Field Trip 3

Haciendas, Irrigation, and Livestock

Karl W. Butzer

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HACIENDAS, IRRIGATION, AND LIVESTOCK: BACKGROUND

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Introduction to the Bajío. By the end of the Colonial era, three basic physical and cultural landscapes could be identified in the interior of Mexico:

(1) The Mesa Central of Mexico state, Hidalgo, and Puebla-Tlaxcala. Although ringed and interrupted by forested volcanic ranges, the impression is that of vast, irregular plains. Tracts of rough hill country with live oak woodlands alternate with cultivated, level terrain, much as they do in Extremadura and La Mancha. This environment was densely settled at the time of Cortés' entrada, and Spanish rural colonization focused on a few fertile basins. In the 1790s it had retained much of its Indian character; 75% of the population remained Indian, if Mexico City is excluded.

(2) Stretching east-west from Querétaro to Lake Chapala, the Bajío forms a great tectonic depression along the northern margin of Mexico's volcanic core. When first visited by Spaniards in the early 1530s, the bottom lands were probably seasonally flooded and grassy, with open oak woodlands along the better-drained piedmonts. The rich black soils were even better than their counterparts on the alluvial terraces of the Guadalquivir Valley. Here the Spaniards encountered only small, indigenous groups engaged mainly in hunting and gathering. Although the summer rainy season was not synchronized with the Mediterranean agricultural cycle, the cool winters favored most Spanish crops and fruit trees, and irrigation waters were abundant. Together with Indian settlers from the south, the Spaniards systematically colonized the Bajío. As a result, only 45% of the population in the 1790s was Indian.

(3) Beyond the Bajío, the Mexican interior opens up to the Mesa del Norte, a landscape of fault ranges and vast basins dominated by succulent thorn bush and increasingly arid towards the north. Confronted by resilient hunting-gathering peoples, this became the Spaniards' "West," and was centered around mining towns, forts, and strings of livestock estancias. By the end of the Colonial era, a hybrid population characterized this region, with only 29% Indians in Nueva Vizcaya and Nuevo León.

The Bajío is therefore unique in many ways. It was the heartland and most productive region of New Spain. But colonization of the Bajío was a shared achievement in which the dominant Spaniards

determined ground rules of the economy, land tenure, and urban physiognomy. It was also a saga of frontier advance and settlement for the agricultural Otomí, who saw themselves as partners of the Spaniards. Tarascans and Tlaxcalans shared in this process as well, as did African miners, vaqueros, and shepherds. Indeed, it was a multiethnic effort that created the prosperous Bajío of the late Colonial era in which Indian barrios flanked Iberian cities and Indian pueblos or ranchos were juxtaposed with Spanish haciendas. Of a total population of about 500,000 people in 1793, some 225,000 were Indians, 130,000 were classified as Spaniards, with 90,000 of mixed African ancestry, and apparently only 55,000 Mestizos. This represented a population density of 16.7 people per km^2, compared with 20.4 km^2 in Spain in 1787, and 17.7 km^2 for Massachusetts in 1790.

This developed and complex landscape of the late Colonial Bajío is the primary focus of the field trips. At least superficially, the Spanish imprint is stronger here than in any other region of Mexico, and provides an unusual challenge for historical interpretation. Equally intriguing are the implicit comparisons and contrasts that can be drawn with the Anglo-American experience during the formative years of the Thirteen Colonies.

Before introducing the different historical components of the rural, cultural landscape that are the focus of this field trip, it is essential to outline the physical geography of the region in order to place the ecological relationships into perspective.

Geology and Geomorphology. The region of Querétaro, and the Bajío margins in general, constitute a volcanic landscape. The skyline is dominated by great volcanic cones peaking at 2400-2700 m, while the low country at 1700-2100 m can be divided into (a) upland plains formed by extensive volcanic flows and ash, and (b) lowland plains with black clayey soils covering thick white lake sediments derived from volcanic materials. Large-scale faulting is apparent in some areas, particularly along the northern margins of the Bajío.

North of Querétaro the extensive rhyolitic massifs that extend northwards to San Luis Potosí possibly represent a large segment of early- to mid-Miocene time. The great dissected cones of andesitic basalt between Querétaro and San Miguel Allende could be Pliocene, while the flows west of Querétaro and the relatively fresh composite volcanic cones along the southern Bajío are probably Quaternary.

Sedimentary rocks in the region are derived from volcanic materials and range from laminated lake tuffs of silt or clay size to stratified conglomerates and sands of alluvial origin. Such

sediments form a logical sequence from inclined fanglomerates around existing mountains to horizontal, fine-grained lake beds exposed in the modern basin floors. The origin of the once possibly interconnected lake basins between San Miguel Allende, Querétaro, and San Juan del Río probably goes back to the initial Miocene extrusion of rhyolitic lavas; lake development was subsequently enhanced, especially in the Bajío, by downfaulting or drainage impedimentation during extrusion of the great Plio-Pleistocene basalt cones.

The identifiable faults of the region trend mainly to the north or north-northwest and involve displacements of 50 to as much as 300 m. There are also major transverse faults striking to the west or northwest. The grid of fractures appears to be linked to that of the basin-and-range country of the Mesa del Norte. The faults displace the lake tuffs as well as the basalt flows, but the resulting escarpments have been eroded by deep, "youthful" valleys, suggesting some antiquity in an environment where stream discharge and weathering are only of moderate intensity. It seems that the fault displacements were mainly concluded by the end of Tertiary time.

Soils and Drainage. The characteristic soils of the region, except for mountain lithosols, are vertisols. They are dark, with at least 30% clay to a depth of 50 cm or more, and have strong vertical structure, due to alternating swelling and cracking. This classification does not do credit to the stony variants on basalt uplands that lack strong evidence of swelling (self-mulching) when wet, or to the thinner profiles (in part eroded) found on white tuff substrates. It best describes the massive, deep-cracking, black clays in the heart of the Bajío that may be many meters thick. These represent a mix of authigenic, montmorillonitic soil, developed in place, and allogenic soil materials derived from the basalt uplands and accumulated by seasonal floods. A radiocarbon age of 5900 years has recently been obtained for carbonates at 1.2 m below the top of these clays. This suggests that, in some areas, accumulation began over 25,000 years ago.

In all probability, the flat vertisolic plains of the Bajío formed seasonal wetlands (cienegas) at the time of 16th-century agricultural settlement. Given the tabular nature of the upland lava flows, which have been repeatedly constricted by volcanic mountains, there are also many other small or large vertisolic plains in flat-floored valleys or larger basins that were once marshy.

As can be expected with lacustrine settings in the recent geological past, drainage development in the Bajío and in the basins

east and northeast of San Miguel Allende is fairly rudimentary. On the other hand, the uplands are incised by narrow, sinuous valleys with a relief of 50-150 m, and that drain centripetally towards the various basin centers or axes. In some areas, bold escarpments of similar relief link valley entrants that form two or three step-like surfaces of erosional origin. Finally, the great Mio-Pliocene volcanic cones are deeply dissected by a network of radially organized canyons with a relief of 100-300 m.

Good soils and adequate moisture are combined on the lowland plains, on lower slopes, and in larger flat-floored valleys. Water retention in the vertisols, even those with thinner profiles, is excellent, while organic matter, phosphates, and all other nutrients except nitrogen are in good supply. With irrigation, productivity here is moderate to excellent, although nitrogen or ammonia must be applied to sustain yields. Permeability of substrates under the lacustrine plains is quite good, making them suitable for deep pump irrigation. The result is that the water table of the Bajío, but not of the outlying valleys, is becoming precariously low.

Contemporary and Prehistoric Vegetation. The climate of the lowland and upland plains is semiarid, while the mountains are subhumid. Annual rainfall ranges from 500-700 mm in the lower country, but is probably 100-300 mm greater on the high mountain slopes. The summer rainy season spans 4-6 months, but interannual variability is high. The onset of the rainy season is unpredictable, and "late" rains can be disastrous. Winter rainfall is minimal -- 30 mm. Runoff is on the order of 50-100 mm per year.

With average temperatures of 70-75°F, the coldest month is January. May is the warmest, with 57-61°F. The annual range is 12-15°F, but diurnal ranges exceed 25°F during the winter months. Consequently, frost poses as serious a limitation on agriculture as does scanty rainfall, and contributed to the regional harvest failures of 1695, 1749, 1785, and 1882. The frost season averages 40-60 days around Querétaro (November to February), and decreases rapidly westward to only 10 days at Guanajuato and Yuríria.

Classifying the vegetation of north-central Mexico is difficult in terms of contemporary physiognomy and diagnostic elements, as well as in regard to its appearance prior to Spanish colonization. The montane woodlands of oak (both live and deciduous) or oak-pine are simple enough. This is not the case for the associations of cactus, arborescent yucca, low deciduous trees, and grass (with a substory of woody shrubs and some thorny elements) known as matorral xerófilo or crasicaule. As the cactus component increases, the grasses phase out. This tree-cactus-grass association forms a belt

extending from San Luis Potosí to Querétaro, and across to Hidalgo State, following the rainshadow of the Sierra Madre Oriental.

To the west of the matorral xerófilo is a thorn tree savanna known as bosque espinoso or matorral subtropical. The characteristic trees belong to several different families, but resemble acacias in profile. Most also have small, paired leaves. On rougher topography, various large cactus genera are added. This association is invariably grassy. Alternatively, thorn trees are found scattered amid cultivated fields. A separate category of "natural pasture" (pastizal natural) appears superfluous.

Riverine vegetation is most typically represented by pirúl (the Mexican pepper tree), a South American introduction that has adapted well in Mexico. The pirúl resembles mesquite at a distance, but has larger leaves and red berries rather than bean pods.

The lower limits of pine and oak are highly irregular, and confirm the assessment that cutting, deliberate firing, and grazing pressures have substantially reduced their original cover. Few pines are found below 2600 m on shade slopes or 2800 m on sun slopes. The limits for oak are 2000 m and 2200 m. Denser thorn-tree woodlands above these elevations are almost certainly secondary. A dated pollen profile from a crater lake at 1700 m elevation near Parangeo, in the central Bajío, suggests that the native lowland vegetation was an oak savanna with pinyon woodland on medium and higher slopes. Mimosaceae and Acacia are consistently represented in small quantities, while the riparian elements include bald cypress, mesquite, maple, elder, ash, walnut, cottonwood, plantain, and brambles.

The widespread thorn-tree savanna of today seems, therefore, to have been limited to seasonal wetlands, and the once rich galeria vegetation has been destroyed. The mesquite stands noted on the floodplain east of Querétaro in 1582 and 1640 have been replaced by pirul. Nothing remains of the tall stands of bald cypress (cedros) described along the Río Querétaro at Apaseo and the Río Lerma at Acámbaro, or the tule (sedge) fringe around a big floodplain lake described at Lagos about 1605. On the other hand, the cactus association further east has considerable antiquity; the ca. 1580 pintura for San Miguel shows oak and pine woodlands around the mountainous rim of the Laja valley, but decorates the plains with prickly pear and Opuntia or maguey.

In effect, the landscape seen by the expeditions of Guzmán, Oñate, and Angulo in 1530-32 looked very different, with much surface water and a rich vegetation cover of more mesic composition.

The lush virgin grasslands of the seasonally wet plains were ideal for pasturing the rapidly growing herds of Iberian cattle. The fertile soils and flood regime had much in common with the natural flood basins of the Nile Valley, and easy water manipulation invited irrigation farming.

These materials serve to characterize the landscape ecology of the region visited by the several field trips, and they are particularly relevant to place into context the representative land use examples selected for the Haciendas, Irrigation, and Livestock field trip.

Evolution of the Agrosystem: A Synopsis. The agricultural settlement and development of the eastern Bajío can be briefly summarized with Figures 1 and 5 of Historical Querétaro, the first chapter of this Field Guide that presents a diachronic overview of Querétaro and its region.

(1) Groups of Otomí farmers began to move from their traditional lands southwest of San Juan del Río in the early 1520s, and settled around Querétaro. They filtered in among the Chichimecs along the Río Lerma at Acámbaro and up into the Laja Valley to beyond San Miguel. This movement accelerated about 1530-45, putting in place a wide network of small communities that provided at least a minimal labor force for subsequent Spanish settlement.

(2) Spanish settlement, led by a few powerful stockraisers, followed more or less the same trajectories after about 1540. The record of land grants (mercedes) begins in 1542, and accelerates about 1555, becoming a flood in the 1570s. About 1605, the number of grants tapered off rapidly, and by the 1620s the best rural land had been allocated.

(3) By about 1600, a dozen or so municipalities had been established at intervals along the camino real from San Juan del Río to San Felipe and Zacatecas along the axis of the Bajío from Querétaro and Celaya to León and Lagos. Complementing the pastoral activities of several hundred estancias, these early towns became centers of irrigation farming, and typically included 500-2000 ha of good land.

(4) The cattle and sheep estancias were the result of land grants for sitios de ganado mayor (cattle grazing tracts of 1750 ha) and sitios de ganado menor (sheep farms of 780 ha). Most settlers secured one such grant, but richer men received as many as four, possibly with an additional caballería or two each (43 ha) of agricultural land. The building complex at the center of these

scattered estancias eventually grew into the nucleus of the notorious haciendas.

(5) About 1620 almost all of the estates of the late Colonial era were in place, allowing for some shifts of site, subdivision, amalgamation, or growth into "interstitial" spaces. Despite the terminologies used, the early estancias were very modest in appearance, and the majority were located in relatively marginal, upland environments. Adobe brick was the characteristic building material in the 1500s, shifting to stone structures during the 1600s. But even then the residential house was small, although usually quite defensible.

(6) During the 1600s, grain cultivation was only important around estates (then called labores) situated on the Bajío bottomlands. Aggregate data from these estates indicates that, contrary to some municipal reports, most concentrated on maize, almost exclusively so. Only around Celaya and Querétaro was wheat important, although still secondary to maize. Relatively elaborate irrigation networks were in place in parts of the Bajío, including diversion dams and extended canals that watered the fields and provided drinking water to the towns. Some of these systems were as large as any late Medieval counterparts around Sevilla or Toledo, but the surviving physical and archival evidence suggests no divergence from Spanish counterparts.

(7) In the upland environments, 17th century estates had a few hectares of irrigated huerta, but the milpas of Indian smallholders, tenants, or sharecroppers were far more important. Instead, the Spanish owners, mainly resident in the towns, emphasized stockraising. Sheep had proved better adapted to the environment than cattle, especially after the virgin pastures had been depleted. There are indications (see the last two stops of the field trip) that range deterioration set in motion a wave of soil erosion around the beginning of the 1600s.

(8) The long, dry winter months created intolerable grazing pressure on the upland pastures, so that large-scale transhumance -- on the Spanish model -- was rapidly adopted. By 1580 sheep from the uplands around Querétaro were being regularly driven to Lake Chapala, and well beyond, where they wintered for over six months. They returned in late May or June after the rains had begun in Querétaro. Between 1600 and 1650, the transhumance pattern shifted to the north, especially to the Río Verde basin with its modest but vast pastures. Typically it appears that the estancieros' grown sons accompanied the flocks, together with a small contingent of Mulatto and Indian shepherds. Those who could afford to do so

acquired land grants on these agostaderos without necessarily building on them. A very few of the largest herd owners, those with 15,000 or so head of sheep, even moved some 600-800 km north to the winter pastures of Nuevo León, where large grazing grants were liberally awarded after 1635.

(9) Little is known about the development of Indian communities after the initial settlement. By the early 1700s they appear as well-defined, corporate pueblos, typically numbering 4-6 within each municipal jurisdiction. By that time there was also a much larger aggregate of subordinate ranchos, the residents of which worked seasonally on the estancias and otherwise cultivated their own fields, in part as sharecroppers on large estates (see the Laja Valley stops). The unusual rural settlement hierarchy that resulted is described in the chapter Historical Querétaro. The pueblos were sometimes successful in holding on to their lands and water rights; in other cases they were not. The contemporary landscape still shows a scatter of areas where irregular Indian fields or dispersed Indian settlement (isolated farmsteads) remain typical. These include large, contiguous tracts in Hidalgo and Michoacán, and in the uplands west of San Miguel and Dolores. Smaller, discontinuous areas are found both south and north of Querétaro, especially in the mountain valleys up to Santa Maria del Río. These can best be interpreted as a visible imprint of the more tenacious Indian communities.

(10) By 1690 the economy of the Bajío was expanding from a long era of depression that had begun 1636/37. From 1715 onward, mining production, agricultural yields, and population grew rapidly, leading to increased investment in agricultural intensification. As the century progressed, the network of dams and extended canals within the Bajío expanded to a scale exceeded only in the Spanish Levante. Another special form of irrigation first comes into evidence, although its origins probably go back to the 1500s: the chains of flood basins enclosed by earthen dams or bordos. As presented by Clint Davis on the preceding excursion, the principle is to soak an impounded field for some weeks under a meter or more of water that is then successively passed down the line. The method replicates the natural pulse of flood waters in the floodplain basins of the Nile Valley, and is totally unknown in Spain or North Africa. This may represent an elaboration of an older Indian method that has not been described thus far. Rural crop and marketing strategies were changing too. By perhaps mid-century, wheat production overtook that of maize, at least in the eastern Bajío.

(11) For the first time, the upland estates strove for major agricultural expansion, harnessing all available waters through

diversion dams and valley-floor impoundments behind multiple earthen dams. The investment in irrigation was immense, especially during the second half of the 18th century. Increased agricultural yields resulted from more labor input and, in turn, fed a growing Indian population on the ranchos. Only those animals that served for plowing, transportation, and home consumption were retained. Large-scale sheepraising was abdicated to the Mesa del Norte. Nonetheless, the mountain pastures, increasingly controlled by rock stock-fences, continued to be used, and great flocks of meat sheep periodically streamed through the area on their way to the slaughterhouses of Guanajuato and Mexico City. Major roadways and valley-margin sheep runs were increasingly lined by rock fences (canadas) that protected the new farm lands from damage.

(12) The new wealth of the 1700s was reflected in a major investment to create manorial residences in the farming compounds of the Bajío as well as in the uplands. The labores that had emerged from the estancias in the early 1600s were, a century later, transformed into haciendas. The basic organization had not changed significantly, but the haciendas aspired to status as symbols of wealth and power, despite their probably incidental use as nothing more than weekend or summer residences for urban owners. The social cleavage between hacendado and workman increased markedly. As the hacendados relentlessly expanded and commercialized their agriculture, the rapidly growing Indian population provided an increasingly cheap labor pool. Wages remained stable as work stipulations increased, and both food and finished goods became more expensive. The only possible response was for more children, women, and old people to join the adult men in the fields. Even so, the campesinos were subject to a steady erosion of their standard of living. On the eve of 1810, the social situation in the region was rife for revolution and violence.

(13) The Bajío entered a difficult era with the outbreak of the wars of independence. Mine production ceased for over a decade, and agricultural activities were interrupted by warfare, pillaging, and general insecurity. Mining activity resumed in 1821 at a painfully slow pace, and with the world market opened up by independence, Mexican textiles could not compete. The elite became impoverished; the haciendas struggled to remain viable. The condition of the rural Indians became even worse, and economic conditions in rural Querétaro barely improved during the Porfiriato years (1877-1910). Transfer of land to communal ejídos or small owners did not materialize for decades after 1919. Instead, the rural Indians refused to work and the haciendas closed down. Some of the Indians drifted to the larger cities; others continued to work their adjacent fields under a wide range of provisional arrangements. Around Querétaro,

current research has revealed no pattern of insidious exploitation, and dismemberment of the haciendas proceeded with a comparative minimum of violence. Elsewhere in Mexico the picture frequently was very different.

(14) Comparison of the Colonial era and its aftermath in the eastern Bajío with the American experience identifies many fundamental areas of contrast. The Spanish New World endeavor was inclusive rather than exclusive in regard to its indigenous peoples. But by formally creating a dual society it also identified a subject people whose rights and economic viability were progressively eroded over time. Trapped as an essentially landless workforce on the vast haciendas, there was no escape for the rural Indians of Querétaro and the eastern Bajío, until the 1920s or later. Their counterparts in the city enjoyed greater upward mobility through hard work or by marrying "up" on the sociocultural ladder.

(15) Comparison with Spain shows some striking similarities with Andalucía. The big estate, under whatever name, was a standard feature of Late Medieval Andalucía, bearing an uncanny resemblance to the Roman latifundia that dominated the same region a millennium earlier. In the northern half of Spain there never was anything comparable in Medieval times, despite the stereotype of the feudal manor. Rural society instead revolved around the corporate community, which effectively circumscribed the prerogatives of territorial lords. Even in Andalucía the social problems of the 1930s -- when up to almost 100% of the rural people were landless day-laborers, living in towns but working on the big estates -- only culminated from a set of historical processes operating during the 18th and 19th centuries. Recent arguments that the hacienda as an institution functioned differently in each era and region of Mexico can also be applied to southern Spain. The key connecting threads through both time and space are that the big estate was an autonomous (not autochthonous) economic unit that operated for commercial goals and competed with or preempted rural corporate communities. It proved to be a highly successful and flexible device, particularly adaptable to the frontier as well as to the uneasy convivencia of a dual society. Unfortunately it also inhibited the process of fusion between Spaniard and Indian in the rural world, and stunted the development of an egalitarian frontier society.

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HACIENDAS, IRRIGATION, AND LIVESTOCK: FIELD GUIDE
Tuesday, 23 May 1989

Karl W. Butzer, University of Texas at Austin

Departure: 8:00 a.m. pronto from the Holiday Inn, Querétaro.

While leaving Querétaro, note the broad band of recent industrial growth around the periphery of the city, especially to the west and north. After about 4 km of travel, a dissected plateau of quasi-horizontal, andesitic basalts rises abruptly on the eastern margin of Highway 57. This essentially straight escarpment follows the road for about 15 km and represents a major fault with a displacement of 50-75 m. On the western side you have glimpses of the small valley of the Arroyo Júrica, which consists of several basins linked by narrow, entrenched stretches. At Km. 11, a secondary road leads down to the Hacienda Júrica (not visible), a Chichimeca settlement in 1564 that became an estate in the 1580s. The remnants of the once-manorial hacienda have been rebuilt and expanded as a five-star hotel.

Km 14. Turn to left down to Hacienda Juriquilla. The estate lies in an almost closed depression, surrounded by lava hills. Cretaceous limestones are exposed under the basalts, and the basin may have formed by large-scale, subterranean solution along a major fracture line, so as to undermine the lava cap.

Km 17. **Stop 1** (SHORT STOP -- 15 min.) JURIQUILLA, ex-hacienda and now center for a real estate development. The estate branched off from the Jurica in the mid-1600s and was a large "farm (labor) and hacienda" in 1712-16, with a workshop to weave cloth and a tannery. At that time it belonged to Santiago de Villanueva, who also owned the Júrica. In 1791 it belonged to Pedro Septién, in 1810 to Juan Antonio Loyates, and in 1910 to Antonio Gómez, but was leased to Bernabe Loyola. This rapid turnover of families is representative of Querétaro haciendas. The estate controlled 8200 hectares, of which 515 were irrigated, 1015 dry farmed, and 6670 were in pasture. There were nine "Spanish" families resident here in 1791, including the administrator, the mayordomo, and eight workmen. Three of these were born on local estates, the others in Apaseo or Querétaro. There also were two families of Mestizo tenant farmers; the much larger number of resident Indian workers and their families is not known for 1791, but totalled 391 people in 1900.

The purpose of this visit is to provide an impression of a restored, manorial hacienda, much as it would have looked at the turn of the present century. This was a wealthy example, the building complex measuring 120 by 165 m. The workforce lived immediately to the east. There are ruins of massive, older buildings 2 km further north, on the plateau, indicating that the hacienda has been moved from its original site. Note the short stretch of aqueduct next to the main complex, terminating in pipes of the industrial era.

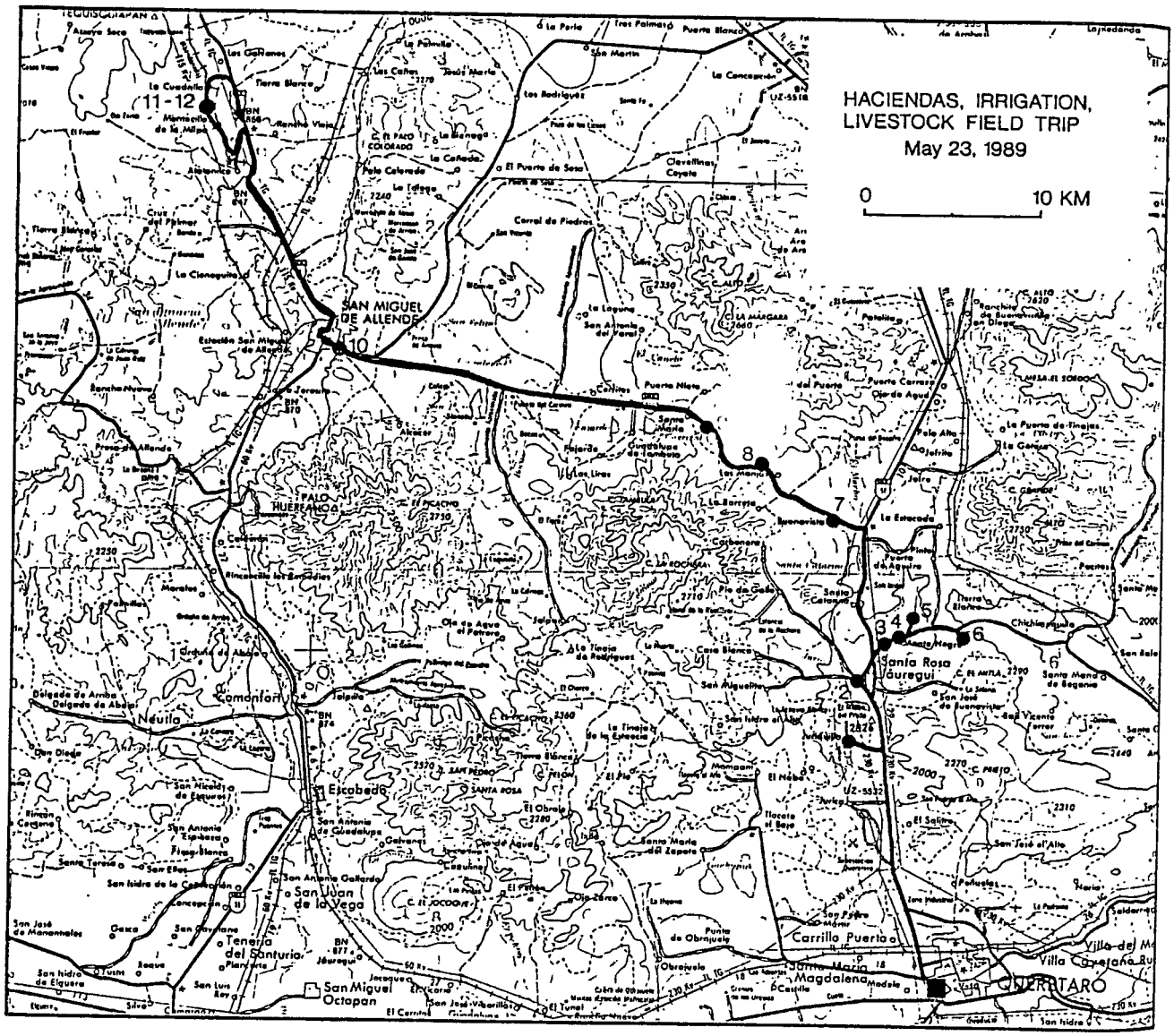

Figure 1. Route and Stops of the "Haciendas, Irrigation, Livestock" Field Trip

Please return to the bus promptly, so that we don't lose time for more important sites.

Km 26. **Stop 2** (PHOTO STOP -- 5 min.) SANTA ROSA JAUREGUI. This town was originally an Indian pueblo that did not yet exist in 1582. (The name "Jaúregui" was recently added to honor the revolutionary scion of a prominent Basque-origin family of Querétaro.) In 1712 Santa Rosa was a labor belonging to Francisco Yáñez, as well as an Indian visita, i.e., a large community periodically visited by the curate of San Sebastian on Querétaro's north bank. By 1791 the lands had been absorbed into the combined estates of Sta. Catarina and Buena Vista.

Of particular interest at this stop is the exterior of the old church, with its eminently rustic false front and cement towers. In fact, the interior is very narrow since only half of the nave was ever built. It expresses the poverty of the humble community of Indians who worked the 3800 ha hacienda. The large, modern church with an attractive, tiled dome was only completed in 1953. The plaza across the street was paved until 1986, when it was converted into a park and the "typical" bandstand added. Note the interesting side streets as we drive back out of town.

Km 28. **Stop 3** (EXTENDED STOP -- 30 min.) SANTA ROSA AQUEDUCT AND EARTH DAM. This interesting, but architecturally simple aqueduct derives its water from a reliable spring, and spans 560 m to cross a broad valley. It was built in the 18th century to provide drinking water for Santa Rosa, to which it was connected by a 2 km acequia. Described by Berlandier in 1827, it is now used only to irrigate relatively small tracts of maize, oats and barley on both sides of its terminus. The eastern canal branch serves as the lavadero for Monte Negro, and the bustle of women and children makes for a good photograph.

For some 160 m the aqueduct is paralleled on its upstream margin by the remnants of an earthen dam with elaborate masonry sluice gates (marcos) of similar 18th century vintage. During the rainy season this dam impounded a sheet of water within an area of 20 ha, serving to soak the soil prior to planting. Originally this broadly concave valley floor was poorly drained along a 2.5 km stretch above the bedrock constriction where the aqueduct was built. In pre-Contact times it undoubtedly was a large cienega. Consonant with this is a much longer earthen dam, just beyond the brick kilns in the valley bottom. This dam is 840 m long and impounded water across 30 ha. There are further such earthen dams to the west, east, and northeast (Figure 2).

While these earthen dams and their function resemble bordos, their basins are not enclosed by earthen ramparts and are much larger than most of those studied in the Bajío by Clint Davis. In some ways they are intermediate between true bordos and oversize check dams. Although they clearly represent a form of flood irrigation, this valley floor was classified as cultivo de temporal

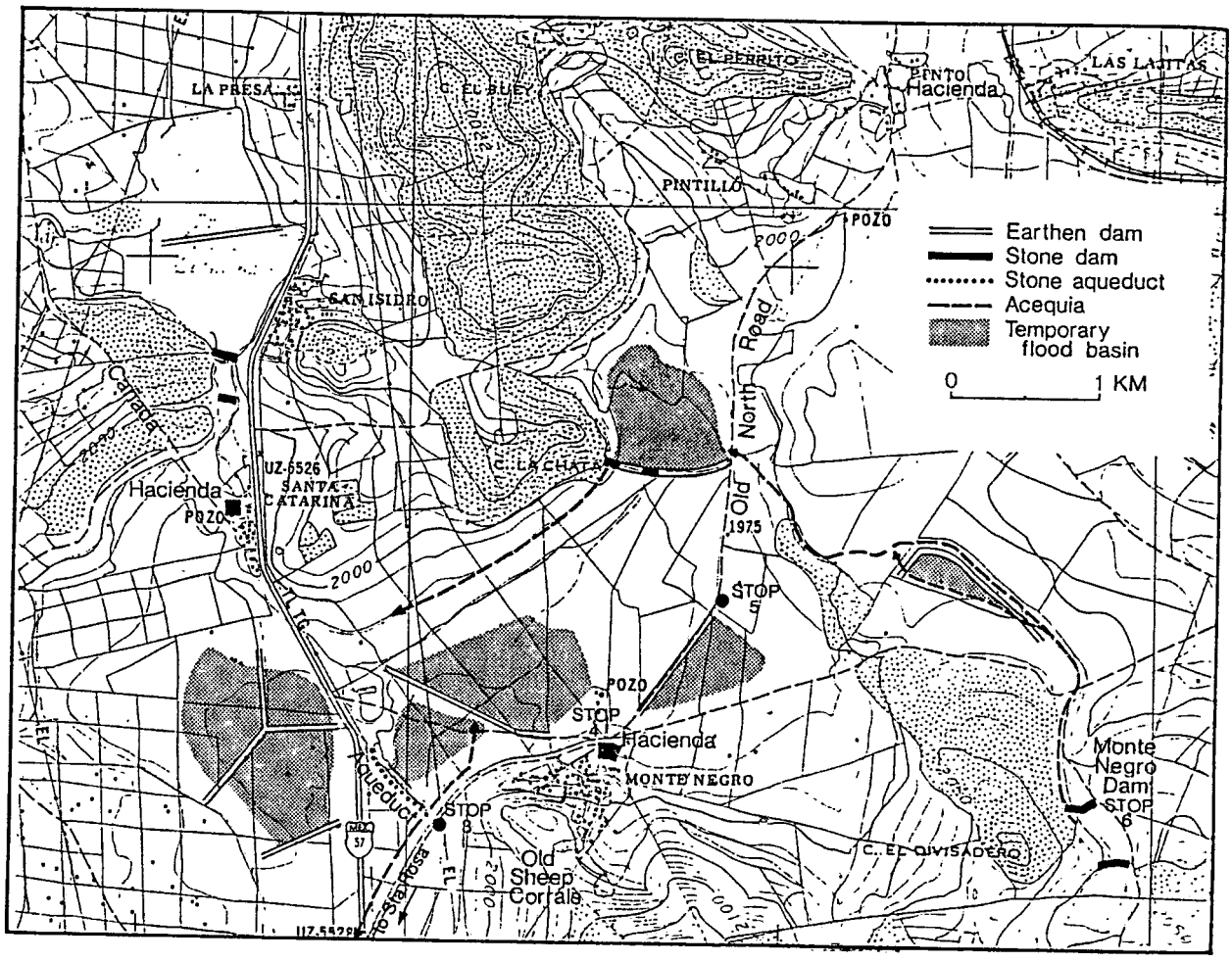

Figure 2. Irrigation Features of the Former Monte Negro Estate (mapped by Karl W. Butzer and Clint E. Davis)

(rainwater farming) at the time the earthen dams were still functional.

Km 30.5. **Stop 4** (EXTENDED STOP -- 30 min.) HACIENDA MONTE NEGRO. Once the seat of a modest 2050 ha estate, Monte Negro had 227 ha of dryfarmed land in 1905, 75 ha of which could be temporarily flooded behind earthen dams. The hacienda appears to have been a dependency of the labor of Santa Rosa in 1716, but is listed as one of several haciendas belonging to the fourth Marqués of Buena Vista, Francisco de Velasco y Bolío, in 1791. A decade later it was owned by Enrique Velasco, probably a brother, and in 1905 it was the property of Angel Burgos, at which time 513 Indians lived on the estate. But even in 1791 Monte Negro was not operated as an independent unit, since it lacked a mayordomo. In addition to an unspecified number of Indians, there were three Mestizo families (from Sta. Rosa, Querétaro, and another nearby hacienda) and five Mulattos (two with families), of whom four came from the nearby Hacienda Jalpa and one from the Buena Vista estate. Two of the Mulattos are listed as vaqueros.

The present building complex (75x125m) was built by a later owner, Manuel Le Carreta, in 1863, and represents an upgrading of the hacienda's status. This is consonant with the neo-Gothic chapel that continues to serve the local community. However, the masonry and gun slots in one part of the complex suggest a 17th century nucleus, built at a time of evident insecurity. The arched storage rooms of this section appear to represent the original living quarters. The name of the estate most probably derives from Juan de Monte Negro, a prominent settler first verified in Querétaro during the late 1590s.

Although in poor condition since its abandonment after 1919, Monte Negro has considerable heuristic value as to the economic components of an hacienda and of the disposition and quality of living space (Figure 3). The rooms are arranged around an arcaded patio with a central well (now covered by debris), and include a master bedroom with a connected library, rooms that suggest a salon and a dining room, a kitchen, several smaller bedrooms, a bathroom on the two-floored south side, and separate "apartments" on the north side. Three small basins and large water jugs indicate a washing area on the side of the patio. The stables and feed bins for the horses (and mules?) lie beyond the patio, behind a smaller "yard" probably used for chickens and pigs. The grain silos and threshing floor represent a large area attached to the front of the building, while the "straw" removed during wheat threshing was stored in a barn adjacent to the cattle corral. A broad, cobbled courtyard or causeway rises from the front gate to the entrance, with feed bins for cattle on one side. A walled garden lay behind the residence, and enclosed orchards and fields extended along the eastern side of the complex.

The basic functions were, then, (a) residential, (b) wheat farming, (c) cattle raising, with (d) horses kept as prestige stock. The hacienda has recently been purchased by a Querétaro architect,

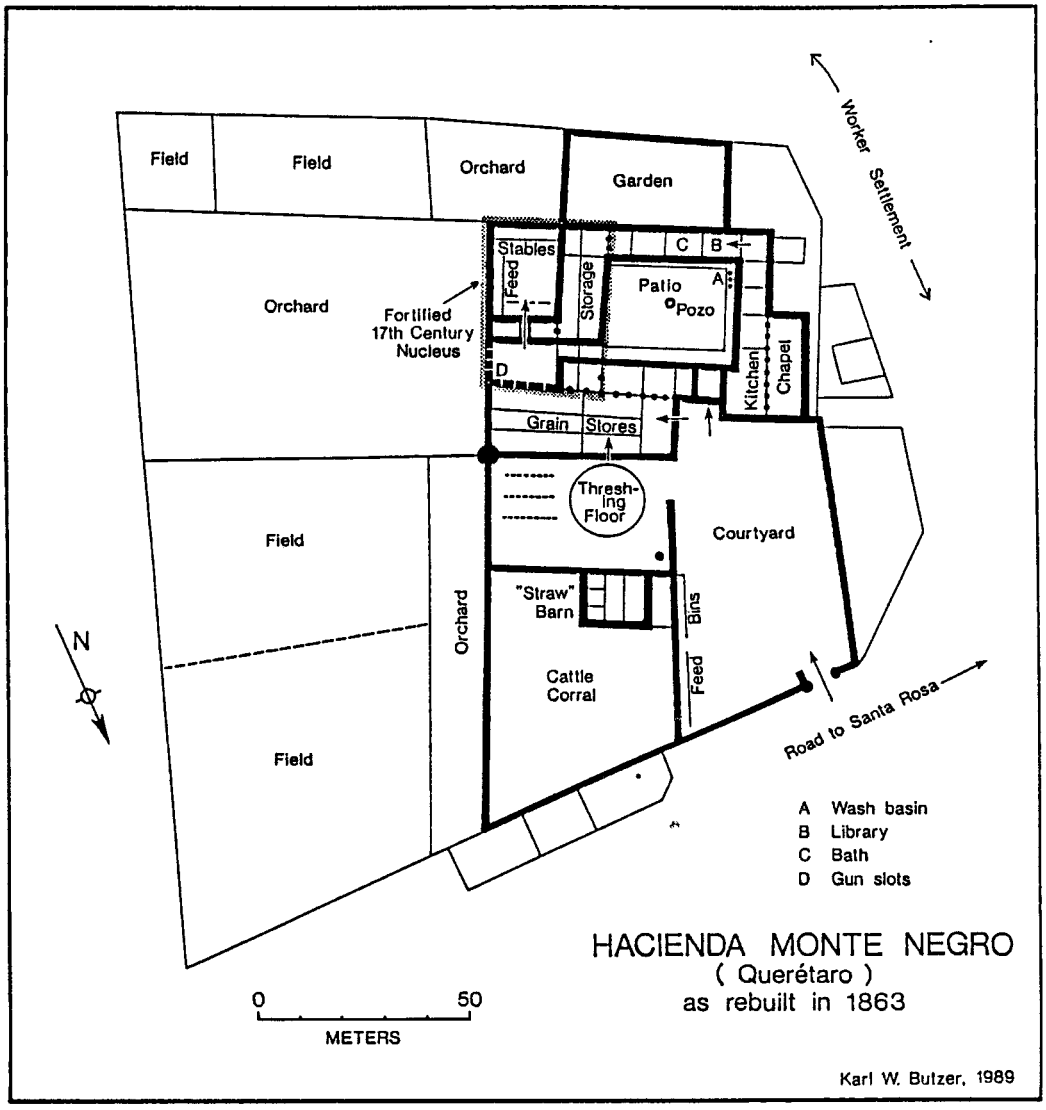

Figure 3. Plan of the ex-Hacienda Monte Negro

Gerardo Vega González, who plans to restore the buildings for resale.

Km 32. **Stop 5** (PHOTO STOP -- 10 min.) We now drive a little way out into the middle of the valley, to get an overview of Monte Negro and its setting. The dirt road follows another old earthen dam, with 18th century sluice gates, for almost 800 m. A kilometer beyond our stop is a bedrock constriction, spanned by yet another earthen dam that has two complex masonry sluice systems, impounding an area of about 35 ha; one gate feeds a canal that follows the northern margin of the valley. The old camino real from Querétaro to San Felipe and San Luis Potosí used to run along here.

From this stop you can see rock-fenced enclosures on the mountain behind Monte Negro. Although the enclosed fields are cultivated today, these probably represent old sheep pens. The four main relief features on the southern skyline represent the remnants of late Tertiary volcanic cones. To the northeast there is a huge mass of deeply dissected, rhyolitic lava, ignimbrites, and tuffs reaching 2750 m elevation, compared with 1970 m for your present position.

We now drive along a poor road to the eastern end of Monte Negro across a ridge of fanglomeratic material, to the

Km 37. **Stop 6** MONTE NEGRO DAM. This presa was constructed to control flooding, to divert the drainage from east to north, and to carry water via a 4 km long acequia, first for a small (12 ha) basin and then to the dam with masonry components (see Figure 2). The upstream catchment is of high relief (over 300 m) and has an area of 6 km^2. Another hacienda uses part of its water, trapped behind a succession of less ambitious dams, the lowest of which is only 400 m upstream of the structure to be visited. Figure 4 provides a sketch of the Monte Negro dam, which has a length of 280 m, a maximum height of 9 m, and a thickness of 3 m.

The masonry units indicate that the dam was built incrementally, in six stages. The first two steps produced a check dam that was 3.5 m high and only 90 cm wide. After two further steps the structure was 7 m high, 3 m wide, and reinforced by a first generation of small buttresses. Finally, at 9 m, four large, stepped buttresses were added. Although excess water could be released by a gate at the eastern end (closed by wood compuertas 75 cm wide and 10 cm thick), the main flow was directed to a very large and high-lying acequia (average crossectional area 8m^2) constructed along the western valley side for over 1 km. This canal may originally have been fed by the upstream dam. The purpose of the elaborate, two-gate spillway -- directed from the acequia back into the impoundment -- is not clear.

The completed dam functioned long enough to allow accumulation of some 4 m of black, clayey fill. Now cut by gullies, this sediment accumulation argues for active soil erosion in the upstream catchment while the dam was functional. Subsequently, the dam was

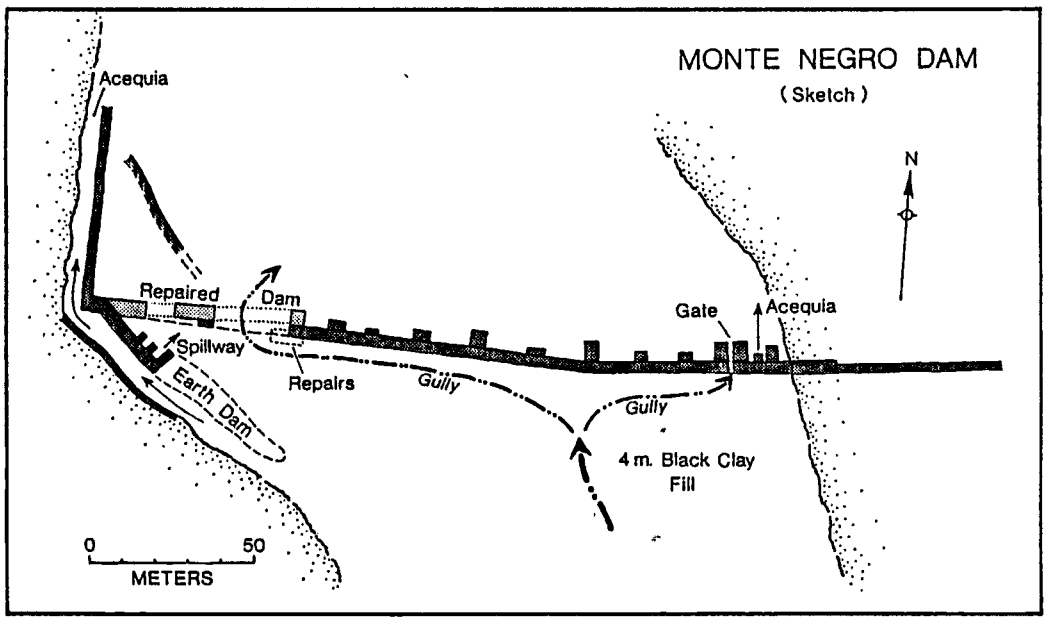

Figure 4. Sketch of the Monte Negro Dam

breached during a major flood event. Three attempts were made to repair it, based on distinct masonry units and different alignments, before the dam was finally abandoned.

The structure is architecturally identical to other late 18th century presas built in the region. How long it functioned cannot be determined. Collectively these dams reflect an enormous effort to expand irrigation farming in north-central Mexico towards the end of the Colonial Era. Considering the small size of the potentially irrigated tracts they were designed for, the investment of labor for construction and maintenance seems enormous and out of all proportion to the expected return in crop yields.

We now return to Highway 57. To the left we pass

Km 46. THE HACIENDA SANTA CATARINA. Although it does not merit a visit, some archival data are informative. Verified since 1712, this estate, together with Monte Negro and Buena Vista (combined area: 30,000 ha), belonged to the Marqués de Buena Vista in 1791 and 1806. The three haciendas were then administered by an administrator and a mayordomo, both resident in Santa Catarina. The work force included six Mulattos and two Mestizos in 1791; two of each category were vaqueros, three of whom came from the district of Celaya. In 1801, Buena Vista and Santa Catarina were rented jointly to the vicar of Santa Rosa and the curate of San Sebastián for 3200 pesos annually. At this time the crops produced on Santa Rosa included, in order: chile and frijoles, maize (irrigated during April and May!), barley and wheat (in part raised without irrigation). The tenant farmers were to receive 87 two-year-old calves for some building tasks, implying a herd of well over 300 cattle, while 380 ewes and meat sheep were awarded to the vaqueros. This presupposes substantial holdings of livestock.

Look for the cañada, defined by a roadway between two rock fences, running straight up the hillside, across the valley to the northwest of Santa Catarina. Next we pass the modern Santa Catarina reservoir. Remnants of a large earthen dam are visible across the middle of it, and crops are progressively planted along the receding shorelines of the lake. At Km 51 we turn west onto Highway 49, toward San Miguel Allende. We turn south at Buena Vista.

Km 53. **Stop 7** (BOX-LUNCH STOP -- 30 min.) HACIENDA BUENA VISTA. Although we have no plans for a guided tour here, there is a comfortable rock wall to sit on in the shade of large pepper trees (pirules). On one side is the old hacienda complex (now a secondary school), and on the other is a magnificent view. The latter includes a former cienega with two striking earthen dams, some complex masonry sluice gates, and a mountainous skyline formed by a breached, composite volcanic cone (2700 m elevation) of Mio-Pliocene age.

This hacienda has a comparatively large, free-standing church, dedicated to San Juan. Although modified, it already existed in 1712, possibly with an hacienda chaplain serving the sizeable Indian

population resident here. In 1791 much, if not most, of this immense estate was leased to 30 tenant farmers, 14 of whom were "Spaniards," 14 Mestizos, and two Mulattos. One of the Mestizos was a vaquero, while two of the Spaniards were married to Indians and one to a Mestiza. The hacienda itself had only four non-Indian workers but, interestingly, was the residence of a school teacher.

We leave Buena Vista for a look at what remains of the regional livestock industry in the Puerto de Nieto. Not visible from the road to the south is a trunk cañada running from Buena Vista to behind the straggling village where the road bends around a mountain.

Km 60.5. **Stop 8** (EXTENDED STOP -- 30 min.) LA CAÑADA. Located along the southwestern side of this historical pass are several small communities that bear the imprint of traditional stockraising. But unlike haciendas and irrigation features, such traces are fragmentary, scattered, and somewhat elusive. The rough pastures of the mountains were once grazed by flocks of sheep, animals that also had to be driven between cultivated fields to adjacent estates, or moved from one mountain to another. But just as the hand-operated looms could not compete with factory textiles in the 19th century, wool could not compete with cotton and acrylics in the mid-20th. Sheep raising had long been on the decline, and now is virtually obsolete. Its imprint on the landscape is, therefore, old and fading. Not even old men can recall the transhumant herds, and they generally fail to understand the function of the surviving features.

In a dominantly agricultural landscape, Mediterranean-style sheepherding is a controlled activity. Local animals graze on stubble in harvested fields during the dormant season, especially in the milpas between mid-autumn and mid-winter. After the maize had sprouted, the animals were moved up onto the uplands or into the mountains, where their movements were controlled by long rock fences, sometimes to be contained in large and irregular enclosures at night. Such fences and enclosures remain conspicuous on the air photos and maps, often also from the road. But today such enclosures have been converted into upland milpas. Where sheep regularly passed from the cultivated lowlands to the rough slopes, roadways were flanked by parallel lines of stone fences, especially in the corridors approaching and passing through settlements. Such sheep runs or cañadas remain, in however discontinuous a form. Once out of the cultivated sphere, the rock fences stop abruptly. Most traditional roadways, including stretches of camino real, are similarly lined with rough walls of untrimmed and unmortared rock, since large herds were periodically driven to distant winter pastures (agostaderos), or to towns where their wool was shorn or their meat in demand at slaughterhouses. The trunk cañadas serving such transhumant herds or drives to market converged at major passes, where complex corralling areas were often required to control the traffic or provide overnight containment.

Puerto de Nieto is one such area (Figure 5). Once the threat of Chichimec ambush was removed, great herds were driven across here

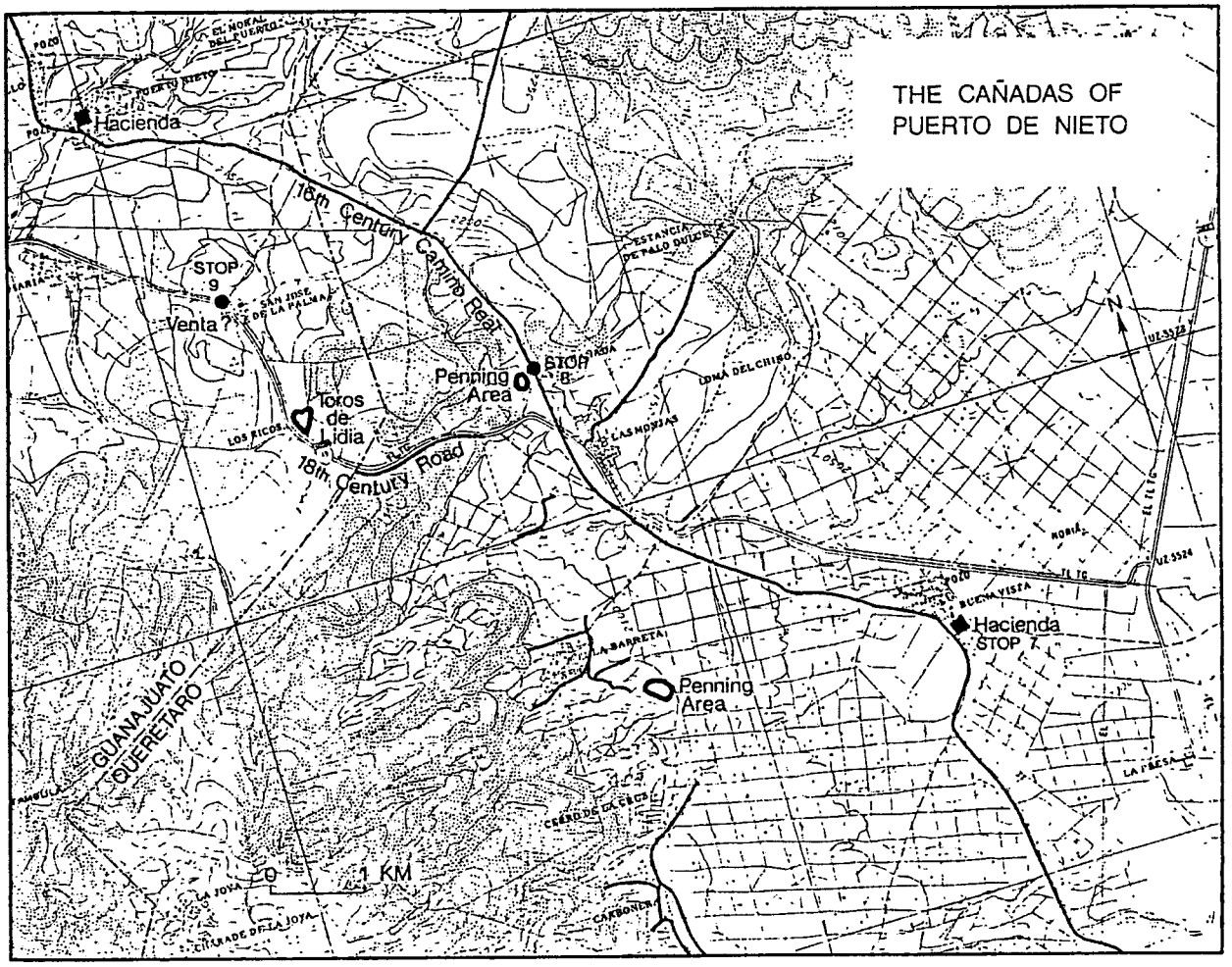

Figure 5. Sheep Runs (Cañadas) in the Puerto de Nieto

from Querétaro and even Hidalgo state, to the wool market of San Miguel, to the agostaderos of San Felipe and San Luis Potosí, or to the butcheries of the Guanajuato mines. Cañada walls line the older road from Buena Vista up through La Cañada, directly to the hacienda Puerto de Nieto. They also follow one side or the other of the highway, swinging due west along the 18th century trace of this same road. Other segments of cañadas can be seen running northeastward up the hillside from Las Monjas, and are apparent around similar small piedmont settlements to the south at La Barreta and Carbonera. The lugar of La Cañada still has a profusion of stock pens and old, tile-roofed sheep sheds that are today used for a few paltry cattle and pigs, or for storage.

We will attempt to negotiate the buses into the lower part of La Cañada, and then have them pick you up on the higher road to economize on time. Take a short walk up the cañada, to reassure yourself that the rockiness was imcompatible with 18th century carriages. Pay attention to the mass of penning facilities. But above all, scan the vistas from the highway for more distant features.

Km 63.5. As we swing north past the high point followed by Highway 49, note a modern FIGHTING-BULL BREEDING FARM. It is billed as "Ganadería Don Tomás -- Toros de Lidia." Having experienced a dozen of the black monsters in full stride, I assure you they're the real thing. At the next bend we pass a half-abandoned hamlet, San José de la Palma, possibly an old wayside inn or venta.

Km 65.5. **Stop 9** (PHOTO-STOP -- 5 min.) PANORAMA OF THE HACIENDA PUERTO DE NIETO, lying serenely in the valley bottom. This estate already existed in the 1630s when Juan Caballero opened a wool workshop here to help create a family fortune used by his son to endow church-building in Querétaro after 1675. In 1791, the then-huge estate controlled all the land you can see to the north and west, and belonged to the Marqués of Buena Vista. The core of the mountains on the northeastern skyline consists of Triassic limestones and metamorphic rocks.

The stretch from here to just above San Miguel represents a great, late Tertiary lake basin that is underlain by fine, white volcanic tuffs. The haciendas lie well off the road, which only passes several modest ranchos -- Santa María (to our left) at Km 67.5, Los Cerritos (to our right) at Km 73, Puente del Carmen (to our left) at Km 77.5, and Corralejo (to our right) at Km 79.5. Further west, a number of small, Indian ranchos can be seen scattered at a distance to the north, while a great, composite volcanic cone rises forbodingly on the southern skyline. The entire area, as far as the eye can see from the pass to here, once belonged to only three haciendas (Puerto de Nieto, Jalpa, and Alcocer). In 1792 their population consisted of 448 "Spaniards," 273 Mestizos, and 93 castas, probably with an additional 500 Mulattos and 2800 Indians.

Km 85.5. **Stop 10** (EXTENDED STOP -- 20 min.) SAN MIGUEL PANORAMA. Standing here on the edge of a great north-south fault (with a

100-150 m displacement), you have one of the most spectacular scenic views in Mexico.

Directly below is the city of San Miguel Allende. Since this field trip is devoted to the rural countryside and time is rationed, we will unfortunately not see more than a few streets on our way through and out of town. So enjoy the best of this photogenic city -- which is disturbingly commercialized and replete with latter-day American hippies -- namely, the bird's eye view. San Miguel was a prosperous colonial city, but of secondary importance. Founded as a mission in 1542 on a different site just above the shores of the Allende Reservoir, it was destroyed by Chichimecs in 1551. Rebuilt on its present location in 1555, it became a center of the livestock trade and a major wool producing town. In 1793 it had two factory-style wool obrajes, but 426 other looms, compared with about 1000 in Querétaro. Leather and metal-working also were unusually well developed. The population in 1794 included 2873 "Spaniards," 1753 Mestizos, and perhaps another 2500 Mulattos and 5000 Indians. From a peak of about 12,000 inhabitants in the early 1800s, the population by the 1820s had declined by a third, and the town never regained its significance.

The skyline of San Miguel is dominated by the twin, peaked spires of the parish church. Remodelled in the 1880s in neo-Gothic style, its architect is noteworthy: Ceferino Gutiérrez, a Tarascan Indian with no architectural schooling and no European travel experience. Some visitors like the innovative facade and towers; others do not. It must, however, be ranked as a major Mexican landmark that anticipates Gaudi's Sagrada Famila church in Barcelona.

Beyond the blue line of the River Laja, Tertiary lake tuffs grade upslope into fanglomerates that spread out below the volcanic uplands on the western horizon. Great pediments cut across this surface, sweeping from south to north, their smooth surfaces interrupted by deep valleys cut by streams draining from the oak-covered mountains of Guanajuato. Now eroded by the Laja, the same beds extend to the foot of the fault escarpment below us.

In prehistoric times, the Laja floodplain provided a great corridor leading north to San Felipe and thence to San Luis Potosí. Through much of the first millennium A.D., agricultural people settled along here, finally abandoning the area after A.D. 1100. There is no evidence of increasing aridity, and pollen profiles in Michoacán, the Bajío, and near San Luis Potosí record nothing more than a decline in agricultural disturbance and in maize cultivation. The regression of sedentary lifeways appears instead to have resulted from changes in the systemic energy generated by the centers of higher civilization in central Mexico.

As early as the 1530s, the Otomí began to recolonize this valley from the southeast. They were followed by Franciscan missionaries and Spanish settlers, who acquired land grants along the floodplain. A pictorial map from about 1580 shows schematic

settlements along it labelled "ribera deste rrio son estancias de vacae y algunas labrancae." Sedentary Indians are shown at work with digging sticks and hoes while cattle graze in an open landscape with a profusion of prickly pear and another, unidentified Opuntia or maguey. This co-mingling of Indian and Spaniard resulted in a polarity of haciendas and Indian ranchos that can be seen more closely at our next stop.

Passing through downtown San Miguel we eventually reach Highway 51, the road to Dolores Hidalgo. At Km 90, on a hill to our left, is the ex-Hacienda Mexiquito, now converted into a plush hotel. The irregular plains north of here are unlike the fertile, cultivated soils east of San Miguel. The bleak white tuffs and occasional capping basalts are poor for potential agriculture, and much of the terrain has a vegetation of widely spaced acacias, clumps of prickly pear, and degraded grass cover. The initial cattle estancias of San Miguel were soon converted to sheep, and during the 1600s large flocks roamed the plains both north and west of the city. By the early 1700s, the district of San Miguel had become primarily agricultural, and the sheep estates were restricted to the present jurisdiction of Dolores Hidalgo. Note that we continue to parallel the great fault scarp to the east, which eventually acquires a relief of 300 m with its superposed lavas.

At Km 98 a small road goes down to the old sanctuary-hacienda of Atotonilco. We would prefer to go this way, but the Colonial bridge across the Laja is too narrow for buses. The church here was built 1740-48, becoming a popular pilgrimage center that resembles a dusty and depressing Western movie set. Of interest would have been the aqueduct and the irrigated sanctuary gardens. Instead, we turn off the highway at Km 103 to follow a former railway track down to the Laja floodplain (Figure 6).

Km 105-110. The LAJA VALLEY retains a complex, cultural landscape, reflected in two types of field patterns and of settlements (Figure 6). Four haciendas -- Atotonilco, Rancho Viejo, Los Ricos (later a dependency), and Petaca -- dominated this section of the river. These haciendas were mainly inhabited by "Spaniards" and Mestizos, while the bulk of the Indian population continued to live in adjacent or dispersed ranchos, -- Montecillo, Bordo Colorado, Los Guerreros, El Salto, La Cuadrilla, El Lindero, and Los Galván -- many with their own chapels. The best bottom lands were cultivated for the haciendas by Indian labor, and can be recognized by their rectangular field forms. Indians, as sharecroppers, were allowed to use smaller plots around their ranchos or up on the hillsides. Such plots normally have irregular shapes.

Unlike in the area north of Querétaro, the direct employees of the haciendas of the Laja were overwhelmingly Mestizo or Castizo, commonly married to someone of another "racial" category, and generally born on the estate. Of 33 employees on the three estates in 1792, only 13 were "Spaniards" and five of these were married to Indians or Mestizas. Five of the Mestizos were married to Spanish women, three to Indians, and two to Mulattos. Only seven of 33 were

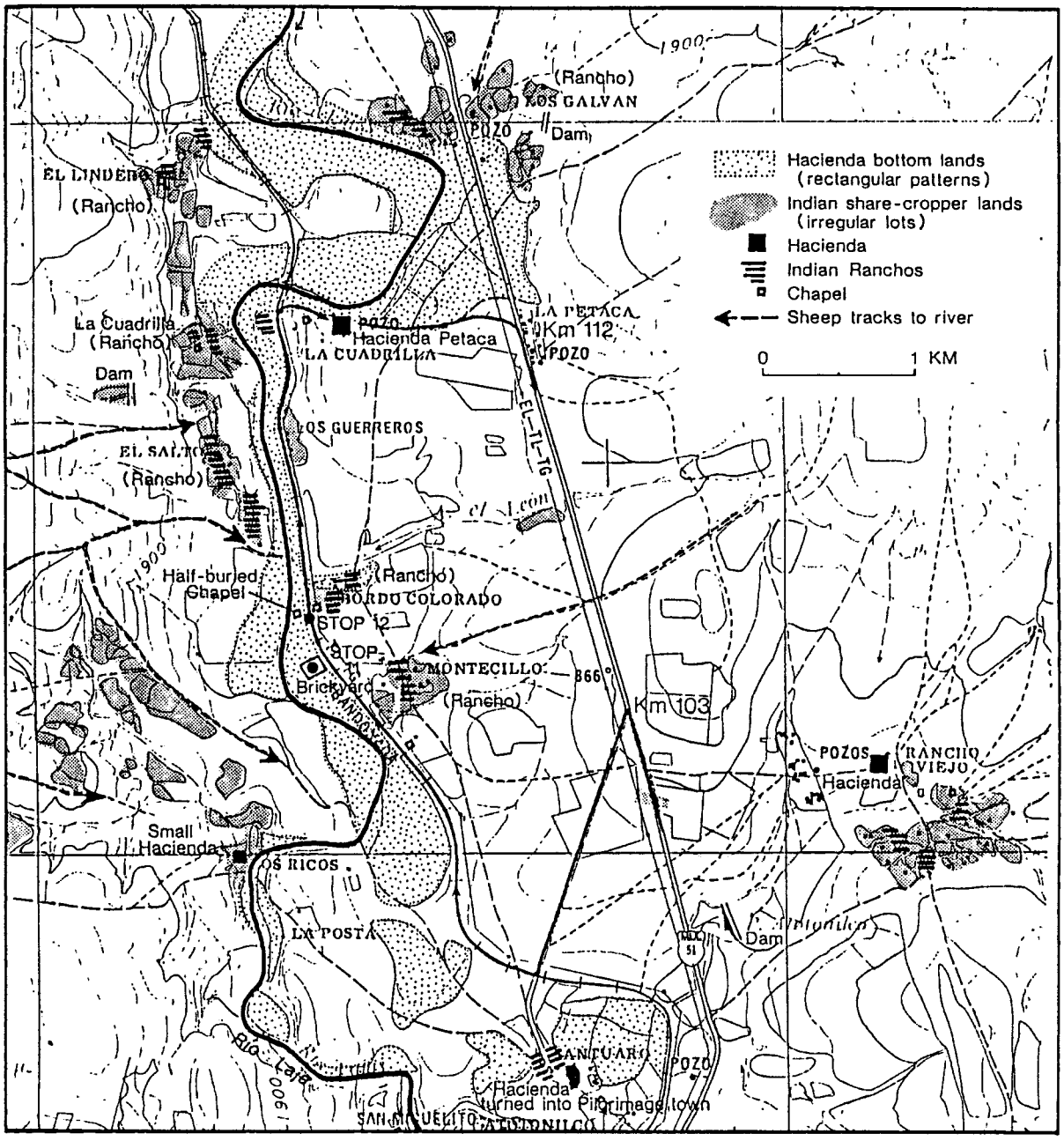

Figure 6. Hacienda and Indian Fields and Settlements in the Laja Valley

born elsewhere than the estate on which they worked. The non-Indian marriage pool within these circumscribed communities was very small, and racial fusion was well underway in 1792. The key hacienda, the Petaca, had a mayordomo, three Spanish domestics, three smiths, two herders, two muleteers, and no non-Indian workmen (labradores). By Querétaro standards, these were modest and relatively poor haciendas.

Km 198. **Stop 11** (SHORT STOP -- 10 min.) BORDO COLORADO (LAJA BRICKYARD). Of principal interest here is the quarry, dug into the Laja floodplain. Immediately below the roadway some 15-20 cm of "overbank" flood silts rest on top of a dark gray vertisol (?Early Holocene), and are covered by some modern overburden. At the base of the flood silts is a striking zone of lime enrichment ($CaCO_3$ "dendrites"). Toward the lower end of the quarry this same dendrite horizon begins below -80 cm and is covered by much thicker flood silts and clays. Below it, down to -120 cm, are older flood silts containing dispersed gravel and abundant artifacts: chalcedony flakes and cores; 'Mesoamerican,' reddish-colored potsherds, some with red and black designs; 'Spanish' potsherds with light green lead glaze; and undiagnostic potsherds. As a group, these materials record Indian settlement early in the Colonial era. In this position, they represent derived artifacts, swept into position by one or more catastrophic flood events. The implications of this record (shown in Figure 7) are discussed at the next stop.

Km 108.5. **Stop 12** (EXTENDED STOP -- 30 min.) BORDO COLORADO TRINIDAD CHAPEL. It is obvious that this chapel and the free-standing tower (Figure 8) next to it are partially buried in alluvium. Inside the chapel, a conspicuous water-line at 1 m over the floor marks the level of the sediment built up outside. The old adobe brick wall in the front encloses an unusual shrine, evidently built before most of the sediment had accumulated. Behind the church is a pothunter pit with 130 cm of flood sands and silts exposed. These sands and silts also include mortar and brick fragments, as well as rare, undiagnostic sherds. The dendrite horizon is not present because it is below the foundation level. As Figure 7 shows, this sediment column is of the same age as the top 80 cm in the lower brickyard.

Rustic chapels are difficult to date architecturally, but the facade suggests the "Middle" Baroque period (early 1700s), whereas the interior painting above the former altar looks "Late" Baroque (mid- 1700s). (Blocks of stucco with identical paintings of scrolls with cherubs are incorporated in the walls of a chapel at La Cuadrilla that was rebuilt in 1807.) The external tower is very different and much older, probably from the 1600s. Informants indicated that the chapel, after abandonment, was reused as a school. The masonry enclosure and the "frivolous" paintings inside the chapel, including a birdcage, probably relate to this function. The birds are done in the style of 19th and early 20th century plates. The chapel was replaced by another one, built on the other side of the road, which is now used as a pigsty. Its architecture

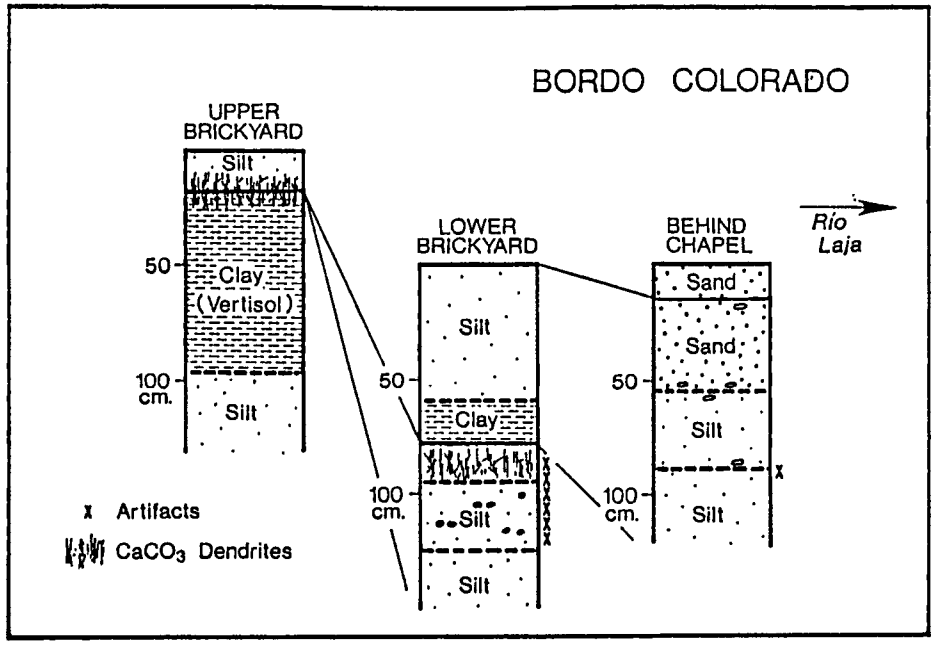

Figure 7. Sediment Profiles in the Laja Floodplain at Bordo Colorado

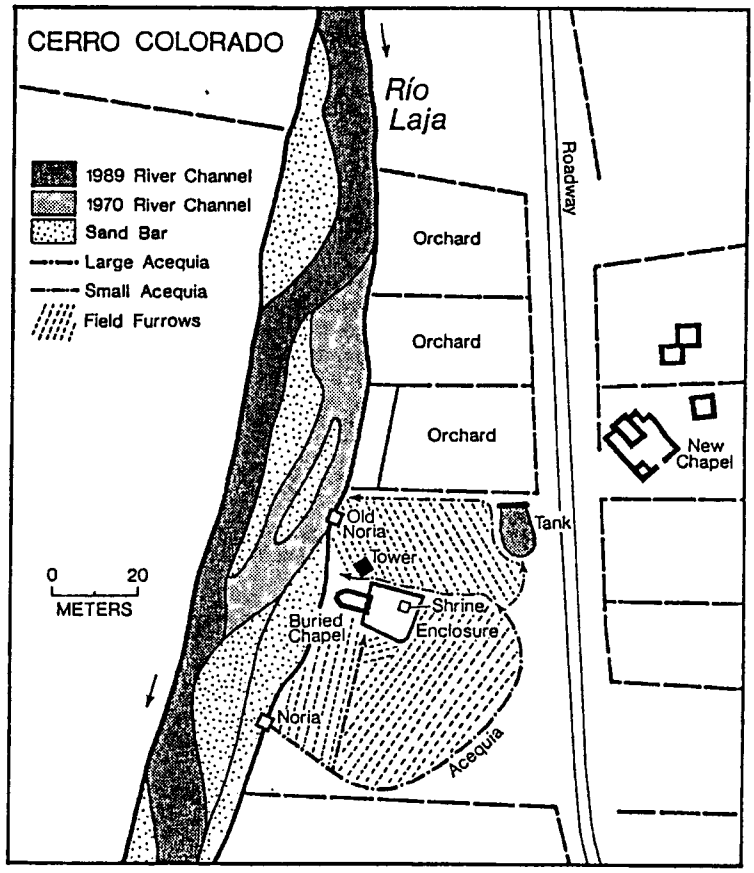

Figure 8. The Chapels and Norias of Bordo Colorado on the Laja Floodplain (mapped by Karl W. Butzer and Clint E. Davis)

is more distinctive -- transitional between Baroque and neo-Classic, done in the last 30 or so years prior to the wars of Independence.

Assembling these points of reference (see Figure 7), the following chronology is suggested:

(1) Otomí settle along the floodplain ca. 1540, followed by Spanish pastoral activity;

(2) Several major flood events lead to an accumulation of at least 50 cm of eroded soil material on the existing floodplain;

(3) The Laja system stabilizes with long-term development of a carbonate-rich subsoil horizon. During this period:
- -- the tower is constructed (possibly as the masonry part of an adobe brick chapel) (1600s)
- -- the "buried" chapel is constructed (mid-1700s)
- -- the chapel used as a pigsty is constructed (ca. 1800)
- -- the "buried" chapel is used as a school (possibly late 1800s);

(4) Several major flood events occur, leading to active accumulation of about 100 cm of eroded soil and subsoil material on top of the floodplain of the 17th-19th centuries;

(5) The Laja system stabilizes, with incipient soil development. The impact of subsequent floods has been restricted to minor shifts among the channel bars (see Figure 8).

The importance of these features is that they document two periods of ecological disequilibrium in the Laja watershed. One followed upon the initial Otomí and Spanish settlement (possibly during the early 1600s), and may have been activated by overgrazing. The trend to increasingly intensified agriculture may have favored a new hydrological equilibrium. The second episode of major flood events (possibly during the early 1900s) may have resulted from disintensification after Independence, particularly when increasing population pressure during the late 19th century would have favored short-term optimization strategies. A Texas geography student, Charles Frederick, is currently beginning a doctoral study of these phenomena of historical alluviation and soil erosion in the Laja Basin. This study should shed considerable light on the ecological impact of land use change over time.

Another item of interest at this important location is a noria (at the river bank), constructed at the time the floodplain was a meter lower. With some modification to adjust to the changing elevation, the noria was used until fairly recent times, as indicated by the regular field lines.

Km 110.5. To the left, a rough track crosses the river bed and goes up to LA CUADRILLA, which has a chapel that was rebuilt in 1807. Unfortunately the buses cannot go in, and so the pattern of small, irregular fields around an Indian rancho of the Colonial era cannot

be properly observed on this visit. Cactus and other thorn-type fences are characteristic.

Km 111. Hopefully the buses can negotiate the difficult entrance to the HACIENDA PETACA, which was rebuilt 1987-88. It may be converted into a hotel. The buildings remain unchanged from those detailed on a late 18th-century plan. The 1792 owner, Juan Lanzagorta, resided in San Miguel. As we leave the hacienda, look down to the left. The neat arrangement of fields visible in the valley bottom below represent the lands once farmed by this estate. The valley itself represents an entrenched meander.

Km 112. Return to Highway 51, opposite the modern roadside settlement of PETACA. Here we begin the return trip to Querétaro via the San Miguel by-pass. This is a "straight" stretch of 87 km (about an hour's ride). Hopefully we will get back to the Holiday Inn for a cold beer at a reasonable hour.

Acknowledgement. Clint E. Davis did preliminary field study of many of the sites visited today, and participated actively in the trips run to select the final itinerary.

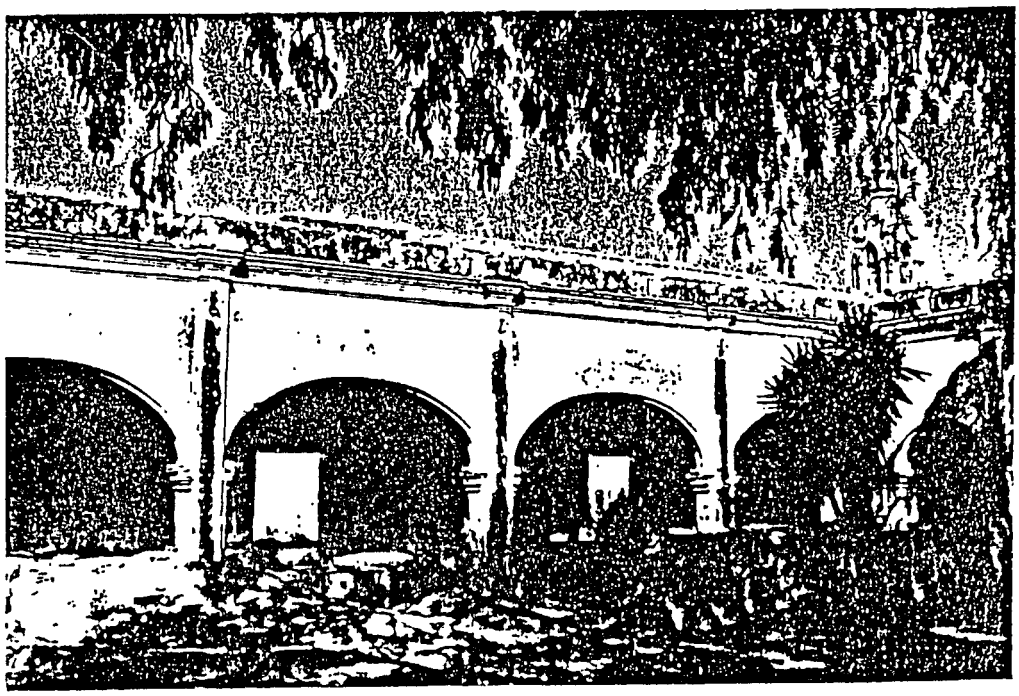

Figure 9. Patio of Hacienda Monte Negro (1863)

Figure 10. View from the Hacienda Buena Vista