

4199 Hwy 82
Elgin, AZ 85611

July 30, 2013

Senator Gail Griffin
Arizona State Senate
1700 W. Washington
Phoenix, Arizona 85007

Re: The San Pedro River

Dear Senator Griffin,

My Grandfather Raymond L. Schock and my Great Grandfather Henry Pike arrived in Benson, Arizona, in January, 1913, in an immigrant car pulled by the Southern Pacific Railroad. Their car included dairy cattle, two bay horses, a springboard wagon and supplies. It was very cold with ice forming on the water barrels in the car. They were eventually switched to a train headed to Fairbank and Charleston. At Fairbank, they were switched to the doodlebug going to Elgin where they found the land office and were able to file for a homestead.

I knew my Grandfather well and often discussed his early days with him. He often spoke about how dry it was here compared to other places he had lived and how dry the San Pedro river was. He always joked about how it wasn't a river at all when he arrived. As a child, I always enjoyed going there with him after the rains so we could see water flowing. We picnicked there under the cottonwoods.

Also, when I was about 14 years old, I read all of Charles Di Peso's books about his excavations of Indian sites along the San Pedro. In his books, I never did read about him finding any artifacts that might be associated with a river going culture. It seems like it must have always had intermittent areas of water.

If I can be of further help, please let me know.

Best regards,

Bill Schock

I included the historical overview
by Hendrickson & Minckly, Two letters
from Jack & Glenn Jones and "The Changing
Mile" by Turner & Hastings Re: San Pedro
~~River~~ Valley Grasslands Starting on page
143.

Mary Ann Black
7457 E. WINCHESTER R
SIERRA VISTA, AZ 85635



From Marshes and Cienegas to Gallery Forests: A Brief Overview of San Pedro River Basin History

(See the bottom of the page for reference sources, of which this essay is largely a precis.)

Hendrickson & Minckley (1985, see below) say that before 1880, southeastern Arizona streams ran mostly unincised across alluvial fills in shallow, braided channels, often through lush marshes, unlike today where sandy, barren streambeds lie entrenched between vertical walls that drop many feet below now-dry valley surfaces. James Ohio Pattie and his companions regarded the San Pedro as "Beaver River" when they first saw it in March 1825 because of large numbers of these swamp-dwellers they found (and trapped) there. Other early accounts describe a little-incised, lush valley with high grass, boggy banks, and a river that flowed perennially (though the flow did go underground sometimes at various stretches). The flow was mostly quite slow, and [as Hastings & Turner, 1965, see below, report that other 19th century visitors said,] "about every five miles there is a beaver dam this is a great Country for them" (1858). "Fish are abundant in this pretty stream. Salmon trout [perhaps Colorado River Squawfish?] are caught by the men in great numbers". In some places, "the bottom lands of the San Pedro... were covered with a dense growth of sacaton grass...." (1858), and below one cut, the river "widens out, and from beaver dams and other obstructions overflows a large extent of bottom land, forming marshes, densely timbered with cottonwood and ash...." (1859) (On the other hand, in some places "the river bottom is a dense thicket of bramble bush, mostly muskeet....") Fremont Cottonwood and Goodding Willow trees (today forming long stretches of Fremont Cottonwood-Goodding Willow Gallery Forest) were present along the river's length, but only in scattered numbers, while substantial stretches were quite wet but largely treeless.

At "The Narrows" about 15 miles north of Benson (where deep valley fill upstream meets a bedrock outcrop that forces water to the surface), the stream then spread out widely to the north below the gorge, forming sporadically extensive swamps with beaver dams running all the way past Cascabel. Malaria became quite serious in the late 1860s at Camp Grant near the junction of Arivaipa Creek with the River, while the Mormon Settlers who established St. David in 1877 were dying of malaria by 1879. (In that year, the Arizona Daily Star described the San Pedro as "the valley of the shadow of death" because of the serious incidence of malaria there, reflecting its then-pervasive swampy conditions.) Aquatic and semi-aquatic habitats apparently extended all the way from the Mexican Border and the Huachuca Mountain fringes to just north of Cascabel, with further swamplands located around the Redfield Canyon confluence and the Aravaipa Stream confluence.

Apparently, many of these marshes were **cienegas**. According to Hendrickson & Minckley, cienegas are permanently saturated wetlands with highly organic, "anoxic-reducing" soils (low air supply, high carbon monoxide content), usually found in Arizona from about 3,000 feet altitude or more, in low-relief drainages where winter conditions are mild and headwaters well-vegetated so that flood scourings are unlikely. The air-poor hydro-soils that result from the standing water produce a distinctive and stable, if restricted flora (semiaquatic sedges and grasses) with few trees in the swampland itself. **Sacaton Grass** stands and typical riparian trees may grow near marsh edges above the water-saturated and often salinated borders. Cienegas act as traps for large amounts of organic materials, and make downstream flows less variable and more permanent, fostering rise of water tables. Thus they contribute greatly to biome productivity, supporting relic populations of small fauna (including various fishes) and stimulating concentration of various herbivores.

Marshes in oxbows and along margins of major streams are different riverine structures, supporting more complex flora in well aerated hydrosols. Willows and cottonwoods form galleries along drier alluvial terraces. But such habitats are transitory, developing rapidly but then being removed by channel-straightening floods or by gradual drying of relic oxbows. Cienegas in contrast may become quite long-lived systems.

Hendrickson & Minckley say that, while 125 previous years of Spanish/Mexican exploitation had included some locally large livestock herds, most Arizona ranching ventures were short-lived until Anglo-American activities

Guerrero Jones
7350 E. Horsethief Draw Rd
Sierra Vista, Az 85635
520-459-4066

In the 40's & 50's the San Pedro River would run full in the rainy season. The river was very shallow when it did not rain - we would wade & catch the tiny fish in the river.

There was very few Cotton wood trees as the cattle would eat the little sprouts and keep them to a minimum - There would be places where the water ran under ground and places would be dry -

In the book "On the Border with General Crook" he states the river was "drier than a millstone's hot" except in the rainy season -

We were one of the first ~~ones~~^{to be} stuck in the river. They did not build the bridge ^{until} long after the road was built. It was only in the rainy season you could not cross the river.

General Ret Bakerich was telling the story when he went
mead

to Tombstone High School - they
likes to brag about the river
was better at Charleston than
at Fairbanks which was dry.
When we were children
we used to brag about stepping
on rock to cross the river
without getting wet.

Guern Songs

Guern Jim

Jack C. Jones
7350 E Horsethief Drowld
Sierra Vista, Az 85635
520-459-4066

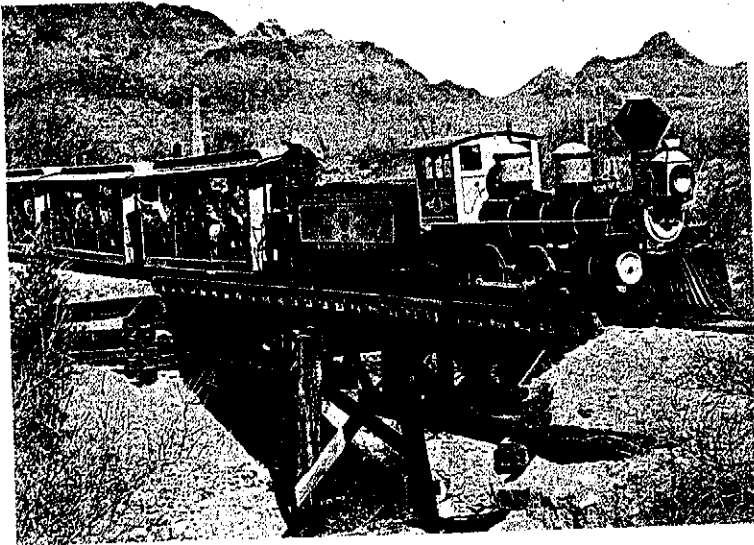
Jack Jones worked as a
Cowboy for Marrow Brothers in the
early 60's. There was not as
many Cotton wood trees as there is
now - When cattle was allowed we
could follow their trails and not
^{ever} get caught in quick sand - to cross the
In the Seventies they cleared fields
and grew alfalfa, sugar beets
milo - It didn't seem to
affect the water in the river
I was raised in Tucson at the
Un. farms - The proffors. From
the UofA told my dad a
Cottonwood ~~would~~ tree would use
up to 750 gal. of water a day -
This seems to be happenig to
the river - A family of four uses
that much - which is more important,
trees or families

Jack Jones
Jack Jones

PROPERTY OF
Cochise County Historical
and Archaeological Society

RAILROADS of ARIZONA vol. I

the southern roads



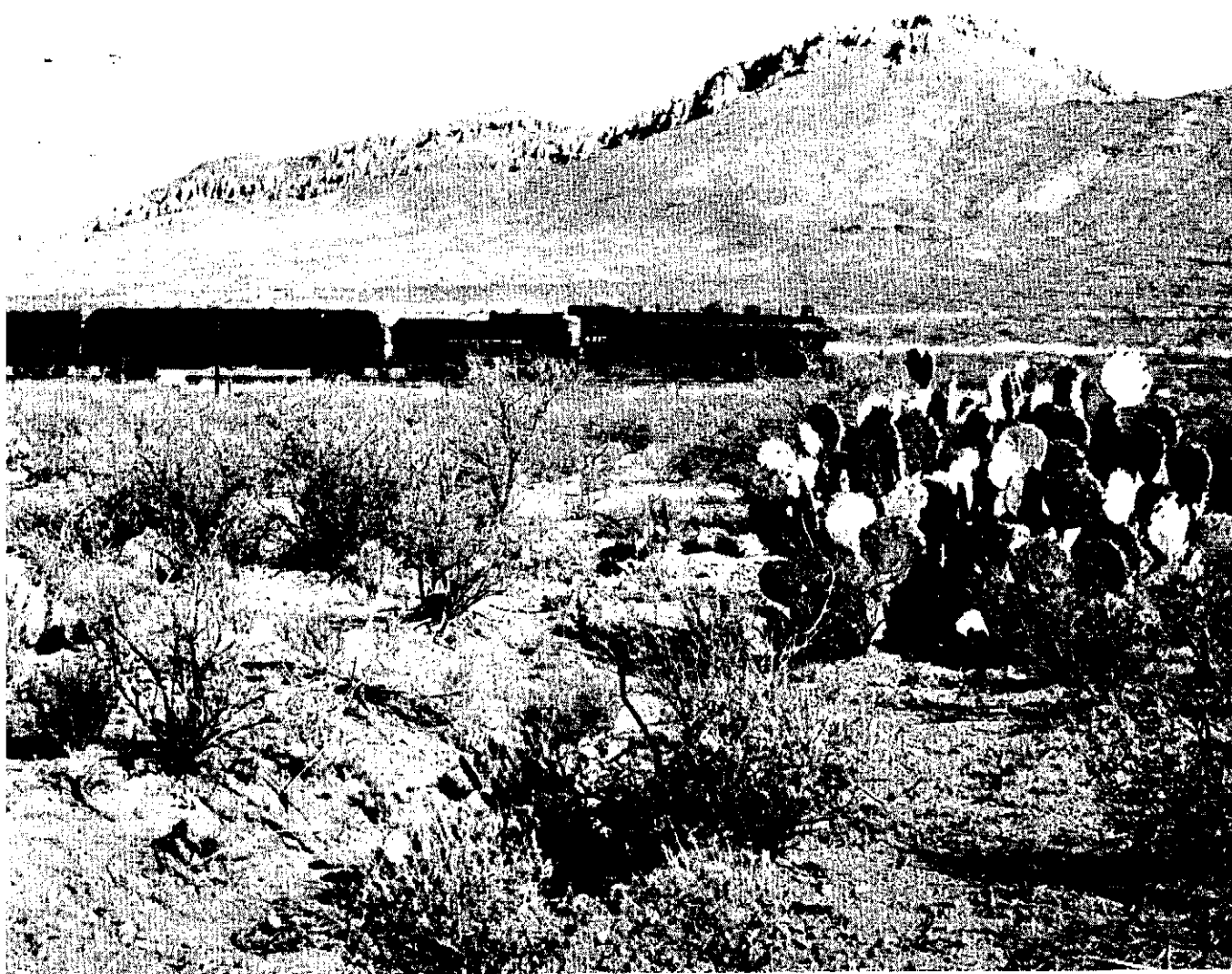
by DAVID F. MYRICK

BERKELEY



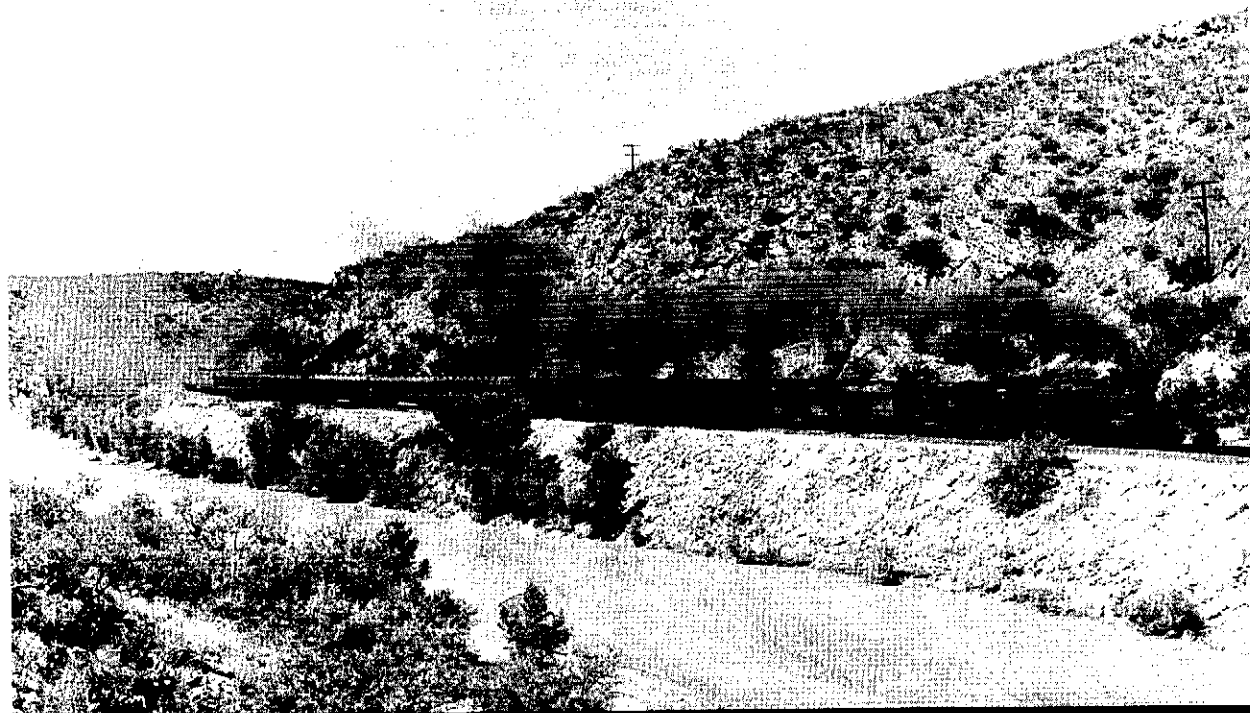
CALIFORNIA

XD09



... tracks reached the new town of Douglas the
 ... ted northeasterly toward the Pedregosa Moun-
 ... tween Lee and Cazador, about a dozen miles
 ... uglas, this eastbound passenger train pulled by
 ... (4-8-2, Schenectady, 1924) is on its way to

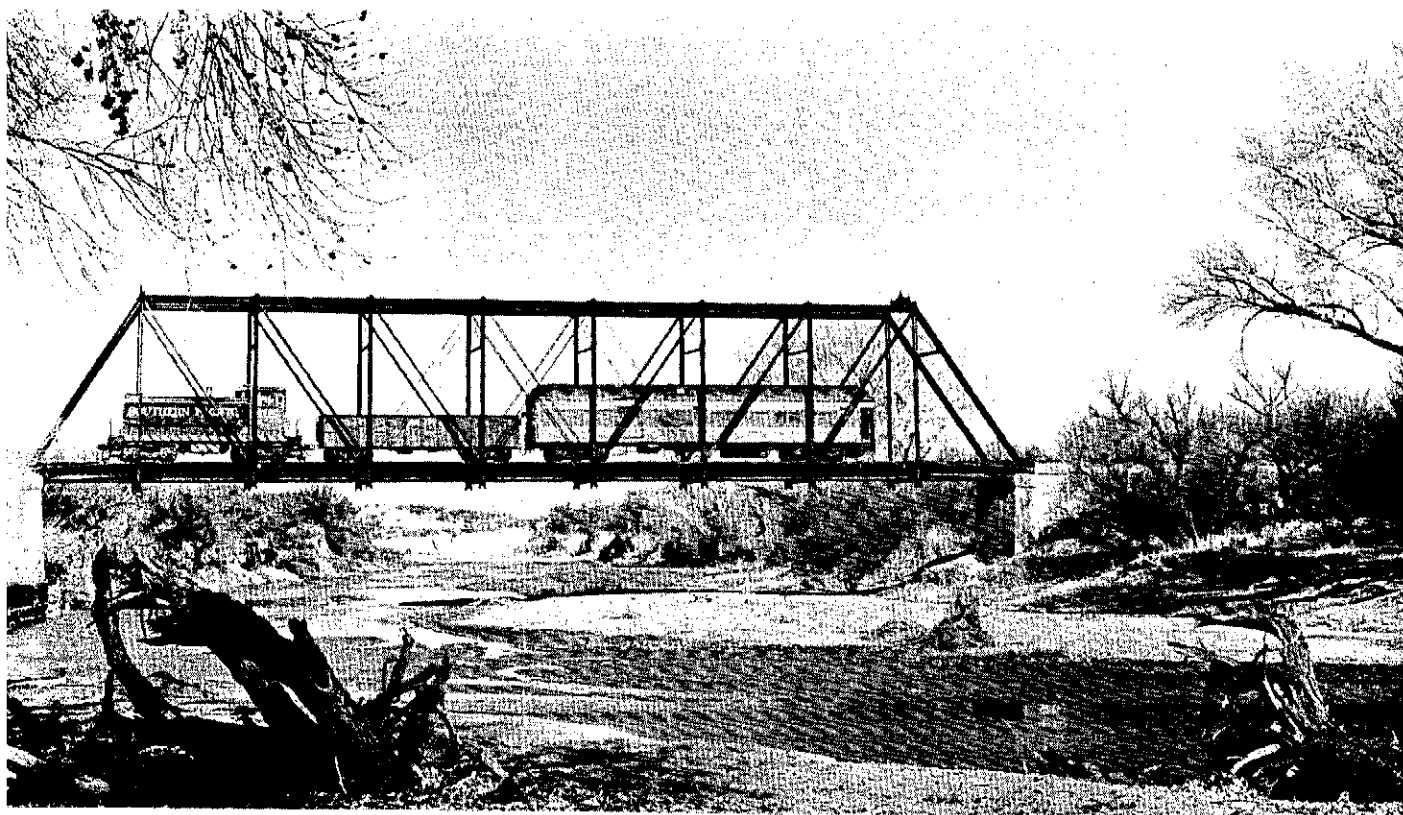
An eastbound train (below) follows the San Pedro River
 near Charleston.



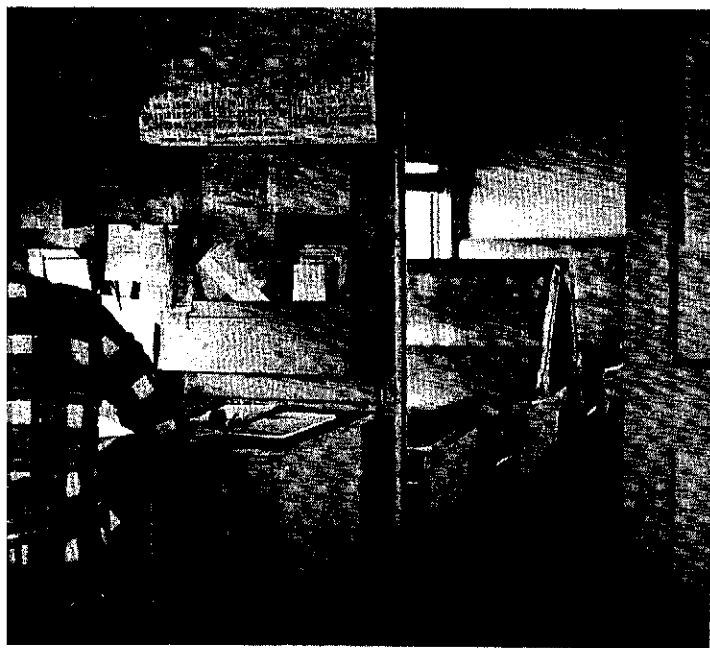
TOCK
 IG.

TS



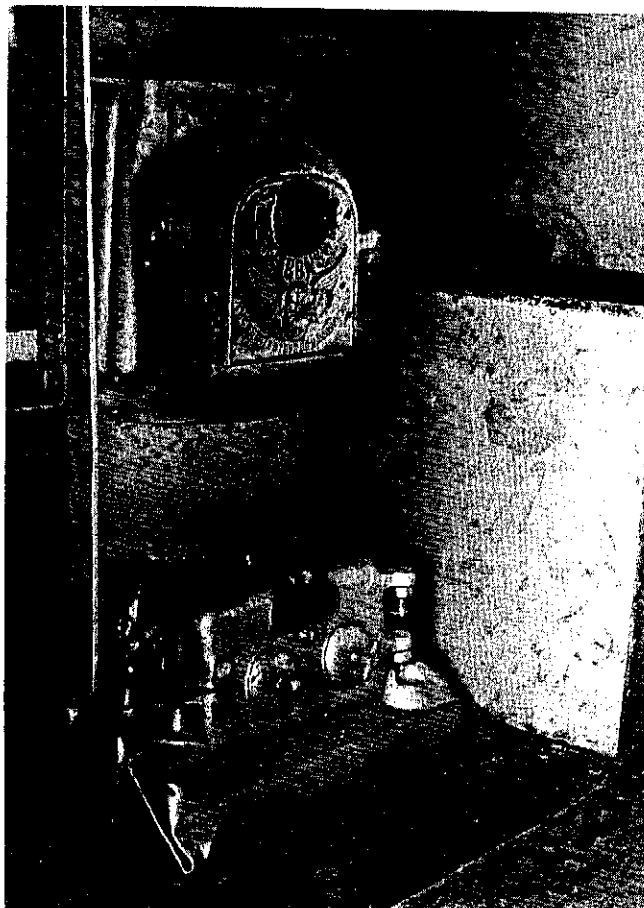


A trip on the "burro" was a delightful pastime and many people made the trip in 1961. In this picture the small diesel used on the Patagonia branch is pictured on the bridge crossing the San Pedro River near Fairbank. Though a quiet stream at this time, the changing course of the river required the revetment (left) to prevent erosion of the grade approaching the bridge. (Tad Nichols)



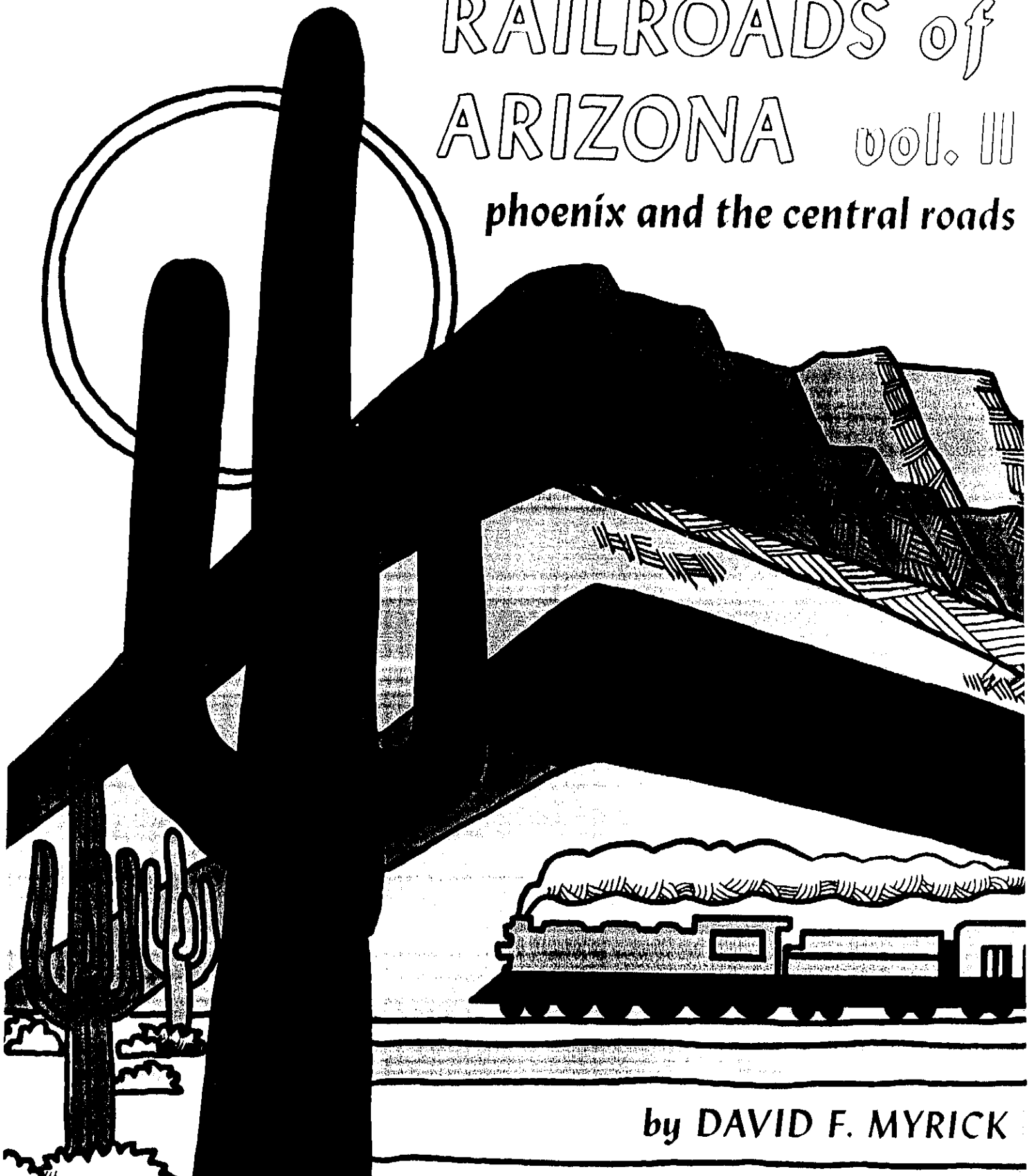
Combine the conductor is busy
perwork. (Tad Nichols)

Made by The Estate Stove Co. of Hamilton, Ohio, the cast iron stove is a welcome furnishing during cold winter days. (Tad Nichols)



RAILROADS of ARIZONA vol. II

phoenix and the central roads



by DAVID F. MYRICK

Galiuro Mountains. Draining the valley is Aravaipa Creek, which runs northwesterly until it comes to a narrow canyon cutting through the mountains before joining the San Pedro River about a dozen miles south of Winkelman. (Aravaipa is an Indian word with varied translations.)

At the beginning of fifty-mile-long Aravaipa Creek is a low, flat summit dividing the two watersheds, the other being Sulphur Springs Valley. An approach from Railroad Pass would take surveyors along a beautiful railroad route connecting with the Gila River and leading into Central Arizona. This was the route suggested by Lt. John G. Parke of the 1854 Pacific Railroad Survey. It is also the route chosen by the Texas & Pacific Railroad during the surveys of 1872-73 and later the same way was seriously considered by Frank Murphy as an alternate eastern outlet for the Phoenix & Eastern RR.

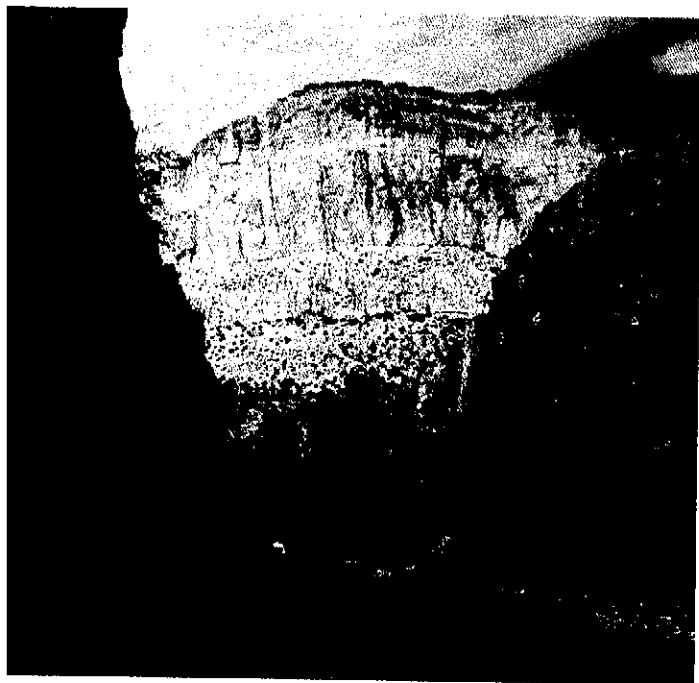
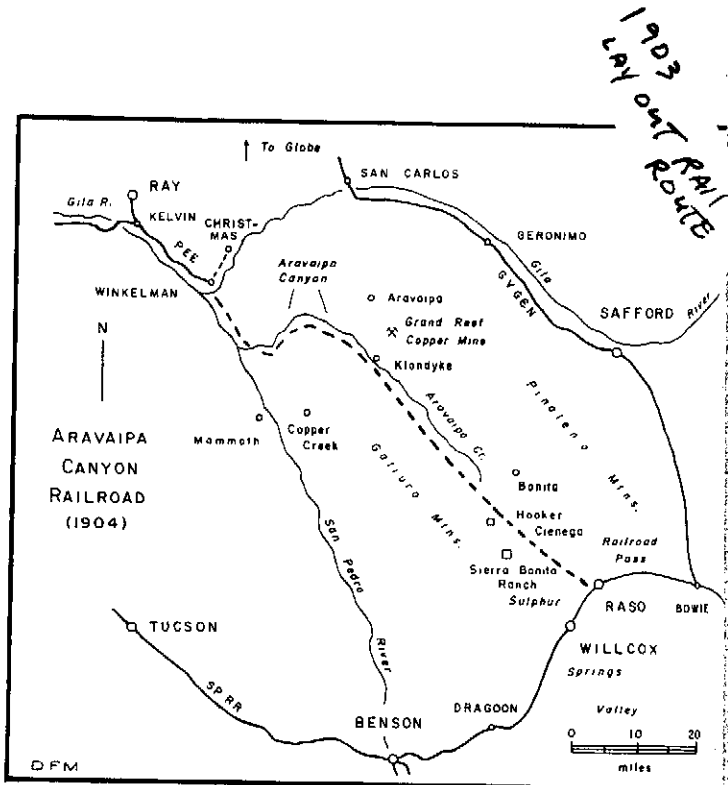
The day before Christmas, 1903, Murphy's surveyors began to lay out a route starting from a point on the Ph&E near the confluence of the San Pedro River and Aravaipa Creek, then up that creek through the narrow canyon and into the

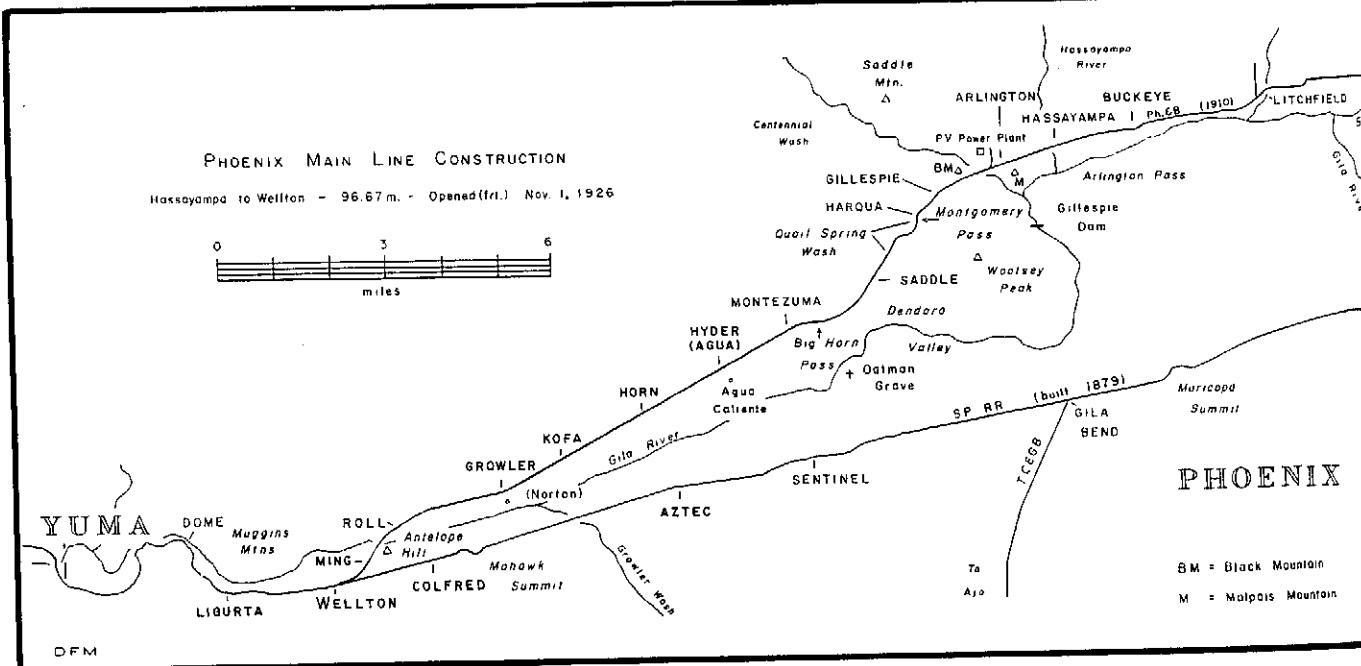
valley beyond before entering Sulphur Springs Valley; the route ended with a connection 1,460 feet west of SP RR MP 1082, near Raso station on Railroad Pass. The total length, as shown on the filing map, was 78.24 miles.

Trackage rights over the SP RR or a parallel line would have provided the link with Deming. Murphy and his associates formed the Aravaipa Canyon Railroad Co. on April 18, 1904, to carry on the work of the survey, which was approved by the Secretary of the Interior on November 9, 1904. Although the Gila River RR and the Aravaipa Canyon RR were not direct Ph&E subsidiaries, they were conveyed to the SP Co. along with the sale of the Ph&E in 1907. Epes Randolph had considered the Aravaipa Canyon route, but had discarded it as the grades he desired could not be obtained here. No physical work was done on this railroad.

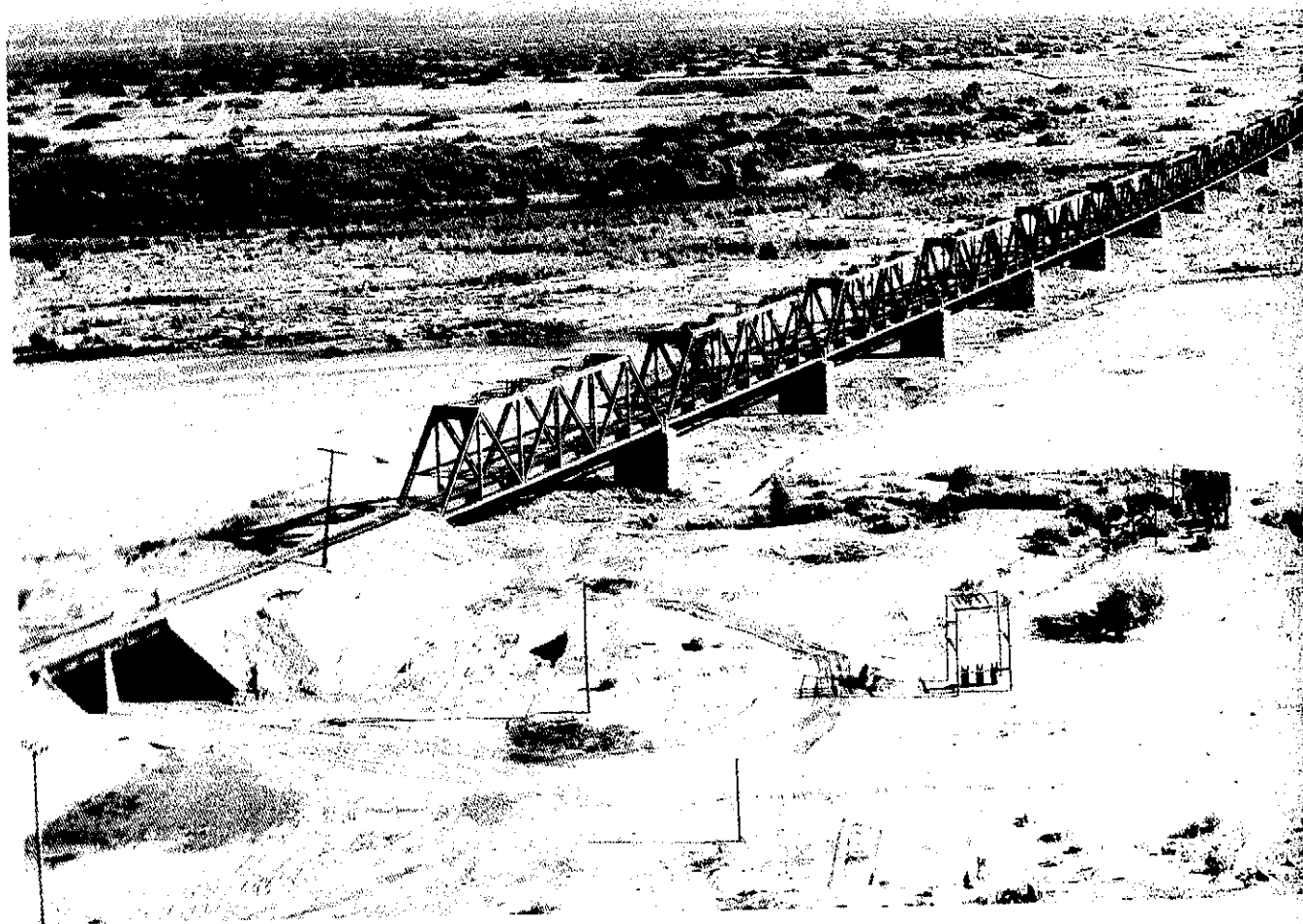
Since 1969, some seven miles of the steep-walled, narrow Aravaipa Canyon have been protected as a Primitive Area by the Bureau of Land Management's office at Safford, Arizona, and through local supervision.

Railroad surveyors, ever since the Pacific Railroad Survey of 1854, have been tempted to use Aravaipa Canyon. Frank M. Murphy, builder of the Phoenix & Eastern, when contemplating the extension of his lines east of Winkelman, arranged for surveys to be made along this canyon. Although he incorporated the Aravaipa Canyon Railroad Co., no construction took place. Approximately one mile from the west entrance of the primitive area Cave Canyon (left) joins Aravaipa Canyon.





The first crossing of the Gila River was made on this twelve-span truss bridge just east of Antelope Hill. The structure is 1,800 feet in length.



Benson Canal Company History ~ Incorporated 1908 ~ Bankrupt 1931

The old original records of the Benson Canal Company came back into existence about 1970. I, Louise Larson, was working at the Benson Middle School as a teacher aid. One day as I was sitting at my desk, two fifth grade boys, Matthew Edwards and John Telles, came into my room wanting to know if I wanted to buy some old stamps. They handed me an old envelope that was holding three or four stamps. I noticed that the return address was Benson Canal Company. I immediately recognized this envelope as being very old. This had to be the same waterway used by the Pomerene Water Users Association. I began to question the boys about where the envelope and stamps came from. They told me they had lots of "stuff" they had found in a garbage can on their way home from school. It was by the home of Mr. and Mrs. A G. Smith, who were both deceased. I found out later that a niece was cleaning out the attic in the Smith home. Mr. A. G. Smith, who had been a local banker, probably was the last president of the Benson Canal Company. When the Benson Canal Company failed, he had kept the books. I asked the boys how much they wanted for the stamps. They said, "A quarter." I gave them each a quarter and told the boys I would buy all the material that they could bring me. Over the next few days, they continued to bring me various items. It took them a while to gather it up. They had it hid here and there as a treasure, and it was truly a treasure for me. They had some gold bond certificates hid in a little cave in the foothills at a place the school children called White Rock, located above the school. Some of it was in an old suitcase under one of the boy's bed. When they had brought all they had, I paid them off, and they each went excitedly out the door. They could not have been as excited as I was."

Records recovered included two minute books of the Benson Canal Company, one for November 7, 1908 to October 16, the other April 3, 1923 to January 12, 1932. Information from the minute books is identified in this report as BCC followed by a date, i.e. (BCC 11/7/08). Other records included an account book, receipt book, share certificates, bond certificates, cancelled checks, blue prints of a proposed dam dated November 1926, seal hand stamp dated 1908, and a few letters.

Sometime during 1989, Wilfrid (Bill) and Ethelene Bailey came to visit me. I knew Bill was interested in Pomerene history, We were talking about Pomerene. I was impressed to ask, "Bill, why don't you take the old original Benson Canal records I have and write up a history of the canal?" He graciously accepted. We made a visit to the Pomerene dam and head of the canal; we took some pictures. It is to Bill, we owe this fine report. I have used parts of it for this article. I thank him for his time and interest in this history.

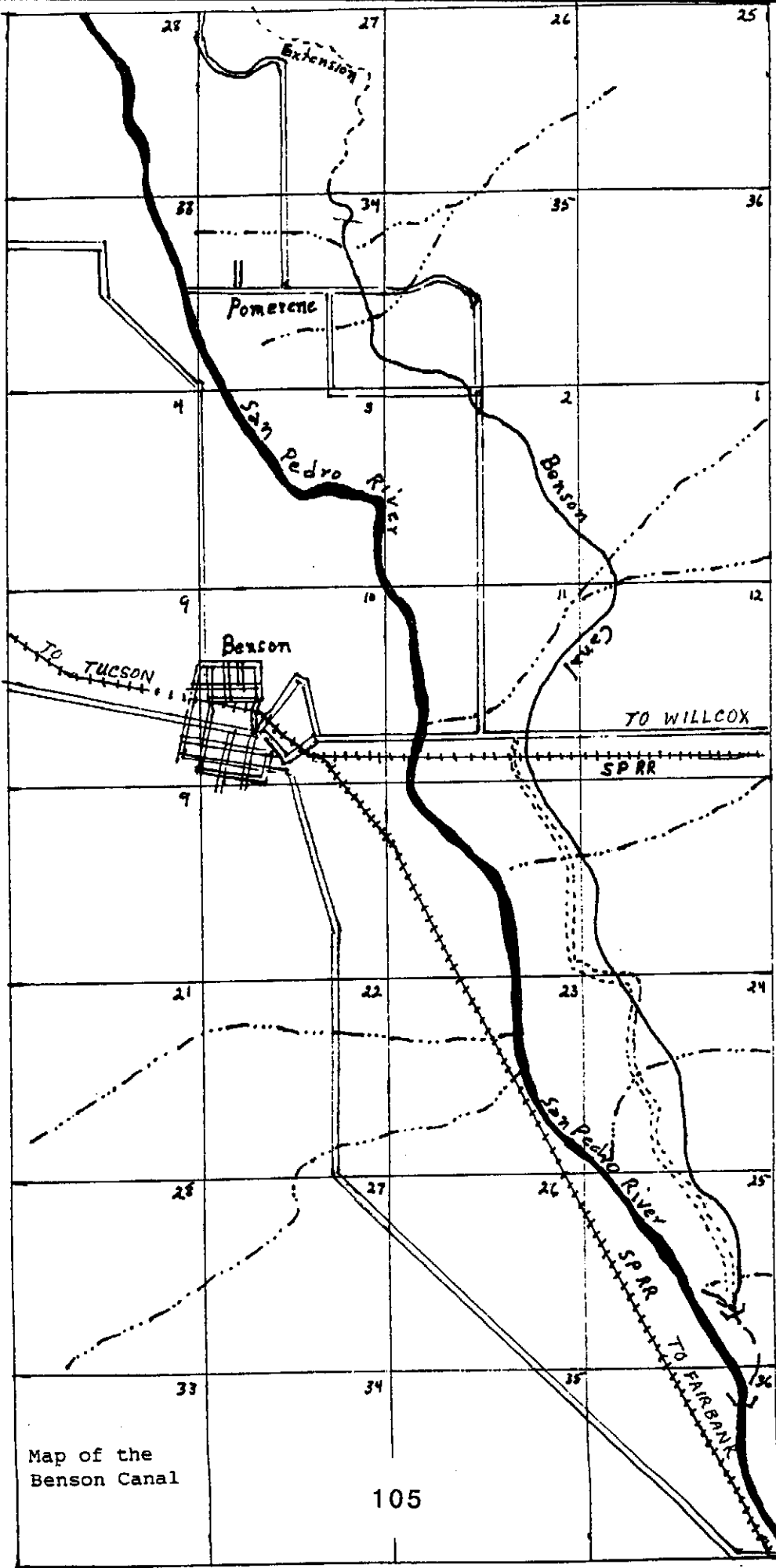
James Melvin Cosby ~ Founder of Benson Canal Company

James Melvin Cosby, the proprietor of a grocery store in Benson, noticed that there was water the year round in the San Pedro River at a point a little over a mile north from St. David. He saw the possibility of utilizing this resource for establishing a Mormon community. (For his history see Pomerene Community.)

J. M. Cosby started to dig an irrigation canal. Then, on November 7, 1908, he met with Steve Roemer and Bert Goodman in the Bank of Benson "for the purpose of considering the excavating and operating a canal for irrigation from St. David to Benson." W. C. Shin was paid forty-five dollars to do the necessary paper work. (BCC 11/7/08).

Articles of Incorporation of the Benson Canal Company were published in the Benson Press and filed in the office of County Records, Cochise County, on November 10, 1908. The officers for the year were to be **James M. Cosby: president and general manager, Bert Goodman: vice president, and Steve Roemer: secretary and treasurer.** The by-laws were adopted on December 7, 1908. Notice of Water Location and Dam Site were filed with Cochise County and with the secretary of the territory on December 17, 1910.

1908
Benson
Canal
Company



Map of the Benson Canal

REUSED
CIRKLE

Construction was to be financed by an issue of ten thousand dollars in stock at one hundred dollars per share. The first payment was ten dollars per share with the balance to be paid when called for. This required a system of assessments on each share of stock. These assessments were paid in either cash or labor.

Two major obstacles blocked the construction of the canal to what is now the center of Pomerene. One was the right-of-way through land owned by the Boquillas Land and Cattle Company. An agreement was made to pay one hundred dollars for the right to go through the land. Boquillas would pay six hundred dollars for a tenth interest in the canal but would not be issued any stock. Further, they would not have any assessments unless they used water. The second barrier was the Southern Pacific Railroad tracks. The SPRR wanted two hundred twenty-two dollars to flume the water under the tracks and would charge the Canal Company one dollar per year rental. Two eight inch pipes were placed under the tracks. (BCC 1/1/09)

Men who worked on the canal included Francis Ami Coons, Charles Sherman, Bert Goodman, Jared J. Trejo, R. H. Martin, Parley P. Sabin, J. J. Johnson, Ed Grant, John L. Sherman, Walter Sherman, and John Sherman.

In 1910, the canal was completed to a point behind the school. Some of the men moved to what became Pomerene and lived in tents while they cleared land.

By November 1912, the canal had been extended to the point of the hill north of S.J. (Jodie) Johnson's place. It was then about seven miles long.

The first assessment on the stock holders was levied on June 18, 1910. It was for ten dollar a share. The stockholders were:

Name	Number of Shares	Amount
B. J. Johnson	4	\$40.00
S. J. Johnson	4	40.00
Frank Coons	3	30.00
H. P. Merrill	8	80.00
P. P. Sabin	2 1/2	25.00
William Sherman	1 1/2	15.00
Bert Goodman	2	20.00
J. M. Cosby	10	100.00
C. L. Sherman	1 1/2	15.00
Steve Roemer	4	40.00
Crozier Kimball	2 1/2	25.00
J. A. Legarra	3	30.00
Charles Curran	3	30.00
Hi Wo	3	30.00
John Sabin	3 1/2	35.00
Frank Coons	3	30.00
Total	57 1/2	\$575.00

1st Assessment
1910

DIVERSION
DAM

Operation of the canal

A diversion dam was constructed across the San Pedro River. It was built out of rock and brush. It was reinforced with piling of iron pipe tied together with barbed wire. A pile driver was constructed to pound the pipes into place. (BCC 5/14/11)

The original canal was constructed without an engineer. John T. Proffitt, whose letterhead read "Hydraulic and Sanitary Engineer," was elected to the Board of Directors in 1911. He was occasionally hired to do some engineering work. "J.T. Proffitt was instructed and hired to establish grade of canal stakes to be set every 100 feet that same might be used when contracting the cleaning of canal and at points of diverting gates. Said



June 19th 1910

A Meeting of the board of directors was called to order by President J M Casby - directors Present J M Casby and Stuel Roesner on Motion by Roesner and second by Casby an assessment of \$10⁰⁰ was assessed against the stock that was in use Motion Carried assessment

No 1

B. S. Johnson	4 Shares	\$10 ⁰⁰	\$40.00
Sam'l Johnson	4 ✓	\$10 ⁰⁰	40.00
H. P. Merrill	8 ✓	\$10 ⁰⁰	80.00
O. P. Saline	2 1/2 ✓	\$10 ⁰⁰	25.00
Wm Sherman	1 1/2 ✓	\$10 ⁰⁰	15.00
Burt Goodman	2 ✓	\$10 ⁰⁰	20.00
J M Casby	10 ✓	\$10 ⁰⁰	100.00
C. L. Sherman	1 1/2 ✓	\$10 ⁰⁰	15.00
Wm A. L. Sherman	2 ✓	\$10 ⁰⁰	20.00
Stuel Roesner	4 ✓	\$10 ⁰⁰	40.00
Crozier Kimball	2 1/2	\$10 ⁰⁰	25.00
J. G. Legarra	3	\$10 ⁰⁰	30.00
Chas Curran	3	\$10 ⁰⁰	30.00
Hi Ho Hopding	3	\$10 ⁰⁰	30.00
Wm Saline	3 1/2	\$10 ⁰⁰	35.00
Frank Coons	3	\$10 ⁰⁰	30.00
Total			575.00

Salary of Watermaster Burt Goodman was fixed at \$30⁰⁰ from June 1-15 Motion by Casby and second by Roesner that H. P. Merrill be elected as Treas and asst Secy Motion Carried

Proffitt to receive eight dollars per them for his services in this regard and also receive five dollars per diem for establishing siphons. If no siphons were established the per diem wage for running grades of the canal was to be ten dollars." (BCC 1/19/12) Proffitt was hired as engineer of the canal on December 30, 1912 and apparently continued intermittently to function as such. However, although the business men who were officers of the canal company may not have had experience with irrigation systems, most of the farmers utilizing the system had extensive experiences constructing and maintaining irrigation systems at St. David and other places.

The day to day operation of the canal was managed by a water master. John H. Sabin was elected as the first water master. He was to be paid a monthly salary of twenty dollars. (BCC 5/22/10) He was water master at various times throughout the history of the Benson Canal Company including the period when the company went out of business.

His duties were detailed as follows: "The said J. H. Sabin in fulfillment of his duties as water master agrees to diligently look after the welfare and interests of said canal passing over the entire right-of-way of same not less frequently than every three days, and at times oftener as he may deem necessary to remove all obstructions from canal, and deliver water to users, to report condition of canal to board of directors when in his opinion their action is essential to the interest of the canal." (BCC 12/18/11)

The everyday task facing the water master was the distribution of water. The first instructions were rather vague. "Regulate the use of the water in a manner calculated to do the most good to the greatest number of users, to regulate the hours of using water, to shut off or turn water when he considered it proper and best to do so. To begin at the end of the canal and give each user the entire water in the canal if necessary and to continue on up the canal in same manner." (BCC 5/22/10)

Regulations were later made more specific. The first business before the meeting was placing the water on turns. Some to take effect the following Monday at 8 a.m. and to commence at north end of canal. Time allowed to used to be three hours per share. (BCC 1/19/12)

Several regulations on the operation of the canal were made clear in a letter to all stockholders. "... after April 20, 1913, no water user to be allowed to take water from the canal by using a check gate unless the check gate in the canal be built like the "Economy Check Gate" which is installed on the John McGuire farm as a sample and water master directed to refuse to furnish water to such users who fail to install such gates by April 20, 1913, and water master to tare (sic) out and remove all boards, brush, ooze (yucca) and obstructions found in the canal as such are considered a nuisance and a detriment to the canal." (BCC 4/5/13)

The check gate was a barrier placed in the canal to divert water into side ditches. The "Economy Check Gate" was not described in the minutes of the board, but it was constructed out of two inch redwood. Subsequent letters to various individuals dated April 26, 1913, stated that the water master would install the required check gate at a cost of \$10.00.

The same series of letters pointed out other regulations. No trees were to be planted within twenty feet of the canal. Lateral ditches were to take out from the canal at a right angle and were not to run closer than twenty feet from the canal. All water users were to close and make tight so as to prevent leaking from their head gates and to remove their check gates within one hour after time for using water was over. Failure to do so would result in a fine of \$10.00. Further, no water user or person was allowed to pollute the water of the canal in any manner or to remove any earth or rock from the bank of the canal.

The canal ran against the hills bordering the east side of the river. In so doing it crossed washes that ran out of the hills and down to the river. It was necessary to carry the canal water across these washes. In some case a flume was constructed. One was built out of two inch redwood and was six feet wide and two feet deep. (BCC 5/14/11) Another was six feet high and three feet wide. (BCC 11/17/11)

However, flumes could be washed out by floods roaring down washes. Siphons under

washes were a more permanent way of dealing with the problem. The first siphons were constructed out of 2 x 12 wood planks. These were replaced by corrugated iron culvert pipes with cement around the openings at both ends. Purchase, installation, and repair proved to be a continuing major expense. For example, 40 foot 42 inch diameter culverts were purchased from the Western Manufacturing Company in El Paso, Texas, at \$3.96 a foot. That would be \$154.40 plus \$24.54 freight for each siphon section. This did not include installation costs. (BCC 3/14/15)

Silt from the river water and dirt washed into the canal by floods created a constant problem. It was necessary to clean out the canal at least once a year. Timing was critical since it was usually necessary to "turn the water out of the canal." Cleaning except for emergency repairs after a flood, was usually done in the winter. Even that could cause a problem. A special meeting of stockholders was held on October 27, 1915. Turning out of water on November 1, was discussed by the stockholders. It was the sense of the meeting that water should not be turned out as many water users needed water for the winter grain crops. The cleaning of the canal with shovels as the water goes up the canal was discussed. Many favored it. It was decided to leave the water in the canal until the first of December.

The canal was to be cleaned so as to be ten or eleven feet wide at the top, eight feet wide at the bottom, and two feet deep to grader (BCC 4/4/29)

The usual pattern was to divide the canal into "stents" (sections) and to take bids for cleaning on each section. Several methods were used. One was to do it by hand. On July 24, 1914, there was a call for 25 men in three gangs to clean the canal. Another was to use a sluice machine to flush material of the canal through sluice gates at some of the washes,

In 1929, an attempt was made to put the care of the canal on a more permanent basis. Bids were called for a period of three years. Bids were submitted. The Board called in A. G. Smith, president of the Cochise County Bank, and asked for a loan to finance the contract. He turned down the request. (BCC 4/15/29; 4/29/29)

Water varied with the fluctuation of the canal flow in the river. There was a need of a source to provide supplemental water. An attempt to solve this problem began in 1916.

"Proffitt, C. L. Sherman and M. P. Cosby explained that the spring being developed near the head of the canal reported that the volume of water of unknown extent had been uncovered. On motion duly carried, H. W. Etz was to go to Tucson at once and see pump men and others about securing a pump to test out the water, and to use his best judgement in the case. Benson Canal Company to pay his expenses." BCC 5/15/16)

Two weeks later, the water hole had been dug down about four feet below the canal and had been cribbed. A pump and engine were borrowed but broke down. An eight horsepower engine and pump were purchased from Aweitzer Machine Company, Tucson, that was to raise 900 gallons per minute at normal speed or 1,200 gallons per minute at top engine speed. They were not satisfactory and raised only 500 gallons per minute at top engine speed. (BCC 6/28/16) The result was a long series of problems with different gas engines and periods when the well could not be used.

"Mr. John Proffitt presented to the Board a statement from O.D. Miller in regard to getting more water for the cantaloupe crop. That they will furnish a large tractor to run the pump. Sending same over here and taking it back at their own expense provided that the canal company will allow them the same for the use as they are paying for the Fordson as follows \$5.00 per 24 hour shift for the tractor and \$5.00 each day for two men, 12 hour shifts to run same. Also the canal company to furnish fuel oil and lubricating oil delivered to the pump. Motion by John H. Sabin, seconded by W. L. Fenn that we accept the proposition and that the secretary notify Mr. O. D. Miller of the acceptance by the Board of Directors. Motion carried." (BCC 7/5/18)

A second well was developed in 1928 (BCC 9/13/28) The wells were cased with 40 inch casing 20 feet long. (BCC 2/22/25)

A more reliable source of power to run the pumps was obtained in June 1928, when a contract was signed with the Cochise Utilities Company of Benson. The Utilities Company agreed to extend its lines from the Goetz paper factory to the wells and supply a

Westinghouse electric motor at cost. The Benson Canal Company agreed to pay a minimum of \$600.00 per year for five years. The price of the current to be five cents per kilowatt. (BCC 6/17/28)

The Benson Canal Company had ended the canal at "the point of the hill north of the S. J. Johnson place." (BCC 11/16/12) Land owners further north needed water. John Sherman stated he had completed the ditch from the canal to his ranch, and wanted water. This was the beginning of the Extension which ran for about a mile. It was first decided the farmers using the Extension were to clean that part of the canal. It was later voted upon to accept the Extension as part of the canal proper.

Wide fluctuations in the weather were always a major factor in the ability of the Benson Canal to provide irrigation water to the farmers.

Grace Fenn wrote her impressions of the weather in 1945. "The seasons were fitful and spasmodic, drouth followed drouth, then fierce electrical storms ravished the area causing tremendous amounts of water to gush down from the mountains and higher country, cutting the valley into deep arroyos and in places depositing huge stretches of rocks, sand, gravel and debris causing great damage to the canal, as well as land in general. In places washouts five to thirty feet deep displaced the former canal bed. Concrete abutments and galvanized siphons had to be installed while other stretches were leveled and had to be reopened by means of teams and scraper. Several times the river went on a rampage washing out both dams and bridges."

"It was moved and carried to place S. J. Johnson as water master for July and August, he to continue to distribute water, to give his entire attention to the canal as such to work his team on canal work as much as possible to do so, to throw up levees along canal banks, to run ditches to throw over siphons, to employ extra men and teams and work them on the canal whenever he could find work to do, especially in the rainy season and at flood time to give his personal attention to the canal to protect it from damage and arrange it that the water will do the most good at all times and for his work of himself and team he will be allowed \$75.00 a month for July and August, no work required on Sunday, unless there be floods or rains and the canal in danger." (BCC 6/27/13)

The pay for the water master on a year round basis had been \$30.00 per month.

A similar arrangement was made in the following year. The keeping of a man at the dam to attend to the head gate and canal in July and August during the rainy season was discussed. Walter Sherman was present. It was agreed to employ him to camp at or near the dam for July and August and tend gates and to work along the canal, build roads, fix canal banks etc., keep his team there to work with. Canal Company to furnish him a tent and shelter, and pay him \$80.00 a month. He to furnish himself and team feed. (BCC 6/29/14)

The fickleness of the summer rainy season was clearly illustrated in 1926. The Benson News reported in the Pomerene news column on September 18, 1926, that "There is no lack of water for irrigation now, since the canal has been kept full of water by recent rains up river." The paper reported in the next issue, "The Board of Directors of the San Pedro Valley Water Users Association showed the engineers and representatives of the bonding houses over the fertile land of Pomerene country last Tuesday. They were regaled with watermelons and fruit after which they repaired to the milk dairy of Coons Brothers where they were treated with some delicious ice cream." (Benson News 9/25/26) The San Pedro Valley Water Users Association had been organized to promote construction of a storage dam up stream at Charleston. The dam was never built. (see Proposal of a Charleston Dam)

A few days later a flood came down the river doing great damage. The Board of Directors of the Benson Canal Company held a special meeting and went to inspect the dam. "Arriving at the dam, we found it all intact having received no damage whatever from the flood waters. The flood waters had cut a channel around both wings causing some little damage. Also washed out about 150 feet of canal bank near the head gate." (BCC 10/4/26)

Bridges on the San Pedro River did not fair as well. Railroad and highway bridges were washed out creating a very difficult situation. This was reported in the Benson News on October 16, 1926.

The immediate task for the farmers was to get water back in the canal. "Work has begun on the Benson Canal and a number of men and teams are at work on the diversion dam, repairing damage wrought by the recent flood, and it is expected to soon have the water into the canal. This will save the alfalfa and grain crops that have been planted." (Benson News 10/23/26)

"An urgent call for men was issued by ditch master Sabin early this week to turn out with teams for ditch cleaning. The canal is now dry and in good condition for cleaning and the work of cleaning it from end to end will be pushed in order to be able to turn the water in at the earliest moment. The farmers have been hampered more or less in the matter of fall and winter gardening owing to the absence of water in the canal. They are also belated in sowing winter wheat. But it is now believed that water will be turned in within a week or ten days." (Benson News 11/27/16)

It was over a year before the bridges were rebuilt. Another flood had damaged the dam again. "The Benson Canal is temporarily out of water on account of high water washing out banks at the head of the ditch. Water master, Joe Sabin, expects to have a force out Monday for the necessary repairs. Frank Coons is directing the building of a new temporary crossing of the river, the old one having been destroyed during the recent raise." (Benson News 7/15/27)

The dam and bridges washed out again in 1929. The canal system was damaged by floods in at least ten of the seventeen years for which records were available. It was a flood in 1931, that brought about the collapse of the Benson Canal Company.

Finances

The Benson Canal Company began in 1908, with a capitalization of \$10,000.00 in stock at \$100.00 per share. There was ten for one stock split on October 28, 1923, which increased the official capitalization to \$100,000.00 divided into 1,000 shares with a par value of \$100.00 each.

When the canal was completed to what was the center of Pomerene in 1910, the cost of building and maintaining the canal was \$16,807.36. (BCC 11/3/10) Expenses to maintain the canal mounted. They included cost of installing siphons, cleaning the canal, repairing flood damage to the dam and canal, development of two wells, pay for the water master, etc. These expenses were to be financed by assessments on the holders of stock. Seventy-nine assessments were levied from June 1910 until July 1931 for an average of 3.5 per year. The assessments varied from \$10.00 to \$40.00 per share for an average of \$19.00 or \$66.75 a year.

There was need for people to pay their assessments in both cash and labor. Cash was needed to pay bills while labor was essential for maintaining and repairing the system. Pay or credit in 1914 and 1915 was \$5.00 per day for a man and team or \$2.00 for a man without a team. (BCC 1/4/15) Pay was increased in 1924 to \$7.00 for a man and team and \$4.00 for a man working an eight hour day. (BCC 9/26/24) It was reduced in 1910 to \$6.50 for a man and team, \$2.50 for a team without a man, and \$3.50 for a man without a team. The working day was increased to ten hours. (BCC 11/5/30)

Two problems with the assessments soon emerged. Financial records showed that some men had worked more than needed to pay their assessments and were owed money. Identification of these men suggests that they lived near the far end of the canal. Men living closer to the dam lost interest in working when the canal was cleaned or repaired up to their farms. Men at the far end might have to work more than their assessment in order to get water to their farms. Other work sometimes made it difficult for men to work on the canal. Some sought outside employment to supplement their income. **In 1916, the water master reported that it was impossible to get men to work on the canal because all were working on the county road into Pomerene.** (BCC 7/12/16) This road was a badly needed improvement.

The second and most critical problem with assessments was non-payment. Delinquent payments were common right from the beginning. On October 5, 1914 delinquent

assessments amounted to \$1,227.14. The board voted to charge delinquent assessments 2% per month. (BCC 10/17/14)

1920: Lebbeus Ezra Coons was watermaster.

It was frequently necessary for the Canal Company to obtain loans to pay bills. These loans were usually from the local Benson bank. Several officers in the Canal Company were also officers in the bank. There was at least one loan from Zions Trust and Savings Bank in Salt Lake City, Utah. Indebtedness had risen to \$16,506.04 in 1923. (BCC 4/17/23)

From time to time the water master was directed to cut off the water to those delinquent in their assessments. (BCC 7/10/15) A notice was sent to delinquents in 1927, telling them that their water would be shut off and action taken to sell the stock for the amount owed. However, shutting off a farmer's water could be counter productive. Without water he could not make a crop and without a crop there would be no money to pay assessments. *"Mr. Chastain appeared before the board and stated that he would have some money soon to pay his assessments. So the board decided to let him have water for the present as shutting his water off now would cause him to loose his crop."* (BCC 7/10/31)

Canal stock was a valuable commodity. It was essential for irrigation rights. Stock was bought, sold, and rented. One indication of its value was that it could be used as collateral against land mortgages. The Cochise Bank in Benson held eighty shares of stock at one time. The bank was not an investor in the Canal Company. The stock had been put up as security on loans. (BCC 3/25/25) The Federal Land Bank of Berkeley, California, held stock put up on loans. For example, a letter from the Land Bank dated June 4, 1927, indicated that land mortgaged by Mary E. Cosby had been transferred to Joseph E. and Mary E. Scott. As a part of the transaction, the bank asked that ten shares of capital stock in the company be reissued *"in favor of the Federal Land Bank of Berkeley, pledge of Joseph E. Scott and Mary E. Scott."*

The banks were responsible for seeing that the assessments against the stock were paid. Delinquent accounts against this stock could be a matter of concern. *"The secretary also presented letters from the Federal Land Bank of Berkeley in reference to delinquent assessments against John T. Proffitt ten shares. Also against the Sherman, Merrill, Tryon stock held by the Federal Land Bank under mortgages."* (BCC 9/23/3-)

In one case the State Land Board foreclosed on mortgaged land. C. E. Post and J. M. Nelson were permitted to take over land and associated 30 shares of stock by settling delinquent accounts for a negotiated sum of \$1,000.00. They were to take control of the land and pay assessments after January 1, 1927, *"with the understanding that however no interference shall be interposed against the cultivation and harvesting of a crop of grain and melons at present being grown by other parties other than said Post and Nelson upon a part of said land."* (BCC 6/11/27)

The financial condition of the Canal Company worsened to the point where the board reached the conclusion that they should try to bond the canal to pay outstanding indebtedness and make some repairs on the dam. (BCC 7/7/25) A special meeting of the stockholders was held on August 23, 1925. Stockholders voting by the number of shares controlled voted 697 2/3 to 30 in favor of mortgaging the Benson Canal Company against a \$30,000.00 bond issue. (BCC 8/23/25) After a period of negotiation, an arrangement was worked out for the Benwell and Company of Denver, Colorado, to sell \$30,000.00 in bonds at 85 cents on the dollar. The bonds were "First Closed Mortgage Seven Percent Coupon Bonds" in the amount of \$500.00 each. The Colorado National Bank of Denver was to hold the deed of trust and be the banker for the money. A special meeting of stockholders was held on February 1926, and all 726 11/12 shares represented voted to allow the board to accept the offer.

Final closure on the deal was complicated by lack of deeds to the canal right-of-way. The only deed was for 30 foot wide right-of-way through the Boquillas property. Deeds were requested by the bank from the owners of land through which the canal ran. The board pointed out, *"That in as much as the owners are badly scattered that it would take considerable time to get deeds from them all."* (BCC 7/22/26) The problem seems to have

been solved when John A. Rockfellow surveyed the route of the canal and filed right-of-way maps with the Cochise County Recorder on June 11, 1926. The officers of the canal were finally authorized to sign and deliver the mortgage and deed of trust for \$30,000.00 on October 20, 1926.

A. A. Weeland of Weeland Engineering, Pueblo, Colorado, represented Benwell and Company, buyer of the bonds. He was to receive a five percent commission on all money spent on improvements he recommended. (BCC 3/12/26) He delivered blue prints on proposed work at the dam. His design was for an earth filled dam over the existing 16 foot high retaining wall. It was to be 20 feet high, 52 feet wide at the bottom and 20 feet wide at the top. The upstream side was to be riprapped with a layer of brush and rock three feet thick. Additional protection would be drift guards constructed out of wooden piles to which 3x10 inch beams would be bolted. (Blue print dated November 1926)

The board objected to this type of dam and voted, "*that we ask A. A. Weeland, consulting engineer, to submit estimates on rebuilding the dam with concrete instead of earth and rock as was first outlined as it will cost 50 to 75 cents per cubic yard to move the dirt as none is available nearby that is suitable.*" (BCC 11/27/26)

The counter proposal was for a concrete dam 110 feet long, 20 feet high, three feet wide at the bottom, and 18 inches at the top with two abutments on the down stream side. The minutes are not clear as to when construction actually took place. However, 400 sacks of cement and 1,000 feet of reinforcing steel were ordered. (BCC2/23/27) Over a year later there was need of \$4,000.00 to pay concrete bills. (BCC 10/9/29)

The regular annual meeting of the stockholders was held on January 7, 1932. The election of officers was held. A. G. Smith, president of the Cochise County State Bank, was elected president of the Benson Canal Company. He replaced George Etz who had been president since 1924, remained on the board. Nothing was decided towards putting water back in the canal pending word from the bonding company. (BCC 1/7/32)

The final action of the board came at its regularly quarterly meeting on January 12, 1932. The board adjourned to the church building in St. David where a meeting was in progress. They went "*to hear a discussion by representatives of the The Church of Jesus Christ of Latter-day Saints and representatives from the University of Arizona regarding water problems. They outlined in their talk that it would be prohibitive for the St. David Canal and the Benson Canal to rebuild their dams as the small amount of acreage that could be cultivated would make the cost prohibitive to the water users. They advised the sinking of wells and each water user to pump his own water.*" (BCC 1/12/32)

The board decided not to levy assessment and passed the following resolution. "That in view of the fact that the Benson Canal Company, a corporation without funds, that the secretary be instructed to write Merrell H. Perkins, assistant trust officer for the Benson Canal Company in Trust Account #2648 held by the Colorado National Bank in Denver, Colorado, that in consideration of our financial situation that it is impossible for the Benson Canal Company to rebuild the dam that was destroyed by flood waters on August 11, 1931, or to build a new dam as the cost would be prohibitive for the small acreage of agricultural land under the system and the uncertainty of a new dam standing or the supply of water." (BCC 1/12/32)

This marked the official end of the Benson Canal Company operation. However, this was not the end of the struggle to provide irrigation water for Pomerene. Temporary brush and rock dams were able to put some water into the canal at intervals. In fact, there was water one week after the Benson Canal Company went out of business.

"There will be water down the Benson Canal ready for use of the farmers on Monday morning." (San Pedro Valley News 1/15/32)

A dam was built one half mile upstream from the old dam where clay provided a better base. It was dedicated April 21, 1934. (See Dams)

The legal end of the Benson Canal Company did not come for over a decade after the directors declared it bankrupt in 1932. Pomerene farmers used temporary brush and rock dams to turn water into the canal until the new concrete dam was completed in 1934.

Several other actions were necessary. Joe A. Sabin obtained a judgement against the Benson Canal Company on December 12, 1934. The Canal Company was, of course, unable to pay the judgement and a sheriff's sale was held in front of the Cochise County Court House on December 18, 1937. Joe A. Sabin was listed as the purchaser of the company for \$7,780.94. Several other farmers helped with the money. The Pomerene Water Users Association, the new cooperative irrigation company, had been incorporated on November 10, 1936 by R. L. McCall, Walter L. Fenn and Marion B. Naegle. Joe A. Sabin signed over the rights to the Benson Canal Company to the Pomerene Water Users Association in February 1940. However, it was not until August 22, 1944, that Earl E. Brown had the final transaction recorded. This closed the last chapter on the Benson Canal Company.

Ref: (1) Original Minutes of the Benson Canal Company in possession of Louise Larson (2) A summary of the Benson Canal Company and the Settlement of Pomerene, Arizona by Wilfrid C. Bailey, PhD Anthropology (3) Historical information gathered as a part of Bailey's 1946-1947 field work in Pomerene (4) Newspaper; Benson News; 11/27/16, 9/25/26, 7/15/27, 10/ 23/26

Towns Throughout The San Pedro Valley

St. David, Arizona

St. David is one of the oldest, and a unique community nestled along the San Pedro River, among old cottonwoods, pecan trees, green fields and beautiful ponds. U.S. Highway 80 is the main thoroughfare, with a few small businesses and the schools to slow down the increasing traffic. St. David residents prefer to remain an unincorporated community, with a population of over 2,000 people.

The rural community is essentially one of nice homes with life centered around the churches, schools and home activities. Nearly all shopping has always been elsewhere.

Men of the community have worked for wages, as well as farmed. Some have been employed at the nearby Apache Powder Company, now known as Apache Nitrogen Products Inc. After World War II, people began to commute to Fort Huachuca, Tucson and other towns to work.

The history of this settlement began as early as 1846, during the war with Mexico, when the Mormon Battalion passed through the San Pedro Valley.

Colonel Phillip St. George Cooke's Adjutant, Philemon C. Merrill, of the Mormon Battalion, could not forget the beautiful valley with its tall grass and perennial stream he had seen in the Valley of the San Pedro. Thirty years later, on January 16, 1877, a company of hardy men and women left Utah and headed south into the Arizona Territory. They had been called to colonize by Brigham Young, prophet and president of The Church of Jesus Christ of Latter-day Saints. Leaders of this group were Philemon C., Dudley, Seth, Thomas and Orin D. Merrill, George Steele, Joseph McRae and A.G. Williams.

After many difficulties, the party reached Lehi, in the Salt River Valley, where they remained for a time. They pitched their tents, dug a canal, and planted crops. Joseph McRae wrote, *"Summer advanced and the heat became intense ... in spite of this we raised that year an abundance of corn, sugar cane, melons, and plenty of vegetables."*

Some of the settlers desired to move further south and had as their destination the San Pedro Valley. They left with scanty provisions, therefore, by the time they reached Tucson, they were badly in need of supplies. Some of the men found work at a sawmill in the Santa Rita Mountains. With this financial support, they made their way to the San Pedro Valley. Philemon C. Merrill preceded the group to the valley so that he might explore for a suitable location for a settlement.

Joseph McRae recorded, *"We soon decided to break ground on the west side of the river. A swamp nearby would, by draining, give sufficient water for our present needs. . . We soon had enough ground cleared to plant a small acreage of grain and garden vegetables which were prolific in their yield. The same year we built a stone fort with eight rooms on the east side of the river."*

The fort was built of rock hauled by wagon from the Whetstone Mountains. They were cemented together with a red clay. Poles on the roof were covered with ocotillo stalks, grass, then clay dirt. The families carried water from a spring about three hundred yards away. The fort eventually became the place for school, church, social activities as well as a place for protection from the Apache Indians, who lived in the nearby Dragoon Mountains.

Malaria, caused by the mosquitoes from the nearby swamp was a great plague to the early settlers. In the fall of 1878, a large part of the population were ill from the disease. This is the way it was when Apostle Erastus Snow and a company of LDS Church leaders came from Salt Lake City, Utah to visit the settlement. On October 6, a meeting was held, and Philemon C. Merrill was presented and accepted as the presiding officer over the people.

Apostle Snow blessed the place and promised them good health and prosperity if they would live righteously. He prophesied that the valley would be settled from one end to the other.

Earlier, when the Mormon Battalion passed through the valley in December 1846, they found the river to be a shallow stream. The new settlers found the channel in the river had



deepened, creating serious problems for farm irrigation. The lifeline of the farming community has always been water and irrigation canals. A canal was dug about three miles above the settlement and a diversion dam of rock, sand and brush diverted the river water into the canal. During the flood season, the dam would wash out and the men would reconstruct the dam with their teams and scrapers. This type of dam is still in use today (1998) with a bulldozer used to reconstruct the dam.

The Curtis family and others living at Curtis Flat constructed a concrete dam about ten miles above the farms. A canal was dug around the foothills. Their gardens, fields and orchards produced in abundance. This dam washed out when all the bridges and dams washed out in the flood of 1927.

Much sickness and hardships were endured by all. At one time early in 1879, food supplies were almost exhausted, every family had someone ill with malaria. John Campbell, a new convert to the LDS Church, arrived in the settlement. He had owned a large ranch and a thriving mercantile business in Texas which he sold. He loaded his freight wagon with supplies and went to Salt Lake City. He was told that his kind of help was needed in Arizona. It was to this man that many owed their lives, even the Mexican ranchers. He opened his supplies to all and let them pay later, or if they were not able to pay, he gave them what they needed. Later Campbell opened a sawmill in the Huachuca Mountains and gave employment to those that could work and paid them well.



Brigham Young, President of The Church of Jesus Christ of Latter-day Saints, called several families to settle in the San Pedro Valley. courtesy Barbara Merrill Hall



Philemon C. Merrill, first Presiding Elder of the St. David Branch, with his wife Cyrena, who was a counselor to the first president of the St. Joseph Stake Relief Society
Courtesy Lola Scott Merrill

During May 1880, the present St. David townsite was surveyed by James H. Martineau and Edward Lofgreen. The first house was built by Philemon C. Merrill with lumber from Campbell's sawmill.

About two years after the first settlers arrived, other families moved into the settlement. Among them were other Merrills, Busbys, Lofgreens, Curtis, Goodmans, Cliffords, Reeds, Kimballs, Beebes, Bingham and others. Homesteads were filed and the community began to thrive. Joseph McRae was the first to take up a homestead in Cochise County. Cochise County was formed from Pima County February 1, 1881. Tombstone was the county seat.

St. David, previously called Marcus, was named in honor of an early apostle of the Mormon Church, David W. Patton, who led the Mormon forces against a Missouri mob in the battle at Crooked River, and was mortally wounded in an encounter with the mobbers,

Tombstone and other mining communities brought some prosperity to the farmers in the settlement. Grass tall enough to cut and bale grew along the swampy areas. The hay along with other produce, grain, eggs, butter, vegetables etc. were marketed in the nearby mining towns.

The St. David post office was established on July 24, 1882, with Joseph McRae as the first postmaster. Prior to this, residents had to get their mail from Tres Alamos, about eighteen miles north. Joseph McRae also donated twenty acres of land to the community for a cemetery. The first burial of record was in 1878 for a Reed baby.

St. David was organized as a ward in The Church of Jesus Christ of Latter-day Saints on February, 1883 with William D. Johnson as the first ward bishop. They were under the jurisdiction of the St. Joseph Stake also formed that day and headquartered in St. David. Christopher Layton from Utah was sustained as president of the St. Joseph Stake. Others sustained were David P. Kimball, first counselor, James H. Martineau as second counselor. That same year the first Quarterly Conference was held in St. David. During 1910, the St. Joseph Stake headquarters was moved to Thatcher, Arizona and St. David ward came under the Los Angeles District of the California Mission.

Rhoda Merrill, wife of Philemon C. Merrill, was mid-wife and nurse for the colony. During her lifetime, she delivered five hundred babies and never lost a mother or baby. Peter A. Lofgreen had studied medicine some and was the only community doctor.

Maria McRae, the first schoolteacher, taught school until 1882. A rock schoolhouse was built and was also used for church as well as the recreation hall until it and other buildings were destroyed by the earthquake in 1887. (At the present time, the bell from this schoolhouse rests at the Twin Lakes Resort, previously known as the Golden Bell, named for this bell). Peter A. Lofgreen taught school from 1885 to 1914, then became the postmaster. *

The earthquake felt on May 6, 1897 brought great changes in the valley. Springs of water disappeared and the marsh lands dried up. Artesian wells came into being and many are still in use. Many wells were dug for irrigation. The flow of the river seemed to be much less. *

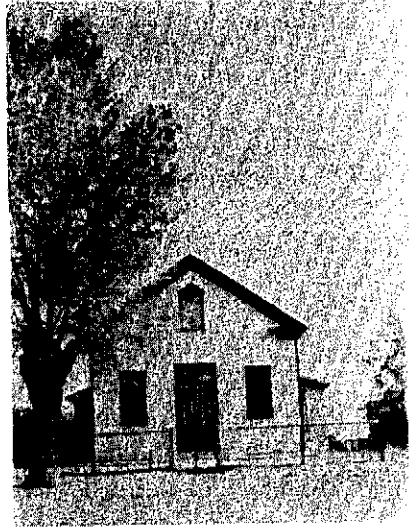
The settlement had little or no trouble with the Indians, but precautions were always taken. However, Apache bands scouted and murdered in the nearby areas and committed depredations within the San Pedro Valley.

Grandma Goodman's Market was started in 1883, when the husband of Margaret Ann Taylor Goodman, Nicholas G. died in 1885, leaving Margaret with nine children. She took her only cow to pay funeral expenses. She had five dollars, so to make a living, she bought a few bars of soap and small articles and sold them in one of the rooms of her home. Gradually, she added more merchandise. She bought a store from Mr. Beebe and continued in the store business for thirty years. She would go by horse and buggy to Fairbank, Tombstone, and Benson for supplies for the store.

Some of the grandchildren of Grandma Goodman, tell about the store as they remembered it. The post office and only town telephone was in one corner. All the merchandise was kept behind counters. She sold canned meats, cheese, salt pork, homemade butter, material and sewing items. The candy assortment was interesting and cheap--two candy bars for one cent, six big cookies for five cents. She also carried a supply of jewelry, hair pins, colored combs, and handkerchiefs. She even kept handles for

homemade coffins.

Credit was given, and eggs bartered as cash for merchandise. Grandma Goodman had be careful of school children trying to barter their lunch of hard boiled eggs for candy. For celebrations, dances, and socials, there was homemade ice cream and carbonated soda available.



Third St. David lumber church building, built in 1900. In 1912, an adobe brick addition was built on the rear. Was razed in 1940



Old schoolhouse built in 1902

below: Early 1930 St. David school bus; Clea and Elnor Curtis with bus driver, Roy Judd.



courtesy Curtis Brown

Bridges on the San Pedro River and It's Floods

If you have never seen the San Pedro River on the rampage during the monsoon season, it would be hard to imagine the incredible amount of red, muddy water laced with crashing boulders, trash, huge trees--roots and all--that come rushing downstream, undermining its banks. It was estimated the water traveled about fifteen miles per hour between St. David and Benson. Alvah (Vay) Fenn who, for years, measured the depth of the water for the United States Geological survey, remarked, *"One flood measured eighteen feet deep. Another year in the early 60s, there were sixty floods over two feet deep. We used to have more rainfall."*

Before 1890, there was a very good road along the San Pedro from the Mexican border to the Pima County line. On May 2, 1887, the Cochise County Supervisors voted to ask for bids for a sixty-four-foot span bridge at Benson. The bridge was built for \$1,076.50.

A disastrous flood during 1890, washed out every bridge on the San Pedro from Benson to the Mexico border. Cooke's wagon road, built by the Mormon Battalion in 1846, was washed so badly that it was abandoned and an alternate route was made.

During 1918, a new \$90,000 concrete bridge had been constructed on the narrow San Pedro River at Benson, where the road still crossed the river at the Ohnesorgen crossing,

The Alvah and Carmen Fenn family lived in a small house near the newly built bridge on the west side of the river. The house had been built for the construction workers to live in while the bridge was being built. Eva Fenn remembers: *"It was in 1919, I was eight years old, when a huge flood came up in the river. I saw the bridge wash out. There were two boys, whose last names were Johnson and Roberts, standing on the bridge watching the flood water when the bridge began to crack. The boys started to run. They had long legs, and they ran as fast as they could. The bridge began to collapse a section at a time. As soon as the boys would get to one section, the one behind them would collapse into the raging water. They barely made it safely across."* (Eva Fenn Harmon told to Louise Fenn Larson)

June 8, 1919, a bridge was built at a cost of \$26,000, which was constructed by Topeka Bridge Company. It had two arches and was one hundred forty feet two inches long and thirty feet above stream. *

courtesy Benson Signal

Another Benson bridge washed out during a big flood in 1923.

On another occasion during 1926, a Benson resident, Sammy Baker recalls: *"Half of the bridge on the west side washed out. Several people, including myself, walked out on the remaining bridge to view the flood. It began to give way. We all hurried off just before it gave way."* (Sammy Baker told to Louise Larson)

October 1929, the Pomerene Dam and bridge washed out again. Ethelene Scott gives this experience: *"I was a senior in the Benson Union high school. Word reached the school that part of the highway bridge had washed down the river and that we would have to walk the railroad bridge to get home. We hurried to get to the railroad bridge to see what had happened. Just as we got close enough to see what was left of the bridge, a wall of trees and other debris coming down the river, hit the remaining part of the bridge; it came loose from the bank and floated down the river with the flood."*

We hurriedly walked across the railroad bridge. We were rather frightened because the flood water lapped at the ties on the bridge. We waded to the Pomerene road and continued on our way home. The Pomerene road was also flooded by the runoff from the foothills. The water was deep, and we had to wade in water almost to our waists. My Uncle Kenneth Fenn came up the road riding a horse, and he gave us a ride home. We learned later that every bridge on the San Pedro had washed out, except the railroad bridge.

It took several days for the water to recede enough so we could go to school. The motor school bus could not be used, so the old horse-drawn school bus was used. We had to leave home about 7:00 a.m. in order to get to school on time. It was fun and a bit exciting to ride in the horse-drawn bus" (History of Ethelene Scott Bailey)

Arthur Wilson and others used their teams of horses to pull cars through the river crossing until a bridge could be built. A fee was probably charged.

*

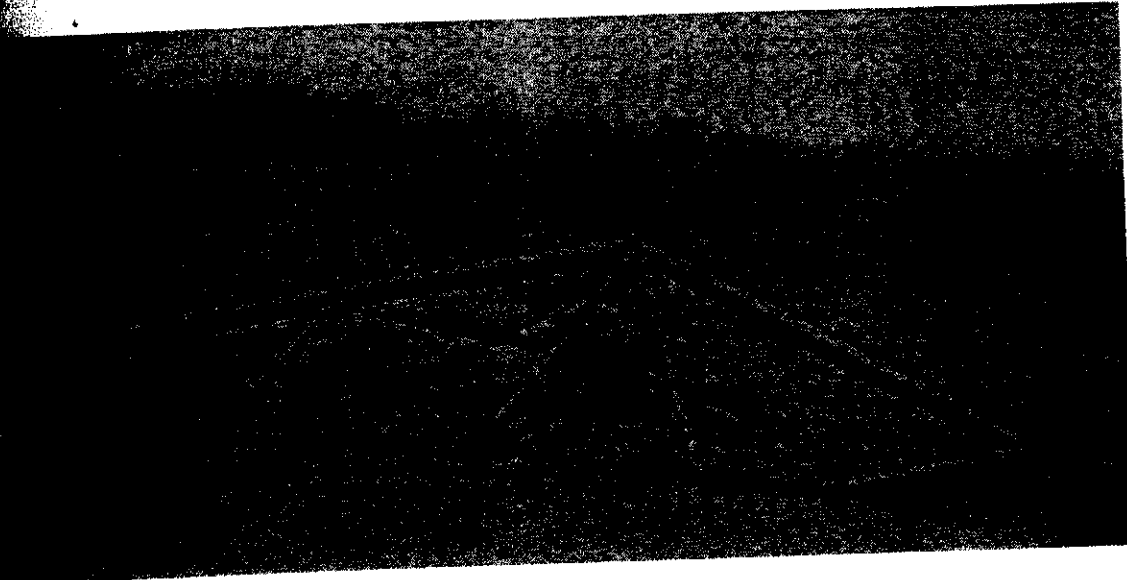
Many stories could be told of experiences on the river, from wading and catching minnows to swimming in a flood or floating with inner tubes. Such was the experience of Geoff McGoffin and Bob Sonnenberg of Benson:

It was on a clear sunny afternoon that a flood of almost two feet of water looked inviting to do a little rafting with inner tubes. Geoff and Bob entered the river at the St. David bridge. The boys floated leisurely to the Pomerene Dam, got out and walked around the dam and got in again. All went well for awhile. It wasn't long before the river began to rise. They found a sand bank and got out thinking the water would recede. After awhile they decided to try floating again. The water became pretty rough and the two boys became separated. It became late. The next morning Geoff had ended up on a sandbar by the Benson river bridge, exhausted. Not seeing Bob anywhere, Geoff climbed out of the river and got into a car they had left parked there and went to get help to find Bob.

In the meantime, Bob had found a place to get out of the river. He had lost his shorts, but found an old curtain to wrap around himself. Early next morning he walked to the Craig Nielson home in Lonesome Valley, and they took him home. (Geoff McGoffin told to Louise Larson)



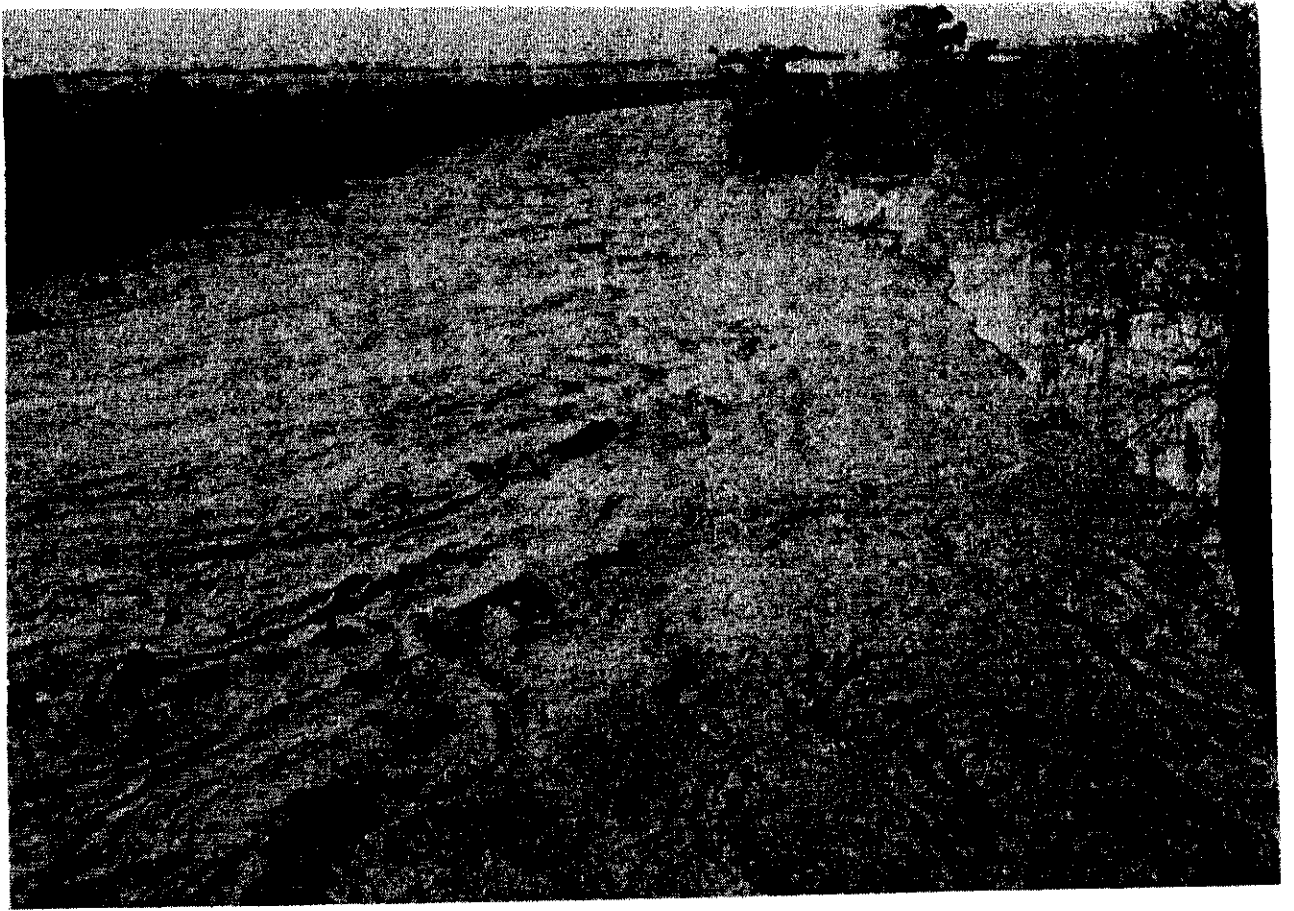
October 1926: All bridges on the San Pedro washed out. Concrete bridge was at Benson, Arizona. Note: Irrigation flume is on the right. courtesy Alice Sherman Coons



Top: The railroad bridge at Benson, Arizona washed out from flood.
courtesy William E. "Bill" Coons.

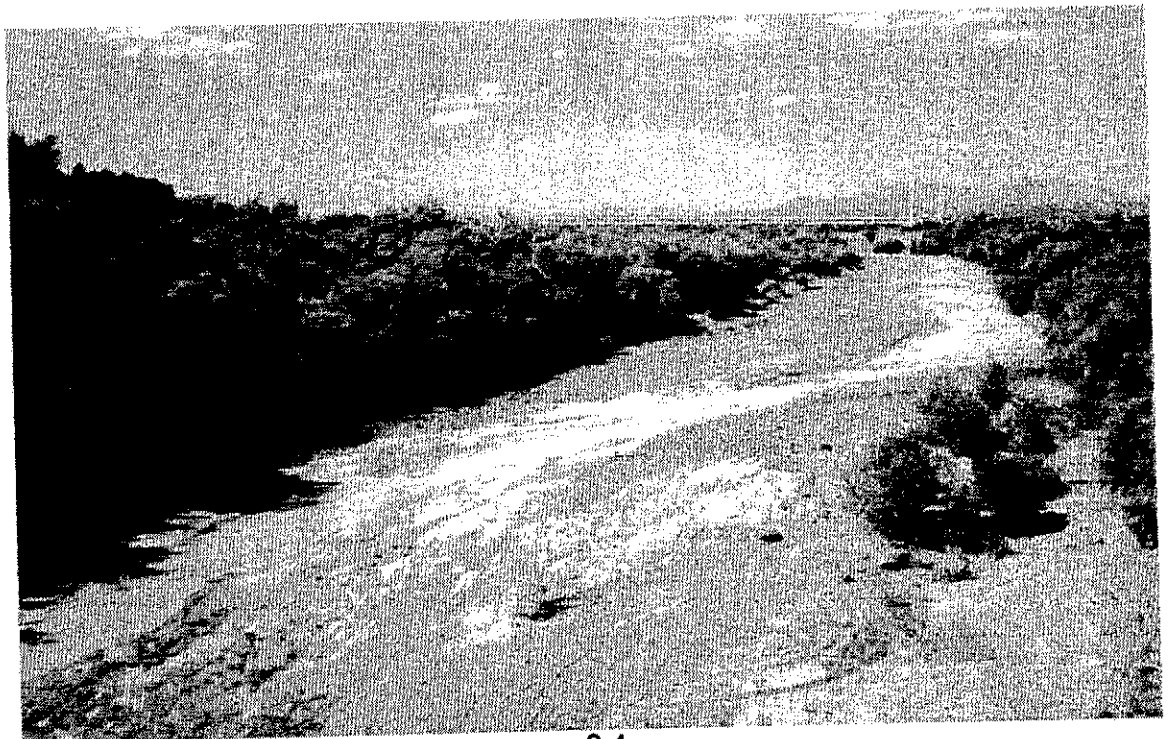
Below: A temporary railroad trestle spans the river.





Top: Over two inches of rain fell in the San Pedro Valley area causing the San Pedro River to go on the rampage; Benson, Arizona October 1977 courtesy San Pedro Valley NEWS-SUN. used by permission

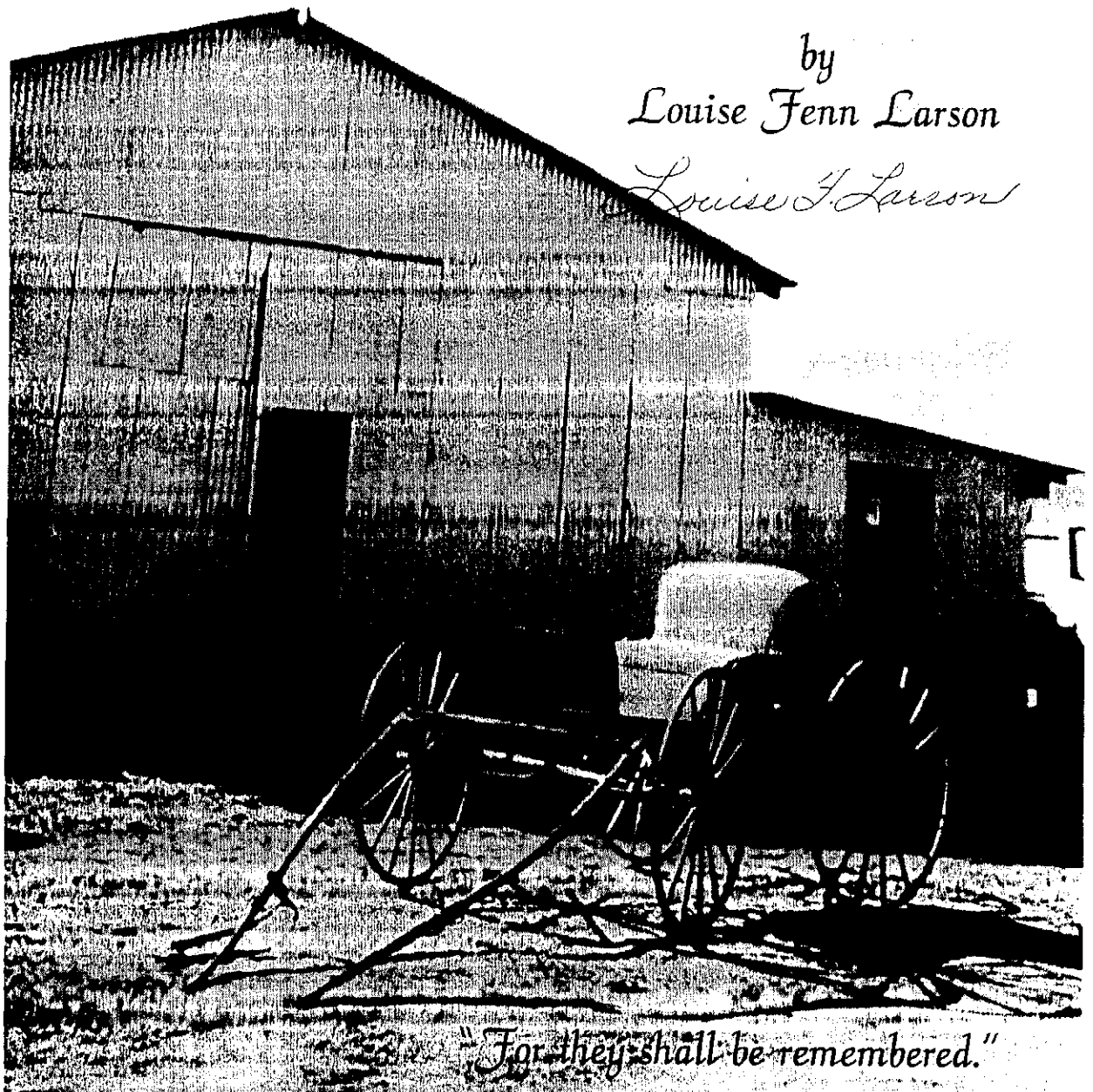
Below: San Pedro River taken in the same area as picture above; shows remains of a small flood; July 1998



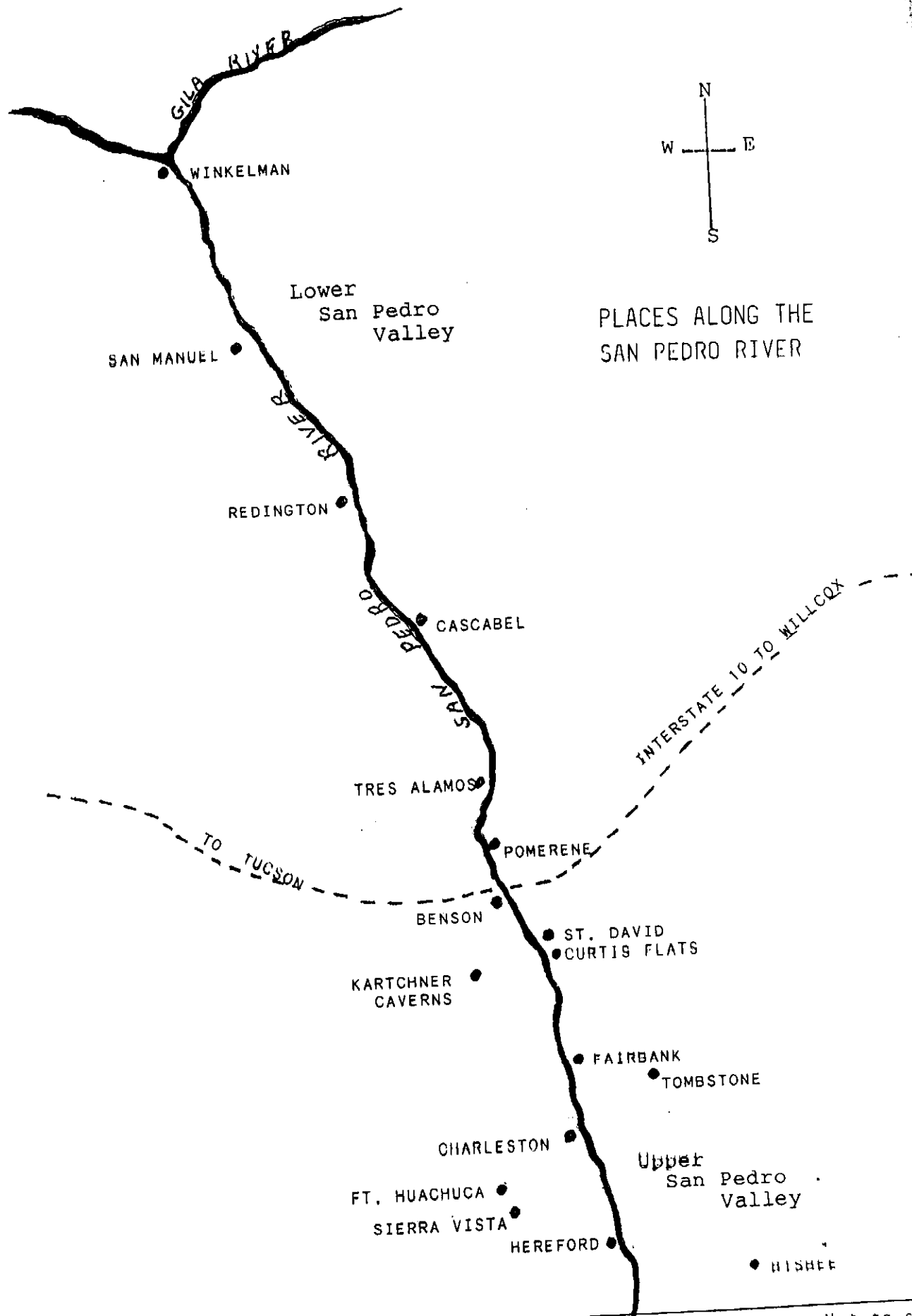
*Pomerene, Arizona
And
The Valley Of The San Pedro
A History*

by
Louise Fenn Larson

Louise F. Larson



"For they shall be remembered."



PLACES ALONG THE
SAN PEDRO RIVER

GILA RIVER

WINKELMAN

SAN MANUEL

Lower
San Pedro
Valley

REDINGTON

SAN PEDRO RIVER

CASCABEL

TRES ALAMOS

POMERENE

BENSON

ST. DAVID
CURTIS FLATS

KARTCHNER
CAVERNS

FAIRBANK
TOMBSTONE

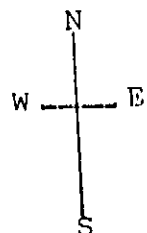
CHARLESTON

FT. HUACHUCA
SIERRA VISTA

HEREFORD

Upper
San Pedro
Valley

HISHEE



TO TUCSON

INTERSTATE 10 TO WILLCOX

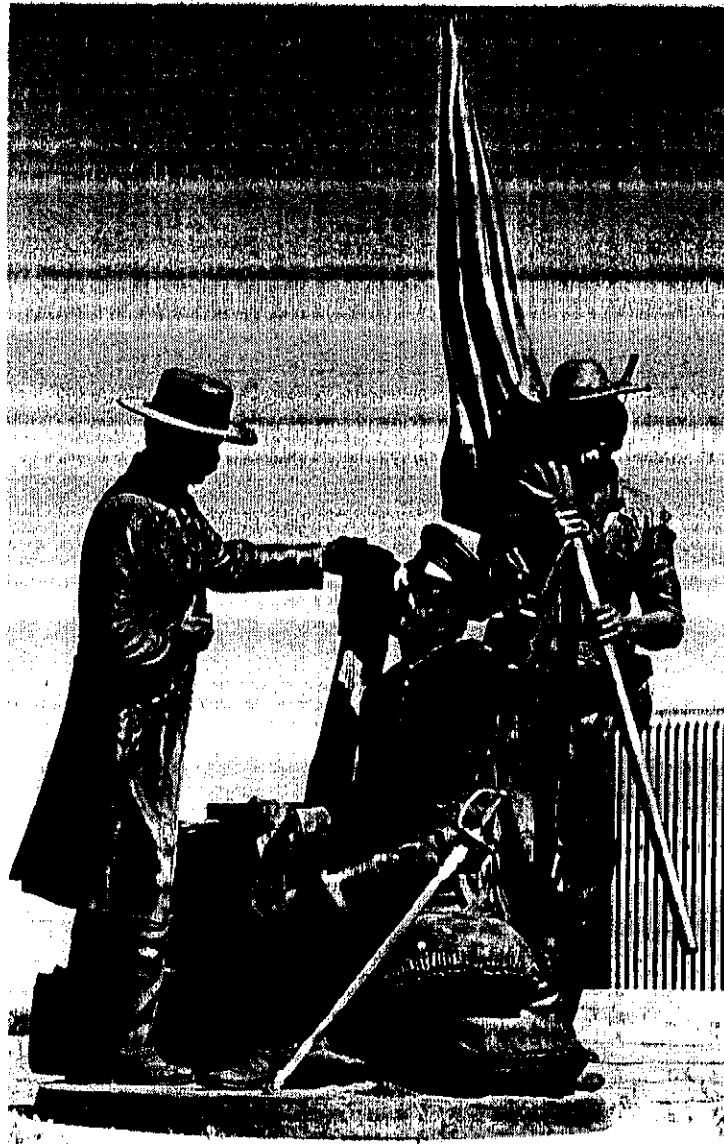
**Mormon Battalion Monument
Tucson Arizona**

Dedicated December 14, 1996

**by Gordon B. Hinckley,
President of
The Church of
Jesus Christ
of Latter-day Saints
Sculptor: Clyde Ross Morgan**

The monument is a two-ton, 19-foot-tall bronze statue of Battalion members, Christopher Layton and Jefferson Hunt, raising the U.S. flag and engaging in peaceful trade with Teodoro Ramirez, a prominent Tucson merchant.

picture courtesy
Lewis H. Leavitt, DDS
Tucson, Arizona



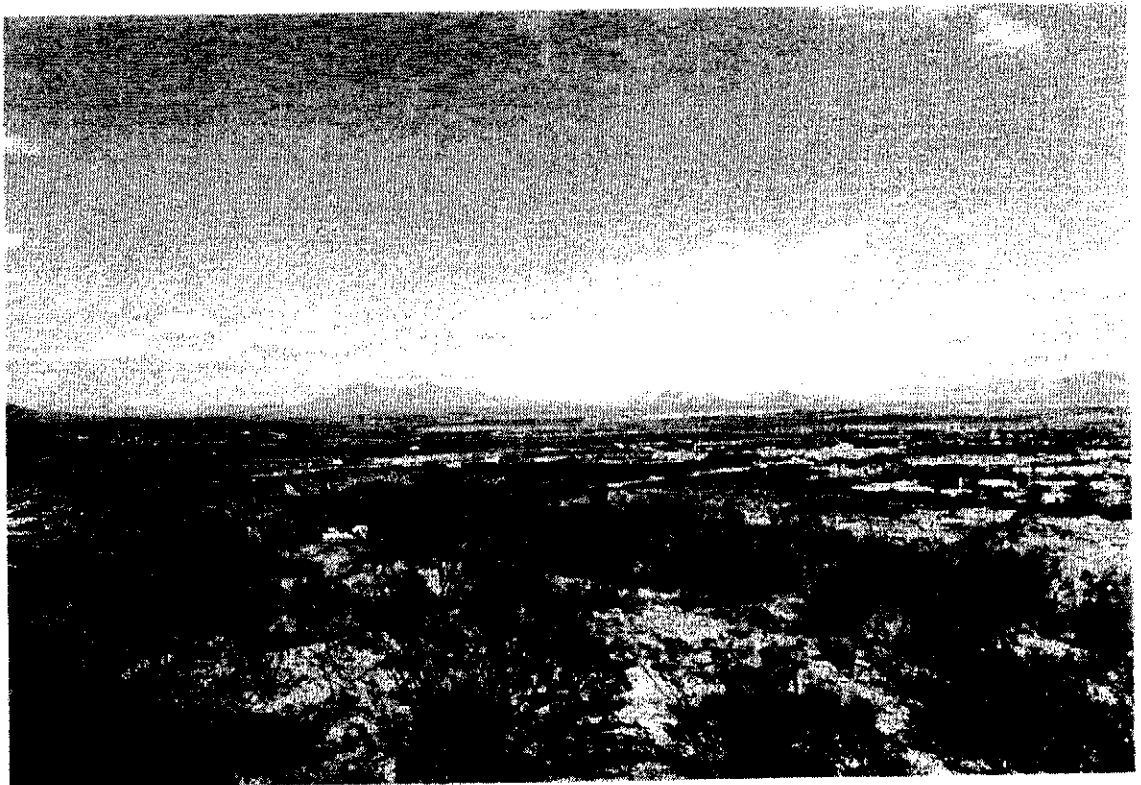
Fur Trapping Along the San Pedro River ~ 1824

The early fur trappers are given much credit for exploring the Southwest and its streams. Not much is known about them as few records were kept of their activities due to the fact they were trespassing on Mexican territory. The following incident was excerpted from Early Arizona -- Prehistory to Civil War.

It was in November 1824, James Pattie, a young man of twenty years, and his father Sylvester and other trappers and traders from Missouri, went to Santa Fe to secure a license to trap on the Gila River. The Governor of the territory was reluctant to give them one. While in Santa Fe, a Comanche band had raided some ranches and carried away several women and children. James Pattie joined a Mexican force to pursue the Indians and was able to personally rescue the daughter of the former governor of New Mexico. He was given the permission to trap. Usually the trappers would market their pelts through the trapper who had the license.

The two Patties and twelve other trappers left Santa Fe for the Gila River and trapped along its various tributaries. Coming up the virgin San Pedro River, the trappers caught many beavers. When the trappers were about ready to leave the camp, some Indians stole into their camp one night and stampeded their horses. The trappers were stranded. The only thing they could do was to hide their pelts and head back on foot to the Santa Rita Mines in New Mexico. They were half-starved and very fatigued from the hardships of the trip. As soon as possible, the younger Pattie organized another expedition and went back for the furs only to find the Indians had found the hiding place and had taken the pelts. They found a few pelts in another cache. Thus, the trappers had nothing to show for so many months of danger, cold and hardships.

Ref: Early Arizona - Prehistory to Civil War; Chapter 8; Mountain Men; pages 244-245 by Jay J. Wagoner; The University Of Arizona Press; Tucson, Arizona; 1975

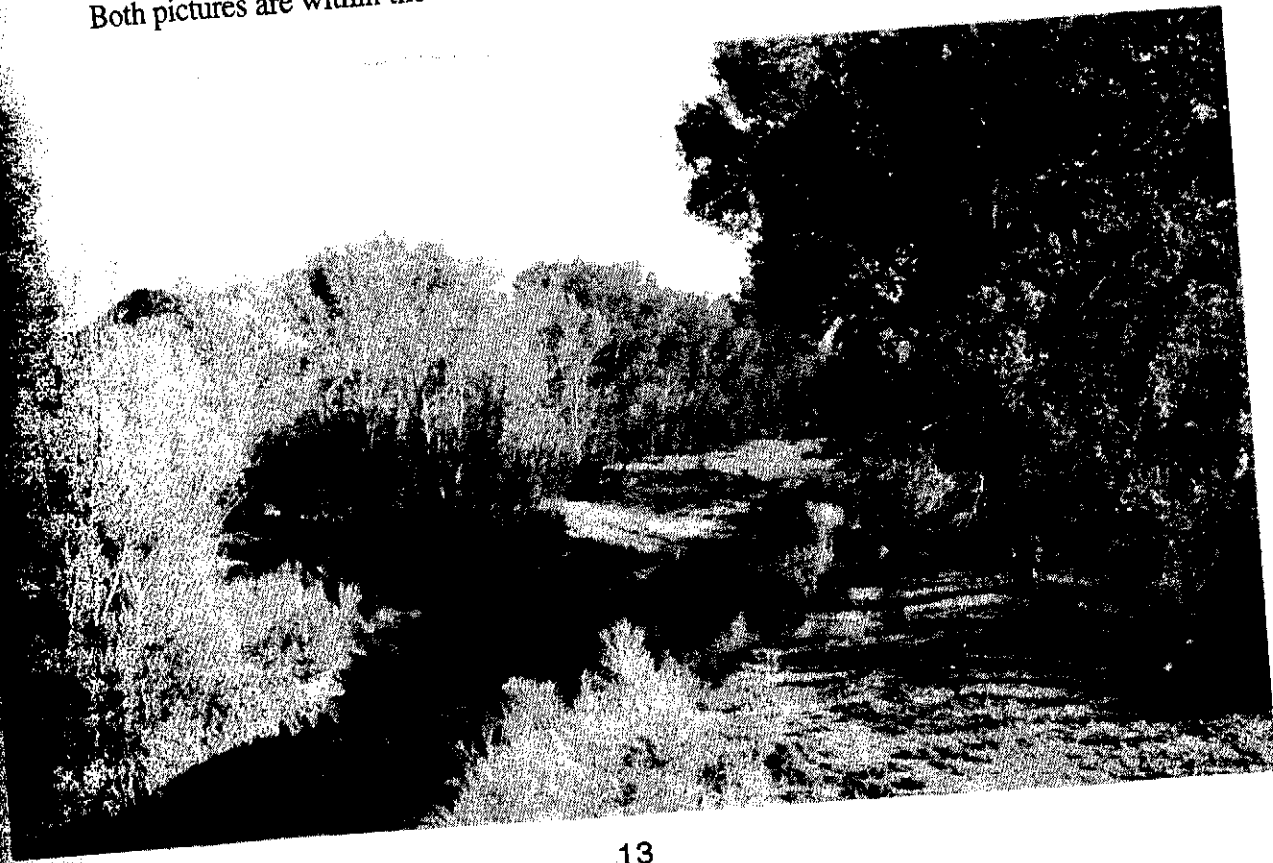


A Glimpse of the San Pedro Valley and Its River - The San Pedro River

The picturesque and spectacular San Pedro Valley with its arroyos, arid mesas and rocky clay foothills are enclosed with steep irregular pink and blue mountains; mainly the Mule, Huachucas, Whetstones, Dragoons, Rincons and Galiuros standing like sentinels guarding the valley, its river and passage ways. The view is enhanced if there are fluffy cumulus clouds to splash the mountains, hills and flora with purple and dark blue shadows.



top: San Pedro River, calm and peaceful, at Charleston crossing
bottom: River at San Pedro crossing in upper San Pedro Valley
Both pictures are within the San Pedro Riparian National Conservation area.



The **San Pedro River** would be hid completely from view with mesquite jungles and brush, but for a very crooked and wide green trail of cottonwood trees that line the river banks from one end of the valley to the other. The river has many tributaries and can appear to be a dry wide swath of sand with high perpendicular clay banks made by raging flood waters or in some areas a lazy winding stream.

The river begins near Cananea, Sonora, Mexico about forty miles south of the Arizona and Mexico border. It is approximately one hundred fifty miles long and joins with the Gila River a mile below the town of Winkleman, Arizona. As one approaches the river one may also see patches of green fields from the farms and ranches that are scattered along its banks. The river has two diversion dams with canals for irrigation. It has several bridges that are located at Hereford, San Pedro Crossing, two at Charleston, Fairbank, St. David, three at Benson and one at Redington. Besides highway crossings, there are two railroad bridges and four natural gas pipe lines that span the river and cross the valley at various locations.

The San Pedro Riparian area designated by Congress in 1988, claims about forty miles of the upper San Pedro River, starting near the Arizona and Mexico border and extending to St. David, Arizona.

One distinct feature that few rivers can claim is that the San Pedro River runs north!

San Pedro Valley Described by John Russell Bartlett ~ 1851

(Commissioner for the United States)

While Surveying a Boundary Line Between the United States and Mexico

On September 8, 1851. John Russell Bartlett, with a company of thirteen people left the Santa Rita, New Mexico Fort for Santa Cruz, Sonora, Mexico. They had been traveling west through a sandy arroyo for nearly twelve miles, then came upon a plain of thick mesquite bushes and no grass. They expected to find a line of trees or luxuriant vegetation to mark the course of the San Pedro River, when all of a sudden they found themselves on the banks of the river. Mr. Bartlett describes the stream to be about twenty feet across, about two feet deep, and quite rapid. The water, though muddy, was pleasant to the taste. They set up camp.

Bartlett's report goes on to describe the San Pedro Valley as being anything but luxuriant. *"It consists of a loam, which if irrigated might be productive; but as the banks are not less than eight or ten feet high, irrigation is impracticable, except by digging a canal a long distance. The grass of the vicinity is miserably thin and poor, growing merely in tufts beneath the mesquite bushes which constitute the only shrubbery, and in some instances attain a height of ten or twelve feet. Low hills approached within a mile of the river on the east side, and on the west side within a quarter of a mile of that distance. Finding it impossible to graze our animals here, I sent men up and down the stream in search of better grass, which they succeeded in discovering about three miles further south, with springs of water near. I therefore directed the camp to be removed there the next day."*

When they crossed the river, Bartlett stated it was necessary to level the banks of the river on both sides and let the wagon down by hand. There was no trail. Before they could move on, a torrential rain storm came, and it appeared the whole surface of the valley was completely deluged with water. The exploring party continued on to Santa Cruz the following day.

Personal Narrative of Explorations and Incidents in Texas, New Mexico, California, Sonora, and Chihuahua 1850-1853 by John Russell Bartlett; The Rio Grande Press Inc.; 1965; Chicago; first published in 1854; pages 379-381

San Pedro Valley Described by Lt. John G. Parke ~ 1854

Lieutenant John G. Parke of the Corps of Topographical Engineers received an appointment while in San Diego from the War Department, December 20, 1853, to make a survey for a railroad route between the Pima villages on the Gila River and Dona Ana on the

Rio Grande. Instructions were received from Jefferson Davis, Secretary of War, that stated the President of Mexico, Santa Anna, gave the government permission to make the survey through the Mexican Territory.

Lieutenant Parke gathered up funds, additional instruments, and supplies, and with a party of fifty-six men left San Diego on January 24, 1854. By February 25, the survey crew saw their first glimpse of the San Pedro Valley. In Parke's report, he recorded: *

Last night was cold and squally, a rain setting in immediately after dark. Started early and soon made the summit of the divide, whence we had a view of the San Pedro Valley -- a dry, parched-looking plain, bounded on the east by a low, bare ridge, beyond which loomed up in the blue distance the Dos Cabezas, the most striking and prominent landmark in this region. The trail bearing too much to the south, we left it, and turning eastward descended to the San Pedro, where we camped. From the summit there is a gradual slope to the valley proper or bottom, which we entered by an abrupt descent of about sixty feet. This bottom is bounded on both sides by an irregular zigzag step, much indented by deep washes, and is at this point about three miles wide. It is covered with a growth of grass, now dry and crisp. The stream is about eighteen inches deep and twelve feet wide, and flows with a rapid current, at about twelve feet below the surface of its banks, which are nearly verticle, and of a treacherous miry soil, rendering it extremely difficult to approach the water, now muddy and forbidding. The banks are devoid of timber, or any sign indicating the course or even the existence of a stream, to an observer but a short distance removed. *

Parke's report included a favorable recommendation for a railroad, however it was twenty-six years before the railroad reached the San Pedro Valley.

Ref: Reports of Explorations and Survey's from the Mississippi River to the Pacific Ocean; made under the direction of the Secretary of War in 1853-54 according to acts of Congress of March 3, 1853 and August 5, 1854; 33rd Congress session; House of Representatives; Vol II; printed 1855; cited book in possession of the Fenn family.

San Pedro Valley Described by Waterman L. Ormsby - 1858 Passenger on the Butterfield Overland Mail Stage

The first Butterfield Overland Mail stage from St. Louis to San Francisco passed through the San Pedro Valley arriving in Tucson on October 2, 1858. A correspondent for the New York Herald, Waterman L. Ormsby, rode the full route on the first westbound stage.

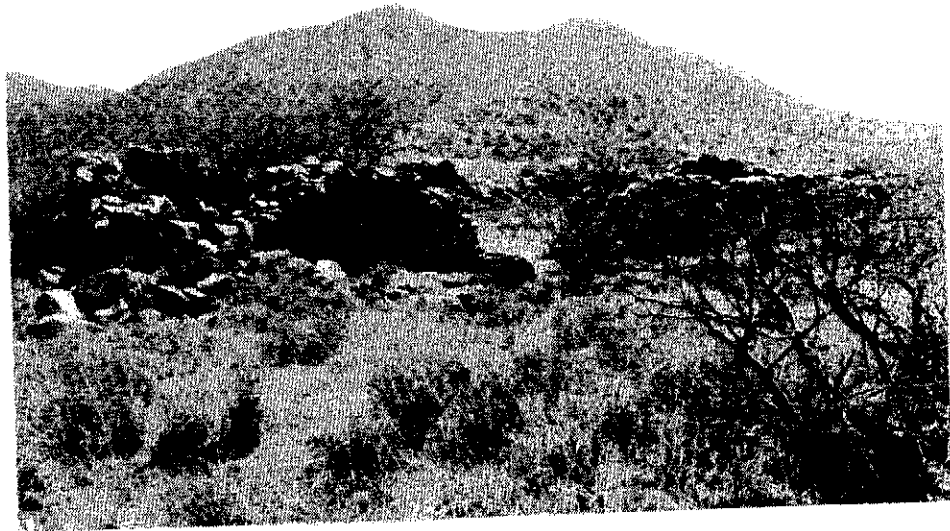
Upon arriving at the Dragoon Springs Station, they found three of the stage workers had been murdered and one severely wounded by three Mexicans, who had been helping them. After help was administered and more help arrived, the stage moved on towards the San Pedro Valley. Mr. Ormsby describes the San Pedro Valley:

"From Dragoon Springs the appearance of the country for the next twenty-five miles is entirely different from the preceding. The road leads through deep gullys and beds of creeks and over walls; and once more we came to the interminable mesquite timber, looking like crab apple trees or stunted oak - when suddenly we wheeled into the valley of the San Pedro. The stream itself is insignificant, but the valley has the appearance of having been once a vast stream itself - bordered, as it is, by the bluffs of an abruptly ending plain, far above its level, on the west, and sloping hills on the east. Our road led a few miles north in this valley in which there is not, that we could see, a respectably sized tree - and finally crossed the stream. (if by that name it might be dignified) and took a westerly course over the hills, from which we had a fine view of the San Pedro Valley. However uninviting this valley may appear, it is said to be very fertile; but so long as it is left, as now, a prey to merciless Indians, no man can settle there in safety. If there is any portion of the route calculated to impress one with the necessity of military protection for the route of this overland mail, it is this very last few hundred miles which I have just described, running through the heart of the Apache country." *

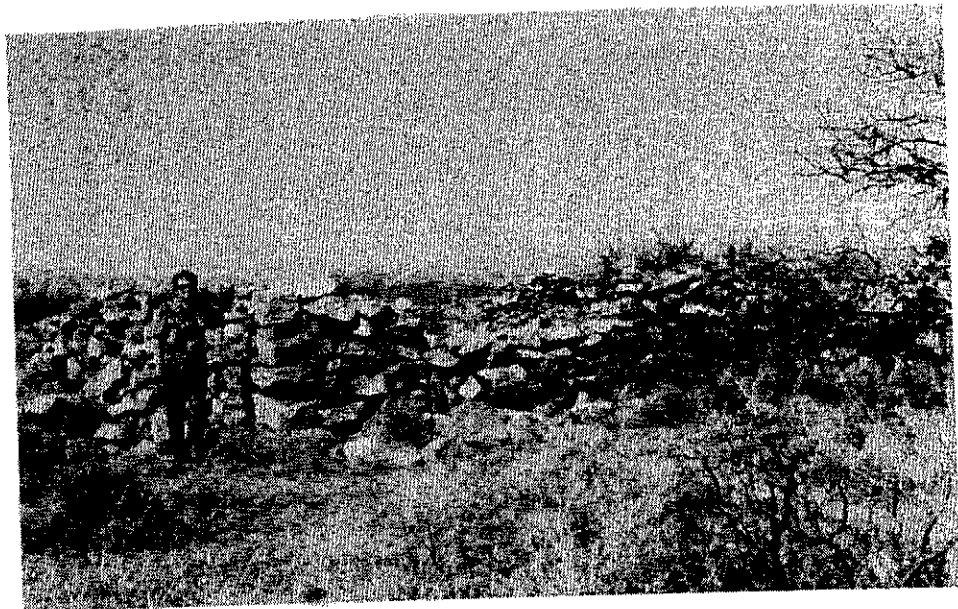
The stage route took them on to Cienega Springs, the next stage stop before reaching

Tucson.

Ref: "New York Herald" Newspaper on microfilm at the University of Arizona; Tucson



Ruins of the Dragoon Springs Butterfield Stage Stop that was used during the 1850s
Below: Louise Larson visits Dragoon Stage Stop - 1999
pictures courtesy Alvah F. Fenn



Tres Alamos (Three Cottonwoods) Butterfield Stage Station

Several small communities flourished for a time along the San Pedro and then were deserted. It is believed the Tres Alamos settlement was the earliest American settlement on the San Pedro River.

The Butterfield Overland Mail Company's stage line left the Dragoon Springs Station, came into the grassy San Pedro Valley and traveled in a northerly direction and crossed the river at a place known as Tres Alamos. The only road being the one made by the Butterfield stage. In 1858 a stage station was built on the east side of the river at this location.

The lands in the valley were first occupied at Tres Alamos in December, 1865 by Mark Adrich, John H. Archibald, Fred Berthold, Jarvis Jackson, John Montgomery and H. Brown of Tucson. A ditch was dug to carry water from the shallow river to the farm lands. Land was prepared for crops and some adobe brick houses were built.

A detachment of soldiers were stationed there for a few months and soon settlers began to arrive until there were a hundred men, women and children. The crops produced in the valley the first year amounted to 350,000 pounds of wheat, barley and beans.

Ranches were scattered up and down the river from three to five miles. All went well until about two years later, when Apache depredations started. Men were killed, horses, oxen, and other stock were stolen, property was destroyed and homes robbed. A petition signed by a number of citizens was sent to General Crittenden asking for soldiers to help guard the place. Ten men were sent immediately.

In June of 1873, more vegetables were being raised by the farmers than ever before. John Montgomery purchased a new grain thresher, the best of its kind. The following year, the potato crop was almost a failure and some corn damaged by a worm in the valley. The following year the potato crop looked good.

Despite the hostilities, the community continued to grow; crops were planted and harvested. A school teacher, Mary Belle Bernard Aguirre, was hired in the fall of 1875. A one-room adobe house with a large fireplace and a dirt floor was used for the school. It was located on the west side of the river. Twenty-three students of all ages enrolled that fall. There were no seats, desks, blackboard or table. There were a few books, some slates and pencils. A stool was acquired for the teacher and the children sat on the floor until a plank held up with two candle boxes was provided.

Mrs. Aguirre and her young son boarded at the Thomas Dunbar home on the east side of the river. Their house was of adobe brick as lumber was very scarce, with a large corral attached and consisted of one large room which was the stage station, post office and sleeping room for travelers going through the country. Two smaller bedrooms were to the back. There were no board floors or unnecessary doors or windows.

Mrs. Aguirre walked a mile across the valley to the school accompanied by some of her students. In April, the school had to be closed because the Indian hostilities became so bad that it made it unsafe for her and scholars to walk to the school. Mrs. Aguirre and son returned to Tucson.

The following fall, school reopened. By then the flies and mosquitoes were expected to emigrate. Mr. Fred Berthold fitted up the school room, and Mr. Fred Pratz appointed a teacher from San Francisco.

The town of Tres Alamos began to dwindle when the railroad came to Benson which was about seven miles up the river. It soon became completely abandoned. A few homesteads were taken up on the west side of the river and a few ranches survived.

All that remains of the town site are a few mounds, bits of glass and tin, mesquite trees, and a beautiful view across the valley to the rugged Rincon Mountains.

Ref: 1. Article to Arizona Citizen, 1871 by John Montgomery; 2. My first school by Mary Belle Bernard Aguirre; 3. Above articles in Benson Historical Museum and Art gallery. Used by permission.



looking from the old Tres Alamos townsite across the valley
and San Pedro River towards the Rincon Mountains

**The San Antonio, Texas to San Diego, California
Mail and Passenger Stagecoach Line Called the "Jackass Mail" Line ~ 1858**

The first mail and passenger stagecoach line to pass through the San Pedro Valley was the San Antonio and San Diego Mail and Passenger Line. It was called the "*Jackass Mail*" line because, besides using the mules to pull the coaches, they were also used to carry the mail and passengers on their backs over the difficult places throughout the desert. The line was not too efficient and was not in operation for very long.

One of the passengers, Phocion K. Way, who was employed by the Santa Rita Mining Company of Tubac, recorded in his diary June 10, 1858, that they arrived at Dragoon Springs expecting to have trouble with Indians, but didn't see any. They left at one o'clock and arrived on the San Pedro in time to prepare their supper. He described the river to be small, short and muddy. He bathed in the murky water and felt much refreshed. * The following day they followed the river six or seven miles north then turned west. They arrived in Tucson on June 12, fully expecting to see "*a miserable place - and we were not in the least disappointed.*"

Since the mail route did not accomodate the people in Northern California, they figured "*the line ran from no place through nothing to nowhere.*"

- Ref: 1. Early Arizona - Prehistory to Civil War by Jay J. Wagoner; 1975; p. 344-350
2. The Arizona Press; 1230 N. Park Ave. #102; Tucson, Arizona 85714-4135

William Ohnesorgen Operates Ohnesorgen and Walker Stage Company-1871

William Ohnesorgen, a young man of twenty-two years, came to the San Pedro Valley in 1871, from Tucson, Arizona. His brother had bought a stage station from Duncan, Renshaw and Fowler and had sent him to be in charge of it. The stage stop was located at San Pedro, about a mile north of where Benson was later established.

Ohnesorgen related: "The station, like most of them, was made of adobe brick walls eighteen inches thick, arranged in the form of a hollow square with port holes in each corner and no windows. How did we get light? Well, we had the doors and if we wanted lots of light, we went outside. The wall of the corral was eight feet high, for we were on flat country." (Noted on an old map as Ohnesorgen Flats)

"The government kept a picket of eight or ten soldiers at the station to protect us and the ranchers around us as well as the emigrants. Indians never attacked the station while I was there, but they did before I went there and killed two soldiers."

"There was no real stage line then just a fish cart running between Tucson and Fort Apache -- a two-wheel affair drawn by one horse. But it was an important point on account of the overland travel and the military. We kept supplies, forage, etc."

"I planted willows and things on either side of the river, but the beavers cut down all but one cottonwood which grew to be some three feet in diameter."


"The old stage station buildings were washed away by a flood which came down eight feet high." ✕

During the winter of 1878-79, Mr. Ohnesorgen built a toll bridge about a mile south of the station. He said: "The bridge had a twenty-five foot span. I got the Mormons to get the timber from the Whetstones. I bought four stringers from the saw mill in the Huachucas, and they cost me fifty-five dollars each. I built the bridge myself. The thing did not pay until 1880, when they were bringing machinery for Contention, Charleston and Fairbank. That year there was high water, and I took in four hundred dollars. My, how people hated to pay toll. They declared it was a public highway. I told them the highway went through the river, and they could use it if they wished, but the bridge was on my land, and if they used it they would have to pay toll. There was no cut in the river then; you could have stooped down and drank out of it at any point."

Ohnesorgen ran a six-horse stage line from Tucson to Tombstone, but got rid of it in 1880, as the railroad to Pantano let him out.

William Ohnesorgen was a member of the Territorial House of Representatives in the Ninth Legislature Assembly in Tucson, 1877. He was Justice of the Peace in Benson for eight years. Mr. Ohnesorgen married Maria Louisa Ruiz on August 25, 1883, and they had eight children: William, Frank, Joe, Edward, Ernest, Conception, Eliza and Beatrice. Many of their descendants still reside in the valley.

Ref: 1. Reminiscences of William Ohnesorgen as told to Mrs. Geo. F. Kitt, October 22, 1928. 2. Miss Dora Ohnesorgen, granddaughter

Ohnesorgen & Co.
PROPRIETORS 
Pioneer Livery Stables,
BENSON, ARIZONA.
First-Class Conveyances of all kinds for hire.
Transient Stock carefully provided for. Hay and Barley for sale

Fourth printing 1980

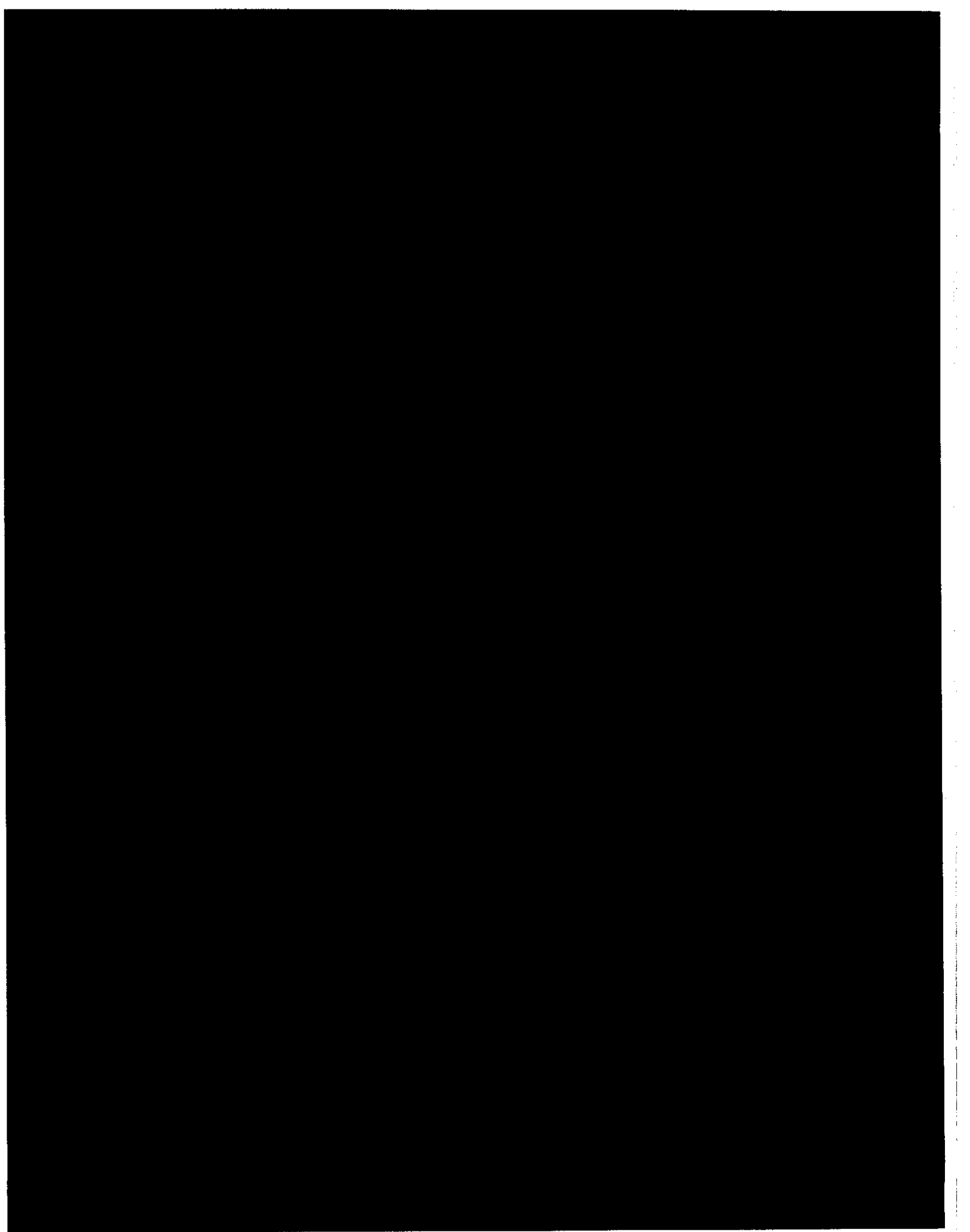
THE UNIVERSITY OF ARIZONA PRESS

Copyright © 1965
The Arizona Board of Regents
All Rights Reserved
Manufactured in the U.S.A.

I.S.B.N.—0—8165—0014—2
L.C. No. 65—25019

TABLE OF CONTENTS

PAGE	
x	LIST OF FIGURES AND PLATES
3	INTRODUCTION
7	I. THE DESERT HABITAT
22	II. THE INFLUENCE OF MAN: INDIANS, SPANIARDS, MEXICANS
35	III. THE INFLUENCE OF MAN: THE ANGLO-AMERICANS
49	IV. THE OAK WOODLAND
109	V. THE DESERT GRASSLAND
185	VI. THE DESERT
271	VII. THE PATTERNS OF CHANGE
275	VIII. SOME HYPOTHESES OF VEGETATION CHANGE
284	IX. CHANGE AND CAUSE
291	NOTES
297	APPENDIX A
299	APPENDIX B
303	APPENDIX C
305	LITERATURE CITED



The Changing Mile

JAMES RODNEY HASTINGS
The University of Arizona

RAYMOND M. TURNER
United States Geological Survey

THE CHANGING MILE

*An Ecological Study of Vegetation Change
With Time in the Lower Mile of an
Arid and Semiarid Region*



THE UNIVERSITY OF ARIZONA PRESS
Tucson, Arizona

INTRODUCTION

The eighties of the last century saw a series of changes initiated in the natural landscape over a large part of the region that had earlier belonged to the Borderlands of New Spain, but which at one time or another during the preceding forty years had been acquired by the United States.

By 1890 the old equilibrium had been so badly disturbed that signs of a major natural upheaval began to appear. Not quite overnight, but certainly during the course of a single summer, many of the streams of the region underwent a striking change in their hydrologic regimes.

Where the San Pedro River of southeastern Arizona formerly wound its sluggish course northward through a marshy, largely unchanneled valley, in August, 1890, it began carving a steep-walled trench through which it thereafter emptied rapidly and torrentially into the Gila. Where it formerly ran more or less consistently throughout the year, after 1890 its flow became intermittent, leaving the new channel dry over much of its length for most of the time (Hastings 1959).

With a few modifications much the same thing happened at about the same time along all of the major watercourses of southern Arizona; the Santa Cruz River, San Simon Creek, Babocomari Creek, Sonoita Creek, and the Sonoita River.

Whether the hydrologic shift was confined to the Sonoran desert region; whether it occurred throughout the semiarid Southwest; whether, if occurring elsewhere, it followed the same chronology—these questions remain to be answered.

In the specific region with which this study is concerned—the northern Sonoran Desert and the highlands within it and to the east—irrigation ditches were left high and dry, and as washes adjusted their levels to those of the main streams, the valley floors became dissected and redissected. Much of the better farm land washed away; much of the rest was rendered unusable. To the farmer and the rancher

the economic loss was severe, but not without at least partial compensation. Malaria, a major plague among the early settlers, disappeared along with the marshes, the beavers, and the fish.

Writing in 1903 about an area (pictured in Plate 38) on the west side of the Santa Rita Mountains, David Griffiths, Agriculturist with the Office of Farm Management, thought he detected change of another sort:

A close examination of the broad, gentle, grassy slopes between the arroyos in this vicinity reveals a very scattering growth of mesquite (*Prosopis velutina*) which is in the form of twigs 2 to 3 feet high with an occasional larger shrub in some of the more favorable localities. . . . One cannot tell whether this growth indicates that this shrub is spreading or not. The present condition rather suggests this possibility (Griffiths 1904: 29).

Seven years of additional observation confirmed his suspicion and he predicted that "the time is coming when these foothill grassy areas, which now have only an occasional small shrub will be as shrubby as the deserts and lower foothills . . . if not more so" (Griffiths 1910: 22).

Turning his attention to another plant, burroweed, he found that it too had "thickened and increased perceptibly during the last five years. . . . It is quite probable that the grasses unmolested would hold their own against its encroachment, but with the grassy vegetation weakened by grazing it may increase to such an extent as to crowd out nearly all of the valuable plants" (*ibid.*, 18).

In the same year J. J. Thornber, a botanist at the University of Arizona, agreed that "the mesquite is one of our species that appears to be on the increase." Writing in retrospect of the preceding thirty years, Thornber also called attention to the deterioration of the grazing ranges:

When once perennial grasses are killed out [by overgrazing and trampling] they are indeed slow to reassert themselves. Such denuded areas are claimed by

the less valuable six-weeks grasses . . . or worse yet, they are seized upon by one or more of the species of obnoxious weeds . . . unpalatable . . . for grazing purposes. On an area where practically everything else is grazed, they alone are left untouched by stock to continue reproduction, and to thus spread farther over the adjacent poorly grazed ranges. Unfortunately, too much of our once valuable grazing domain has become thus converted into unproductive weed wastes which hold the ground against valuable grazing plants (Thorner 1910: 276).

Also in 1910, an *amnis mirabilis* in the perception of changing conditions, Forrest Shreve of the Desert Laboratory of the Carnegie Foundation noticed that things were not right with the saguaro, or giant cactus.

Young plants less than 1 dm in height are so rare, or inconspicuous, that nine botanists who have had excellent opportunities to find them report that they have never done so. . . . [A study of its establishment rate] compels the conclusion that it is not maintaining itself [in two favorable situations studied]. A fuller knowledge of its germination and the behavior of its seedlings, together with a more complete knowledge of the periodicity of certain climatic elements within its range will be sure to throw light on the fall in its rate of establishment (Shreve 1910: 240).

In subsequent years the fact of a mesquite invasion has gained complete credence—although the reasons for it are still very much in dispute (Parker and Martin 1952). The failure of the saguaro to repopulate in some areas—most notably at Saguaro National Monument—has been well established (Alcorn and May 1962). One can read in various sources that burrowed and snakeweed have proliferated on overgrazed ranges (Benson and Darrow 1954).

Changes like these in the natural vegetation, together with others that have gone unnoticed, constitute the subject of this study. That they have taken place at all may be surprising. And that they have taken place on a scale so large over a period of time as short as eighty years is certainly surprising. Taken as a whole, the changes constitute a shift in the regional vegetation of an order so striking that it might better be associated with the oscillations of Pleistocene time than with the "stable" present.

To understand why this has happened is a problem of consuming interest. And Janus-like it faces in two directions. On the one hand, it is a challenging scientific problem; on the other, it is an important human problem. On the one hand, it is intimately involved with the workings of hydrology, climatology, and ecology. On the other, it is closely tied to man's activities both by its origins and its implications.

As a problem in human geography much of its importance stems from the climatic context in which the changes are set—that of an arid and semiarid

region. With each decade, these drier parts of the earth's surface—variable and delicately balanced—become increasingly important; principally so by virtue of their being vacant.

For the most part the humid, temperate areas have undergone a relatively intensive development; to a considerable extent man's ability to find a place for still more of his kind lies in the degree of success with which he is able to populate the sixteen million square miles of the earth's surface where there is room, but where rainfall is inadequate for conventional agriculture (McDonald 1959: 3).

The utilization of these regions poses special difficulties, the paramount one being survival. An advanced civilization with abundant production and efficient transportation can evade the problem by attaching its arid parts to a humid, mother region that supplies them with food, energy, and most of their other needs. The arid zone in this case becomes a mere suburb and supplies only living space.

Few nations, however, outside of our own, can afford the luxury of a national bedroom, and with the majority the solution lies in skillfully using the meager resources at hand to develop an arid-land economy that, if not self-sufficient, can at least pay a large part of its own way.

Water is at the heart of the matter; how to use the meager supply effectively; how, if possible, to make it stretch. To realize that the dilemma as seen at a particular point in time may not be as confining as it seems, one has only to look back at the myth of the Great American Desert, the high plains lying between the ninety-eighth meridian and the Rocky Mountains.

Dr. Edwin James, physician with the Long Expedition of 1819-20 up the Platte and down the Canadian River, described the region as follows:

In regard to this extensive section of country, I do not hesitate in giving the opinion, that it is almost wholly unfit for cultivation, and of course uninhabitable by a people depending upon agriculture for their subsistence. Although tracts of fertile land considerable extensive are occasionally to be met with, yet the scarcity of wood and water, almost uniformly prevalent, will prove an insuperable obstacle in the way of settling the country (Thwaites 1905: 147, Morris 1926).

Yet in 1960 the tier of states carved from the High Plains ranked as major agricultural producers. In 1871 Colonel Green, Commandant of Camp Apache, Arizona Territory, described that country as follows:

If you wish any further correspondence from me as to my views of Arizona, I can only tell you I have been over a great portion of it . . . and found it a rocky, mountainous desert, not fit even for the beasts of the field to live in (*Arizona Citizen*, April 22, 1871).

Yet in 1960 Arizona had, excluding beasts of the field, a population numbering well over a million.

Walter Prescott Webb (1931), one of the few historians to treat at any length the problem of man's adjustment to aridity, notes that the Great Plains defied the Spaniard, held up the western migration of Americans for many decades, and fell at last only when the proper tools came to hand. In some cases these tools were new inventions—the windmill, barbed wire, the six-shooter. In other cases they emerged from an improving technology: new methods of dry farming; advances in plant and animal genetics. Finally, some arrived only when man, at times his own worst enemy, was able to modify the more cumbersome of his legal and social institutions.

The New England village could not be transplanted onto the Sonoran Desert; nor could the riparian common law of England governing brooks and rivers be applied in apportioning the scanty water of the West. No pithier commentary on man's institutional inflexibility exists than the *Report on the Lands of the Arid Region of the United States* of 1878 in which John Wesley Powell, father of the United States Geological Survey, pointed out, among other things, the absurdity of applying the philosophy of the Homestead Act—one hundred and sixty acres and a mule—to semiarid grazing lands (Powell 1962: 32f.).

That man needed to adapt his institutions to meet the conditions of the dry regions was Powell's central thesis. And to some extent the westerner did so: in developing the prior appropriation doctrine for water; in providing for irrigation districts so that farmers collectively could build the dams and the ditches that a single individual could not; in evolving, among the Mormon pioneers in Utah, a cooperative society flexible enough to respond rapidly to challenge.

But that, by and large, we have failed to adapt, and that mere technological brilliance obscures this basic failure is Webb's latest contention, in a sort of pessimistic afterthought to *The Great Plains*. Looking this time at the Far West (Webb 1957), he says that instead of adjusting, Americans have created an oasis civilization. Holing up in his city, the westerner lives a life of humid abundance. His wells tap the water resources of a vast surrounding area—and irrigate clover lawns. His air conditioners, powered by energy from Texas gas or from a river five counties away, enable him to evade the discomfort of high temperatures.

Efficient transportation links him with the other oases and with the humid East, but not at all with the hinterland around him. He is, to push Webb's thought possibly beyond what was intended, enmeshed with the national economy of abundance and not at all with the regional economy of scarcity. He lives at the expense of an arid region and surrounded

by it, but not with it. His technology enables him to escape its rigors without making concessions.¹

Should an oasis need more water, engineers extend an aqueduct to a river two hundred miles away. Or they throw up surface reservoirs to collect runoff that has fallen at another place. Or they put down deeper wells to tap an underground supply deposited at another time, possibly during another geologic era. These are not, of course, solutions. They are mere borrowings from Peter to put off for a little the inevitable reckoning with Paul.

This study records the obverse of Webb's coin: what has been happening outside the oasis. Of necessity it is a record of man's failure to come to grips with aridity. He has failed because in his own scheme of values burroweed is a poor substitute for grass. A mesquite thicket in the terms of human economics is not the equivalent of a grassland. Not only does it waste water through excessive transpiration, it is relatively nonproductive.

But precisely where the failure lies is another question, the answer to which is contingent upon knowing what caused the streams and the vegetation to change in the first place. And this, as a scientific problem, is very much a matter of dispute.

In general the answers that are commonly given fall into two categories: those that hold man responsible, directly or indirectly; those that see natural factors, primarily climatic, operating independently of man.

If the cultural explanation is correct, our fault lies with having played bull in a china shop; in having, through inadvertence, brought down in ruins a delicately balanced structure that for all its sturdy resistance to heat, dust, and drought, was more fragile than it seemed to be.

If, on the other hand, the climatic explanation is correct, then we have merely failed to be sufficiently informed about the limits within which our environment operates. The error can have tragic consequences, even to an advanced society; but that the mistake is not new, even to such a society, the dust bowl on the High Plains in the thirties may attest to.

Evaluating the relative merits of the two explanations is by no means easy. Causation in historical, natural phenomena is a knotty problem for many reasons, not the least of which is that it places the experimental scientist, normally the one to be concerned with it, at such a disadvantage. He cannot go back and rerun the sequence of events, manipulating one variable at a time while he holds the others constant. Nor can he devise an experiment involving all the variables and perform it in any laboratory yet built. Too many factors must be considered, and the interaction between them is too complex.

So, although many experiments have been devised

There is, of course, no reason to suppose that one cause has to suffice for all of the changes. The natural world being what it is, there is, in fact, every reason to suppose that many factors are involved. But this is all the more reason for not accepting single-factor ecology, even in the case where it attempts to explain changes in the distribution of only one species. For every striking relationship that can be demonstrated experimentally there may be three, untested, that in the complex environment of the plant counteract the reason. Prudence demands that any factor known to be operating in the case of one species at least be examined for its possible effect on others.

What must be done before a satisfactory consensus evolves in regard to the changing plant life of the Southwest is to look at each of the cultural explanations that have been suggested—not just the three cited—and test its applicability to each known change—not just one. And the various climatic hypotheses must be similarly tested. In spite of the affection with which paleobotanists regard climate, almost nothing is known about the extent to which a given change in rainfall or temperature can dislocate the range of a species.

When all of this has been done the conclusion—if anyone ever arrives at it—will follow from the summing up for each plant of a long series of big pluses and little minuses, zeros, little pluses and big minuses—one quantity for each factor, and generalizing from these, all the while juggling the complex interaction between the independent variables themselves.

The problem, handled experimentally, burgesons out of all proportion to the simplicity of the initial question: what caused the changes? And yet any other approach yields only another opinion. This study makes no attempt to settle the matter once and for all, and in the last analysis it may raise more questions than it answers. But it does attempt to present a comprehensive view of the changes that have occurred since 1880, to sketch their historical context, to review the principal explanations that have been advanced to account for them, and to evaluate the evidence to date.

Inevitably some of the hypotheses considered fare better than others. For whatever consolation it may be to the losers, the explanations suggested here may not stand the test of time either. The moral perhaps is that the changes are "a better subject for study than for debate" (Anderson 1956: 776).

from time to time to test specific hypotheses connected with one or another of the alleged agents of change, the conclusions, perfectly valid in themselves, are of limited application to the larger problem. More of the explanations will be examined later, but for illustration, consider three of them:

1) A rodent species feeds on succulent young saguaro seedlings. In the course of settling the Southwest, man exterminated most of the predators that kept the rodent population in check. Subsequently the number of rodents has increased to the point where very few saguaros ever get past the seedling stage un eaten. Man's coming, then, has indirectly resulted in the failure of the giant cactus to maintain itself.

2) Before American settlement, recurrent fires used to sweep the grasslands of the Southwest. These resulted in little permanent damage to the grasses, which were able to emerge the following season as strongly as before, but the burning did periodically kill off any woody seedlings that had become established since the preceding fire. The effect of fire prevention has been the proliferation of shrubs, and consequently the deterioration of the grasslands.

3) Cattle browse on mesquite beans, some of which pass unharmed through the alimentary tract to be deposited, still viable, in a medium ideal for their germination. The wholesale introduction of cattle into the Southwest has resulted in the wider dispersal of mesquite seeds and thus in the plant's spread.

In light of the one factor examined, each of these three statements presents an explanation for the one phase of vegetation change that it considers. The last two, at least, have wide credence; one frequently hears them advanced, for example, by ranchers to explain why their range land has been invaded by mesquite. But mesquite invasion is only one amid a host of changes that have taken place.

Do cattle also eat the seeds of ocotillo and turpentine bush—plants that, as the following pages will show, have registered substantial invasions of their own? And can these seeds also pass unharmed through the alimentary tract of a cow? The rancher does not know, and neither does the scientist, but the answer is probably "no." The cow-flap explanation breaks down when applied to the broader problem. So does the fire-suppression hypothesis in accounting for the widespread death among oaks and saguaros. So does an increased rodent population when one attempts to explain why *Acacia vernicosa*, whose seeds are a favorite rodent food, has increased, not decreased.

III

THE INFLUENCE OF MAN: THE ANGLO-AMERICANS

INTRODUCTION

The earliest American accounts of the desert region date from shortly after the Mexican War for Independence when the mountain men—the early fur hunters—taking pelts where they found them, trapped beaver along the Gila and its tributaries.¹

As the western migration swelled, and well before title to the lands south of the Gila passed to the United States, travel across the region became commonplace. For the decade prior to the Gadsden Purchase, there exist a score of journals describing the country, most of them the offspring of troop movements during the Mexican War or the rush of the forty-niners across the continent on their way to the gold fields of California. Taken as a whole, the early accounts present a rich and detailed picture of the natural conditions that prevailed in the forties and fifties.

The landscape that they describe lasted for another generation, and the cultural factors that had helped to shape it changed very little in the 1850's. Some settlement took place immediately after the Gadsden Purchase; a few military posts came into existence (Eaton 1933); a few mines opened up in the hills. By and large, however, the years until the Civil War constituted for the region's ecology merely an extension of the Mexican period.

CONDITIONS UNTIL THE CIVIL WAR

From the early journals there emerges a picture of the country that in many respects contrasts sharply with present conditions. In particular the appearance of the valleys and the grasslands has changed (Hastings 1959).

The valleys. Today the streams in the Arizona part of the region—the San Pedro, the Santa Cruz, and their tributaries—maintain highly irregular regimes. Except in their upper reaches or along the parts of their course where rock formations force water to the surface, the beds much of the time are dry, sandy wastes that support little, if any, vegetation. Five to thirty feet above the channel and set apart from it by abrupt vertical banks, one typically

finds a bosque dominated by mesquite. During the summer rainy season, flash floods render the streams impassable. At such times the channel is filled bank to bank with a raging, muddy torrent that carves new incisions into the flood plain and sharpens the edges of the old.

Before the Civil War these same streams wound sluggishly along for much of their course through grass-choked valleys dotted with cienegas and pools. In spite of the onslaught by the mountain men, beaver dams were still numerous, and as late as 1882 a settler on the San Pedro could report that:

Our ditch was just above a beaver dam and if the water was low and we tried to irrigate at night the beaver would stop up our ditch so that the water would run into their dam.²

Of the San Pedro, Cooke noted a fact equally improbable from the perspective of the twentieth century: "Fish are abundant in this pretty stream. Salmon trout are caught by the men in great numbers; I have seen them eighteen inches long."³

Although they flowed more regularly than they do today, the rivers nevertheless did go dry at times or along particular stretches:

The San Pedro river as they call it—is a stream one foot deep six feet wide and runs a mile and half an hour and in ten minutes fishing we could catch as many fish as we could use and about every 5 miles is a beaver dam this is a great country for them—and we have went to the river and watterd and it was running fine and a half mile below the bed of the river would be as dry as the road—it sinks and rises again (Tevis 1954: 55).

Exceedingly to the surprise of every member of the expedition who had passed over this route in the months of March and April it was discovered after a march of a few miles that the waters of the San Pedro had entirely disappeared from the channel of the stream. . . . Where the present reporter took quantities of fine trout in March and April 1858 not a drop of water was to be seen [in September, 1858] (Itinerary 1858: 33).

Similarly, although there was far less channeling than at present, there was some, with the river's

A description appearing in the documents pertaining to the Leach Wagon Road makes it clear that the contrast between mesquite forest and open valley was sometimes sharp:

A forest of heavy mesquite timber about one mile in width extends from the [San Pedro] . . . Running nearly due north a road lies opened in March last through the Mezquite forest . . . for a distance of about three miles. . . Leaving the forest it enters upon a tract of the bottom lands of the San Pedro . . . from one fourth of a mile to one mile in width. . . The entire body of these lands were covered with a dense growth of sacaton grass . . . (Itinerary 1858: 32).

A second account by the builders of the wagon road describes the same part of the river:

The San Pedro, at the first point reached in the present road, has a width of about twelve (12) feet, and depth of twelve (12) inches, flowing between clay banks ten or twelve feet deep, but below it widens out, and from beaver-dams and other obstructions overflows a large extent of bottom land, forming marshes, densely timbered with cottonwood and ash, thus forcing the road over and around the sides of the impinging spurs (U. S. Congress 1859: 87).

Collating the two descriptions yields the information that the open, grassy bottoms were marshy, and that at the point in the bosque where the road intercepted the river, a channel trench already existed. In the account by Bartlett already quoted, the same identification exists between mesquite land and a shallow, adjacent arroyo. Given these clues, one can partially reconstruct the pattern of riparian vegetation. Along the parts of the river where there was no trench, the water table was high, the bottoms marshy, the soil waterlogged and too poorly aerated during at least part of the year to support anything but marsh vegetation dominated by grass.

Where there existed an arroyo, on the other hand, the bottom of the trench fixed the elevation of the water table. Between the surface of the water and the top of the bank there existed a layer sufficiently well drained to support mesquite and other plants whose roots require aeration and cannot tolerate waterlogging. This appears to be a reasonable explanation, but it may be oversimplified. An 1854 description of the river about two miles above the point where the Leach road reached it, warns of some pitfalls:

At the Tres Alamos [crossing] the stream is about fifteen inches deep and twelve feet wide, and flows with a rapid current over a light, sandy bed, about fifteen feet below its banks, which are nearly vertical. The water here is turbid, and not a stick of timber is seen to mark the meandering of its bed (Parke 1857: 25).

Here a treeless condition is equated with the presence of a channel trench. But this account, in turn,

course defined in varying degrees. An early picture of the junction of the San Pedro River and Babocomari Creek appears as Plate 57. The creek seeped through a rank growth of marsh grass and can hardly be said to have a course. Near Tucson, at a place where its channel is now ten feet deep and seventy-five feet wide, the Santa Cruz in 1849 ran in an untrenched, but well contained stream better defined than the Babocomari's, and perhaps with multiple channels:

We encamped in a grassy bottom, much covered with saline efflorescence. The river has divided to a mere brook, the grassy banks of which are not more than 2 yards apart (Powell 1931: 145).

A distinct channel trench existed in places along the San Pedro and probably along the other streams:

The valley of the San Pedro River [near the mouth of Dragon Wash] . . . was anything but luxuriant. It consists of a loam, which if irrigated might be productive, but as the banks are not less than eight or ten feet high, irrigation is impracticable. . . The grass of the vicinity is miserably thin and poor, growing merely in tufts beneath the mesquit bushes which constitute the only shrubbery, and in some places attain a height of ten or twelve feet. . . In order to cross the river, it was necessary to level the banks on both sides, and let the wagon down by hand.

A few miles farther north Bandler (1892: pt. 2, 478), writing just before the severe erosion of the 1890's, found "a cut with abrupt sides . . . 10 to 15 feet deep, and about 25 wide." In Plate 51, a picture of Charleston about the time of Bandler's visit, a clear, small trench is visible. About the presence of brush, there is similarly no simple generalization that will hold. It is apparent from many of the old photographs and accounts that parts of the valleys were more open than at present. Nevertheless brush and even bosques are frequently mentioned.

The valley of this river [the San Pedro near its junction with the Gila] is quite wide, and is covered with a dense growth of mezquite . . . cotton wood, and willow, though which it is hard to move without being unhorsed. The whole appearance gave great promise, but a near approach exhibited the San Pedro, an insignificant stream a few yards wide, and only a foot deep (Emory 1848: 75).

The bottom of the San Pedro is one mile broad [at the same site], and of the character of those on the Gila above, dusty dry soil, grown in places with cottonwoods and willow, in others with grass and again mesquite, chaparral, other places bare (Johnston 1848: 592).

The land on each side of the Pedro river bottom is a dense thicket of bramble bush, mostly muskeet, with which millions of acres are covered (Golder, Bailey, and Smith 1923: 193).

The Grassland of the San Pedro Valley

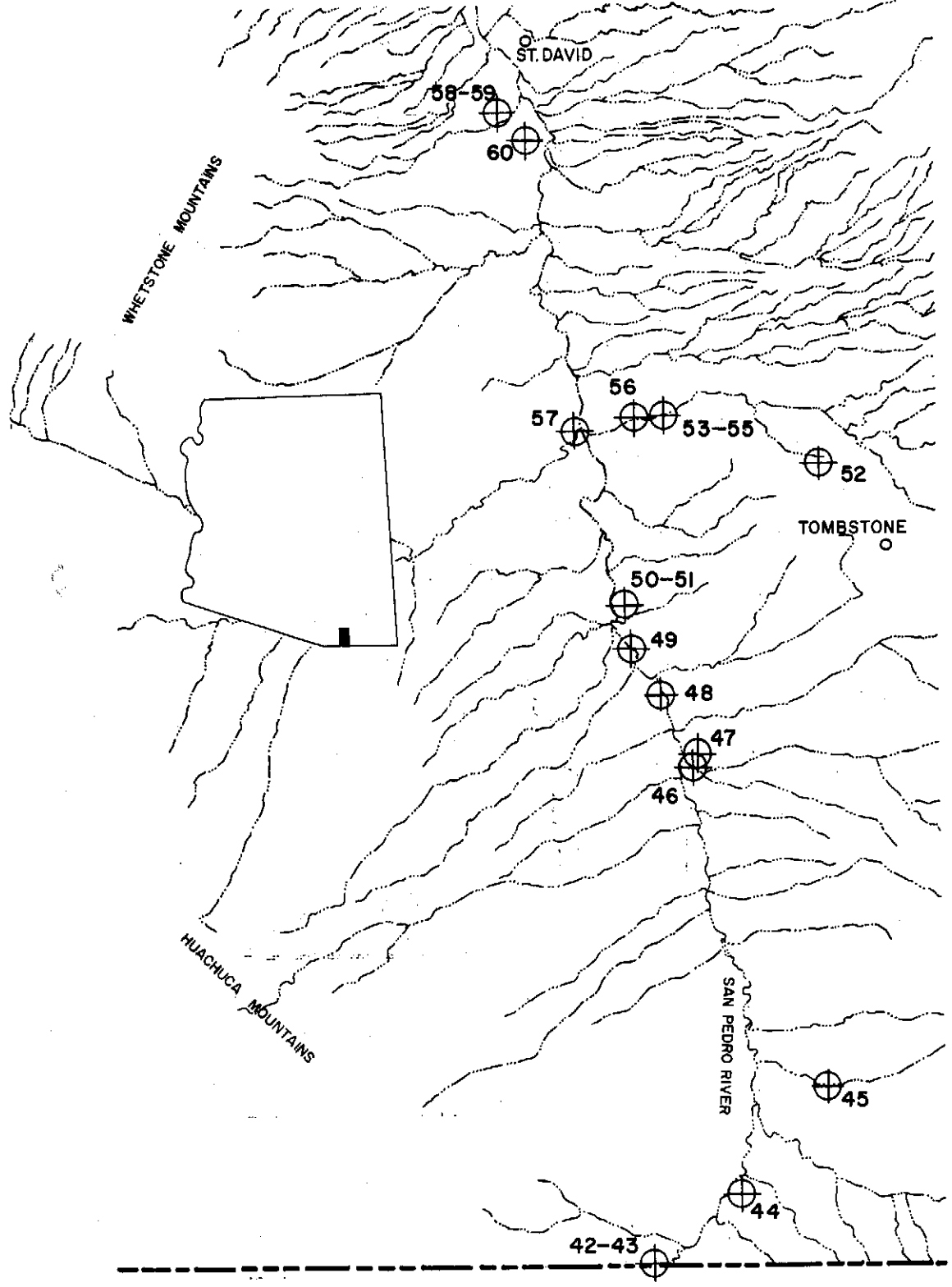
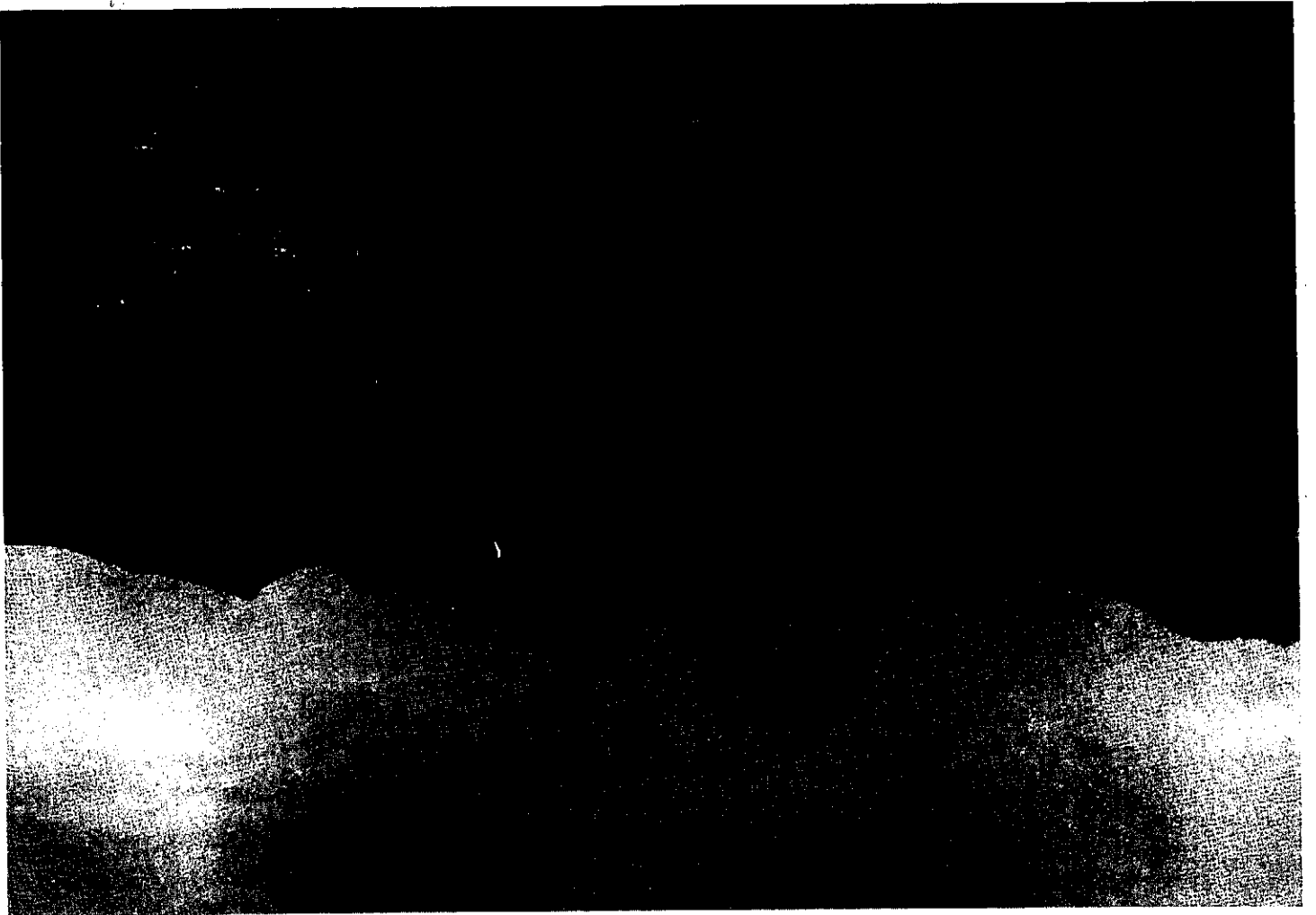


FIG. 9—The location of photographic stations in the San Pedro grasslands.

THE CHANGING MILE



backed up into a series of large pools by beaver-dams, and is full of fishes. West of the river there are no steep banks or terraces, the prairie presenting a gentle ascent" (Emory 1857: I, 99 ff.). The slopes of the terrace along the east side appear, like the valley, to be grassy and open. Palmillas inhabit the basin in front of the camera, and several individuals among them persist into the present. The other shrubs may be Mexican tea or, in the case of the larger ones, mesquite. Elevation 4350 ft.

PLATE 42a (1891). On the International Boundary at a point just west of the San Pedro River, looking southeast into Mexico toward the Sierra San José. "At this point, approaching from the east, the traveller comes within a mile of the river before any indications of a stream are apparent. Its bed is marked by trees and bushes, but it is some sixty or one hundred feet below the prairie, and the descent is made by a succession of terraces. Though affording no very great quantity of water, this river is

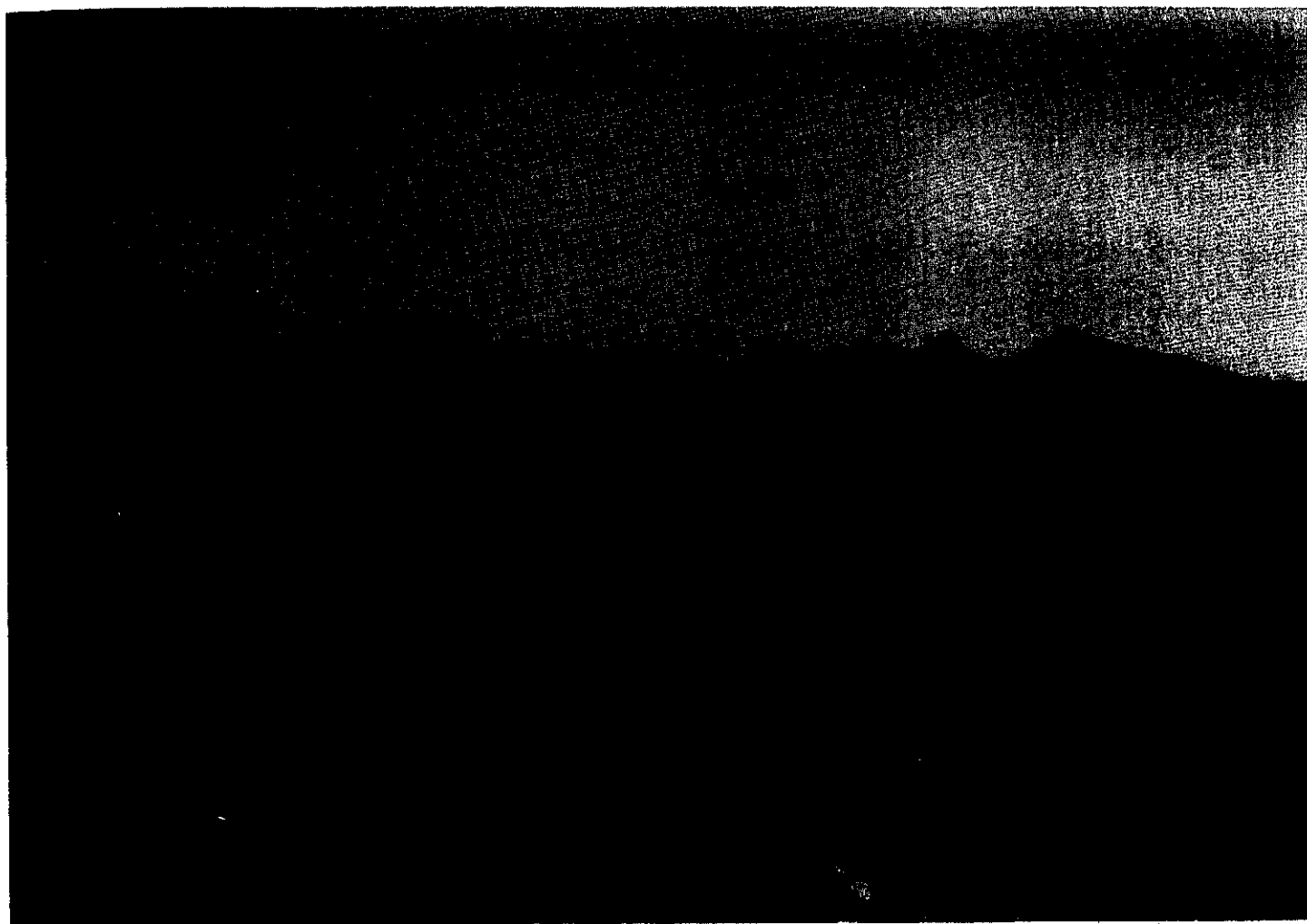


PLATE 42b (1962). *Acacia vernicosa* instead of grass dominates the terrace sides. The river's deeply scoured channel is marked by a line of trees that were not identified, but which, in addition to cottonwood, may include Goodding and desert willow, velvet ash, and walnut. A dense growth of mesquite and sacaton grass blankets the flood plain. In the small basin: palmillas, some of

them probably a century old, mesquite, desert willow, rabbit-brush, and sacaton. The curved spit of high ground half encircling the basin supports Mexican tea, wait-a-minute, threadleaf groundsel, mesquite, fairyduster, blue grama, hairy grama, *Aristida glauca*, and a species of blue stem.

THE CHANGING MILE

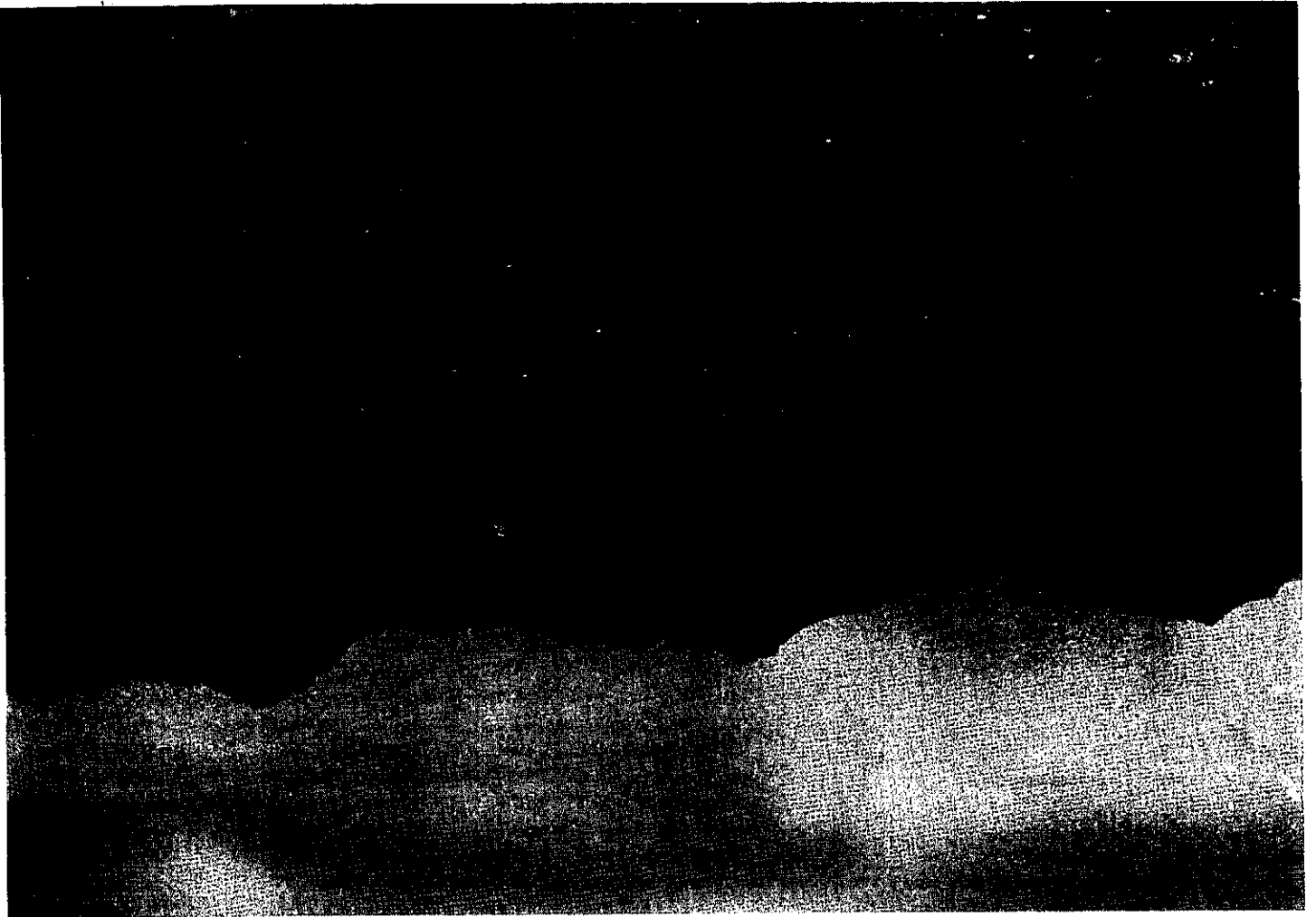


PLATE 43a (1891). From a point fifty feet east of the preceding station and looking west up the bajada of the Huachuca Mountains along the International Boundary. The wash at the left bends abruptly southward, and is at the right in Plate 42. In it palmillas can be recognized and, to the left of and behind the surveying party, what appears to be a grove of desert willows. The scarcity of grass is probably not representative of the conditions before 1890. The year 1891 marked the peak of overgrazing on Arizona ranges; in addition, the summer saw the beginnings of a disastrous drought that decimated cattle herds all over the region. Emory (1857: pt. 2, p. 18), thirty-seven years before this picture, described the bajada as "composed of hard gravelly soil, and supporting a close sward of grama grass, giving a peculiarly smooth shorn look to the general face of the country." Elevation 4350 ft.

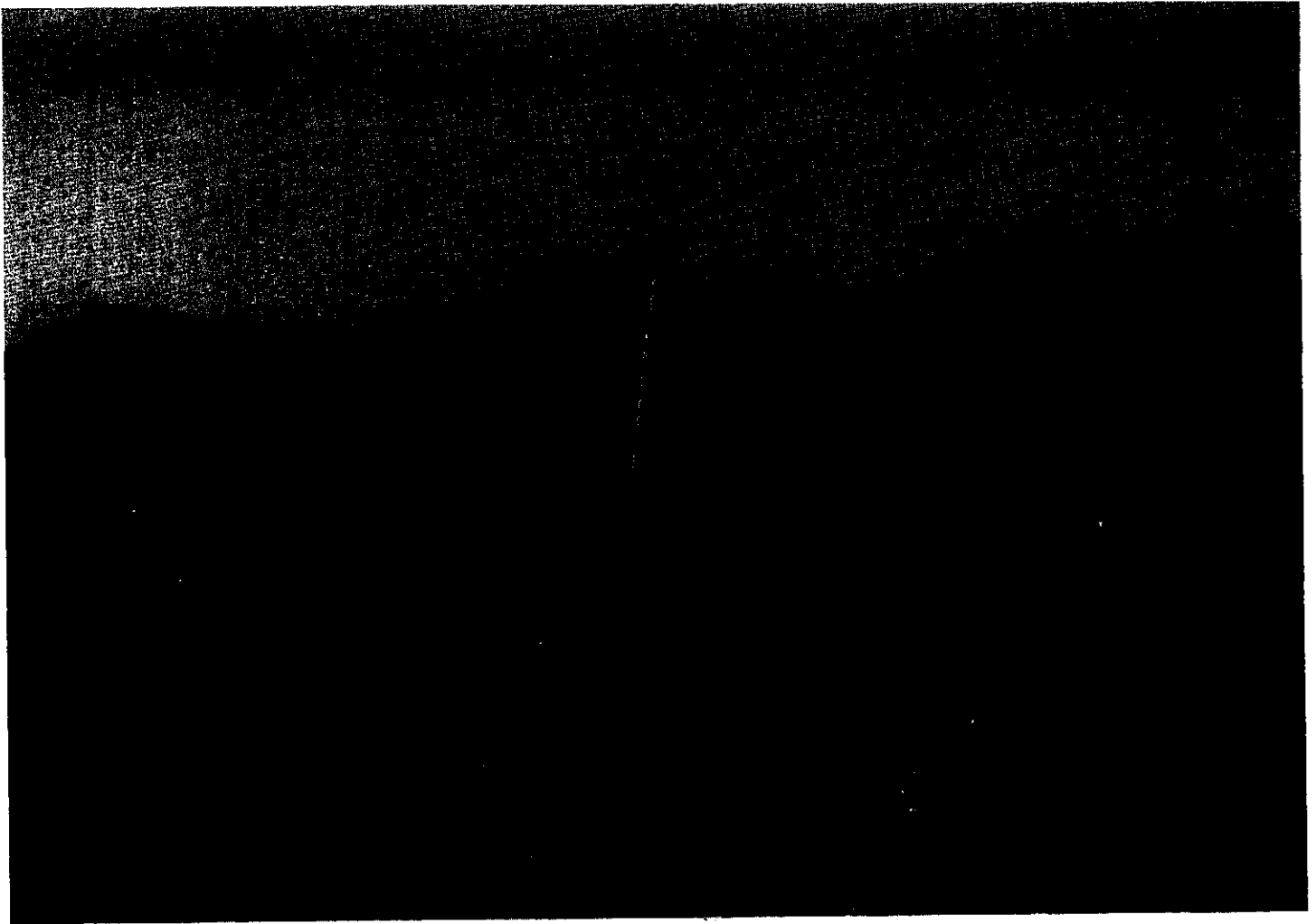


PLATE 43b (1962). This picture was taken on the Mexican side of the fence and looks toward Monument 98, which has replaced the old rock cairn. The foreground, almost unchanged, supports wait-a-minute, several small mesquites, and some threadleaf groundsel, a plant that is seldom grazed and is toxic to cattle. Although mesquite, desert willow, and desert broom choke the wash, woody plants have invaded the uplands only slightly. The

grasslands of the upper bajada here and those of the rolling country around Sonoita are the only major ones in southeastern Arizona that remain free from brush and substantially unchanged. In the background, at the foot of Montezuma Peak and extending down into the bajada along drainages, is the oak woodland.

THE CHANGING MILE

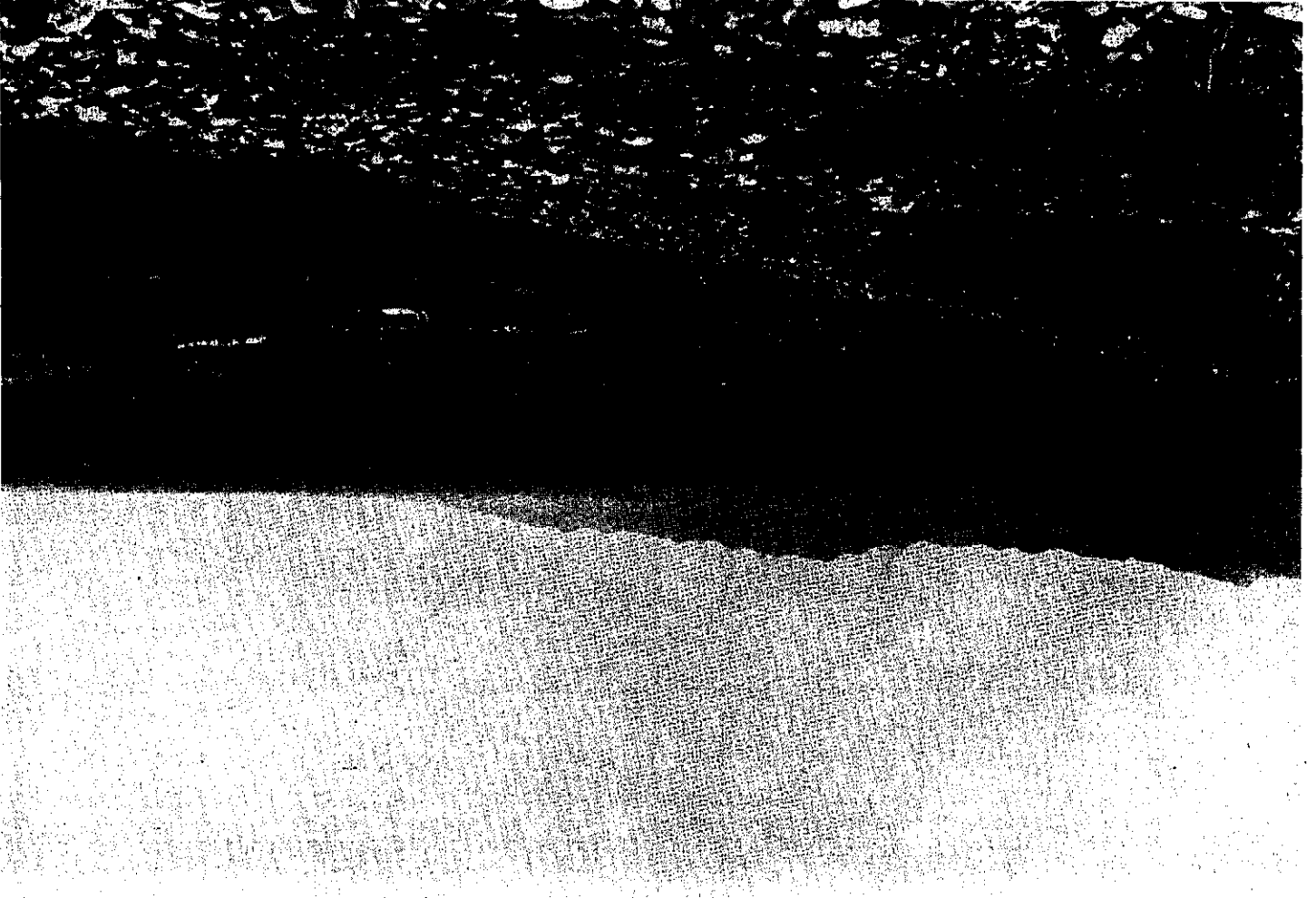


PLATE 45a (1891). The north end of the Huachuca Mountains as seen from across the upper San Pedro Valley. The camera looks west down Spring Creek across the broad valley which along this section supports shrubby vegetation alternating with more open areas. The photo station is located in one of the latter; a sparse covering of grasses is interrupted by plants of blue yucca, palmilla, and sotol. Although positive identification is not possible, shrubs seen in the photo probably include creosote bush, Mexican crucillo, fatyduster, and *Acacia vernicosa*. Elevation 4400 ft.



PLATE 45b (1962). After seventy years the patches of grassland are gone and sites already shrubby before are even shrubbier now. The camera station is covered by *Acacia vernicosa*; the small valley below the camera supports a growth of mesquite,

desert willow, *Rhus microphylla*, and sacaton. The three relatively large trees growing along the channel at center midground are walnuts.

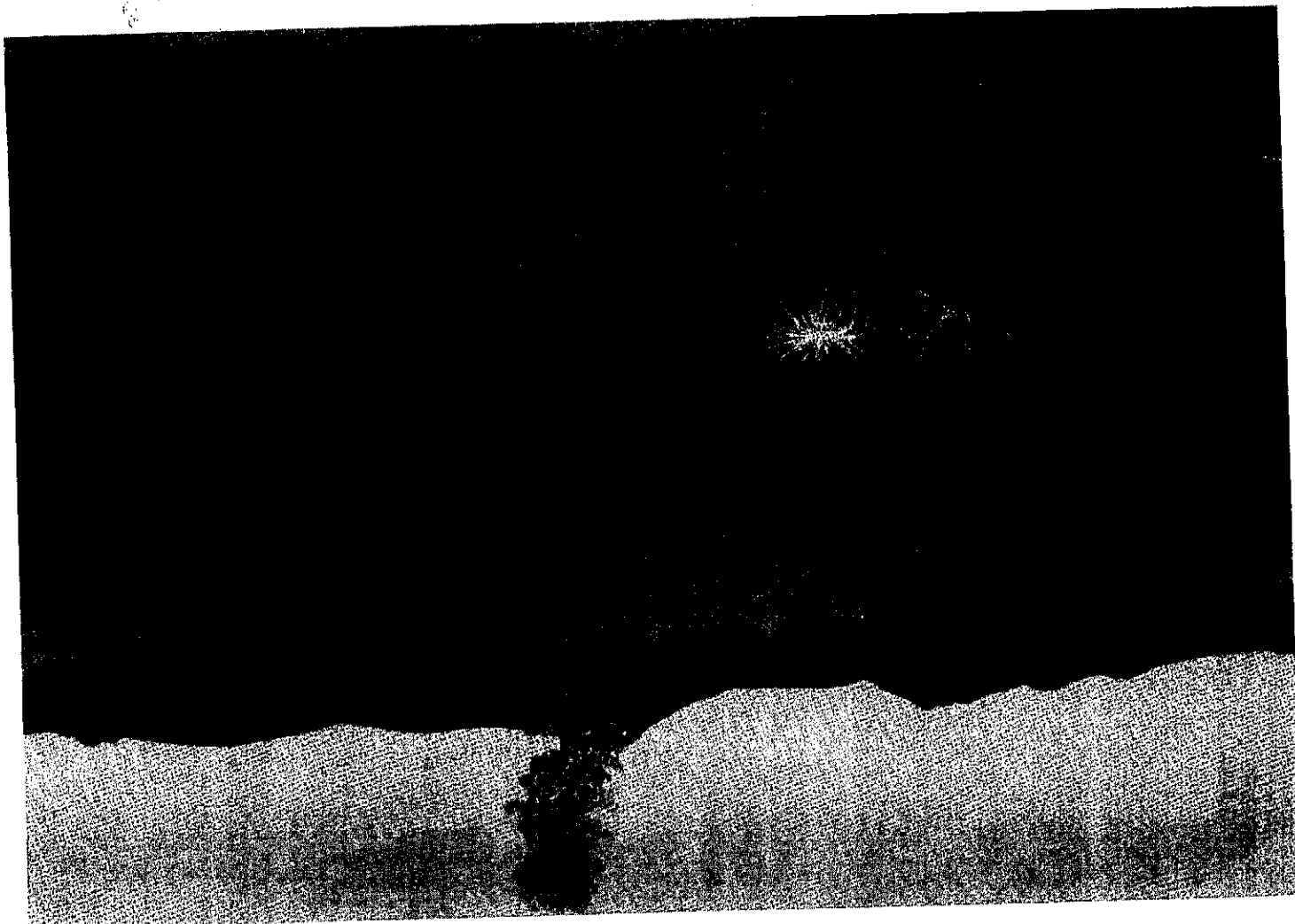


PLATE 46a (1891). From a point on the east side of the San Pedro about one and one-half miles southeast of Lewis Springs, looking north toward the Lewis Hills. The picture shows a classic grassland community, palmilla being the large dominant. Because of the dead, inflammable material along its stem the plant is highly susceptible to fire injury, which, while not necessarily fatal, does induce a different form (inset), with multiple sprouts being sent up from the uninjured subterranean stem. Many of the yuccas in the main picture are over fifty years old, have shaggy stems, are not clumped, and in short do not show evidence of having been burned. It seems clear that recurrent fire cannot explain why mesquite and other woody invaders are absent from the area. Elevation 4050 ft.



PLATE 46b (1960). From a station within one hundred yards of the old one, which cannot be located precisely. The railroad cut and the dirt highway to Lewis Springs have disturbed the surface so badly that it is almost unrecognizable, but in spite of the disturbance, three major invasions can be distinguished: beyond the highway, *Acacia vernicosa* has replaced the grassland; a mes-

quite bosque dominates the lower-lying area between the acacia and the river; cottonwoods line the channel of the San Pedro. In the foreground at the right *Acacia vernicosa*; at the left, the dried inflorescence of a palmilla. In and along the cut: sacaton, Mexican tea, gray thorn, mesquite, and *Acacia vernicosa*.



PLATE 47a (1891). The picture was taken about one-half mile north of the preceding one and looks in the same direction. Here, however, the camera station is on the border between the yucca-grassland community of Plate 46 and the low-lying plain surrounding the San Pedro River, which is about one-half mile away at left and center. A palmilla is in the foreground, and three cottonwoods can be seen in the midground. Burrobush and small mesquites may be two of the other midground plants. Elevation 4050 ft.



PLATE 47b (1962). Only mesquite branches can be seen from the old station. The new one is on the top of a dike within fifty feet of the old, and looks out across the top of the bosque that now blankets the plain. Among the treetops at left is a relict palmilla. The inset is a close-up view of the plant, which, in competing

with the mesquite, has grown to an atypical height. On the floor of the bosque: sacaton, burroweed, desert holly, cane cholla, Mexican tea, and palmilla. Burrobrush occupies some areas closer to the river. The cottonwoods, partly leafless in December, have greatly proliferated since 1891.

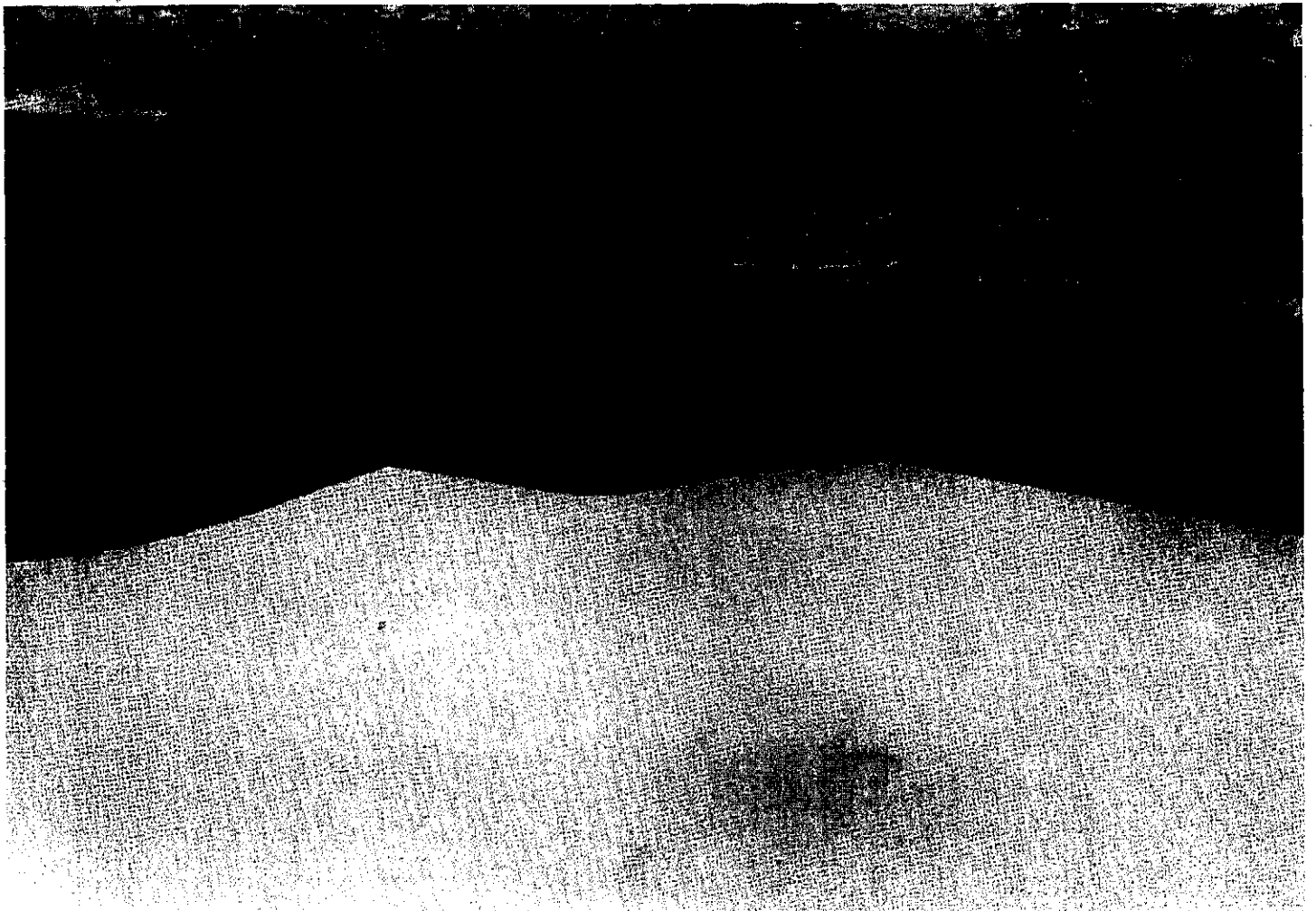


PLATE 48a. (1891). The San Pedro River, visible between the second line of low trees and the railroad tracks, follows what appears to be a channel with already eroded banks. The course is difficult to follow, partly because of the absence of the large riparian species that mark it today. Although the valley and the hills beyond are relatively open, at this date they already support a prominent shrub stratum, varying greatly in density. Elevation 4050 ft.



PLATE 48b. (1962). The river channel, now outlined by cottonwood, willow, and mesquite, is deeply entrenched in the valley just beyond the cultivated fields. The hills to the east are covered

by shrubs among which are *Acacia vernicosa*, creosote bush, and ocotillo.

PLATE 49a. (About 1883). A few miles downstream from the preceding plate, looking east-southeast toward Bronco Hill and the Gird Dam, one and one-half miles above the old town of Charleston. The dam, which supplied water to the mills at Charleston for use in processing the ore from the Tombstone mines, was destroyed in 1887 by a forerunner of the flood that three years later initiated channeling on the San Pedro. The enclosed tree at the upper left is an Emory oak, one of the now extinct colony whose carcasses still litter the moister slope on the other side of the ridge. Their presence in the valley, even in 1883, is surprising; they can be best explained as a relic colony left from the time when oak woodland bridged the San Pedro Valley from the Mule and Dragon Mountains on the east to the Huachuca and Whetstones on the west. Elevation 4000 ft.



THE CHANGING MILE

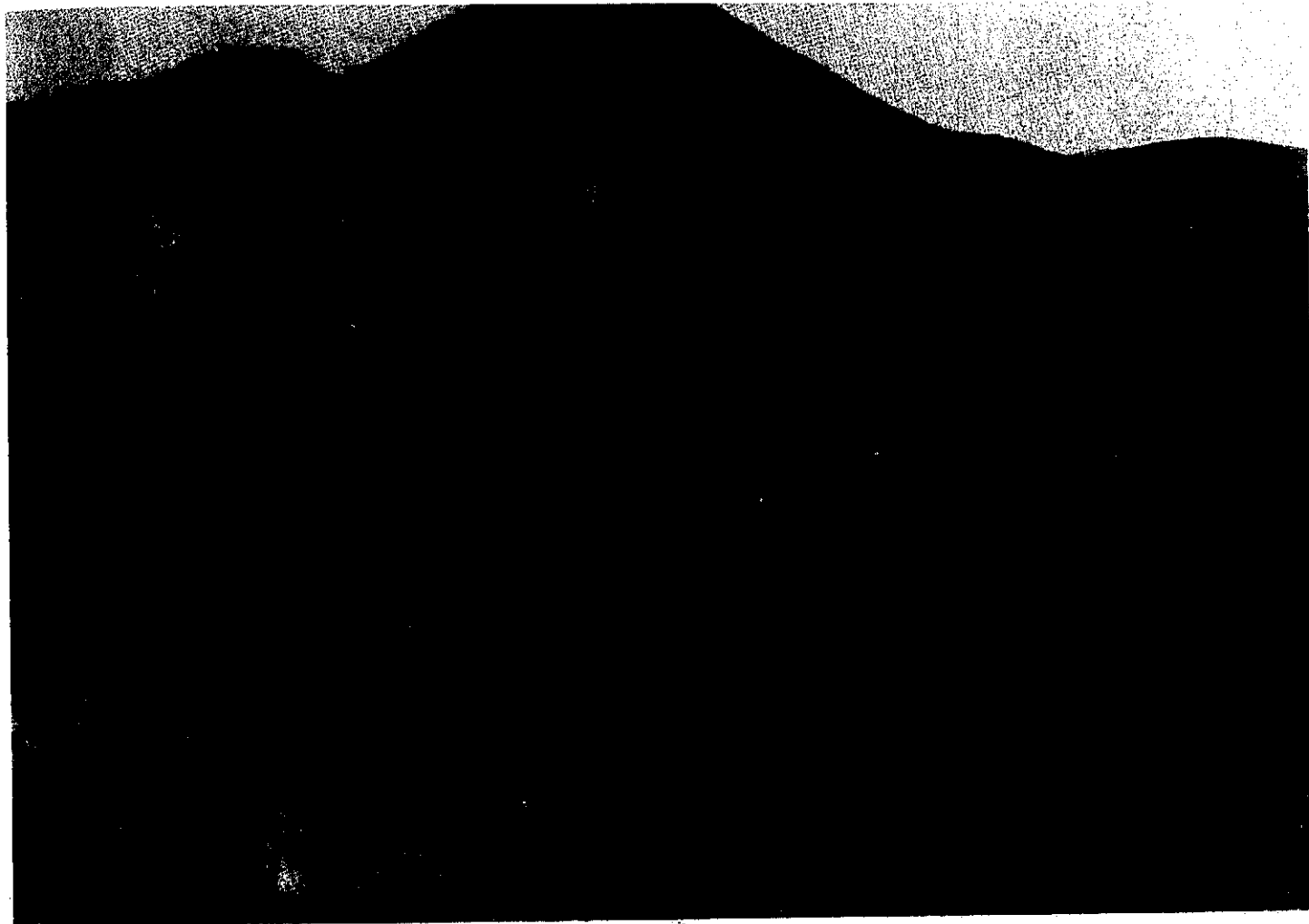


PLATE 49b. (1960). The modern steep-walled channel is obscured by trees; however, erosion has claimed nearly all of the ground on which the wing of the dam rested, at the left side of the picture. Cottonwood and Goodding willow now line the river; seep willow and Mexican devilweed grow abundantly on the sandy bed. The rocky hill in the foreground supports a distinctive community composed of Wright lippia and *Acacia vernicosa*, an association which also dominates the hills in the right midground and the left background. On the slopes of Bronco Hill, center,

sotol joins the other two plants. In all locations the vegetation is appreciably denser than before. Along the floor of the little valley in front of the camera, mesquite and *Acacia vernicosa* have invaded. Also visible in the picture are ocotillo, desert broom, chamiso, soapberry, and sacaton grass. The oaks have nearly vanished; except for one survivor the nearest ones, so far as is known, occur perhaps ten miles away and nearly 1000 ft. higher in elevation.

THE CHANGING MILE

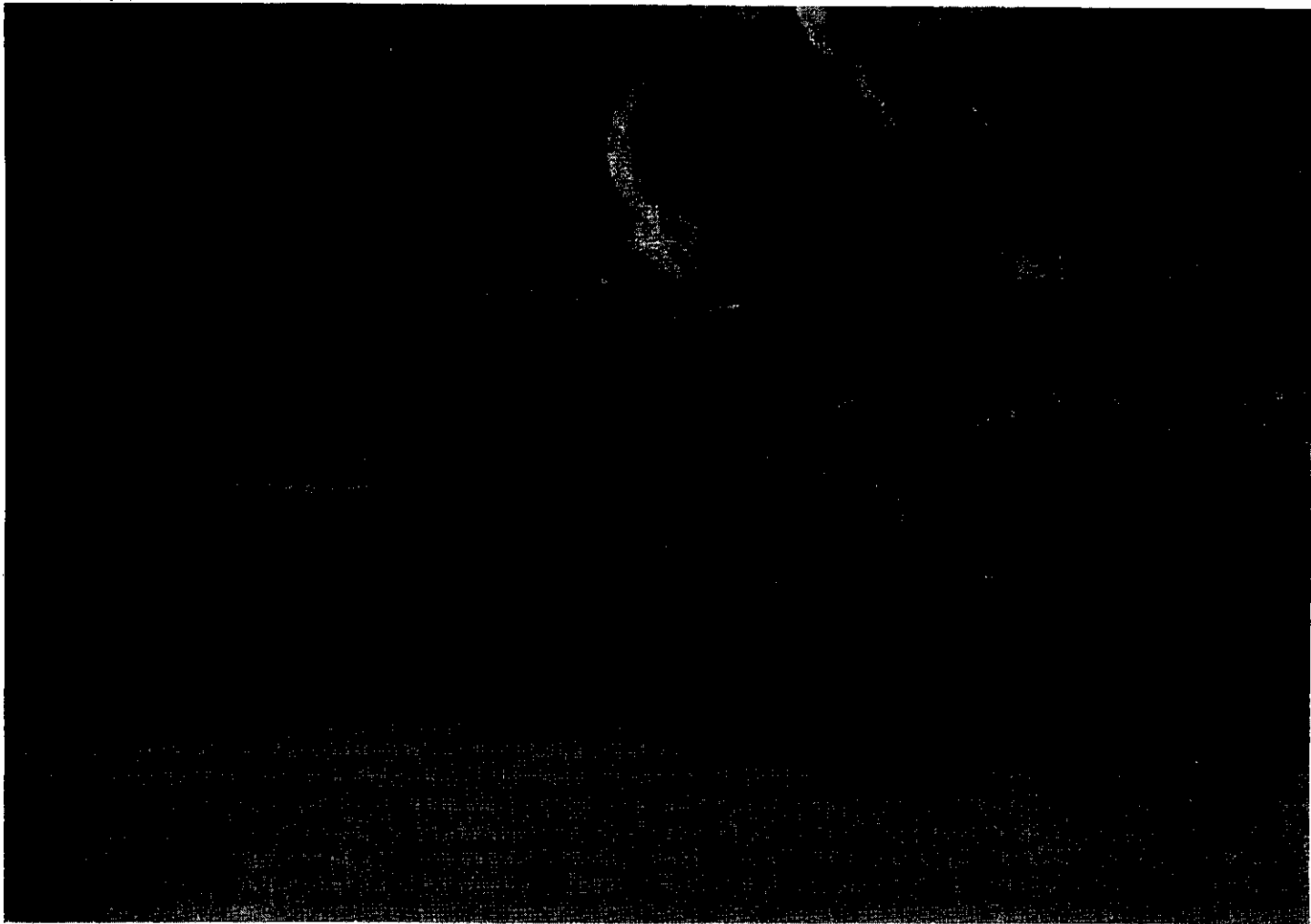


PLATE 50a. (1884). From a hill north of Charleston looking south-southeast across the town toward Bronco Hill. The San Pedro River is off-picture to the right. At this time Charleston was in its heyday, boasting two mills (the Gird, left foreground, and the Corbin, left background) and a polyglot population of some two thousand. Properly speaking the town shown here is Millville; Charleston, its commercial and residential sister, lay clearly lay in the grassland. Elevation 4050 ft.

point of most interest is the open, grassy appearance of the rolling country on the far side of town. Charleston at this time mills with water. The flumes in this picture, in turn, conveyed tailings to the pond shown in the next plate. Ecologically, the Gird Dam, in the preceding plate, supplied the



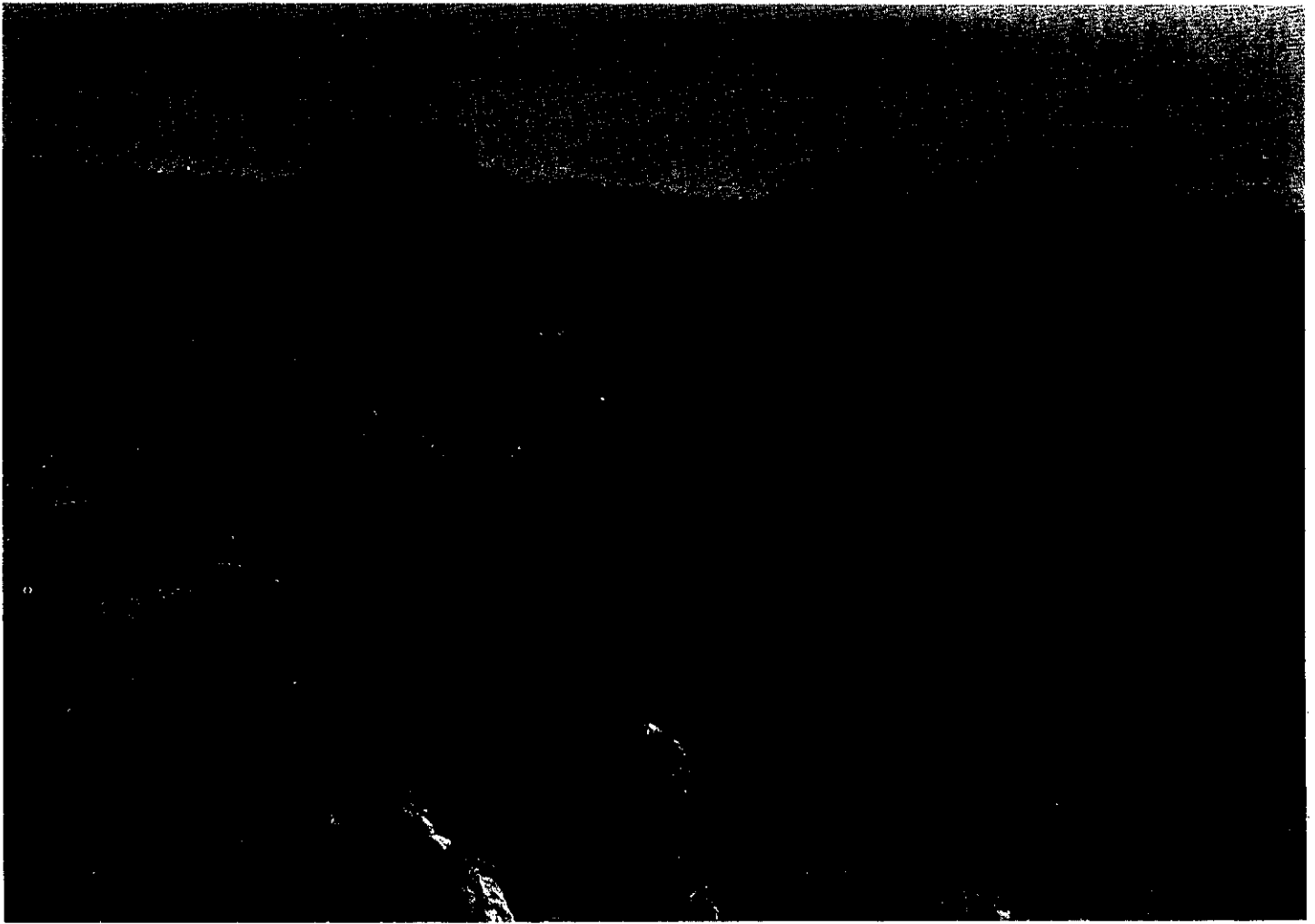


PLATE 50b. (1960). Of man's work only the mill foundations and the adobe walls of the old Gird house remain. The foreground grass has given way to a thicket of *Acacia vernicosa*, with tanglehead and sideoats grama occupying the spaces between shrubs. The midground, center and right, is dominated by mesquite, with an understory of sacaton. The hill behind the Gird house, a rocky habitat similar to those in the preceding plate, supports the same association of Wright lippia and *Acacia vernicosa*. In the darker area at center and immediately to the

right of the old house, the lippia drops out, leaving a pure stand of acacia. In the lighter, more open area to its right: small mesquites, sacaton, and *Aristida glauca*. On the rolling country in back of town the grassland has been engulfed by a dark tide of *Acacia vernicosa* studded locally with patches of tarbush and creosote bush. The light area (arrow) at extreme right is perhaps a relict colony of the old grassland; in it occur scattered mesquite, palmilla, Rothrock grama, and *Aristida glauca*. Also abundant in the picture are cane cholla and catclaw.

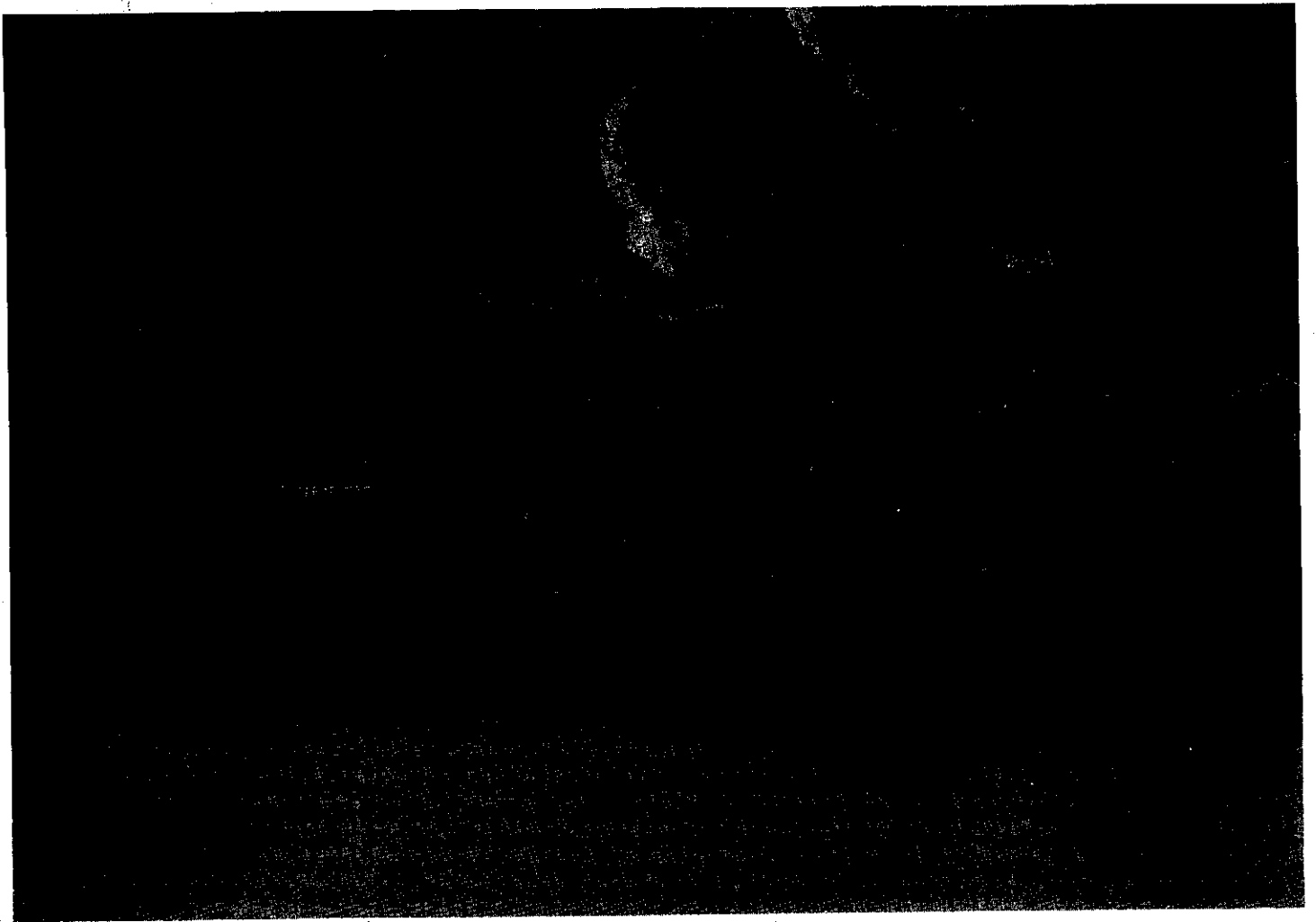


PLATE 50a. (1884). From a hill north of Charleston looking south-southeast across the town toward Bronco Hill. The San Pedro River is off-picture to the right. At this time Charleston was in its heyday, boasting two mills (the Gird, left midground, and the Corbin, left background) and a polyglot population of some two thousand. Properly speaking the town shown here is Millville; Charleston, its commercial and residential sister, lay clearly lay in the grassland. Elevation 4050 ft.





PLATE 50b. (1960). Of man's work only the mill foundations and the adobe walls of the old Gird house remain. The foreground grass has given way to a thicket of *Acacia vernicosa*, with tanglehead and sideoats grama occupying the spaces between shrubs. The midground, center and right, is dominated by mesquite, with an understory of sacaton. The hill behind the Gird house, a rocky habitat similar to those in the preceding plate, supports the same association of Wright lippia and *Acacia vernicosa*. In the darker area at center and immediately to the

right of the old house, the lippia drops out, leaving a pure stand of acacia. In the lighter, more open area to its right: small mesquites, sacaton, and *Aristida glauca*. On the rolling country in back of town the grassland has been engulfed by a dark tide of *Acacia vernicosa* studded locally with patches of tarbush and creosote bush. The light area (arrow) at extreme right is perhaps a relict colony of the old grassland; in it occur scattered mesquite, palmilla, Rothrock grama, and *Aristida glauca*. Also abundant in the picture are cane cholla and catclaw.

THE CHANGING MILE

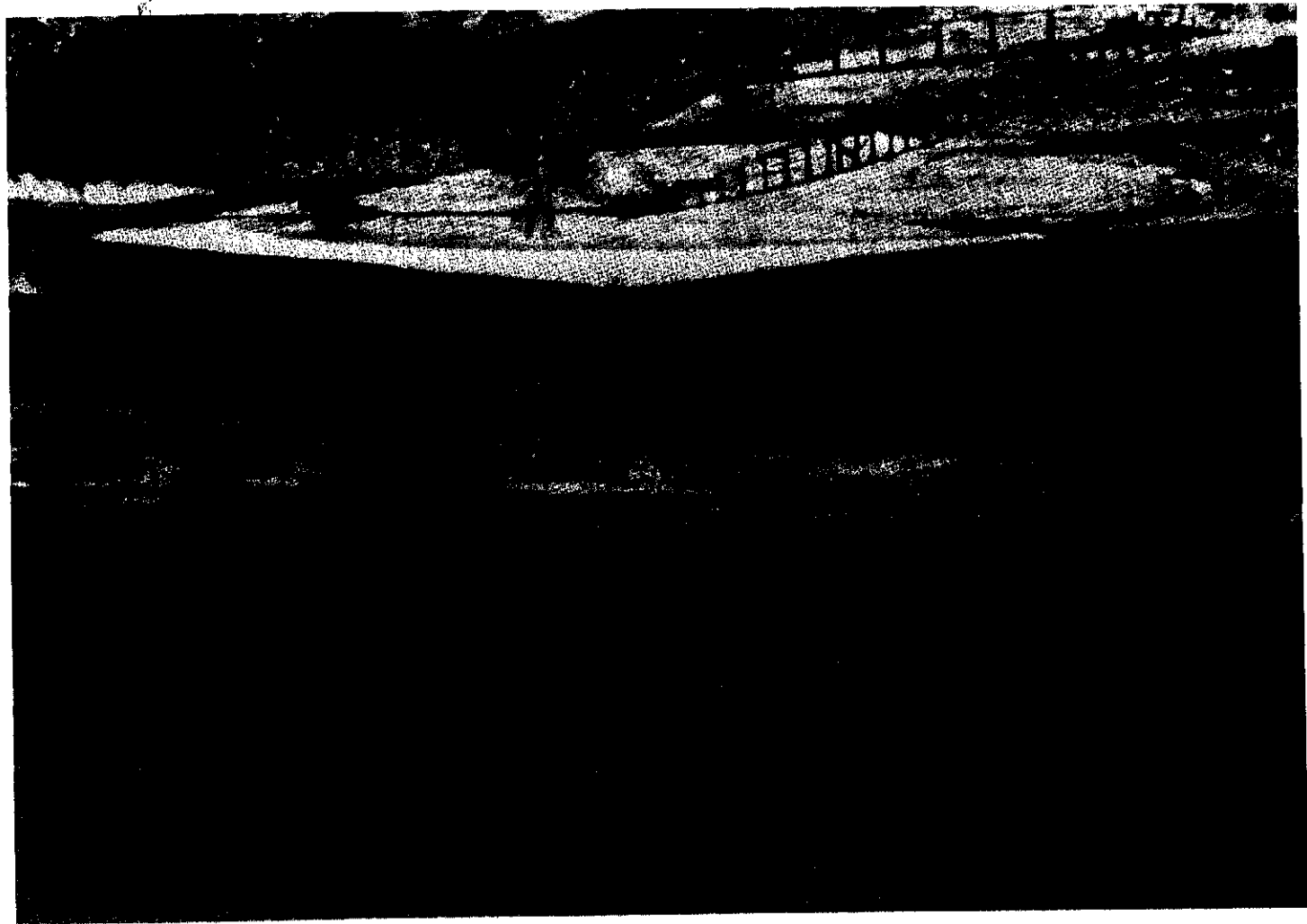


PLATE 51a (1883). Charleston, for eight years one of the principal cities of Arizona. The picture is taken from the hill that appears between the camera and the Gird Mill in the preceding plate, and the view is down slope, southwest toward the Huachuca Mountains. The San Pedro River runs from left to right through a channel trench that is well defined, but hardly comparable to the modern one. The foreground hillside is spotted with *Acacia vernicosa*. One lone cottonwood stands on the riverbank; the slopes of the terrace across the river are open and relatively free from brush. Elevation 4000 ft.



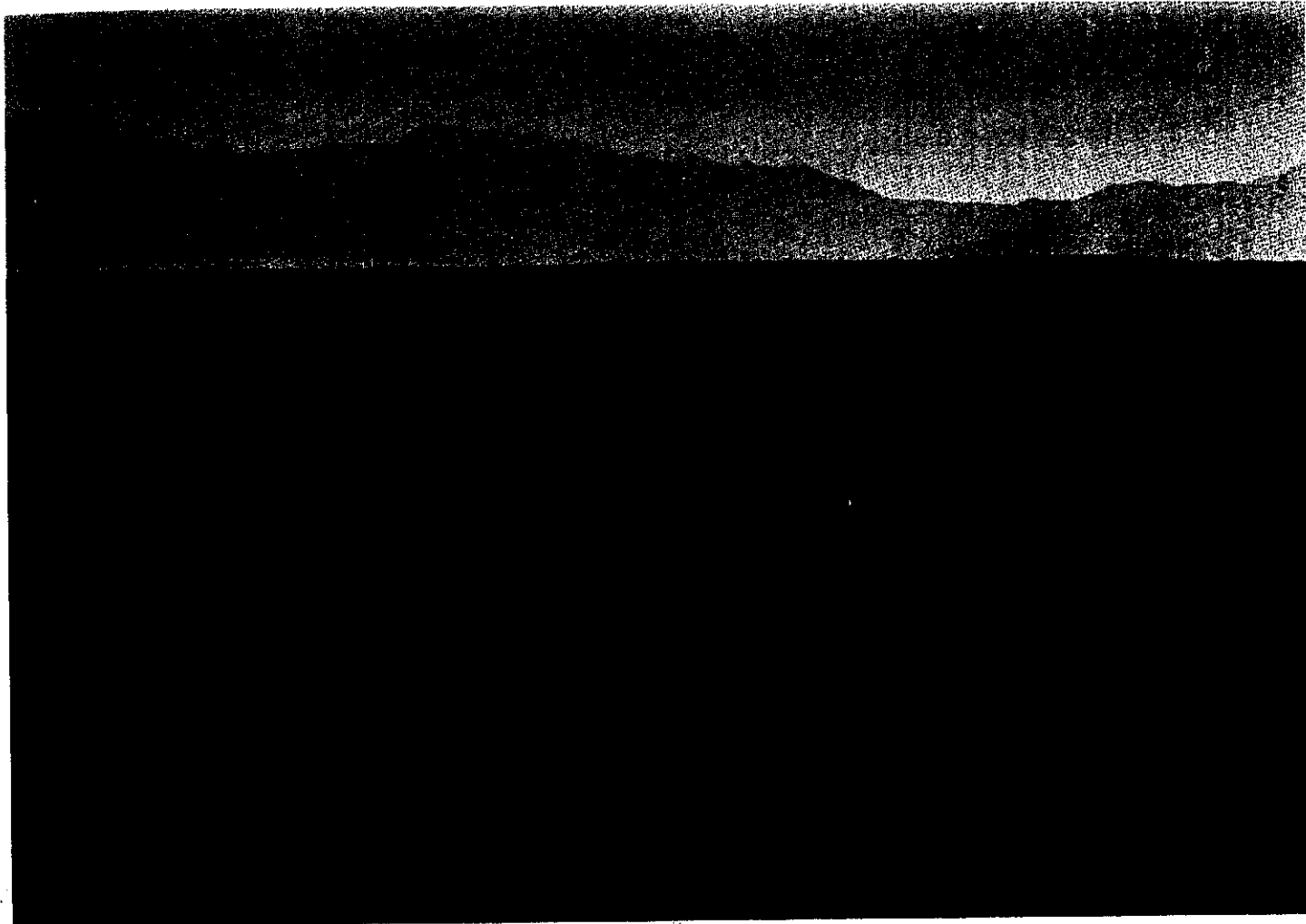


PLATE 51b (1960). The old city has vanished. Its death knell sounded when the Tombstone mines struck water, making the nine-mile ore-haul to the river unnecessary. A drop in silver prices accelerated the decline of both towns. Finally, leveled by an earthquake in 1887, Charleston disappeared into the mesquite. On the foreground slope *Acacia vernicosa* has registered a sharp

increase and now dominates a sparse flora that includes cane cholla, catclaw, desert zinnia, black grama, sideoats grama, and three-awn. Cottonwoods line the river channel, delineating faithfully its backward-S curve. The terrace sides, once grassy, support an almost impenetrable thicket of *Acacia vernicosa*.

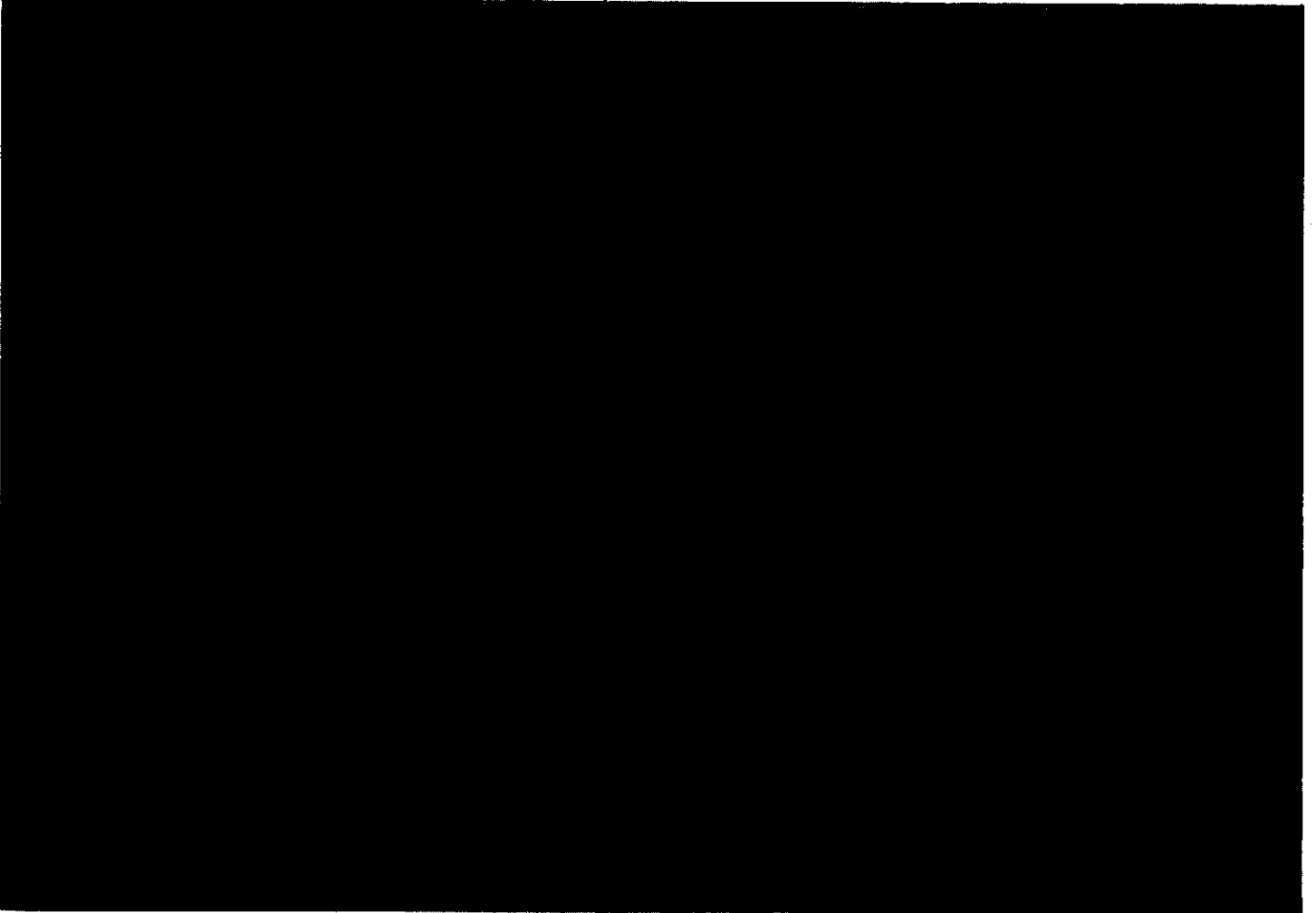


PLATE 52a (About 1884). With this plate the photographic progression down the San Pedro River is interrupted, and the camera records upland conditions about seven miles east of the river. The view is due north toward the Cochise County mountains, across Tombstone in its silver age. The Cochise County courthouse, just constructed, stands at the far left. The hills on the near side of town present an unmistakable picture of a grassland community. The shrubs dotting it cannot be identified, but probably include agaves, beargrass, and sotol. In the foreground Wright lippia, century plant, and sotol can be recognized. Like Charleston before 1890, Tombstone clearly lay in the grassland. Elevation 4850 ft.

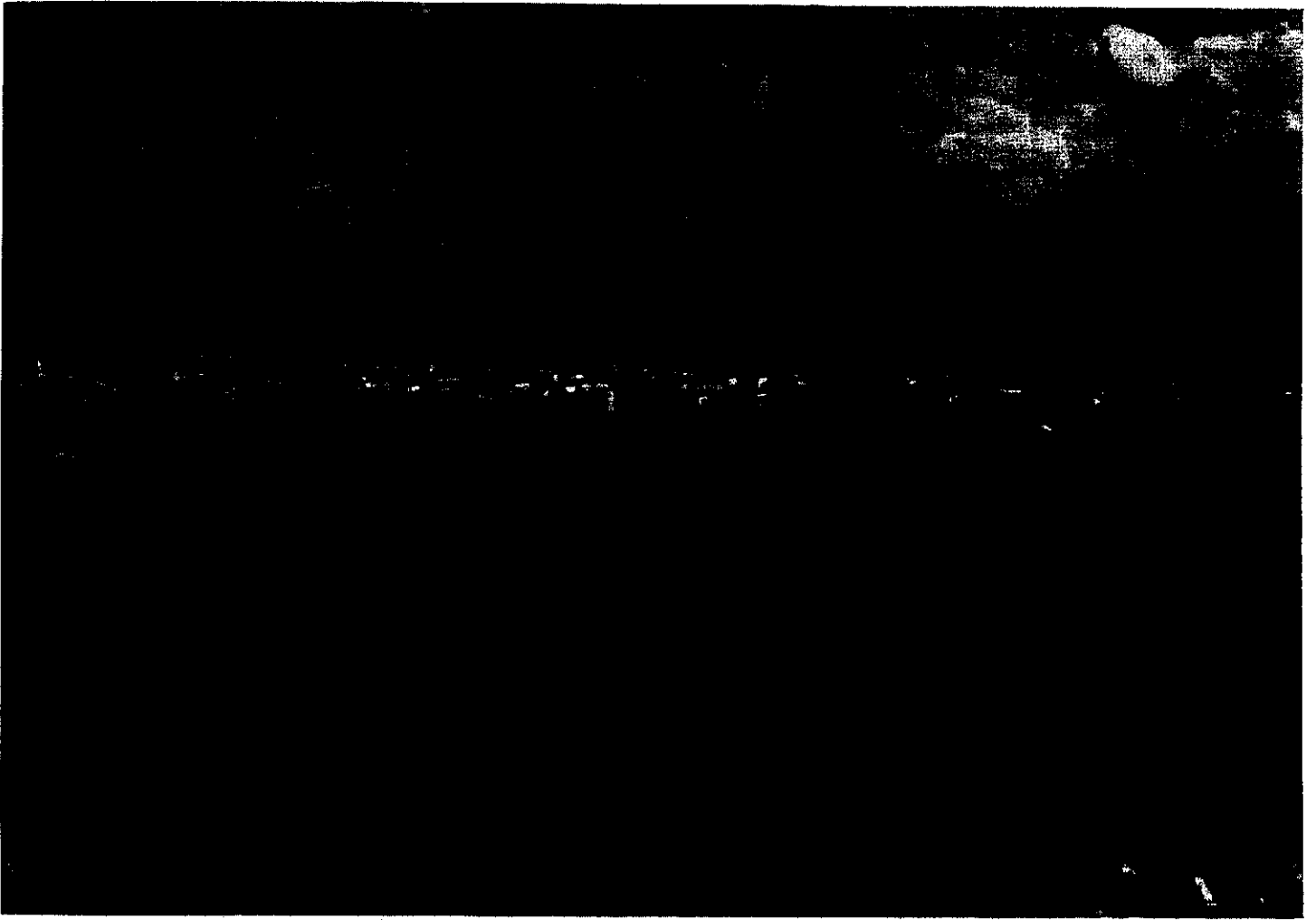


PLATE 52b (1960). The grassland has given way to the vegetation of the Chihuahuan Desert. On the hills in front of town creosote bush, ocotillo, tarbush, mesquite, and *Acacia vernicosa* are the principal plants. The foreground has undergone an appreciable invasion by ocotillos, many of which have been cut away to clear the view. On the north-facing slope in the foreground the flora is varied and dense; it includes Wright lippia—the dominant—beargrass, sotol, century plant, tarbush, mariola, mesquite, and a species of *Brickellia*. Because of the poor resolution in the

background of the old photograph, it is difficult to generalize about conditions on the bajada behind town. Much the same transition from grassland to scrubland has probably occurred there, however. The region is now dominated by an *Acacia vernicosa*—creosote bush—tarbush community whose characteristic drab hue is familiar to any traveler along Highway 80. *Mortonia* is also an abundant bajada plant. The arrows point to Walnut Gulch, where the next four pairs of photographs were taken.

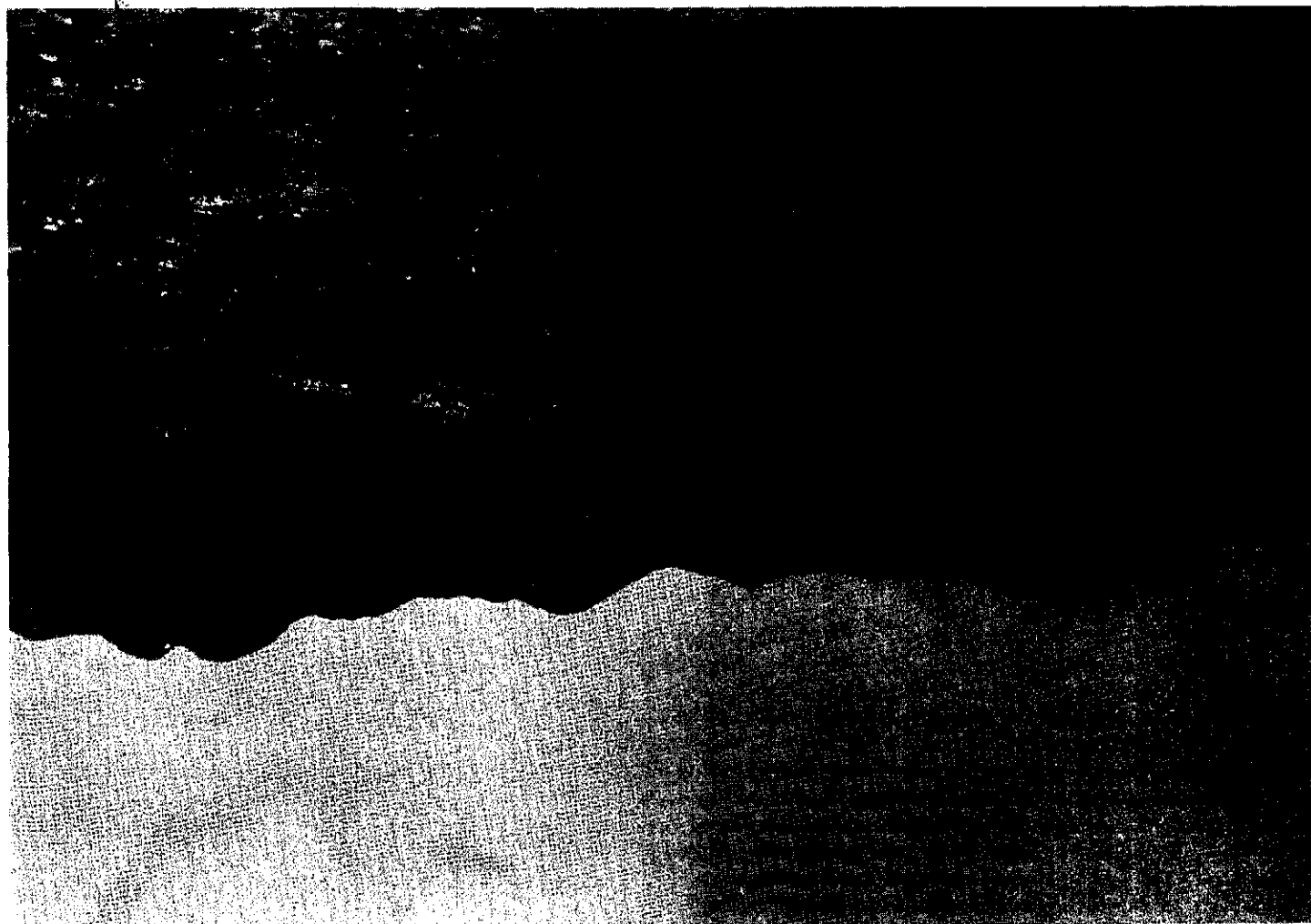


PLATE 53a (About 1890). About six miles west of Tombstone, from a station part way up the north terrace of Walnut Gulch, looking southeast across the gulch toward the south terrace and the Three Brothers Hills. The flood plain is open and largely free from brush. The two dark shrubs at the right designated by arrows look like Mexican tea, a plant still abundant in that location. The clumps of grass are probably sacaton. At left the circle encloses what may be a young mesquite; a large individual occupies the spot today. Elevation 4000 ft.

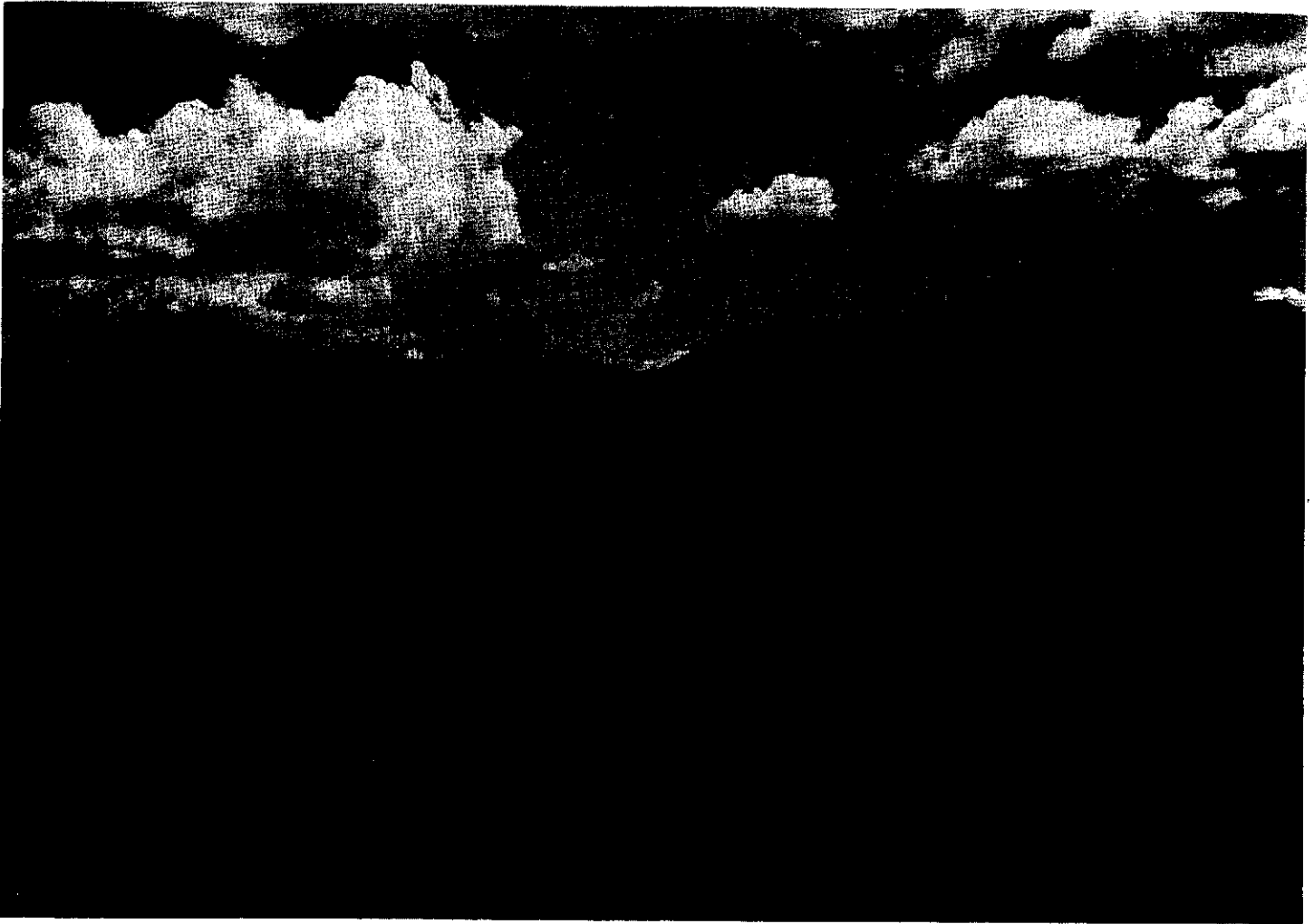


PLATE 53b (1960). The floor of the wash has undergone a pronounced shrub invasion by both mesquite and *Acacia vernicosa*. Normally the two plants do not occupy the same habitat, but here they grow side by side, a juxtaposition conveniently illustrated in the foreground where acacia is in the center and mesquite at the right. Since many small plants of both species are present, it is probably safe to assume that neither invasion has attained its maximum development, and each will continue. The south terrace

is shrubbier than before and supports the *Acacia vernicosa*—creosote bush—tarbush community typical of so much of the region. One Mexican crucillo (circle) is visible at center on the slopes. A half-dead walnut tree grows at the right (arrow). Out of sight behind the mesquites are burrobrush, desert willow, and *Rhus microphylla*. In the midground, Mexican tea, palmilla, and some clumps of sacaton.

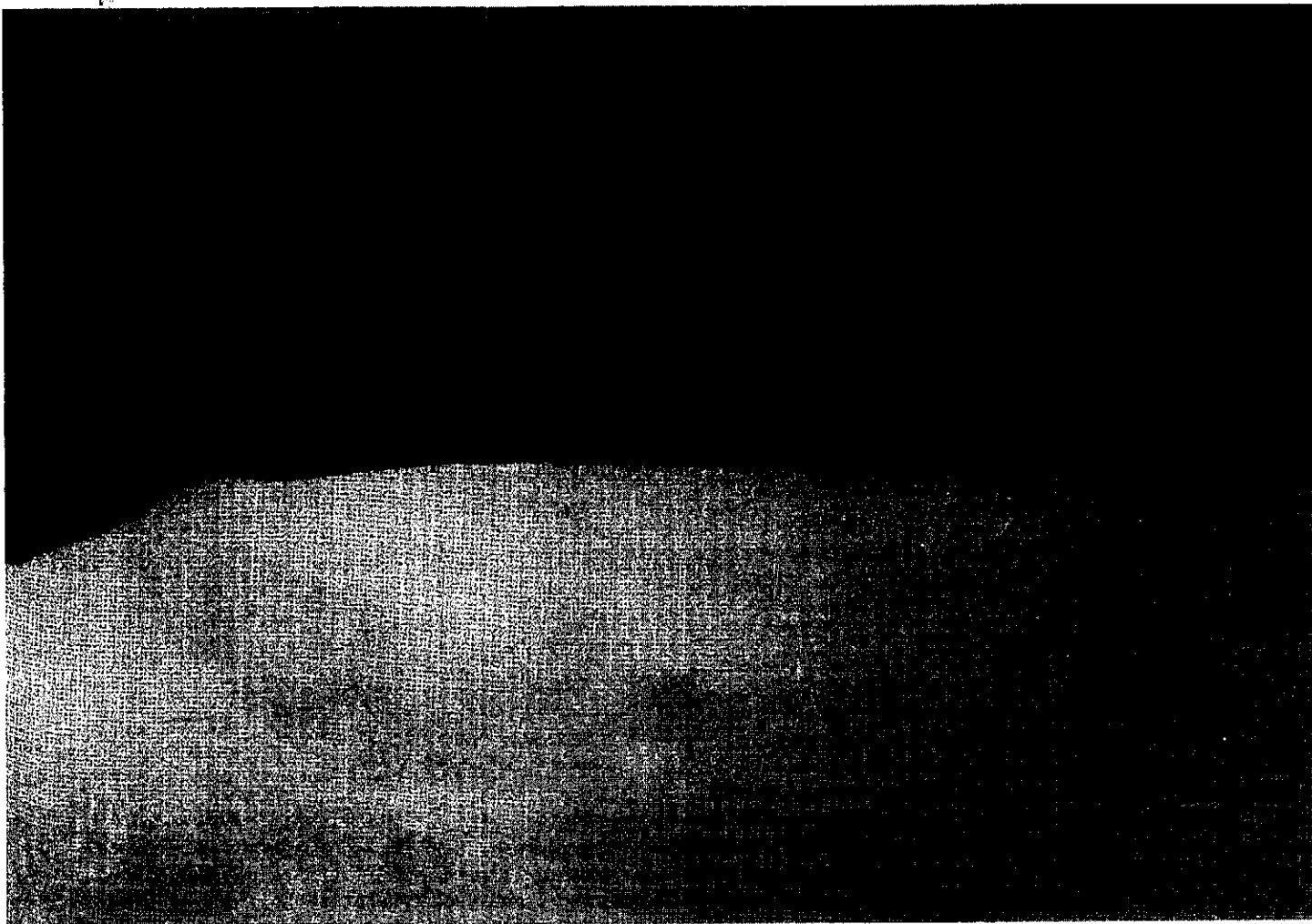


PLATE 54a (About 1890). This photograph, which partly overlaps the preceding one, is taken from the same station, but looks south base of the little hill in center are young mesquites (see next plate). The abundant dark plant on the plain to the left of the hill may be tarbush, still locally abundant there. Elevation 4000 ft.



PLATE 54b (1960). This picture registers the same invasion by mesquite and *Acacia vernicosa* shown in Plate 53. The mesquite has come in most densely at the base of the terrace, along the course of a small tributary that cannot be seen. The conspicuous bunch grass in the fore- and midground is sacaton, 1. The

abundant smaller plants are vine mesquite (a grass) and bull-nettle. Among the distinctive, easily recognized shrubs near the camera are *Acacia vernicosa*, 2; Mexican tea, 3; some small mesquites, 4; and chamiso, 5, which here is heavily grazed and assumes a low, compact shape.

THE CHANGING MILE



PLATE 55a (About 1890). From a station on the flood plain of Walnut Gulch looking northeast toward the small hill that appears in the preceding plate. Numbers 1 to 3 designate mesquites which carry over into the new picture; 4 is an *Acacia vermicosa* present in both; 5 marks a cane cholla which is downslope from one in the new photograph. Since the last-named species propagates freely from fallen joints, the plant here may be a vegetative ancestor of the newer one. The mesquites are all young—perhaps five to fifteen years of age—a fact that helps date the invasion and suggests that twenty years before this picture was taken the hill may have been almost completely free from brush. Elevation 4000 ft.



PLATE 55b (1962). The mesquites have matured, and the hill is badly overgrown with *Acacia vernicosa*. Both species protect clumps of bush muhly, a grass that commonly is found associated with a "mother" plant. Although some co-mingling exists, the two dominant plants have assumed their normal habitat preference, with mesquite occupying the lowlands; acacia, the rockier

uplands. Sacaton, chamiso, and cane cholla also grow on the hillside; sacaton and chamiso in the foreground on the floor of the wash. The *Acacia vernicosa* invasion has probably paralleled that of mesquite. Many of the adult acacias in this picture may have been present in the old one as seedlings.

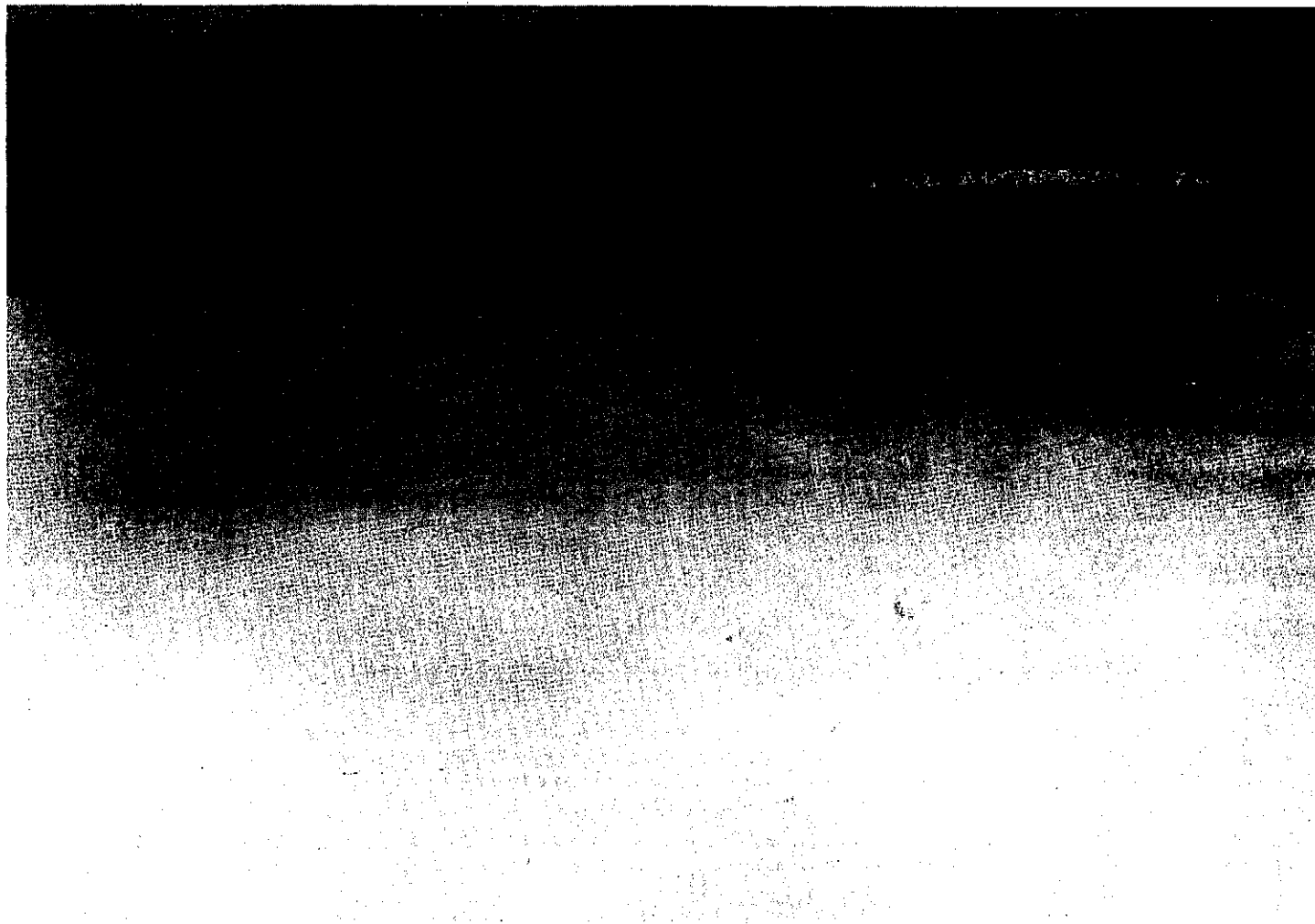


PLATE 56a (About 1890). From an island in the middle of Walnut Gulch about a mile below the site of the preceding plates, and looking southwest down the wash toward its junction (right) with the San Pedro River. The river is inconspicuous here; however, its course is clearly defined in the new photograph by quite. Elevation 3950 ft. The large shrubs are probably mesquite. As in the preceding plates, the valley floor is open and apparently grassy. The Huachuca Mountains are in the background at the left.



PLATE 56b (1960). From a point twenty-five feet south of the old station, the view from which is obscured by mesquite. The wash now sweeps to the right of the island, having changed its channel. Along the abandoned bed rabbitbrush, desert willow, burrobrush, and *Carlowrightia (linearifolia?)* have become established. The north-facing terrace slope at the far left, much brushier than before, has been invaded by Wright lippia, *Acacia vernicosa*, tarbush, and creosote bush, the last named becoming dominant toward the top of the slope. The valley floor is heavily overgrown with mesquite, rabbitbrush, burrobrush, desert willow,

and some very large catclaw trees. The water tank in the mid-ground at the left belongs to the railroad station at Fairbank. In front of it and to the right is a small, light-colored hill that presents an interesting anomaly. The slope visible in this picture has apparently changed very little, and supports a heavy cover of black grama, with some bush muhly near the few shrubs. The south-facing side, however—away from the camera—is brushy, boasts many dead mesquites, and is dominated by the typical *Acacia vernicosa*—creosote bush—tarbush community.

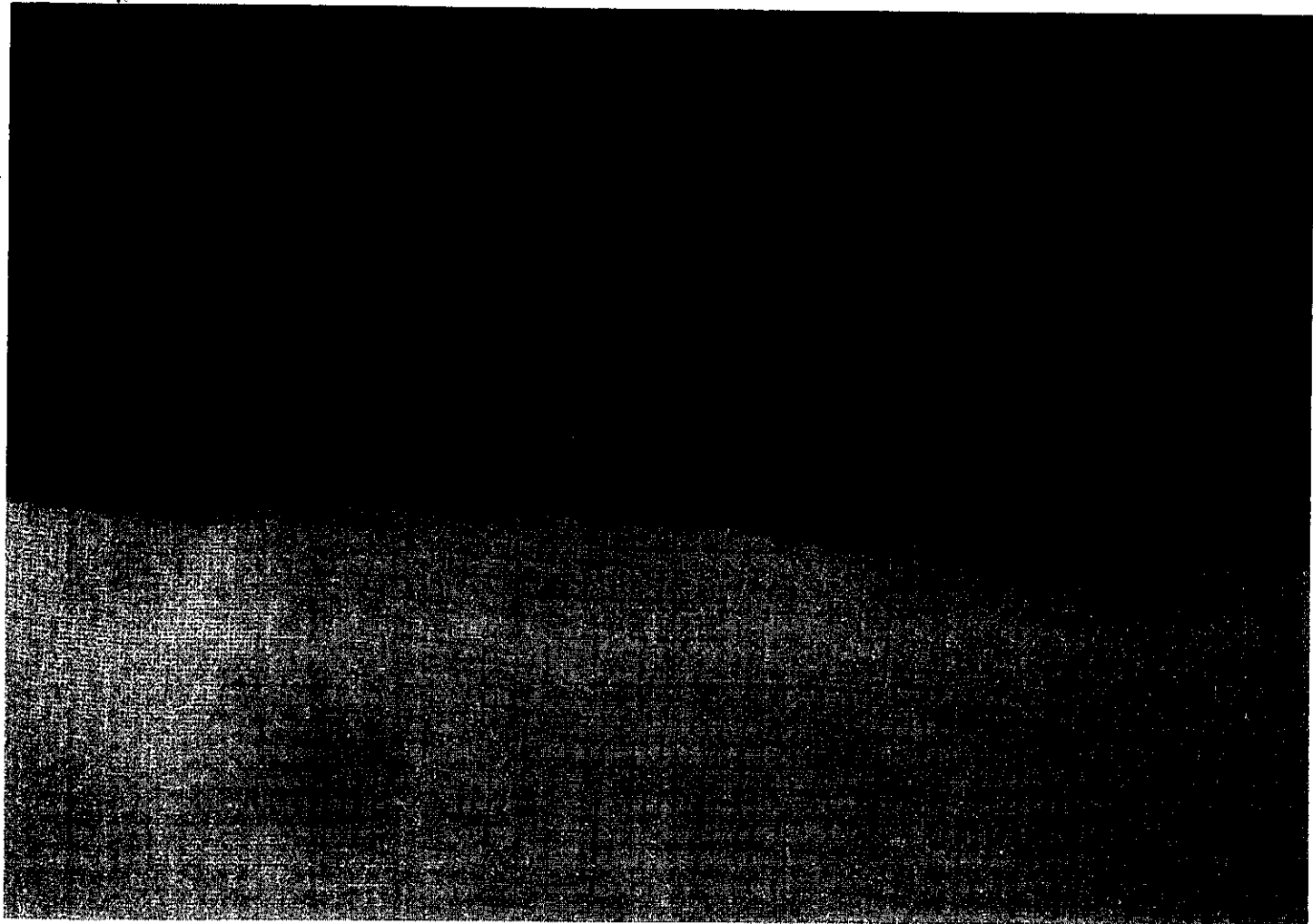


PLATE 57a (About 1890). From a hill west of Fairbank looking southeast across the junction of Babocomari Creek (lower arrow) with the San Pedro River (upper arrow). The Mule Mountains are at the right; the Tombstone Hills at the left, with the south terrace of Walnut Gulch, the site of the stations for the preceding four pairs of plates, rising in front of them. This rare photograph, lacking though it is in resolution, verifies much of what has been alleged about conditions along the rivers before the onset of arroyo cutting. Neither stream has a distinct channel, Babocomari Creek winds sluggishly through a marshy, grass-choked plain; and the course of the San Pedro is almost invisible. Except for the mound in the right midground, the site of the modern railroad station at Fairbank, the valley appears to be treeless. Elevation 3800 ft.

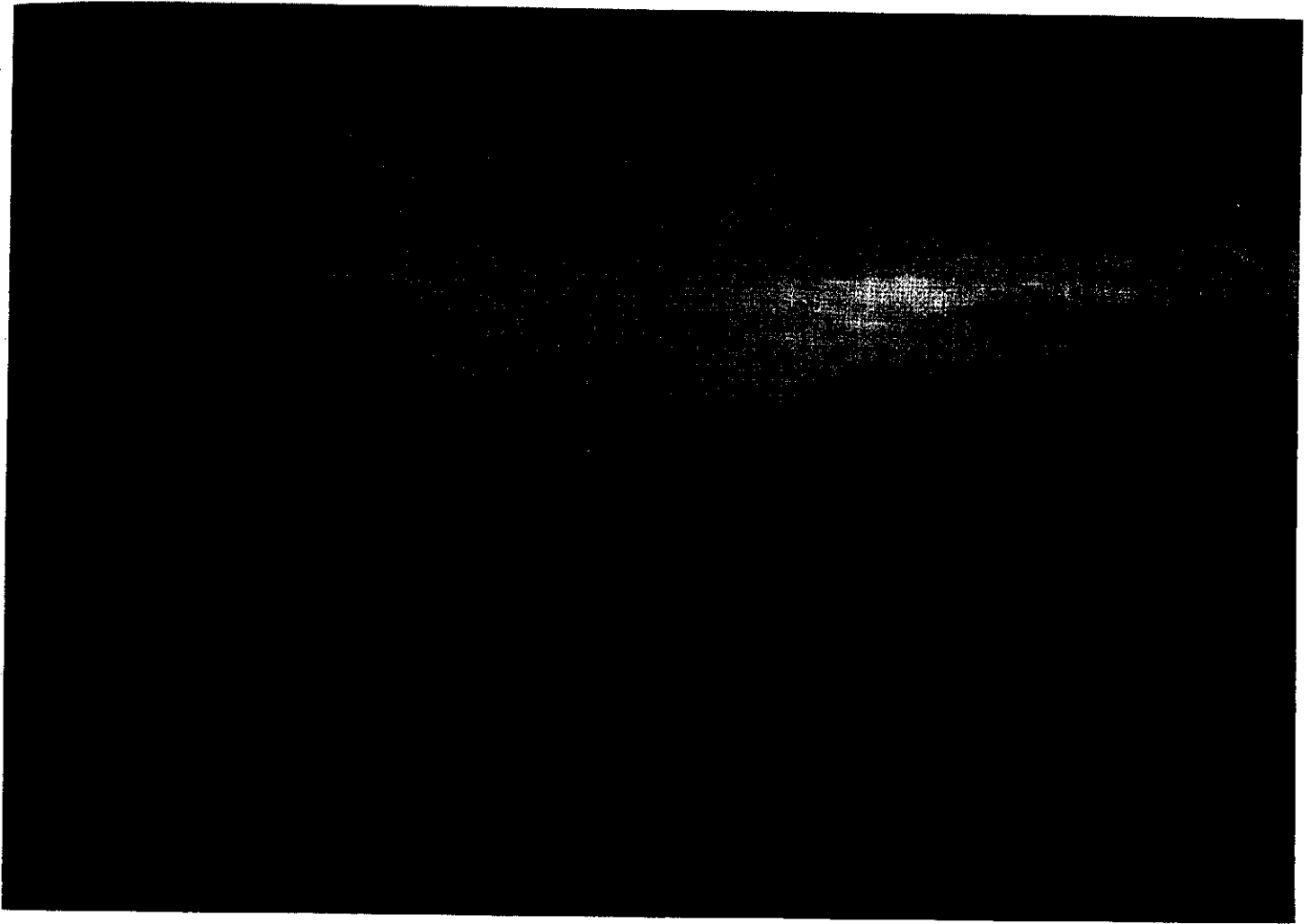


PLATE 57*b* (1962). In carving a channel, part of which is visible as it sweeps around the lower left, Babocomari Creek has cut deeply into the hill from which the original picture was taken. The new camera location is about one hundred feet northwest of the old, which no longer exists. The dike at the left of the picture forms part of a project to divert the creek, now threatening Highway 82, to a new channel, visible at the center and about

on line with the water in the old picture. The San Pedro's trench is obscured by brush; the junction of the two streams is off-picture to the left. Mesquite, cottonwood, and Goodding willow choke the valley floor. Sacaton is the dominant grass, and forms with mesquite a distinct community at many places along the San Pedro.

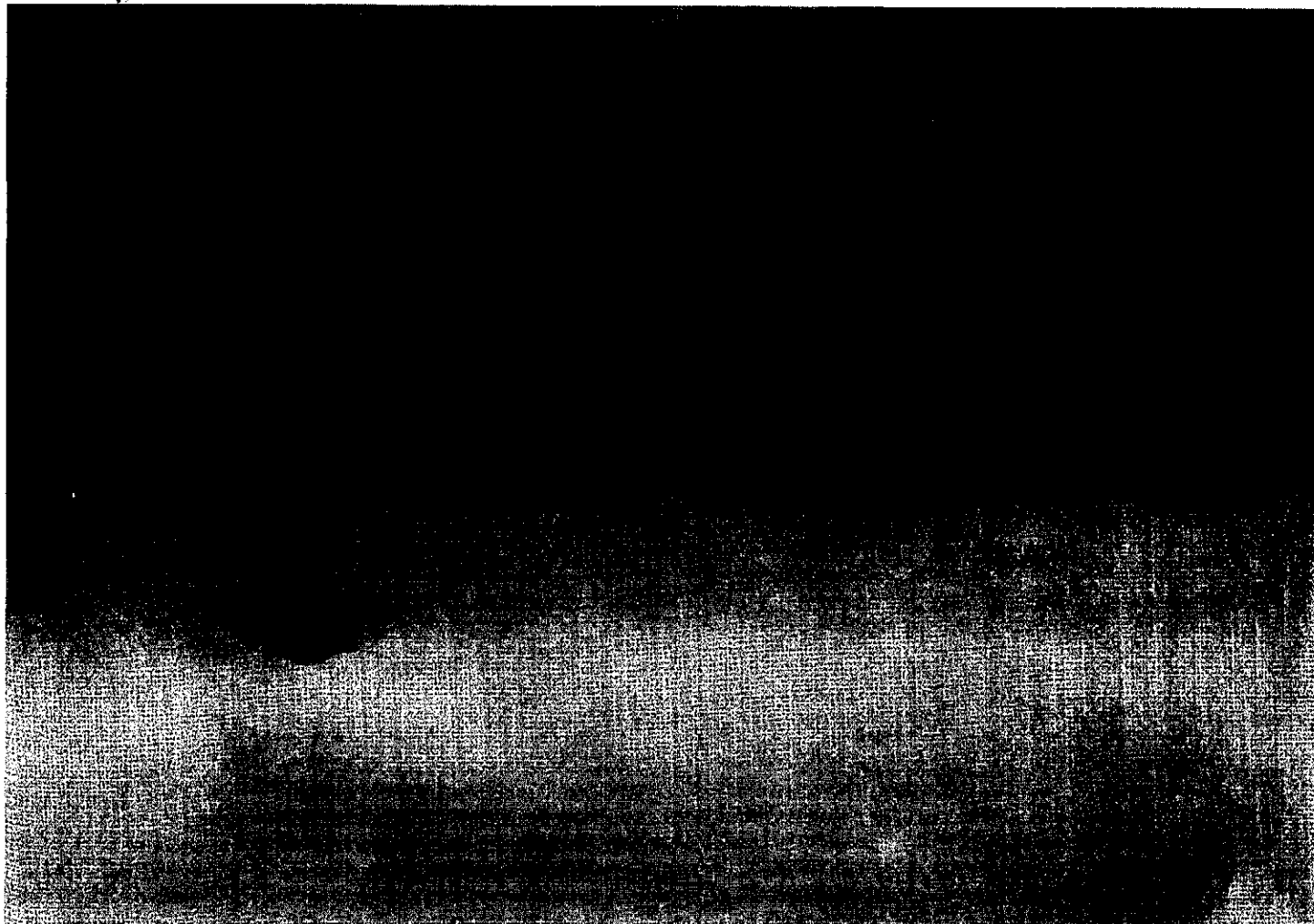


PLATE 58a (About 1890). From a point about three miles south-east of St. David looking east across a low range of hills toward Cochise Stronghold, center, in the Dragon Mountains. The San Pedro River is out of sight behind the hills. In 1890, the area with short grass, uneroded and, although detail is missing, tufted plain is open, uneroded and, although detail is missing, tufted evidently lay at the lower edge of the grassland. A few shrubs, many of them palmillas, dot the picture, but by and large the

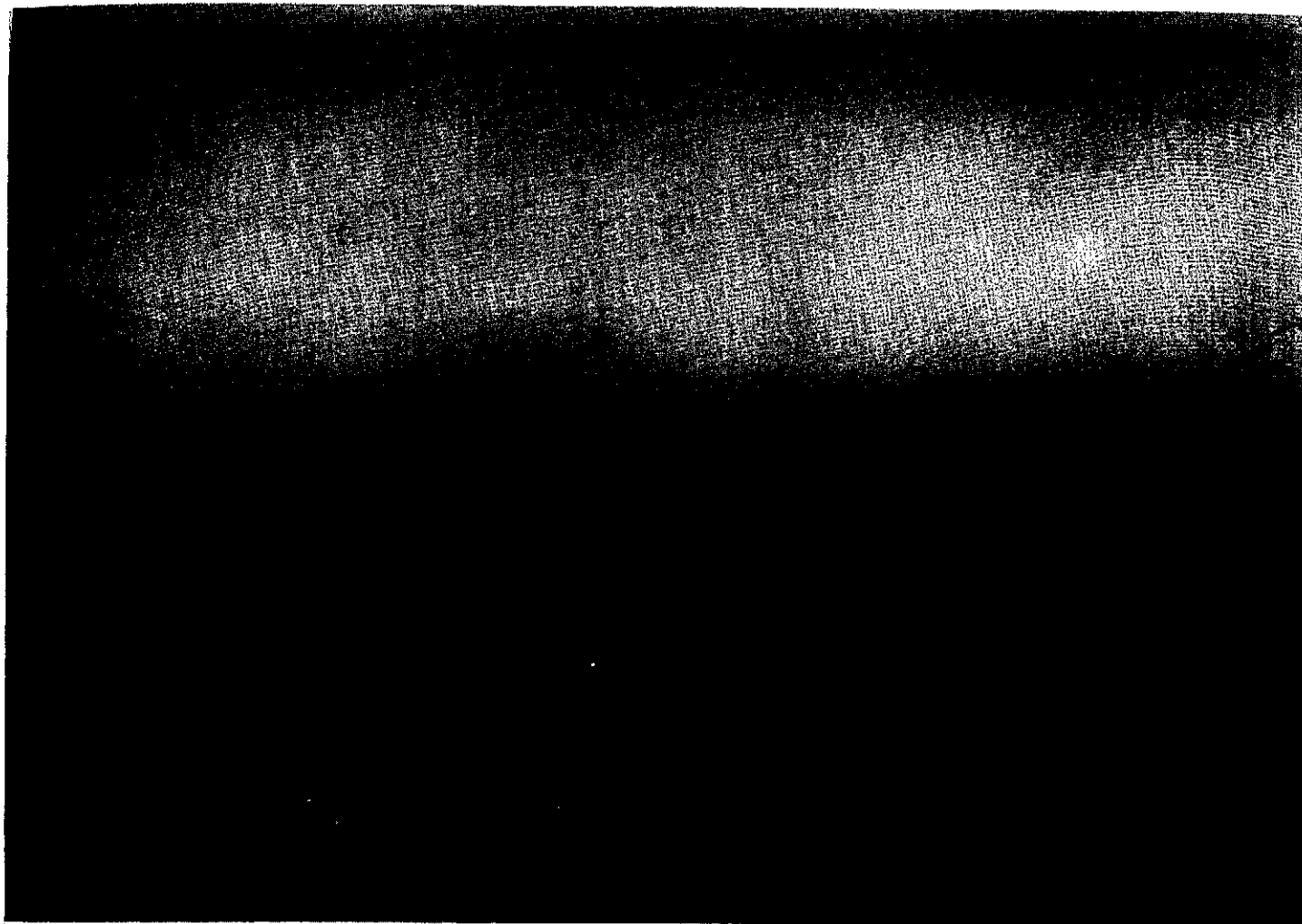


PLATE 58b (1962). The camera station has been shifted about twenty feet away from the old location in order to avoid a large mesquite. Mesquite, catclaw, and *Acacia vernicosa*, which dominates the foreground, are the most important shrubs on the lowlands. Palmilla (an inflorescence of which appears at right) and cane cholla are less abundant, but still important. Of the five,

only the palmilla plays about the same role as it used to. Little remains of the old grassland. The ground, bare and eroded, supports only a scanty understory of fluffgrass, burroweed, and desert zinnia. On the hills, which look about the same, are *Acacia vernicosa* and creosote bush.

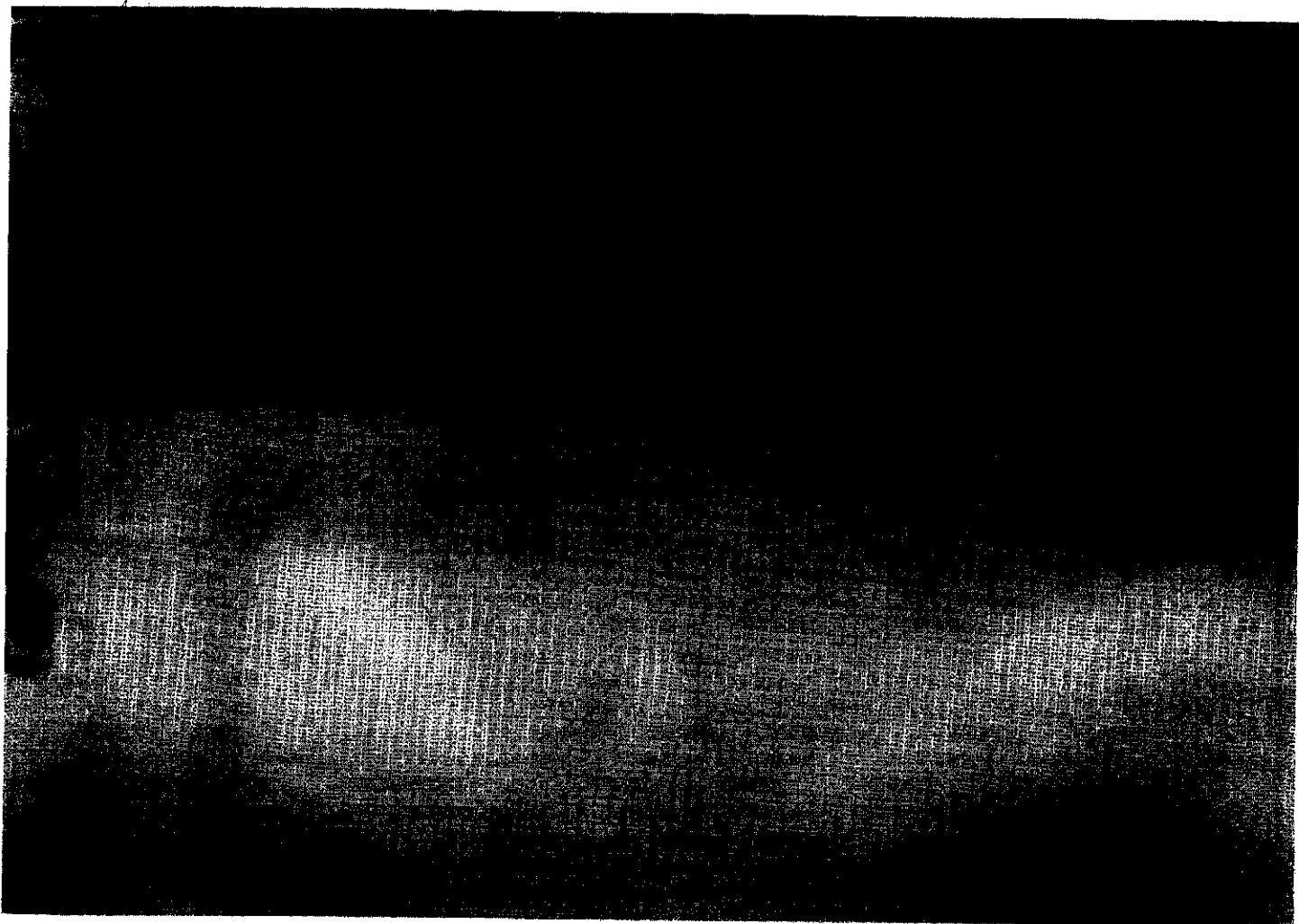


PLATE 59a (About 1890). Taken a few feet away from the station for the preceding pair, this picture looks south-southeast across the San Pedro River toward the Tombstone Hills. In this direction the plain appears even more open than in Plate 58. Except for a few yuccas and some unidentifiable shrubs, grass, are conspicuously absent from the lowlands along the river. Elevation 3700 ft.

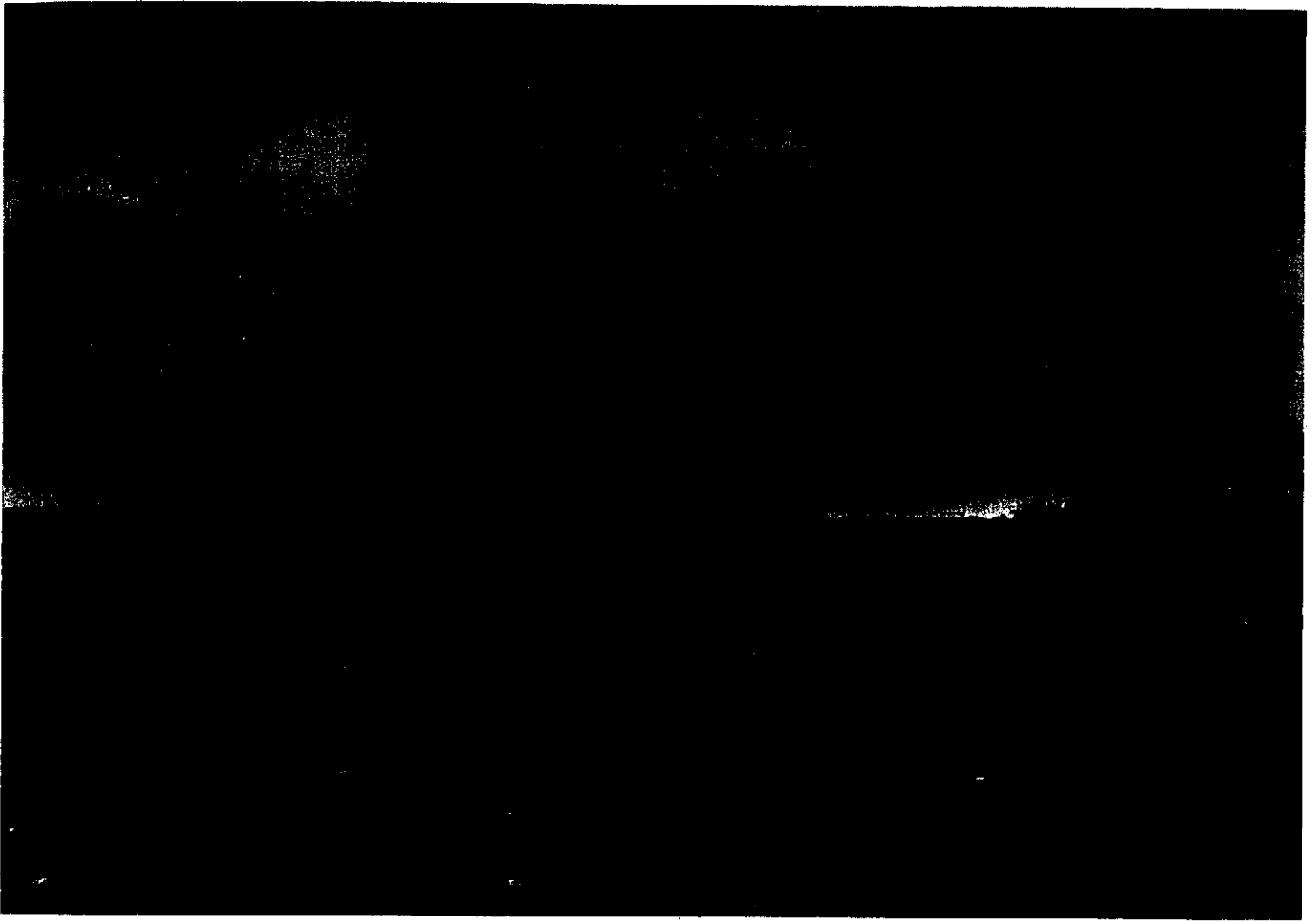
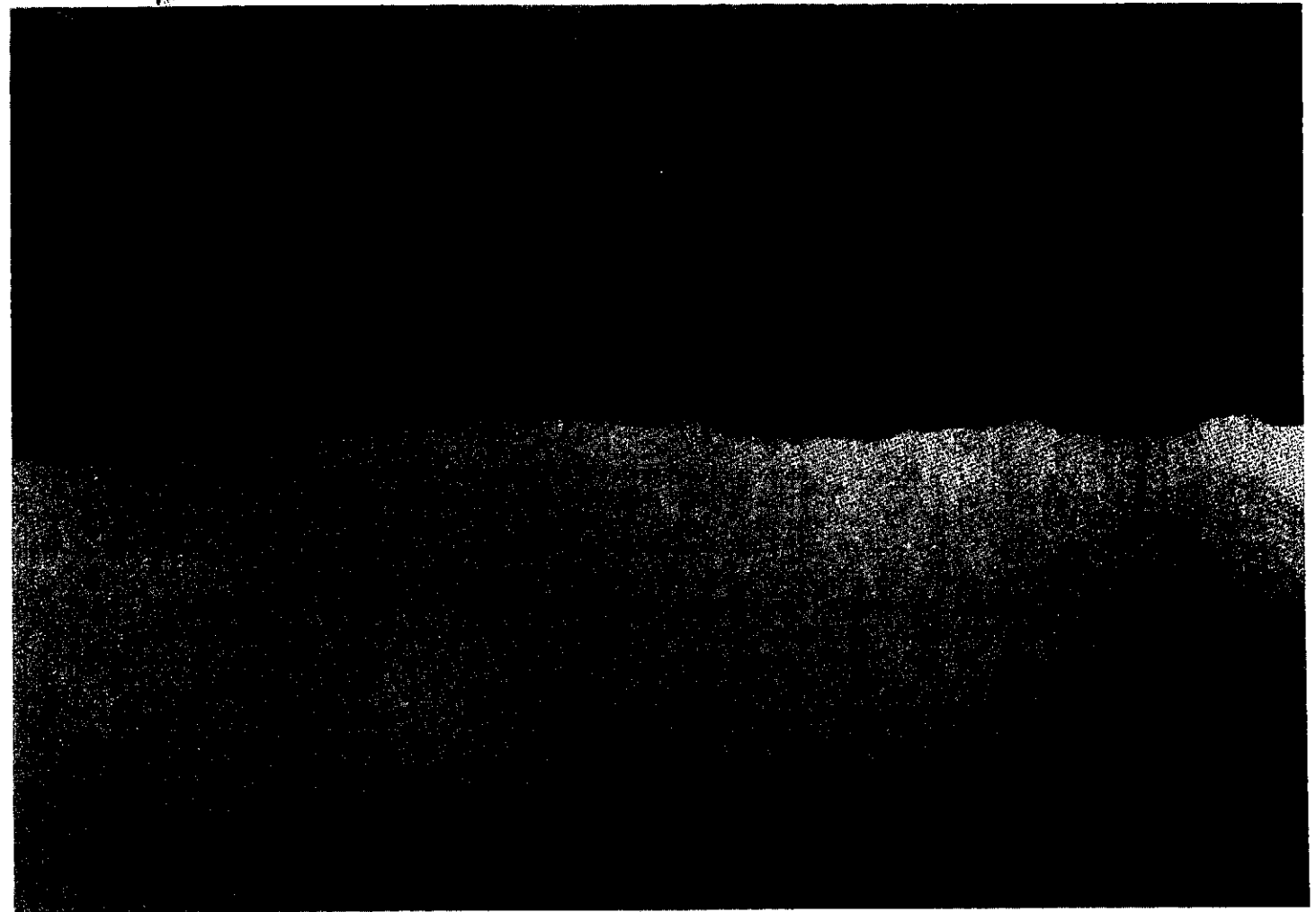


PLATE 59b (1962). All of the plants of Plate 58b occur here and, in addition, tarbush, sacaton, and *Bahia absinthifolia*, which appears as one of the abundant small herbs in the foreground, mixed with desert zinnia, fluffgrass, and burroweed. In the mid-

ground a lower, probably moister area has a dense cover of mesquite, *Acacia vernicosa*, sacaton, and bristlegrass. The tall trees in the background are cottonwoods, also recent invaders.

PLATE 60a (About 1890). This picture, taken about one mile southeast of the two preceding plates, and looking due north, is of interest primarily because of the shrubs in the foreground. The one farthest to the right along the lower edge of the photograph is probably chamiso, but the others look like nothing that can be found in the area today. The best guess is that they are mesquites that have been chopped for firewood, and that have resprouted from the stump. Since American settlement in this area dates from around 1879, the chronology for this explanation is about right. Elevation 3700 ft.





are
have
area
n is

PLATE 60b (1962). The camera is only approximately at the site of the old picture. Mesquite and gray thorn are the large shrubs visible. Chamiso and one small palmilla (right foreground) make

up the remainder of the vegetation. At the left side of the pyramidal hill in the right of the picture a grove of cottonwoods marks the course of the San Pedro River.

Invasders observed at the fifteen stations in the Santa Rita grasslands. Mortonia (which has probably also increased in the San Pedro), 2; white thorn, 2; turpentine bush, 1; burroweed, 1; Russian thistle, 1; hopbush, 1; one-seed juniper, 1.

Invasders at the thirty-four grassland stations. Mesquite, 29; ocotillo, 10; catclaw, 5 (?); gray thorn, 2; desert broom, 2 (?).

Invasders from the Chihuahuan Desert. Many plants in the first two categories enjoy wide ranges and no doubt should be placed in the third group also; but for one reason or another, they did not happen to be noted at the stations for the other sector. Conspicuously absent from the Santa Rita listing, for example, are plants of valley and gallery forest. The reason is obvious: washes and valleys were sampled less extensively in the western part of the life zone.

In spite of uncertainty about the extent of overlap-ping, it is apparent that the eastern group includes one important element lacking in the western: *Acacia vernicosa* and tarbush, which are plants of the Chihuahuan Desert, have been important invaders in the San Pedro Valley. *Acacia vernicosa* has, in fact, come to exercise a dominant position in the vegetation of the uplands and the bajadas within the valley, although before 1900 it evidently played but a minor role. Today it occupies in the eastern uplands the same importance that mesquite has assumed on the bajada around the Santa Rita Range Reserve (Plates 18, 19, 38), and that white thorn has assumed on terraces near Tumacacori Mission (Plates 40 and 41). Together with tarbush and creosote bush, it forms a distinctive community on limestone soils. In company with Wright Ippia, it inhabits rocky hillsides. By itself it dominates large stretches of gentle bajada, where it may form nearly impenetrable thickets in areas that seventy-five years ago were grassy and open. Its proliferation must rank as one of the major events in recent vegetative developments in the grassland.

CONCLUSIONS

In the past, the plant dynamics of the desert grassland have been studied more intensively than those of the other life zones, and the principal conclusion to be drawn is already well known: that woody species have taken over the dominance formerly exercised by the grasses, which are in decline.

Several of the species in question have been identified in the preceding chapter as invaders of the oak woodland. Mesquite, ocotillo, turpentine bush, desert broom, rabbitbrush, one-seed juniper, cottonwood, and Goodding willow have apparently increased their density in both life zones, although the last two, properly speaking, belong to neither the oak woodland nor the grassland, but to a gallery forest that threads its way through several zones.

The plates show that an increase in some thirteen additional species can be detected at one or more of the stations devoted to the grassland. Some of these plants undoubtedly are invaders of the oak woodland, as well, but either did not happen to be present at the localities sampled there or, if present, could not be quantitatively evaluated by the methods of repeat photography.

Altogether there are twenty-one species that can be categorized as invaders of the desert grassland, some shared with the life zone above, some not. They can be divided into three groups: those noted only in the Santa Rita area (seven species); those only in the grasslands of the San Pedro Valley (nine species); those common to both sectors (five species). In the listing below, the figures denote the number of stations at which an increase was observed.

Invasders observed at the nineteen stations in the San Pedro grasslands. *Acacia vernicosa*, 15; cottonwood, 7; tarbush, 4 (?); Goodding willow, 3; Wright Ippia, 2; desert willow, 2; threadleaf groundsel, 2; wait-a-minute, 2; rabbitbrush, 1. Cottonwood, Goodding willow, and rabbitbrush occur not in the grassland proper, but in riparian habitats.