

SHOEMAKER REPORT
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II. JEMAKER REPORT

Shoshone Agency, Wyoming,

March 14, 1900.

The Honorable,

The Commissioner of Indian Affairs,

Washington, D. C.

Sir:

I have the honor to submit the following relative to irrigation matters on the Navajo Indian Reservation in Arizona and New Mexico.

On the 30th of July 1890 your Office made the following recommendation, pertaining to the reservation, to the Department, with the suggestion that the President be asked to give the necessary instructions to carry the same into effect; First, That the Navajo Reservation be divided, under the direction of the General commanding the Department of Arizona, into as many districts as he may in his judgment deem expedient, for the purpose of making a survey and contour map thereof, with a view to establishing a system of irrigation and developing a water supply thereon sufficient for the needs of all the Navajos, together with their flocks and herds.

Second; That as many officers of proper rank, the number to be designated by the commanding General, be detailed from the Army, and one assigned to each of such districts, to make a preliminary topographical survey thereof, and to prepare from the results of such survey a contour, or topographical map, all upon the same scale and of similar character, so that a proper and correct map be made of that large reservation.

Third; That the survey be made also with a view to establishing and maintaining a system of irrigation and developing a stock water supply sufficient for the Navajo Indians, in all, some 16000 or 13,000, - and that the irrigation ditches, or canals, dams, laterals, etc., necessary for irrigation purposes, and the lands to

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be irrigated therefrom, be indicated on the proposed maps, together with the available and suitable places for artesian wells, bore wells to be worked by windmills, points in canyons or mountains where storage reservoirs may be constructed, or where springs or other sources of water supply may be developed.

Forth: That an estimate of the cost of constructing the proposed ditches, dams, laterals, flumes, etc., necessary for irrigation purposes, be submitted in detail; that an estimate of the annual cost of maintaining and repairing the same be also submitted; and that the estimate of the cost of each artesian well, bore well, storage reservoir, etc., including machinery and appliances, be also submitted.

Fifth: That a full and complete report be made upon the question of the feasibility of constructing and maintaining a proper system of irrigation upon the Navajo Reservation, and of providing a suitable supply of water to meet the wants of all the Navajos now there, and of those to be removed thither, the report to contain also any other information or plans necessary to put into successful operation the system proposed.

On December 20th 1892 the War Department informed the Interior Department that the surveys had been made as recommended, and transmitted the original reports of the Army officers detailed for this work. Based on this, recommendation was made by your office that "Congress be asked to appropriate \$84,000 for the purpose of developing a water supply and a system of irrigation on the Navajo reservation sufficient to meet the actual and immediate needs and wants of the Navajo Indians, under the general plan submitted by the military officers." This Office report together with the reports of the officers referred to and accompanying documents and maps, was submitted by the President to Congress. (See Senate Ex. Doc. No. 68, Fifty second Congress, Second Session.) When it is remembered that the time spent in the field by these officers was less than six weeks, and that the reconnaissance was made without instruments, one ditch only excepted, and by men unfamiliar with this branch of engineering, their work was most creditable.

There was about \$20,000 available for this work; and, this, together with the \$40,000 appropriated by clause contained in the Indian appropriation act approved March 3, 1893, making about \$60,000 for this work, was thought to be sufficient to carry out the scheme advised by the military officers, in the report above referred to, the accomplishment of which scheme it was hoped would warrant the Department in returning to the reservation the roving Navajos and restraining those others who were in the habit of going beyond the reservation limits for the purpose of securing grass and water for their flocks and herds.

On the 10th of March 1894 the Honorable Secretary of the Interior appointed a Superintendent of Irrigation for this work, under the provisions of the act of Congress approved March 3rd 1893, and on September 25th 1895 I was transferred from the irrigation work on the Crow Indian Reservation in Montana to be assistant Supt. of irrigation on the Navajo work; and on May 22, 1896 was appointed Superintendent, assuming the duties of that position on the first of July 1896.

I was instructed to ascertain the nature, character and extent of the work of irrigation done; and, if it was found to be defective or imperfect, to repair, improve and strengthen the same if practicable, whether the defects or imperfections were in the ditches, dams, reservoirs, head gates, flumes, laterals, etc. I was also required, when this work should be completed, to determine whether it was practicable to construct other irrigating ditches.

dams, reservoirs, on the reservation; and make report in regard thereto, indicating the quantity of land that might thereby be reclaimed and the approximate cost of construction, and to furnish any other information that might be useful and necessary to the Department. I was also informed that there was on hand a balance of \$21,210.73 available for irrigation and sawmill purposes; that on the basis of that year's expenditures of the cost of operating the saw mill and from the estimates submitted of the expense of irrigation work for the then current quarter, there would have to be deducted from this amount about \$11,625.00 leaving something like \$9,500.00 to be expended by me.

In obedience to these instructions, I proceeded to examine and repair the several small ditches which had been begun but had never been completed; and chose that one known as the Carriso Ditch as the one to be first put in shape.

This ditch, named for the creek from which it diverts water to the land lying on the south of left bank, is situated about seventy miles north from the Agency. The dam was found to be weak and low, there was no head gate to regulate the flow of water in the ditch, the alignment was poor, and the bank in many places weak, especially near the head, owing to disregard in the disposal of earth from the channel. About 1600 feet from the head of the ditch, which seemed to have been run on a gradient of 0.1 in 100, it was emptied into a small gully or wash and taken out again

lower down. This expedient has been resorted to at six or seven other places on the line, evidently to lose grade, and to hold to the gradient determined on, and prevent the line from climbing the foot hills; but this procedure caused heavy erosion of the channel above where it emptied into the gully, and the consequent filling up and obliteration of the ditch for several hundred feet from where it was taken out, or almost to the next drop. There was absolutely nothing to save below the first drop, and the original line was abandoned there, and a new line, with increased grade, to compensate for some of the drops, located and built.

The completed ditch was four feet wide on the bottom, side slopes 2:1, bank four feet high at the head decreasing to a height of three feet at the end. The length of line is one mile. The crib dam was strengthened and raised, and a substantial head gate and three lateral diversion gates constructed for the control and delivery of the water. The cost of this work was about \$1135.00 and the estimated area of land reclaimed 300 acres. The ditch was formally delivered to the Agent on the 8th of November 1895.

About the first of November 1899 I visited this ditch to note its condition and see what benefit had accrued therefrom to the Indians in its vicinity. I found the dam broken and almost entirely washed out, the head gate buried four feet deep in sand, the channel immediately back of the gate bank full of sand which continued down the ditch gradually becoming less until, at about 900 feet from the head, the ditch was free and in good condition. Lower down the line were places showing quite heavy erosion from

from the excessive amount of both flood water and surface drainage which the ditch had been compelled to carry. From all I could hear and see the head gate had never been closed at any time since November 1896, and the ditch, instead of being required to conduct the normal flow of the stream at such times as the water was actually needed for irrigation, had been strained for the past three years by the excessive flood waters which at times pour down the creek channel, and which have, no doubt, been often augmented by the simultaneous surface drainage from land just above the ditch; an amount of water the ditch was never built to carry and to avoid which the head gate was especially constructed. Even under these conditions the ditch has stood and done service for three seasons, having been used to divert water to the past year's crops. The unusually heavy flood of this past Fall, which finally filled the head of the ditch, took out most of the crib dam which had been weakened by previous floods and never repaired; and filled the creek bed, with huge boulders and rocks, from three to four feet above what it was when I completed the work. From this fact a dam may not be required for some time to come as a channel can be cleared through the rocks of the creek bed and water bed directly into the ditch. There is not much work required to clean out the sand in the head of the channel, and the damage lower down the line from erosion can be stopped and remedied economically.

Among the photographs which were taken last Fall, with a view

to showing the general class of work and its condition at that time, will be found some which may convey some idea of the present condition of the head works of this ditch.

The next work undertaken for repair and completion was a ditch about forty miles north of the Agency taking water from what is known as Wheatfields Creek and carrying it to land lying on the right bank, or north side of the creek. The selection of the site for the head works was good, being just below the confluence of the two branches of the stream. The crib dam was weak and poorly constructed, and showed signs of breaking and destruction by most any normal flood. There was no head gate to the ditch nor any other structure; the alignment was poor, the slopes were very steep and almost vertical in places. The ditch had been run along the creek bank from the head for about 600 feet and the upper side of the ditch channel rose almost vertical for fourteen feet; as a natural sequence the earth and sand of this side were constantly crumbling and falling, or being washed by the rains and snows into the ditch. The line followed more or less closely the creek for about three quarters of a mile to the head of the arable land of the valley, when it swung back towards the foot hills, and followed around the upper edge of the valley for about half a mile. The gradient which was used seemed to have been 0.075 in 100 and at the end of the first mile and a quarter the line began climbing the foot hills, and wandered through the pinons and cedars and over the

rocky ridges at a considerable distance, both vertically and horizontally, from the lands to be served. I could not discover that water from this ditch had ever been used except on a patch of about 200 feet square.

The first mile and a quarter of the old line was thoroughly overhauled and repaired, the old gradient being retained, and a channel made with a bottom width of four feet, side slopes 2:1, and bank four feet high at the head gradually reducing to three feet. Owing to its poor construction and delapidated condition and on account of its location, it was found to be better and cheaper to abandon the old ditch at this point and construct a new one contiguous and more accessible to the lands to be watered. At the bifurcation a division gate was built to provide for the use of the old ditch as a lateral should it ever be needed. The new channel extends down the valley for a mile and three quarters maintaining the bottom width of four feet for the first three quarters, the lower end having a bottom width of three feet with a bank three feet high. The total length of line is three miles and there have been laid out and plowed nearly a mile of laterals. A new crib dam about 100 feet long with an overflow notch 66 feet long and 3 feet high has been built; about 600 feet of ditch bank along the creek bank revetted with rock; and a main head gate, one diversion gate and four lateral diversion gates constructed. The ditch cost a little more than \$2,500.00 and covers fully 500 acres of excellent land which area can be slightly increased if ever

required; was finished August 16th 1897 and delivered to the Agent soon afterwards.

Last November I found the work in fairly good shape, although no maintenance work had been expended upon it. The dam is in good condition, but some of the rock have been washed away from face or down stream side, and should be replaced; and the back filling in some of the cribs has settled, which ought to be attended to. There is very little sedimentary deposit in the channel where the grade is light; and at the lower end, where the fall was necessarily heavy, there has not been much erosion and none to hurt, although there has been little or no management of the flow of water for nearly three years.

This I regard as the best and most profitable piece of Irrigation work on the reservation and I found that there was harvested about 250 acres of wheat and other crops under this ditch this year. The Indians have settled and improved this tract fairly well, all things considered, and from what they told me I apprehend that next year nearly, if not fully, 500 acres will be put under cultivation here.

What is known as the Cottonwood Ditch is about 25 miles north of the Agency and carries water to the lands on the left or south side of the creek. Water had been raised and diverted from the creek by a crib dam of logs, but it had been poorly constructed and unprotected at the ends and had washed out. The head gate was

most primitive and crude. The alignment and construction here was similar to that described above and for the first 500 feet the channel was built under the cut bank of the creek and was in places washed out by water in both creek and ditch, while in others it was continually being filled by caving and slipping of earth from the vertical bank above it, which was from 10 to 15 feet high. The entire length of channel was a little less than three quarters of a mile and the fall was 0.1 in 100.

The head works' site was changed to a point 600 feet lower down the creek, where a crib dam about 75 feet over all was built. This crib rests on a sand stone ledge which was trenched and leveled for the lower tier of logs; has an overflow 40 feet long and four feet deep, the bottom of the notch being 10 feet above the underlying sand stone, and the down stream side or face is well protected from wash by supplemental cribs. A head gate was placed for the control of water to the ditch, and the channel, which is three feet wide on the bottom with side slopes of 2:1 and bank three feet high, follows the old alignment as closely as was consistent with good work in the practical reconstruction. There was an extension of about 2000 feet built, which makes the total length of ditch a little over a mile and it covers from 150 to 200 acres of good land. There were three diversion boxes built for delivery of water from the ditch to the lands and also a culvert to pass surface drainage, which was encountered near the head, across the

line. The work cost a little over \$1200.00 and was delivered to the Agent in the Fall of 1897.

Last November I found that the dam and head gate was in good condition; but, not being kept free from trash, the culvert had become choked and the ditch for about 200 feet either side of this structure was bank full of sand. This stoppage of the channel had caused quite a heavy break just back of the head gate which had, however, been repaired by the Indians. The ditch has done service for two seasons, but though there were three boxes in place and in good condition and working order for the diversion of water, the bank had been cut in five or six places, in some places only a few feet from the boxes, and water drawn through these cuts in the bank. The timbers and planking of the lower bulkhead of the culvert have been chopped out and carried away, probably by some Indian. I apprehend they will dig out the balance of the structure when they think they need it enough to expend this amount of work for the lumber. The cultivated area has been considerably increased since the work was finished and there was an area approximating 150 acres last year in crops of wheat, corn, melons, etc. A few days work with three or four teams would put this ditch in as good shape as when we left it.

The Red Lake System, lying about 12 miles north from the Agency, is the only storage system which has been undertaken. There was a crude crib dam of logs, brush and rock across the

channel of Black Creek where it has cut through a low rock ridge of hog back, which was built to divert the water to the feed ditch of the Red Lake reservoir. This dam was about 175 feet long and 10 feet high, and had an overflow notch in the center a foot deep and 10 feet wide. This feed ditch, which was taken out near the north end of the dam, was about four feet wide on the bottom with side slopes almost vertical. Near the head it ran so close to the creek bank that there was only a narrow ridge of earth between the two channels and the ditch could never have been maintained. The line extended about a quarter of a mile from the dam or to a point where the natural slope of the ground would turn the water into the Red Lake basin a few hundred feet away. There was no head gate to this ditch and no way to control the water after the reservoir should become full.

A dyke about 1000 feet long, 7 feet maximum height, tapering out to nothing at either end, 10 feet wide on top and slopes about 1 1/2:1, had been constructed across the lower end of a basin or depression in the valley just below the Black Creek dam. This was the storage reservoir, but the slope of the bank was not flat enough to withstand the erosive wave action of so large a body of impounded water as was contemplated. The spill-way or overflow from the reservoir, which was supposed to prevent an excessive head of water on the dyke, was an earth cut at the west end of the dyke about 200 feet long, 10 feet wide on the bottom, side slopes about 1:1, and which would discharge into the natural wash from the head.

from the basin and against the bank of the ditch about 300 feet below the dyke. The regulating gate of the ditch from the reservoir was a box one foot high, three and a half feet wide, extending through the dyke at the point of greatest fill, and was closed by a gate or slide made of inch boards. The intake was protected by a short apron and wings about two and a half feet high, but there was no protection to the lower or discharge end of the box. The ditch from the reservoir was about four feet wide on the bottom, banks varying from one to three feet high, slopes from vertical to 2:1 and extended to the right or west bank of Black Creek about half a mile from the dyke. A flume crossing had been contemplated and a half or three quarters of a mile of the projected line on the east side of the creek built.

The Black Creek dam has been partially removed and rebuilt, having now an overflow 90 feet long and 4 1/2 feet deep, with crib abutments at either end. The overflow and abutments are log cribs securely drifted with 2 foot iron pins to the underlying logs which were left in place. A close laid pole floor runs the entire length of overflow and abutments, the poles extending about 10 feet up stream and well under the earth, and the cribs are rock filled. Near the south end of the dam is a head gate to pass the normal flow of the creek to about 90 acres of fine land lying on the west side of Black Creek immediately below the dam, and which has not heretofore been covered. This ditch which has a bottom

width of four feet, banks two feet high, side slopes 1 1/2:1 and a fall of 0:1 in 100 extends from the gate for three quarters of a mile, where it empties into a small wash which drains into that portion of the old Red Lake Ditch on the east side of Black Creek above referred to, and which can thus be utilized. There is one lateral gate on the ditch.

The feed ditch from Black Creek to the Red Lake reservoir which takes out close to the north end of the Black Creek dam, was thrown hard into the hill, necessitating a rock cut about 300 feet long. The lower bank here, between the ditch and creek channels, is now as substantial as it is possible to make it. The ditch has a bottom width of 1 foot, side slopes 2:1, and is protected by a head gate 16 feet wide and 9 feet high. Flash boards have been used for the control of the water as they were deemed better than the ordinary lift gate. As there was about 90 acres lying under this feed ditch and below the Red Lake dyke which could not be watered from the reservoir, a lateral diversion gate and 2600 feet of lateral ditch have been built from the feed ditch for its reclamation.

The Red Lake dyke has been raised, its crown being not 10 feet wide and 11 feet above the grade of the Red Lake ditch at the head. The outer slope is 1 1/2:1 while the inner slope is 3:1 and is revetted from top to bottom with heavy rock laid close. The length of the dyke is 1390 feet. The area of the reservoir on

the 8 foot contour is about 630 acres and it will hold sufficient water to irrigate at least 1500 acres. Should there be a demand in the future for more water than the reservoir will now store the embankment has been so built that its height can be cheaply and quickly increased to the end that any required amount can be stored. There has been constructed through the embankment a gate or box for the passage of water to the Red Lake ditch. This ditch has a bottom width of three feet, slopes 2:1, bank three feet high with a crown of three feet. The fall from the reservoir to Sta. 70 or about a mile and a quarter, is 0.1 in 100. Here the line crosses quite a large drainage channel, after which it is run on a fall of 0.4 in 100, skirting the lower slopes of the foot hills for about a mile. The entire length of the line is two and a half miles. A flume has been built across the drainage channel above referred to, extending for 64 feet from bank to bank and with a maximum height of eight feet for water way. The flume box is three feet wide and one foot ten inches deep with both intake and discharge ends extending well into the banks and well protected. There have been no steps taken to collect and pass the surface water across the line of ditch, but as the ditch channel is small it will not be an arduous task to clean out yearly the sediment which may be washed into it; and it would have been an unwarranted expense to have provided for this drainage.

The amount of land covered is about 625 acres, and the entire

acres reclaimed by the system over 1000 acres; and this can be somewhat increased by the extension of the Red Lake ditch. I would however, advise the settlement and cultivation of the land near the reservoir, and that covered by the ditches from the creeks, first. New ground or land which has not been irrigated requires much more water for irrigation than that which has been watered for some years. When irrigation has been resorted to for several years the ground becomes more or less saturated, the duty of water is increased, and not nearly so much is required to mature crops. The subsoil waters often flow down the valley in the direction of the stream, as well as towards the creek, and the level of the water table in the lower portions of the valley is thereby often raised. In such a case the first irrigation of the upper portions of the valley is of direct benefit to the lower portions. Also if the head of the valley is first watered there is subsequently more water that can be spared to the lower part.

This work was turned over to the Agent on October 10, 1899, his receipt therefore being forwarded you on the same day. An outline map of this system was submitted July 6, 1898 through Major Williams, Acting U.S. Indian Agent, to which in the consideration of this work I would respectfully invite your attention. It is the only map it has been possible for me to make owing to the many and varied duties evolved upon me and the extremely limited white help at my disposal.

The Agency or Bonito Creek ditch was taken out of the creek at a point in the canyon about half a mile above the upper Agency buildings. A dam of loose rock, brush and sand about 75 feet long and 5 feet high had been thrown across the channel, which is here confined by the vertical rock walls of the canyon. At one end of this dam was built a crude head gate which discharged into a flume 10 inches high, 2 feet wide, about 400 feet long, built of slabs and culls and which was hung to the walls of the canyon. At the end of the flume the ditch channel left the creek and ran in thorough cut, with sides extremely steep, for a short distance; then for about 1000 feet it followed closely the cut bank of the creek. Just north of the Agency the ditch was carried across a wide sandy draw which drains considerable territory. While there was no indication of channel at the ditch crossing there was, a few hundred feet both above and below, heavily marked washes indicating heavy drainage. After crossing this draw the line was carried along the side hill at the east of the Agency, through loose rock ^{and} boulders, and on a gradient of about 0.1 in 100, until it began to get too high on the slope when it was dropped down the hill 8 or 10 feet and continued on the established fall. In this manner it was built until it crossed a low saddle and was pitched into a small basin, about two miles from the head, which had been thought of as a possible storage reservoir. The Ditch was inoperative and almost obliterated, and for most of its length

was impracticable. The head gate was buried under a bank of sand; the mass of rock, brush and sand which had been erected as a dam was almost entirely gone; and the flume was filled with sand which had broken it down in several places, and was past redemption.

A point about 300 feet below the site of the old dam was chosen for the new head works and a dam or check of lumber, with an overflow 75 feet long and 6 feet deep, and a sluice gate to aid in keeping a clear channel to the ditch, now diverts the water of the stream. A regulating gate controls the flow of water to the ditch, which has a bottom width of 5 feet and a bank 4 feet high. About 1300 feet from the head is a division gate so that the stream can be turned into the ditch which supplies the Agency lands and land lying on the east side of the creek, or into the one which serves the land on the west side.

There was nice tract of land on the west side of Bonito Creek which had been irrigated by water carried through an old ditch built by the Indians, and a crude flume of one inch lumber built across the creek by the Agency carpenter. As both ditch and flume had become unserviceable a substantial flume and about three quarters of a mile of ditch, with three diversion boxes on the line, have been constructed to reclaim this land.

To protect the toe of the ditch bank which is in the channel of the creek immediately below the dam for about 1200, a rock wall averaging 5 feet high and 4 feet wide at the base has been built.

The normal flow of water in Bonito Creek is ample for 150 acres, and by judicious management and care I have no doubt but that this acreage could be somewhat increased. Water has been supplied through this ditch for the past three seasons and used on Agency, School and Indian lands; but aside from two or three day's work of four or five Moqui Prisoners, under the supervision of an Indian Farmer, in repairing a break in the ditch bank near the head, I know of no work or care being expended on this system; nor have I been able to learn of any one, either white or Indian, ever having been over the work with a view to its operation or maintenance.

The other ditches, being further removed from the Agency, have had, quite naturally, less attention than ^{that} given the Agency Ditch; and, so far as I can learn, there has not been a single employee of the Service who has ever seen any of the work since it has been finished and turned over, unless through accident or idle curiosity. If the same interest in these ditches that has been evidenced in the past is manifested in the future and the resultant care of them is the same, they will be a consideration for the Department for an exceedingly short time; they will probably be practically obliterated in two years more.

You direct me to make such suggestions as I may see fit in regard to keeping in repair the reservoirs, ditches, flumes, etc., constructed upon the Navajo Reservation. These works may properly

be termed communal and should be operated, controlled and maintained as such are by the whites. Some man, intelligent, thoroughly acquainted with the best irrigation methods in farming and gardening can take charge and direct, as well as do, work necessary to repair or replace dams, headgates, lateral gates, banks and channels, etc., should be selected to be put in charge of these works. He should be conversant with the methods of planting crops for irrigation, and the subsequent watering of them; and should study the Indian method of procedure to the end that he could engraft on their ways the more advanced and better methods. Should he try to force an immediate radical change he would probably find his efforts futile; for the Indian, like all humans, is wary and suspicious of the untried and unknown; and a failure of their crops means to them starvation.

Under the direction of this supervisor, mayordomo or superintendent, the ditches should be maintained by those Indians who derive benefit therefrom. There should be an equitable assessment of labor made against everyone drawing water from the ditch, the labor required from each individual being proportionate to the acreage of land cultivated and quantity of water required therefrom, and the relative distance his land is from the head of source of supply. This levy of work should be expended in hauling lumber to repair or construct structures, and the subsequent work on them; in the maintaining of dams and the creek channel and banks above and below them; in cleaning out the main channel of

the ditch as occasion may arise, and in repairing the banks or strengthening them as they may need; in building new laterals and extensions; and the many ways which are absolutely essential to the preservation and profitable operation of such works. This labor can, and should be, performed in Spring and Fall thereby leaving the Indian free to attend to planting, growing and harvesting his crops.

During the farming season the superintendent will find his time fully occupied in advising the different Indians as to their best crops, and the manner of planting them; and seeing that they are properly planted in well prepared ground so as not to waste precious water by having to spread it over half planted fields. Then the supervision of the construction of individual laterals and distributing ditches by the several Indians will occupy some of his time, and he will find that, like his white brother, the Indian will have his water rights and water fights and water needs that will have to be keenly and shrewdly judged and equitably, the firmly decided by the superintendent.

The duty of water is increased up to a certain point by the continued application to and the consequent soaking of the land; but the reclaimable area is augmented more by proper care and judicious management, distribution and application of the water than from all other factors.

Leaving out of consideration the Agency Ditch, which might possibly be supervised by someone there, the distance from the

Red Lake system to the work at Carrise is about 50 miles, and Wheatfields and Cottonwood are not far off the road between them. It ought to be feasible to put all this work under the control and direction of one man; but he should be located or have his station somewhere between the two first named points so as to be near his work. If he attends to his work he will have his hands full for at least ten months of the year and he won't often have a chance to visit the agency.

I would here like to note a suggestion that I proffered the two Agents who were on the reservation during the period of my work there; to the effect that the several areas under the different ditches should be divided into tracts of 10 or 15 acres, or not to exceed 20 acres; a tract to be held by an Indian so long as he profitably and thoroughly farmed it. I doubt if an Indian can rightly tend more than 20 irrigated acres in crops; and this method would prevent the scattered, straggling fields they would otherwise fence.

During nearly the whole time of my work here I was fortunate in having as an interpreter Charles Damon. He is a half breed, his father being a white man and his mother a full blood Navajo. He has been educated in part at the Agency school from which he was sent to Carlisle Penn. where he remained for some years; returning to the reservation several years ago. I have used him as foreman, assistant carpenter, on the survey, plowman and teamster, in fact in every position except clerk, and he has proven apt in

acquiring a general knowledge of the work. While I know little of his knowledge of irrigation farming I do know that he has a working acquaintance with Navajo methods, as well as farm and garden work as practised at and around Carlisle Penn. through the outing system of that school; and as I have proven his integrity, ability and devotion to his duties, I had thought of recommending him to your notice for the position of superintendent of the constructed work, especially as he knows the people and can speak both languages. The man who may be put in charge of these ditches will have to be given the unqualified support of the Agent and be sustained in everything he undertakes, or he will be ignored by the Indians, his word will pass unheeded and his efforts rendered fruitless. In ignorance of what support and backing will be rendered, I cannot recommend Mr. Damon for a position in which his status with his tribe may be irreparably ruined and himself caused to lose heavily.

That territory which has been set aside for occupancy and use by the Navajo Indians, lies in the northeastern portion of Arizona the north western part of New Mexico, and in a small degree in the south eastern corner of Utah. Extending from east to west for 160 miles and north to south for about 105 miles, it includes within its area of over 12000 square miles a varied topography and structure peculiar to this region; The mountains ranging in elevation from 8000 to 9500 feet, are covered with a thick growth

of pine which conserves the snows and rains to a large degree, causing numerous springs and seeps and a few small streams, some perennial for a short length of their course. From the foot of the mountains the land stretches in rolling broken ridges, or high mesa lands, towards the valleys. These foot hills and high mesas, in elevation from 6000 to 8000 feet, are covered in many places with piñon and cedar which grow up to, and mingle with the lower fringe of pines on the mountain sides; while in others the only growth is sage brush, grease wood and a little grass. These mesas are scarred by innumerable washes and gullies near the mountains, which, uniting as they extend outward, form ravines and canyons whose rocky sides are from a hundred to a thousand feet high where they debouche on^{to} the valleys. The valleys, from 5000 to 6000 feet above sea level, are often quite wide; the lands fairly smooth, or gently undulating and nearly always covered with a scanty growth of weeds, sage brush and grass, but there are no trees or large brush.

Through these valleys run the water courses, dry except at short and infrequent periods of flood, winding their way to the main drainage streams, the channel being in places well defined by its thirty or forty foot banks a hundred or so feet apart, while lower down it spreads out over an undefined waste of sand a mile or more in width.

The only stream of any moment in the region is the San Juan

which flows in a westerly direction and marks the northern boundary of the reservation for a part of its length. Its valley along the eastern portion of the reserve is narrow, ranging in width from a few hundred feet to about two miles, and is segregated into acres from one to two hundred, to a thousand or possibly fifteen hundred acres, by the hog backs and ridges through which the river passes, or the projecting points of the table lands which abut thereon. These table lands, rising from fifty to two hundred feet above the river are crossed by many heavy drainage channels; they are broad fairly level stretches of dry sand and sandy loam, and have at best but a stunted vegetation. As it flows westward the river's banks become higher and its valley narrower until it finally enters canyon formation in which it continues until it empties into the Colorado.

An enumeration by the Census Bureau in 1890 gave the total number of Navajo Indians as 16,102,- 9241 of whom were noted as off the reservation at that time, leaving 6,861 as residing within the confines of the reserve. Their stock was enumerated as cattle 9,168 head, 118,798 horses and 1,583, 754 sheep, which number probably included the goats. Of this stock the women are universally conceded to be the owners of the sheep and goats. They pasture them on the uplands and mountain ranges when the weather is warm and the grazing good, watering at the springs, small streams and ponds. In the winter the flocks are driven to the lower country and held in the valleys and low lands where they

subsist on the few forage weeds and scant grass, dependent mainly on the snow for water. Some of the wool is carded and spun in the old primitive ways, and is worked up mainly into blankets; but by far the larger part is sold, as it is taken from the sheep, to the traders and is the main source of revenue to the Indians. The meat of both sheep and goats is much used for food, and the pelts are sold to the traders. The men have little or nothing to do with the flocks and the work of herding, shearing, etc. is done by the women and children; the children being used as herders from about four or five years of age until they reach maturity.

The estimated number of sheep in 1890 was, as stated, 1,583,754 and it has been since given as the opinion of some that the number was increasing. There have been numbers of them consumed for food and thousands have been sold of late years for from 75 cents to \$1.50 a head; a large number sold the past year averaging 85 cents a head. The sheep have been rapidly diminishing in number and I doubt if there are a half million on the reservation today.

The idea seems to have been evolved by some one that the available grazing lands could be increased manifold by the development of water for the flocks at numerous places scattered over the reservation, and this the Department has evidently repeatedly urged. I do not think this scheme is practicable today to any great extent, although it may have been some years ago. The annual precipitation of both rain and snow is much less now than of

former years and sections that once afforded good grazing are now barren of vegetation. One strip of country thirty miles in length where the grass could be profitably cut for hay up to sixteen years ago now affords but poor picking for a few sheep and goats, and the pitiable condition of the few half starved ponies which wander over it is also proof of the little feed on this range. The past fall I remarked on the numerous bands of sheep and goats that were being moved from a certain region and was told that there was not a spear of grass or any other feed on a strip about thirty miles wide and more than a hundred miles long; and that it was either move or starvation for the flocks. This strip extends from the west slope of the Lukachukat mountains westerly toward the Colorado River, crossing the Chin-a-lee Valley. This barren condition is true of many other localities on the reservation, but this is the largest area I know of which has failed totally the past year. From the materially decreased annual precipitation, the water supply from springs and streams is consequently diminished; but grass and forage weeds are getting less from the same cause, and, while water is necessary to the existence of the flocks and herds, food is equally necessary.

The horses, mules and cattle are the property and care of the men and are not so important as the sheep. Some of the cattle have been butchered and sold to the Government for the use of the Agency Boarding School; but a far greater number have been sold on

foot to the whites on and around the reservation. The Indians infrequently kill a beef for their own consumption. Concerning the number on the reservation, I have no information upon which to base an estimate; but from the many being sold I infer the number is diminishing. The horses, supposed to number 118,798 in 1890 which was and is probably excessive, are poor specimens of cayuse. The better grade of ponies and mules, which are better and more highly valued than the ponies, are used for riding, the poorer specimens being used to wagons and for the little freighting they get to do for the Government and the hauling they do for themselves. Both horses and mules are often killed for meat and the substitution of burro and horse for sheep and goat meat, spares numbers of sheep which would otherwise have to be killed for food. ||

Both cattle and horses are herded on all portions of the reservation, but mainly in the mountains. They can paw through a snow which would prevent sheep and goats from getting anything to eat, and the heavier the snows of the mountains and high lands does not often force them down into the valleys. Unless feed is abundant sheep pull grass and weeds up by the roots and eat the whole plant, and in a short time the ground is devoid of vegetation. Cattle are averse to staying on a range with them and their dislike to sheep and goats is better understood after one has tried to drive a bunch of wild cows across a sheep trail. Yet the

conflicting interests of these two kinds of stock has not been a cause of trouble and blood shed among the Navajos as it has been among his white brothers. #

In the agricultural pursuits men, women and children are engaged. Their principal crops are corn, wheat, pumpkins and melons. Sometimes the wheat is planted by drilling holes in the ground with a pointed stick into which some grain is dropped and covered, but lately they have been breaking the ground by shallow plowing and sowing the grain broadcast. The grain is cut by hand with sickles, butcher knives or anything that has an edge, and bound by hand; it is then carried and laid on a smooth piece of ground which has been cleared off, a temporary fence of poles and posts built around it, and the grain is threshed out by running or milling ponies over it. The wheat is then gathered and taken to the hogans to be winnowed in blankets and baskets, and ground by hand between two stones, and is made into busquits or tortess as needed and baked on hot stones or in frying pans. The winnowing and grinding is done by the women and older girls. There has lately been a water mill built on the upper San Juan by some whites, and many of the Indians in that section have hauled their wheat for from ten to fifty miles to have it ground there. While the crop of wheat is not large it is considerable and of good quality, but both quality and quantity could easily be increased. This crop is usually planted in sections too high and cold to permit of raising

corn and where there is some little stream that will afford water for flooding the fields.

The principal crop of the Navajos is corn, and to the raising of this is given as much care as to the flocks. The snow water of the Spring is intercepted and diverted from the washes to the adjacent lands which are thoroughly wetted and then left to dry out somewhat on top as the water sinks to the subsoil. When the ground is sufficiently dry on top to permit of being worked and planting time has come, holes are dug at irregular intervals and of varying depth, and a small handful of corn is dropped in and covered. The moisture in the ground sprouts and continues a slow growth until the rains of July and August come to mature it. As the rains are usually a little earlier and more plentiful on the mountains than in the valleys, the water is taken, as before, from the washes and the cornfields are irrigated by flooding instead of by furrowing irrigation; but as a plow is never used on a corn field this latter method is not possible. When a wash spreads out over a wide expanse in a valley, the Indians often plant their corn in the broad level bed of sand which is here its channel. Here they dig with hands, hoe, post hole digger or stick a hole to the underlying strata of earth, which may be six inches or more than two feet down; but he goes down to the sub soil for food for the plant and to where there is always moisture during the early part of the year. A flood is counted on to come down some time in July and

spread out over these fields. Sometimes the corn is entirely submerged and often much of it is washed out of the ground; but on the whole this method of corn culture is profitable to the Indian. Aside from one or possibly two, weeding by men, women and children, there is no thinning out of the corn or other cultivation. The corn is harvested, husked and shelled and some of it taken to the hogans or winter houses. Here it is stored in large jar shaped holes dug in the ground that have been dried by fire; from these it is taken and ground into meal as it is needed by the women and girls. The rest, and by far the greater part, is sold to the traders and none is fed to stock. Neither is the corn fodder and wheat straw stacked for winter forage although it should be profitably done.

The melons and pumpkins grown among the corn or on patches close to it. The melons are luxuries, many of which, both watermelons and cantaloupes, are eaten long before they are ripe. The pumpkins are a source of food from the time they mature until late winter or early spring. They are either stored as plucked, or cut into strips, dried and then put away.

These Indians are very fond of vegetables and especially so of onions and potatoes; and why they do not raise sufficient quantities of them I do not know, unless it be they have never been shown how or have not seed, or cannot keep it from one crop for another.

The fields which they cultivate vary in size and distance from their homes. On one good sized field close to a big wash, I have known as many as seventy-five Indians to farm; some living in the vicinity and others coming seventy or eighty miles. During the summer a family may pasture its sheep and goats in one region, the few head of cattle they may own in another, raise their corn in another section and their wheat in still another; but they all have their permanent or winter homes, or hogans, to which all is taken in the fall for preservation or use. As a permanent home the wood earth covered hogan is being replaced by log or stone cabins and the more modern buildings are exerting a civilizing influence on the Indian which he appreciates and approves.

I regard the Navajo as an agricultural as well as a pastoral people; and if any one, traveling over their country, will observe closely and note the hundreds of futile efforts towards the conservation and utilization of the little water they have, I think he will agree with me that it is not the fault of the Indian that he is not a successful agriculturalist.

There are some of these Indians who at times wander beyond the confines of their reserve to visit friends and other peoples, to trade, to hunt, to cultivate small fields more favorable than any that are unoccupied on their reserve, or to find grazing for their stock which would otherwise die of starvation. There are others, not roving bands, who have their homes, stock and fields

apart from the reservation and have had for years, and who are holding today as their own what was held by their ancestors long before the advent of the white man. The number of whites increases and there are more sheep and cattle to be grazed on the public ranges, feed is necessary and the white is progressive; or it may be aggressive. The Indian is a ward of the government, is protected by the government and, consequently, cannot protect or defend himself or his property being a ward and having control of no property. With this feeling entertained toward the Indian by them, what more natural than that Gentile, Mormon and Mexican should combine to take from him what they want and need as well as he? It is the law of nature, the survival of the fittest, the destruction of the weak that the strong may live. What justice will be meted out to him if, being sinned against, he take his case to court? Arizona is ruled by the Mormons, New Mexico by Mexicans. What justice is meted out in a Mexican court to the Gentile or Mormon; what by the Gentile judge to the Mexican? What can the Indian expect? In nearly every trouble between the races and white, and not the Indian, has been the aggressor,- as witness the justifiable killing of Lot Smith by Chace in self defence some time back; and the legal (?) cold blooded murder of five Navajos last Fall. Then take the appraisement, assessment and attempted collection of taxes on their flocks, from some Navajos by a sheriff backed by an armed posse of fifty men one winter evening in 1896-7. Because the Indians could not pay the illegal levy, men, women and

children, some babies in arms, were herded with the sheep and goats, and driven that same evening and ensuing night through the snows of the prairie and waters of the half frozen streams to the reservation.

While I have written strongly on this subject I feel more strongly than I have written, for I firmly believe that nearly all of these troubles, and there have been many, have been pre determined and carried out, so that the Department could be asked, with some show of reason, to return the "roving, marauding bands of Navajos" to their reservation. Two things must be born in mind in this connection: the first is that nearly all of the Indians residing in the country where most of the troubles has been and is, have always lived there, were never captured by Kit Carson and taken as prisoners to the Boske Redondo, have never lived on the reservation and consequently cannot be "returned"; the other is that the similar interests of the sheep men of the two races conflict, and the whites will use every endeavor to secure the exclusive right to range on the public domain, and to which, I think, the Indian has an equal right. I know only too well how heavily handicapped the Office is in this matter, what a source of trouble and anxiety it has been made by the local and territorial authorities, and how earnest have been the efforts to make the reservation, by the only means possible, capable of supporting the whole tribe; to the end that these Indians could justly be held within its confines.

The irrigation work that has been done is comparatively small and more on the nature of an experiment; yet it is large enough to demonstrate the value larger and more profitable works of the same kind would be to these people. Should they prove a wise and profitable investment to the Office and a continuation of the work be deemed advisable I would suggest that then a reconnaissance be made by some competent irrigation engineer in charge of a full party of assistants equipped with all necessary instruments. This reconnaissance should develop the possible reservoir sites, the area of the catchment basins tributary thereto, the size and kind of the necessary embankments or retaining walls, and the impounding capacity; also the length and size of ditches therefrom, the structures necessary, and the amount and kind of reclaimable land. The San Juan, the only important stream, should be thoroughly exploited and the different possible systems outlined; giving the lengths and sizes of the different ditches, structures necessary and the areas of the lands under the several lines. The springs and sub surface waters might be regarded and a geologic examination made to determine the small artesian basins, that artesian wells, and wind mills and pumps could be employed where grazing would be increased or made available by their use. The reservation, or necessary parts of it, should be mapped and the different schemes should be shown thereon. Then maps, plans, profiles and detailed estimates should be made of each of the different systems.

This reservation presents to the hydraulician some most inter-

esting and complex problems, the practical and best solutions of which are among some of the most difficult I have ever seen; and a thorough and proper preliminary survey will cost considerable money and time; but it is the only way that complete and definite information, on which to base intelligent action, can be obtained, and an estimate made for money necessary to reclaim sufficient land to warrant the Department in placing the absent Indians on the reservation.

In this connection I would invite attention to the two following extracts:

Revised Statutes, U.S. Sec. 2339.- Whenever, by priority of possession rights to the use of water for mining, agricultural, manufacturing or other purposes, have vested and accrued, and the same are recognized and acknowledged by the local customs, laws, and the decisions of courts, the possessors and owners of such proved rights shall be maintained and protected in the same; and the rights-of-way for the construction of ditches and canals for the purposes herein specified, is acknowledged and confirmed.

Sec. 2340. All patents granted or pre-emption or homesteads allowed, shall be subject to any vested and accrued water-rights, or rights to ditches and reservoirs used in connection with such water-rights, as may have been acquired under or recognized by the preceding section.

P. E. Harroun, C.E. in his report of September 29, 1898, to the Commissioner of Irrigation and Water Rights of New Mexico has the following to say as to District No. 1 of the San Juan District and which probably embodies all irrigation data relative to this stream now available.

"Geographical location; Northwestern portion of the territory, covering San Juan and parts of Rio Arriba and Bernalillo counties. Acreage irrigated, 13,670.

This district comprises the areas drained by the Rio San Juan and its tributaries in New Mexico, and occupies the extreme north-western part of the territory.

The river enters the territory just below its junction with the Piedras, a short distance below Arboles, Colorado, and thence

turning toward the west, passes out near the northwest corner.

This stream receives several tributaries of importance in its passage through the territory, and all of these are from the north, rising in the San Juan and La Plata mountains in Colorado.

The drainage entering from the south is exceedingly small and uncertain, and may be entirely neglected in a general consideration.

In 1896, the mean flow of the Rio San Juan during the irrigation season, was 580 second feet at Arbole, while the Piedras was delivering a mean flow of 360 second feet during the same period, making a mean flow for the river at the Colorado line of 960 second feet.

The flow from the Rio de los Pinos at its junction with the San Juan, is unknown, and but few measurements have been made at any time.

From an examination of the data available, however, it is believed that the mean flow may be safely placed at 80 second feet.

Las Animas is the largest tributary of the San Juan in New Mexico. Its mean flow at Durango in 1896 was 856 second feet and it is probable that this flow reaches the San Juan below Bloomington with but little change, for, although the Rio Florida enters about 12 miles below Durango, its waters are entirely in use during the dry season for irrigation, while its surplus at other times perhaps no more than compensates for losses from seepage and filtration below.

Rio La Plata enters the San Juan about three miles below Farmington. No data is available as to the flow, but it is believed to carry a mean of 50 second feet. (No water delivered to San Juan during irrigating season. Butler.)

These streams are all permanent in character, but the flow fluctuates with the season, depending primarily upon the melting of winter snows in spring and upon the so-called rainy season, occurring here usually in the latter part of August and in September.

Spring flow usually begins in the early part of March and reaches the maximum from May 10 to 20, thence gradually declining until the fore part of July, when it reaches the normal, summer flow. The rainy season flow, occurring in August and September, is characterized by sudden freshets which are at times of great volume as is instanced in September, 1896, when a flow of 7,800 second feet was observed on the Animas River.

The irrigation system in this district comprises 19 ditches on Las Animas, 18 on La Plata, and 18 on San Juan.

There are also a few small ditches on Rio de Los Pinos, but here the valley is narrow and the fall heavy, every reach having its own small ditch.

All these ditches are either private or community, with the exception of the "Animas La Plata and San Juan Canal," which has been built for speculative purposes.

There is an actual cultivation under the 19 ditches on Las Animas, 4,480 acres; under the 18 on La Plata, 3,270 acres; under the 18 on San Juan, 3,840 acres; while on Rio de los Pinos, some 300 acres (estimated) or a total of 11,820 acres actually under cultivation on these streams.

This acreage could be increased to 25,000 without extension of the present system."

If the use of water from the San Juan River is not already secured to the Indians as a tribe, by riparian rights, or through some other law, it may be well to see if a requisite amount cannot be in some manner reserved for their use, to the end that when the Department deems it wise to water the San Juan lands of the reserve, water will be available. There is ample water now in the river for all including these lands, and the acreage outside of the reservation under ditches from this stream and its tributaries will probably not be fully cultivated for some time to come. It will not be many years, however, before the water and land of this district will be utilized by the whites for it is one of the few good semi-developed possibilities in the arid west. I am not versed in law and I do not know what may be possible in the premises but I respectfully invite your attention to this matter as it concerns the best, cheapest, largest and most profitable irrigation scheme for the Navajo Reservation.

The report of Mr. Davis is herewith returned.

Very respectfully,

Superintendent of Irrigation.

Enclosure.