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HISTORICAL GEOGRAPHY OF THE MIDDLE RIO PUERCO VALLEY, NEW MEXICO

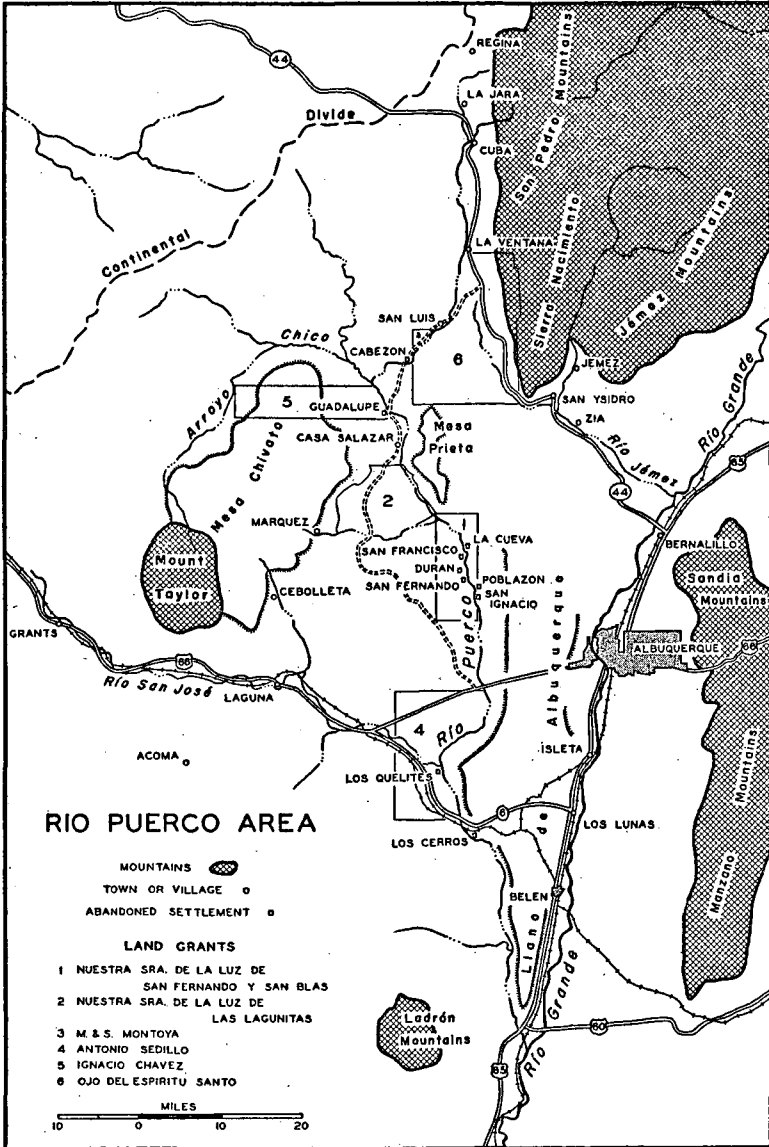
By JEROLD GWAYN WIDDISON*

To survive in any part of the world, man "must form a workable connection with the resources of the land."¹ In some areas it is relatively easy to establish such a "connection," for many parts of the world offer abundant resources and hospitable environments; and in these regions man is able to choose and develop within wide limits his characteristics of occupation and land use. The arid Rio Puerco valley of New Mexico, however, offers very few resources; and man is closely limited in his occupation by adverse conditions of climate, vegetation, topography, and soils. In this region man must necessarily adapt his way of life to a few basic economic activities permitted by the physical environment. Relatively few variations are possible in carrying out these activities, and such variations depend in large measure on the technical abilities of the peoples who inhabit the land.

The watershed of the Rio Puerco is an area of about 6,000 square miles in northwestern New Mexico. Most of the land is stream-dissected plain and plateau country and has an altitude between 5,000 and 7,000 feet. The only mountains in the watershed are the isolated Mount Taylor and Ladrón Mountains and, along the northeastern margin, the San Pedro Mountains. Except in the mountain areas, the climate of the watershed is arid and semi-arid. Precipitation is meager and its effectiveness for plant growth is lessened by high surface runoff. The pattern of natural vegetation is largely a reflection of the climate and its local variations: there are extremes of mountain forest and meadow on the one hand, and expanses of barren soil on the other. Much of the watershed is covered by a thin forest of piñon pine and juniper species, but in the lower areas grasses and desert shrubs are domi-

* Excerpts from a Master of Arts thesis, Department of Geology, University of Colorado. The author's home address: 3333 Wilway Dr., NE, Albuquerque, N. M. See Notes and Documents.

1. P. E. James, *A Geography of Man* (Boston: Ginn and Company, 1949), p. vii.



nant. As another expression of the climate, almost the entire watershed is drained by intermittent streams; a few small creeks in the higher elevations of Mount Taylor and the San Pedro Mountains are the only permanent streams. The Rio Puerco itself and its two main tributaries, the Rio San José and the Arroyo Chico, are the largest streams in the watershed; but they have only occasional flows of water in their channels. The San José and the Chico rise in the high plateau country in the western part of the watershed—along the continental divide—and they flow eastward to join the Rio Puerco, which is located quite near the eastern margin of the watershed. The Puerco has its headwaters on the slopes of the San Pedro Mountains and flows southward from those mountains to its junction with the Rio Grande.

Natural supplies of water throughout the Puerco watershed are few and undependable, and this lack causes the most basic restrictions on man's occupancy of the area. Population has always been small and located in those places where water can most easily be made available. A number of widely scattered ranches, trading posts, and Indian settlements are supplied by springs and wells; but the major area of settlement is the immediate valley of the Rio Puerco. In the upper part of this valley, near the headwaters of the river, there is sufficient stream water available for both domestic and agricultural use to support a population of more than 2,000 persons. Farther south in the valley the supply is much more limited; but—originally at least—there was enough to support a scattered population of a few hundred people. Even these few, nevertheless, were closely limited in their occupancy by the severity of the environment. All elements of the natural landscape combine into a harsh environment in which life is a daily struggle for existence.

The Rio Puerco is about 150 miles long and, with the exception of the Pecos River, is the longest New Mexico tributary to the Rio Grande.² Several short streams from the western slopes of the San Pedro join along the front of the

2. The Rio Puerco of this thesis is also known as the Rio Puerco of the East. It is thus distinguished from (1) the Rio Puerco of the West, a stream of New Mexico and Arizona that joins the Little Colorado River, and (2) a smaller Rio Puerco that is tributary to the Chama River in New Mexico.

mountains to create the Puerco. These small streams are fairly permanent in their mountain valleys, but often dry up as they near the base of the range. The stream beds become gullies, and what little water flows in them is lost by seepage in the sandy bottoms. As a result, the Rio Puerco itself is a dry gully almost from its beginning. The newly created river "flows" away from the base of the mountains and enters the plain and plateau country. This country becomes more arid toward the south, and through it the Puerco flows almost directly southward. If for this reason alone, flow of water in the river tends to disappear long before it reaches the mouth.

A trickle of water can usually be found in the Puerco river bed as far south as La Ventana, and the river may be called perennial to about that point. Below La Ventana, however, the Puerco must necessarily be termed intermittent and ephemeral. The stream bed may be completely dry for several weeks at a time, save an occasional "water hole" where water is protected from rapid evaporation by the shade of the river bank.³ During the spring there is a period when the mountain streams that create the Puerco furnish the river with a small but fairly steady flow. Even this water, however, may completely evaporate and seep into the ground before reaching La Ventana. In brief, waterflow in the middle and lower parts of the Rio Puerco is not dependent on the headwaters. The source of water for these sections of the river is precipitation that falls directly on the middle and lower parts of the watershed.

The Rio Puerco and its tributaries all have occasional flows of large quantities of water—"flash floods" that result from high surface runoff. An account written in 1897 accurately describes these floods and the streamflow of the Rio Puerco as follows: "This river drains a large area of country, but on all of it . . . the rainfall comes principally in sudden heavy downpours, so that the Puerco is a torrential stream when in flood, but is dry nine-tenths of the time."⁴ More re-

3. Carle H. Dane, "The La Ventana-Chacra Mesa Coal Field," part 3 of *Geology and Fuel Resources of the Southern Part of the San Juan Basin, New Mexico*, U. S. Department of Interior, Geological Survey, Bulletin 860-C, 1936, p. 86.

4. U. S. Congress, Senate, *Equitable Distribution of the Waters of the Rio Grande*, 55th Cong., 2d Sess., Doc. 229, 1897-98, p. 53.

cently it has been recognized that two types of flash floods occur on streams such as the Rio Puerco. Local thunderstorms cause small-volume floods in those arroyos and streams beneath the storms; large-volume floods are produced by general rainfall over all or much of the watershed.⁵ Small volume floods are the more common type. Within the last century a decrease in the vegetative cover of the Puerco watershed has promoted larger flash floods by permitting increased surface runoff. The large quantities of silt carried in the flood waters of the Puerco are the source of the river's name, which means "Dirty River."

Such streams as the Rio Puerco must be viewed in larger context as they affect the Rio Grande. Many of the tributaries to the upper Rio Grande are ephemeral streams that give only a little water to the main stream, but contribute a great deal of silt. In this regard the Puerco is the worst offender in either Colorado or New Mexico. Of the measured sediment entering the Rio Grande above Elephant Butte Dam, forty-five percent is contributed by the Rio Puerco. The same river, however, produces less than eight percent of the water inflow.⁶ The huge quantities of sediment provided by this and other streams are the source of several water problems of the Rio Grande valley, but only a beginning has been made to reduce the sediment loads of these streams.⁷

From the base of the mountains to its mouth, the Rio Puerco flows in a long narrow valley bordered by sharp-edged mesas and cuestras and partially filled with alluvium.⁸ This valley varies in width from less than a mile to three miles.

5. E. J. Dortignac, *Watershed Resources and Problems of the Upper Rio Grande Basin*, U. S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station (Fort Collins, Colorado, 1956), p. 34.

6. *Ibid.*, p. 49.

7. John C. Thompson, "Conditions on Irrigated Sections of the Middle Rio Grande in New Mexico," *Problems of the Upper Rio Grande*, U. S. Commission for Arid Resource Improvement and Development Publication No. 1, 1957, pp. 28-29.

8. The mesas and cuestras constitute the natural physical boundaries of the Rio Puerco valley. "Cultural boundaries" of the valley, i.e. the outer limits of occupancy, are located at greater distances from the river and are less exact: it is true that the settlements of the valley are located near the stream; but livestock are allowed to graze the country several miles back from the river on either side, and settlers of past times used timber from mountains and mesas located several miles from the valley. For simplicity the term "Rio Puerco valley" is used in this thesis to mean the natural, or physical valley of the river, though discussion of the cultural geography cannot always be limited to such a narrow area.

The floor of the valley was formerly a flood plain for the river, but with the last seventy-five years the river has entrenched itself into the alluvium to depths as great as fifty feet; and only here and there has it reached bedrock. Even the largest flash floods of the Puerco are now confined to the deep channel which the river has cut. No longer can flood waters inundate the old flood plain, which is essentially "a terrace above the present stream grade."⁹ This entrenchment of the river is one of the major changes that has taken place in the physical landscape of the Rio Puerco valley. It has greatly influenced the success of settlement in the valley, since the "settlement capability" of the land is based to a great degree on the river and the ease with which irrigation water may be diverted from it.

Aside from its effects on stream flow, climate is another factor that restricts occupancy of the Puerco valley. The climate of the valley is arid and semi-arid, with an average annual precipitation that varies from about nine inches at the mouth of the river to more than 18 inches at the base of the headwater mountains. Most of the valley receives between nine and fourteen inches annually.¹⁰ The period of maximum precipitation is summer: during June, July, August, and September the valley receives about seventy-five percent of its annual rainfall. The summer rain comes mainly from thunderstorms, which are very localized in their occurrence but from which rainfall is very heavy. Preceding the rainy season are two or three months in the spring when high winds and duststorms are common.

Temperatures in the Puerco valley are not as high as those of some other arid regions in the southwestern United States, since the area is at both a high altitude and a fairly high latitude. Average annual temperatures range from 55° in the south to about 47° at the base of the San Pedro Mountains. Despite these moderate figures, however, summer tempera-

9. Kirk Bryan, "Historic Evidence on Changes in the Channel of the Rio Puerco, a Tributary of the Rio Grande in New Mexico," *Journal of Geology*, XXXVI (1928), 266.

10. U. S. Department of Agriculture, *Survey Report, Flood Control, Rio Puerco Watershed, New Mexico*, 1941, Map 16; B. C. Renick, *Geology and Ground-Water Resources of Western Sandoval County, New Mexico*, U. S. Department of Interior, Geological Survey, Water Supply Paper 620, 1931, p. 6ff.

tures may become unbearably warm. During the daylight hours in summer, air and surface temperatures become extremely high, while at night the heat is lost rapidly and the air becomes uncomfortably cool. Winter temperatures, in contrast, are comparatively low throughout the 24-hour day. Both temperature and precipitation exhibit moderate and fairly even latitudinal gradients, the temperatures decreasing from south to north and the precipitation increasing from south to north.

Climatic conditions greatly affect the vegetation of the Puerco valley, for the scanty precipitation—and including here its spotty distribution and extreme variability—is the main hindrance to plant growth. In addition, the high temperatures and generally low humidity of the air in summer permit a large amount of transpiration and evaporation from plants and the ground. Therefore, all natural vegetation is xerophytic; and other plants introduced as agricultural crops can thrive only when artificially irrigated. But since the occupants of the valley developed irrigation imperfectly, and since there was little water with which to irrigate, introduced plants were small, seeds poorly developed, and yields meager. In contrast to summer conditions, the cool temperatures of fall, winter, and spring are not hazardous to either agriculture or grazing—the two dominant types of land use. The growing season is at least 110 days everywhere in the valley, and there is never enough snow to interfere with grazing.

The greater part of the valley is underlain by essentially horizontal sedimentaries, mostly Cretaceous sandstones and shales.¹¹ Considerable thicknesses of these strata are exposed in the mesas, cuerdas, and hills on either side of the Puerco valley. The steep, often vertical, slopes of these uplands limit access to the valley from either side and help keep it isolated from other areas of settlement. Above the edges of the cliffs and scarps most of the land extending away from the valley in either direction is fairly level, but is rough and rocky. Soils on these uplands are thin and stony, and this, together with

11. Renick, *op. cit.*, p. 5; Dane, *op. cit.*, p. 91; Herbert E. Wright, Jr., "Tertiary and Quaternary Geology of the Lower Rio Puerco Area, New Mexico," *Bulletin of the Geological Society of America*, LVII (May, 1946), 392ff.

lack of water and the impossibility of irrigation, makes the land useless for agriculture. Grazing is its only suitable use, and even grazing capacity is limited by the steep slopes and rocky surfaces of the land.

Standing above the general level of the middle valley are two large mesas capped by basalt flows: Mesa Chivato and Mesa Prieta. The two were probably once joined, but the Puerco now flows between them.¹² Associated with these two mesas as part of the Mount Taylor volcanic region are a large number of volcanic necks—the most striking geomorphic features of the Puerco valley. These necks, in various stages of exposure, are widely scattered in the middle part of the valley. The largest neck is Cerro Cabezón (“big head”), a name also given to one of the settlements in the valley.¹³ These landforms are important only in that their steep slopes increase the difficulty of grazing.

A final noteworthy topographic feature is the Llano de Albuquerque, a long narrow upland separating the valley of the Puerco from that of the Río Grande. The west side of this flat, mesa-like feature borders the lower Puerco valley and presents a continuous scarp for a distance of about seventy miles; the scarp is known as the Ceja del Puerco (“eyebrow of the Puerco”).¹⁴

Soils in the Puerco valley are developed from the alluvium of the valley, which is composed of material both deposited by the river and washed into the valley from the uplands on either side. At least fifty feet deep in places, this alluvium is well displayed in the vertical banks of the Puerco trench, but there is a noticeable lack of soil profiles. On the other hand, the entire thickness of the alluvium may be termed soil, since it is fine material that was transported in Quaternary time from upstream. There are few gravel-sized, or larger, particles contained in the alluvium; in most places it is a heavy-textured material from the surface downward.

12. Renick, *op. cit.*, p. 5.

13. Douglas W. Johnson, “Volcanic Necks of the Mount Taylor Region, New Mexico,” *Bulletin of the Geological Society of America*, XVIII (July 16, 1907), 305.

14. Wright, *op. cit.*, pp. 387, 399, 439.

The present soil at the surface is sandy to silty in texture. This soil "holds" water fairly well, but not so well as the still heavier soil of the Rio Grande valley. In the opinion of local residents this makes the Puerco land more suitable for agriculture than is the Rio Grande valley. The soil is very easily eroded, however. Cracks develop readily due to the expansion and contraction that accompanies alternate wetting and drying. These cracks

permit penetration and concentration of water, and thus contribute to gullying and sloughing of vertical arroyo banks. Gullies are commonly subterranean "piping holes" and may travel underground for long distances before entering the lower entrenched drainages. Gully erosion, including bank caving, probably constitutes the principal source of silt to the Rio Puerco.¹⁵

The valley soil has usually been described as fertile and productive of crops. Soil productivity depends chiefly, however, on such factors as types of crops and methods of cultivation. In all parts of the valley, for example, irrigation is essential for the production of even small yields. Dry farming has been attempted in the upper valley, but with only slight success.¹⁶ A comment written in 1856 summarizes the situation adequately: "the soil looks rich, but is barren for want of moisture. If it could be irrigated by artesian wells, as the geologist believes to be practicable, or by reservoirs for the surplus water of the rainy season, this region would be worthy of cultivation."¹⁷ As it is, soil characteristics in the Puerco valley and surrounding area play a minor role in determining land capability for agriculture or grazing, compared with such factors as water availability and range management.

Of all the elements of the natural landscape, vegetation is the most obvious indicator of the use capabilities of the

15. U. S. Department of Agriculture, *Survey Report . . .*, *op. cit.*, p. 207.

16. *Ibid.*, pp. 114-115.

17. U. S. Congress, Senate, *Reports of Explorations and Surveys to Ascertain the Most Practicable and Economical Route for a Railroad from the Mississippi River to the Pacific Ocean*, 33d Cong., 2d Sess., Ex. Doc. 78, 1856, p. 53 of the Itinerary, A. Whipple's Report.

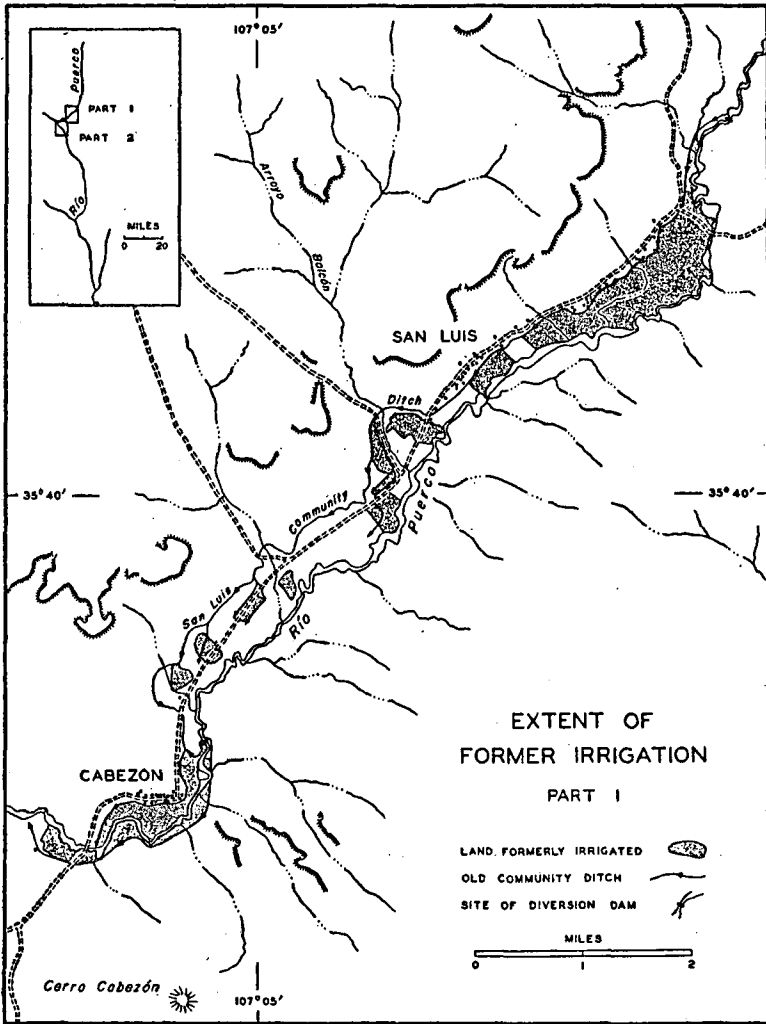


Fig. 16

land. The xerophytic vegetation of the Puerco area is evidence to the most casual observer that here is a land naturally suited only for grazing as an economic activity. Semi-desert grasses and shrubs cover the valley and much of the upland adjacent to it. The grasses do not form a complete sod cover, except in a few small locations at the mouths of arroyos. The shrubs are mostly greasewood (*Sarcobatus vermiculatus*), saltbush (*Atriplex* sp.), sagebrush (*Artemisia* sp.), and snakeweed (*Gutierrezia* sp.), all plants of low grazing value. Several species of cacti are also found in the area. These and the shrubs are scattered throughout the grassland in greater or lesser abundance, depending on local conditions.¹⁸ The grass cover of many large areas has been ruined by overgrazing and replaced by Russian-thistle (*Salosa kalitenufolia*). In some areas a weed known as pingue (*Actinea richardsoni*) has also become well established. This plant has toxic effects on livestock.¹⁹

Natural vegetation in and near the Puerco valley was extremely varied even before the entrance of white settlers. Nineteenth century travelers reported dense stands of sagebrush in some areas and "good grazing" in others.²⁰ It is also apparent, however, that there have been changes and variations in natural vegetation of the valley due to the use of the land by settlers. For example, there were once several locations of the valley floor where native grass was sufficiently thick and tall to be cut for hay.²¹ Cottonwood trees and willows commonly grew along the river banks. Today the tall grass has completely disappeared and many of the trees are dead. Some of the flood plain is now completely bare. There can be little doubt that vegetation in the Puerco area has decreased in quantity and quality in the historic past, with resultant increases in erosion and surface runoff. The "most serious conditions of vegetation depletion and erosion on the

18. Dortignac, *op. cit.*, p. 6, Fig. 2; Renick . . . , *op. cit.*, p. 9.

19. U. S. Department of Agriculture, *Survey Report* . . . , *op. cit.*, p. 181.

20. Luna B. Leopold, "Vegetation of Southwestern Watersheds in the Nineteenth Century," *Geographical Review*, XLI (April, 1951), 301-305.

21. Bryan, *op. cit.*, p. 278.

Rio Grande watershed [above El Paso] are encountered on the Rio Puerco watershed."²²

The streams, climate, topography, soils, and vegetation of the Rio Puerco valley all combine to create a natural landscape in which human settlement can barely exist. Even the most complete and ingenious use of the valley's resources cannot raise occupancy above the subsistence level, a level at which poverty and hardship are characteristics of everyday life. And even under these conditions, only a few people can be supported by the land. The inherent paucity of resources has made it impossible for a large population to live in the valley, and will probably continue to make it impossible.

Settlers have occupied the middle Rio Puerco valley twice within the last 200 years. The first of their periods of settlement was short-lived and ended abruptly; the second was longer and came to a gradual end through many years of population decline.²³ The two periods were separated by almost a century, during which there were no settlements anywhere in the valley; yet the characteristics of the occupancy of these people were much the same in each period, so that in describing the occupancy the two periods may be considered without differentiation.

In the 1870's, small farms and villages were again established along the flood plain of the river, and this time even alongside the little creeks that flow out of the mountains to create the Puerco. There were probably a few more settlers in the upper and middle parts of the valley this time, but the lower valley, as before, remained unoccupied. Resettlement of the valley took place quickly, largely because the Indian danger had been suddenly removed.

Most of the new villages were built in the same locations as the old ones and, in some instances at least, the settlers were heirs of the original settlers. A survey map of 1877 shows four villages in the old Montaña grant. One of these

22. U. S. Department of Agriculture, *Survey Report . . .*, *op. cit.*, p. 8; also Leopold, *op. cit.*, pp. 295, 305.

23. By 1950 the middle valley was almost deserted, bringing the second period of settlement to an end. But in the upper valley, where the environment is more favorable to settlement, there still exists a considerable population.

was La Cueva, doubtless located on the site of La Cueva of the first period of settlement. The three others were San Francisco, Durán, and San Ignacio.²⁴

Farther south, Los Quelités was re-established at the mouth of the San José, and still farther south was a new village known as Los Cerros. It was located a little way downstream from the present railroad crossing of the Puerco and was the southernmost of all settlements in the valley.²⁵

North of the Montaña grant there were established the villages of Casa Salazar, Guadalupe, Cabezón, San Luis, La Ventana, and Cuba. Casa Salazar may be at the site of the old Lagunites, San Luis is at the location of the old Ranchos de los Mestas, and Cuba is at the site of Nacimiento. The others have the same names as in the first period of settlement.

Above Cuba the settlers and their farms were widely scattered along the watercourses at the base of the mountains. There was lacking here the village type of organization characteristic of the middle valley; La Jara and Regina had only slight semblance of being villages.

Both the physical environment and the historical necessities of the people shaped the areal pattern of settlement in the middle Puerco valley. The physical environment, on the one hand, made desirable a pattern of scattered settlement, whereas such centuries-long characteristics as common use of rangeland, community irrigation systems and defense against Indians tended to bind the settlers into compact village units. Taken as a whole, the pattern of settlement illustrates a series of compromises between these opposing forces.

Population of the Puerco villages, a first consideration in the pattern of settlement, was always quite small. Limited by the dearth of natural resources, probably none of the vil-

24. Kirk Bryan, "Historic Evidence on Changes in the Channel of the Rio Puerco, A Tributary of the Rio Grande in New Mexico," *Journal of Geology*, XXXVI (1928), 275-276. The New Mexico Principal Meridian, located near the Puerco valley, was surveyed in 1855; and the notes of this and later surveys were used by Bryan in investigating these villages. One of these surveys noted the ruins of an additional town in the Montaña Grant, San Fernando; but apparently the old town of San Fernando was not re-established in the second period of settlement, and the ruins were those of the original village.

25. *Ibid.*, p. 277.

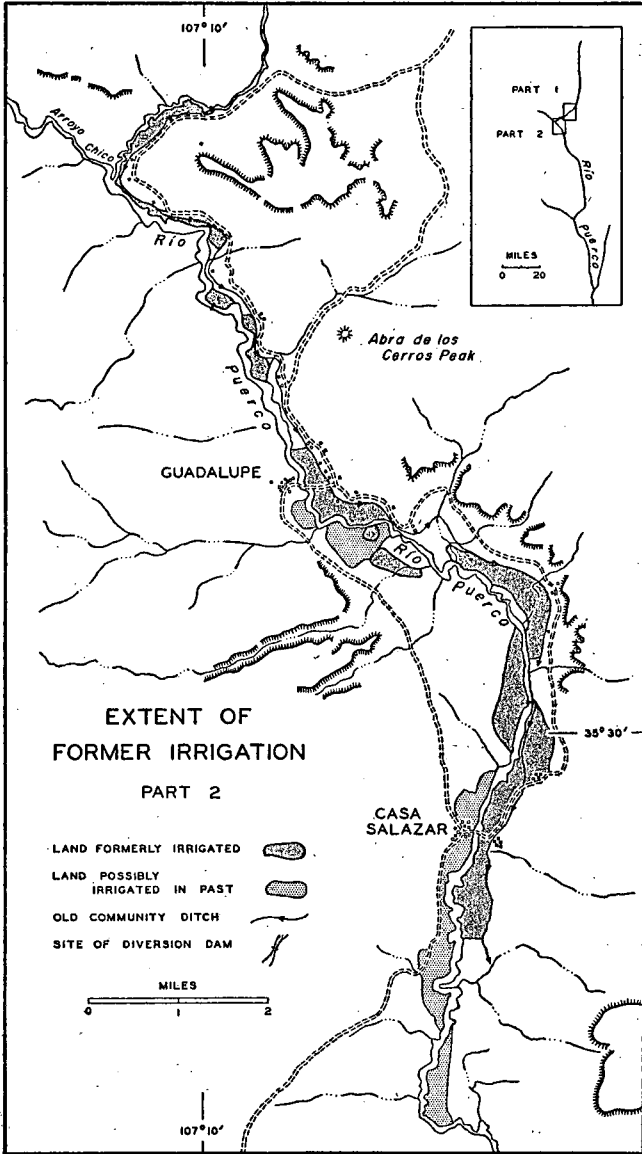


Fig. 17

lages in the middle valley ever contained more than about 200 persons.²⁶ In 1877 the population was estimated to be 100 at San Francisco and 150 at San Ignacio. La Cueva and Durán were still smaller, as there were reported to be only three occupied houses in each of these villages. At that time, however, both these villages were already past their peaks. San Francisco and San Ignacio, in contrast, may have grown a little larger, as indicated by the number of ruins visible in 1909 and at present [1957].²⁷ The village of Los Cerros was reported to have a population of 50-60 persons in 1881.²⁸ More recent population figures for the villages of San Luis, Cabezón, Guadalupe, and Casa Salazar reveal a decline from a total of 411 in 1930 to 20 in 1957.

Cabezón was the largest town in the middle valley, and is said to have once had four stores, four saloons, and three "dance halls." Cabezón, San Luis, Guadalupe, and Casa Salazar, at least, each had a small school and church, and there was long a post office at Cabezón and another at Guadalupe.

Each settlement consisted of little clusters, groups, or strings of adobe buildings. Some of the villages were quite compact, such as San Francisco and Guadalupe, while in others a row of houses extended two or three miles along a main irrigation ditch, as at San Luis. Topography of the valley and the land use associated with it made desirable a "stringing out" of the villages. The main factor in the layout as well as the location of each village was the presence of easily irrigated bottom land. Such land was found only here and there, and usually in narrow strips adjacent to the river. Where there were several hundred acres of this irrigable land, there was likely to be a village. Houses were often scattered along the upslope edge of the irrigated area, located as near as possible to the fields.

This distribution of houses and its variations are easily seen in the village layouts of Casa Salazar, Guadalupe, Cabezón, and San Luis. At Casa Salazar, the farthest south of these four villages, there were houses and fields on both sides

26. No census information about the valley is available except for the last few decades, and only a few estimates were previously made.

27. Bryan, *op. cit.*, pp. 275-276.

28. *Ibid.*, p. 277.

of the river. Some of the houses were grouped into a small nucleus of settlement, but many others were widespread in the valley. This distribution was made possible primarily by considerable areas of land suitable for agriculture on each side of the river. It was also possible for the people to construct irrigation ditches on both sides of the stream. Houses were built alongside the ditches, adjacent to the individual fields. Usually the houses stood on one side of the main ditch and the fields lay on the other. A close grouping of the villages was thus sacrificed for the convenience of living near the family croplands.

At Guadalupe the layout was somewhat different. Here most of the houses were on the west side of the river, clustered around a little spring. In this case it was more important to the settlers to be near the supply of domestic water than to be near their fields, though most of these were also within easy walking distance. A few other settlers were scattered throughout this part of the valley where there were small patches of irrigable flood plain.

Cabezón, largest and most important of the middle Puerco villages, was located at the foot of a high bluff overlooking the valley on the west. The buildings were closely hemmed in between the bluff and the community's main irrigation ditch, for there was little space to be wasted in this section. High ground pinched out the flood plain just above and below Cabezón; and this limitation on cropland made necessary the close spacing of the buildings. At one time there were also some houses on the east side of the river at Cabezón, but some of these were destroyed by widening of the river channel; today the only buildings left standing are those on the west side.

San Luis was the least compact of the villages described. Houses were scattered along the community's main ditch for a distance of more than three miles, located wherever the flood plain seemed most suitable for cultivation. In this area the flood plain on the west side of the river was comparatively wide and uninterrupted, so that the settlement was not as restricted in area as was Cabezón. On the other hand, houses and fields at San Luis were all limited to one side of the river;

a slightly elevated area on the opposite side broke the flatness of the valley floor and made ditches and fields impracticable.

Though the population and villages of the middle Puerco area were seemingly thinly scattered, actually most of the valley land suitable for agriculture was occupied. Comparatively short distances separated the settlements from each other; and, for the most part, the unoccupied bottom land between villages was too sloping, too rocky, or too narrow for irrigation and crop raising. In brief, the settlers occupied the valley to almost the maximum physical extent possible.

The presence or lack of good sources of domestic water was a minor factor in the location of the Puerco villages. The main settlement of Guadalupe had the advantage of being located at a spring, but the other villages had no such convenient water supply. In the early days at least, some water for domestic use was obtained from wells, and even river-water was used. Later, after the entrenchment of the river—and consequent lowering of the water table below the depth of most wells—the people used rainwater drained off corrugated metal roofs and stored in barrels and cisterns. Sometimes it was necessary to haul water in barrels from the spring at Guadalupe or from the Espíritu Santo spring several miles east of the valley.

At all the villages the houses and other buildings were constructed of adobe and stones, with either earth or metal roofs. A few refinements such as glass windows were the only major contrast with the eighteenth century period. Most of the old houses are presently in ruins, and they lend an aspect of desolation to the valley. This impression is heightened by the old croplands, now slowly returning to brush and native grass.

Livestock grazing and irrigation farming were the two basic economic activities of the settlers. Grazing was probably secondary in importance, but much more land was used for this activity than was devoted to agriculture. Large numbers of cattle, sheep, goats, and horses were fed on both the unplowed lands of the valley and on the crop fields themselves after harvest. In addition, the upland range was used for miles on either side of the river.

In the early days fences were few or non-existent, and the range was used in common by all the settlers. There was nothing to prevent each farmer from grazing his cattle wherever he wished. The flocks of sheep and goats, while kept under closer watch than cattle, were also pastured anywhere and everywhere on the watershed.²⁹ Grazing was thus unrestricted, yet the Puerco settlers were careful to cooperate with each other. Likely they pooled not only the range but their efforts in herding and managing their stock. A few riders and herders would have been sufficient to control the stock of each community, leaving the majority of the population engaged in farming. This was only one of the ways in which the settlers cooperated among themselves to make their occupancy of the middle valley more secure.

Livestock were watered from puddles in the river bottom and from a number of earthen reservoirs. These reservoirs, which were also more or less common property, were constructed by damming small drainage ways wherever it was convenient—often where they entered the flood plain from the surrounding uplands. The more favorably located of the reservoirs still collect small permanent pools of water, but many others were failures. Usually the unsuccessful ones did not collect the drainage from large enough areas, so that they dried up in the summer. Much of the water was also lost by seepage unless considerable efforts were made to give the reservoirs impermeable bottoms.

In recent years several wells with windmills have been drilled into the alluvium of the valley floor, and these, together with the river and the old reservoirs, adequately supply the present livestock.

The history of stocking by the Rio Puerco settlers followed closely that of the entire Rio Grande watershed above El Paso. Numbers of livestock reached a peak about 1900, after which there was an almost steady decrease until the present. In the Rio Grande watershed cattle decreased almost sixty percent between 1900 and 1935.³⁰ Perhaps the most im-

29. U. S. Department of Agriculture, *Survey Report . . .*, *op. cit.*, pp. 149-150.

30. Based on information from U. S. Department of Agriculture, *Survey Report . . .*, *op. cit.*

portant factor accounting for this decrease was the depletion of range vegetation. This factor must have been important in the Puerco valley as well, but probably more significant here was the decrease in available rangeland.

The animals and their products were used by the settlers themselves and also were sold in the Rio Grande valley, thus giving the people some cash income. But commercial marketing of livestock was not important enough to overcome the basic subsistence economy. The only notable exception to this economy was Mr. Richard Heller. He was one of the most influential citizens of Cabezón (1889-1949) and is said to have once owned 10,000 sheep and 2,000 cattle. He regularly took stock to market in Albuquerque,³¹ and probably also served as an agent for other settlers of the middle valley.

The crop land of the middle valley, in contrast to the range, was controlled by the head of each family. The holdings of each family, however, were very small, usually little odd-shaped tracts less than fifteen acres in size. Nevertheless, these patches of irrigable valley bottom were the fundamental land resources upon which settlement of the valley was based. On these lands the folk grew their staple foods of corn, beans, chili, and wheat, and secondary crops of alfalfa, oats, and vegetables. In addition, there were a few orchard fruits—apples, pears, plums, and cherries. For the most part these were all subsistence and forage crops used locally, but some of the wheat was hauled to market in Albuquerque. In this regard it is reported that the Puerco valley was once known as the "bread basket of New Mexico,"³² but it is unlikely that such a poor area farmed by so few people could fully warrant the title. At one time a small flour mill at Cabezón served the local area, but it disappeared so long ago as to be almost forgotten.

Tall native grasses were another commercial product of the middle valley. At a number of locations along the river, especially at the mouths of certain tributary arroyos, wild

31. Henry T. Gurley, "A Town out of the Past," *New Mexico Magazine*, XXXV (April, 1957), 51.

32. Quoted by Mr. Richard Strong, Soil Conservation Service, Albuquerque. Also see article by Mr. Strong in *Albuquerque Tribune*, September 11, 1957.

grasses once grew two to three feet or more in height. The grass was cut annually in these comparatively well-watered places, and was sold in Albuquerque as "wild hay."

All planted crops in the middle valley were grown under irrigation, but not the Indian type of flood-water farming. No evidence exists that the settlers practiced this primitive type of irrigation. On the contrary, they irrigated their crops with water diverted directly from the Rio Puerco—though the Puerco was always a poor stream for such a purpose. The occasional flow of water in the river meant that crops could be irrigated only occasionally. However, it was possible, in time of summer flashflood in the river, to give the fields a good soaking, and one that would last until the next flood. No estimate can be made of the amount of water that was actually delivered, in an average year, to the crop lands. For maximum yields, however, the land would have needed about 1.5 to 3 acre-feet per acre per year.³³ This optimum was probably rarely achieved.

In the years before the river had entrenched itself deeply, it was relatively simple to divert water for irrigation. Many farmers built small dams and ditches of their own. A settler at San Ignacio stated that "low brush dams were thrown across the channel during later phases of the flood, and the water was diverted into ditches or simply warped over the land."³⁴ Also, when there were unusually large flash floods, the water left the river channel and inundated large areas of the valley floor. Apparently this flooding was gentle enough that there was little destruction of crops. When the floods occurred, according to one investigator, the soil became so saturated that crops grew with no further irrigation during the year.³⁵

Despite the ease of irrigating the land, most of the irrigation carried on in the middle valley was not done by the farmers as individuals, but by community effort. Probably from earliest times the settlers used "community ditch systems,"

33. U. S. Department of Agriculture, Bureau of Agricultural Economics, Division of Land Economics, Water Utilization Section, *Water Facilities Area Plan for Upper Rio Puerco Watershed, Sandoval and Rio Arriba Counties, New Mexico*, 1939, pp. 44-46.

34. Kirk Bryan, "Flood-water Farming," *Geographical Review*, XIX (1929), 454.

35. *Ibid.*

which were common features of New Mexico. In establishing these systems each community (sometimes two adjacent communities) constructed one or two large irrigation ditches. Water was diverted from the river into these ditches by dams located short distances upstream from the settlements. Both dams and ditches were community property. From the ditches each farmer was allowed to take water to irrigate his fields, and in return was required to help keep the dams and ditches in repair. Each ditch system was governed by a commission of three men and an executive major-domo who were elected annually. Duties of these men were to apportion the water and see to it that every water-user contributed the necessary amount of labor to the upkeep of the ditch and dam.³⁶

Though the community ditch system did not originate in the Puerco valley, it may be viewed as definitely an adaptation of the occupance to the environment of the valley, for it made the most economical and efficient use of the river water that could be devised. In a wider view the system also illustrates the community efforts found necessary by the Spanish in settling the arid parts of America.

But despite their utility and comparative efficiency, the community ditch systems were still much less than perfect. The first trouble was that the community dams were not made to hold water in storage for any length of time, but only to divert it when the river ran. This was because the settlers had neither materials, finances, nor, perhaps, ability to construct water-tight structures. Even further beyond their conception were large reservoirs capable of watering crops through an entire season. What was possible to build, on the contrary, were small log and stone structures that could divert only a fraction of the ephemeral floodwaters. At first these structures were very small, but as the river channel enlarged they necessarily became larger also. Eventually they were structures of considerable size and major importance.

A second trouble with the ditch systems was that irrigation methods were always very poor. Even now, in the few

36. New Mexico, *Eighth Biennial Report of the State Engineer of New Mexico*, 1928, pp. 227-237.

systems still in use in the upper valley, water is usually applied to crops in a wasteful and inefficient manner. "Irrigation systems are poorly laid out, land has not been properly leveled or terraced, and substantial quantities of water are lost down road ditches and natural drainage-ways."³⁷ The ditches were usually built without being properly surveyed, and were of uneven grade and cross-section. Perhaps as much as 50 percent of the water carried in them was lost in one way or another before it could be delivered to the fields.³⁸

Each of the community ditches in the middle valley extended more or less parallel to the river channel for several miles, but was located near the upper edge of the flood plain. The ditches quite closely followed the contour of the land where the floodplain begins to steepen toward the base of the *cuestas* and uplands. Most of the agricultural fields were located between the ditch and the river, so that irrigation water would flow by gravity across the land and drain into the river. Most of the old fields and sections of the ditches are still visible and give an indication of the life and activity that once pervaded the valley.

Transportation routes in the Puerco valley in the 19th and early 20th centuries were of minor importance, as there was relatively little travel or trade among the villages or with the "outside." The routes that did exist were only wagon-track roads or trails. In the valley these ran almost parallel to the river, connecting the villages one with another. There were also several roads that led eastward out of the valley toward the Rio Grande valley. On the opposite side a road or two led westward to Marquez (Juan Tafoya) and the mountains and mesas from which wood was obtained.

Several routes of travel extended entirely across the middle Puerco valley. The best known of these were the ones followed today by highways 6 and 66 and one that crossed the river at Cabezón—the latter a route from Santa Fe to Fort Wingate (Fort Wingate was near present-day Gallup). U. S. Army troops and a stage line used the Cabezón route, and

37. U. S. Department of Agriculture, *Survey Report . . .*, *op. cit.*, p. 117.

38. U. S. Department of Agriculture, *Water Facilities Area Plan . . .*, *op. cit.* p. 46.

Cabezón village was important as a way station and watering stop. Even a temporary army post was set up at the village in the last decade of the century.³⁹ Other advantages of this route were a bridge near the settlement, which existed until at least 1882,⁴⁰ and the Cerro Cabezón, a landmark visible for miles. The Santa Fe railroad was built west from the Rio Grande valley in 1880. The railroad and the wagon roads from Los Lunas and Albuquerque began to carry most of the traffic across the valley, and the route through Cabezón began to dwindle and disappear.

But the disappearance of this route was only a minor change in comparison to others about to take place. The entire population of the middle Puerco valley soon began to feel changes occurring in both the landscape around them and in the nearby Rio Grande valley. Soon it became apparent that irrigation and grazing, as the settlers practiced them, were insufficient for gaining a livelihood in the middle valley, and they began to desert the area for the second and final time.

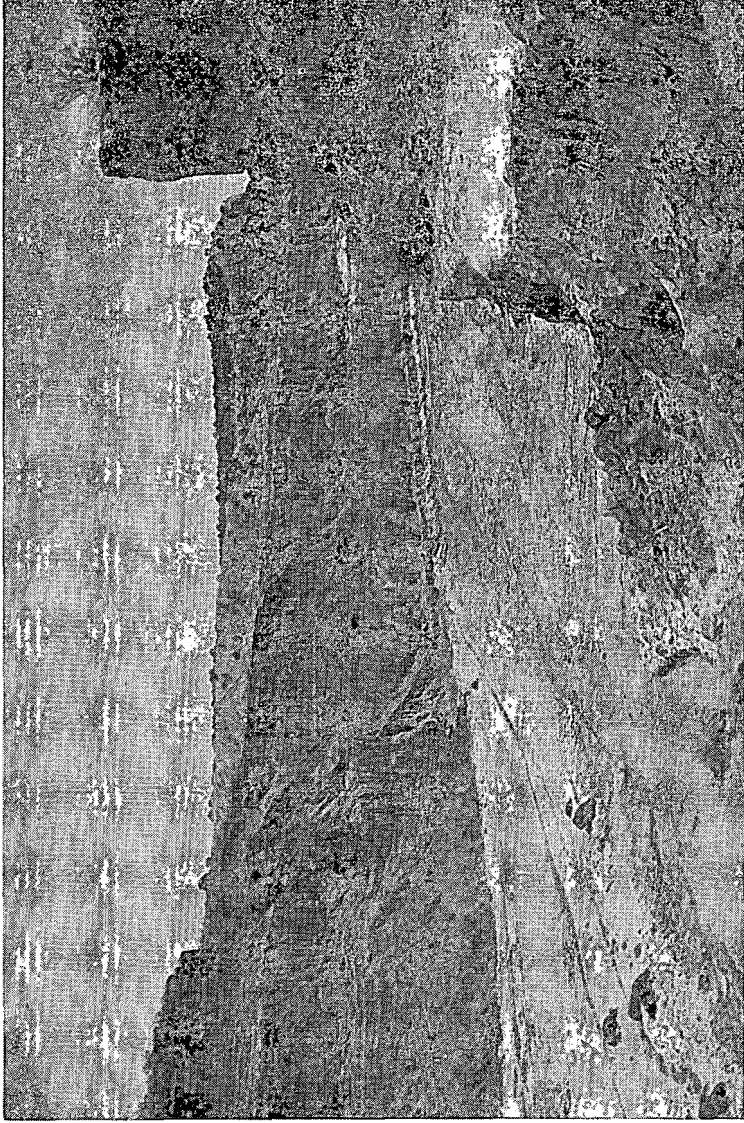
The people of the settlements farthest downstream were first to find they could not make a living in the valley, for they deserted their little communities as early as the 1880's and '90's. At the villages of San Luis, Cabezón, Guadalupe, and Casa Salazar, the settlers were more successful for a time, but eventually the majority of them were also forced to move. Guadalupe and Cabezón were abandoned only a few years ago. San Luis and Casa Salazar are still occupied, but only by a few families [1957]. The four villages of this area either met or are meeting the fate of the lower villages—it has only taken longer. Yet all during the twentieth century these villages were declining in prosperity. At least one man moved away from Cabezón as early as 1900 because, according to him, he could no longer farm successfully and the town was not prosperous.⁴¹

Yet only the villages and their associated croplands were deserted; the rangeland on all sides is still used for grazing. At the downstream settlements, the land passed into private

39. Gurley, *op. cit.*, p. 50.

40. Bryan, *Historic Evidence . . .*, pp. 273-274.

41. *Ibid.*, p. 274.



Entrenchment near La Ventana, approximately 50'; 1870's about 8'

or government ownership and is now grazed by stockmen who live far from the valley. Similar conditions exist in the San Luis-Casa Salazar area except for the few remaining settlers, who also graze a few animals—the last remnant of the old occupance.

The basic changes in the occupance of the middle valley have been, therefore, not only the abandonment of villages, but a shift from the dual economy of irrigation agriculture and stock-raising to stock-raising alone. The significance of this second change is that grazing as a single economy is incapable of supporting a resident population within the valley. The few settlers who still remain are only partially supported by their livestock, and they will probably all leave the valley soon. The outsiders, those who have taken over the use of the land, find no necessity for living in the valley. Briefly, then, except for the villages and croplands, the middle valley has not been deserted, but only given over to the use of non-resident graziers.

Among the several causal factors for the change, the most fundamental was the harsh desert environment in which the settlements were placed. The type of occupance and land use practiced was extremely hazardous under the most favorable natural and economic conditions. But the period of settlement was not a time in which conditions remained always favorable. Considering only such minor factors as annual variations in rainfall and flash floods, it is probably correct to surmise that the occupance was most closely adjusted to the "wet" years and was very imperfectly related to the "dry" ones.

In the larger view, a series of adverse changes occurred in both the physical environment and in economic conditions that encroached on the settlers. Each of these changes contributed in some degree to the abandonment of the valley, yet the relative importance of each change can only be estimated. The alterations in the physical environment were those of severe injury and deterioration of land resources, with a resulting decrease in productive capacity of the land. The economic changes were the growth and development of the

Rio Grande settlements and other nearby communities, so that the Puerco valley was left an area of relative as well as absolute poverty.

One of the most serious changes in the land base of the middle Rio Puerco area was the impoverishment of its vegetative cover. Vegetation depletion has been general on almost the entire New Mexico watershed of the Rio Grande—grazing capacity has decreased 40 to 50 percent—but the most pronounced conditions of range depletion within this area are found in and near the Rio Puerco valley.⁴² Some areas are more badly deteriorated than others. The most severely injured rangelands are located between Cuba and La Ventana, and between Cabezón and Casa Salazar. “Intermediately deteriorated” and “slightly deteriorated” plant cover is found throughout the remainder of the valley.⁴³

Depletion of the range was caused by overgrazing: it is estimated that as early as 1890 the rangeland surrounding the middle valley was overstocked.⁴⁴ Deterioration of plant cover followed promptly, and probably continued little abated until almost the present day. The blame for overgrazing must be shared by both the Rio Puerco settlers and by other graziers who brought animals into the area beginning in the 1880's. The animal population was so large, near the turn of the century, that the range grasses were eaten down almost to ground level, many of the plants died, and few new ones became established. In some locations grasses were replaced by hardy cactus, Russian-thistle, snakeweed, and other plants of low grazing value.

A small part of the range adjacent to the valley has a grazing capacity of one animal unit per year for each 50-80 acres. Capacity for most of the range is one animal unit for every 80-130 acres, and another small area has a capacity of one animal unit for every 130-210 acres. In almost every case, however, the past use of the range has exceeded grazing capacity. On some of the land, for example, less than 50 acres

42. U. S. Department of Agriculture, *Survey Report . . .*, *op. cit.*, p. 8.

43. *Ibid.*, from a map based on field surveys of range conditions, overlay on Map 6. Criteria not stated.

44. *Ibid.*

have been allotted per animal unit, whereas 80-130 acres were needed.⁴⁵

No correlation is apparent between the various degrees of overgrazing from place to place and the history of abandonment, yet overgrazing and vegetation depletion were important in both decreasing present grazing capacity and in their effects on erosion.

The natural grass cover of the middle Puerco area was the principal control over the rate of runoff and soil erosion. With much of its cover destroyed by overgrazing, the land became more subject to both water and wind erosion, of which water erosion was by far the most serious. The two types of water erosion, sheet and gullying, are both found in the area; but sheet erosion, which is most active in reducing the topsoil, has proceeded to only a slight degree. The entire valley and closely adjacent area as far south as the Montaña grant have suffered "slight" sheet erosion, but much gullying. Farther back from the valley on either side, there has been a greater amount of sheet erosion ("moderate") with less frequent gullies, and the entire lower section of the valley has suffered slight sheet erosion. In the terminology of the Soil Conservation Service, "slight sheet erosion" signifies a removal of less than 25% of the topsoil, and "moderate sheet erosion" signifies removal of 25% to 75%.⁴⁶ Generally speaking, it appears that sheet erosion has been one of the less important factors in the decline of the Puerco settlements, but the same cannot be said of gully erosion.

Accelerated gully erosion, including the entrenchment of the Rio Puerco, was the most significant and striking change in the physical environment of the middle valley. The alluvial sediments of the old flood plain have been scarred and grooved by countless deep erosion channels, of which the Puerco channel is the largest. Thousands of tons of unconsolidated material have been eaten away, slumped off, and carried downstream by the river and all its tributary arroyos. Not only has this erosion removed and ruined considerable areas of useful land, but it has also made natural floods im-

45. *Ibid.*

46. *Ibid.*, p. 207 and Map 12.

possible, has resulted in lowering of the water table, in silting of irrigation systems, and has made more difficult the construction of diversion dams. Each of these associated factors, in turn, and especially the last, has been significant to some degree in the decline of settlement.

Accelerated gulying and channel erosion began in the 1880's, thus coinciding with overgrazing and depletion of the range. Overgrazing must be considered the primary causal factor in the entrenchment of the Rio Puerco and its tributaries. For this reason overgrazing is one of the basic causes of the valley's decline.⁴⁷

The channel of the Rio Puerco, created by the tremendous erosional abilities of flash flood waters, is perhaps the largest "gully" of its kind in New Mexico. As flash floods increased in volume with the increased runoff on the watershed, the river channel deepened and widened rapidly. At several locations in the lower part of the valley, for example, the channel increased in width from an average of 75 feet in 1881 to 790 feet in 1939.⁴⁸ In 1927 the remains of an old dam were found at the site of Los Cerros; the base of the remnants was 22 feet above the bottom of the channel, indicating a deepening of that many feet since the dam was used in 1887.⁴⁹ At La Ventana the channel was only about eight feet deep in the 1870's, whereas it is now approximately 50 feet in depth.⁵⁰

As the channel deepened and widened, the settlers had an ever-increasing task in the construction and maintenance of their diversion dams. At first the dams were only flimsy struc-

47. Bryan has found some evidence that long term fluctuations in climate may be the ultimate cause of arroyo entrenchment in southwestern United States. He agrees, however, that overgrazing on the Rio Puerco watershed was the immediate, if not the ultimate, cause of the rapid entrenchment of the river. See Bryan, *op. cit.*, p. 281; Bryan, "Pre-Columbian Agriculture in the Southwest, as Conditioned by Periods of Alluviation," *Annals of Association of American Geographers*, XXXI (December, 1941), pp. 232-236; and Bryan, "Change in Plant Associations by Change in Ground Water Level," *Ecology*, IX (1928), p. 477.

48. U. S. Department of Agriculture, *Survey Report . . .*, *op. cit.*, p. 216.

49. Bryan, "Historic Evidence . . .," *op. cit.*, p. 277.

50. *Ibid.*, p. 275. Local baselevel for the Rio Puerco is the elevation of the Rio Grande at the point where it is joined by the Puerco. This baselevel is actually rising slightly because the Rio Grande is aggrading its bed. A part of the lower Puerco, in response to this change, appears to have ceased downcutting. Farther up, the Puerco is still well above its local baselevel and is able to continue downcutting unabated.

tures of logs, brush, and stones and were easily destroyed by flash floods. When the river channel increased in size, the dams had to be larger and stronger, and these in turn were more costly to build and required more frequent repairs. Finally, when even their most carefully constructed dams were washed out, the people—already discouraged and impoverished by the other changes that were taking place around them—found it easier to abandon their villages than to replace the dams once more.

That the downstream settlements in the valley were abandoned first was probably partially due to the headward deepening of the river channel, which affected these settlements first. The old dams, croplands, and ditches of these downstream villages have all disappeared, and little remains of the villages themselves, with the exception of San Francisco. Though deserted sixty years ago, many of the stone and adobe walls of this village are still standing. Following the abandonment of the settlements in this area, and even before San Ignacio was totally deserted, two commercial companies attempted to irrigate part of the valley in the Montaña grant. The plans and efforts of these companies soon failed—for much the same reasons that private settlement failed—but not before considerable expenditures had been made.⁵¹

The history of community ditch systems in the San Luis-Casa Salazar area is somewhat confused, yet it aids an understanding of the importance to this area of the entrenchment of the Rio Puerco. According to one report "an irrigation system of considerable extent was put into operation at Cabezón in 1865."⁵² a date previous to that believed to mark the beginning of the second period of settlement. But according to an early investigation, all the ditches in the area were constructed in 1872, which date seems to coincide with the

51. Kirk Bryan, "Historic Evidence . . ." *op. cit.*, p. 276; New Mexico, *First Report of the State Engineer of New Mexico*, 1914, pp. 52, 34-39; New Mexico, *Second Biennial Report of the Territorial Engineer to the Governor of New Mexico*, 1910, see "Rio Puerco Irrigation Co." and "H. A. Jastro" in table opposite p. 70; New Mexico, *Fifth Biennial Report of the State Engineer of New Mexico*, 1922, same names, in table following p. 77.

52. U. S. Department of Agriculture, *Water Facilities Area Plan . . .*, p. 40.

founding of the settlements.⁵³ The ditches and dams at that time were probably in about the same locations as those most recently used. The northernmost dam was one above San Luis that diverted water into a long ditch on the west side of the river. Perhaps San Luis was also served, at one time in the nineteenth century, by a ditch that began at La Ventana, about twelve miles upstream.⁵⁴ Just above Cabezón a dam marked the beginning of two ditches, one on either side of the river, that irrigated the farms of this community. A short distance below Cabezón a dam diverted water into a ditch on the east side of the river. Another short distance downstream, and below the mouth of Arroyo Chico, was a dam from which ditches extended on both sides of the river. These two ditches, which were those of the Abra de los Cerros system, are believed to have extended all the way to Guadalupe and Casa Salazar. In addition there was yet another diversion above Casa Salazar from which a ditch on the east side began.

Although the diversion dams were easily destroyed by large flash floods, they were almost as easily replaced in the early days of settlement. There is a record of dam failures, for example, at both Cabezón and San Luis in about 1877.⁵⁵ The San Luis barrier, then "a very small affair of brush and poles," was soon rebuilt, as was the Cabezón dam. But by 1880 the latter structure must have been destroyed again, for the San Luis ditch was extended south to serve Cabezón. Later, however, each town seems again to have had a separate ditch. One local resident said that the Cabezón dam was washed out for the last time in about 1922 (a very few remnants of it may yet be seen), and apparently the San Luis ditch was then extended to Cabezón again. Somewhat later, in 1936, the last diversion to serve Guadalupe and Casa Salazar was washed out,⁵⁶ and not since that year has irrigation farming been practiced at either community.

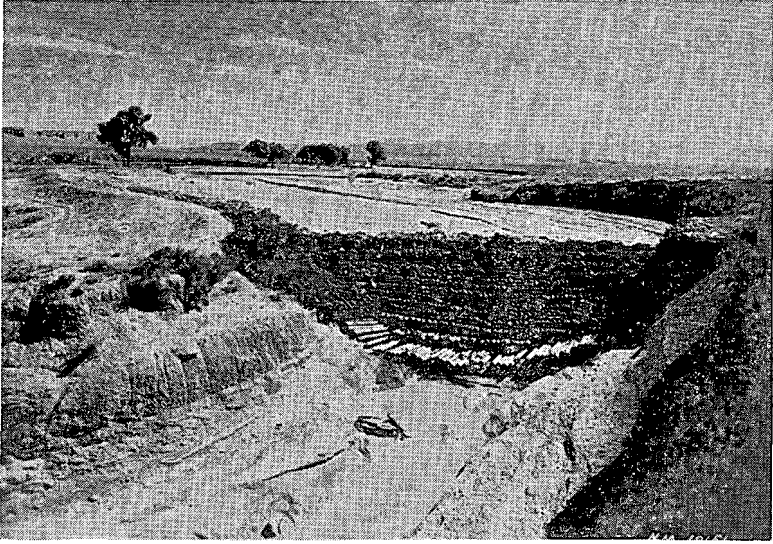
Meanwhile the dam at San Luis was destroyed again in

53. U. S. Congress, Senate, *Equitable Distribution of the Waters of the Rio Grande*, 55th Cong., 2d Sess., Doc. 229, 1897-98, p. 167.

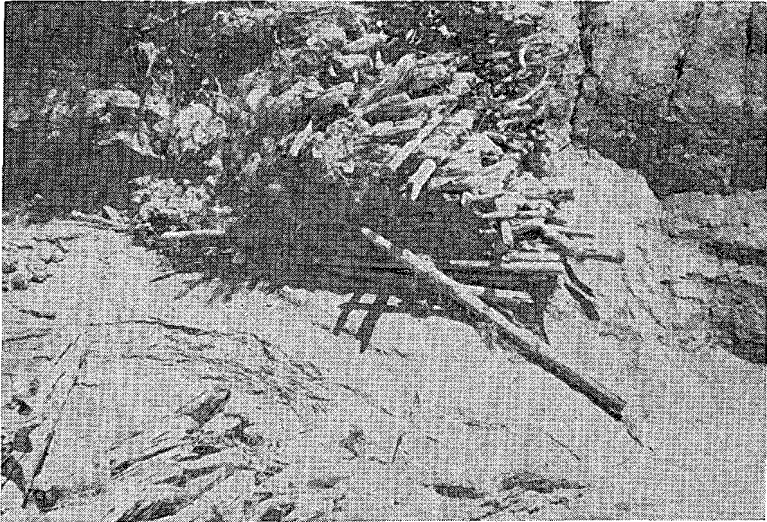
54. Information from Soil Conservation Service file on San Luis Community Ditch.

55. Bryan, "Historic Evidence . . .," p. 273.

56. Soil Conservation Service file, *op. cit.*



San Luis Dam 1938



Ruins of San Luis Dam

1926 or 1927.⁵⁷ Soon thereafter the people requested the state engineer's office to investigate a new site for it. In 1928 a location was selected about one-half mile above the site of the destroyed barrier, and an appropriate structure was recommended.⁵⁸ Apparently the local people were planning to build the dam themselves, as in the past; but the structure was not begun until 1934, when construction was aided by federal funds. In 1936 the new structure was completed by the Soil Conservation Service, working with the local people. In 1939 and 1940 the Civilian Conservation Corps and the Soil Conservation Service made a few repairs and relocated the heading of the ditch. Diverted waters served only San Luis and not Cabezón.

The San Luis Community Ditch system was the only one in the middle Puerco valley ever to receive government assistance. For all repair and construction work, the local residents furnished the labor, and the government provided materials, equipment, and supervision. But no great expenditures of public money were ever made. Total cost to the government for work done in 1939, for example, was estimated at \$3,697.⁵⁹

San Luis dam was also the only one in the Puerco valley built according to recommendations of qualified engineers. All the others were haphazard contrivances wedged into narrow sections of the river channel. Usually there was no bedrock on which to build, and the unconsolidated alluvium of the valley made very unsound footing. Poor construction and poor foundation conditions, in addition to the pressures of floodwaters, were the most important factors in destruction of the dams. Even the one at San Luis, though better engineered and constructed than the others, was not proof against summer flash floods. It was destroyed by a large flood on July 24-25, 1951. This was the last dam in existence in the middle Puerco valley, and with its destruction one of the basic eco-

57. *Ibid.*

58. New Mexico, *Eighth Biennial Report of the State Engineer of New Mexico*, 1928, p. 58.

59. Soil Conservation Service file; *op. cit.*

conomic activities of the Puerco settlers, irrigation agriculture, became a practical impossibility.

Little information exists concerning crop yields in the Puerco valley, but it may be assumed that productivity was always low. In the drier middle valley, the yields were probably somewhat lower than those of farther upstream. Dry farming was attempted in the middle valley when irrigation became impossible, but without success. Dry-farm corn ("unimproved native corn") yielded only five bushels per acre at San Luis, but much of the acreage that was planted failed completely.⁶⁰

The low crop yields were not so much a product of the destruction of land resources as they were of the natural poverty of the land. Lack of water was the major difficulty—there was never enough rain and often not enough irrigation water. Soil quality was less important, even when the soils were somewhat eroded by sheet wash. Nevertheless, yields probably did decrease somewhat as a result of the removal of top soil.

Periodic drouth was a contributing factor to the decline of the middle valley that had a special effect on crop yields. Sometimes drouth took the form of local "dry spots" and sometimes it was general over the entire valley. If in any year or series of years there happened to be insufficient rain, and thus insufficient floods, there was probably a high percentage of crop failure. Then the people had to depend mostly on their livestock. Although there has been no agriculture in most of the middle valley for over a decade, the prolonged drouth of that period has adversely affected the range vegetation.

Not long after resettlement of the Puerco valley in the 1870's, the open rangeland available to the settlers became more and more restricted. In Spanish times unoccupied and ungranted land between settlements had been considered to be for the use of anyone, but the Americans put into practice the idea that all land was to be under some definite ownership. At the beginning of the American period (1846), most

60. Soil Conservation Service file, *op. cit.*

of the land of New Mexico was placed under federal government ownership as public domain. In time much of it passed into private ownership, and non-resident livestock operators gained control of large tracts on either side of the Rio Puerco valley; the Puerco settlers were deprived of the range they had used so freely. At first they were probably unaware of what was happening. Later they were financially unable to acquire their own rangelands.

More recently the available range has dwindled still further due to such measures as the creation of national forest (in the San Pedro Mountains), purchase of land by the government for Indian use, and control of the public range under the Taylor Act.⁶¹ Thus public land that once was parcelled out to private owners is now being returned to government ownership or control. This trend results from both a desire to safeguard the resources of the Puerco area and from nationwide federal conservation policies.

Even the old land grants, except the crop fields in the valley bottom, have long since passed out of private hands, so that the range lands of these grants are no longer freely available. The federal government now owns the Ignacio Chávez, Ojo del Espíritu Santo, M. and S. Montoya, Montaña, and Sedillo grants. Resident and non-resident graziers of the valley are allowed to use some of this land, but much of it is reserved exclusively for Indians of nearby pueblos. At the present time only a few dozen animals are owned by the remaining settlers in the valley. Their stock is restricted to small areas for which grazing rights have been acquired and to the old croplands in the valley.

From outside the Puerco valley came a number of economic influences on the settlers, in addition to range restriction. While the middle valley remained in a state of semi-isolation, New Mexico as a whole became "Americanized." This meant such things to the settlers of the valley as property taxes, military service, and need for larger cash incomes. These new conditions tended to disrupt both the isolation and especially the self-sufficiency of the valley.

61. Ralph Charles, "Land of Mañana," *Land Policy Review*, I (November-December, 1938), 10.

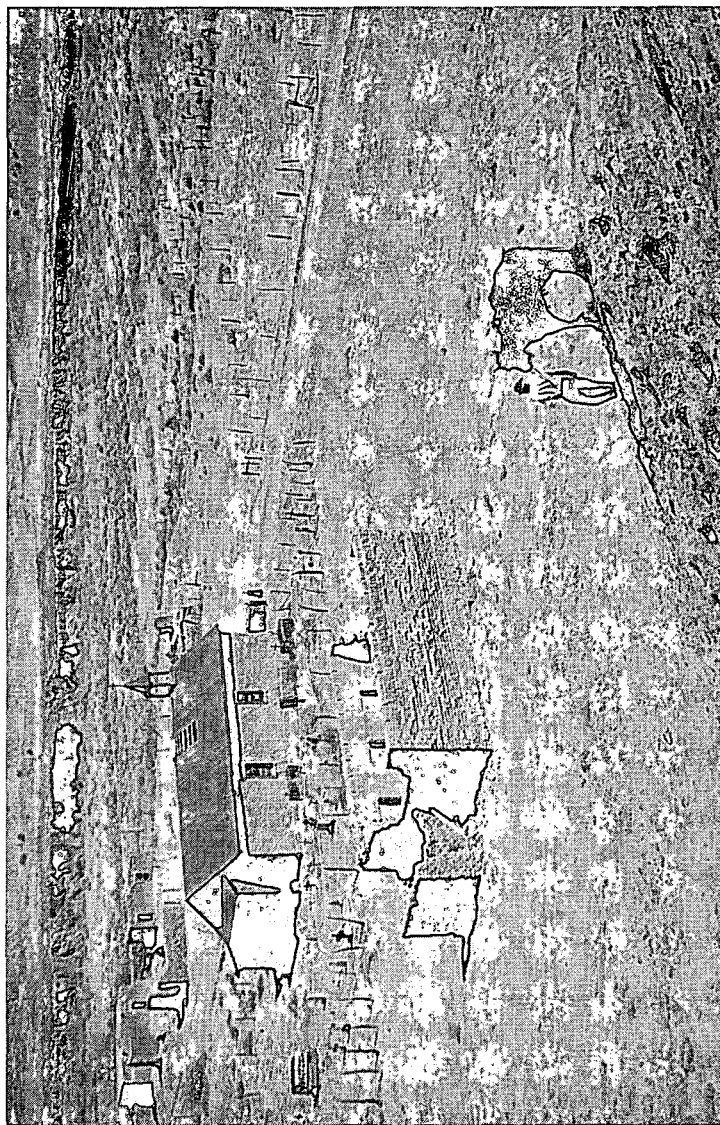
That the middle Puerco valley could not supply the new wants and necessities was especially obvious to young men returning from the world wars—the valley offered them little or nothing in comparison to what was offered elsewhere. Most of them were attracted by opportunities for wage labor in Albuquerque and other nearby cities and towns. Those who remained on the land in the Puerco valley also found it necessary to supplement their incomes with part time wage labor outside the valley. In short, there was so much greater economic opportunity in other areas that few felt they could afford to remain in the valley. A subsistence economy had little appeal in the midst of modern economic conditions.

A final agent in population decline and abandonment of the villages was the fact that each farmer had a very small acreage of cropland. At San Luis, for example, there was a total irrigable area of 546 acres, which was divided into 28 different land holdings; the largest holding of any individual was 71 acres and the smallest was 3 acres. Average size of the holdings was 19.5 acres, but most of them were smaller than this average. Obviously most of these farm units were too small to support the settlers at other than subsistence levels.⁶³

The crop fields were of irregular shape, due mostly to the exigencies of the topography, and bore no relation to the grid system of land subdivision which they long antedated. Most of them were long and narrow, with one end at the community ditch and the other at the river bank. This was in part due to the necessity of having each field supplied by the community ditch, and in part a result of land inheritance. The original farm lands were subdivided lengthwise among heirs, so the subdivided tracts came to form the long narrow strips.⁶⁴ On the whole, however, the small size of the crop fields was not so much the result of change through the years

63. Only at San Luis was a contemporary survey made of the irrigated land and its subdivision, but a similar pattern of land holdings probably existed at each of the other communities in the middle valley. Irrigated acreage at these other settlements cannot be accurately determined at present because much of the crop land is now indistinguishable. A rough comparison may be made, however, between the irrigated acreage at San Luis and that at nearby areas as shown in Figures 16, 17.

64. Soil Conservation Service file, *op. cit.*



The last of the inhabitants abandoned Cabezón in 1950

as it was a characteristic of the occupation from the beginning; there was always a comparatively small amount of cropland in relation to the population.

With the single exception of field size, the causal factors in the decline of the Spanish-American settlements were all changes in the physical and cultural setting. Most of these changes may be traced, in turn, directly or indirectly to the overuse and injury of land resources. When coupled with the fact that these resources were meager initially, it is not surprising that a major change took place in the occupation of the Puerco valley. Basically this change represented a lessening in the intensity of land use, and it may be viewed as a compensation for the overuse of the land that preceded it.

During the declining years of the villages there was a heavy dependence on public assistance as a source of income. A census taken in 1939 at San Luis showed that of 44 families in the community only two were without some form of government welfare aid. Twenty-six families were subsidized by Farm Security Administration grants, nine families had members on WPA projects, six were assisted by the state department of public welfare, and one had a member working for the state highway department.⁶⁵ The population at San Luis has now decreased to two families, and these still depend on livestock, wage work, and subsidation.

Travel into and within the middle valley is very difficult at present, as the roads are almost impassable. Countless detours must be made around headward-eroding gullies, collapsed bridges, and mudholes. Three high and rickety bridges on the "main" road through the valley—two across the Puerco and one crossing Arroyo Balcón—are much in need of repair or replacement. At Guadalupe this same road fords the river and is always impassable at this spot during the rainy season. In the summer of 1957 a section of the road north of Guadalupe was completely washed away by flash flood waters, cutting off that village from all motor travel.

Not only are the roads neglected, but the entire area is generally forgotten. The middle valley is located in the west-

65. Soil Conservation Service file, *op. cit.*

ern parts of Sandoval and Bernalillo counties, and each of these counties, with an orientation toward centers of population along the Rio Grande, can spare little attention to such remote and slightly populated areas as the middle Puerco valley. In short, the middle valley has lost all influence in New Mexico, just as it will probably soon lose the last of its inhabitants.

The physical and cultural environment of the upper valley has also changed, but not so greatly as in the middle valley. The settlers of the upper valley have made a re-adjustment to the changed environment. Crop agriculture, though not entirely disappeared, is much less important than it once was. Approximately twenty community ditch systems were constructed in this area, but few of them are still in use. Farming ceased at La Ventana long ago, even before 1910; and just south of Cuba, irrigation has been impossible for the last ten to fifteen years. A few remaining families in the latter area make some attempt at dry farming, but with little success.

All the presently irrigated acreage is far upstream, in the mountain valleys from which the Puerco originates. Here the water supply is more constant and there is less danger of large flash floods. Erosion and gulying are problems locally, but the streams do not have deeply eroded flood plains and channels like those in the middle Puerco. The main problem in these valleys is the usual drying up of the streams and ditches in the summer, when the water requirements are greatest.⁶⁶ For this reason, together with all the factors indicated for the decline of the middle valley, the amount of farmed and irrigated land in the upper valley has decreased greatly. In 1939 more than 5,500 acres in the area were irrigated by a total of seventeen ditch systems, but now much of the acreage and most of the ditches have been abandoned.⁶⁷

Meanwhile there have been other economic developments in the upper valley and, in comparison with these, the remaining crop agriculture is no longer an important factor in the

66. U. S. Department of Agriculture, *Water Facilities Area Plan op. cit.*, pp. 33, 43f.

67. *Ibid.*, p. 41.

total economy of the area. The new developments have also increased the population of the area from less than a thousand to about 2,000 persons.

Of these new American economies, commercial cattle raising is most important, though it came about indirectly. In the 1920's a number of new settlers moved into the upper valley west of Cuba and attempted to dry farm some of the lands. Failing in this because of the climate, they were soon forced to leave the area or switch to cattle raising. Their cattle industry now provides these people a fair living, but it is not as successful as the same industry in more humid areas.

Two other new developments are lumbering and copper mining. Lumbering is carried on in some of the forested areas near Cuba, and there is a sawmill southwest of the town. Copper mining was formerly important in the mountains just east of town, and mining activity may resume shortly.

For many years there have been a number of coal mines in operation in the region between Cuba and La Ventana. Only a few tons of coal are now produced per year, but there was a considerable production in the past. During the 1920's the coal was transported to the Rio Grande valley on a railroad that extended into the Puerco valley at La Ventana, but mining production declined with the depression, and the railroad went out of business. The small amount of coal presently mined is taken by truck to local markets in Bernalillo and Albuquerque.

The larger coal mines were located near La Ventana, which became the hub of mining activity. In 1930, about the peak of the village's importance, it had two general stores, a hotel, a post office, and a school.⁶⁸ Today there is a trading post surrounded by ruined buildings.

Like the agriculture of the earlier settlers, all the activities introduced into the upper valley by the newcomers have been only partially successful. Attempts at farming, as formerly, were limited by the physical environment. And in

68. Carle H. Dane, "The La Ventana-Chacra Mesa Coal Field," part 3 of *Geology and Fuel Resources of the Southern Part of the San Juan Basin, New Mexico*, U. S. Department of Interior, Geological Survey, Bulletin 860-C, 1936, p. 87.

other activities, because of their closer ties to the external economy, they were even more limited than were the original settlers by the cultural environment. Most noticeable in this regard was the decline of mining, which was intimately linked to the economy of the Rio Grande valley.

And yet, despite the decline of occupance, the total population of the upper valley has not decreased within the last years. In fact, there has been a notable increase, from a population of about 1,000 in 1930 to 2,000 at the present. But the increase is due only to the success of one settlement, the town of Cuba. Long ago Cuba became the trade center of the entire upper valley, and one might reasonably expect that the town would have declined in size and importance just as did all the settlements it served. On the contrary, Cuba has become more important and prosperous than ever before. Most of its prosperity, however, results not from the life of the Puerco valley, but from the highway that passes through the town. This highway (State Road 44), though paved less than ten years, is the only direct transportation route between two of the most well developed regions of New Mexico, the Rio Grande and San Juan River valleys. Cuba is about midway between the two valleys and is the only town of notable size on the 160 mile route. Much of its business is in supplying the needs of travelers passing through on the highway.

Cuba is the only un-characteristic settlement in the entire Rio Puerco valley. All other villages, whether in ruins or still occupied by a few families, are visible evidences of deterioration and change that have taken place in the occupance of the valley. Every hillside and gully presents similar evidence of deterioration and change in the physical environment. What further changes may occur, whether of improvement or further deterioration, await only the future.