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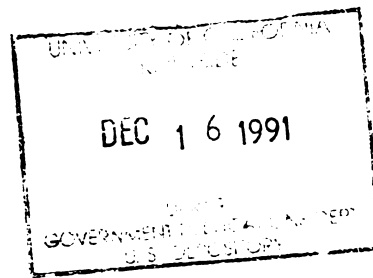
Recollections of Surveyors



U.S. Department of the Interior
Bureau of Land Management



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September 1991

U.S. Department of the Interior
Bureau of Land Management
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About This Book

For hundreds of years, cadastral surveyors have tramped across the country, braving the elements, to perform an important public service. They have had an exciting history, and they take great pride in their heritage. They enjoy swapping old surveying stories and sharing their experiences with others. Tales of the challenges surveyors have faced in the past, the accomplishments of the surveying crews, and the influence of outstanding surveyors abound. Such stories are a treasure of information, and lend themselves to helping surveyors better understand the issues that have influenced the way the surveying system is today. These stories of individual dedication, wisdom, and professionalism can be a source of pride, and help surveyors face today's challenges.

Marlin (Lin) Livermore's assignment to interview Glenn R. Haste about his surveying experiences initiated the idea for this book. Livermore is presently a Section Chief in the Branch of Cadastral Survey for the Bureau of Land Management's (BLM's) Colorado State Office and has been with BLM for 30 years. Surveying is in Livermore's blood — his grandfather worked for the General Land Office from 1908 to 1954. When Livermore was born, his father was working on a General Land Office survey crew. Livermore remembers eating dinner at the camps during the thirties, as survey crews' families were often asked out to camp for Sunday dinner. He also remembers going out on line with the crew when he was 4 or 5 years old, riding in a truck as the crew ran line over open, flat country. Through the years he has met and worked with many surveyors who have left their mark on this country and have been a strong influence on him. Livermore welcomed this opportunity to share a bit of history with fellow surveyors, historians, and others.

The first part of this book relates the stories of W.R. (Roy) Bandy. Bandy, who passed away in 1972, spent almost 50 years making public land surveys in the Western States as an employee of the U.S. Department of the Interior. Bandy was a Life Member of the Fellow of the American Society of Civil Engineers. At the time he retired, he was an engineering staff officer for BLM. In 1955, he received the Department of the Interior's highest honor, the Distinguished Service Award. Bandy wrote many articles on his experiences as a surveyor. This section is compiled from three such articles: *The Surveyor — A Good Life*, *Breakfast on the Big Horns*, and *The Pay Was Small But It Was a Good Life*. The articles were obtained from the Montana Historical Society and used with permission from Bandy's daughter, Zoe Reith.

The second part of this book is a narrative based on notes from Livermore's interviews with Glenn R. Haste. Livermore has known Haste for a lifetime. Not only did he work with Haste in the Albuquerque Region and in the Denver Area Office of BLM, but his father worked for Haste as well. Even Livermore's grandfather and Haste were lifelong friends. Haste started working for the General Land Office (GLO) in 1913 as a survey aid (the GLO merged with the Grazing Service in 1946 to become the Bureau of Land Management). His career spanned 49 years and involved surveys in over 200 townships in New Mexico, in addition to surveys in other states. He retired in 1961 from his position as area engineering officer for 11 of the Western and Midwestern States. He also received the Department of the Interior's Distinguished Service Award soon after his retirement. He currently resides in Albuquerque, New Mexico.

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Preface

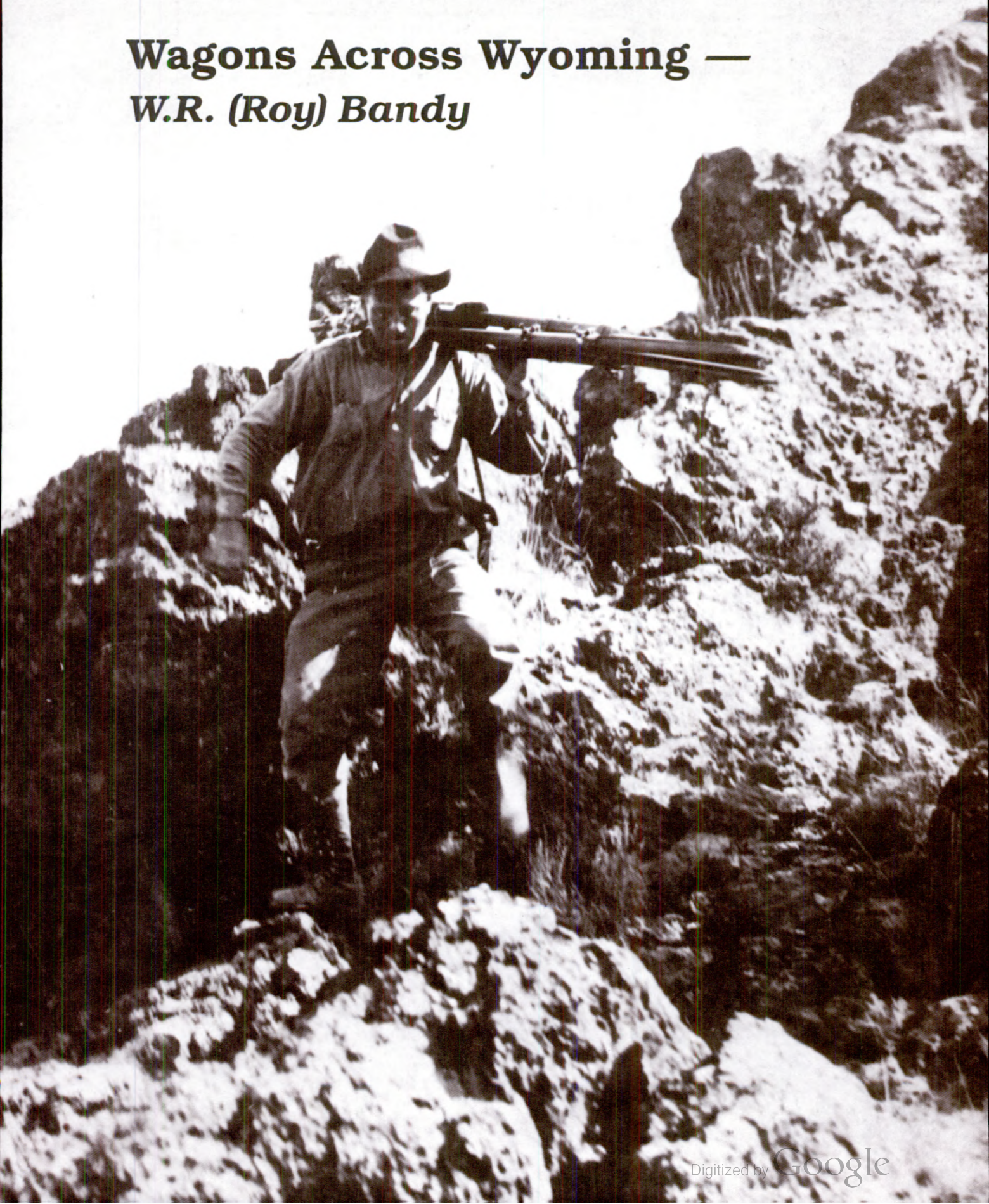
If you have ever spent time on a cadastral survey crew or in a survey camp, these memories merge with yours...the memories of companionship as a crew spent week after week together on the line and in camp...the long hot days surveying in the summertime...the hard ground and sparse supplies, camping in the mountains...the dedicated surveyors, striving to prove the “direct system” worked...the winter times in the office, when the pressure for mileage was off, and the surveyors could relax and swap stories — some, of course, more exaggerated than others...the pleasure of returning home after long weeks in camp and being able to enjoy your family.

The survey became part of you and you became part of it. You left part of yourself on every survey and the land became part of you. It was challenging, fun, frustrating, humorous, and serious. It was hot, cold, dry, and windy. It was companionship and loneliness. But, most of all, it was a way of life that was rewarding, with memories that will endure.

I would like to express my appreciation to these surveyors for their stories and the memories they have stirred within me, and for the opportunity to pass along their experiences to others.

— *Lin Livermore* —

Wagons Across Wyoming — *W.R. (Roy) Bandy*



— Chapter One —

Boyhood Dreams

Growing Up

Our farm home in Western Missouri was a good place for my three brothers and me to grow up. Being 13 miles from the nearest town, we learned to entertain ourselves. That was easy with the tall maple trees from which we hung swings, trapezes, and tightropes to practice exercises on. There was timber in the pasture where we could hunt rabbits and squirrels, and a large creek where we could swim and fish. Good training for the work that lay ahead! We learned reading, writing, and arithmetic at the one-room school a mile and a half south.

In those days we did not travel far. The extent of my travels, until I was 16 years of age, was the slow, all-day trips we made by wagon to Nevada, the county seat. There, Mother traded

butter, eggs, and a few old hens for groceries and clothes for us. On such trips we enjoyed the smell of coal smoke, and watched the trains whiz by — the puffing engines hissing steam to scare our horses. The long drive home in the late evening, usually after dark, was an adventure for us boys. Passing along pitch-black, tunnel-like

roads through the dense timber in creek bottoms, we watched lightning bugs glow and heard katydids chirp. And the occasional hoot from a wise old owl gave us a creepy feeling. Never to be forgotten was the welcoming home by old Rover — upon hearing the team and wagon, he met us a half mile from home, jumping at the horses' heads in play.

But time marched on. By the time I was in my middle teens my brother Elmer had graduated from college and was teaching at a country school in Routt County, Colorado. His exciting letters, telling of deer hunts, mountain trips, and


*"In my mind's eye I
could see greater
opportunities in
the West."*



An early survey party leaving camp in Colorado.

other adventures, caused me to long for the day when I, too, could go "West." But my father's passing away when I was 17 forced a change of plans. I would be needed at home to help Mother

run the farm. I did manage to attend college and obtain a diploma in bookkeeping and banking by the time I was 19 years old.



Plains Country

Getting off the train at Toluca, not a house could be seen as I gazed at the low, sagebrush hills. This, and the fact that two families of Indians dressed in their native costumes were sitting flat on the ground in the station yard, made me realize that I had already arrived in the plains country.

At 8 o'clock we all climbed aboard the train, which was made up of several boxcars, a combination express and passenger coach where we common passengers rode, and a Pullman sleeping car in the rear that had been switched to this train at Toluca. Pulling our train was a small, squat, engine with a large flaring smokestack, puffing clouds of coal-black smoke, which appeared sort of out of place in the clear Montana air. Indians were permitted to ride free on trains crossing their Reservation.

Because the railroad was still rather new and the novelty of a train ride had not worn off, families piled on and off at every stop. This allowed me a good opportunity to closely observe the Indians on their home grounds. The Indians were friendly in their quiet way, and attended strictly to their own affairs. The men usually led their families by walking solemnly ahead, followed by the women and children, who were especially respectful, quiet, and attentive. The men usually wore dark coats, varied colored leggings, wide brimmed black hats with high crowns, and two or three large eagle feathers dangling in the breeze, under which hung their long black hair in two braids. The women wore bright colored blankets, thrown over the shoulders, a scarf on their heads, and beaded moccasins reaching 12 inches high on their legs. Babies were strapped tightly to a papoose board slung on their mother's back, facing the rear. The infants, displaying no objections to being restricted in their movements, gazed solemnly at those who followed behind.

The thrilling experience of feeling that I was actually on the real frontier gripped me as I gazed out the car windows watching the slow train crawl across this virgin grassland, where, from horizon to horizon, not a fence or plowed field marred the unbroken landscape. An occasional group of tepees, nestled along the brushy creeks, and pinto ponies grazing nearby enhanced this overall impression of being in the midst of an untamed land. Why, a herd of shaggy buffalo might be grazing peacefully just over the distant skyline!

As I waited, my longing to go to Colorado or Wyoming grew greater and greater. In my mind's eye I could see greater opportunities in the West. I was not interested in an office job or work on a farm in Missouri if I could find something better. Fortunately, in the early spring of 1905, Elmer, then working on a Government survey project in Wyoming, secured a position for me with the same outfit, to start the first of June. He had told me glowing stories of his work — living in tents, camping out in uninhabited areas, seeing new country almost every day, with game and other wild animals running about — and the prospect of such a life appealed strongly to me. I then did my best to get the home crops planted by the last of May so I could leave the farm work to my younger brothers, Ray and Willis, and go to Wyoming.

First Journey

It was a joyful day for me that first day of June 1905 when I left home on the jerkwater train for Kansas City. I had a basket of fried chicken sandwiches and apple pies Mother had prepared for me to eat along the way, some extra money pinned inside my shirt, and enough train fare to take me to faraway Garland, Wyoming. Leaving Kansas City on the Burlington train I enjoyed hearing the car wheels begin their rhythmic click-e-ty click, click-e-ty click over the rail joints with increasing tempo as we pulled out of the yards amidst clanking bells and hissing steam. I then realized I was on my way to the promised land.

As the long train whistled its way westward across the plains of Kansas, Nebraska, and a corner of Wyoming, the houses and fences kept getting farther and farther apart as we approached the open spaces of the West. On the second morning I arrived at Toluca Junction, a red section house in the lonely sagebrush prairie 35 miles east of Billings, Montana. Toluca, which is on the Crow Indian Reservation, is where I changed trains onto the Cody branch line, which

runs through the Indian Reservation on the way to my destination of Garland, Wyoming.

Pryor Gap

We soon entered Pryor Gap, where I received my first close view of the mountains, the Pryor Range, which here consisted of thick tiers of light-gray limestone ledges and cliffs, one above the other, separated by rocky, timber-covered slopes. This famous defile, according to legend, served as a natural passageway for ancient tribes, who traveled between the mountain valleys to the south and the grassy buffalo country to the north. A line of prehistoric stone mounds, found at regular intervals throughout the length of the gap, strengthened the theory that this was an ancient passageway. The great age of the monuments, which were about 10 feet in diameter by 3 feet high, was indicated by the stunted, gnarled, cedars now growing on them.

Seeing so many new and interesting sights on this last leg of my journey had whetted my anxiety to see, as quickly as possible, the place where I was to work the next few months.

About 3 o'clock in the afternoon, the engineer blew the whistle signaling the approach to Garland. Rushing to the window as the train rounded a long curve entering town from the northeast, I got a glimpse of the main business section. It consisted of a half-dozen white frame store buildings on the west side of the main street, which ran northward for about an eighth of a mile from the red depot. On the east side of the main street were a livery stable, feed yards, and some warehouses. The newness of the town, which was only 3 years old, impressed me, in comparison with the old rundown sections of the towns I had just passed through in the Midwest.

Upon leaving the train, I noticed that just south of the railroad siding was a high railroad trestle and coal chute for use in refueling train engines. Mr. Norton, the station agent, informed me that just south of this trestle was the Brunt survey camp, where I was headed.

— Chapter Two —

Adventures in the Wilderness

Arriving at Camp

Taking my baggage, I walked under the trestle to the largest one of a group of tents where I found Miss Rhoda Huber, the camp cook, busy in the cook tent. Rhoda, a friendly girl in her 20s, extended a hearty welcome, saying they were expecting me, which was reassuring news for me in this strange land.

Miss Huber informed me that the men, who were all in the field, would return to camp in time for supper, an event that I was looking forward to with much pleasure. The fragrant smells floating up from the roasting beef in the oven, and the freshly baked "light" bread on the table, had already convinced me that I liked my new temporary home. This canvas kitchen, a most important adjunct to any survey camp, was sup-

plied with a homemade cupboard, a mess box set on boxes in the back of the tent, and a sheet-iron camp stove in front. The stove's lid formed the cook's work table, with the cookware needed to prepare meals for the large crew of men. Lights

for the camp were furnished by tallow candles placed where they would do the most good; many of them were stuck in the tops of catsup bottles. Drinking water, not only for this camp but also for the whole town of Garland, was brought in by the railroad company in tank cars.

The camp came alive when the field men, about 20 in all, walked into camp after their long day in the hot desert. It seemed everyone was trying

to talk at once, relating their experiences of the day, while washing up for supper. The meal, which seemed one of the best and most satisfying ones I had ever eaten, was served "roundup"

*"I rolled out my
bedroll ... then
bedded down for
my first night
in camp ..."*



Survey camp around 1915. The larger tent near the center is the cook tent.

style, as were all camp meals. After supper my brother showed me to one of the bunk tents pitched nearby, where I would sleep for the night. I rolled out my bedroll on the bare ground, as did everyone else, then bedded down for my first night in camp, serenaded by lonely coyotes barking, yapping, and howling in every direction. My camp bedroll, which was about standard equipment for the age, included a sogan, double wool blanket, a light cotton blanket, and a small pillow, all surrounded by a tarp as protection from dust, rain, or snow.

In those days each employee had his own bedding, towels, toilet soap, and some other toilet articles as required. The personal baggage was limited to such articles as could be carried in a bag or seamless sack called a "warbag"; all suitcases and trunks were stored in town. My main objection to a warbag was that everything I wanted to get out of it was always in the bottom. If I needed a clean pair of socks, I would ram my arm down in the bag, feeling around for the wily socks, but encountering instead such items as gloves, underwear, shirt, or perhaps a piece of mosquito netting, and after yanking up a few of the unwanted items by mistake, I would give up, emptying the whole lot out on my bed. I threatened to make another opening in the bottom of the bag to save time. As a forerunner of today's fancy

toilet case, I preempted a used, empty 2-pound Union Leader tobacco tin, in which I kept my Arbuckle brand razor, shaving stick (soap), shaving brush, hand mirror, needles and thread, and a teaspoon of flaxseed my thoughtful mother had given me in case I got a grain of sand or some chaff in my eye!

The Colonel

The purpose of this crew's cadastral survey was to divide the unoccupied public domain land into townships and sections, which was the first step necessary in bringing irrigation water to this parched land and making it available to farmers in the future. This prospective farmland was a level, dry, desert stretching for miles to the west and north from Garland, with not a tree, fence, or anything to break the monotony of the shimmering landscape. Only the ribbonlike railroad track could be seen pointing straight west, just to disappear in a mirage a few miles away. There was nothing on the powdery soil but saltsage, grasswood, cactus, anthills, prairie dog towns, and buffalo skulls.

Mr. Samuel W. Brunt, better known as the Colonel, and his son Arthur headed up the surveying organization I had joined. The Colo-



Survey crew setting a wooden corner stake.

Horse Play

I'll never forget the time Old Denver, the big work horse, jumped up into the wagon box! A couple of weeks after I had joined the survey party I took a team and wagon to the Shoshone River, a few miles away, for a load of firewood for the cook. Upon returning, I unharnessed and tied the two horses to the sides of the wagon. The horses, named Ben and Denver, were big clumsy draft animals, weighing around 1,700 pounds each. Later in the afternoon, hearing a commotion out at the wagon, I rushed out of the tent and saw the two horses rearing, pulling, and jumping for all they were worth, trying to break loose. The wagon, a light 2 1/2-inch Studebaker with bolster springs, was parked almost under the railroad trestle, and an engine was pushing a loaded coal car up the incline to the coal chute, puffing clouds of black smoke and shooting spurts of hissing steam out over my horses, scaring them almost to death. At the height of the excitement, Old Denver jumped all the way up into the small wagon box with all four feet. The big ungainly animal, with his large clumsy feet and long hair on his lower legs and fetlocks, looked odd standing up in the small wagon box, gazing uneasily down from his strange perch. This was a new experience for him, and he paused to view his surroundings while I cringed, wondering what would happen next. Fearing the horses would hurt me in their excitement, I was afraid to rush in to untie the halter ropes. Fortunately, the poor horse managed to hop out onto the ground again without injuring himself. By this time the engineer, having spotted the horses, was coasting quietly down the incline, and the show was over.

nel was a land surveyor of long experience, having held contracts in California before going to Wyoming. He was an elderly man with gray whiskers and a twinkle in his eyes. And being blessed with a jovial disposition, he was the life of the outfit in camp or on the trail. By showing a friendly interest in each of his employees, and inquiring into their general welfare, he kept the morale of the party high.

To break me in on the first day, the Colonel assigned me to Wilford Utterback's line crew as cornerman. Utterback was a slender young man, 6 feet, 2 inches tall, from Iowa, who set a swift gait that was hard for me to maintain. Walking, I soon discovered, was an important part of the job for surveyors. After walking 2 or 3 miles to the starting corner, they continued to walk as

they surveyed 5 or 6 miles of section lines, stopping to dig holes for marked corner stones every half mile, then walked back to camp.

My duties on Utterback's crew included supplying corner stones as I could find them along the line, mark them with a chisel, and set them in the ground. At times I would carry a suitable stone on my shoulder for a half mile. If no stones were available, we were permitted to set a wooden stake for a corner. There were also corner accessories to build, consisting of mounds of stone or pits dug in the ground. However, other members of the party usually helped me with those chores.

If the terrain was passable for wagons, we sometimes drove one along to haul the tools and corner stones. I, being used to doing farm work

and driving horses, was sometimes detailed to take a wagon 10 miles south of camp to the river to pick up dry cottonwood limbs and logs for stove wood. I enjoyed the wood detail because I was then my own boss and could take my rifle along and look for coyotes.

On one occasion a badger ran after me. I ran for the wagon and jumped in. The badger continued under the wagon to its den. I had gotten between him and his hole! But a badger is not above attacking a person. They are fearless. I had one attack my saddle horse, running and blowing at the horse because it had overtaken the badger along a trail.

Life in Garland

On the first clear day I had in Garland, I was impressed, and deceived, by how clearly objects could be discerned at great distances. For instance, in the clear, bright, rarefied atmosphere, without trees or buildings to obscure the view, Hart Mountain, 29 miles away to the west, seemed almost in walking distance from our camp. This landmark, standing volcanolike, high above the surrounding country, was capped by massive layers of light yellowish limestone, tilted slightly to the east, and was surrounded by perpendicular cliffs some 500 feet in height on all but the east side. A heavy growth of pine and fir timber covered the central portion of the flat top and extended down the gradual east slope, providing an easy access route to the summit. This high

vantage point provided a magnificent view of the surrounding country — a new experience for us plains dwellers. Once, when the crew was working in the area, we saw a pack of timber wolves from the top of the peak. Seven of the surly, ill-tempered brutes on a ridge a half mile west barked and howled defiance at us across the chasm that separated us, sending cold chills up and down our spines.

Hart Mountain, standing apart from the main mountain range and easily identified by its peculiar markings, served as a guidepost for travelers throughout the Big Horn Basin. Basin residents, returning after a long absence, again seeing the familiar landmark, regarded it as a sign of welcome, for it gave them a feeling of warmth and homecoming.

Garland's most interesting attractions for me were long freight teams of horses pulling two or three wagons loaded with sacks of wool. Ten or more horses hitched two abreast in a long string were driven by one man riding one of the wheel horses (the team next to the wagon). It was marvelous how one driver could turn the outfit around in the street, and maneuver the heavy wagon into position for loading freight cars. They did it by using a jerkline to guide the lead team. The swing team hitched to the front end of the wagon tongue played a most important role when going uphill on sharp curves. Often, they would have to step over the draw chain and pull at right angles to prevent the wagon from going off the roadway.

— Chapter Three — Learning the Trade

Badlands Country

After completing surveys around Garland on June 30, 1905, the surveyors moved to Cody, Wyoming, where they were split into three groups. I was assigned to a crew going 85 miles southeast to Worland, Wyoming, to survey a correction line called the 11th Standard Parallel for 60 miles straight west. The base line we were to survey started at a corner that had been set the previous year on Fifteenmile Creek northeast of Worland. I was promoted to chainman and worked with Arthur Brunt as my chaining partner. Two sets of chainmen were employed on the base line. It ran up Fifteenmile Creek, over Tapman Mountains, and crossed the Greybull River below Meeteetse. It ran through desolate badland country where many wild horses were seen. The wild horses were not afraid of us on foot, but would run from any rider at sight.

Water was scarce and Colonel Brunt, on his horse, Tamarack, often went ahead, scouting for new campsites where water was available, and guided us into them at quitting time. Camps were moved every other day so we never knew where to find the next camp. It was often a weary crew that tramped through the badlands on hot afternoons, with their canteens empty and their tongues sticking to the roofs of their mouths. After reaching the Greybull River in August the water situation was much improved.

It was my good fortune to have Arthur Brunt take an interest in explaining the technical side of surveying to me. During spare time in the evenings and on Sundays he taught me how to read the verniers on the transit and solar compass; to make simple calculations, such as computing declinations of the sun, the azimuth of Polaris, and triangulations; and to close sections.

The Standard Parallel project was completed early in September 1905, when we set the last corner, a standard township corner, near the top of Carter Mountain. My party was then transferred 6 miles east to the valley along Meeteetse Creek where the remainder of the season was spent subdividing a township on the north side of the Standard Parallel we had just established. The parties were disbanded the last of October and I returned to my home in Missouri.

Purchasing a set of books on surveying and civil engineering from the International Correspondence School of Scranton, Pennsylvania, I studied surveying during the winter of 1905-1906.

*"For what seemed
like eons, I stood
there balancing on
the face of that
awful chasm."*

A Frightening Experience

Returning to Wyoming in April 1906, I was put in charge of a survey party of my own, thus beginning a new chapter in my career as a surveyor. My party consisted of two experienced chainmen, former colleagues Sam Hutton and Luther Glasgow. My camp tender was a former cowboy, Ed Myers. His wife, Edith, was cook. My cousin from Missouri, Troy Troutman, was my cornerman, and Tommy Jones and Dave Shaffer were my flagman and axeman.

In 1906, a frightening experience occurred while I was surveying a meander line along the south bank of the Shoshone River through the 2000-foot deep canyon separating Rattlesnake Mountain from Cedar Mountain on the north. I was carrying my transit southward along a narrow 1-foot wide ledge on the north face of a cliff some 900 feet above the canyon floor. A 4-foot high rotten stump blocked my way. To pass it, I quickly swung my body out and around the obstruction. Grasping the stump with my left hand for support as I swung outward, the stump



Stagnant Water

I found the most disagreeable feature of my work was going all day long in midsummer on 1 quart of drinking water. Until a newcomer got used to conserving his water, he usually suffered from thirst in the afternoons. Experienced hands would try to refrain from drinking until noon, thus saving a full canteen to sip on while eating lunch, and a few swallows for the afternoon when their mouths got dry. When extremely thirsty, I was not choosy about the kind of water I would drink. I would often greedily drink from stagnant pools having a heavy green scum, dead bugs, and grasshoppers floating on the surface. I managed to make out pretty well by bellying down, carefully blowing back the scum, and quickly dunking my face in the murky water well below the scum and drinking my fill, straining the water through my teeth. No ill effects were suffered from drinking such water unless it had built up a heavy concentrate of alkali. Strong alkali water standing in pools having muddy banks could be identified by being crystal clear, but we found that standing murky water was usually safe to drink.

gave way, leaving me teetering on the brink. I could not move my feet on the narrow ledge to balance myself. Looking down, I could see Lilliputianlike wagons on the road 900 feet below! For what seemed like eons, I stood there balancing on the face of that awful chasm. Quickly thrusting my left arm to the left (south) I shifted my center of gravity while springing forward to safe footing and a long breath. The Lord had his hand on my shoulder.

The First Season Ends

On July 1, 1906, I was appointed U.S. Deputy Surveyor for the State of Wyoming by Mr. A.P. Hanson, U.S. Surveyor General for Wyoming. That appointment gave me authority to make official surveys and resurveys of public land, and to sign the official field notes.

At the close of the first season in 1906, I took the team and wagon to George Mueller's ranch

at Burlington, and put the horses on winter pasture, then started out looking for a winter job. At the Eaglesnest Camp of the Bureau of Reclamation, Mr. E.F. Tabor, project engineer, offered me a job as teamster to drive the engineer crew to and from work on construction of the Shoshone Canal. Although it was quite a reduction in status from the transitman job to teamster, I accepted it. I saw an opportunity to learn something about irrigation engineering. It turned out to be a lucky break for me.

In addition to taking care of the surveyor's team and driving the surveyors out to work 6 days a week, my duties also included feeding, currying, harnessing, and hitching Mr. Tabor's team to a buggy. Tabor's team was nervous and spirited. They were always rearing to go when the last trace was hooked. The right-hand horse watched me, and when it saw me hook the last trace, it would start to prance. If not permitted to go at once, he would back up, rear, and throw his head. I would hold the lines taut as Mr. Tabor



Facing the perils of the landscape is just one of the challenges of a surveyor's job.

eased himself into the buggy seat. I hastily hooked the last trace, handed the lines to Mr. Tabor and away he would go in a cloud of dust. I suppose Mr. Tabor was satisfied with my work. He said if I would like to learn more about irrigation engineering and surveying he would be glad to teach me at night. That was good news.

With my correspondence school books, I soon learned the principles of running curves, cross-sectioning, and computing areas, and computing the grade and capacity of canals. On February 1, 1907, I was named "surveyman," relieved of my teamster's duties, given a crew, planetable, and transit, and told to make a contour map of Ralston Reservoir. That job was completed to the satisfaction of the engineers.

In April, I again left the Reclamation Service and resumed work on my survey contract with the U.S. General Land Office in Dry Creek Basin. Field work on that contract was completed June 30 and I again joined the U.S. Reclamation Service, this time at Camp Coulter on the Garland Flat. Here I located and cross-sectioned portions of the Franny Canal and lateral "F" and staked out the concrete "drops" along the Garland Canal.

On September 15 of the same year, the survey work closed down and I was sent up to the Eaglesnest Camp to work as a carpenter's helper on the Eaglesnest Flume.

— Chapter Four —

New Responsibilities

Irrigation Canals

On October 1, 1907, Mr. George W. Zorn, chief engineer for the Big Horn Basin Development Company at Wiley, Wyoming, called me. He hired me as field engineer for that company, in charge of surveys on construction of three irrigation tunnels and the main canal from the South Fork of the Shoshone River to Oregon Basin south of Cody. There were about 6,400 feet of tunnels and 10 miles of canal along the north slope of Carter Mountain. The tunnels were excavated 13 feet in diameter, with a grade of 0.25 foot drop per 100 feet, and the canal had a bottom width of 100 feet and a slope of 1.00 foot per mile. They were all designed to carry 2,000 cubic feet of water per second.

No. 2 tunnel, 2,600 feet in length, had curves under the ground at each end, and was worked from each end. My job included keeping the miners on line around the curves, and on the proper grade, so the two headings would meet and water would flow through the tunnel. I also set grade stakes for a steam shovel digging the canal a few miles above the tunnels. I lived and had my office in a tarpaper-covered cabin the company furnished me at No. 2 tunnel camp, and I took my meals at the company mess halls.

Three tunnel crews of 12 to 14 men each worked 8-hour shifts at each tunnel heading. Tunneling was carried forward at four different headings during 1907 and 1908. Alignment was furnished the miners by means of plumb lines I hung from the center of the ceilings of the tunnels.

Blasting was done with dynamite and powder fuses. There was a fuse for each charge of dynamite, and usually 20 or more charges were

fired at the close of each shift. I sometimes helped the shift boss split the fuses just for something to do. Twenty or more lighted fuses spewing at my feet made a novice like me have some second thoughts as I continued to light other fuses. I stayed up all night the night they were expected to break through No. 2 tunnel. When the graveyard shift shot at 7 a.m. and broke through, I was the first to stick my nose in the small opening to get a breath of fresh air and call through to the opposite crew. Later, I found the line brought in from each end checked within 3/8 of an inch.

"I stayed up all night the night they were expected to break through No. 2 tunnel."

Our next problem was to prepare to line the tunnels with concrete. Gravel chutes and bins were erected to carry the material into the tunnel portals where concrete mixers were placed. Lining the tunnels was proceeding satisfactorily, when in December 1908, the Big Horn Basin Development Company encountered financial difficulty in raising funds to carry on the work. Everything came to a sudden standstill. On January 9, 1909, I

severed my relations with the company and returned to my home in Missouri.

I vacationed around home on the farm in Missouri until August 1909, when I started for the West to look for an engineering job. I bought a round-trip railroad ticket to the World's Fair at Seattle, Washington, good for 6 months with the privilege of stopping off any place. I stopped off in Idaho to look for jobs at American Falls, Minidoka, Twin Falls, and Nampa without success. At Boise I met a Mr. Crocker, who was on his way to take the train for Chicago. Mr. Crocker employed me on the spot to take a party over on the Snake River and spend a month or 6 weeks making preliminary surveys for a proposed pumping plant irrigation project across the river from Grand View, Idaho. He would be

back in time to pay us off, he said. I completed that job and went on to see the World's Fair. Returning, I stopped off at Spokane and surveyed summer homesites along the shore of Hayden Lake for the Northern Pacific Railroad until the snow forced us out in November 1909. I then returned home.

In April 1910, I again went to Idaho as field engineer for the Snake River Irrigation Company where I had made the preliminary surveys for Mr. Crocker the year before. I was in charge of location and construction of irrigation canals along the Snake River across from Grand View. Mr. Charles Franklin of Boise was chief engineer. The job closed down for the winter in November 1910, and I again returned to Missouri.

Marriage and a Government Job

I was married to Inez Estes, a Missouri girl, on February 12, 1911, and we went to Denver on our honeymoon, where we rented a one-room and kitchenette apartment and spent the rest of

the winter. I was looking for a job to go to work on in the spring.

While in Denver I renewed acquaintances with employees of the Bureau of Reclamation Offices and the General Land Office that I had worked or corresponded with when I was in Wyoming. I also visited Mr. A. Lincoln Fellows, a well-known consulting engineer I had met in the field in Idaho on irrigation projects he was examining. I looked to him for help and advice. In April I was offered two engineering jobs. One was as location and construction engineer for the Snake River Irrigation Company at Grandview, Idaho; the other was as cadastral engineer in charge of a field party under civil appointment with the U.S. General Land Office. I accepted the Government job, with headquarters in Wyoming.

That position with the Civil Service of the Federal Government appeared to be more or less permanent, so I was glad to get it. However, it would take me away from home for months at a time, camping throughout the mountains. When Inez saw me preparing to spend the summer in a survey camp, she wanted to go along, stay in camp where she could be helpful to me, and,



Survey camp in Washington State around 1914.

A New Camp Cook

I was glad to find Inez willing and desirous of sharing in the camp life, though she was a little dubious as to whether she could please the men with her cooking. I encouraged her by saying the boys would be easy to cook for because they were always hungry. So I bought her a White House Cook Book and she was in business!

Being raised in Missouri, camp life in a tent on the Western Frontier presented many problems Inez had never heard of, most of which arose when she was alone in camp and had to cope with them as best she could. A wind storm might swoop in and flatten the tents, or work the stovepipe loose from the stove with a fire going. She would have to grab a gunny sack and fit the pipe back on the stove before the canvas caught fire, with soot flying all over and settling on the table and dishes.

One morning while washing dishes at the stove, she looked back at the cupboard and spied an animal watching her over the edge of the gingersnap keg. She had never seen a packrat before, and its big ears, bug eyes, and long whiskers looked pretty savage to her! She had never shot a gun, but she hurried to get the old revolver I kept under my pillow. Taking rest on the table, she fired at the beast. When the smoke from the black powder shell cleared away, up popped the head again, with eyes glistening and tail slapping the side of the carton. She shot the remaining shells with no result, except to riddle the messbox. Not to be outdone, she courageously wrapped a gunny sack around the gingersnap box and nailed the package tight in an empty egg crate. When we returned to camp she proudly pointed to the egg crate and asked us to take a look and name it!

incidentally, see a lot of new country. Regulations prevented anyone from living in a Government-maintained camp unless they were employees of the Government, so she volunteered to give the cooking job a try.

I entered on duty in Cheyenne on April 10, 1911, and was assigned to survey six townships north of Cody. The Surveyor General outfitted me with a new Young and Sons solar transit and the necessary surveying equipment. I was authorized to proceed to the field, employ a crew, purchase tents and mess equipment, tools, and supplies for running a camp, and hire horses and wagons for transportation. The land to be surveyed had been surveyed 30 years before, but the original survey was defective in alignment and

measurement, and in many instances cottonwood stakes, which no longer could be found by the settlers, were used for corner monuments. This was a free resurvey by the Government, using iron posts for corner monuments, to aid the settlers and promote the development of the country.

Moving Cross Country

In mid-August 1912, we were on a long move overland in wagons from one section of the country to another—from Martin Ranmael's homestead farm about 10 miles southeast of Cooke City to the W.T. Broderick homestead



Mess wagon on the move in eastern Montana, 1915.

and the Hilton Lodge east of the Little Horn River and south of Wyola, Montana. Mr. Ranmael, a native of Norway, had waited several years for a survey because his homestead was such a difficult place to reach. When he built his house the nearest road to his place was at Cooke City. He was most friendly and courteous, and a man of unusual dexterity. According to reports he had built his nice house, all with smooth shingles and weatherboarding, entirely from native logs, using only the broadaxe, foot adz, and handsaw. It was a showplace, really.

Having completed surveys around Ranmael's place the first part of August, we were directed to proceed to the Little Horn area some 150 miles east, by a roundabout road. Mr. Ranmael bade us a fond farewell as we left with wagons piled high with camping equipment and supplies. At that time, there were no swank motels or garish hamburger stands dotting the landscape and it was the custom throughout the West for travelers to stop overnight wherever darkness overtook them. They thought nothing of pitching camp on the edge of a town rather than go to a hotel or rooming house.

The first day out, we found Sunlight Basin almost impassable because of some bad mudholes and steep hills. One time we got stuck with the bedwagon and had to carry a part of the load by hand ahead to dry ground. In Sunlight we met

Forest Supervisor R.W. Allen, who was helpful in advising us about roads. We passed over Dead Indian Hill, the famous landmark where anyone going west must drag a good sized tree with the limbs still on it, to keep the wagon from getting ahead of the horses! The first night out we camped on the head of Pat-O-Hara Creek at the foot of Hart Mountain. There the wolves kept us awake with their blood-curdling howling.

The second night out we were at the Cody Bridge. There we replenished our supplies and also soaked ourselves in DeMaris Hot Springs, the outdoors bathing pool of boiling sulphur water that gave the river its Indian name, "Stinking Water."

We continued our trip, crossing the Big Horn River at Kane, Wyoming and camping at the foot of the mountain. The next day Inez and I took a shortcut and walked ahead while the men doubled up the teams and pulled each wagon up one at a time. For us it turned out to be more of a climb than anticipated. About noon we got hungry and discovered we had inadvertently left our lunches in the wagons! Seeing a sheep wagon over by a spring, we swung over to it. There was no one home, but a part of a mutton hung in a tree wrapped in a flour sack. It looked like "manna from heaven" to us. Inez fried some mutton chops, opened a can of tomatoes and a can of corn and we had a feast. We left a thank

you note for the nice shepherd. About 4 p.m. we luckily joined up with the wagons and joyously climbed aboard. It was a great relief to again settle ourselves in a spring seat. We could enjoy the interesting scenes of nature much better from that vantage point. As the caravan continued along the old crooked Indian trail that is "nobody knows how old," my brother, Willis, spotted a covey of ruffed grouse and bagged a few young ones for breakfast with his "38 Special" Colt revolver.

It was getting near sundown before we found water for an overnight camp. We began to wonder if we could find water before darkness closed in on us in that vast solitary wilderness. We were at an elevation of 9,500 feet, with not even a road in sight. The big snow drift ahead looked promising, so we pulled down and parked the wagon on a level spot below the drift and found a small trickle of water seeping from beneath it.

Everyone was tired and hungry and no time was lost in getting supper started. Groceries were hurriedly dug out of the wagon. Some got the stove out and set it up, others got wood. Potatoes were peeled and ham cut. It was not long before the fragrant smell of frying ham filled the mountain air! Road dust was wiped off the granite dishes and supper was ready, with

plenty of gravy and hot biscuits. A tent was put up for my wife, and the horses were fed their oats. After supper the horses were hobbled, a cowbell put on one, and all turned loose to graze during the night. The men slept out beneath the star studded dome.

Breakfast on the Big Horns

Waking up during the night and hearing the gentle tinkle of the cowbell, I turned over and went to sleep again with the comfortable feeling that all was well! At least we still had a saddle-horse. The next morning the stream had quit running, the pools were frozen over, and there was ice on the water pails I had thoughtfully filled the night before. It was a little breezy, so one of the boys put a piece of striped canvas under the edge of the wagon box to protect Inez from the cold north wind, "the fierce kabbabinokka" of Hiawatha fame, while she made breakfast. After breakfast we all went up on the snow to frolic so the boys could write home about snowballing in August. The snow was too hard to make snowballs, and it was hard to stand upon. Although we were well above timber line and it froze ice every night, many alpine flowers and shrubs were seen growing



Fall camp in northeast Wyoming in 1913.

along the edge of the snowbank, struggling to live out their life cycle in spite of the many handicaps. As soon as the snow edge moved slowly upward, uncovering the dormant plants, the impatient buttercups, clustering rock asters, snowdrops, and other alpine flowers lost no time in doing their "thing" to brighten their part of the world. Even with an inch or more of snow yet to go, the sun's life giving rays penetrated the icy pane, causing the struggling bulb to push up through the ice, straighten up, and unfold in all its glory. We stuck some of the flowers on our hats.

The idea to take a picture of the breakfast scene came to me on the spur of the moment as I glanced at the busy camp there at the foot of the

huge bank of last winter's snow. As I stood there downwind from the outdoors kitchen waiting for breakfast and enjoying the aroma of frying mountain grouse and the coffee pot, the rising sun at my back cast its warming glow over the colorful scene ahead. I then snapped the picture catching a perfect view of my wife, Inez, as she stood, rosy-cheeked that frosty morning. Standing between the cookstove and the red and green painted wagon, she dominated the scene. With the stove loaded with frying pans and skillets, she deftly speared herself a choice piece of grouse with that ever busy left hand of hers! So intent was she, my picture taking went unnoticed.



"Breakfast on the Big Horns." Photograph from an oil painting by Montana artist Shorty Shope. It was painted from a photo that Roy Bandy took of his wife Inez preparing breakfast on an August morning in 1912.

— Chapter Five —

Hard Work and Cooperation

A Visit From Buffalo Bill

In September, an unusual event occurred. While we were camped on the Pitchfork Ranch on the Greybull River, Buffalo Bill Cody and the Prince of Monaco, on a hunting expedition, stopped at our camp. Mr. Cody had an elaborate outfit, with two four-horse wagons and a carriage, and he was attended by several riders and loose horses. He was impressively dressed with a fringed buckskin jacket with his characteristic goatee and glowing silver hair reaching his shoulders. Mr. Cody inquired of my wife, who was alone in camp during the day, about a report that I had recently killed a bear. Mr. Cody explained that they were hunters and were interested in learning where other bears might be found. She gladly gave him full particulars of our encounter with the bear and they proceeded on their way. Incidentally, we en-

*"We had many
exciting encounters
with grizzlies while
working in the ...
park."*

joyed the bear steaks, and Inez found the lard excellent for making biscuits.

A few days later we left that camp on an extended trip by wagon, crossing the Continental Divide and continuing to the head of Green River to survey some land along the shore of Lower Green River Lake. That route took us through Thermopolis and Lander, Wyoming, and through famous South Pass, southeast of Lander, where we could still plainly see old wagon ruts left on the prairie by the emigrants traveling the Oregon Trail 60 years before. We crossed the Green River at Daniel, Wyoming, and turned up the river north along a dim trail for some 30 miles to the lower end of the lake. While camped on the lakeshore, one of the boys killed a bull elk, supplying us with choice fresh meat while we were there.

On November 16, 1913, we disbanded camp at Daniel. We shipped the outfit by horse stage



Bandy's survey camp in the Missouri River Breaks south of the Bear Paw Mountains around 1918. Both wagons and motor vehicles were used at the time.



Bandy's outfit on the move on the Blackfeet Indian Reservation in Montana, 1922.

to Opal, Wyoming, on the Union Pacific Railroad, and then by express to Cheyenne. We started the wagons back to Cody; the men and I took the stage to Opal, then the train to our homes.

After spending the winter in the Surveyor General's Office in Cheyenne, I was transferred in April 1914 to the Montana District, with headquarters at Helena. I continued to work in the Montana District under J. Scott Harrison and other supervisors until 1945, with the exception of special details to other duties. Supervisor J. Scott Harrison retired in 1937 and Montana was put under the Boise, Idaho District Office.

Resurveys

In 1914, the need for resurveys in the prairie sections of the eastern part of the State of Montana was being felt, as new settlers reported that they were unable to find section corners. Many of the corners that had been set in the 1880's were wooden posts that had become lost or obliterated. I was assigned to resurvey those townships from 1914 to 1916.

In the spring of 1917, Glen Sawyer and I were assigned the difficult task of setting section corners in the Missouri River Badland Breaks south of the Bear Paw Mountains, starting at Eagle Creek across from the mouth of the Judith River and going east on the north side of the

river. The area included Black Coules and Bullwhacker Creek, where some of the roughest badlands in the Nation are found. Some of the multicolored jagged slopes were more than 700 feet high, rimmed with stunted, scrubby, twisted, and gnarled pine and juniper trees and brush that were hard to penetrate. Water within reach of camping spots was scarce. We were forced to haul water with four-horse teams from Bear Paw Springs and Cow Creek to our camp in water wagons we made from 2-inch tongue and grooved planks. During the 3 years we spent along the river, we continued east across Cow Creek to Hide-a-way Coules and the mouth of the Musselshell River; Seven Blackfoot, Hell and Snow Creeks; and the Larb Hills where our feet sank in 3 or 4 inches as we walked on the decomposed shale slopes. We also covered the country to Huxby and Hole-in-the-Rock on the head of Great Porcupine Creek.

While camped at the Long X Ranch during the war, we drank water out of a shallow pond with the horses. The horses had the advantage, they could wade out in the water belly deep and drink where the water was not as thick as along the bank where we dipped it up. At that camp we ate horse meat with the cowboys on account of meat rationing.

Our next big job, in addition to the routine surveys, was setting allotment corners on the Blackfeet, Crow, and Cheyenne Indian Reservations in Montana.

From the Forests to the Mountains

By 1924, most of the remaining unsurveyed public land in Montana lay within National Forests. There was a continuing effort by the cadastral engineers to make the township plats more useful by showing more accurately the topography in the interior of the sections. To better accomplish that goal, the Montana surveyors started in 1924 to close all sections vertically as well as horizontally. Sea level elevations along the section lines were obtained by measuring vertical angles to bench marks on mountain peaks. Through cooperative efforts with Forest Service personnel, the topography and contours inside the sections were filled in, making a much more useful map.

In 1924, the Government surveyors in Montana adopted the use of the "Trailer Tape" for measuring section lines, which greatly simplified the procedure. By that method of measurement, true horizontal distances to points along the section lines were always known even though measurements were made on the slopes.

In 1929, due to the Forest Service's need for better maps for fire fighting and for the administration of National Forest lands, the General Land Office started a program to survey into sections of the high timbered mountains of northwestern Montana. Ernest Parker and I were assigned to that work in the Pinkham Creek, Cripple Horse, Hungry Horse, and Kootenai country. To establish camps far back from roads, pack animals were necessary. Mr. J. Scott Harrison, Supervisor of Surveys, acquired a string of pack animals for our use, consisting of 16 young mules and 3 saddle horses. New Decker pack saddles and a complete outfit of mountain type camping equipment were also provided. Many of the mules were unbroken. Our first job was to break and gentle the wild mules so they could be caught without a corral or rope throwing. For that task experienced horsemen were recruited from Powder River and Belle Fourche.

Camp was established at the end of the road east of Eureka, Montana. The packers trained the mules for a week while the crew opened up new trails back into the mountains.

In 1931 to 1933, I surveyed the revised boundaries of Yellowstone National Park. The



Member of a survey party on line in the Rocky Mountains in Montana.

The Packers

The packers started training young mules by letting them stand with saddles on for a half day. Then they would hang some sacks filled with pots and pans that would rattle on each side of the animals, and lead them through the timber with pans dangling, until the mules learned to follow the leader. Some mules were not satisfied until they did their best to buck off their noisy load. The mules also had to learn to go on the right side of a tree or get their necks stretched, and to judge how narrow a space they could go through with a pack on.

If the packers treated the mules gently, they would soon be able to catch the mules just by feeding them oats from a nosebag, without using a corral. The most wily mule will take a chance on getting caught just to get a mouthful of oats. A gray mare is a good magnet to keep the mules from leaving camp. Picket the mare, and the mules will usually be nearby.

91 miles of new line followed the crest of the Absoraka Range of Mountains forming the divide east of Yellowstone Lake. We had many exciting encounters with grizzlies while working in the untamed wilderness areas of the Park.

In 1932, I recommended names for four peaks in Yellowstone National Park, which were approved by the National Geographic Board. The names are: President Grant, President Arthur, William F. Cody, and Chief Plenty Coups.

Missouri River Basin Project

Congressional approval of the "Pick Sloan" plan for the comprehensive development of the water resources of the Missouri River Basin marked the beginning of extensive surveys and planning by the Bureau of Reclamation and the Corps of Engineers throughout the Basin. The Bureau's plans included the preparation of contour and planimetric maps of the irrigable lands by photogrammetric methods. Cadastral surveys of each project were also needed to determine the boundaries and acreages of the farm units on each project. Mapping from aerial photographs requires accurately located horizontal



Humphrey Mountain on the east boundary of Yellowstone Park, 1931. The men at the top of the peak are building a corner. There is another corner on the rock under Roy Bandy's transit.



Roy Bandy's pack train moving along the eastern boundary of Yellowstone National Park at the top of the Absaroka Range, 1932.

control points on the ground, and the same points identified and carefully marked on the aerial photographs of the area, so the pictures may be enlarged to scale.

I believed that much time and money could be saved by resurveying the section lines before the maps were made, so the reestablished corners could be used as horizontal control points for the aerial mapping, and thus the expense of putting in another set of control points could be saved. To speed up the work and reduce the overall cost, I suggested that consideration be given to having the cadastral survey division of the U.S. General Land Office execute the resurvey of the section lines on a reimbursable basis. The cadastral surveying division of the General Land Office is the agency authorized by law to survey all public land, and was organized and had the trained personnel available for that particular kind of work.

To get my plan considered by high officials of the Bureau of Reclamation, I started at the grass roots by presenting my plan to my engineer friends in charge of the field work in the Bureau. My plan was favorably received by them and some said they would be glad to be relieved of the land survey work. The first of the field men to apply for help was Fred Munro, project engineer for the Kinsey Resettlement Project for dry farmers on the lower Yellowstone. In 1940, Mr.

Munro allotted \$4,000 to us for that job. I completed the field work and turned over the resurvey township plats to him, at a cost below the estimate. In 1944, an application was received from the Bureau for the resurvey of the right-of-way lands for the Canyon Ferry reservoir site. Mr. R.Y. Lyman, Ernest Parker, and I personally did that job without employing additional help. The work was complicated because of the many mining claims involved, and because some sections of the original survey had not been tied across the river.

In 1945, the Bureau of Reclamation allotted \$75,000 to the General Land Office for the resurvey of project lands on the Marias Irrigation Project on Lonesome Prairie north and west of Big Sandy and Box Elder. Mr. Ernest Parker and I completed the survey of the Marias project that season.

In 1946, the payoff for our hard work came! To my great surprise, in January of that year, the Director of the U.S. General Land Office put me in charge of all public land surveys in 10 Missouri River Basin states, with special instructions to survey all lands requested by the Bureau of Reclamation. I was directed to prepare to start a crash program of resurveys on Reclamation projects in early spring, with as many crews as I could organize, and have each crew headed by an experienced cadastral engineer. I was further



Ant Hills

In addition to reestablishing section corners on irrigation and reservoir projects, the Bureau of Reclamation requested U.S. General Land Office engineers to pinpoint on aerial photographs the exact position of at least three-section or quarter-section corners at well-spaced points on each photograph. That was so the photograph could be enlarged to a fixed scale. That service was new to us, and required the training of personnel for that purpose. At first, difficulty was encountered in the great smooth fields of eastern Montana and North Dakota because of lack of detailed topography on the ground that could be identified on the photograph. Then ant hills came to our rescue.

Ants have a habit of forming a round bare spot about 3 or 4 feet in diameter on the ground, which under favorable circumstances may be spotted on the aerial photograph. Our experts soon learned to identify them and make ties to a nearby section corner. A suitable notation was then made on the back of the photograph. The Aero Service Corporation of San Francisco sent men to inspect our ant hills.

authorized to call to my region any or all experienced cadastral engineers then employed by the Government in California, Arizona, Nevada, and other Western States. Mr. Glenn R. Haste of Denver was appointed as my assistant, and in April of that year, he opened an office in Flaxton, North Dakota. I opened an office in Fort Peck, Montana with George F. Rigby as assistant. Ample funds were provided for the work and to purchase needed equipment. By May 1, survey crews were in the field in the area extending from Superior, Nebraska, to Hinsdale, Montana, and from Minot, North Dakota, to Kaycee, Wyoming. Later, engineers Haste and Rigby were called on to other work, and engineers Lyman and Parker were designated my assistants.

Reestablishing lost or obliterated section corners in a settled community to fix disputed boundary lines between adjoining landowners

was much more exacting than where only Government-owned land was involved. Exhaustive searches for evidence of the original corner monument, examinations of previous survey records, and inquiries of old residents were often necessary.

Resurveys made for the Bureau of Reclamation, under that cooperative agreement, during the years 1940 to 1955, covered more than 14 million acres of land. That project is thought to be a landmark in cooperation between Government bureaus.

I was most fortunate to have well-trained and long-experienced party chiefs available for that difficult job. They were all dedicated engineers used to hard work and operating on a tight budget, and were pleased to have a part in that important project.

— Chapter Six — Within a Lifetime

In 1955 and 1956, after retiring from the Bureau of Land Management, I was employed by the Corps of Engineers, U.S. Army, as a consulting cadastral engineer. I assisted in determining the ownership of lands formed by erosion and accretion along the banks of the Missouri River, which would be flooded by the Garrison Dam, and I also testified in court as the Government's witness in those matters.

To reminisce a moment — it is gratifying now to see an important development like the Shoshone Irrigation Project, and know that I had a small, rather insignificant part in getting it underway. I also feel great pride when I drive through Wyoming country and see

the gross changes that have taken place. Noting the thriving metropolis of Powell, Wyoming, surrounded by fertile irrigated farmland dotted with modern, well kept, farm homes and by large groves of shade trees, all of which are connected by a network of paved roads — it is difficult to realize that only a few years ago, within a man's lifetime, this whole area was a wild untamed desert.

In those bygone days, as I tramped wearily over this barren, uninhabited region setting section corners, herds of wary antelope raced ahead of

me, their white rumps bobbing as they kicked up the dust. Circling back they would pause to gaze at me while the old bucks stomped and whistled

"... I remember how glad I was ... to obtain my first employment on a survey party."



Survey crew member in the "wilderness" with pack mules.

their challenge. Occasionally I could see a slinking coyote sneaking up a draw, glancing over his shoulder, seeking the safety of a distant hill, where he would turn and let out a high-pitched wail just to let me know that he considered me an intruder. Or I might flush a black-and-white faced badger, who would waddle off on his short bowlegs, stopping to turn and boldly stare me in the face, hissing his defiance before backing into a prairie dog hole to peep out at me over the edge of the round. Sometimes I would encounter a treacherous rattlesnake, already

coiled and facing me, blocking my path. Fortunately a rattler almost always gave a warning buzz before striking, giving me time to stop and prepare for battle.

Now, in retrospection of my first days as a surveyor in 1905, I remember how glad I was, and also how fortunate, to obtain my first employment on a survey party. Although it was a minor position, the pay of \$40 per month plus board loomed big enough to lead me into following a profession that has proven both healthful and interesting.

Scouting the Southwest —

Glenn R. Haste



— Chapter One —

Early Memories, Early Days

Youthful Adventures

My folks were married in Mattoon, Illinois, and on hearing of "new country" in northwest Arkansas, moved to Arkansas to open a country store. I was born in Arkansas on February 27, 1895. In 1898 an uncle, who had received a contract for moving dirt with mules for railroad grades and canals, contacted my parents telling them that the area around Gueydon, Louisiana, was "a coming country." And so we moved to Gueydon, where my folks opened a store.

One of my first memories was of people talking about the sinking of the *Maine*, how the United States had to go to war with Spain, and the heroism of Admiral Dewey.

I grew up and graduated from high school in Gueydon. Upon finishing high school I started college at Texas A & M, staying with an aunt and

uncle at Bryan, Texas. Shortly after, I had to quit college and go to Deming, New Mexico, to assist my parents, who had moved there and opened a hotel.

In 1913 I was working for a gentleman building homesteader cabins out of sandstone, receiving 25 cents a day wages, working from daylight to sunset. That spring, a cadastral surveyor by the name of Roy Chase stopped by dad's hotel, asking him if he knew anyone who wanted to go to work on the survey. Dad contacted me and I said, "Sure, I will just chuck this job."

With the survey I got \$45 a month, plus room and board. All I had to furnish was a bed-roll. The first day on the job the

crew met at the livery stables, as mules were a vital element of all survey parties in those days. Roy Chase had been a contractor and he had a bunch of pack mules. After he started working for the government, they would rent his mules.

*"With the survey I
got \$45 a month,
plus room and
board."*



Hotel where Haste started project with Coast and Geodetic Survey in eastern New Mexico.



Feeding the mules — there were about six mules per crew. Mules were essential for moving camp and carrying supplies along the line.

We hitched the mules to the wagon and started for the job site.

My First Job

After 2 days of travel on this first job, we arrived at Hachita, and Chase let us eat at a Chinese restaurant. The crew claimed the menu consisted of ham and eggs with no eggs, or bacon and eggs with no bacon. On the third day we

reached a survey camp south of Hachita in the flats. I noticed how Daddy Thorne had his tents all lined up in a row with a flag in front. Daddy Thorne was the chief of parties.

We stayed one night at Daddy Thorne's camp and then proceeded to the job site in the Hachet Mountains in southeast New Mexico. We had a double crew on this first job — Roy Chase and Hugh Neighbors were the party chiefs.

I was a moundsman the first year. It was in rough country. I had a mule with leather pack-saddles to carry the digging tools and iron posts. I would mark and set the corners.

Roy had an idea he could use stadia. Neighbors would chain his tier of sections and Chase would use stadia to measure his distances, using the chain to measure the fractional distances. Chase would close on Neighbors and see which distance fit. Invariably we would have to move the section corners, based on the closure against Neighbors' chained distances. We would never go back and move the quarter section corners. It soon became apparent to Chase that stadia was not accurate enough and we began chaining our lines.

Joining Up With Harrington

When we completed the first job, Roy Chase returned to Colorado. I was told that if I wanted to continue working, I would be assigned to Hugh Neighbors' crew. We were to join Guy P. Harrington in Bernalillo, where we would travel about 90 miles by mules and wagon to Cuba.

After meeting Harrington's crew, we surveyed a township near Canjilon, while Harrington surveyed small holding claims near Cuba. I was an axeman on this job. Later we joined parties and surveyed several townships southwest of Cuba. While on this job I met Mrs. Weatherall, the widow of the man who discovered Pueblo Bonito.

In late fall of 1913 we finished some small holding claims near Nunez, and the crew shut down due to cold weather. Guy P. sent the wagons and equipment in by mule train, and the rest of the crew rode the narrow gauge Denver & Rio Grande Railroad into Santa Fe. I returned to Deming for the winter.

Life in Camp

The crews were well outfitted. The crew consisted of a teamster or packer, two chainmen, a flagman, an instrumentman, and a notekeeper. Of course in camp we also had a cook.

During these years, we spent most of the time in camp. We usually camped near water so that we did not have to haul it. We would work 6 days a week, having Sunday off. In the evenings I was kept busy on computations.

We would have permanent cooks, and the food was good and nourishing. The cooks were individualistic and had strong characters. They were in charge of the camp, obtaining supplies, cooking the meals, and keeping the camp orderly. We ate pretty good — just as good or better than you would in town — that's one thing that kept the morale high. The cook would make his own bread and bake pies and cakes. We ate a lot of beans and rice, and had large breakfasts, which included bacon, eggs, biscuits, and pancakes.

The meat kept better than you would think in camp. Mishler, one of our regular cooks, would keep the meat and other perishables on the shady side of the tent, wrapped in canvas that he kept wet. At night he would hang it outside the tent to cool off.

Anyone familiar with tents knows that they are hot in the summer, cold in the winter, and leak every time it rains. To waterproof the tents we would melt paraffin — in gasoline heated over a campfire in a number nine tub — and spread it on the tents with a broom. This worked very well in waterproofing the tents, but it also made the tents highly susceptible to fire, and when one caught on fire, it would burn almost instantly.

The tents were usually scattered here and there where the ground was level. Normally two to four survey aids would stay in one tent, and the chief of parties had a tent of his own, which also contained his office. The chief of parties would set his tent separate from the others. This provided privacy and quiet for the surveyor to do his computations at night and, as a colleague told me one time, buffered the surveyor from hearing the crew call him an S.O.B.

The cook tent consisted of a wood stove, with a long table for feeding the crew. The table was often used after supper as a congregation place for the crew, where they would play various card games or just visit.

When Guy P. Harrington became supervisor of surveys, he obtained some tents with canvas flooring. This assisted in keeping the dust down. Tent camps were used in New Mexico until the mid-1950's, when we bought some trailers.



Crossing Escobado Wash, close to Pueblo Bonito. Stuck in the quicksand and wading out.

Working with Spanish Settlers

In the spring of 1914 I received word to join Guy Harrington at Socorro. We were assigned to execute surveys of hundreds of small holding claims in the Lemitar area, just north of Socorro. I knew enough Spanish so that I could assist Guy P. in making out the proof of claims by the Spanish settlers, to establish their rights to claims.

The survey of small holding claims required a large amount of calculations. My math background had been useful the previous year in establishing my ability to handle survey computations. I was therefore assigned as principal assistant under Harrington. I was paid \$60 a month, plus room and board.

The owners of the land being surveyed would often accompany us. We did not have calculators in those days, so it was necessary to use traverse tables when computing in the field. We therefore ran the lines on even one-fourth degree and measured distance to ten links, to enable us to use the traverse tables.

Some houses had two owners and we had to use the division wall to determine ownership. My front chainman was the best. The claimants

would want him to chain along their fences, which would meander somewhat. To assure they wouldn't get upset he would pull the chain along the fence. At the time we would measure, I would place him on line, we would straighten the chain, and make our measurement.

The claims all abutted on the Rio Grande River; the banks of the river were frequently covered with dense tamarack and other brush. When it was time to run the closing boundary of the claim, I would compute the closing bearing and distance.

I can remember on one occasion when two of the claimants were accompanying the crew, and I calculated a closing course from a point in dense brush alongside the river. Upon running the line through the brush, the claimants were astonished to see us intersect the beginning point.

Gaining a Promotion to Principal Assistant

At the end of the season, Guy P. had me come into Santa Fe where he suggested to Alonzo E. Compton, the supervisor of surveys, that I be kept on the payroll and assist in preparing the notes on the small holding claims we had sur-

veyed that season. Compton was surprised at the request and, instead of keeping me in the office, assigned me to a job with George Rigby's crew near San Antonio, New Mexico.

I therefore took a train to San Antonio and joined Rigby's crew. Compton had assured me that I would be reassigned as a principal assistant in the Carlsbad area the next spring, but my wages went from \$60 to \$45 a month while at San Antonio, because I wasn't working as a principal assistant.

After working on Rigby's crew I was assigned as a principal assistant to H. G. Bradsley's crew working east of San Antonio. Bradsley was a typical cadastral surveyor in this early era of the direct system — he was well aware that the direct system was under a trial period.

Thus, Bradsley was not the type of person to dilly dally around. After we had set up camp on

the first day, Bradsley located the southwest corner of the township and we surveyed 3 miles north. The next day we started from the southwest corner and surveyed 6 miles east on the south boundary. Everett Calvert was my head chainman and one of the best in the service. Calvert was not only capable of staying on line through use of hindsights and foresights, he was also fast on his feet, therefore the first 6 miles went fast. We then turned north and ran the east boundary of the township. Although it was still early, Everett and I looked at each other, thinking we had accomplished quite a bit of surveying that day. We were hoping we would be rewarded, by quitting at this point, and getting back to camp early. However, Bradsley, running the instrument, turned west on the north boundary and we ran another 6 miles. It was getting late. We had run a total of 18 miles of line, and Everett and I were ready to call it a day.

However, Bradsley wasn't through. He set up the instrument and turned south and we ran an additional 3 miles to connect up with the 3 miles we had surveyed the first day. We ran a total of 21 miles of survey that day, and Everett and I both were glad we had run the 3 miles the previous day, or Bradsley would have had us run that also.

New Work as an Instrumentman

In the spring of 1915, I was assigned to Mr. Lewellyn D. Lyman's crew as principal assistant on a survey in the Carlsbad area. I actually ran the crew as instrumentman. Lyman would take one survey aid from each crew, retracing miles of line adjacent to our project. He did not report these lines, only searched and reestablished the corners. Lyman insisted we dig pits at every corner on this job, despite the fact that we were in very sandy land and the wind would cover up the pits soon after we dug them.

This job gave me experience on running, adjusting, and taking care of the Smith Solar Transit. These were original surveys. We used the tangent method on the east and west township lines, offsetting to the true east and west lines. The crew would run the lines north, connect the east and west lines through a tier for



Haste receiving a haircut from Robbe. Robbe was a cousin of Alonzo Compton, supervisor of surveys for New Mexico in the 1910's.

From Contract to Direct System

In the 1880's, New Mexico had their share of fraud in the public land surveys under the contract system. Under the contract system, the surveyor general would make a contract with the surveyors and give them the money before they went into the field. Naturally they didn't do the work. Several prominent people in Santa Fe were involved in the frauds. One group was referred to as the Santa Fe Gang and the purported leader was Thomas Catron, a prominent attorney and politician in New Mexico.

Thomas Catron was still around when I first went to work and I saw him many times walking down the streets of Santa Fe. About the first year I was in Santa Fe, I knew an elderly woman who had worked in the surveyor general's office. At that time they didn't have retirement and those older people would hold on for years. She told me that she had once watched Catron start to walk out of the office with some information under his arm. She beat him to the front door and closed it and made him put it back.

The surveyor general was a political position and a very important job during the contract era. At times the surveyor general of the State was a more important position than the Governor. However when the direct system was incorporated, the surveyor general lost his power because he had no authority over the field surveyors. The position was abolished in 1925.

The direct system of surveys was initiated by statute in 1910 to eliminate fraud. Under the direct system, surveyors were hired as government employees, rather than as contractors for the government. Survey contracts made prior to the passing of the statute were allowed to be completed, resulting in a few contract surveys being executed in 1911 and 1912.

The early years of the direct system were years of hard work, rewards, and adjustment for the surveyors. For instance at the onset, Frank Johnson and Arthur Kidder were appointed as co-equal supervisors of surveys. As can be expected, a system with two bosses didn't work, and this was soon changed. Frank Johnson was given the job as supervisor of surveys, with an office in Denver, and Kidder became associate supervisor of surveys, with headquarters in the Washington Office. An assistant supervisor of surveys was appointed for each of ten districts that were created. New Mexico was designated District No. 4.

The surveyors knew that critics were still arguing that the direct system would be more expensive than the contract system and that critics were looking for reasons to claim the former was a failure. The

surveyors were aware of the criticism and worked hard to prove the direct system would work.

Charles (Devie) Devendorf was another surveyor who worked hard at proving the direct system was efficient. Charles worked in New Mexico during the early contract years. He would put the transit on his shoulder and run from point to point. Once when I was being transferred from one job to another, Devendorf had me wrap six iron pipes in my bedroll so that we wouldn't have to pay shipping charges on the pipe.

a day's work. This consisted of 11 miles of survey.

Upon completion of this job, I was assigned to Carrizozo in charge of a crew. Everett Calvert was my front chainman on that job. While there, he committed suicide by shooting himself in the head. I hired a practical nurse to take care of him, as he lingered about a day before dying.

Working Along the Rio Grande

After Carrizozo the General Land Office received money from the Bureau of Reclamation

to resurvey a large area around Elephant Butte Reservoir. Several crews were assigned to this survey. I was principal assistant for Lyman and we resurveyed four or five townships. In executing these resurveys we had to address the riparian problems along the Rio Grande River, determining if any river movement was a result of avulsion or accretion.

One of the surveyors was over his head on this type of work, unable to make the decisions and execute the calculations necessary for this type of work. He was stationed at Hatch and while we were resurveying the four to five townships, he resurveyed only one. He would spend every morning figuring and figuring.



Making a corner move. Glenn Haste is running the instrument.



Packing into camp east of Glenwood Springs.

Towards the end of this job, we had to close the standard parallel quite some distance from our main camp, so we took one tent along for a "fly camp," doing our cooking with a dutch oven, and each of us carried a blanket to sleep on.

Mr. Lyman, true to form, wanted to retrace the standard parallel eastward, even though it wasn't part of the assignment. Red, our teamster, had a mule for packing in water and our grub. At the end of the second day Lyman asked Red how much food was left. Red told him we only had one can of corn. Mr. Lyman said, "Fine,

we will stay one more night." Red informed Lyman that the corn was in the fly camp down by the river, thusly ending the retracement.

Surveying on the Mexican Border

I continued working as a principal assistant until 1917. During this time I worked for several party chiefs. We were on one survey near the Mexican border in the southwest part of the state. Our camp was located at Lonesome Wells. Charles Devendorf was the chief of parties and, as was his custom, he sent a wagonload of grain and supplies ahead while the crew finished up a survey. The teamster arrived at the Lonesome Wells after dark and was unhitching the mules in the corral when he heard a voice say, "Who's that there?"

Upon looking around he saw rifles pointed at him from all sides. This was soon after Pancho Villa had raided Columbus, and the Ninth Cavalry was stationed there to patrol the border. The soldiers in the Ninth were proud of the outfit and had a tendency to brag about their past and future accomplishments, including the fact that the unit had been in Cuba charging up San Juan Hill with Teddy Roosevelt.

Itching for action and feeling his oats, one of the soldiers stated to the survey crew, "That international line, if President Wilson just say



Packing in and setting up camp east of Glenwood Springs. Haste assigned to survey after Kimmell had broken his leg.

Pancho Villa

One early morning Pancho Villa and his troops snuck up an arroyo into Columbus, New Mexico and surprised and killed some of our soldiers. They brought in "Black Jack" Pershing down there to track him down. My brother Myron was in the National Guard at Deming and they sent them down to Pershing. He led the troops into Mexico to catch Pancho Villa. By living off the land in guerrilla fashion, Villa had no trouble staying ahead of Pershing's troops, which were slowed down by cannons and supply trains. As a consequence, Pershing — after running around the Mexican countryside for a couple of months — returned to the United States without capturing the guerilla bandit.

the word, this here Ninth Cavalry just naturally picks up that line and takes it on the other side of the Panama Canal."

I was also assigned to a job in the Jemez Mountains, working for Lee S. Miller. Miller had hired a cook for the job from that area, who had been cutting and stacking cord wood for the boilers of nearby mining mills. Just recently two fishermen attending a Rotary Club meeting said many of these wood piles are still there, and the wood in the interior of the piles had not yet rotted.

Becoming a Transitman

I passed the U.S. Transitman exam in early 1917. The exam lasted 2 days covering such areas as astronomical observations, the use and adjustment of instruments, and the 1902 Manual requirements.

Upon receiving my appointment, I was assigned as associate transitman to Tom Daly around Hope, New Mexico. During a severe storm we had to abandon camp and go into Hope to wait it out. When we returned to camp, a quarter of beef we had left on the cook table was frozen stiff on the table.

We were camped close to the headquarters of a ranch owned by a man who had a reputation as an outlaw. He appeared to be an agreeable gentleman, telling us we could use his horses anytime and when we were through to just let them loose.

I was feeling pretty proud of my civil service appointment and one day, while running near his headquarters, he came out just as we closed almost perfectly around a section. I asked him, "How was that for a closure?" He quickly put me in my place by replying, "That's damn good for a kid."

At that time I had a gentleman by the name of John Gatlin working for me. We had a contract with him, paying him a \$100 a month plus room and board to furnish and take care of horses. John was sick and wanted to return to his home in Magdalena. He offered to sell his buckboard for \$10 — a bargain price — however, I did not have the authority to buy this type of equipment. I therefore issued John a voucher for 1 month's rent of the buckboard at \$10, and John left it. George Wells asked me after I returned from the service, "How in the hell did you buy that buckboard without my permission?"

— Chapter Two —

Off To War

Joining Up

The country was at war and I decided to join the services. I went into Santa Fe to resign and join up. I was informed I could join a road and bridge engineering unit that was being formed in Washington, DC. The office wrote out a transportation request for a railroad ticket to Washington. Knowing the process, I asked the girl to make out a new one so that I could ride Pullman. I therefore rode to Washington in style. The only other soldiers in Pullman were

officers, including a general. After joining the engineering unit and receiving my training, I was shipped over to France for 16 months, 8 months before the armistice and 8 months after. The French had claimed that we destroyed their roads, and we were required to rebuild them. I was discharged on July 15, 1919.

Veterans of WWI were not guaranteed their positions after the war like they were in WWII, so I had to reapply for my appointment and lost all of my opportunities for promotions during this period.

After the War

My first assignment after the war was chief of parties on a survey southwest of Alamogordo. John S. Knowles ran the other party, having been sent down from the Denver office. We surveyed a number of townships on this project. Knowles, not being used to surveying in the wide open spaces, ran an east-west tangent line for 12 miles across two townships, not realizing how far from the true line he was diverging. By the time he had extended his tangent for 12 miles, his offsets to the true line were considerable.

During this period there was considerable homesteading going on in New Mexico, and most of our work was original surveys to facilitate the homesteads or surveying boundaries for lands claimed under the Treaty of Guadalupe. Harrington would look around for unsurveyed areas and we would survey them. Most of our surveys we did until 1940 were original.

Near the Arizona Line

I executed a survey in 1920, in the vicinity of Highway 60 and the Arizona state line. Highway 60 crossed close to a cave and the state line went right through the cave. I monumented a corner with an iron post in the cave about 4 feet off the ground against the back wall. A few years ago I went through there with some friends and the iron post was still there.

The description of the Navajo Indian Reservation boundary is based on the Gila and Salt River Meridian. When we initiated the surveys on it, we calculated where the south boundary would hit the New Mexico and Arizona boundary, based on latitude and longitude, and started our survey there by setting a closing corner on the state line. Of course the accuracy of the actual latitude of the meridian and the accuracy of our equipment in obtaining latitude were direct factors in the accuracy of the establishment of the point.

The oil companies had a lease with the Navajos for prospecting for oil on the reservation. No rights had been obtained based on surveys on the Navajo meridian within New Mexico. I therefore requested that the meridian be canceled. We could then extend the surveys in the area based on the New Mexico meridian.

*"... there was no
firewood or mes-
quite in the area to
cook with or keep
the tents warm."*

The Washington Office, after considerable delay, agreed to cancel the meridian within the state of New Mexico.

The El Paso Natural Gas Company wanted to execute some resurveys in the Farmington area using their own personnel. I agreed to use their surveyors under the supervision of Everett Kimmell. They had tried to execute the surveys using aerial photography. They soon discovered that photography could depict the topography, but not on-the-ground survey evidence.

Without the survey evidence, they could not locate the boundaries. I only needed the permission of the area director to make the agreement. I got it, discovering later that Earl Harrington, chief cadastral engineer in Washington, was not happy about it.

Harrington was right. The project did not turn out very well. The oil company surveyors did not have cadastral experience, which increased the cost of the survey. They then tried to cut corners, not making proper corner searches. We and the El Paso Natural Gas Company mutually agreed to cancel the project.

From Mules to Trucks

We used mules until the 1920's. Mules were invaluable for moving camp, packing equipment on line, transportation, and packing in supplies. The surveyors considered them one of the most valuable assets for a survey crew, and we all developed a soft spot for them in appreciation of their utility.

We were working on surveys around Carlsbad in 1915, when Supervisor of Surveys

Compton went to Roswell and bought six of the best mules I have ever seen. However they were not broke in. The drivers had to keep the brakes on most of the way between Roswell and Carlsbad to keep them under control. By the time they arrived in Carlsbad, they were broken in. I would ride one of them on line, carrying the transit on my shoulder.

After WWI we began phasing in trucks in place of mules. The first trucks had hard rubber tires. Later they bought Dodges, which had a low compound in them. I had one survey aid by the name of Elmo (Slim) Bell. He was the best truck driver I ever saw and would drive the trucks in areas where it would be hard to drive a four-wheel drive today.

On one survey, upon completing a township, I asked a rancher if I could move my camp further down the road in a canyon. He replied, "Ordinarily I would say no, but the other day I saw something shine on the mountain, and I got my spyglasses out, and I'll be damned if one of your trucks wasn't up there." He then gave me permission to move camp.

In 1921 I was working in Chaco Canyon. I had mules and also was given a truck. The truck worked so well we just turned the mules loose and let them graze. By the end of the job they had scattered over quite a large area of the range and we needed to gather them up. I went down to the trading post and asked the owner if he knew any of the local Indians that would be willing to gather them up. He talked to one of the women in the trading post and she went out and gathered them. When I started to pay her, the trading post owner told me she only wanted 25 cents.



Camp, 1920. Had just started using trucks and were still using wagons. Note water wagon in foreground.



Chaco Canyon, 1921.

When I was assigned to survey the boundaries of the Pueblo Bonito (Chaco Culture National Historic Park), it only consisted of 13 Indian ruins, I surveyed only the sections where these ruins existed. The Indian ruins were in pretty good shape, but covered up. The National Geographic Society sent Neil Judd to begin excavating the ruins the year I was there, and he had me make a map of the ruins. He sent the map in and it was published by "National Geographic." The first year we found more ruins. In one cave we found some pots and one of them had grain in it. We gave the grain to Judd and he sent it into Washington. Judd had a crew of about six men. My truck driver would bring out groceries and supplies for Judd's camp when he went into Gallup to get our supplies. The National Geographic (Society) had given Judd \$4,000 for the first year's excavation.

Marriage and Family

About the time I was working in Chaco Canyon, a young lady who was working as a stenographer for the Charles Ilfied Company in Santa Fe was rooming at the Devendorf's. Mrs.

Devendorf was a fine lady and also, I suspect, a matchmaker. She invited me to supper one night and I met Elsie. We got married in 1922, after I received a raise to \$150 a month and figured I could afford marriage.

Through the years Elsie moved with me on the survey, stayed home while I was in camp, and raised our three children, Evelyn, Peggy, and Glenn Jr. In relating stories about working on the survey, the understanding and patience of the wives often go unmentioned. The surveyor spent much of his time out in the field and in camp; the wives were left with the responsibility of raising the family and running the household, often moving from job to job living in rented quarters that all too often were barely habitable.

In the Oil Fields

In 1928 the Midwest Oil Company struck oil just west of Hobbs, discovering one of the largest and most productive oil fields in the United States. The oil field had just started to develop when I surveyed a township there.

We had one problem with camp in this area — there was no firewood or mesquite in the area to cook with or keep the tents warm. An oil operator heard of our problem and had a crew pipe gas straight into the camp. He told us how to line our tin stoves on the inside with firebrick and to obtain a shutoff valve for each stove's front opening. The cook's stove had a 3/4-inch pipe with small nicks in it for a burner.

The New "Monroe" Calculators

It was in the early 1920's that we first got the hand-crank Monroe calculators. These calculators were the mainstay for almost all cadastral calculations until the late 1960's, when the electronic calculators were introduced. This was a great improvement from using traverse tables and logarithms to do our calculations.

Soon after we started using the Monroe's, one of the surveyors from Utah was traveling through the state on vacation and noticed a survey camp near the highway. He stopped by, and was shown how one of the calculators oper-

ated. As soon as he got back to Salt Lake he talked the supervisor of surveys into buying some for the Utah office. It wasn't long after this that all the offices had them.

In 1924 I surveyed the west boundary of the Maxwell Grant. I used marked rocks for monumentation instead of iron post, due to the isolation of the survey, which followed the crest of the Sangre de Cristos. The line was approximately 30 miles long and we had to pack in and fly camp for the entire project. I had a packer, two mules, a dutch oven, and a canvas fly to stretch between trees, to protect us from the almost daily rains, and as a shelter at night.

Off to the Nation's Capital

In 1926 I was detailed for 3 months to the Washington office. Tom Havil was the last

assistant commissioner of the General Land Office. He took the attitude that the surveyors coming into the office got more money than the surveyors already in the office, and so he cut our per diem. Oh boy, that was hard on me. Just as soon as I got there, I had the hotel bill to pay and my per diem had been cut off. I had taken my wife and two daughters with me and, not being able to afford the hotel, I soon rented an apartment. That was the only time per diem was withheld from the surveyors on travel, and it placed me in a hard financial condition for quite some time.

The work consisted of examining surveys from the field offices, mainly Alaska and the Western States. C.G. Tudor supervised the examiners. He had no field experience and we would often have a hard time convincing him of the correctness of a survey before he would permit forwarding the returns to the assistant commissioner.



Unidentified group — possibly from the Washington office. Haste is at top left.

Per Diem

In the early years of the direct system, the cook was a government employee, per diem was not paid, and the government furnished all room and board. In the early 1930's, the General Land Office changed to the per diem system where we were paid a straight rate, and the crews hired the cook and paid for their food.

Per diem made it harder on the party chiefs because they had to fill out the per diem forms and at the first of the season had to have enough money to support the crew until they got paid. This would require the party chiefs to have to carry several hundred dollars on them at the first of the season.

I will always believe that the government changed to per diem because it was cheaper, and that the crews lost money on straight per diem, at least when it was first started.

When the General Land Office was still providing the cook and board for the crews, vouchers for groceries were carefully scrutinized. If Frank Johnson, the Supervisor of Surveys, did not think expenditures were warranted, he refused to approve them.

Devendorf bought a large bag of peanuts for his crews, which was disallowed because it was "too fancy and out of place for a survey crew." Devendorf appealed to the General Accounting Office, arguing that peanuts were a cheap, efficient food, full of vitamins and energy. His argument received no sympathy from Frank Johnson, and therefore from the General Accounting Office. Devendorf had to pay for the peanuts himself.

I was surveying in the area of Elephant Butte Reservoir and got word that a Texan had raised a bunch of watermelons in the sand at the head of the reservoir. I sent the truck driver to bring back a small load of the watermelons, paying for them with a sub-voucher. Knowing Devendorf's problems with the peanuts, I was surprised when the sub-voucher was approved. In the fall I asked George Wells, our financial clerk, why they had been approved. George told me, "Glenn, don't worry about that, I changed your watermelons to potatoes."

They didn't say a word at the end of 3 months about my returning to New Mexico. We hadn't seen all the sights in the area, so we accepted the decision to extend the detail. In the meanwhile, I had bought a secondhand Ford with the spark and gas controls under the steering wheel and foot pedals for shifting gears. We made good use of the car, sightseeing in places

like Mt. Vernon, driving to Baltimore to eat oysters, and other trips.

We had rented our Santa Fe home, which helped pay for the expenses. After an additional 3 months had passed, they still didn't say anything about returning to New Mexico. Then 9 months passed and I still remained in Washington. I got the idea they wanted to keep me there.

It was hot and we didn't have air conditioners. Washington was not a good place to raise my family. I liked New Mexico and the freedom given a field surveyor, so I wrote Guy P. Harrington to get me reassigned. It took 3 months for the request to go through. After a year in Washington I finally returned to New Mexico.

Meeting Indians

In 1929 I was surveying small holding claims within the Pojoaque Indian Reservation and met a well-educated Pojoaque Indian who related many stories about their early history. He told how the Pojoaques had joined the Taos Indians in driving the Spanish out of Santa Fe and the New Mexico Territory in the late 1500's, and how the Indians would go across the Sangre de Cristos to hunt buffalo, bringing back meat and hides to the tribes. Thinking this wealth of Indian folklore should not be lost, I contacted the state historian. On my first day off, my wife, the state historian, and I went to interview the Indian. The Indian's stories were impressive and obviously the truth. The historian immediately started writing down his accounts.

Finally I asked the Indian how all this information was handed down from generation to generation. He asked, what did I mean? I asked, how had he obtained the information? From person to person through the years? He said no — that when he went to school he had studied New Mexico history. We folded our tents and went home.

Testimony of Landowners

The Spanish settlers around Dixon, New Mexico, had not received title to their land. The government decided that it would be easier to issue a patent for a large block of land to a trustee and let him settle the individual claims, have them surveyed, and issue title. The trustee hired Guy Turley, a competent surveyor from Santa Fe, to do the survey, and the settlers ran him off. The General Land Office was then assigned to

do the survey and Harrington assigned me to the job.

The job required determining the boundaries through evidence of land use and testimony. Efforts were made to influence my judgment, especially by the Catholic priest who would try his best to get me to stop by his place for food and wine. I completed the job without any conflicts or disagreements.

The General Land Office had been lax in prosecuting timber companies from removing timber from Federal lands. However, this attitude changed in the 1930's, and the government decided to prosecute a large timber company that had been illegally cutting timber. There was no forester in New Mexico to investigate the trespass, so they detailed a forester from Oregon to work with the U.S. Attorney.

After arriving and initiating his investigation, he requested a resurvey be made in the area of trespass and I was assigned to the job. I was talking to him one day and he told me that he could always tell who had executed a survey by what they had for lunch. Not believing him, I asked him, since he had been following my survey for several days, how would he identify me from my lunch. He said, "I would look for the olive can."

The Depression Hits

With the 1930's came the Depression. The General Land Office was assigned Civilian Conservation Corp (CCC) crews to assist them in their surveys. Roy Bandy was detailed to New Mexico and was in charge of all the CCC crews in the southern part of the state. I was in charge of the crews in the northern part of the state. Before long, Bandy returned to Montana and I was in charge of all the crews.

We had a number of principal assistants capable of running crews. We bought additional trucks and equipment, and were able to expand our crews to the point that we had over 100 people on the payroll.

During the Depression, the Resettlement Administration Commission was buying worn out farm land in West Virginia and resettling the farmers in Ohio. The appraisers soon discovered

that the surveys in the West Virginia area were haywire. The surveys were based on vague metes and bounds descriptions, such as calling for lines running to a chestnut tree or a wooden stake which had been gone for many years. Without accurate surveys, appraisals could not be made.

Although all of our surveyors were in the western states, the Commission agreed to pay per diem if the General Land Office would execute the necessary resurveys. As a result, I spent almost the entire year of 1935 in West Virginia, over several parties assigned to the

project. Most of my assistants were from New Mexico.

The Commission hired local survey aids for the crew and, although the General Land Office employees had no problem receiving their pay, the pay for survey aids working for the Commission was often several months late.

The economy in this area was primarily based on barter, and the workers were able to survive. However after I had been there for several months, an elderly survey aid we called Uncle John told me he was going to have to borrow some money because he had gotten in terrible debt, "more so than he had in all his life." I asked him, "How much do you owe? Maybe I can help." He once again restated that, "It is more than I have ever owed in my life and I am terribly worried about being able to pay it off." Once again I asked him to tell me how much he owed and he replied, "\$8.36."

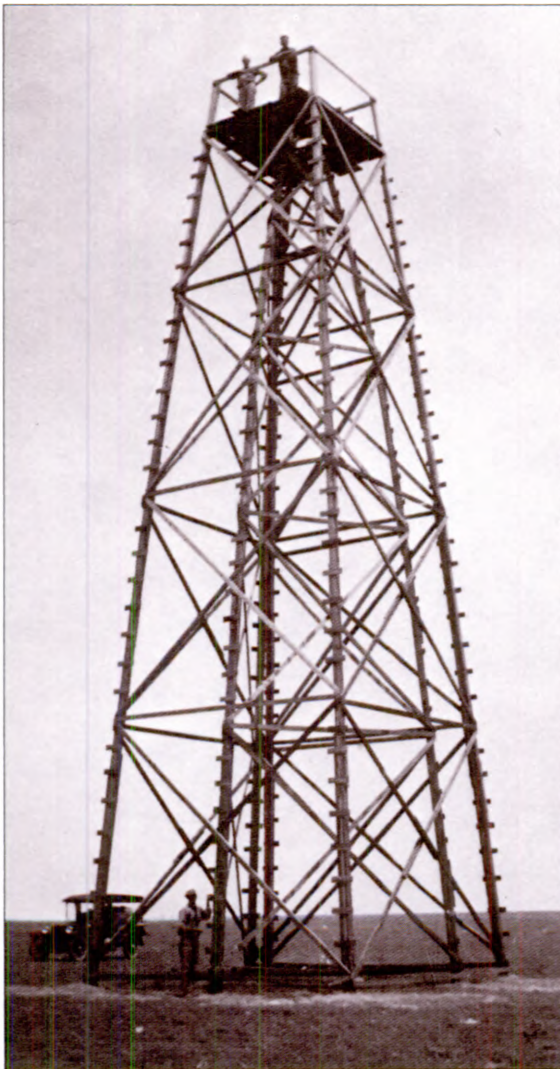
Once during the Depression, Devendorf and Parker Warner were laid off for 3 months to save money. Oscar Walsh, Tom Daly, and I were kept on because we had lower salaries. All three of us were paid \$2,800 a year and we went 10 years without a raise.

Back Home Again

After spending a year in West Virginia, I was replaced by a surveyor from Montana and returned home to New Mexico to my family, discovering that my son had learned how to walk while I was gone. Soon after returning home, I received orders to report to Sneedville in eastern Tennessee on a similar project. The Resettlement Commission soon realized that the people were not going to leave their homes. They shut down the operation and I returned home.

There was a lot of survey activity in New Mexico during the Depression. Many of the farmers driven out from the Dust Bowl states came to New Mexico to homestead and surveys were necessary for them to obtain their patents. Most of our work was still original surveys and, among other areas, I surveyed several townships in the Quemado area.

Later I had to return to this area to investigate a case where an individual was moving corners. The movement of the corners was obvious as the



Coast and Geodetic Survey tower set over a section corner. Haste was assigned to the crew to locate and remonument corners. The crew would turn into corners by triangulation.

individual had not bothered to destroy the bearing trees, and the holes where the iron pipe were pulled out were still there.

In the late 1930's, I was assigned to the survey of quite a few townships in the Las Cruces area and moved my family there for several years. We were there long enough for my daughters to go to school at New Mexico A & M. There was an extensive triangulation net in the area and I would use the net to obtain true bearing and check closures.

The Bureau of Reclamation had attempted to execute resurveys in the Las Cruces area before we moved in. They did not pay any attention to the original surveys, measuring out sections 5,280 feet square. They sent in the survey data for approval and after we refused to approve it they decided to have us execute the work. However, due to land actions taken on the Bureau of Reclamation surveys, we could not destroy all of their corners.

— Chapter Three —

World War II and Beyond

During the War

Survey activity slowed down considerably during World War II, for obvious reasons. At one time the surveyors were all put together as one crew.

In 1946 the General Land Office and the Grazing Service were combined to form the Bureau of Land Management. At about this same time, the Bureau of Reclamation requested that several cadastral survey crews be assigned to the Missouri River Basin to conduct surveys, on a reimbursable basis, in the areas along the Missouri River where the Bureau was involved in extensive dam building and canal projects.

I was assigned over the project for about 3 years. Surveyors from various parts of the country were detailed to the project to get it started. They paid me per diem for the whole time, but did not transfer me to the project's headquarters in Billings, Montana.

The Missouri River Basin surveys were somewhat different than what we had been used to in New Mexico. Many of the lines were identified by section line roads. Original evidence would often be nonexistent and we would accept the roads as the best available evidence of the original surveys. They had a reason for accepting the position of the lines when the roads were built, and there was no reason to dispute their positions.

I had one surveyor named Voigt, who insisted on proportioning everything, and I couldn't convince him to accept local control. He was hardheaded — he always was and stayed that way.

Moving Up

In 1949, about the time they were going to transfer me, Guy P. Harrington retired and I got his job over the region covering New Mexico and Arizona. The General Land Office where he worked had been in Santa Fe since it was first established on December 28, 1854. After the reorganization in 1946, the office was transferred to Albuquerque. Harrington planned on commuting from Santa Fe to Albuquerque, but his wife objected so he soon retired. Harrington had been supervisor of surveys for New Mexico for about 25 years on his retirement.

In the process of the 1946 reorganization, the cadastral offices were placed under a regional organization instead of a state organization. The region I was over included the states of New Mexico and Arizona. Surveyors from both states were assigned to the region. It had been 36 years

since I first started with Roy Chase as a survey aid in 1913.

The cadastral organization was running on a shoestring, using the same equipment we had used in the thirties: tents for the camps, the solar transit, and chain for running line. The only significant differences in our methods were the use of trucks instead of wagons and mules, and the introduction of the hand crank calculator.

In 1913 we were working 6 days a week. In the 1930's this was reduced to 5-1/2 days a week, and by this time we were on a 5-day week. However the surveyors would put in long hours, the crew working 10- to 12-hour days despite the fact they were supposedly on an 8-hour day. Then the surveyors would put in long hours in

"The cadastral organization was running on a shoestring, using the same equipment we had used in the thirties ..."



New Mexico State Cadastral Office in the mid-1940's. Haste is second from the left in the back row.

the evenings computing random lines, closures, astronomical observations, and corner moves. All this required many hours of looking up trigonometric functions and turning the hand crank on the "Monroe."

In the mid-fifties the regional concept was abandoned and the cadastral organization was organized under the area concept. I was appointed as chief cadastral surveyor over Area III. The headquarters for Area III was in Denver and the area covered 11 Rocky Mountain and Mid-western states. The Missouri River Basin Project was melded into the Area Office's responsibilities soon after the reorganization.

A cadastral surveyor was left in each state office to manage the Public Land Survey Records and provide technical advice. John S. Knowles was the office engineer assigned to the Colorado State Office. Having worked with Knowles personally, I knew his excellent professional reputation was well deserved and I wanted him

working in the Area Office as the office engineer.

When I first asked John to take the job, he didn't think too much of the idea. But I finally talked him into coming. Bill Teller was over the field crews and Jim Minnie was in charge of the Missouri River Basin surveys. We ran 10-15 surveyors out of the Area Office.

Resurveying the Colorado-New Mexico Line

In 1960, the U.S. Supreme Court made its latest decision to date about the Colorado-New Mexico line. The original survey of the boundary, called the Darling Line, was made by E. N. Darling in 1868 and did not exactly follow the 37th parallel of latitude — it was off by half a mile in some places. In 1901, the State of



The New Mexico-Texas Line



In 1911 Kidder also surveyed the New Mexico-Texas boundary along the 105th meridian. They had no radios. To obtain time for the astronomical observations for latitude and longitude, he ran a telegraph line to the point of beginning. With the available equipment he missed the 105th a little ways. Texas brings it up every once in a while, but that is the way it was surveyed and that is the way it will stay. Kidder was very exacting in his surveys.

The west boundary of New Mexico was described as on the 32 degree of longitude west of Washington, DC. The monuments are marked with mile numbers and a 32 WL on them. The idea to make a 0 degree meridian through Washington, DC did not last long.

Colorado acted to reestablish the Darling Line. However, the resurvey was not accepted by New Mexico.

In 1902, at the request of the State of Colorado, Congress authorized the resurvey of this line to correct the original survey. The line was resurveyed by H. B. Carpenter in 1902-03. This new line, temporarily used by the General Land Office, was later vetoed by the President.

In 1919, New Mexico filed suit against Colorado in the U.S. Supreme Court to settle the boundary dispute. In 1925, the Supreme Court decided in favor of the original Darling Line, due to its initial acceptance.

The Supreme Court, with the approval of the boundary commissions of both states, appointed Arthur Kidder to reestablish the Darling survey. Kidder commenced the resurvey in 1926. Hugh Crawford worked as a transitman for Kidder. Progress was slow because each state was supposed to pay for the survey, and the money was dependent on the state legislatures' appropriations. The field work was completed in 1946, but

money was not appropriated to write the field notes. Kidder died and the notes were still in limbo. When I was in Denver years later, I contacted Joe Toma, who had worked with Kidder, and he agreed to write the notes. Based on his estimate of cost, we wrote both states and they deposited the money and Toma finished the notes. The U.S. Supreme Court approved the survey in 1960.

Ending a Career

In 1961 they reorganized cadastral surveys back to the state organization. I was 66 years old and it had been 48 years since I first started working as a survey aid, and it was time for me to retire.

The years had been rewarding. I had seen survey technology progress from mules and wagons to the use of helicopters, from the use of the chain to electronic distance measurements and satellites.

— Chapter Four —

“Colorful People”

Alan Arnold started working on the Missouri River Basin surveys. He was chief cadastral surveyor for the reimbursable survey organization in Denver until he retired in the late 1970's. Alan is presently living in Cedar Ridge, Colorado.

Roy Bandy was in charge of the western New Mexico surveys during the 1933-34 winter. His wife Inez was from El Dorado Springs, Missouri. She was really after him and finally she got him to marry her. Inez would often accompany Roy as camp cook. Roy's fine work on surveys for the Bureau of Reclamation and the respect he gained from them resulted in the initiation of the Missouri River Basin Projects.

Willis Bandy and his brother, Roy, were two of many surveyors from Montana that I had the opportunity to meet and work with. Surveyors in that area were sent to New Mexico during the winter. Willis was a good surveyor, one of the best.

Clarence Bilbray worked in New Mexico when we were in the Regional Office and remained in Santa Fe after the reorganization as office engineer. He retired in the mid-1960's and is living in Monroeville, Alabama. Clarence was a bachelor until he was in his fifties and then married Lucille, a childhood sweetheart.

H.G. Bradsley worked for a railroad company before working for the General Land Office. He only worked for a short time in New Mexico and then moved to Nevada.

Roy Chase was a party chief on my first job. He was later assigned to Washington as an examiner of surveys and retired while in Washington. He was 35 to 40 years old when I first started working for him.

Alonzo Compton was supervisor of surveys for New Mexico. He had been appointed by Kidder, and Frank Johnson was not impressed with him. Somewhere around 1920, Compton was demoted to the field and Guy P. Harrington

was appointed supervisor of surveyors for New Mexico. Harrington remained in that position until he retired in 1946. Compton quit soon after the demotion and opened a photography shop in Albuquerque.

Hugh Crawford was Tom's brother. Hugh worked with Kidder as instrumentman on the resurvey of the Colorado-New Mexico bound-

ary. When I was in Denver he was assigned to do surveys east of the Mississippi River, most of them consisting of island surveys.

Tom Crawford was staying in a small town in western Colorado. He and his crew attended a dance one night and after the dance Tom decided to take an astronomical measurement.

Tom set up and picked a street light, which he needed as a backsite. When the dance ended the town's generator was shut off. Determined to get the measurement, Tom had one of the survey aides drive the pickup alongside the light, stand on the pickup and shine a flashlight behind the light. About that time a couple of the local boys came out of the cantina, one of them took one look and said, "My God, they are drunker than we are. I can see from here that the light is out." Tom was an excellent surveyor, and after he retired he came back to work as a chief of parties when I was in Denver.

Tom Daly was a surveyor in Canada before he went to work with us. I worked for him as a transitman. We were working in the mountains around Hope, and encountered a long cold spell. It was awful cold, so cold we had to go into town to wait it out. Daly worked until the 1940's.

Charles (Devie) Devendorff had executed some contract surveys previous to the initiation of the direct system. Devie was very conscious of the need to prove the efficiency of the direct system. He was the only surveyor I knew who would have one crew working while the other crew moved camp. He was about 30 or 35 years

*"Devie ... would have
one crew working
while the other
crew moved camp."*

old when I first started to work and met him. He didn't get married until 1915. He died while still working for the General Land Office.

Lucious Dills was surveyor general for New Mexico when I first started running crews. He was kind of a jackleg surveyor from around Roswell, and never did believe we depended on the solar for true bearing. He thought we were still using magnetic bearings.

Clark Gumm, who was later chief cadastral surveyor in Washington, worked as an assistant on the West Virginia surveys. Clark was from Raton and I can remember him calling his future wife Ruth in Raton while in this job.

Wendell V. Hall was a contract surveyor before the direct system started. Later his son, Wendell G. Hall, became a surveyor and was over the cadastral surveys in Alaska in the late fifties. In the sixties he was Chief, Branch of Cadastral Surveys in New Mexico until his retirement.

Guy P. Harrington transferred from the Indian Service to the General Land Office. He was supervisor of surveys for New Mexico for approximately 25 years, retiring in 1946 shortly after the Survey Office was transferred from Santa Fe to Albuquerque. His retirement was approximately \$400 per month.

Through the years as I worked with him, his fairness and his abilities to mediate were demonstrated time and time again, as was the faith others had in his judgement. For instance, on my second job, we bought our supplies from Johnny Young, a descendant of Brigham Young. Johnny and his wife were having marital trouble, so Johnny's wife asked Guy P. Harrington to assist them, and Guy P. did. This request was not unusual because of Guy P.'s dignified and judicial nature.

The government benefited from Harrington's abilities, too, for they were used in settling boundary problems. Under the Treaty of Guadalupe Hildago, Spanish settlers had rights to small holding claims. Occasionally there were disputes among the claimants over the boundaries. The surveyors were under strict orders — they were not to act in a judicial capacity. Nevertheless, when a dispute arose, the claimants would insist that Harrington settle it. After dinner every night we had what we

called "court." Each side in a dispute would bring in their testiques (witnesses), Guy P. would make his decision based on the testimony, and we would survey the claims on that basis. Without exception the parties appeared to be satisfied.

Harrington served on the Santa Fe School Board for several years. Harrington Junior High is named after him.

George Holland, like Alan Arnold, started working on the Missouri River Basin surveys. George Holland retired in the 1970's and moved to California where he died in 1987.

Lewellyn D. Lyman started in Montana, and always talked about surveying in the Crazy Horse Mountains in Montana. He had a ranch in South Dakota and had a good manager taking care of the ranch. However, Lyman's wife wanted him to quit surveying and take care of the ranch himself. The manager died, so Lyman quit and went back to the ranch.

Carter Maxwell was assigned to my crew in West Virginia in 1935. Carter was a friendly, easygoing type of person from Estancia with a western brogue. His easygoing ways were a great assistance in helping our crews get along with the people and he became good friends with the head of the Resettlement Commission. This also assisted in our relationship with that agency.

Lee S. Miller had been an examiner of surveys. He ran the southern boundary of Texas and New Mexico from the southeast corner of New Mexico to the Rio Grande River.

Doc Mishler was one of my favorite cooks. He worked for years as a cook on the survey. When he first went to work for us his name was Burgher and he was trying to get away from his wife in Denver. She had sent him to theological school to make a preacher out of him.

One winter when I was working as an assistant, several of us rented a house in Santa Fe, waiting for the crews to start in the spring. We let Mishler stay with us, with the understanding that he did not have to pay for room and board if he would do the cooking for us. Mishler liked to gamble and worked for a gambling outfit on the "QT" while we were waiting for the crews to start up. The others were so impressed with his gambling abilities that they left him in charge of the enterprise while they went on vacation. When



Doc Mishler, Cook.

they came back they were thousands of dollars in debt from his gambling. He just couldn't resist the urge.

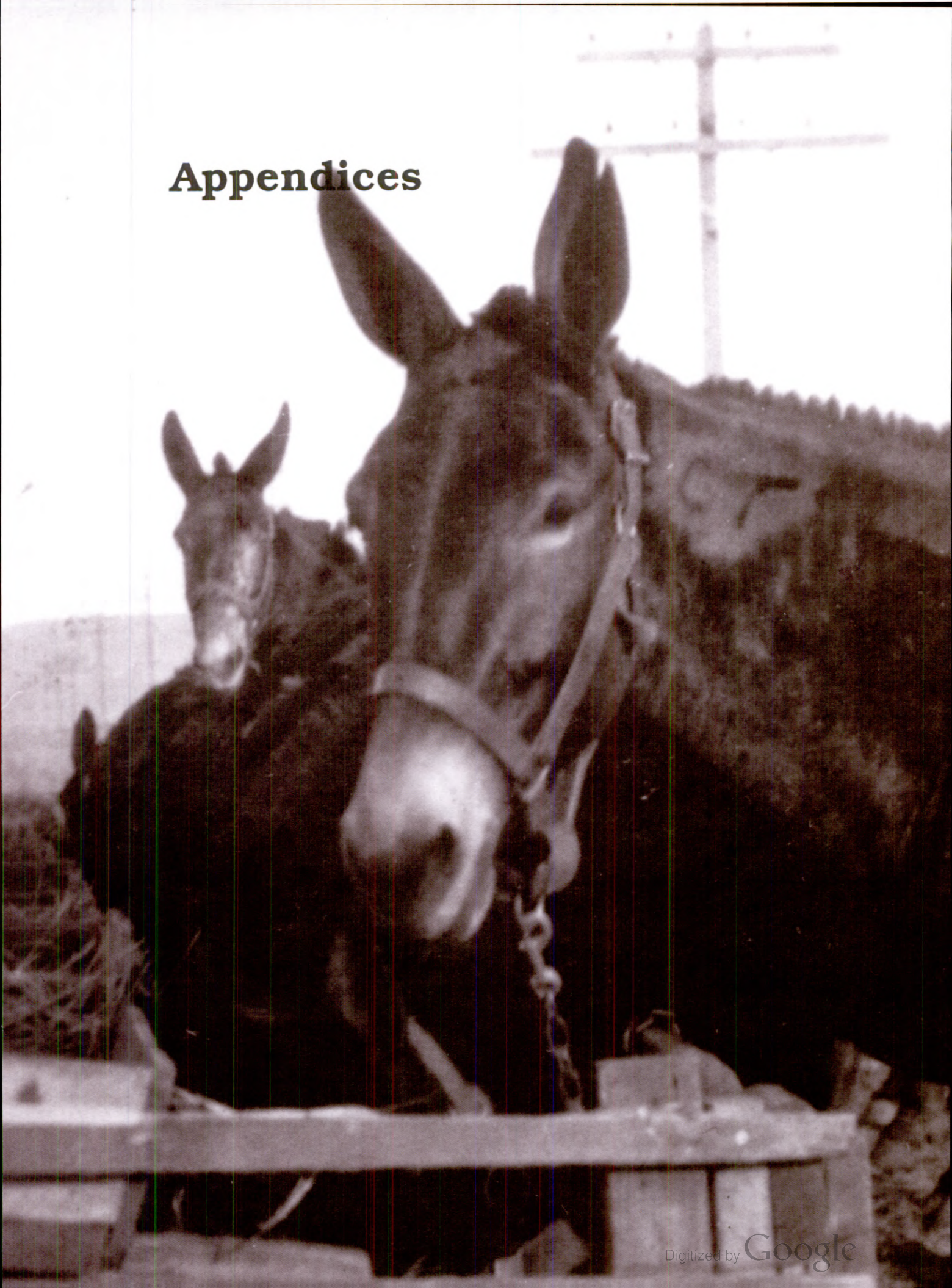
Hugh Neighbors transferred to the General Land Office from the Indian Service. He later got a job with the City of Los Angeles. He was about 30 years old when I started with GLO.

George Rigby was from Montana. When I was working for him around San Antonio, he would not ride the mules in to get the mail. He would walk from camp to town, a distance of approximately 5 miles one way.

Daddy Thorne had been an examiner of surveys before the direct system was initiated. He did only one job in New Mexico, working mainly in Arizona and California. He lived a long time in Bakersville, California.

Lloyd Toland started in New Mexico as an assistant, and he married a Harvey House girl from Kansas. Toland was chief engineer over Area II in Salt Lake, finally retiring in the 1960's. He worked mostly with Tom Daly, more than he worked for me. Toland worked with me on several townships around Quemado.

Appendices



— Appendix A —

Background on Surveying

Cadastral Surveys

Cadastral surveys are the surveys that create, mark, define, retrace, or reestablish the boundaries and subdivisions of the public lands of the United States. They cannot be repudiated, altered, ignored, or corrected; the boundaries created or reestablished by them are unchangeable so long as they control rights vested in the lands affected.

In general, cadastral surveys are based upon the intent of the 1785 Land Ordinance, which established the rectangular system of surveys. This system was retained by the Land Law of 1796.

All cadastral surveys contain three basic elements:

1. Initiating documents;
2. Actual field survey and the preparation of the official records of the field work; and
3. Official approval process.

Cadastral surveys are the foundation upon which rests title to all land that is now, or was once, part of the public domain of the United States.

The Rectangular Survey System

The 1785 Land Ordinance established the rectangular system of surveys for the public lands of the United States. Under this system it was very easy to describe and locate any one parcel of land. There could not be another parcel of land with the same identification.

In the rectangular system, the land was plotted into a grid of squares, each approximately 6 miles by 6 miles, called "townships." The township was further divided into sections of 1-mile squares containing 640 acres. Individual sections were identified by a numbering system that started with section 1 in the southeast and ran from south to north in each row to section 36 in the northwest corner. In 1796 the numbering

36	30	24	18	12	6
35	29	23	17	11	5
34	28	22	16	10	4
33	27	21	15	9	3
32	26	20	14	8	2
31	25	19	13	7	1

Before 1796

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

After 1796

scheme was changed. It started with section 1 in the northeast corner, with the first row running from east to west, the next west to east, alternating until it ended with section 36 in the southeast corner.

Prior to extending the rectangular system across the United States, 36 principal meridians were established. One of these, the Navajo meridian, was canceled. The initial point for each meridian was selected by the original surveyor. From initial points, two lines were run — one north-south, the other east-west. The north-south line became a principal meridian and was identified by a name. Because of the shape of the Earth, principal meridians came closer together as they extended toward the North Pole. To adjust for this, correction lines were run every 24 miles. The east-west line became the base line for the meridian.

Working along the principal meridian and the base line, the surveyor set township corners at 6-mile intervals, and then, by extension, the tract was marked off into a grid. Each of the 6-mile squares was a township of 36 square miles, or approximately 23,040 acres. Any specific township could then be located according to its relationship to the appropriate principal meridian and the base line.

Survey Corners

Proper corner monuments were vital to a survey. After the survey crews measured to the corner points, they would mark them temporarily with wooden stakes. The moundsman would follow, digging holes to set permanent monuments.

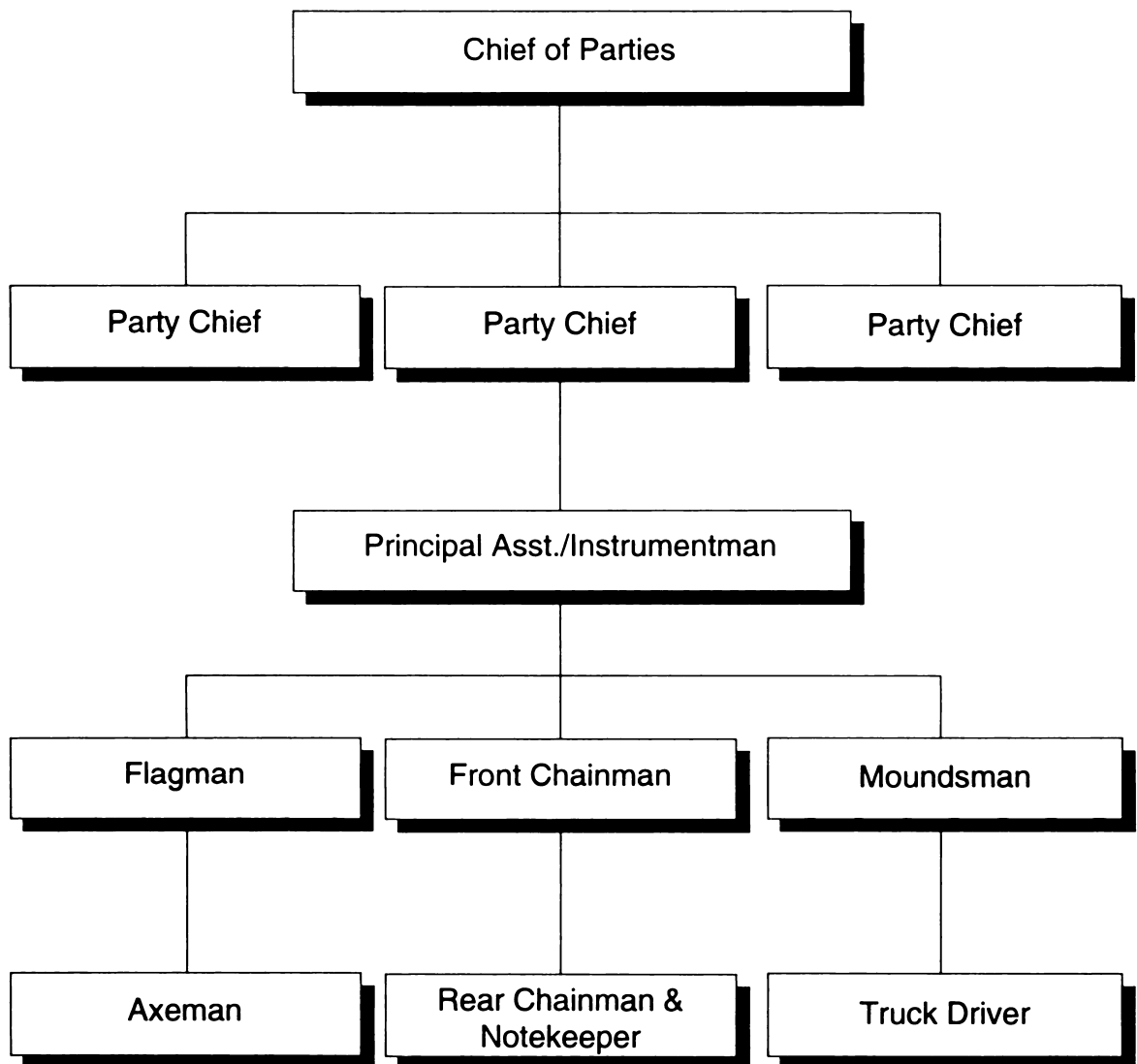
Previous to the 1910 Public Land Survey System, rock or wood posts were used for corner monuments. Each monument was marked by grooves or slashes and/or letters and numbers, based on a system that provided unique markings for each corner. After 1910 the monuments were concrete-filled, 36-inch iron posts with brass caps attached. The four corners of a township were monumented with posts 3 inches in diameter. The section corner monuments were 2-inch diameter posts. Quarter section corners and others, such as mineral survey corners, had 1-inch diameter posts for monuments. During the 1940's, 30-inch iron posts — 2-1/2 inches in diameter, with brass caps — were used. Presently several types of steel and aluminum monuments are in use.

— Appendix B —

Survey Crew Members

The chart below shows the different positions on a survey crew. However, duties often overlapped, and sometimes one person performed the duties of more than one position. Usually

every member of the crew helped out wherever necessary. Following the chart are brief descriptions of duties that went along with each position.



Chief Of Parties

The chief of parties was a surveyor in charge of multiple crews working together.

Party Chief

The party chief was an experienced surveyor in charge of one crew.

Principal Assistant

The principal assistant was an experienced survey aid, usually considered to have potential as a surveyor. His duties were to assist the surveyor on computations and the administrative work of processing various forms, such as time and attendance, truck reports, etc. He would supervise the crew in the field if the surveyor was not present. The principal assistant would sometimes be assigned the duties of instrumentman or notekeeper on the crew.

Instrumentman Or Transitman

An instrumentman or transitman would "run" the transit, usually a solar transit. The transit is an instrument with a telescope that measures vertical and horizontal angles used for obtaining directions and lining-in points. The solar transit has an instrument attached to it that provides a mechanical means of determining the bearing (direction) of a line through sighting of the sun. The solar compass was patented by William Burt in 1836 and provided a practical and more accurate means of determining bearings and running survey lines than using the magnetic compass. Later the functions of the solar compass and transit were combined into the solar transit.

Operating a solar transit was an art requiring a certain expert touch; therefore only the most

experienced surveys aids were allowed to run instruments. Often the party chief ran his own instrument; if not, the job was reserved for the principal assistants.

Flagman Or Rodman

The flagman or rodman was in front of the crew. He would determine where to set points along the line to provide stations for the instrumentman. This also provided foresights and hindsights for chaining along line. In addition, it was his duty, through pacing and estimation, to determine initial search areas for corners and search for them as the crew moved up.

An experienced flagman could pace 1/2 mile within 10 feet over level terrain, and by using hindsights and foresights, stay within a few feet of line, making it easier for the instrumentman to "line" him in for setting a point. In running line through vegetation, the flagman would help cut a line of sight using an axe or "brushhook."

Axemen

When surveying, a "line of sight" had to be obtained from one point to the next. If vegetation was in the way, it had to be removed. To assist in clearing line in these areas, one or two axemen were assigned to a crew.

The efficiency of the crew depended on the flagman's and the axemen's abilities to stay on line and cut brush while the crew was moving up. Staying close to line and keeping the cut line narrow minimized the amount of cutting necessary; therefore, cutting half as much brush meant getting twice as much line. If one branch was left in the way where the instrumentman could not see from one point to the other, someone had to go back and cut the branch. In thick vegetation, the flagman, truck driver, and front chainman all assisted in the cutting, and the cutting was constant throughout the day.

Often the axemen were the most inexperienced members of the crew and were directed by the flagman.

Chainmen

Chainmen used a procedure to measure distances with a "Gunter's chain," similar to measuring distance with any measuring tape. The "front" chainman pulled the front of the chain while the "rear" chainman positioned himself at a point from which the measurement was to be made. When measuring, the chainmen straightened out the tape, pulled it taut, and measured between the points. The front chainman marked the point he measured to with a chaining pin, a steel wire about 10 inches long and pointed at one end, so that it could be stuck in the ground.

Often the chainmen had to "break chain," or measure distances less than the total length of the chain, in order to keep the chain straight without bending it over vegetation or changes in the slope of the ground. When measuring, each chainman held the chain and, with a whipping motion similar to straightening a hose when watering the lawn, cleared it from brush or other obstructions and then stretched the chain along the line to measure the distance.

The vertical angle was measured with a hand-held instrument called an abney level. The rear chainman then recorded the distance, measured the vertical angle, determined the horizontal distance, and added this to the accumulative horizontal distance to determine the distance from the last corner. All distances used in the measurement of lines in the Public Land Survey System are horizontal distances.

Dragging the chain through rough country was an art. In timber and/or rough terrain the ability of the front chainman was a primary factor in the number of miles a crew could survey. Straightening the chain to obtain an accurate measurement was a problem under these conditions. The front chainman had to remain close to line while moving from point to point, weaving the chain through, over, under, and between trees, brush, and rocks so that when it was time to measure, the chain could be easily cleared. Placing the chain on the wrong side of a limb made the chain impossible to straighten until the snag was removed.

With the exception of short distances, measurements today are made with electronic measuring instruments, which are more efficient and provide very accurate measurements.

Notekeeper

In all public land surveys a detailed record is kept of the measurements, topography along the survey line, and monuments set, including descriptions of mounds, pits, and bearing trees used to mark the corners. The recording in the field was the responsibility of the notekeeper, which was usually the rear chainman.

Moundsman

The moundsman marked the corner monuments for townships, sections, and quarter sections. He set and witnessed them with pits, mounds of stones, and/or bearing trees. During the process of a survey the crew would measure to and place temporary wood stakes at the corner points. The moundsman would follow the crew and set the monuments, iron pipes with brass caps attached, by using a shovel and digging bar to dig holes approximately 30 inches deep, and setting the monuments in the holes.

When rock was available, the moundsman would then build a mound of rock alongside the corner or around the corner, to support the monument. He would mark the corner monument with the proper number and letter designations using steel dies, a set of which had all the numbers and letters of the alphabet.

If no rocks were available, mound pits were dug alongside the corners as references. The pits would eventually fill up with soil, but the vegetation that grew in them was often different from the surrounding area, enabling a surveyor to identify them.

The moundsman would also blaze and mark nearby trees for bearing trees as corner references. He used a tool called a timber scribe, which had a blade that made it easy to cut numbers and letters into the wood. These blazes

would grow over, leaving a scar on the tree which was easily identified by an experienced surveyor or survey aid. They could cut into the blaze to the original scribe marks, which were easily discernible.

The moundsman would use a mule to pack the monuments, timber scribe, and digging tools. Upon initiation of trucks on the survey, it became one of the duties of the truck driver to set the corners.

Teamster Or Packer

The packer was what is today called a "wrangler." He took care of the horses and mules. On fly camps the packer would move camp and cook the evening meal while the crew was surveying during the day.

Truck Driver

Truck drivers were needed after World War I when trucks were being phased in to replace mules. The driver was responsible for moving the truck around from corner to corner, setting the corners, and picking up the crew. Most of the driving was off-road, picking through timber, across arroyos and canyons, and up and down hills. A truck driver had to know the limitations of the truck, taking it as close as possible to the corner points, or where the crew was, without tearing up the truck or getting it stuck. He also had to instinctively drive for many miles on unmapped roads and across country to a designated point for picking up a crew at the end of the day. If he got lost, the crew had no transportation back to camp or the field office.

— Appendix C —

Glossary

Accretion — The slow movement in the course of a river through the gradual buildup of material along the banks and bed of a body of water. If an accretion changes a body of water that forms a property boundary, the boundary follows the movement of water.

Astronomical Declination — The angular distance of a celestial body north or south from the celestial equator.

Avulsion — A sudden change in the course of a river, usually due to severe flooding, where the river abandons its former channel and forms a new channel. If avulsion changes a body of water that forms a boundary, the boundary will remain where it originally was.

Bench Marks — A surveyor's monument or mark made on a relatively permanent material object (natural or artificial) of known altitude. It is used as a reference point in determining other altitudes.

Broadaxe — An axe with a broad blade used for hewing timber.

Buckboard — A four-wheeled open carriage with the seat(s) carried on a flooring of long, flexible boards whose ends rest directly on the axles.

Chaff — The husks of wheat or other grain.

Closure — Involves returning to the starting point of a survey to complete a survey measurement. By closing a survey, a surveyor can check the accuracy of his measurements.

Contour Line — A line connecting points that are at the same elevation. A contour map is a map showing topographic configuration by contour lines, each of which is separated from the next by a definite difference in height.

Defile — Any narrow valley or mountain pass.

Fly Camps — Survey crews could go into remote areas with a minimum of camp supplies, and stay until the survey in the area was complete. Because the crews had to

move camp daily as the survey progressed, they called these setups fly camps.

Foot adz — An axelike tool for trimming and smoothing wood, etc., with a curved blade at right angles to the handle.

Gunter Chain — A chain that was 66 feet long and consisted of 100 links. A link was 7.92 inches and each link was wired to the next, similar to links in a common chain. In the early 1900's the long steel tape replaced the "Gunter chain" as a measuring instrument for surveys. The long steel tape consisted of a wire, usually 5 chains (330 feet) or 8 chains (528 feet) long. Measurements in the Public Land Survey System are still recorded in the "chain unit" — 80 chains equal 5,280 feet (1 mile), 10 square chains equal 1 acre.

Jemez Mountains — Lie west of the Rio Grande in Sandoval and Los Alamos Counties. Los Alamos and Bandelier National Monument are located there. The national monument's boundaries were surveyed by the Civilian Conservation Corps and Works Progress Administration survey crews under Haste's supervision in the 1930's.

Jerkline — A single rein that was fastened to the brake handle and ran through the driver's hand to the bit of the lead animal.

Jerkwater Train — Trains on early branch railroads were called this probably in reference to pulling the valve on the water tank to fill the engine boiler.

Lilliputianlike — Very small; tiny.

Manual of Surveying Instructions — The "bible" for survey of the public lands.

Maxwell Grant — The largest land grant and area of sole ownership in the Western Hemisphere, covering over 1,700,000 acres in northern New Mexico and southern Colorado.

Meander Line — The traverse run at the mean high-water line of a permanent natural body of water. In original surveys, meander lines

were run to generally define the sinuosities of the bank or shoreline.

Photogrammetric — From the art or process of obtaining reliable measurements (as for map making) from photographs, especially aerial photographs.

Planetable — A drawing board mounted on a tripod with a sighting instrument to measure and plot angles and distances graphically. It is used for plotting survey data directly from field observations.

Planimetric Map — A map that presents only the horizontal positions for the features represented; it does not show relief in measurable form.

Pueblo Bonito — The largest of 18 major Indian ruins found in Chaco Canyon. It contained over 1,800 rooms and had as many as 1,500 people living there when it was occupied during the 9th through 12th centuries.

San Juan Hill — As Assistant Secretary of Navy, Roosevelt actively sought the declaration of war on Spain in the Caribbean. He formed the "Rough Riders," charged up San Juan Hill and later became President, partially as a result of publicity about his attack.

Solar Attachment — A refinement of the solar compass. A mechanical device attached to the transit, it obtains direction relative to a true north/south line in contrast to a compass bearing. The "Smith Solar Transit" modified the solar compass to combine the means of determining the direction of the line, by "shooting" the sun with the attachment, with the transit's telescope and accuracy of measuring angles. The solar transit was used into the 1970's as a versatile public land survey instrument. The value of the solar compass and transit in establishing the Public Land Survey System during the years of their use was immeasurable.

Spanish/American War — Started in 1898 when the battleship *Maine* blew up in Cuba's Havana Harbor; some say this was an accident and not a result of sabotage by the Spanish, as the United States claimed. American Admiral George Dewey's victory several months later at the Battle of Manila Bay ended Spanish power in the Philippine Islands. As a result of the war, the United

States obtained jurisdiction over Cuba and the Philippines.

Stadia — An optical technique of distance measuring that involves using the telescope of a transit of alidade.

Standard Parallels — East and west lines that are approximately 24 miles apart in the rectangular system of survey. Also called correction lines, they were established to limit the affect of convergence of north and south lines as they approach the poles. The survey standards required to establish standard parallels are stricter than required for township and section lines.

Sugan — A coarse blanket.

Tangent Method — Consists of surveying a straight line contiguous to a parallel of latitude (a curved east or west line on the earth's surface that is parallel to the plane of the equator). The calculated distance is then measured from the tangent north to establish points on the parallel of latitude.

Transit — A surveying instrument for measuring horizontal and vertical angles.

Transitman — "U.S. Transitman" was a title given to an apprentice surveyor, similar to our surveyor-in-training designation today.

Traverse — A series of straight lines connecting a number of points. The lengths of these lines and the angles between these lines are measured, and the lines are usually arranged to return to the place of beginning so that the extent of the errors can be computed. Traverse tables are derived from trigonometric functions that facilitate reducing a direction and distance measurement to cardinal directions (east, west, north, and south) and distances.

Treaty of Guadalupe Hildago — The Spanish began settling in New Mexico in the late 1500's, based on land grants from the King of Spain. Later, Mexico became independent and issued its own grants. Under the Treaty of Guadalupe Hildago at the end of the Mexican-American War, the United States obtained New Mexico and was required to recognize all valid Spanish and Mexican grants.

Triangulation — A method of surveying using a series of triangles. From points on the

ground, angles are measured instrumentally, and sides are derived by computation. When one triangle is computed, the newly computed sides offer entry into adjacent triangles and the process continues, forming a network of triangles or a triangulation net.

Verniers — A scale reading device that makes possible a finer setting of a tool or measuring instrument; uses alignment of graduated marks.

