piedrafita and Bubal. Each "quiñón" had two types of towns: one directed to an intensive exploitation of the land, as pastures and potato fields, located in the lower parts (Pueyo, Lanuza, Saqués), and other ones, located further up, that cut and dried for forage more extensive lands during the summer (Sallent, Piedrafita, etc.). This organization permitted in winter the upkeep of huts for a considerable herd of cattle, to which were added nomadic flocks of sheep, giving rise to a heavy load of summer pastures.

At present the great tourist invasion of the valley and, especially, the Bubal and Lanuza reservoirs, inundating the best lands of the valley, have dismantled the ancient organization and seriously compromise the exploitation of the entire region for agricultural and cattle raising purposes.

The newly constructed road reaches Sallent, the last village of the valley, at the foot of the Peña Foratata limestone mass, at the confluence of the Gállego and the Aguas Limpias Rivers. The latter comes from the Northeast and drains the North of the granite massif. Going up the Gállego River, the Formigal summer range is reached. A web of stone fences can be observed on the Peña Foratata slopes. They are the remains of ancient fields, proffiting the lateral water and nutrient inputs, reserved in spring for summer grass cuttings, and used later to the best advantage, as the rest of the range.

Relics of beech groves with Abies alba still remain at the headlands of ravines on the slopes exposed to the humid winds of the North and Northeast.

The rest of the valley, subject to ancient grazing pressure, is covered with pasture grounds of great mosaic complexity. The steep slopes, especially the ridges, appear heavily eroded, where periglacial phenomena produce easily detectable land slides. The herbaceous communities, dominated by Festuca scoparia, are rich in powerful colonizing species, so that the ensemble is probably in a dynamic steady state, with equilibrium between erosion and colonization.

The bottom of the valley presents a constructive type of landscape where the accumulation of materials exceeds their evacuation. Small swamps surrounded with Carex fusca are frequent. These swamps originate mostly from the melting of snow, and shelter a batrachian fauna of the highlands (Rana temporaria, Triturus helveticus, Salamandra sp.) that constitute interesting material for phenological studies profiting the variations of their biological cycle to adapt themselves to the altitudinal thermic gradients and to the summer drying of most of the swamps.

Jaca, August, 1.975