From: *The Journal of Big Bend Studies* Vol 1 1989

The Physical Geography of a Significant Border Region, La Junta de los Rios[1]

Russell Gardinier

INTRODUCTION

Too hot, too dry, too remote, too poor, too wild, too far from God, too close to the Devil, ignored by governments, and forgotten by history, the land in the area of Presidio, Texas and Ojinaga, Chihuahua bears with stoic resignation its unheralded role in the development of several human cultures in a harsh physical environment of northern Mexico and the American Southwest.

But it was not always thus. This is the stage set as seen through the eyes of people with a modern European background.

During the late 1920s through the 1930s the weather station at Presidio gained notoriety on the United States national radio as "the hottest spot in the nation." The rainfall in the area, highly erratic at best, averages barely over eight inches per year and gives rise to recurring severe droughts such as in the middle 1950s when one year provided less than one and three quarters inches of precipitation. Yet the area has averaged a flood in at least three out of every four years, including one in 1917 which washed out most of the Texas town at the center of the region.[2]

In July 1852, Major William H. Emory of the United States and Mexican Boundary Commission visited the area and described the village of Presidio and its environs as "isolated and very remote from any other settlement." He found that it had been "suffering from famine," "that the Indians had run off most of the cattle," and that the "drought for the preceding three years had caused a failure in the corn." He described the settlement as "a miserably built mud town" and mentioned the "barrenness of the soil." He also noted that "while the immediate neighborhood is very dry . . . so great were the rains to the south that the [river] was swollen . . . and the whole valley was inundated. This is said to occur annually."[3]

Other observers have been less kind than Major Emory. United

Russell Gardinier is a retired U.S. Air Force Colonel. He currently lives in Fort Davis, Texas.

States troops stationed at this border site during the Pancho Villa era and during World Wars I and II, after noting the tortured landscape, the isolation, and the intense heat were wont to describe it in unprintable terms. One of their less epithetic descriptions had a common element as being "the place where God dumps his garbage" or "where He swept His scraps when He had finished making the earth." Mexican natives are aware, however, that the ecoscape is but a reflection of the Devil's handiwork; while modern "Anglo" observers simply identify the jumble of landforms and extremes of climate as "Paradise put together by a committee."

Local legend suggests that evil was so rampant in the area and there was so much wickedness that the local parish priest caused a special chapel to be built high up on a cleft of Santa Cruz mountain, which overlooks the town, from which fissure issued El Diablo on his frequent swings encouraging sin and depravity. The attempt at exorcising was unsuccessful; the Devil in the form of a huge vulture escaped the intended entrapment and flew off. But to this day he leaves a trail of scorched ground and seared souls wherever his shadow passes on the earth as he soars overhead, while the chapel has become a place of special pilgrimmage on Easter Sunday.

Others say that overgrazing by imported animals and a change in climate caused the native grasses to disappear and be replaced by desert plants and shrubs, many of which stick, prick, or scratch and are unsuited for any economic use. As for the seared human souls, no scientific explanation has been offered, but it may be instructive to note that the last "witch" to be convicted in the New World was reportedly executed nearby in May of 1954.[4] A huge vulture still soars overhead today, though sensitive Texans are quick to point out that this is mainly on the Mexican side of the Rio Grande.

First visited by Spanish intruders in 1535 (some 85 years before the Pilgrims found themselves in New England instead of Virginia where they had been headed) and by Anglo adventurers three hundred plus years later, this site remained without effective political, military or ecclesiastical control until the ultimate elimination of the Apache/Comanche threat in the late 1800s. Yet temporary Spanish missions were established in 1581-83, permanent ones in 1683; a Spanish fort was built in the area about 1725, and a bigger, fully-manned "new" fort followed in 1759. A few Anglo settlers established baronial forts in the region in the middle 1800s. Spanish/Mexican troops, Texas Rangers, and Confederate forces failed to pacify the region, and United States horse soldiers did no better until close to the turn of the nineteenth century when the buffalo plains to the north and the arid bolsons to the south were

eliminated as Texican and Mexican redoubts for the (by then) "renegade" Indians.

Archeological and later written evidence points to continuous habitation in the region for over 10,000 years, first by big animal hunters and then by archaic peoples and their descendants who were among the earliest in the New World to practice rudimentary agriculture and to enjoy the benefits of domestication of both plants and animals. A historical marker on U. S. Highway 90 just east of Marfa, Texas proclaims "Presidio - the oldest continuously inhabited site in North America." Whether this claim is a bona fide one or not, the locale has been a *liebensraum* of human occupation for many millenia. From these early cultures and especially from the pre-Columbian Indians, trade routes emanated southward to "civilized" central Mexico, northeastward to the buffalo plains and salt flats of the southern great plains and to the Gulf coast of Texas, as well as northwestward to the piney mountains and the pueblos of New Mexico. Some trade goods apparently arrived also from the Gulf of California. Europeans followed these well established trails first with the horse of exploration, then with the wagons and mules of commerce, and finally with the iron rails of mercantilism. These routes are now paralleled by the auto routes of tourism.

A political boundary was established across the middle of the area after the U. S.-Mexican War, but its existence was more real in Washington and Mexico City than locally where people crossed the border without regard for the boundary as they had done for centuries. Geostrategic and physical factors created the setting for a long, continuous span of human history in the region which was largely unrecorded, but which may be traced in bits and pieces through the centuries.

But Man does not exist in a vacuum. Except for a few recent space events, Man lives on the earth, and for the most part he lives on the land. It may be well to note at this point the words of geographer Preston E. James who said that "land" refers to the natural surroundings of human settlement--the habitat. The natural surroundings, he averred, includes "the surface features, the climates, the water, the wild vegetation, the soils and the minerals." These are the features which "make up the resource base which forms the background of settlement."[5]

Let us look at this resource base more closely.

THE PHYSICAL REALM

Location and Physiography

The central site is Presidio, Texas together with its sister city of Ojinaga, Mexico--originally a single village astride the Rio Grande

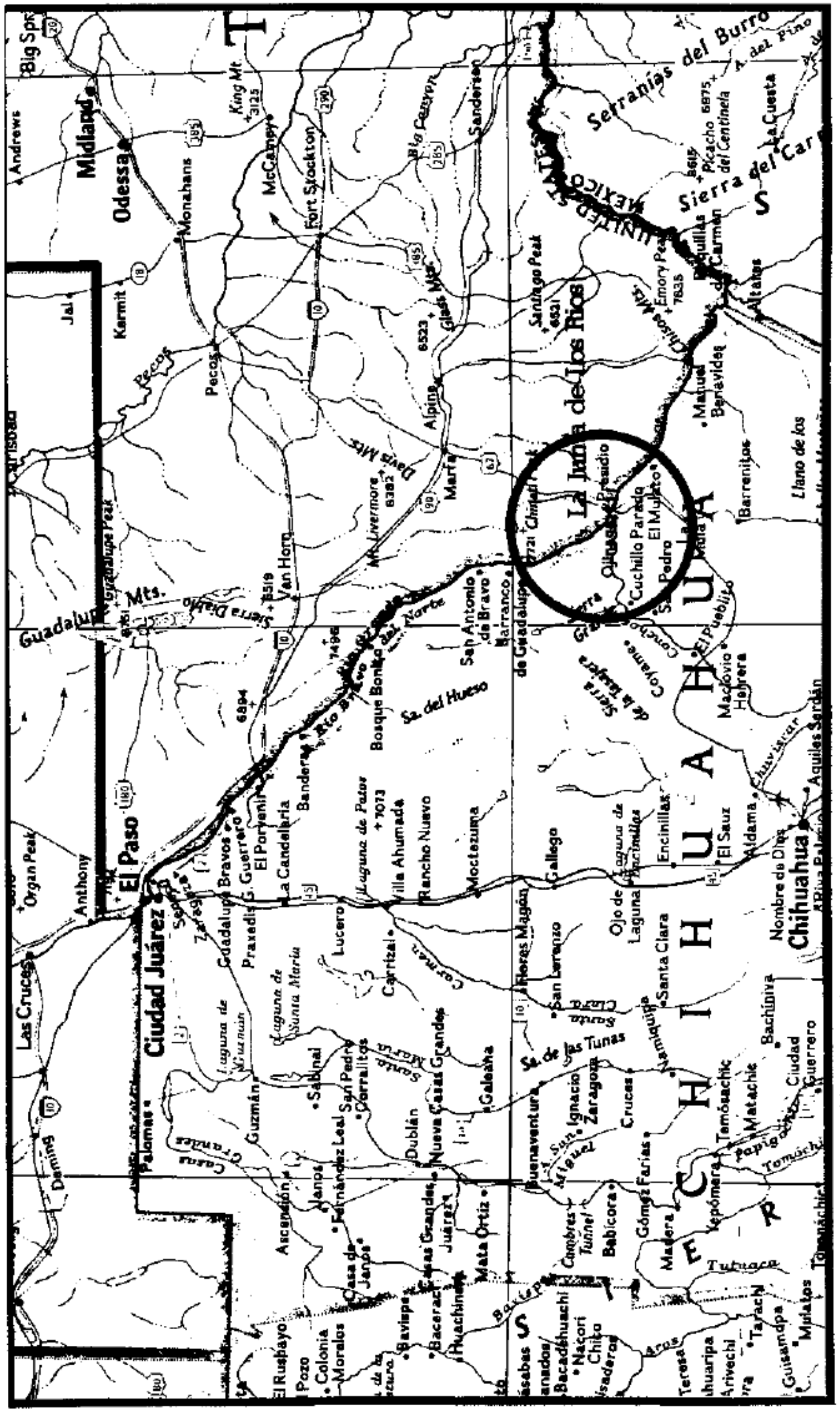

FIGURE 1. La Junta de Los Rios, Location

in what are now known as the states of Chihuahua and Texas. Its common name was Presidio del Norte.

It is at this site that the Conchos River of Mexico joins the Rio Grande a short distance from the point where the Alamito Creek of Texas enters the latter river. This juncture, which also includes the outflow from Cibolo Creek from the north is, of course, the reason that the zone became known as La Junta. The zone extends up and down the Rio Grande along its northwest-southeast axis for about sixty-five miles and up the Rio Conchos along its east-west axis for about forty miles. The elevation of the Rio Grande and Rio Conchos confluence is about 2,500 feet above sea level; the 3,000 foot contour line roughly encloses the area. This zone is, in turn, a part of the larger Trans-Pecos region of Texas and the Conchos Basin region of Mexico. For the most part, the area is situated in the geographical and ecological realm of the great Chihuahuan desert. The population density is quite small. It is perhaps significant that the locale lies in one of the most remote parts of both Texas and Chihuahua--the largest states of the contiguous United States of America and the United States of Mexico, respectively.

In a still broader extent, this strategic zone is part of the mountain and basin region of the southern Rocky mountains and is transitional between the southern region of the Rockies and the central plateau of northern Mexico. A United States Geological Survey map, "Physical Divisions of the United States," classifies the area as part of an intermontane plateau, a "basin and range province of the Mexican Highlands," characterized by "isolated ranges (largely dissected block mountains) separated by aggraded desert plains."[6]

Physiographically the locale is a river basin/floodplain surrounded on all sides by mountains. To the north and west lie the Chinati Mountains and to the east the Cienagas and Torneros. On the Mexican side of the Rio Grande the basin is bordered to the south and east by Las Sierras Ricas, La Sierra Grande, and Las Sierras Chinati. Numerous, lesser individual mountains with local names are included in these major ranges. The general thrust of these mountains is along the course of the Rio Grande. Conversely, the Rio Conchos cuts across the grain of the Sierra Grande in a spectacular water gap only about twenty-five miles above La Junta.

The terrane for the most part consists of gravel, bolson deposits and alluvium of the Quaternary period. Overall geologic deposits in the region originated in the latter part of the Paleozoic era (230-600 million years ago), although much material developed later as evidenced by the fossils of ammonites and related forms of life found in the Santa Cruz outlier a mile south of Ojinaga and elsewhere in the region.[7] It was in the Cenozoic era (63 million years ago to the present) that this region witnessed the major part of the uplift forming the main mountain ranges as well as the rise of mammals

and flowering plants. Volcanic activity, in general, coincided with the upthrusting of the Rocky Mountains and the central plateau of Mexico, usually dated between 50 and 60 million years ago. This most likely accounts for the igneous intrusions in the form of dikes, sills, laccoliths and baccoliths into the sedimentary (mostly limestone) and metamorphic strata. It likely accounts also for the silver and quicksilver ores found in the area. No volcanic activity has been noted in historic times, but hot springs mark the furthermost limits of the delineated area along both the Rio Grande and Rio Conchos while early travelers reported a hot spring somewhere along Alamito Creek as it descended to the Rio Grande from the Marfa plateau. Deep wells on the adjacent ranches find hot water at from 600 to 800 feet. More recently, the "energy crisis" of 1974-75 stimulated interest in the area's geothermal potential to the extent that promoters and entrepreneurs obtained water rights' leases over large acreages of private lands.[8]

With most of the general uplifting completed by the Tertiary period of the Cenozoic era, the general landforms were extant at the start of the Quaternary period about a million years ago. However, during much of this period a series of worldwide glaciations alternately advanced and retreated. According to estimates, the waxing and waning of the global glaciers occurred as recently as 5000 to 8000 years ago in North America. Indeed, some climatologists insist that the earth is even now in a lull period before the next ice advance. In the microplex area under review here, this alternation of glaciation and melt had a considerable effect upon the landforms. By the end of the last glacial retreat it also had grossly affected animals and human beings who by then had acquired a considerable tenure in the region. This is not to say that the ice sheets reached the Rio Grande and Rio Conchos; there is no geological evidence--rock striations, drumlins, eskers, glacio-lacustrine deposits, moraines or similar features--to support such hypothesis. However, the freezing and melting with its high atmospheric moisture in higher latitudes, provided copious quantities of water to force the two rivers to cut through mountain barriers into adjacent valleys and ultimately (in the case of the Rio Grande) to the sea. The sheer-walled canyons of the Big Bend Park, and the canyon of the Conchos, were incised into the earth's face during this three quarters of a million years. As the rivers cut their way down into the mantles of the depositions from earlier ages, outwash from the remaining higher ground contributed much dirt and rock in lesser streams as these, too, eroded or deposited sand, gravel, rocks and boulders across a series of river terraces descending in steps to the present river bed.

These terraces are readily evident to even the untrained observer who drives to Presidio down the twenty miles of United States Highway 67 from the community of Shafter; a series of five fairly

FIGURE 2. Looking westward up the Rio Grande above Lajitas toward Presidio and Ojinaga; Chihuahua, Mexico on left; Texas, U.S.A. on right.
Museum and Archives of the Big Bend

distinct water-washed, rounded-rock, river terraces are clearly visible. The large size of many of the rocks and boulders in deposition on these terraces suggests the high gradient, heavy volume, and long duration of the water forces during the Quaternary. Less distinct, but still noticeable, are the same five terraces which can be seen in ascending Mexican Highway 16 from Ojinaga, Mexico to near the crest of La Sierra Grande about thirty miles to the west. It could thus be conjectured that four great periods of abundant moisture occurred, with the fifth and final terrace (close to the present river courses) being the result of erosion in the time since the last glaciation.

The various oceanic and lacustrine deposits, primarily the limestones, sandstones and clays of these early periods and the weathered rock of both metamorphic and igneous forms, provide the source material of the soils of La Junta. Agricultural pursuits being very characteristic of the area, an examination of the soils should be informative.

The General Soil Map of Texas and the General Soil Map of Presidio County include soil classifications representative of La Junta. These fall into two general categories: one is the river bottom lands along the Rio Grande (and assumed the same along the bottom

lands of the Rio Conchos), and one is the upland soils of the adjacent terraces. The Presidio General Soil Map offers the most detailed description of these two soil associations. The first is called the "Nickel-Canutio" association:

> NICKEL-CANUTIO association: Deep to shallow, undulating to rolling calcareous gravelly soils on basins and valleys. This association consists of light colored, gravelly, calcareous soils on undulating and rolling hills. Their main use is for rangeland and wildlife.[9]

The second is the "Glendale-Anthony-Toyah" association:

> GLENDALE-ANTHONY-TOYAH association: Deep, nearly level, calcareous soils on the flood plains of large rivers or arroyos. This association consists of light to dark colored soils on flood plains of the Rio Grande and large arroyos. Most of the soils are used for rangeland and wildlife. Some areas along the Rio Grande are used for irrigated cropland.[10]

The high calcareous content of both groups of soils reveals the lime and calcium and magnesium deposited under the warm seas of the Paleozoic and Mesozoic eras. Since the outwash of the higher terraces carries the lightest particles the farthest, few stones and pebbles but much clay and some fine sand are found in the alluvial soil which is frequently regenerated in fertility by floodwaters over the flood plain of the Rio Grande and Rio Conchos, as well as Alamito Creek.

Archeological evidence points to the presence of man in the area by around 10,000 B.C. during the period of mastodon, woolly mammoth, and ancient bison, and to virtually continuous occupation since. Man was thus present to observe the start of the most recent terracing and to participate in the transition from the cold, wet, water-dominated landforms to the present hot, dry, sun-dominated terrain with its concomitant change in soils, vegetation, and animal regimes.

The Local Climatology

Historical climatology is a difficult and imprecise science. Like archeology, its counterpart for the early history of man, climatology of the unrecorded past must be deduced and postulated on limited evidence. Somewhat as that described in the preceeding section, the evidence of earth building, erosion, and deposition are the clues with which the historical climatologist must work. For the more recent period, tree-ring dating, carbon 14 dating, and pollen counting by specie in buried depositions permit reconstruction of some of the past vegetation and its probable age. Since vegetation is one clue to climate (palm trees simply do not grow naturally in temperate and polar climates, for example), the evidence of early plant life can

be most instructive. Similarly, the evidence of prehistoric animals may be a clue to the climate of the past. For example, the woolly mammoth did not need his heavy coat in a hot climate. Additionally, a knowledge of basic patterns of climate on a world-wide basis makes it possible to construct with some fidelity probable patterns of climate in earlier ages over large areas of the earth. Finally, since patterns of climate are usually of considerable areal extent, it is often possible to extrapolate evidence of climatological history from one location to another within a broad climatological zone.

Armed thus with the evidence of historical geology, botany, and zoology as well as the records of written history and with a methodology and an earth model, the historical geographer-climatologist is able to suggest with some confidence a probable climatological history of a given area.

What, then, does it say about La Junta?

Since the emphasis here is on the time period of man, the eons prior to his appearance are limited to brief statements for the Paleozoic and Mesozoic periods and the early part of the Cenozoic period.

During the Paleozoic the earth was forming; shallow seas covered the La Junta area; and the sedimentary deposits underlying these seas were forming. Marine animals of the lower forms were emerging. Year-round heat with year-round moisture identified the climate. Because of its low-middle latitude location, La Junta was in a region of perpetual hot, wet tropics with extreme heat in the high sun season.

In the Mesozoic, land began to appear and with it amphibious creatures and the beginnings of marked seasonal variations in climate, as the differential heating and cooling of land and water became more widespread. Though still hot and wet, marsh and swamp were more characteristic than widespread seas. Plants and animals that could survive in the air medium with moderate seasonal and diurnal variations of temperatures appeared to test the newer climate. This was the period of the dinosaur and the first birds (flying reptiles) and plants that flowered and propagated in the medium of air, not water. Variations in seasons, in temperatures, and in rainfall occurred as land appeared and the uplift from the sea began to produce hills and mountains. The climate of La Junta was still generally warm and moist, gradually becoming less so as the land masses cooled in the low sun period and as hills and early mountains cast a rain shadow on their downwind slopes.

Finally, in the Cenozoic period, with still more land and less sea, with higher mountains emerging and the sea disappearing into a few large basins, plants and animals emerged which could adapt to the considerably greater ranges of temperature and humidity which the greater continentality brought.

Warm-blooded animals arrived. Those plants which acquired mechanical means of controlling their transpiration and solar response in order to maintain a smoother, more level internal operation of life functions also made a showing. The saber-tooth tiger, the camel, the predecessor horse, and ancient bison appeared early in the period, while a succession of other mammals including Man appeared in the Quaternary Epoch of the Pleistocene--an epoch which includes modern times. Again, the climate was growing progressively more severe, that is more widely variable in temperature and in rainfall. Being unable to adapt to more severe climatic regimes or to life on land, only a relatively few plants and animals survived during the several world-wide glaciations which occurred over a span of 750,000 years extending to the present. The climate of La Junta began to experience winter (seasonal) cold and probable winter dryness (less wet) as well as depressed temperatures throughout the year resulting from the same forces that produced the world-wide glaciations.

During the last 40,000 to 65,000 years of this period, man is believed to have appeared in the New World. The evidence at La Junta suggests that he arrived there some 10,000 or more years ago at a time when the rivers had not yet begun to cut down into the existing flood plain but were still working along the level of the fourth terrace. The evidence of man is primarily found in "points" and other stone artifacts relating to a hunting people. Finds of large points of the Plainview (broad) and Eden (narrow) types and of the Folsom and Clovis forms indicate the presence of early man in La Junta during the large-animal period, hence prior to the end of the last glaciation. Considerable evidence from surrounding areas in Texas, New Mexico, and Mexico supports the association of these types of points with the extinct mammoth, mastodon, bison, and others.

These animals existed during a cold and intermittently very wet (pluvial) period. La Junta man then was experiencing a much colder, much wetter climate than that of today and far colder than that which preceeded the glacial epochs. Strong seasonality was undoubtedly exhibited as the sun shifted to north and south during the year and the rivers drained much of the remaining water from the now fully-uplifted land away to the sea, thereby making the weather more dominated by land-mass than by water-mass.

The terminal date for the final glaciation in North America is indistinct. It seems probable that post-glacial climates may have been noted first in the lower latitudes and more recently in the more poleward regions. The span of "de-glaciation" in North America has been estimated to have transpired from about 8000 to 2500 B.C., but the transition was neither abrupt nor uninterrupted. During this period, and perhaps earlier if archeological "finds" can be accurately dated, early La Junta man apparently shared with some

of his neighbors in the present southwestern United States and northern Mexico characteristics which denote the transition from a hunter culture to hunter-gatherer and then to hunter-gatherer-grinder. This is indicated by milling stones found in nearby areas in association with large stone points and, in adjacent territory, with bones of extinct animals. Kenneth MacGowan in *Early Man in the New World* states the case as follows:

> The reason for the precipitate outcropping of milling stones in the Americas is not that our early man practiced agriculture. He did not do that . . . . He was merely a food gatherer . . . . It seems more than a coincidence that the earliest American milling stones appear in the arid southwest, where desert plants have more seeds and larger seeds than plants in more moist areas.[11]

These early, crude milling stones--not to be confused with the "metates" used today in Mexico to grind corn or the "mortars" which seemed to have appeared between the early milling stones and the metates--have been found in considerable quantity in the La Junta area but so far rarely below the level of the fourth terrace (last de-glaciation). From this it may be deduced that the climate of La Junta was beginning to turn dryer and hotter by perhaps 6000 to 7000 B.C., though the absolute difference was small at first.

Since this is when man was entering the current climatic era and since the climatological pattern was being established for the modern historical period, it is worthwhile noting how decisive was the change. Michael Coe, a leading American anthropologist, summarized the situation as follows:

> Six thousand years of almost uninterruptedly high temperatures, as much as 2°C (3°F) above present averages in some places, set in on the heels of the Valders ice advance, around 7000 B.C. Of course, within this span there were minor fluctuations such as the Cochrane Advance in North America at about 5000 B.C. and near 2000 B.C. the first sporadic indications of a "Little Ice Age" . . . . In North America this long interval was largely one of desiccation. In contrast to the oak forests of humid Europe, vast areas of the New World were transformed into desert wastes.
>
> . . . . New tools, new hunting methods, other sources of food, perhaps different forms of shelter, all these enabled men to adapt to radically altered conditions of life, whereas other species were trapped by the extreme slowness of biological, as opposed to cultural, evolution.[12]

La Junta man survived the transitional period as the artifact record shows, and though he had never been totally dependent upon large game animals, or large and small ones for that matter, his reliance upon hunting decreased while his dependency upon

gathering of plant products grew. In a display in a museum at the Casas Grandes Indian ruins about 225 miles west of La Junta, a location which likely experienced nearly similar climatic changes, Mexican anthropologists there have estimated that a sort of 50-50 division of hunting versus gathering was extant before the dramatic climatological change. A picto-chart there suggests that the transition at Casas Grandes centered on the period 7000-5000 B.C. but that by the time of Christ no more than ten percent of man's sustenance was derived from the hunt. The change to a desert climate had inclined man toward agricultural pursuits.

At this point it is appropriate to speak of "man" at La Junta as "Indian." His original tribal name, if any, is unknown. What is known is that he was present in some numbers as suggested by numerous camp sites and that he was Indian as his cultural effects and disinterred bones reflect. The Indians of this period (6000 to 0001 B.C.) at La Junta and throughout the desert of the southwestern United States and northern Mexico are usually referred to as "archaic" or "desert archaic." Before this time, the Indian was simply "early man."

The archaic Indian at La Junta suffered much the same climatic regime as is experienced today and was accustomed to much the same landforms. The climate 5000 years ago was hot in the summer, cool (but not cold) in the winter, seriously deficient in moisture throughout the year, and strongly influenced by direct solar radiation at all times. Just as at present, there was a fairly long, but not year-round, growing season, and there were wide variations in both daily and seasonal temperatures. As with all desert climates, rainfall was low and notably erratic. The winters were usually dry. Most of the precipitation occurred in the middle and late summer months. Dust storms were not uncommon, though wind velocities were usually not grossly damaging, and storms lasted only a few hours. Arctic (Polar Continental) air masses occasionally reached the La Junta area in mid-winter, but more frequently they were stopped by the Chinati or Davis Mountain ranges to the north.

In *Man's Domain: A Thematic Atlas of the World*, La Junta is included in the climatic zone BWh in the modified Koeppen climatic classification system.[13] This zone is defined as "hot and dry the year round." However, the zone at La Junta is quite narrow, making it necessary to inspect the adjacent climatic zones to gain a complete picture of the true local climatology. Immediately to the north and east on the Edwards Plateau of Texas lies the zone, BSh, while to the south and west on the Meseta Central of Mexico lies the zone, BSk. The BSh zone is described as hot year round with unreliable precipitation while the BSk designation is applied to any region

which has hot summers, cool to cold winters, and unreliable precipitation.

The specific differences in these climatic zones center upon the extent of year-round heat and year round dryness. The "B" is a dry area in each case; the "W" and "S" stand for desert (German for *Wuste* or waste) and steppe (German for *Steppe* or treeless plain) respectively. The "h" and "k" are divided by the boundary of 64.4°F average annual temperature--the minimum lower limit for the growth of palm trees. Here the "h" represents the German "heis" or hot and the "k" equates to the German "kalt" or cold. Since La Junta's average annual temperature is 69.4°F (the same as Houston, Texas), it falls well above the dividing line and into the "heis" (h) zone.

In La Junta it is the sustained high summer temperatures which account for the high yearly average. Only the hardiest species of palm will survive, but will not reproduce in the basin. Interestingly, petrified palm plants of earlier warmer periods are not uncommon in the ancient deposits in the area. The climate, therefore, is best classified as BWh in the summer and BSk in the winter. The difference between the "W" and "S" from summer to winter is explained by the fact that the winter months (whose mean minimums do not drop below freezing) are nonetheless cool enough to preclude excessive loss of moisture from the steppe-desert plants and encourage steppe-type vegetation. Conversely, the summer months (whose mean maximums exceed 100°F) are so demanding of plant life that they would surely produce a true, almost plantless desert waste if not interrupted by seasonal cooling. Insofar as this temperature regime is concerned, the climatic characterization is shown in Table 1. The figures for Presidio are considered representative of the entire La Junta region.

Several items may be noted from the forty year averages given in Table 1:

a. June is the hottest and January is the coldest month. The strong influence of solar radiation at the high sun period (summer soltice--June 21) is reflected in the June maximum, while the incursion of polar continental air masses, more frequent in January than December, is reflected in the January minimum.

b. The three summer months' mean monthly maximums of over 100 degrees, together with mean monthly minimums of approximately 70 degrees for the same period, clearly show the sustained high heat for which Presidio (and La Junta) is notorious. Conversely, the three winter months with mean monthly minimums definitely above the freezing level suggest a salubrious winter season. In contrast, Marfa, Texas less than sixty miles (one degree of latitude) to the north but over 2,000 feet higher in elevation and protected by only one mountain range from the "northers" has December, January, February, and March mean monthly minimum

TABLE 1
Temperature Records for Presidio, 1927-1968 (degrees Farenheit)

	Mean Monthly Max	Mean Monthly	Mean Monthly Min.
Jun*	102.5	86.2	69.9
Jul	101.2	86.6	71.9
Aug	100.2	85.4	70.6
Sep	94.6	80.1	65.5
Oct	86.7	70.9	55.1
Nov	74.2	57.4	40.7
Dec	66.5	49.9	33.2
Jan**	66.3	49.6	32.8
Feb	72.9	55.1	37.2
Mar	80.7	62.0	43.3
Apr	89.6	70.9	52.2
May	97.1	79.4	61.6

* Hottest month; ** Coldest month

temperatures well below 32°, while November averages scarcely above that figure.

c. The average daily ranges in temperature for all months at Presidio is thirty degrees or more, a fairly large average variation--one of the largest in the world, in fact. This considerable variation is more conspicuous when extremes are noted. It is a result of the intense solar radiation by day and rapid re-radiation by night, unimpeded by atmospheric moisture or pollution. Cloudless skies and very low humidity are year-round phenomena at La Junta.

Climatic averages are meaningful in themselves, for what is climate but "average weather"? But it is also useful to be aware of the degree of deviation from the averages. For example, many plants upon which the early Indian and now the farmer at La Junta might have successfully employed at the averages could not stand the stress of the extremes. Similarly, the measures taken by man in his long sojourn at La Junta to adapt himself and his way of life to the environment necessarily had to take in to account the extremes. The current commercial farmer in the basin is well aware, for example, of the fact that he has an average 238-day growing season between the average dates for the last and first frosts at March 20th and November 13th respectively. But he must also be aware that frosts have occurred as late as April 20th and as early as October 25th. His cantelope crop does not always grow on the averages. The 1987 crop, for instance, had to be replanted after a late frost. In addition to the temperature extremes (which gave Presidio an

undeserved reputation of being the hottest spot in the United States), rainfall in this steppe-desert is notoriously deviant from the averages. These factors are reflected in Tables 2 and 3.

TABLE 2
Record Maximum and Minimum Temperature Extremes for Presidio from 1927-1968 (degrees Farenheit)

	Min.	Year	Max.	Year
Jan	4*	1962	88	1943
Feb	11	1951,56	95	1940
Mar	20	1929,42	105	1946
Apr	25	1928	106	1961
May	38	1930	114	1951
Jun	50	1946	117**	1957,60,62
Jul	59	1946	112	1944,54
Aug	58	1936	114	1951
Sept	45	1945	112	1952
Oct	30	1939	102	1931,51
Nov	18	1938	93	1935
Dec	10	1929	87	1951

* Lowest for period; ** Highest for period

TABLE 3
Rainfall Totals in Inches for Presidio from 1927-1967 (ten year increments)

Year	Total	Year	Total	Year	Total	Year	Total
1928	6.40	1938	10.83	1948	6.27	1958	14.00
1929	8.44	1939	11.58	1949	7.87	1959	7.68
1930	9.82	1940	12.11	1950	7.40	1960	5.94
1931	9.95	1941	23.43**	1951	4.80	1961	8.61
1932	9.46	1942	8.66	1952	5.46	1962	9.56
1933	2.11	1943	10.94	1953	N/A	1963	7.10
1934	5.65	1944	14.84	1954	4.98	1964	6.18
1935	6.41	1945	9.82	1955	4.70	1965	6.77
1936	9.03	1946	6.55	1956	1.61*	1966	10.29
1937	7.60	1947	8.94	1957	4.23	1967	9.29

Total over period = 325.31 inches; av. per year = 8.34 inches.
* Lowest for period; ** highest for period.

The statistics relating to temperature and rainfall are instructive in that they reflect the great range of the extremes, as well as the considerable departure from the averages. For example, the January absolute (record) minimum of 4°F contrasts greatly with

an average minimum for that month of 32.8°F, while the same month displays an absolute high of 88° versus an average high of only 66.3°F. The June absolute minimum of 50°F contrasts with the absolute (record) maximum of 117°F reached in that same month.

These temperature extremes produce severe stresses on both plants and animals which, when coupled with wide variations in rainfall amounts and distribution, cause both long and short term shifts in the ecological balance. Only plants which are able to sustain themselves at high temperatures with little moisture (or short periods of below freezing temperatures and year-round dryness) are found in La Junta. Animal populations shifted with the terminal plant colonies; those which could not adapt biologically to the climatic extremes or the newer climax vegetation were lost.

Although scientific support for this hypothesis is lacking, some physical anthropologists speculate that the Indians of the southwestern United States and Mexico are much more adapted to a diet of vegetable protein (in beans, for example) than Europeans, especially Anglos, because of the latter's much more recent dependence upon animal protein (large animals). In other words, the Indians of the hot, dry climates had to adapt to a vegetable diet thousands of years sooner than the northern Europeans who were still beseiged by ice sheets or cold, damp weather. It is interesting to note that people in La Junta with Indian ancestors relish chili and beans while residents with Anglo progenitors prefer steak and eggs.

With respect to climate-related cultural adaptation, J. Charles Kelley suggested in the *American Anthropologist* in 1952 that climatic changes in the La Junta region were responsible for population movements into and within the area. Kelley noted similarities in cultures and habitation periods of the early agriculturalists in La Junta and the Anasazi and Mogollon cultures of New Mexico and Arizona, pointing out the abrupt, nearly simultaneous abandonment of pueblo type villages in all three areas before 1400. In the case of La Junta, however, this abandonment was confined to the region of the Rio Grande valley above its juncture with the Rio Conchos, there being sufficient water in the latter river and below its juncture with the Rio Grande to continue to support Indian irrigation.[14]

This was neither the first nor the last time that man had to adapt to climatic changes in La Junta. But the incident, in part, suggests some clues to the climatic phenomena which has so considerably affected the history of man in the region. The forty-year rainfall statistics in Table 3 emphasize the diversity inherent in the desert precipitation pattern of La Junta. Note first the difference between the greatest and least annual rainfall in the forty year period: 23.43 inches versus 1.61 inches--a 1,455% difference! Then note the

difference between the highest and lowest ten-year averages: 11.77 inches versus 5.26 inches--a 224% difference. These are the variations between two arbitrarily selected, consecutive ten-year groupings. If the ten years with the most rainfall is compared with the ten years with the least, averages of 12.78 and 4.57 inches respectively are seen--a 280% difference.

It takes only a year or two of low rainfall to exhaust moisture in the soil, cause crops to fail, and deplete water in rivers. Not one, but a succession of droughts occurred in New Mexico and along the headwaters of the Rio Grande in the late thirteenth and fourteenth centuries, apparently driving the inhabitants from the famous cliff dwellings of Mesa Verde and Chaco Canyon and others of the same region. Only slightly later, the agriculturists on the Rio Grande just above the Rio Conchos junction with the Rio Grande abandoned their villages and moved below the confluence or to sites along the Rio Conchos where water was sufficient for irrigated agriculture. The Rio Grande had dried from its headwaters down the length of its course to La Junta.

The dry riverbed was not a unique phenomena. Early missionaries and Spanish military expeditions occasionally reported using the dry bed of the Rio Grande above La Junta as a highway to the New Mexican pueblos. In *Commerce of the Prairies*, published in 1866, Josiah Gregg noted that Baron Maximillian von Humbolt had reported that in 1752 the Rio Grande had disappeared for thirty leagues above and twenty leagues below Paso del Norte (El Paso). Gregg went on to say, "during very great droughts, however, this river is said to have entirely disappeared in the sand, in some places, between San Elceario and the Presidio del Norte."[15]

Gregg also noted that despite the potential water supply of numerous small streams which supposedly feed the Rio Grande "very few reach their destination before they are completely exhausted." He pointed out that the Conchos and Pecos rivers

> may be considered the first constant-flowing inlets which the Rio del Norte receives from Santa Fe south--say for the distance of five hundred miles! It is then no wonder that this Great River of the North decreases in volume of water as it descends.[16]

Finally, it should be noted that the Rio Grande downstream from La Junta may be considered an extension of the Rio Conchos. Historically it has always received at least thrice the flow from the Rio Conchos than from the Rio Grande system above the junction. Moreover, the building in 1914 of the Elephant Butte dam and reservoir above El Paso on the Rio Grande severely impeded the flow, leaving only surplus floodwaters to reach the confluence at La Junta. After 1915, the drying of the Rio Grande for forty miles above the confluence at La Junta caused substantial depopulation of what was already a sparsely populated region. Estimates of the number

of people who abandoned irrigated land in the region on both sides of the Rio Grande total between twenty-five and thirty thousand.[17] Like the Indian agriculturists of the thirteenth and fourteenth centuries, these people either moved to below the confluence of the Rio Conchos and the Rio Grande where water still flowed or migrated to other regions.

The interplay of climate and man is graphically displayed in the La Junta area. Water is a dominant factor; when the climate does not supply it in the form of precipitation, it must come from other sources. At La Junta, the other sources are the Rio Conchos and the Rio Grande watershed below Presidio. Limited life support is available also from wells close to the river channels and occasional springs in the hills. Fortunately for La Junta, the Rio Conchos has been a reasonably dependable river. Its headwaters spread over a considerable range of Mexico's Sierra Madre Occidental and extend well into the easterly air mass flow of the lower mid latitudes which provides more rainfall than in the higher latitude upper reaches of the Rio Grande in New Mexico and Colorado. Thus, while Presidio in its 2,500 foot basin gathers but 8.31 inches of rain per year from the variable air masses that descend into its valley, the air masses that move in from the Atlantic Ocean and Gulf of Mexico and across the Mexican plateau (the Meseta Central) are adiabatically cooled upon being uplifted by the western sierra, and precipitate considerable year-round moisture upon the highland headwaters of the Rio Conchos.

The mountains in the headwaters region increase to 4,700 feet at Chihuahua and to over 10,000 feet near Parral. Annual rainfall amounts at Rio Conchos headwater sites are: Chihuahua, 15.75 inches; Santa Barbara, 16.14 inches; Vergel, 20.87 inches; Bocoyna, 27.95 inches.[18] Although these locations ascend in altitude none is near the highest elevation, but it may be safely assumed that near the crest of the sierras the annual rainfall is above thirty inches and is steady because of easterlies which are quite constant the year-round at these latitudes. The mountain range and its accompanying band of higher rainfall lies in an arc nearly two hundred miles in radius to the south and west of La Junta. Water loss through evaporation and filtering into the ground is not as great as that of the Rio Grande over its five hundred miles flow from Santa Fe to Presidio del Norte.

In a sense, then, the climate of the Rio Conchos headwaters is a significant part of the climate of La Junta, is a significant factor in stabilizing human occupation in the La Junta region, and helps to explain floods during drought periods. The floods originate in the constant flow of the Rio Conchos from its sources. The flow is greatly augmented by copious convectional and frontal precipitation triggered by the 6,000 foot Sierra Grandes and associated mountains

only thirty miles to the west and south of La Junta and sometimes by the 5,000 plus feet Chinati Mountains located twenty miles to the north. The rainfall is of high intensity with rapid run-off and occurs usually in the late summer and early fall.

A total of forty-two flood peaks were reported on the Rio Grande just below Presidio-Ojinaga by the International Boundary Commission between 1904 and 1938. Only one of these occurred in June; three were in July; one each occurred in December and November. The balance of thirty-six were reported in August, September, and October with the heaviest concentration being twenty-five in September.

One other characteristic of the climate of La Junta which has affected man's life style there is the relative humidity. Throughout much of the year the relative humidity is so low that it is hardly noticeable. Long term measurements are not fully conclusive, but reported relative humidity ranges from a minimum of five percent to a high of forty-five percent. It is highest during the coolest of the twenty-four hours and the lowest when the temperature is high. Thus the stickiness associated with high heat elsewhere is not known at La Junta. With rapid evaporation cooling the body as fast as perspiration takes place, the sensible temperature is always much lower than the actual in summer. Conversely, the absence of moisture to conduct heat away from the body in winter makes cold winter temperatures sensibly higher with the dry air acting as an insulator.

Low atmospheric moisture, in turn, influences plants which, like man, maintain more moderate internal temperatures through use of water. With low humidity, more moisture is lost through transpiration and surface evaporation than with high humidity. Consequently, drought conditions quickly are apparent in the drooping plant life, especially among agricultural products not adapted to desert-like conditions. Some plants are simply not capable of transpiration rates high enough to preclude wilting from the summer heat even though their root systems are supplied with plenty of moisture by irrigation. This, together with other related climatic factors such as length of growing season, degree of winter cold, etc., severely limits the types of crops which can be raised even with irrigation.

The low relative humidity (and low absolute humidity, too) permits a maximum of the sun's rays to reach the earth. In La Junta with its low humidity, "heat waves," hot muggy nights, and hot sticky days are virtually unknown. None of the heat syndromes (asthenia, cramps, exhaustion, stroke) except sunburn have ever been recorded there, and even sunburn tends to be confined to the blue-eyed, fair-skinned Anglos and tourists.[19] It is this radiation and re-radiation in the absence of atmospheric moisture that per-

mits warm-to-hot days to be accompanied by cool-to-cold nights and that accounts for the great daily variation in temperature.

A little noticed corollary of the high perspiration rate is the loss of body salts, especially sodium chloride by humans. That the primitive Indian was intuitively aware of the need to replace these salts is clearly reflected in his great emphasis on salt as an article of trade. The considerable use by Pre-Columbian and historic Indians of the salt trail from La Junta to the Fort Stockton, Texas area, via Alamito Creek and present day Alpine, appears to have been as much for the purpose of gaining salt at salt springs as for buffalo meat and hides.

In summary, the climatology of La Junta has numerous specific climatic factors, some of which are unique to the area and all of which greatly affected and continue to affect the life of man and other biota in the area.

The Plants and Animals--The Biota

The major classes of plants and animals associated with the La Junta environment over the great geologic eras have been mentioned in the preceding sections. Briefly, the Paleozoic and Mesozoic periods witnessed the increasingly complex proliferation of animal life forms from barely mobile tribolites to reptiles and reptilian "birds" to dinosaurs. Plant life evolved from sponges and algae to more complex oceanic, and then swampy and marsh forms, through ferns and fungi to tropical plants including the palm, the tree fern, the cypress family, and others. Some of these are today preserved in the wet tropics. As noted previously, these early biota were associated with warm seas on the margins of which amphibious forms of both plants and animals developed in the new medium of a gaseous atmosphere. These gradually grew more complex as more land was raised from the sea and inland waters freshened. Flowering plants appeared for the first time toward the end of the Mesozoic era.

It was in the Cenozoic era, however, that the more familiar biota of today made an appearance. At the outset of the Cenozoic, the mammalian species began to replace dinosaurs, and temperate forests replaced lush swamp vegetation. Many unique creatures appeared, prospered for several million years, and then faded into the unwritten past. Animals now extinct appeared for a while and then perished leaving their skeletal remains in the sediments of La Junta and adjacent regions.

Sometime in the last million years--the Quaternary period of the Cenozoic era--the woolly mammoth, mastodon, ancient bison, and man entered the scene. At La Junta they found cool forest vegetation, especially on the higher slopes, while the lower, warmer zones

began to nourish some grasses and intermediate trees and brushy plants, the food for the large herbivores.

During the cold of the glaciation period, aspen, Ponderosa pine, Arizona cypress, maple, and Douglas fir were likely common in the region. As the ice sheets retreated, trees of the Mexican pinon pine, alligator and drooping juniper, and Texas madrona suitable to the slightly warmer climate appeared. The existence of these vegetative covers are deduced from lost island colonies of cool, temperate, forest stands still existing on the higher slopes and the peaks of nearby mountains where more abundant moisture and cooler temperatures have preserved them from the desiccation and heat of the lower elevations. The isolation and remoteness of these areas also has protected these trees from complete destruction through exploitation by human beings.

As already noted, the archaic Indians at La Junta succeeded in adapting to the altithermal period after the retreat of the ice sheets while the large game animals which were hunted did not. As some animal species succumbed to the heat and desiccation, so also did many of the plants. Those of temperate, moist acclimation survived only at higher latitudes and altitudes, while new forms, more suited to the steppe and desert took over. These smaller, sparser, more widely spaced plants, including some adapted grasses, were insufficient for the large animals, causing the Indian diet to consist more and more of plant foods, small animals, insects, reptiles, and amphibians.

At La Junta the animals that remained, then as now, included hares, rabbits, pocket gophers, kangaroo rats, deer, foxes, wolves, coyotes, badgers, bobcats, racoons and their relatives, mountain lions, javelina (peccaries), antelope, doves, quail, hawks, eagles, carrion birds, song birds, and the all-purpose bird and everybody's favorite--the road runner. Near the water courses were found ducks, geese and lesser acquatic birds. The rivers contained various fish, notably catfish, able to survive in the warm river water with its low oxygen content. Reptilians were often found near the watered areas.

The Antonio de Espejo expedition which visited La Junta in 1582-83 noted a considerable variety of both plant and animal life during its passage through the area.[20] These included an array of cultivated crops such as maize, beans, mescal, and calabashes as well as various fishes, acquatic birds, rabbits, deer, and various other animals, judging from skins seen. Mesquite (pods) were used as food for the horses. Diego Perez de Luxan, who kept a journal of the expedition, reported that on the 22nd of August, 1583, during the return to Mexico, the party stopped at the Rio Conchos where it joins the Rio Grande and found it too high to ford. Because of the

abundance of food and the friendliness of the Indians, the expedition stayed at La Junta for some time.

Neville Clarke, in *A History of Small Grain in Texas*, notes that wheat and probably other small grains, including corn, were grown by the Jumano Indians at La Junta as early as 1581, and that Espejo identified both wheat and corn as being grown on both sides of the river in 1582, apparently the first location in Texas where this occurred.[21]

Of the insects, the honey bee is by far the most beneficial for both its pollination of crops and honey. A stingless variety seems to have been known to the Indians of the area, but it has been replaced by escaped colonies of domesticated, imported types. Today honey production is a large-scale, economic enterprise in the La Junta region.

Modern vegetative cover reflects a denudation of the native grasses since the introduction of European grazing animals. Other factors, including burning of the grasses by the Indians to drive game or to thwart a persuing enemy, may also have been important. The terminal or so-called "climax" vegetation is difficult to postulate because the so frequent periods of severe drought alternating with periods of rainfall sufficient to encourage growth of certain plants, especially grasses, established no fixed pattern. However, there is considerable evidence that in early historic times (before grazing) the desert brush vegetation was much less extensive than today.

The office of the United States Soil Conservation Service in Presidio County, Texas has postulated some probable climax vegetative covers for the La Junta valley floor and the adjacent terraces. Conclusions drawn are that the plant communities which probably existed prior to the early Spanish settlements along the Rio Grande were much heavier in grasses and less brushy than at present. These postulations were based on ecological knowledge of plant succession and regression for the various sites, under the then prevailing conditions of climate and soils. The Soil Conservation Service has several charts reflecting the climax vegetation on the sloping terraces and the river floodplains. Those charts provide essential details and are available for use.[22]

Geostrategic Factors

One of the most overlooked factors of influence in the physical realm is that of "location." Intrinsically as well as with references to externals, location is both a strength and a limitation.

Considering first the inherent or intrinsic value of La Junta's position, it has already been noted that its low mid-latitude, interior location has produced a hot summer, cool winter temperature regime. Its continental, interior position and its basin setting with respect to the surrounding mountains reduce its precipitation to

that of a semi-arid desert. But, conversely, its location on the constantly-flowing Rio Conchos and the sometimes-flowing Rio Grande has made possible the support of a fairly dense population from well before the recorded period of its existence. The rivers and their adjacent valleys not only provided life support for a large population, but also provided a surplus of goods for trade with the indigeneous peoples of nearby regions. Today over 12,000 acres are irrigated on both sides of both rivers in the vicinity of the confluence, a fortunate circumstance of geographic location. The rivers also were routes of Indian trade into the interior of Mexico, to the pueblos of the upper Rio Grande in New Mexico, and to the salinas and the buffalo plains of West Texas.

From an external point of view, the natural crossroads and convergence of the several routes along the Rio Conchos and Rio Grande and Alamito Creek, together with the collocated river fords and places of trade, rest, and repair, made this site strategically important to Indians, Spaniards, Mexicans, and Anglos. The designation of the Rio Grande as an international boundary in the nineteenth century increased its importance from a geopolitical viewpoint. Both Presidio and Ojinaga are ports of entry where customs facilities are maintained to regulate the flow of trade and traffic across the border.

Border areas are also frontier areas. Long before it became a political boundary between Mexico and Texas, the Rio Grande at La Junta demarked the frontier where Spanish culture clashed with Apache and Comanche cultures which, in turn, had forced out the more peaceful Indian agriculturists and traders of the sixteenth and seventeenth centuries. The routes of trade became the trails of terror as the Apaches and sometimes the Comanches plunged deeply into Mexico via La Junta on raids of plunder and deprivation.

The Presidio del Norte was erected at the Conchos-Grande confluence because this location interrupted many of the Indian invasion routes into Chihuahua from the north and because the natural resources of the area permitted the garrison to be supported by locally-grown food. The horse troop which numbered as high as 1,400 (14 horses, including brood mares and colts per man, for 100 soldiers) found sufficient forage at La Junta as well. It was the fact of physical location as well as physical resources available that caused Spaniards, Mexicans, and Americans to establish the modern microplex of Presidio-Ojinaga; they followed the pattern of the Jumanos and their neighbors who, centuries before, had established communities in the area, and who, in turn, had followed the practice of archaic Indians and earlier big game hunters.

In the middle 1800s the Great Chihuahua Trail of wagon-borne commerce from Missouri and points in Texas crossed the Rio Grande at La Junta and followed the Rio Conchos to Chihuahua. Today a

modern highway parallels this historical passage, and a railroad extends across the international border at Presidio-Ojinaga to the Mexican west coast.

A SUMMATION OF THE PHYSICAL FACTORS

It has been shown that the physical environment at La Junta was sufficient to attract and maintain ancient man and his Indian successors in considerable numbers and that the region has been continuously inhabited for over 10,000 years. The various physical forces which combined to create a liveable environment were (1) physiography and topography--a level flood plain with soils suitable for agriculture, (2) a river location which provided irrigation water in an otherwise arid land, (3) a climatic environment suitable for the growing of certain of the food plants domesticated by the Indian as well as seed and vegetable producers applicable to the practice of food gathering, (4) a biota along the rivers and in adjacent hills and mountains which supported hunting and gathering, and (5) natural, intersecting trade routes to other areas in which the surplus of local production could be bartered for goods not available locally. In addition to providing protection from more severe winter weather in the surrounding areas, the rugged country at the edges of La Junta offered an inhospitable face to potential invaders. La Junta was thus able to support a fairly dense population of early man and later Indians.

The Spanish Europeans found the same physical features in the region and found them somewhat satisfying. They, too, found that La Junta supported a fairly dense population, though the struggle with the natives for possession of the land required a military force and constant vigilance. Before the Apache invasion (c. 1700-1725), the combination of (1) large numbers of peaceful, sedentary Indians to perform labor, (2) a good agricultural base to provide food and grazing, (3) easy access to the "civilized" interior of Mexico for supplies and cultural accretions, (4) known deposits of silver, and (5) a frontier post for furs and hides and other trade goods provided a propitious situation for dramatic economic advance in the European manner. That this advance did not occur and that it remained for the later invading Anglo-Americans from the north to try to develop is a story which involves many cultural factors which go beyond the physical realm, a story which remains to be told at a later date.

1. La Junta - A shortened version of La Junta de Los Rios, signifying "the juncture of the rivers." In the instance of this monograph, the phrase references both a specific location, the juncture of the Rio Conchos of Mexico with the Rio Grande at the boundary of Texas with Mexico, and a general geographic area, the floodplain and basin of the two rivers surrounding the specific site. The Rio

Grande was often referred to by the Spanish as the "Rio Bravo del Norte." The name also refers to the Spanish presidio at the confluence of the rivers. In a shortened version this presidio was frequently referred to as the "Presidio del Norte" to distinguish it from other presidios such as the Presidio del Paso at Juarez, Mexico at the Pass of the north. According to material in the Archives of the Indies in Seville, Spain, the proper name for the La Junta presidio and its geographic location was:

Nuevo Real Presidio de Nuestra Senora de Betlem y Santiago de las Amarillas de La Junta de Los Rios Norte y Conchos.

Even this is a shortened version of the name because the "Rio Norte" was really the "Rio Bravo del Norte." The central locale is now identified with the twin cities of Ojinaga, Chihuahua (Mexico) and Presidio, Texas (USA).

2. U. S. Department of State, Flow of the Rio Grande and Tributary Contributions, *International Boundary Commission Water Bulletins* No. 8 and No. 9 (1938 and 1939).

3. William H. Emory, *Report of the United States and Mexican Boundary Survey*, 2 vols. (Washington, 1857-1859; reprint, Austin: Texas State Historical Association, 1987), I: 85-89.

4. Frank X. Tolbert, *An Informal History of Texas* (New York: Harper, 1957), 19. A physiographic map of Chihuahua reflects a nearby mountain pass as La Puerta de Las Brujas ("Pass of the Witches").

5. Preston E. James, *Latin America*, 4th ed. (New York: the Odyessy Press, 1969), 20, footnote.

6. United States Geological Survey, Map 7-C, "Physical Divisions of the United States," (1946).

7. A current (1986) tourist map of the state of Chihuahua identifies a large area to the southeast of La Junta as a *Zona de las Fosiles Marinos*, thus suggesting the vast expanse of the oceans that once covered the earth in this area. Interestingly this same area is today known as the *Bolson de Mapimi*, a redoubt zone for the Comanches and Apaches during their famous raids from Texas deep into Mexico during the latter 18th and most of the 19th centuries. "Bolson" is a geographers' term for an area of interior drainage with intermittent lakes.

8. Geothermal resources are considered surface waters and are not under the jurisdiction of the same commission (in Texas) as are the energy sources of oil and gas.

9. Detailed descriptions of these soil associations are available in the U. S. Soil Conservation District office in Marfa, Texas.

10. Ibid.

11. Kenneth MacGowan and Joseph A. Hester, Jr., *Early Man in the New World*, Rev. ed., The Natural History Library (Garden City, New York: Doubleday and Company, Inc., 1962): 167.

12. Michael D. Coe, *Mexico*, 2nd ed. (New York: Frederich A. Praeger, Inc., 1966): 43-44.

13. N. J. W. Thrower, ed., *Man's Domain: A Thematic Atlas of the World* (New York: McGraw-Hill Book Co., 1968).

14. J. Charles Kelley, "Factors Involved in the Abandonment of Certain Peripheral Southwestern Settlements," *American Anthropologist*, Vol. 54, No. 3 (July-September 1952): 356-385. Also Kirk Bryan, "Pre-Columbian Agriculture in the Southwest as Conditioned by Periods of Alluviation," *Annals of the American Association of Geographers*, XXXI, No. 4 (December 1941): 219-241.

15. Josiah Gregg, *Commerce of the Prairies*, 2 Vols. (New York: Henry G. Langley, 1866; Readex Microprint Corporation, 1966), I: 139-140.

16. Ibid., 140-141.

17. Author's estimate based on his review of the historical sources relating to the region.

18. James E. Preston, *Latin America*, p. 900 (table); Campbell W. Pennington, *Tarahumara of Mexico: Their Environment and Material Culture* (Salt Lake City: University of Utah Press, 1961), endpaper (Map No. 3, Average Precipitation); Table, p.27.

19. Clyde Vaught, M.D., interview with author. At the time of this interview, Vaught had been a resident physician at Presidio for over fifty years.

20. See "Diego Perez de Luxan's account of the Antonio de Espejo Expedition into New Mexico" and "Report of Antonio de Espejo" in George P. Hammond and Agapito Rey, eds., *The Rediscovery of New Mexico, 1580-1596: The Exploration of Chamuscado, Espejo, Castano de Sosa, Morlete, and Leyva de Bonilla and Humana* (Albuquerque: University of New Mexico Press, 1966): 210-211, 216-217.

21. Neville P. Clarke, *A History of Small Grains in Texas* (College Station: The Texas Agricultural Experiment Station, Pub. No. B-1301, 7-80): 1-4.

22. U. S. Department of Agriculture, Soil Conservation Service, Presidio County, Texas; communications with author.